HO'OPILI

O'AHU

FINAL
ENVIRONMENTAL IMPACT STATEMENT

VOLUME 1 OF 2

JULY 2008

Prepared by:

PBR HAWAII
& ASSOCIATES, INC.

Prepared for:

D·R·HORTON
America's Builder
SCHULER DIVISION

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HO'OPILI

FINAL ENVIRONMENTAL IMPACT STATEMENT

Submitted Pursuant to
Chapter 343, Hawai'i Revised Statutes
and
Title 11, Chapter 200, Hawai'i Administrative Rules

Prepared for:
D.R. Horton - Schuler Division

Prepared by:
PBR HAWAII
& ASSOCIATES, INC.

This Final Environmental Impact Statement and all ancillary documents have been prepared under my direction or supervision and the information submitted, to the best of my knowledge, fully addresses document content requirements as set forth in Chapter 343, Hawai'i Revised Statutes and Section 11-200-17, Hawai'i Administrative Rules.

Dean Uchida, Vice President
D.R. Horton - Schuler Division

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Executive Summary

EXECUTIVE SUMMARY

DESCRIPTION OF THE ACTION

The Proposed Action involves development of a mixed-use community in 'Ewa which entails the reclassification of approximately 1,553.844 acres from the Agricultural District to the Urban District (Petition Area). Urbanization of the Petition Area will enable the Petitioner ("Petitioner" and "Applicant" used interchangeably, as discussed in Section 1.0, Introduction) to develop the proposed Conceptual Land Use Plan. The proposed plan for Ho'opili – which means "coming together" in Hawaiian – reflects the ideas, hopes and dreams of what the community wanted to see from and within Ho'opili. The plan reflects the community's desire for vibrant and safe neighborhoods where people feel a sense of connection with one another, and with the rest of O'ahu.

The Conceptual Land Use Plan reflects the desire for a community that is complete, with: employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents; and diverse, including affordable, housing options. Residents will live, work, learn, play, and shop in one area. In addition, Ho'opili will incorporate green building practices to be an environmentally-sound, healthy and resource-efficient community.

To achieve the vision for Ho'opili, a Conceptual Land Use Plan has been formulated that illustrates a mixed-use community that would complete and connect 'Ewa with surrounding communities. Originating from the common vision and values of a community-driven planning effort, the conceptual plan contains a series of neighborhoods with a mix of uses including residential, retail, office and light industrial. Included in this mix are a series of parks, schools, public buildings and community centers which act as a focus and help define the identity of each neighborhood. Additionally, the project was designed in consultation with adjoining landowners, such the Department of Hawaiian Home Lands (DHHL), the University of Hawai'i at West O'ahu (UHWO) and the Hawaii Community Development Authority (HCDA).

Ho'opili is planned to be connected to the surrounding 'Ewa District (and neighboring DHHL, UHWO and HCDA properties) by a network of streets and bicycle paths which should allow a variety of circulation options for residents and visitors. During the public review period, the Hawai'i Community Development Authority (HCDA) wrote that: "The HCDA supports the development of an internal network of closely-spaced gridded streets and bike paths linking the project to the surrounding communities of University of Hawaii West Oahu (UHWO), Department of Hawaiian Home Lands (DHHL), Ewa Villages, and the KCDD. This objective is consistent with the HCDA Kalaeloa Master Plan. Improving connectivity throughout the region was one of the most important issues identified during the strategic planning meetings for the region as well as the KCDD. The extension of the

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Kapolei Area Bikeway Plan to include UHWO, DHHL, and the KCDD in the DEIS is also noteworthy and consistent with our Master Plan."

Wider tree-lined boulevards are intended to create a distinct axis running north-south and east-west across the site. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. Also possible is a transit maintenance and storage facility. While the proposed residential unit count should not materially change, it will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as ridership generation, "capture" of transit-oriented development potential and the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will concentrate higher intensity development (and density) around the transit station(s). A site for a transit maintenance and storage facility is also possible. (As of this writing, the City and County of Honolulu (City) has begun work on the Draft Environmental Impact Statement (EIS) for the Honolulu High-Capacity Transit Corridor (HHCTC) project, with a target publication date in the second quarter of 2008. By the time the HHCTC Draft EIS is published, the final alignment of the high-capacity transit corridor, the location of transit stations, and the location of the transit maintenance and storage facility will be known).

In the geographical center of the site there is a public square or Civic Plaza that is surrounded by higher density housing development and mixed-use buildings. Housing density transitions to lower-density small-lot single-family homes along the eastern and southern peripheries of the site. A significant open space and pedestrian/bicycle trail network provide a wide variety of recreational opportunities for residents and other members of the 'Ewa community. Ho'opili is planned to incorporate traditional Hawaiian building styles with a modern, contemporary aesthetic that befits the landscape and climate.

SIGNIFICANT BENEFICIAL AND ADVERSE IMPACTS

The development of the proposed project will impact Petition Area resources; however, past and current agricultural uses of the property have significantly altered the natural landscape. Among the many regional transportation improvements long-planned by the State of Hawai'i (State) and the City and County of Honolulu (County) include: the proposed Honolulu High-Capacity Transit Corridor (HHCTC) mass-transit project; the completion of North-South Road and a new H-1 Freeway interchange; and the widening of Farrington Highway. Portions of each of the aforementioned regional transportation projects (as well as the recently proposed East-West Connector (connecting Farrington Highway to Fort Weaver Road through UHWO, DHHL and Ho'opili) will require land area from under the Ho'opili project.

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Ho'opili has been planned with the reduction of traffic impacts in mind. First, it includes transit-oriented development. Bus lines have been identified to encourage residents throughout the project to use rapid transit or to use buses or bicycles within the project area. Street sizes and connectivity will encourage pedestrian and bicycle movement. To the extent that automobile use declines (or Ho'opili attracts new residents who are less committed to automobile use than others), residents can expect to have more exercise, and be healthier than people in other subdivisions of Leeward O'ahu.

Ho'opili will contribute to the growth of the urban community life in 'Ewa by providing new job locations, recreational areas, and schools as well as housing. It is designed as a community in which many residents will not need to drive to Honolulu often. Its transportation planning will work to address the region's serious traffic congestion problems. It will help to link existing and new communities, serving its neighbors as well as its residents.

PROPOSED MITIGATION MEASURES

Various mitigation measures will be implemented throughout the development of the proposed Ho'opili project to minimize impacts on the environment. Infrastructure improvements will incorporate appropriate engineering and design methods to meet basic infrastructure requirements.

Drainage/Flood Control/Water Quality/Soil Erosion. All grading operations will be conducted in accordance with dust and erosion control and other requirements of the City and County of Honolulu Grading Ordinance. All construction activities must comply with the relevant provisions regulating Fugitive Dust set forth under Section 11-60.1-33, Hawaii Administrative Rules (HAR). A grading permit is required to modify the topography, and additionally, a National Pollutant Discharge Elimination System (NPDES) permit will be required prior to construction to address ~~non-~~point source discharges.

Archaeological Resources. An archaeological inventory survey report prepared for the Petition Area has been accepted by the State Historic Preservation Division (SHPD) in fulfillment of Sections 13-284 and 13-276, HAR. In addition, a preservation plan and archaeological monitoring plan is being prepared and will be submitted to SHPD for its review and approval. If burials are encountered during project construction, the Petitioner will comply with the relevant notification and stop work requirements.

Noise. Noise will be generated by construction and earth-moving equipment during the project's development. However, construction noise will be relatively short-term (in the vicinity of where construction will occur), occur only during daytime hours, and comply with State Department of Health (DOH) noise regulations. If construction noise is expected to exceed DOH's maximum permissible property line noise levels, a permit will be obtained from the DOH to allow the operation of vehicles, construction equipment,

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power tools, et cetera. Additionally, construction equipment, vehicles, or devices will be equipped with mufflers, as necessary.

Air Quality. During all phases of construction, there is a potential for fugitive dust emissions. These short-term air quality impacts will be mitigated by the implementation of a dust control management plan and compliance with the relevant provisions on Fugitive Dust set forth under Section 11-60.1-33, HAR.

After project construction, long-term impacts to air quality can result from increased activity within the Petition Area. Vehicles will increase exhaust emissions, although public transportation will be encouraged by proximity to the planned transit nodes and corridors. Stricter vehicular emission controls will also help to mitigate air quality impacts. The project is being designed to promote walking/biking by integrating land uses. This should encourage residents to walk/bicycle from home to work, school, day care, retail outlets, and parks and trails, and reduce the reliance on the use of personally-owned vehicles for commuting to work, going to the park, going shopping or attending school.

Transportation. As previously mentioned, there are several major transportation projects that have been long-planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting the Petition Area; the proposed East-West Connector Road through the Petition Area; and the segment of the proposed HHCTC mass-transit project through the Petition Area.

The proposed project has been designed to reduce future residents' reliance on private motorized vehicles through the following measures:

- the project is the first new project designed to ~~embrace~~ support the City and County of Honolulu's plan to develop a high-capacity transit (elevated, fixed-guideway) corridor and station(s) (and possible maintenance yard);
- the project is large enough to be designed and offer a full range of mixed land uses, including a wide range of places of live, work, shop, recreate and learn and will aspire to achieve a job-housing balance;
- the project is designed to maximize connectivity (transit, pedestrian, bicycle and vehicular) with surrounding streets and communities (including DHHL and UHWO), while minimizing cul-de-sacs and dead-end streets;
- the project will be designed to take advantage of the relatively flatness of the site and proximity to UHWO by designing streets and grade-separated multi-modal pathways for walking and bicycling; and

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- the project will seek to implement other transportation management and transportation demand management strategies (such as requesting that the State/County consider extending or instituting contra-flow of major transportation corridors during a.m. and p.m. peak travel times).

Visual Resources. The visual appearance of the Petition Area will change from vacant scrub and cultivated vegetation to a landscaped mixed-use community with parks and open space. This is consistent with the *Kapolei Area Long Range Master Plan* as well the *Ewa Development Plan*. Project landscaping, the provision of open space buffers, and sensitive architectural design will help to establish the planned community visual character of the area.

Infrastructure/Public Facilities/Utilities. The de facto population associated with the project will require potable water (i.e., drinking water) from the existing municipal water system (including the existing source, transmission and storage components of the Board of Water Supply (BWS) safe drinking water system). It will be a requirement that the project provide system upgrades to the transmission and storage components to ensure that the system operates effectively and meets BWS standards. With respect to non-potable water requirements, the project will be maximizing non-drinking usage to minimize the demand on the safe drinking water system. Street right of ways of the Ho'opili project will have underground non-drinking distribution systems.

Over time the project will result in an increase in wastewater being generated than currently being generated on-site (by agricultural activities). To mitigate this effect, new collection system components consisting of gravity sewer, pump stations and relief sewers will be constructed. To date, the Petitioner has already contributed $2 million towards increasing the capacity of the Makakilo/Kapolei Interceptor sewers from the intersection of North-South Road to the Honouliuli Wastewater Treatment Plant (WWTP). The project will generate additional flow that must be treated at the Honouliuli Wastewater Treatment Plant (WWTP). To mitigate the additional burden, the project will participate in the Wastewater System Facility Charge (WSFC) program and contribute funds (based on building permits) to expand the treatment plant. Land is available at the Honouliuli WWTP site to allow for expansion.

The project will increase impervious surfaces such as roadways, roofs, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Petition Area. However, detention basins and/or retention basins are being planned and sited to detain and/or retain storm water to ensure that areas downstream of the project are not impacted.

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Surface water quality can be impacted through development. The project will be providing detention basins to meet City and County of Honolulu Standards for water quality treatment. Structural methods may also be used to meet water quality requirements of the Rules Relating to Storm Drainage Standards. Structural methods include the use of Stormceptor® type storm drain manholes.

For the portion of the Petition Area within the West Loch drainage basin, it is planned to collect all storm water and route it to an existing detention basin located on the east side of Fort Weaver Road and south of the Oahu Railway & Land (OR&L) railroad tracks. The basin would be expanded to ensure that the water quality storage component of the City and County of Honolulu Standards was achieved. While there are existing drainage easements under Fort Weaver Road, additional drainage, access and utility easements may need to be obtained under Fort Weaver Road and other State and County road right-of-ways.

Solid Waste. Project construction will conform to the guidelines and objectives of the Integrated Solid Waste Management Act, Chapter 342G, Hawaii Revised Statues (HRS). Construction will also comply with the City and County of Honolulu's approved integrated solid waste management plans in a schedule and time frame satisfactory to the DOH. The goal for waste management is to appropriately reduce, reuse and recycle materials, to minimize generation of solid waste and achieve diversion from landfills. As such, in conformance with Section 344-4(2), HRS, the project will promote the optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling. The City and County of Honolulu is restarting its curbside pick up recycling program. In November, 2007, two pilot curbside recycling programs began in Mililani and Hawai'i Kai. During the six to twelve month evaluation period, the City and County of Honolulu Department of Environmental Services staff will be coordinating plans for islandwide expansion.

On June 27, 2008, the Associated Press reported that Mililani and Hawai'i Kai residents have recycled 54 percent of their cans, bottles, newspapers and green waste during the city's six-month curbside recycling pilot project. City Officials with the City and County of Honolulu Department of Environmental Services (DES) are reportedly satisfied with the results and are moving forward with plans to provide some 160,000 O'ahu homes the curbside recycling service by May 2010. In the new plan, the city will collect garbage and recyclables each once a week. The DES will no longer have garbage pickup twice-weekly. A study released by DES predicts the program will divert an estimated 53,800 tons of mixed recyclables and green waste from O'ahu landfills. They plan to begin expanding the program to more communities in November 2008.

ALTERNATIVES CONSIDERED

Development of the 'Ewa region as O'ahu's Second City has been studied and planned for over three decades. Further study or delay of any proposed development on the property

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would not be consistent with the *Ewa Development Plan* or the County's objective of directing growth to 'Ewa. Therefore, various alternatives for the site were rejected, such as: 1) continued agricultural use; 2) locating the 1,554-acre development elsewhere on O'ahu; 3) more density (with the same number of units as proposed) resulting in more open space; and 4) less density, less open space; as it would not achieve the overall objectives for the project, which would create a mixed-use community including residential, business, and commercial areas, schools, parks and open space.

UNRESOLVED ISSUES

Honolulu High-Capacity Transit Corridor (HHCTC) Alignment Through Ho'opili. As of this writing, the high-capacity transit corridor alignment through Ho'opili has not been finalized by the City and County of Honolulu. As previously noted, Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count should not materially change, it will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as ridership generation, "capture" of transit-oriented development potential and the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will concentrate higher intensity development (and density) around the transit station(s). (As of this writing, the City and County of Honolulu has begun work on the Draft EIS for the Honolulu High-Capacity Transit Corridor (HHCTC) project, with a target publication date in the second quarter of 2008. By the time the HHCTC Draft EIS is published, the final alignment of the high-capacity transit corridor, the location of transit stations, and the location of the transit maintenance and storage facility will be known).

State of Hawaii Department of Education (State DOE) School Fair Share Requirements. The Petitioner is currently coordinating with the State DOE regarding the number of schools that will be required for the development of the Ho'opili project. <u>During the Draft EIS public review period, the DOE commented that it will determine the actual number of schools required for the Ho'opili development after the developer provides more definitive data on respective market prices, size, and number of bedrooms for each type of unit planned.</u> This will be identified as an unresolved issue until the number of schools required is finalized.

Drainage. The Petition Area falls within three different drainage basins. The portion of the Petition Area within the West Loch drainage basin is planned to collect all storm water and route it to an existing detention basin located on the east side of Fort Weaver Road and south of the OR&L railroad tracks. The basin would be expanded to ensure that the water quality storage component of the City and County of Honolulu Standards was achieved. An overflow from the detention basin would discharge to the West Loch of

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Pearl Harbor. The overflow from the proposed makai detention basin would have to cross Navy property. Permission of the Navy would be required. The concept of the overflow across Navy property is not new and was approved in concept back in the early- to mid-1990's. However, as of this date, the Navy has rejected any considerations to allow increased runoff to cross Navy land. Permission from the Navy needs to be resolved for the overflow option to move forward, otherwise the detention basin system for the West Loch drainage basin will need to be expanded to retain all increased runoff generated in the West Loch drainage basin.

COMPATIBILITY WITH LAND USE PLANS AND POLICIES

State Land Use Law, Chapter 205, HRS. The Petition Area is within the State Agricultural District. As such, a State Land Use District Boundary Amendment is being sought to change the site's district boundary from the Agricultural District to the Urban District.

Coastal Zone Management Program, Chapter 205A, HRS. All lands of the State of Hawai'i are included within the Coastal Zone Management (CZM) Area as defined in Chapter 205A, HRS. As such, the Petition Area is within the CZM Area; however, it is not located along a shoreline or within the Special Management Area.

Hawaii State Plan, Chapter 226, HRS. The Hawaii State Plan (Chapter 226, HRS), which serves as a guide for the long-range growth and development of the State, establishes a set of goals, objectives, policies, and priorities for the State. Conformance to applicable goals, objectives, and policies set forth by the Hawaii State Plan is discussed in detail in Section 5.2.4.

Hawaii State Functional Plans. The Hawaii State Plan is primarily guided by the State Functional Plans (Chapter 226, HRS) and implemented by the State Department of Budget and Finance and the State Land Use Commission (LUC). State Functional Plans are prepared by various state agencies to serve as the primary implementing vehicle for the goals, objectives, and policies of the Hawaii State Plan. The functional plans applicable to the proposed Ho'opili project are discussed in Section 5.2.5.

City and County of Honolulu General Plan. As required by the City Charter, the *General Plan* for the City and County of Honolulu establishes long-range objectives focusing on the social, economic, environmental, and design objectives for the general welfare and prosperity of the residents of O'ahu. The *General Plan* also establishes broad policies designed to achieve the objectives. Conformance with specific elements of the *General Plan* is discussed in Section 5.3.1.

Ewa Development Plan. The *Ewa Development Plan* was updated and officially adopted by the City Council in August 1997 and is presently being updated. The plan presents a vision for 'Ewa's future development and provides conceptual land use plans that will serve as a policy guide for more detailed zoning maps and regulations, and public and

AR00027032

private sector investment decisions. Provisions of the *Ewa Development Plan* that are applicable to the proposed project are discussed in Section 5.3.2.

Land Use Ordinance. The Petition Area is presently zoned AG-1 Restricted Agricultural District by the City and County of Honolulu Land Use Ordinance (LUO). As such, a Zone Change will be required for approximately 1,555.145 acres of the Project Area.

LISTING OF PERMITS AND APPROVALS REQUIRED

As presented below, a list of major permits and approvals is required for the project.

PERMIT/APPROVAL	APPROVING AUTHORITY	STATUS	PROJECT SUBMITTAL DATE
State Land Use District Boundary Amendment (with EIS)	State of Hawai'i Land Use Commission	Petition has been filed; processing on hold until EIS process has been completed.	First Quarter 2007
Zone Change	City and County of Honolulu Department of Planning and Permitting/City Council	Application to be filed assuming successful processing of SLUDBA.	Third Quarter 2009
Large Lot Subdivision ~~Approval~~ Action	City and County of Honolulu Department of Planning and Permitting	Application to be submitted after change the Zone Change application is approved.	Third Quarter 2010
National Pollutant Discharge Elimination System (NPDES) Permit	State of Hawai'i Department of Health	Application to be submitted prior to Building/Grading Permits.	2011
Building/Grading Permits	City and County of Honolulu Department of Planning and Permitting	Application to be filed after the Zone Change application is approved.	2011
Water Use Permit	State of Hawai'i Department of Land and Natural Resources, Commission on Water Resource Management	Application to be submitted prior to Building/Grading Permits	2011

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1.0
Introduction

1.0 INTRODUCTION

This EIS is prepared in accordance with Chapter 343, HRS, and Title 11, Chapter 200, HAR, *ENVIRONMENTAL IMPACT STATEMENT RULES*. The applicant, as defined under §11-200-2, HAR, is the petitioner for district boundary amendment presently before the State Land Use Commission and proposes certain actions that would trigger compliance with Chapter 343, HRS, as discussed below. "Applicant" and "Petitioner" shall be used interchangeably to mean D.R. Horton – Schuler Homes, LLC.

1.1 PROJECT PROFILE

The following summary describes the existing entitlements and proposed actions:

Project Name: Ho'opili

Project Location: 'Ewa District, O'ahu, Hawai'i

Petitioner: D.R. Horton – Schuler Homes, LLC, a Delaware Limited Liability Company, d.b.a. D.R. Horton – Schuler Division

Landowner Within the Petition Area: D.R. Horton – Schuler Division

Landowners Outside the Petition Area but within Project Area:
D.R. Horton – Schuler Division
Monsanto Company
United States Naval Reservation
City and County of Honolulu
Hawaiian Electric Company

Total Project Area: Approximately 1,600.265 acres. In addition, the project will require easements over State and County road right-of-ways for the installation of roadways and various infrastructure and utility lines such as water, sewer, drainage, electricity, telephone and communications.

Total Petition Area: Approximately 1,553.844 acres. (While the total Project Area is approximately 1,600.265 acres, it should be noted, that most of the difference in acreage between the total Project Area and the total Petition Area is required for off-site infrastructure which does not need to be located on lands within the State Urban Land Use District. Development of the Petition Area will require easements over State and County road right-of-ways for the installation of

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	roadways and various infrastructure and utility lines such as water, sewer, drainage, electricity, telephone and communications. The Petition Area includes lands that would be condemned by various State and County agencies for the completion of North-South Road and its interchange with the H-1 Freeway, a portion of the intersection of North-South Road and Farrington Highway, the widening of Farrington Highway, the HHCTC project, and the proposed East-West Connector Road.
Tax Map Key Parcels:	*Petition Area:* 9-1-17: 04 (portion), 59, and 72; 9-1-18: 01 and 04; *Remainder of the Project Area:* 9-1-10: 02, 14 (portion), and 15 (portion); 9-1-17: 04 (portion); 9-2-01: 04, 05, 06 and 07; and 9-2-02: 02.
Proposed Action:	Reclassification of approximately 1,553.844 acres of land from the Agricultural District to the Urban District, and the use of State and County lands for access, and various municipal infrastructure and utility improvements.
Existing Uses:	Diversified agriculture, pasturage, storage/processing/distribution facility for produce, seed cultivation, agricultural research station, parking for school buses and Handi-Vans.
Proposed Uses:	Development of a mixed-use, transit-ready community including: low-medium density residential/live-work, mixed-use medium density residential, mixed-use/high-density residential, light industrial mixed-use/business, schools, parks, open space and long-planned regional transportation improvements planned by others (including a portion of North-South Road and its intersections, the future widening of Farrington Highway, and a portion of the HHCTC alignment).
Existing State Land Use Designation:	Agricultural District (within the Petition Area) and Urban and Agricultural Districts (outside of the Petition Area)
Existing Zoning Designation:	AG-1 (Restricted Agricultural District)
Ewa Development Plan:	Low and Medium Density Residential, High Density Residential, Agricultural and Preservation, Parks, Transit Node (High Density Residential and Commercial), and Future Intermediate School

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Special Designations:	None. Petition Area is not situated in a Special Management Area or in the Shoreline Setback.
Permits/Approvals Required:	Compliance with Chapter 343, HRS and Title 11, Chapter 200, HAR State Land Use District Boundary Amendment City and County of Honolulu Zone Change Grading /Building Permits National Pollutant Discharge Elimination System (NPDES) Permit Subdivision Approval
Accepting Authority:	State of Hawai'i Land Use Commission

1.2 PROJECT LOCATION

The approximately 1,600.265 acre Project Area is located in 'Ewa District, island of O'ahu (See Figure 1.1: Location Map). The Project Area is comprised of ten distinct parcels of land situated in between the H-1 Freeway (north) and Mango Tree Road (south), and in between the proposed University of Hawai'i West O'ahu (UHWO) property (west) and Old Fort Weaver Road (east). The Petition Area consists of 1,553.844 acres and three of the 10 parcels (See Table 1.1: Project Area Tax Map Key Parcels).

1.3 PROJECT AREA

The 10 parcels are identified as Tax Map Keys (TMK) and include 9-1-10: 02, 14 (portion), 15 (portion); 9-1-17: 04 (portion), 59, and 72; 9-1-18: 01 and 04, 9-2-01: 04, 05, 06, and 07 and 9-2-02:02 (See Figures 1.2 – 1.4: Tax Map Keys). For purposes of this EIS, the parcels labeled A through G are shown in Figure 1.5: Parcels Map, and listed below in Table 1.1. Parcels 9-1-10:02, 14 and 15 will be reserved for drainage only, and Parcels 9-2-01:04, 05, 06 and 07 and Parcel 9-2-02:02 will be used for reservoirs and storage, making the Petition Area approximately 1,553.844 acres. An additional 43.297 acres from 9-1-18:04 and 9-1-17:04 in the Petition Area will be condemned by the City and County of Honolulu for the creation of North-South Road.

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Table 1.1. Project Area Tax Map Key Parcels

PROJECT AREA	LANDOWNER	PARCEL NAME	TAX MAP KEY	ACREAGE
Petition Area	D.R. Horton-Schuler Homes LLC	A	9-1-18: 04	52.289
		B	9-1-18: 01	447.592
		C	9-1-17:04 (portion), 59, and 72	1053.963
			TOTAL PETITION AREA	1,553.844
Non-Petition Area	D.R. Horton-Schuler Homes LLC	G	9-1-17:04 (portion)	1.301
	D.R. Horton-Schuler Homes LLC	D1	9-1-10: 02	30.825
	U.S. Naval Reservation	D2	9-1-10:14 (portion) and 15 (portion)	4.5*
	HECO	E1	9-2-01:04	.243
	Monsanto Company		9-2-01:05	.392
	City and County of Honolulu	E2	9-2-01:06	1.49*
		E3	9-2-01:07	.359
		F	9-2-02:02	7.311
* Approximate Acreage			**TOTAL APPROXIMATE NON-PETITION AREA**	**46.421**
			TOTAL APPROXIMATE PROJECT AREA	**1,600.265**

In addition, the project will require easements over State and County road right-of-ways for the installation of various infrastructure and utility lines such as water, sewer, drainage, electricity, telephone and communications.

1.4 EXISTING USE

The Project Area currently contains cultivated fields for diversified agriculture, pasturage, and agricultural research, and fallow fields formerly used for sugar cane cultivation.

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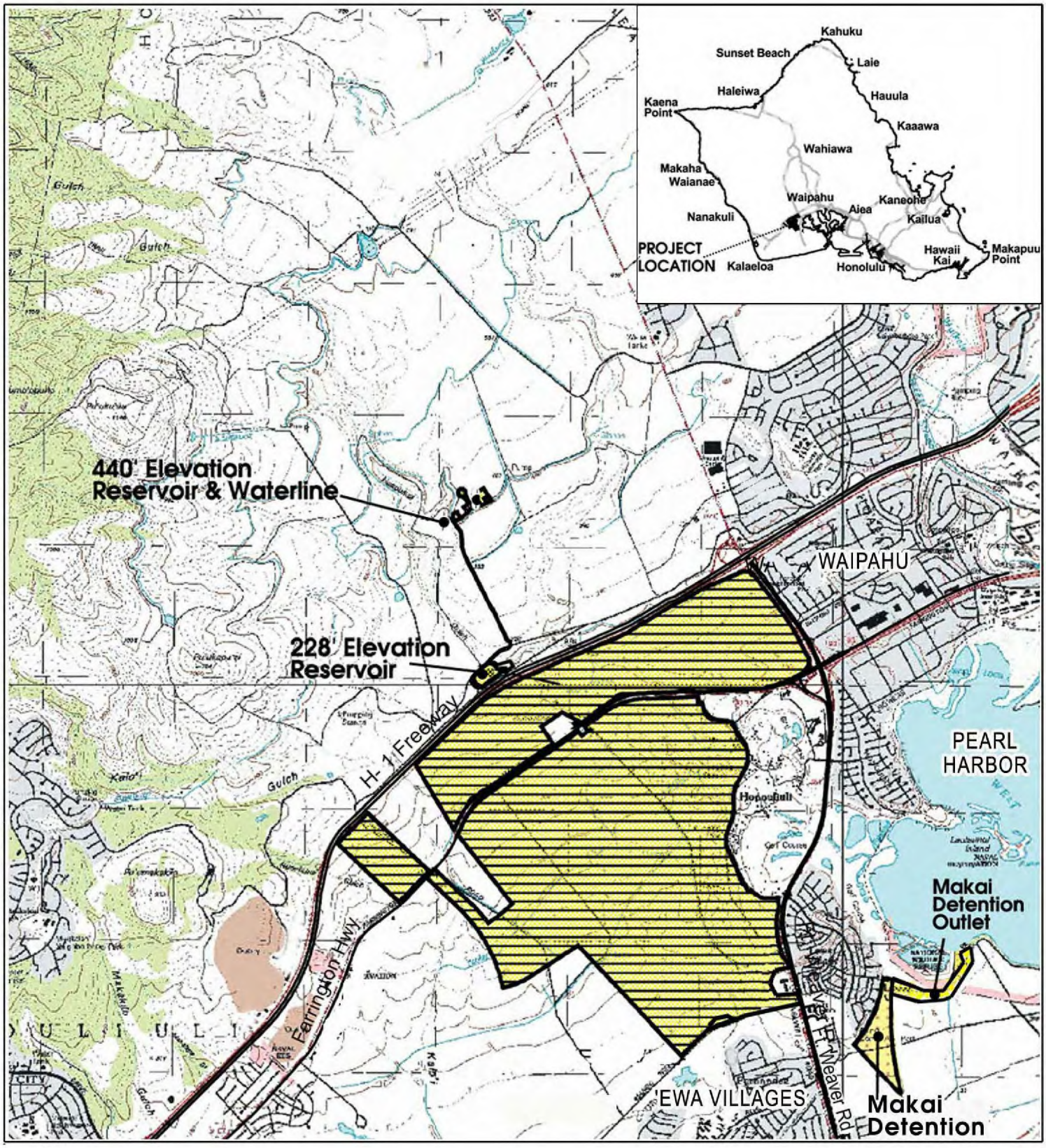


LEGEND

- Project Site Boundary
- Petition Area

Figure 1.1: Location Map

HO'OPILI

O'ahu, Hawai'i

NORTH

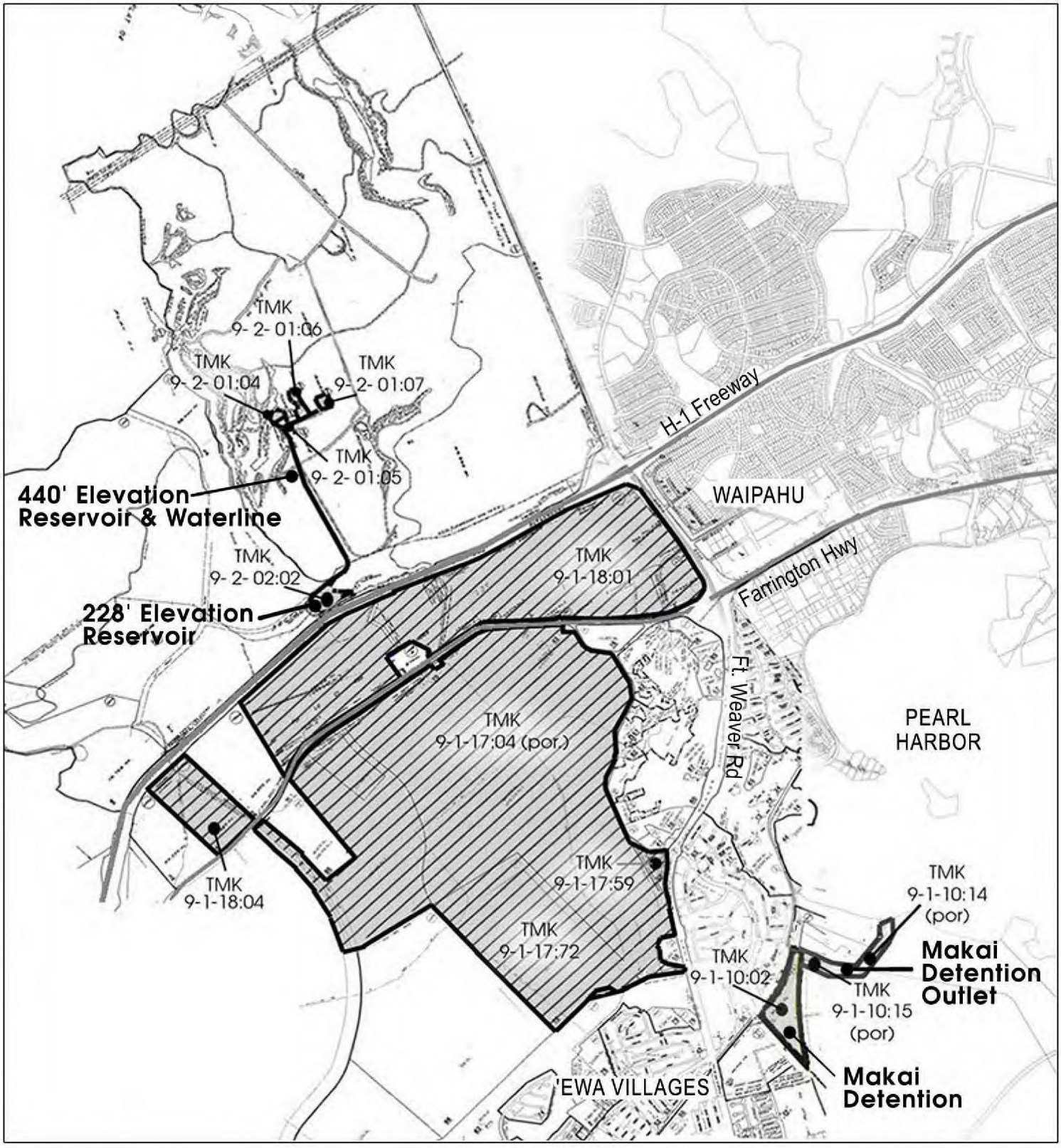
LINEAR SCALE (FEET)

0 3,500 7,000

PBR HAWAII & ASSOCIATES, INC.

Source: US Geological Survey

Disclaimer: This graphic has been prepared for general planning purposes only.



LEGEND

- Project Site Boundary
- Petition Area

Source: Tax maps Zone 9, Sec. 1, Plats 10, 17 and 18
Zone 9, Sec. 2, Plat 1 and 2

Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 1.2: Tax Map Key

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

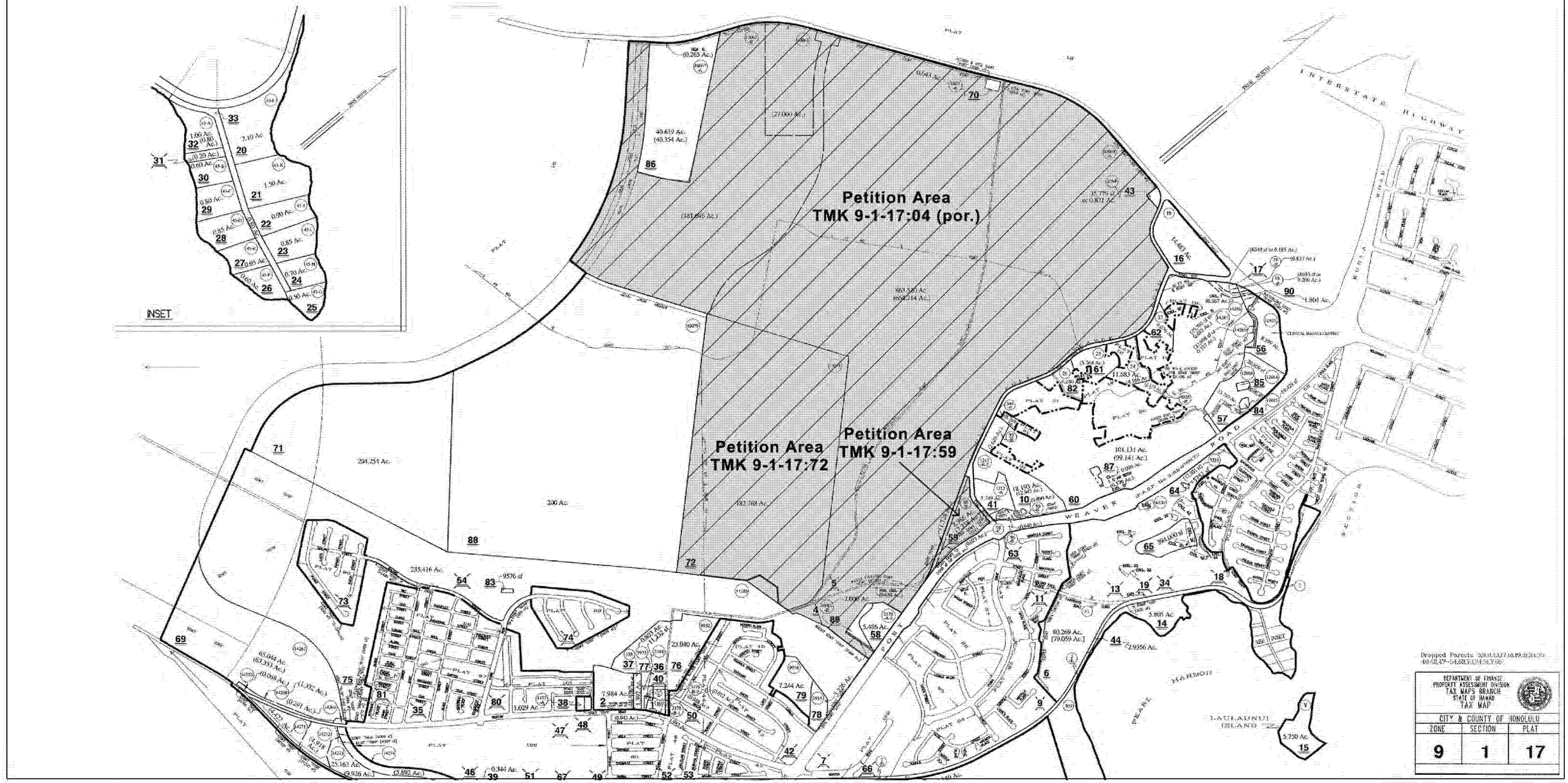


Figure 1.3: Tax Map Key
(Zone 9, Section 1, Plat 17)

HO'OPILI

O'ahu, Hawai'i

LEGEND

- Project Site Boundary
- Petition Area

NORTH

LINEAR SCALE (FEET)
0 1,400 2,800

PBR HAWAII & ASSOCIATES, INC.

Source: Tax Map Zone 9, Sec. 1, Plat 17

Disclaimer: This graphic has been prepared for general planning purposes only.

Owners, lessees, & vendees name recorded on this tax map print may not be current. Please refer to computer and listery sheets for current owners.

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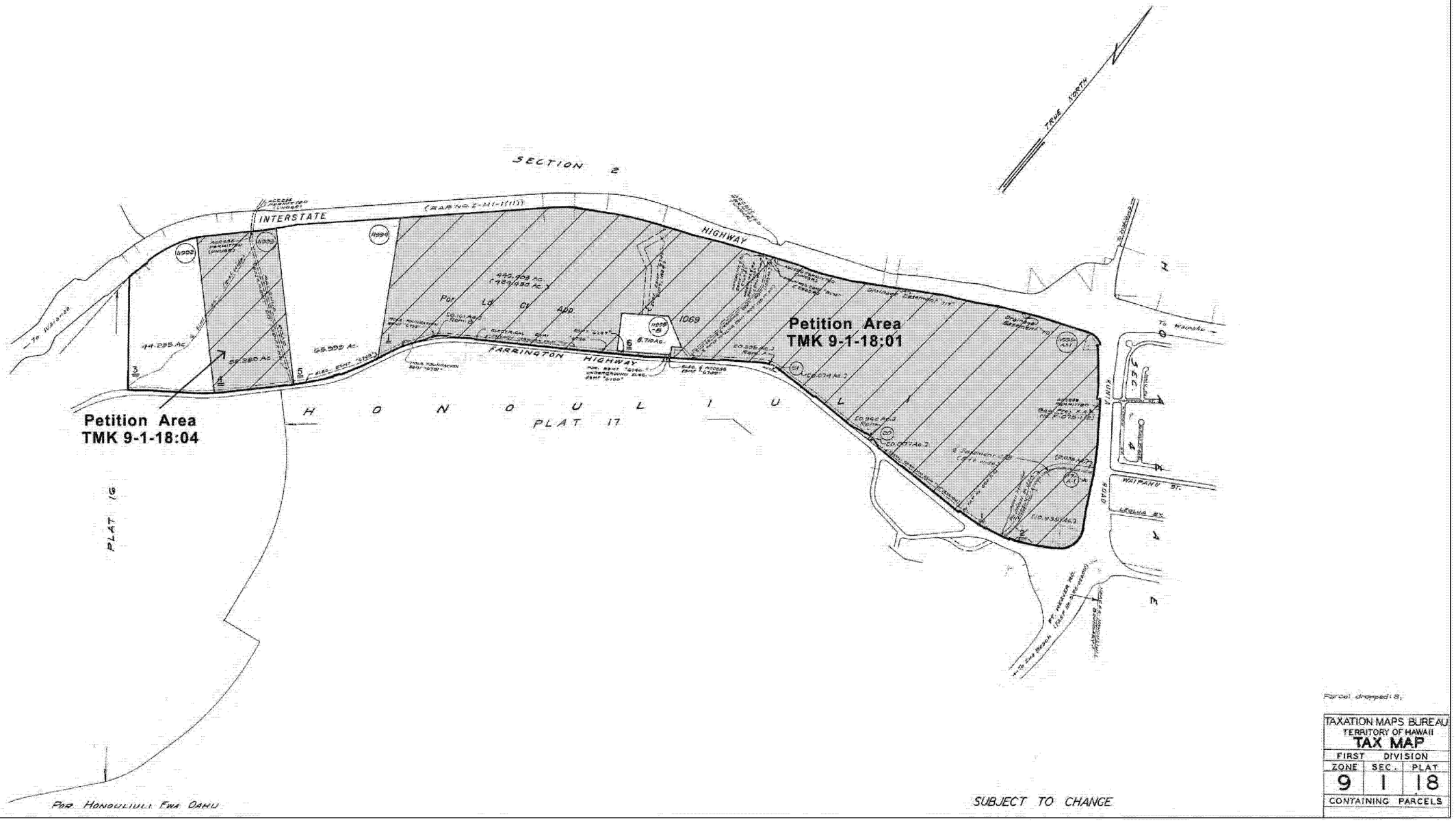
FOR PROPERTY ASSESSMENT PURPOSES, PARCELS MAY NOT BE LEGAL SUBDIVIDED LOTS - SUBJECT TO CHANGE



LEGEND

- Project Site Boundary
- Petition Area

Source: Tax Map Zone 9, Sec. 1, Plat 18

Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 1.4: Tax Map Key
(Zone 9, Section 1, Plat 18)

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 1,400 2,800

PBR HAWAII & ASSOCIATES, INC.

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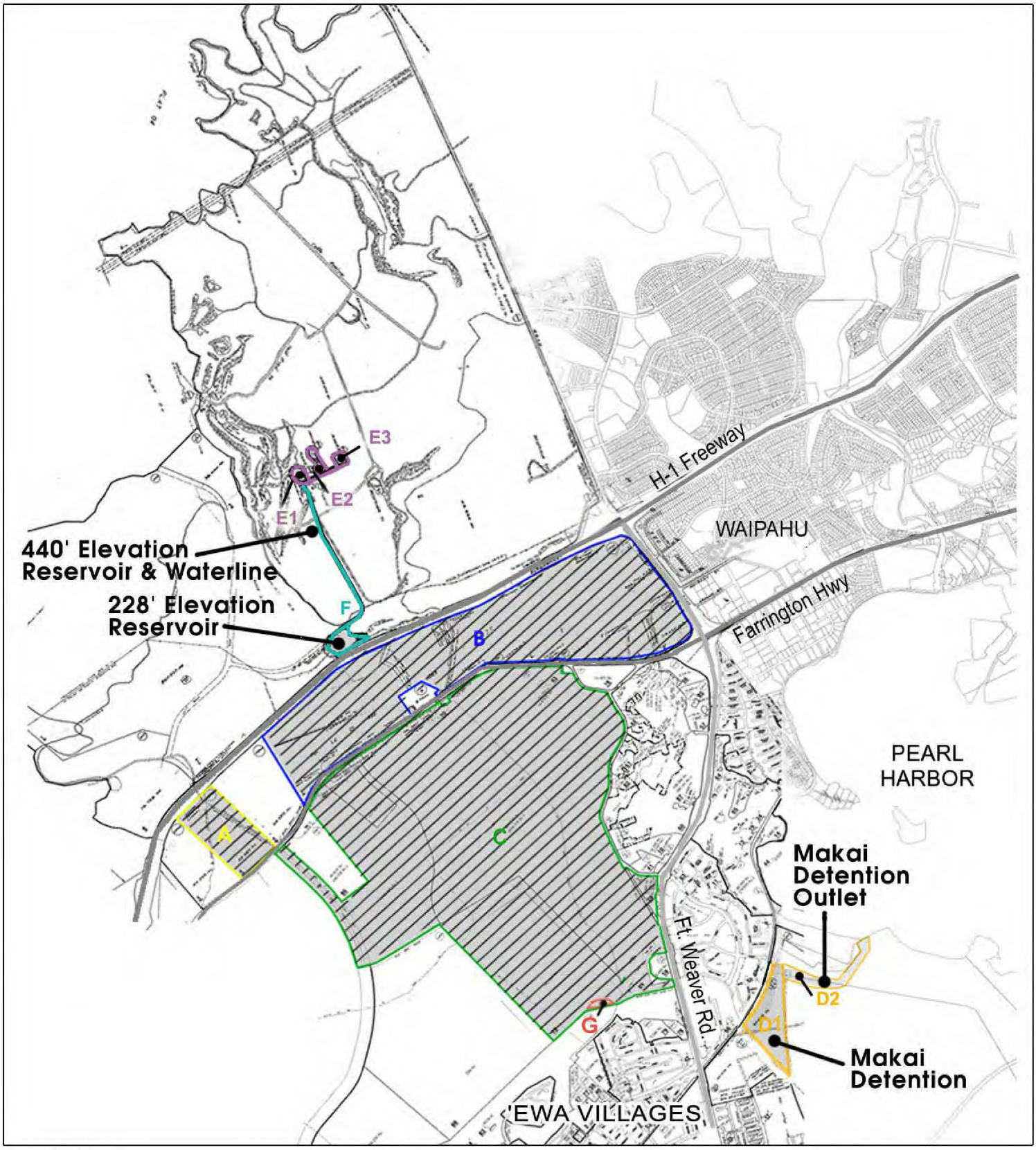

LEGEND

Petition Area

- A: Parcel A: 52.289 Acres
- B: Parcel B: 447.592 Acres
- C: Parcel C: 1,053.963 Acres

Non-petition Area

- D1: Parcel D1: 30.825 Acres
- D2: Parcel D2: 4.5 Acres*

- E1: Parcel E1: .635 Acres
- E2: Parcel E2: 1.49 Acres*
- E3: Parcel E3: .359 Acres
- F: Parcel F: 7.311 Acres
- G: Parcel G: 1.301 Acres

* Approx Acres

Source: Tax Maps Zone 9, Sec. 1, Plats 10, 15,17 & 18 and Zone 9, Sec. 2, Plats 1 and 2
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 1.5: Parcels Map

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)
0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

1.5 LAND OWNERSHIP

D.R. Horton – Schuler Division is the owner of the parcels (A, B and C) located in the Petition Area. D.R. Horton – Schuler Division, Hawaiian Electric Company (HECO), the City and County of Honolulu, the U.S. Naval Reservation and Monsanto Company own property situated within the non-petition area of the Project Area.

1.6 PETITIONER

The Petitioner is D.R. Horton – Schuler Homes LLC., a Delaware Limited Liability Company, d.b.a. D.R. Horton – Schuler Division (D.R. Horton).

Contacts: Mr. Michael Jones, Division President
Mr. Robert Q. Bruhl, Vice President, O'ahu Development
Mr. Dean Uchida, Vice President, Ho'opili
D.R. Horton – Schuler Division
828 Fort Street Mall, 4th Floor
Honolulu, Hawai'i 96813
Phone: (808) 521-5661
Fax: (808) 538-1476

1.7 PLANNING CONSULTANT

The Petitioner's environmental and entitlement planning consultant for the Ho'opili community is PBR HAWAII.

Contact: Mr. Vincent Shigekuni, Vice President
PBR HAWAII
1001 Bishop Street
ASB Tower, Suite 650
Honolulu, Hawai'i 96813
Telephone: (808) 521-5631
Fax: (808) 523-1402

1.8 ACCEPTING AUTHORITY

According to Section 343-5, HRS, "The authority to accept a final statement shall rest with the agency initially receiving and agreeing to process the request for approval." Privately-initiated EIS documents must be accepted by the government agency empowered to approve permits for a project. The accepting authority for this EIS is the State of Hawai'i Land Use Commission, hereinafter simply referred to as the "Commission."

AR00027045

Contact: State of Hawai'i
Land Use Commission
P.O. Box 2359
Honolulu, Hawai'i 96804
Phone: (808) 587-3822
Fax: (808) 587-3827

1.9 COMPLIANCE WITH STATE OF HAWAI'I AND CITY AND COUNTY OF HONOLULU ENVIRONMENTAL LAWS

This document has been prepared in accordance with the provisions of Chapter 343, HRS, (Environmental Impact Statement Law) and Title 11, Chapter 200, HAR, (Environmental Impact Statement Rules). Section 343-6, HRS, establishes nine "triggers" that require compliance with these regulations. The trigger(s) for the proposed Ho'opili project include, but are not limited to, the following:

- Use of State/County lands and funds.

The proposed project's on- and off- site infrastructure improvements relating to roadway, traffic, water, sewer, utility (electricity, telephone and communications) and drainage facilities may affect State and/or County roadways or other lands. While the specific nature of each improvement is not known at this time, the EIS is intended to address all current and future instances involving the use of State and/or County lands and funds relating to the Ho'opili project.

1.9.1 Studies Contributing to this Environmental Impact Statement

A number of specific technical studies were prepared for the proposed Ho'opili project. These studies are included as appendices to the environmental impact statement and include:

- Agricultural Impact Analysis (Decision Analysts Hawaii, Inc.)
- Air Quality Study (B.D. Neal & Associates)
- Archaeological Inventory Survey (Cultural Surveys Hawai'i Inc.)
- Cultural Impact Survey (Cultural Surveys Hawai'i Inc.)
- Faunal Survey (Rana Productions, Ltd.)
- Flora Survey (LeGrande Biological Surveys Inc.)
- Fiscal Impact Study (Mikiko Corporation)
- Market Assessment Study (Mikiko Corporation)
- Acoustical Study (D.L. Adams Associates, Ltd.)
- Conceptual Water Master Plan (Bills Engineering Inc.)
- Preliminary Wastewater Collection System Master Plan (Bills Engineering Inc.)
- Drainage Master Plan (Bills Engineering Inc.)

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- Preliminary Electrical and Communications Master Plan (MK Engineers, Ltd.)
- Social Impact Assessment (Belt Collins Hawaii Ltd.)
- Traffic Impact Analysis Report (Wilbur Smith Associates)
- Arthropod Survey and Assessment (Pacific Analytics, L.L.C.)

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2.0
Description of the Project

2.0 DESCRIPTION OF THE PROJECT

This section provides background information and a general description of the proposed Ho'opili project, and discusses the development timetable and preliminary development costs.

2.1 BACKGROUND INFORMATION

2.1.1 Location

The approximately 1,600.265 acre Project Area is located in the 'Ewa District on the island of O'ahu (See Figure 1.1: Location Map). The Project Area is comprised of eleven distinct parcels of land situated in between the H-1 Freeway (north) and Mango Tree Road (south), and in between the proposed University of Hawai'i West O'ahu (UHWO) property (west) and Old Fort Weaver Road (east). The Petition Area consists of 1,553.844 acres and three of the 10 parcels (A, B and C).

2.1.2 Ownership

D.R. Horton–Schuler Division is the owner of the parcels (A, B, and C) located in the Petition Area. D.R. Horton–Schuler Division, Hawaiian Electric Company (HECO), the City and County of Honolulu, the U.S. Naval Reservation and Monsanto Company own property situated within the non-petition area of the Project Area (See Figure 2.1: Current Land Ownership). In addition, the project will require easements over State and County road right-of-ways for the installation of various infrastructure and utility lines such as water, sewer, drainage, electricity and communications.

2.1.3 Surrounding Land Uses

The Petition Area consists of 1,553.844 acres of the 1,600.265 acres in the Project Area. The Project Area consists of 10 distinct parcels of land situated within the Agricultural District. For purposes of this EIS, the parcels have been labeled as A, B, C, D1, D2, E1, E2, E3, F and G (See Figure 1.5: Parcels Map). The Petition Area parcels are A, B and C. The remaining Project Area parcels, D1, D2, E1, E2, E3, F and G, do not need to be reclassified to urban.

Parcel A is located west of Parcels B and C, and north of the UHWO. It is bordered by State land to the west, Farrington Highway to the south, the proposed North-South Road (under construction) to the east, and the H-1 Freeway to the north.

Parcel B is located north (mauka) of Parcel C and Farrington Highway. It is the second largest of the 10 parcels. Parcel B is bordered to the west by land proposed for multi-family residential use by the HCDCH, to the south by Farrington Highway, to the east by Kunia Road, and to the north by the H-1 Freeway.

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Parcel C is located south (makai) of Farrington Highway. It is the largest of the 10 parcels. Parcel C is bordered by the proposed North-South Road to the west; State Department of Hawaiian Home Lands (DHHL) landholdings, 'Ewa Villages, and the 'Ewa Villages Golf Course to the south; Old Fort Weaver Road and (new) Fort Weaver Road to the east; and Farrington Highway to the north. There are two out-parcels along Farrington Highway. One out-parcel of land near the planned University of Hawai'i West O'ahu (UHWO) campus and North-South Road is proposed for multi-family residential use by the Housing and Community Development Corporation of Hawaii (HCDCH). The other out-parcel of land is used by the City and County of Honolulu Board of Water Supply (BWS).

Parcel D1 is located east of the other four parcels and Fort Weaver Road. Pearl Harbor National Wildlife Refuge is located to the north, West Loch Estates is located to the northwest, 'Ewa by Gentry is located to the south and southwest, and Waipahu and Pearl Harbor are located to the east.

Parcel D2 functions as an outlet, connecting Parcel D1 to Pearl Harbor and its use would require approval from the United States Navy.

Parcels E1, E2 and E3 are located north (mauka) of the H-1 Freeway. The parcels are numbered from west to east, with E1 on the west and E3 on the east. All are surrounded by open space, and are connected to Parcel F via narrow parcel of land which will serve as a waterline.

Parcel F is located north (mauka) near to the H-1 Freeway. It is linked to Parcels E1, E2 and E3 by a narrow band of land. It is bordered by the H-1 Freeway on the southern boundary and by open space on its north, east and western sides.

Parcel G is adjacent to the makai boundary of Parcel C and is located north (mauka) of the 'Ewa Villages Golf Course, and is already located within the State Urban Land Use District boundaries.

Adjacent landowners to the Project Area, from a regional perspective, are identified in Figure 2.2: Surrounding Land Ownership.

2.1.4 Description of the Project Area

The Project Area has been used primarily for agricultural purposes. The Project Area was previously leased to the 'Ewa Plantation Company/'Ewa Sugar Company and the O'ahu Sugar Company. The Project Area's current tenants and existing land uses are listed in Table 2.1 below and shown on Figure 2.3: Current Lessees.

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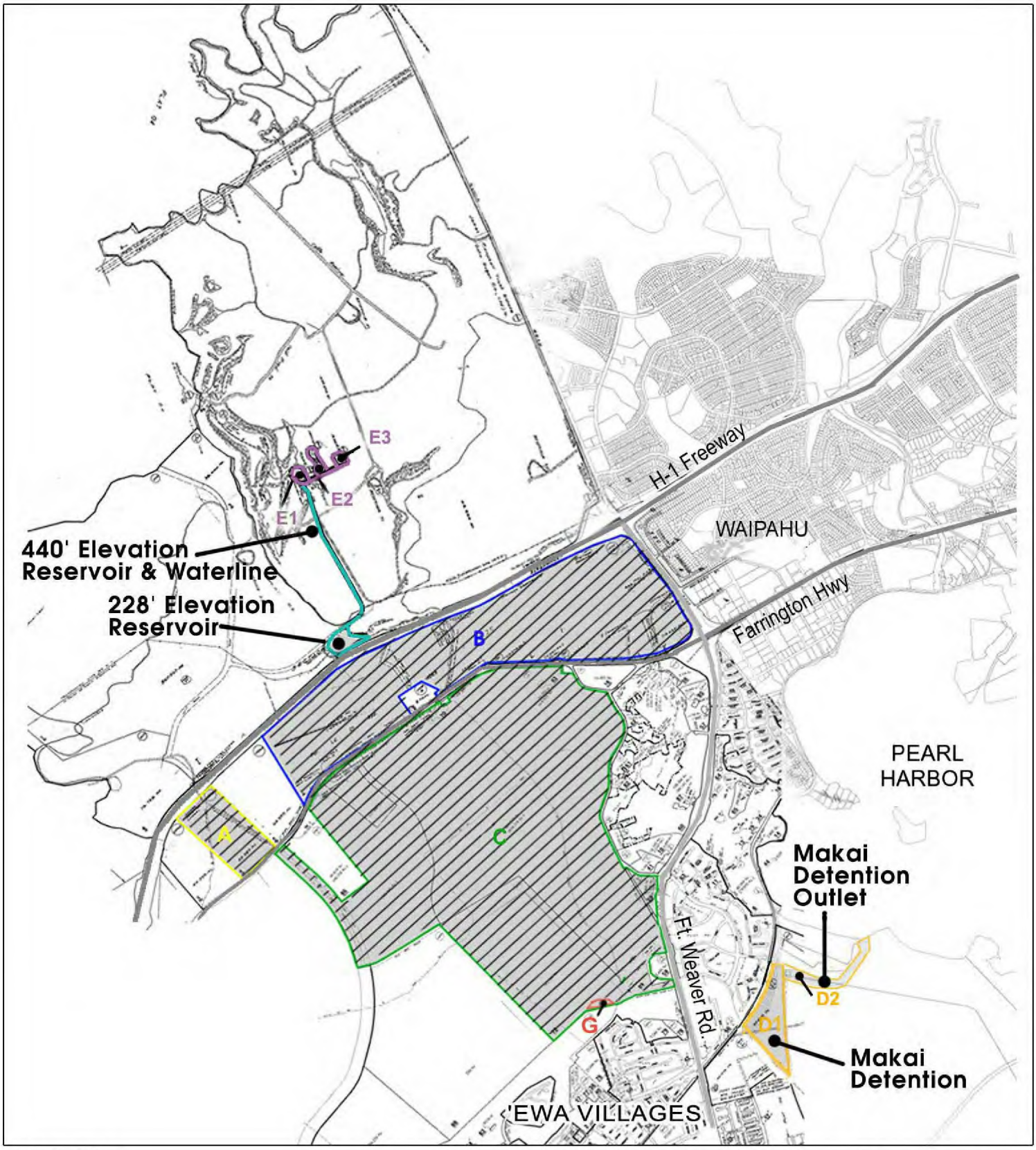


LEGEND

Petition Area

- A: Parcel A: D.R. Horton
- B: Parcel B: D.R. Horton
- C: Parcel C: D.R. Horton

Non-petition Area

- D1: Parcel D1: D.R. Horton
- D2: Parcel D2: U.S. Naval Reservation
- E1: Parcel E1: HECO/Monsanto Company
- E2: Parcel E2: City and County of Honolulu
- E3: Parcel E3: City and County of Honolulu
- F: Parcel F: City and County of Honolulu
- G: Parcel G: D.R. Horton

Source: Tax Maps Zone 9, Sec. 1, Plats 10, 15,17 & 18 and Zone 9, Sec. 2, Plats 1 and 2
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2.1: Current Land Ownership

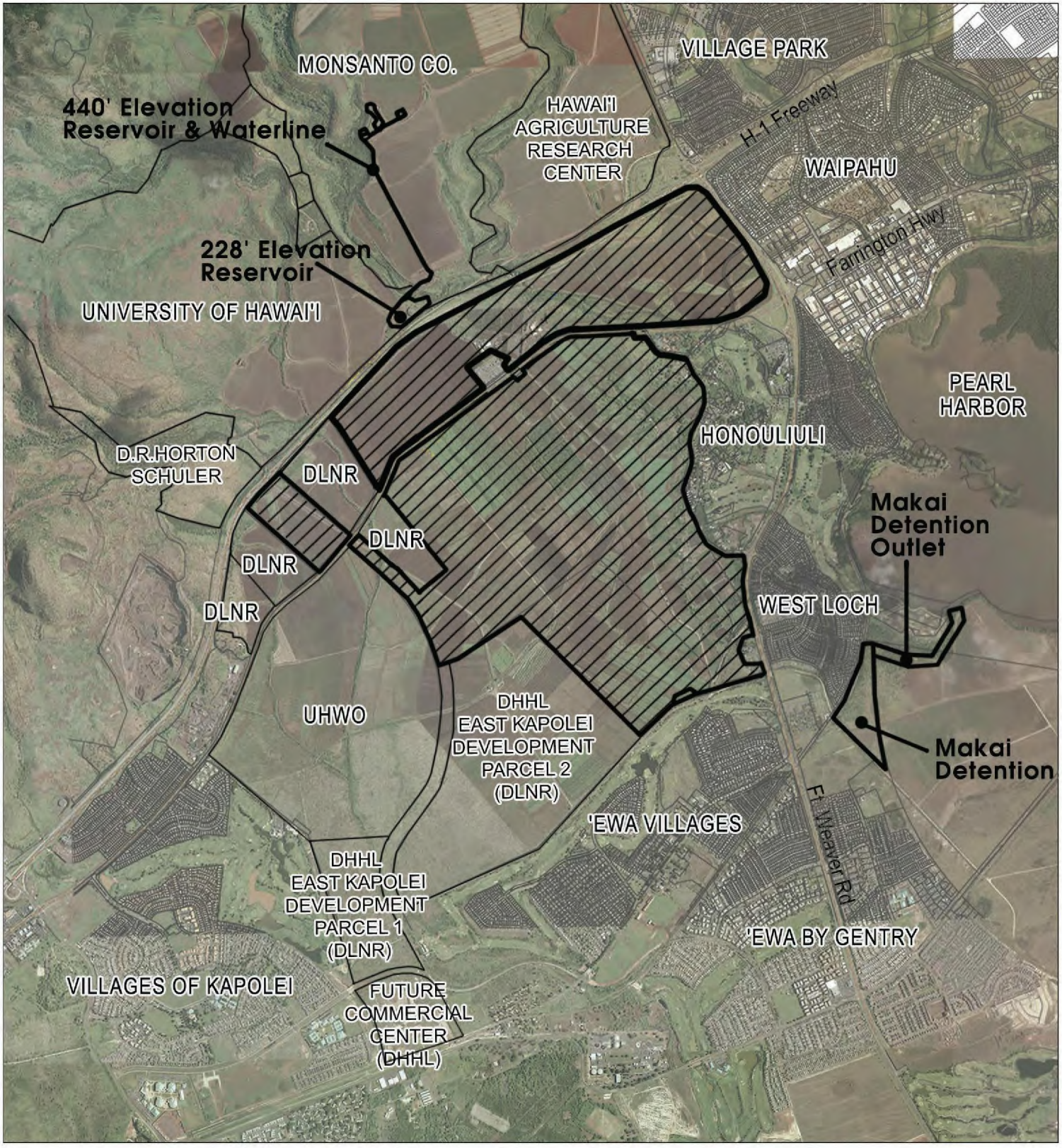
HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)
0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.



LEGEND

- Project Site Boundary
- Petition Area

Source: USGS Seamless, 2004
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2.2: Surrounding Land Ownership

HO'OPILI

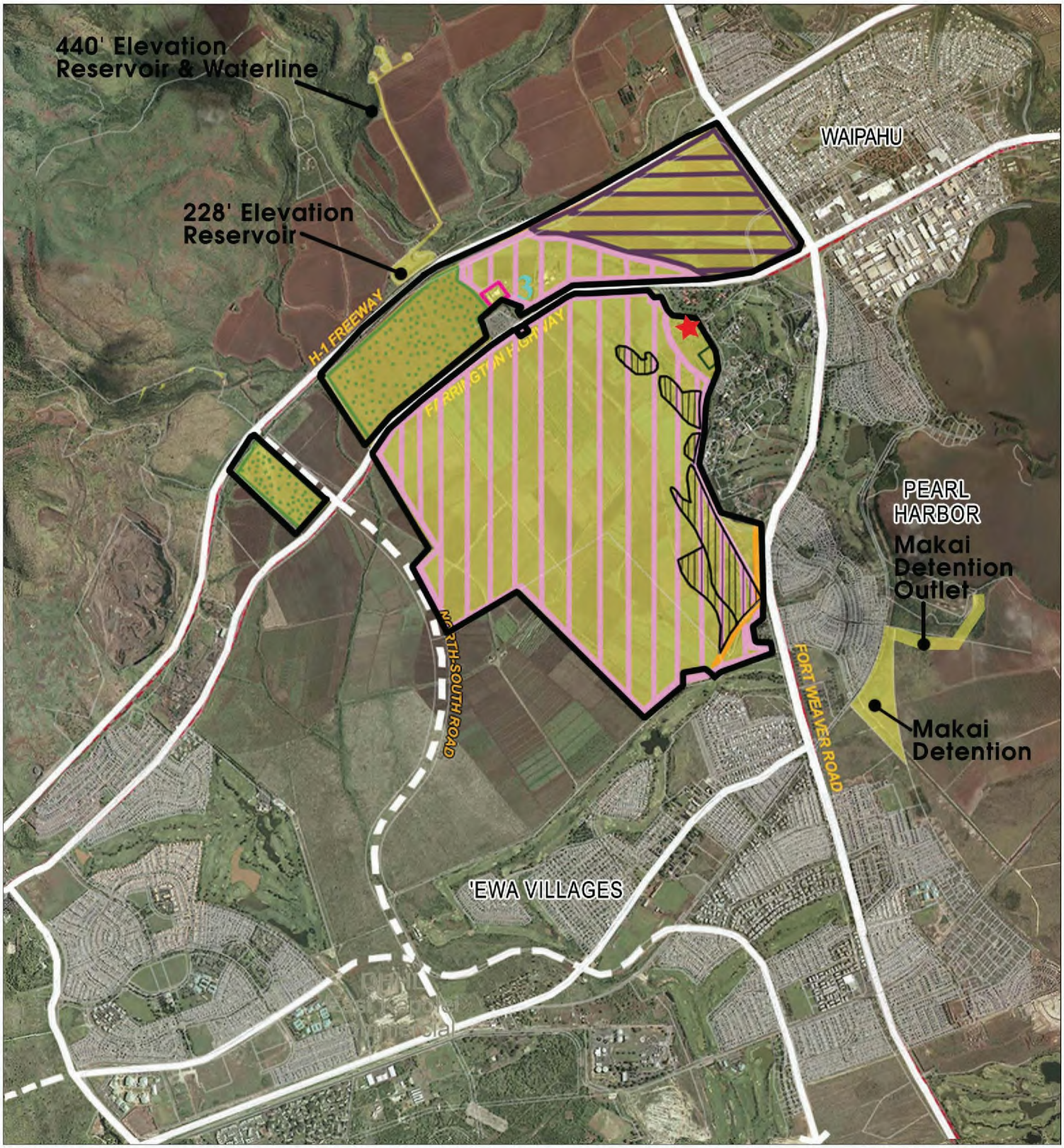
O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.



LEGEND

- Project Site Boundary
- Petition Area
- Aloun Processing Plant Lease (3 A.C.)
- Aloun Farm Lease
- Sugarland Lease
- Garst Seed Lease
- Hawai'i Agricultural Research Center Lease
- U.S. Filter Operating Lease (Non-Major #3)
- Subleased Areas
- Approximate Location of Roberts Hawaii School Bus, Inc.

Source: D.R. Horton-Schuler Division
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2.3: Current Lessees

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)
0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

Table 2.1. Current Tenants and Existing Land Uses

TENANT	LAND USES
Aloun Farm, Inc.	Diversified agriculture, pasturage, storage/processing/distribution facility for produce
Sugarland Farms, Inc.	Grazing of livestock, cultivation of crops
Rocker G. Livestock (d.b.a. Bud Gibson)	Pasturage
Larry G. Jefts	Diversified agriculture, ranching and grazing of cattle
Garst Seed Company	Cultivation of legal seed corn and other agricultural crops
Roberts Hawaii School Bus, Inc.	Parking of no more than 30 school buses and 60 Handi-Vans
Hawaii Agricultural Research Center	Agricultural research station

2.1.5 State Land Use District

The Petition Area is currently in the State Agricultural District (See Figure 2.4: State Land Use District). Lands outside of the Petition Area are located within the Urban and Agricultural Districts. D.R. Horton filed a petition (A06-771) with the State Land Use Commission to reclassify the Petition Area to the Urban district.

2.1.6 Ewa Development Plan

The *Ewa Development Plan* designates the Petition Area as Low and Medium Density Residential, High Density Residential, Agricultural Land Preservation, Parks, and Transit Node (High Density Residential and Commercial) and Future Intermediate School (See Figure 2.5: Ewa Development Plan and Figure 2.6: Ewa Development Plan Open Space Map).

2.1.7 City and County of Honolulu Zoning

The Petition Area is presently zoned AG-1 Restricted Agricultural District by the City and County of Honolulu's Land Use Ordinance (See Figure 2.7: Current Zoning Map). As such, the Petitioner will be seeking a Zone Change for the 1,553.844 acre Petition Area, and the 1.301 acre Parcel G [TMK: 9-1-17: 04 (por.)].

2.2 STATEMENT OF PURPOSE AND NEED

According to the City and County of Honolulu Department of Planning and Permitting (DPP), the year 2006 population of the *Ewa Development Plan Area* (Ewa DPA) was 86,000 (DPP, 2006). This comprised an increase of 25.1 percent from its 2000 population of 68,718. The DPP expects the population of the Ewa DPA to increase to 180,200 by the

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year 2030. In comparison, the population for the City and County of Honolulu as a whole increased only 3.8 percent from 876,156 to 909,863 between 2000 and 2006. The City and County of Honolulu is expected to experience a population growth of 27.5 percent (241,144 persons) from 876,156 to 1,117,300 total residents during the same 30-year period.

With the expected increase in population, most of O'ahu's new housing stock is planned for development in the 'Ewa and Central O'ahu regions. Indeed 'Ewa is the City and County of Honolulu's lone "Development Plan" area. This trend is expected to continue over the next several decades to accommodate the projected population growth and housing demand. Large-scale housing development projects in the 'Ewa region provide an opportunity for fee-simple home ownership at relatively affordable prices.

The Ho'opili community will provide numerous socio-economic opportunities to residents of Hawai'i. Development of the Petition Area would include development of a mixed-use, transit-ready community including residential, business, and commercial units; and transit stations, schools, and parks. As such, Ho'opili aims to provide: employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents; and diverse, including affordable, housing options. Residents will live, work, learn, play, and shop in one area. In addition, the project will generate direct and indirect jobs during construction and post-construction, and enable residents to live, work, learn, play, and shop in one area.

2.3 THE VISION

Ho'opili – which means "coming together" in Hawaiian – reflects the ideas, hopes and dreams of what the community envisioned during the planning and preliminary design phases of the project. The plan envisions vibrant and safe neighborhoods where people feel a sense of connection with one another, and with the rest of O'ahu.

Ho'opili reflects the public's desire for a community that provides: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents, thus allowing community residents the ability to live, work, learn, play, and shop in one area. In addition, Ho'opili will incorporate green building practices and to be an environmentally-sound, healthy and resource-efficient community.

To achieve the vision for Ho'opili, a Conceptual Land Use Plan (See Section 2.5.1) has been formulated that illustrates a mixed-use community that would complete and connect 'Ewa with the surrounding communities. Originating from the common vision and values of a community-driven planning effort, the conceptual plan contains a series of neighborhoods with a mix of uses including residential, retail, office and light industrial. Included in this mix are a series of parks, schools, public buildings and community centers which act as a focus and help define the identity of each neighborhood.

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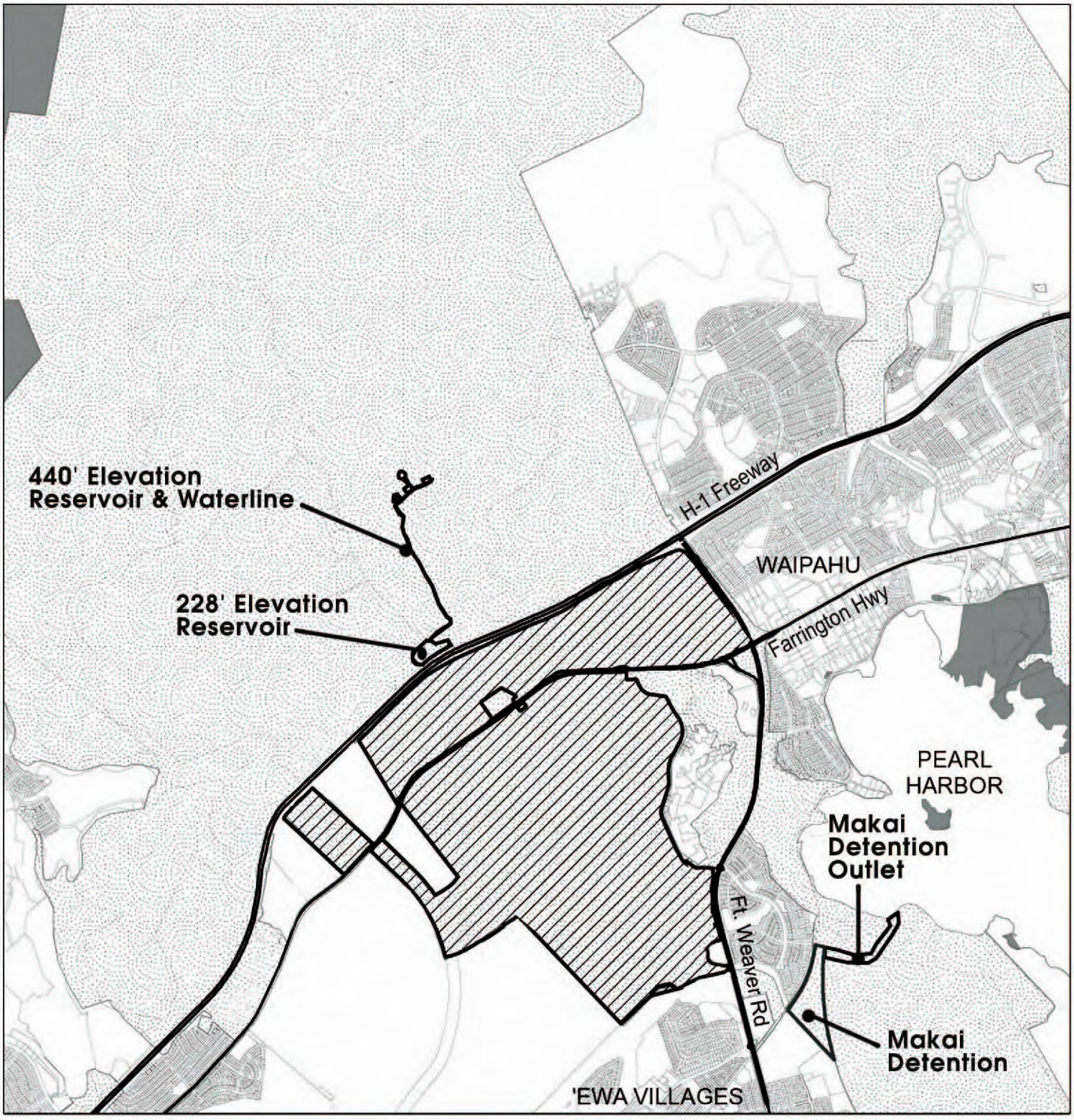


LEGEND

- Project Site Boundary
- Petition Area
- Agricultural
- Conservation
- Urban

Source: State Land Use Commission (2004)

Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2.4 State Land Use District

HO'OPILI

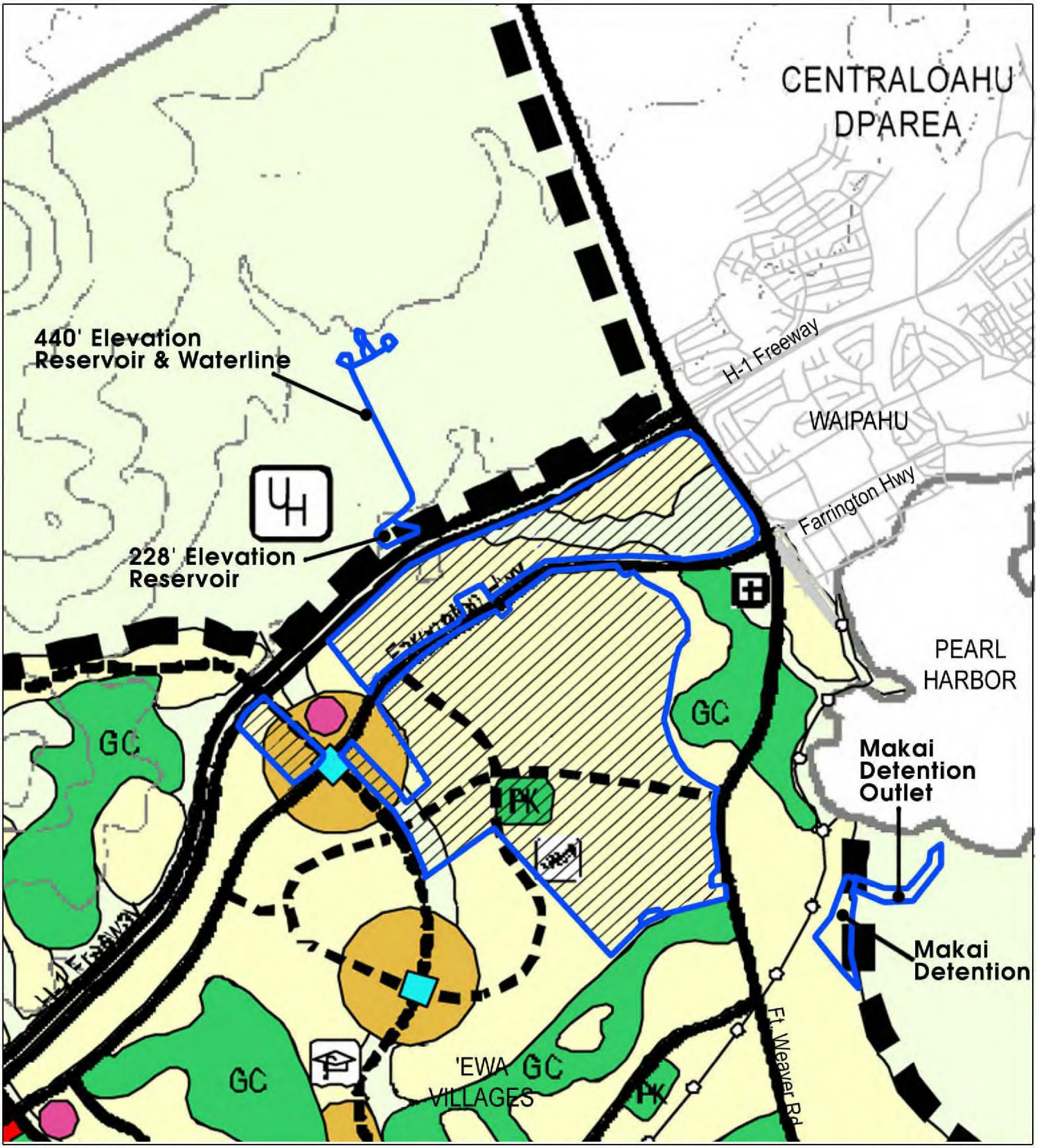
O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 3,500 7,000

PBR HAWAII & ASSOCIATES, INC.



LEGEND

- Project Site Boundary
- Petition Area
- Low & Medium Density Residential
- High Density Residential
- Community Commercial Center
- Agricultural Land Preservation
- PK/GC Parks & Golf Courses
- Transit Nodes/ High Density Residential & Commercial
- Urban Growth Boundary

Source: City & County of Honolulu 'Ewa Development Plan Urban Land Use Map (1997)
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2.5: 'Ewa Development Plan

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

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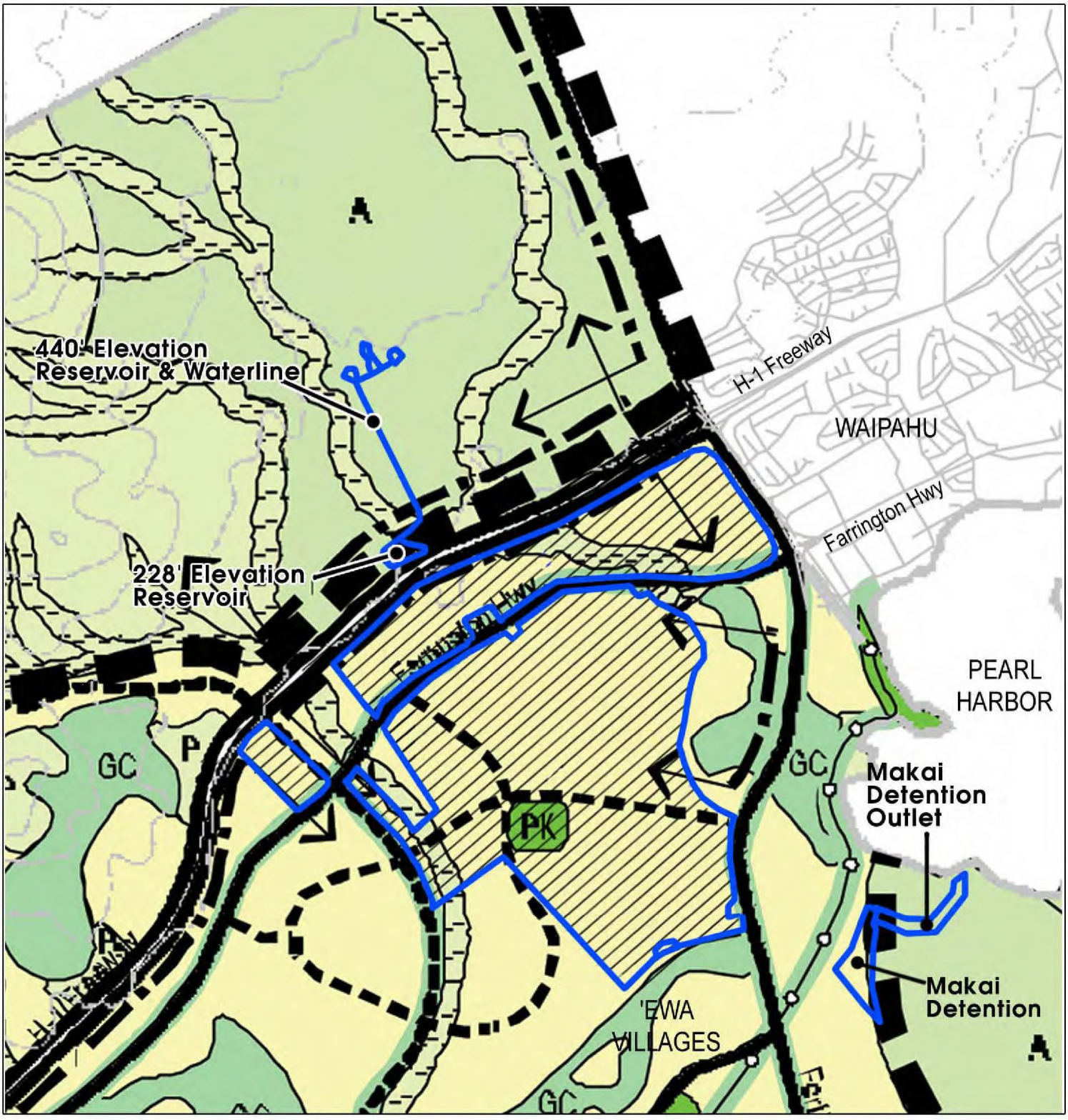

LEGEND

- Project Site Boundary
- Petition Area
- P — Preservation Areas
- A — Agricultural Areas
- PK — Regional, District, Shoreline, and Nature Parks
- GC — Golf Courses
- Existing/Future Highways, Arterial and Major Collector Streets
- Existing/Future Landscaped Boulevard/Greenway
- Natural Drainageways/ Gulches
- Panoramic Views
- Historic Railway/ Bikeway Corridor
- Shoreline Access
- Urban Areas
- Urban Growth Boundary

Source: City & County of Honolulu 'Ewa Development Plan Open Space Map (1997)
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2.6: 'Ewa Development Plan Open Space Map

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET) 0 3,000 6,000

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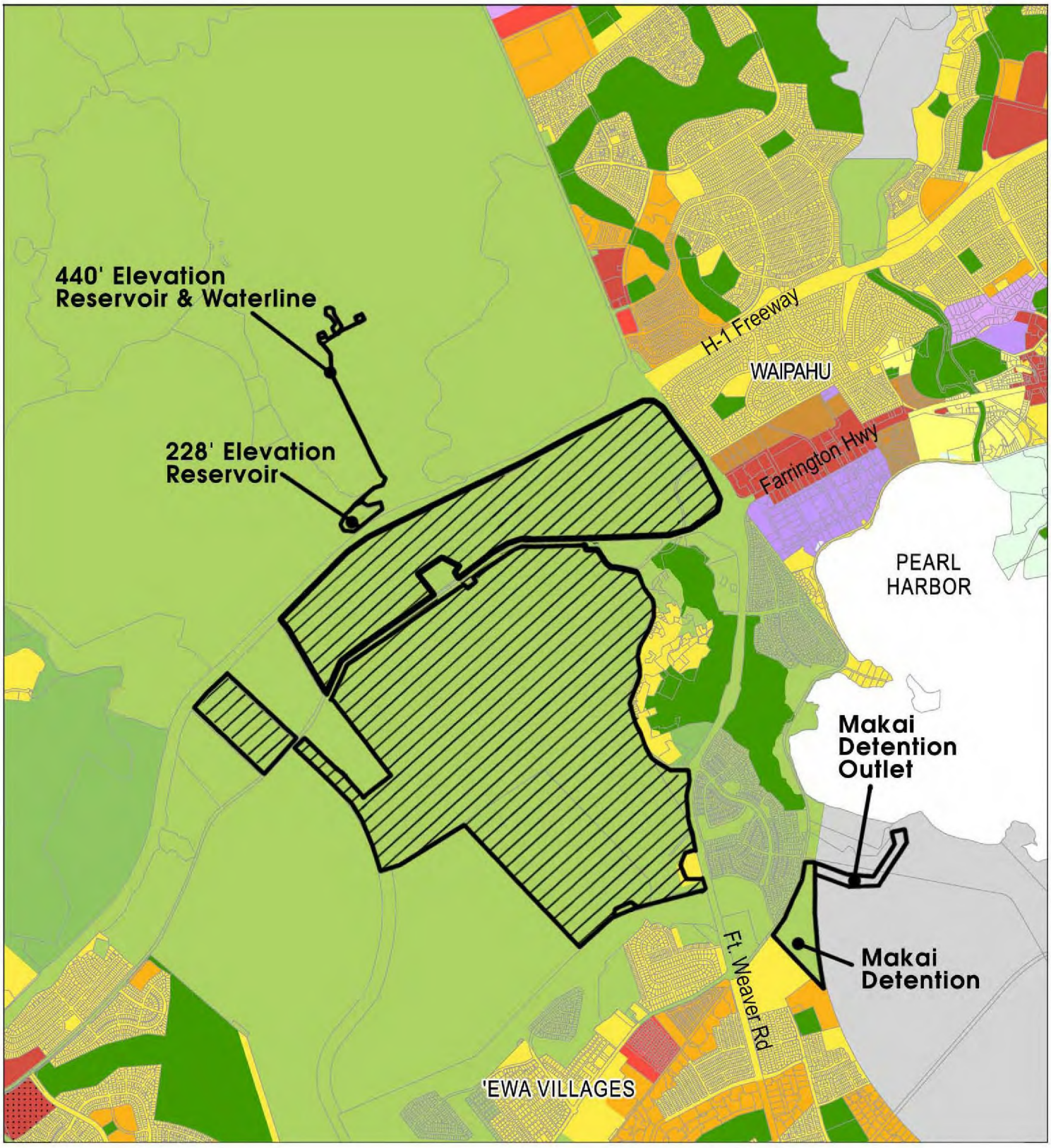

Figure 2.7: Current Zoning Map

LEGEND

- Project Site Boundary
- Petition Area
- AG-1 Restricted Agriculture Zone
- F-1 Military and Federal Zone
- R-5 Residential Zone

Source: City and County of Honolulu (2005)
Disclaimer: This graphic has been prepared for general planning purposes only.

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

2.4 THE COMMUNITY PLANNING PROCESS

Representatives from various West O'ahu community groups began work on formulating a vision and master plan for a new West O'ahu community being planned by D.R. Horton in October 2005. The group, the Ho'opili Community Task Force, met nearly once a month – and sometimes more often – for a year (October 13, 2005; November 9, 2006; February 1, 2006; March 1, 2006; March 29, 2006; April 17, 2006; May 15, 2006; June 5, 2006; June 26, 2006; August 14, 2006; and October 16, 2006), to explore the communities' needs and desires for the completion of the 'Ewa Vision on topics such as "gathering place," "parks and community facilities," "transportation and infrastructure," "education," "employment," and "housing." After the completion of the master plan, the Ho'opili Community Task Force has continued to meet (March 5, 2007; April 2, 2007; May 7, 2007; June 4, 2007; June 25, 2007; July 16, 2007; August 6, 2007; September 17, 2007; and October 15, 2007) to address the most challenging issue of the region, traffic, especially daily commuting to workplaces and schools outside of the 'Ewa region. The group will be asked to reconvene in early 2008 to continue its work on the plan and anticipated development issues.

The planning effort produced a community-driven vision for a new kind of development, one that improves the quality of people's lives by allowing them to live, work, learn, shop and play – all right in their own community.

The proposed plan for Ho'opili hopes and dreams of what the community wanted to see in this new community. The plan reflects the community's desire for vibrant and safe neighborhoods where people feel a sense of connection with one another, and with the rest of O'ahu.

The Conceptual Land Use Plan also reflects the desire for a community that provides: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents.

Finally, the community expressed a desire to see this new community incorporate green building practices and to be an environmentally-sound, healthy and resource-efficient community.

The Ho'opili Community Task Force identified three core values for its vision for 'Ewa:

- **Connected community**
  - Connects the City of Kapolei with the surrounding communities of 'Ewa, 'Ewa Beach, 'Ewa Villages, Honouliuli, Kalaeloa, Kunia, Makakilo, Waipahu, West Loch, and the rest of O'ahu
  - Make it easy for residents to connect to local shops, parks, schools, employment areas, such as the City of Kapolei and the planned

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University of Hawai'i at West O'ahu through a walkable, transit-oriented community with pedestrian/bicycle paths
- Acknowledge the transportation issues in 'Ewa, and provide a thoughtful and real response to these issues
- Use technology to connect businesses and residents with others to create a healthy "live-work" environment

- **Lifestyle-enhanced community**
  - Create a healthy, balanced and vibrant community that offers a unique urban lifestyle in a "village" setting
  - Provide a wide diversity of housing, including truly "attainable" housing
  - Create a "gateway" to West O'ahu that establishes a strong sense of place and a warm sense of community, both for this generation and the next
  - Plan for schools of every type: public and private; daycare through bachelor's degree; and life-long learning opportunities
  - Provide more quality jobs so people can live, work and thrive in their own community
  - Provide a gathering place that creates a real community "center" and gives residents "somewhere to go"

- **Sustainable "green" community**
  - Incorporate green building practices and an environmentally-sound, healthy and resource-efficient community
  - Provide lots of parks, open space and community facilities
  - Plan for and properly-phase utility infrastructure
  - Reduce automobile dependency by creating a compact community with a mix of land uses
  - Preserve views to Diamond Head and surrounding mountains

The Ho'opili Community Task Force's vision and values manifested itself in the following proposed land uses for a mixed-use community:

Variety of Parks and Open Space. Various large and small parks are planned throughout Ho'opili. These include:

- A District Park with active playfields
- Canyon Park (a unique "wilderness"-type park)
- Civic Plaza - a community gathering space for outdoor concerts, farmer's markets, et cetera.
- "Mini" parks, located throughout the project to be within walking distance of most residences
- Linear parks and open space that encircle Ho'opili with walking/biking paths

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Various Community Gathering Spaces. Ho'opili is planned to provide a number of gathering places including the Civic Plaza, the various parks, a community center, houses of worship and new public school cafetoriums that can be used for community meetings, et cetera.

Wide Range of Educational Facilities. A range of educational facilities are planned for Ho'opili residents, either on-site or nearby. Possible schools include daycare and/or pre-school facilities, public elementary schools, a public middle school, and a public high school, and possibly private schools. Ho'opili will also be designed to connect with the new UH West O'ahu campus. Providing such facilities in Ho'opili will help reduce trips outside of 'Ewa.

Diverse Career Opportunities. Through 2025, it is expected that more than 40,000 new jobs will be created in the 'Ewa region and Kapolei. While many of its residents might fill these jobs, Ho'opili is designed to be a well-balanced community, hoping to allow residents the opportunity to integrate their personal and professional lives by offering a number of new employment alternatives. The Petitioner hopes to help attract new employers to the area in its goal to achieve a jobs-housing balance to help reduce the need for commuting outside of 'Ewa. At full build out, Petition Area employment is expected to account for approximately 1,550 jobs. Possible jobs-creation areas include research and development parks associated with UH West O'ahu, medical offices that will complement Hawai'i Medical Center West and Kahi Mohala, schools, offices, restaurants and retail. As at Mehana, in the City of Kapolei, Ho'opili will include "live-work" units where residents can own homes that also serve as business locations. Off-site, but within 'Ewa, career-type opportunities include those at the City of Kapolei, Ko 'Olina and UH West O'ahu.

Various Home Choices. Ho'opili is planned to feature a variety of housing options, including: low-density residential, including single-family homes; medium-density (including "live-work" housing featuring townhouses and semi-attached homes); and higher-density residential condominiums and apartments.

Shopping, Dining and Entertainment Choices. Ho'opili is planned to include shopping, dining and entertainment establishments concentrated within walking distances of the Civic Plaza, medium and higher density residential areas, offices and the planned high-capacity transit stop. These establishments should add to the social opportunities within 'Ewa and reduce the need to drive to "town" for shopping, dining and movies.

Multi-Modal Transportation. Ho'opili is designed to be bus/high-capacity transit-ready with a vast, interconnected internal street grid that provides numerous ways of getting around by bus/high-capacity transit, on foot, by bicycle, and by car (See Figure 2.8: Proposed Circulation Plan).

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Pedestrian-Friendly Environment. Ho'opili is planned to include a comprehensive pedestrian/bicycle system that connects homes to schools, gathering places, community facilities, parks and open spaces. Also, Ho'opili's proposed mix of land uses should mean that jobs, goods and services that residents need (including day care), will be either just "steps away" or a "couple of doors down." Reducing automobile dependency can lead to an enhanced lifestyle that encourages healthy living.

2.5 THE HO'OPILI COMMUNITY

2.5.1 Ho'opili Conceptual Land Use Plan

The Proposed Action involves the reclassification of approximately 1,553.844 acres from the Agricultural District to the Urban District. Urbanization of the petition area will enable the Petitioner to develop the proposed Conceptual Land Use Plan (See Figure 2.9: Conceptual Land Use Plan). The proposed Ho'opili Conceptual Land Use Plan will be a community where residents can live, work, learn, play, and shop.

To achieve the communities' vision for Ho'opili, a Conceptual Land Use Plan has been formulated that illustrates a mixed-use community that would complete and connect 'Ewa with the surrounding communities. Originating from the common vision and values of a community-driven planning effort, the conceptual plan contains a series of neighborhoods with a mix of uses including residential, retail, office and light industrial. Included in this mix are a series of parks, schools, public buildings and community centers which act as a focus and help define the identity of each neighborhood.

Ho'opili is planned to be connected to the surrounding 'Ewa District (and neighboring DHHL, UHWO and HCDA properties) by a network of streets and bicycle paths which should allow a variety of circulation options for residents and visitors. Wider tree-lined boulevards are intended to create a distinct axis running north-south and east-west across the site. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. Also possible is a transit maintenance and storage facility. While the proposed residential unit count should not materially change, it will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as ridership generation, "capture" of transit-oriented development potential and the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will concentrate higher intensity development (and density) around the transit station(s). A site for a transit maintenance and storage facility is also possible. (As of this writing, the City and County of Honolulu has begun work on the Draft EIS for the Honolulu High-Capacity Transit Corridor (HHCTC) project, with a target publication date in the second quarter of 2008. By the time the HHCTC Draft EIS is

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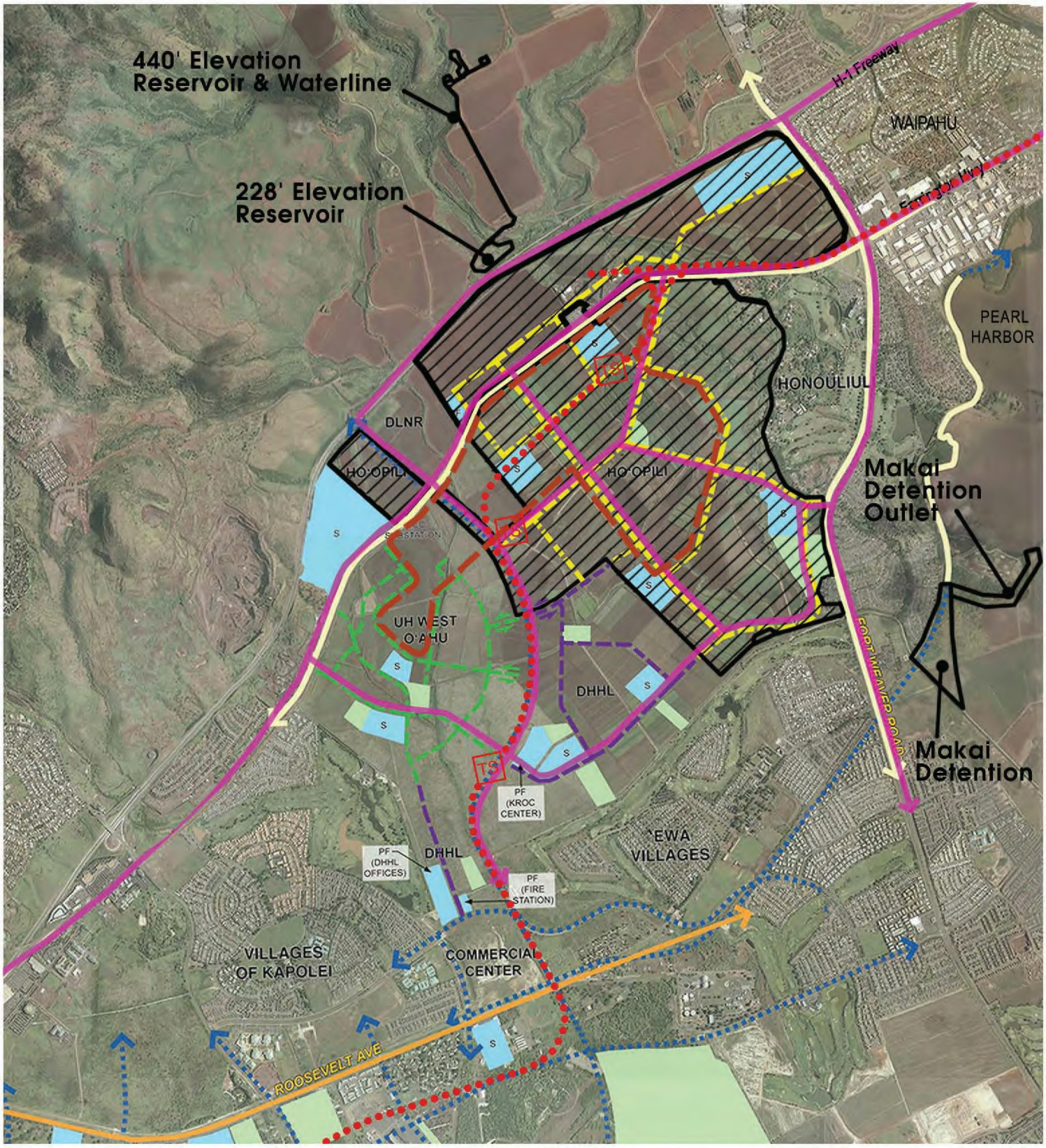

- Project Site Boundary
- Petition Area
- Proposed UH West O'ahu Bikeway
- Proposed Ho'opili Bikeway
- Proposed DHHL Bikeway
- Proposed Bikeway by Others
- Existing State Bike Plan
- Pearl Harbor Historic Trail and Leeward Bikeway
- Express and Local Bus Routes
- Proposed HHCTC Corridor
- TS Proposed Transit Stop
- Circulator Shuttle
- Proposed Parks
- S Proposed Schools
- PF Proposed Public Facility
- Right-in / Right-out
- Right-in / Right-out

Source: State of Hawaii Department of Transportation Bicycle Plan 2000;
Draft Ewa Connectivity Study 2007.
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2.8: Proposed Circulation Plan

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)
0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

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LAND USE		Approx. Gross Acres	Approx. # of Units
	Project Site Boundary		
	Petition Area		
	Low-Medium Density Residential / Live-Work*	535	5,100
	Mixed Use / Medium Density Residential*	340	5,200
	Mixed Use / High Density Residential*	50	1,450
	Business / Commercial	145	
	Light Industrial / Business	50	
	Open Space / Buffers*	150	
	Parks*	60	
★	Neighborhood Parks*	*	
	Public Facilities	100	
	Major Roads* (as shown)	124	
	TOTAL: (Approx.)	1,555	11,750

*Neighborhood parks and secondary roadways included in residential areas

Figure 2.9: Conceptual Land Use Plan

HO'OPILI

Oahu, Hawaii

D·R·HORTON America's Builder
SCHULER DIVISION

NORTH

LINEAR SCALE (FEET)
0 2,000 4,000

PBR HAWAII & ASSOCIATES, INC.
VAN METER WILLIAMS POLLACK, LLP
Charlier Associates, Inc.

440' Elevation Reservoir & Waterline
228' Elevation Reservoir
Makai Detention Outlet
Makai Detention
KUNIA ROAD
TO HONOLULU
WAIPAHU
H-1 INTERSTATE
OLD FORT WEAVER ROAD
HONOULIULI
DLNR
DLNR
WEST LOCH
UH WEST O'AHU
DHHL
NORTH - SOUTH ROAD
FORT WEAVER ROAD
TO WAI'ANAE
FARRINGTON HIGHWAY
MAKAKILO
MAKAKILO DRIVE
'EWA VILLAGES
'EWA
DHHL
RENTON ROAD
FORT BARRETTE ROAD
VILLAGES OF KAPOLEI
VARONA VILLAGE II
KAMOKILA BLVD.
CITY OF KAPOLEI
KAPOLEI PARKWAY
DHHL
GEIGER ROAD

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published, the final alignment of the high-capacity transit corridor, the location of transit stations, and the location of the transit maintenance and storage facility will be known).

In the geographical center of the site there is a public square or Civic Plaza that is surrounded by higher density housing development and mixed-use buildings. Housing intensity transitions to lower-density small-lot single-family homes along the eastern and southern peripheries of the site. A significant open space and pedestrian/bicycle trail network provides a wide variety of recreational opportunities for residents and other members of the 'Ewa community. Ho'opili will incorporate traditional Hawaiian building styles with a modern, contemporary aesthetic and will reflect the landscape and climate.

The general land use allocation illustrated on the Conceptual Land Use Plan is summarized in Table 2.2 and described below:

Low-Medium Density Residential/Live-Work
Ranging from traditional single-family detached homes on varying lot sizes to multi-family dwellings with a variety of live-work opportunities, there are approximately 535 gross acres (which includes secondary roads and mini-"neighborhood" parks) planned to accommodate approximately 5,100 residential units at densities of 5 to 14 units per acre. These areas would include mini-parks located as focal points and activity centers of the community.

Mixed-Use/Medium Density Residential
Planned to be oriented along future high-capacity transit and major roadway alignments, these medium density mixed use districts would include live-work residential units or residential uses over ground floor commercial and office uses. Within these districts that comprise approximately 340 acres (all of which will not be developed for housing because the acreage includes secondary roads, off-street parking and mini-"neighborhood" parks), there are approximately 5,200 dwelling units planned at densities of 15 to 29 units per acre along with retail and office use.

Mixed-Use/High Density Residential
Planned to be located near major transportation junctions, these higher density mixed use districts would include commercial, office space, and higher density live-work residential units or residential uses above ground floor businesses. Within these districts that comprise approximately 50 gross acres (which includes secondary roads, off-street parking and mini-"neighborhood" parks) would be approximately 40 net developable acres that would accommodate approximately 1,450 dwelling units planned at densities of 30 to 50 units per acre along with retail and office use.

Business / Commercial
To serve the neighborhoods and surrounding communities and to provide a variety of employment opportunities within Ho'opili, the business/commercial uses are located to be conveniently accessed from the major transportation corridors of the region. The

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approximately 145 gross acres illustrated (which includes secondary roads and off-street parking) are estimated to yield a net development area of approximately 130 acres that are projected to accommodate retail and office use. These areas would be significant employment generators for Ho'opili and the region.

Light Industrial / Business Mixed-Use
To meet regional demands and to provide for an additional employment center for Ho'opili, approximately 50 gross acres (which includes secondary roads and off-street parking) are planned to provide an area for larger light industrial type users and businesses. It is estimated that there would be a net development area of approximately 40 acres industrial mixed-use.

Open Spaces / Buffers
Integral to the connectivity of Ho'opili to the surrounding neighborhoods, a variety of open space buffers and drainage detention areas are planned. Some of the key open space buffers include along the H-1 Freeway, Honouliuli Gulch and along Old Fort Weaver Road.

Parks
Some of the key parks being planned include a district park along Fort Weaver Road and a downtown civic square to serve as the community gathering area.

Mini-Parks
Integral to the establishment and identity of neighborhoods, a variety of smaller parks of approximately one to two acres in size are planned. Properly planned and located, most residents will be within walking distance of one of these mini-parks.

Public Facilities
The proposed project could include as many as five public school sites. The Conceptual Land Use Plan shows the possible locations for five State Department of Education (DOE) school sites planned to be as accessible to the neighborhoods of Ho'opili as the community is developed; one high school, one middle school and three elementary schools. The plan can also accommodate private schools as the need is determined. In addition, area is set aside along the western end of Farrington Highway fronting the Petition Area for either a fire station or a police substation. In total, approximately 100 acres are allocated to meet public facility needs. The master plan will likely be adjusted prior to zoning to achieve DOE-desired public school campus site configurations.

Major Roads and the Honolulu High-Capacity Transit Corridor (HHCTC) Project
To provide for improved regional circulation and to define and serve the various neighborhoods of Ho'opili, the major boulevards planned within the community are illustrated. In addition, there will be a well planned network of local streets to provide connectivity and alternate routes throughout the community in a safe and pedestrian friendly manner. This land use category includes the portion of the property that will be

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utilized for 1) the widening of Farrington Highway fronting the Petition Area, 2) a portion of North-South Road between Farrington Highway and Kapolei Parkway, 3) portions of the intersections of North-South Road with Farrington Highway and the H-1 Freeway, and 4) the segment of the East-West Connector through the Petition Area. As previously mentioned, a portion of the project site may be taken for a segment of the HHCTC project, including a possible transit maintenance and storage facility.

Proposed land uses are shown in the Conceptual Land Use Plan (See Figure 2.9: Conceptual Land Use Plan) and generally described below. The approximate land use areas may be adjusted as the proposed Ho'opili Conceptual Land Use Plan is refined through the land use review and approval process, as well as when the HHCTC alignment is finalized within Ho'opili. During the EISPN public review period, the City and County of Honolulu's Department of Design and Construction recommended that "the developer meet with City officials from the Department of Planning and Permitting, Department of Design and Construction, and Department of Parks and Recreation (DPR) at an early stage in the development's planning process to develop a conceptual plan for overall development which is acceptable and appropriate." As such, the Petitioner will continue to coordinate with City and County of Honolulu agencies to develop a conceptual plan for overall development which is acceptable and appropriate.

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Table 2.2. Conceptual Land Use Plan – Land Use Summary for Petition Area

LAND USE	APPROX. GROSS ACREAGE	APPROX. DEVELOPABLE NET ACRES	APPROX. NUMBER OF UNITS	GENERAL LAND USE DENSITY RANGE (DWELLINGS/UNITS PER ACRE)	PROPOSED ZONING DISTRICT****
PETITION AREA					
Low-Medium Density Residential/Live-Work*	535	400-475	5,100	5-14	R-5/AMX-2
Mixed Use/Medium Density Residential*	340	250-300	5,200	15-29	AMX-3
Mixed Use/High Density Residential*	50	40	1,450	30-50	BMX-3
Business/Commercial	145	130	-	-	B1
Light Industrial/Business Mixed Use	50	40	-	-	IMX-1
Open Space/Buffers*,**	150	N/A	-	-	P-2
Parks*	60	N/A	-	-	P-2
Mini-"Neighborhood" Parks*	*	N/A	-	-	P-2
Public Facilities	100	N/A	-	-	AMX-3
Major Roads (as shown)**	124	N/A	-	-	Varies
TOTAL (approx.)	**1,554*** **	**-**	**11,750**	**-**	**-**
* - Mini-"Neighborhood" parks and secondary roadways included in residential areas					
** - May increase as developable areas decrease in residential and commercial categories					
*** - Total acreage to be rezoned is approximately 1,555.145 acres					
**** - Zoning designation may vary depending whether a Transit-Oriented Development overlay district is adopted					
***** - If a transit maintenance yard is sited within the Petition Area, it is assumed that it would fall in the Land Use Ordinance (LUO) land use category of "Public uses and structures." Public uses and structures are defined in the LUO as "uses conducted by or structures owned or managed by the federal government, the State of Hawaii, or the city to fulfill a governmental function, activity or service for public benefit and in accordance with public policy...Typical public uses and structures include: libraries, baseyards...). Once the HHCTC DEIS is published, the location of the transit maintenance yard will be known, and if required, the conceptual land use plan for Ho'opili will be updated.					

2.6 INFRASTRUCTURE IMPROVEMENTS

In support of the Project, infrastructure facilities to be installed, expanded or improved include access and circulation roadways, drainage systems, water and wastewater collection lines, and electrical/communication systems. All infrastructure improvements will be designed and sized to accommodate the project, and for possible future dedication and acceptance by the appropriate agencies. One or more of the proposed infrastructure and utility improvements may require the use of State and/or county road right-of-ways or other lands. Project construction will commence with development of the infrastructure upon issuance of the necessary grading permits.

AR00027070

Major on-site infrastructure improvements required for the project include: facilities for water transmission and distribution; wastewater collection; traffic circulation; drainage; and electrical and communication systems. It is possible that one or more micro-utility companies may be providing a portion or all of the electrical and/or communication systems for the project. For instance, there are companies that can install solar photovoltaic panels on buildings for free in return for charging lower electrical rates than HECO. While the specific nature of each improvement is not known at this time, the EIS is intended to address all current and future instances involving the use of State and/or County lands and funds relating to the Ho'opili project, including micro-utility companies that may require the use over State and/or County lands to operate and maintain any utility lines or facilities. Per comments made by the State Department of Transportation during the Draft EIS public review period, drainage systems, other project construction plans and work affecting the highway right-of-ways require prior DOT review and approval.

It should be noted that the project has been designed to accommodate long-planned regional transportation improvements to be constructed by others including: a portion of North-South Road and its intersections, the future widening of Farrington Highway, and a portion of the HHCTC alignment).

Typically developers will set aside land for and/or build facilities that are designed to meet County standards, such as roads, water storage facilities and transmission lines, sewer collection lines and parks, schools, et cetera, and typically these are dedicated to the appropriate State or County agency to operate and maintain. At Ho'opili, it is possible that community associations, businesses, other private entities or a separate authority, will be accepting the liability, security, operations and maintenance responsibilities for some facilities such as roads, parks, transit stations, et cetera.

2.7 DEVELOPMENT TIMETABLE AND PRELIMINARY COSTS

The following Table 2.3 is a list of major permits and approvals required for the implementation of the proposed Ho'opili Conceptual Land Use Plan.

AR00027071

Table 2.3. Required Permits/Approvals

PERMIT/APPROVAL	APPROVING AUTHORITY	STATUS	PROJECT SUBMITTAL DATE
State Land Use District Boundary Amendment (with EIS)	State of Hawai'i Land Use Commission	Petition has been filed; processing on hold until EIS process has been completed.	First Quarter 2007
Zone Change	City and County of Honolulu Department of Planning and Permitting/City Council	Application to be filed assuming successful processing of SLUDBA.	Third Quarter 2009
Large Lot Subdivision ~~Approval~~ Action	City and County of Honolulu Department of Planning and Permitting	Application to be submitted after change the Zone Change application is approved.	Third Quarter 2010
National Pollutant Discharge Elimination System (NPDES) Permit	State of Hawai'i Department of Health	Application to be submitted prior to Building/Grading Permits.	2011
Building/Grading Permits	City and County of Honolulu Department of Planning and Permitting	Application to be filed after the Zone Change application is approved.	2011
Water Use Permit	State of Hawai'i Department of Land and Natural Resources, Commission on Water Resource Management	Application to be submitted prior to Building/Grading Permits	2011

AR00027072

The Petitioner estimates that the development of the Ho'opili project (major off-site and on-site infrastructure improvements including grading, drainage, sewer, safe-drinking water, non-potable water, roadways, landscaping and improvements to Farrington Highway and North-South Road for access) will cost approximately $4.6 billion (in Year 2007 dollars), spent over the project timeline of 2009 – 2030. During the public review period, both the Land Use Commission and the State Office of Planning made reference to subsection 15-15-50, Hawaii Administrative Rules (HAR). Subsection 15-15-50, HAR identifies the form and contents of a petition to the State Land Use Commission to amend the State Land Use District Boundaries, including representing "…that development of the subject property in accordance with the demonstrated need therefore will be accomplished before ten years after the date of commission approval. In the event full urban development cannot substantially be completed within such period, the petitioner shall also submit a schedule for development of the total of such project in increments together with a map identifying the location of each increment, each such increment to be completed within no more than a ten-year period." The construction of Ho'opili's development will be a challenging process that will require ongoing coordination between many fundamental parts. Infrastructure and road access, neighboring property development, demands of the commercial and housing markets, careful continued agriculture and general property management, and economic viability will all be considered throughout the construction planning process. Furthermore, the City and County of Honolulu's (City) transit project, the largest public works endeavor in Hawai'i's history, will within Ho'opili have its longest traverse through privately owned property and further expand development challenges undoubtedly in unprecedented ways. Many of these parts may involve developing different areas of the project site within the same construction timetable as discussed further below:

Several major development priorities include in no particular order:

- **Water Service from the North.** Both of Ho'opili's main potable water storage and transmission systems will reside mauka of H-1. Considerable investment will be required in the construction of tanks and transmission lines that will ultimately service two water zones within Ho'opili that roughly divide the site between northern and southern halves. (Necessary offsite utility easements have already been secured at a price.) Nonpotable water will be sourced from the reclamation operations at the Honouliuli Wastewater Treatment Plant (WWTP), meaning it will be delivered to Ho'opili from the opposite end from where its potable source will come. Preliminary budgetary construction cost estimates range from between $35 million to $40 million with another $20 million possible from BWS for service connections.

AR00027073

- **Sewer Service from the South.** Unlike Ho'opili's main water system, sewer service will come from the southern end of the property. The first of what is expected to be several Joint Development Agreements (JDA) to secure and construct wastewater transmission is in place with DHHL, UHWO, DLNR and the City and funded. Indeed, the DOT has already constructed this line as part of the North-South Road Phase 1A contract. Discussions are expected to commence later this year in earnest on separate JDAs for two additional segments. Nearly $2 million has already been invested to date, preliminary budgetary costs estimates for these two JDAs range from $10 million to $15 million to stub service at the property's southwestern border, $5 million to $10 million to route through to the mauka area and as much as another $60 million for the City's Department of Environmental Services uses connection charges.

- **Balancing Spread out Access, Initial Infrastructure Needs and Cash Flows.** Today, Ho'opili's lands along the Farrington Highway corridor, its northernmost boundary, present Ho'opili's easiest access for construction purposes and future occupants. Once DHHL completes its section of the East-West Connector Road and the State DOT completes the North-South Road (both now under construction), Ho'opili will have construction and occupant access open at its southern and westernmost locations. This is significant because while available for development today, the Farrington Highway corridor is expected to present some of Ho'opili's greatest development challenges, predominantly the distance sewer lines will have to run through undeveloped land for service, as well as timing development to the City's planned improvements to Farrington Highway itself. Thus, the Petitioner will look to mobilize on these other areas as early as practicable. Nonetheless, there are several key commercial parcels in this Farrington Highway corridor that will need to be among the earliest to be marketed in order to generate cash flow to support needed upfront utility (such as water and sewer as detailed above) and road infrastructure throughout Ho'opili. As a result, development should be started in more than one area from the onset. Over the build-out of the project, it is expected that as much as $50 million to $60 million could be spent on drainage systems and hundreds of millions will be invested in roadway systems servicing the project.

- **Balancing Job Generation, Appropriate Initial Housing Deliveries and Transit**. The majority of the employment areas within Ho'opili are within the Farrington Highway corridor to the north of the property, while the residential development areas that could be most sensible to develop first – the single-family areas – are to the south. Starting housing construction there could generally preserve higher density development in the areas in and around the transit corridor to the north to be better staged with transit's completion and more appropriately address the various demands it will create.

AR00027074

- **Managing Agricultural Operations.** As lands are moved into development over time, consideration will have to be given to the significant challenges of maintaining a working agricultural water system and providing ongoing and unencumbered vehicular access to crop areas. This will be no small task, as it will be the objective of the Petitioner to keep active farms onsite as long as practicable.

As previously stated the development is expected to occur over approximately 20 years. This area of 'Ewa has long been planned for development (Kapolei Area Long Range Master Plan and Ewa Development Plan).

There are several major transportation projects that have been planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the first segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area. As major off-site infrastructure (water, sewer, drainage, electrical and communications) would likely occur in most of the above major road right-of-ways, and the exact timing of the completion of these transportation improvements undetermined, it is difficult for the Petitioner to provide a map identifying the phasing of the proposed action in 10 year increments with any degree of certainty. While the phasing of development may be more relevant where there is little or no development, 'Ewa has rapidly developed in recent years and proposed transportation improvements are indicative of State and County assumptions that this portion of 'Ewa would be eventually developed.

2.8 SUSTAINABLE BUILDING DESIGN

Sustainability options are being considered for the Ho'opili project. Where feasible, project buildings, activities, and site grounds are intended to be designed with energy-saving considerations. Given the natural climate, the project may be suited for the use of renewable energy technologies including photovoltaics. During the public review period, the Office of Hawaiian Affairs wrote: "...OHA recommends the use of not only photovoltaic cells but also small wind harvesting electrical generation for peripheral uses such as parking lot lighting."

According to the American Wind Energy Association, small wind energy systems typically range from $3,000 to $5,000 for every kW (kilowatt) of generating capacity, or about $40,000 for a 10 kW system (installed). According to the Hawaiian Electric Company (HECO), wind generation energy resources typically cost approximately $.08 to $.11/kW per hour, however these rates apply to larger wind systems (wind farms) as opposed to individual wind systems whose rates are not readily available by HECO.

AR00027075

Photovoltaic (PV) systems range in price from $8,250 for a one-kW system to more than $40,000 for a five-kW system. According to HECO, internal estimates for photovoltaic (PV) energy resources typically cost approximately $.30 to $.40/kW per hour.

The average energy consumption by a single-family residence in Hawai'i is approximately 600 kW per hour. According to HECO, "Non-firm sources, such as wind and solar, are called "as-available" resources and must be backed up by firm generation to ensure electricity is available when customers need it -- 24 hours a day, regardless of whether the wind is blowing or the sun is shining."

"In addition to not being available 24-hours-a-day, the variability of wind, typical of the trade winds in Hawaii, can cause power problems. It can affect the quality of power produced. Today, a lot of sensitive electronic equipment can be damaged or disrupted by the variability of power produced from sources like the wind. These fluctuations can also place a big strain on the utility's fossil fuel generators if they have to kick in and meet the demand for electricity when the wind power is suddenly not available."

Even when "as-available" resources are available, HECO still needs to cut back on "as-available" renewable energy sources during off-peak periods of electricity use. This is due to scenarios where customer demand for power drops too low, generation must be turned off to cut back on power production. Otherwise, the electric system could potentially overload and become unstable. Furthermore, fossil-fuel generation can only be reduced so much. This on-and-off cycling could lead to damage and accelerated deterioration of fossil-fuel generators. It also causes the generators to burn more fuel than necessary which leads to an increased cost of electricity.

In June 2008, Governor Lingle signed SB 644 which requires that solar water heaters be required before issuance of a building permit on or after January 2010 for single-family residences.

In addition, based on the Department of Business, Economic Development & Tourism (DBEDT), Strategic Industries Division's recommendations, Ho'opili's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies.

AR00027076

3.0

Assessment of the Natural Environment, Potential Impacts, & Mitigation Measures

3.0 ASSESSMENT OF THE NATURAL ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

This section describes the existing natural environment associated with the Petition Area and the project's potential impacts that may result from proposed development. Mitigation measures are proposed to address the project's potential project impacts.

3.1 CLIMATE

Existing Conditions

Average annual daily minimum and maximum temperatures in the Petition Area are 65 and 84 degrees Fahrenheit, respectively. The annual prevailing wind direction for this area of O'ahu is east northeast, about 40 percent of the time, at approximately 10 knots (12 miles per hour). The 'Ewa Plain experiences light rainfall, with a mean annual precipitation of about 20 inches per year, most of which occurs between the months of November and April.

Anticipated Impacts and Mitigation Measures

The project is not expected to have an impact on regional climate. With project build-out, there may be some localized increase in temperature as a result of paved surfaces and roofs. However, shade trees will be incorporated into project landscaping and necessary irrigation will help mitigate any localized temperature increases from roadways, walkways, and buildings.

3.2 TOPOGRAPHY

Existing Conditions

The island of O'ahu was built by the extrusion of basalt and basaltic lava from two shield volcanoes, Wai'anae and Ko'olau. The Petition Area is located on the southwestern flank of the Wai'anae Volcano. A sedimentary wedge, formed by eroded sediment and coral and algae, is located in the Petition Area and to the south. This wedge forms the 'Ewa Plain and serves as the "caprock" over the Southern O'ahu Basal Aquifer (SOBA).

The approximately 1,600.265-acre Project Area consists of 10 distinct parcels of land (See Figure 1.5: Parcels Map). Parcels A, B, C, D1, D2 and G are situated makai of the H-1 Freeway while Parcels E1, E2, E3 and F are situated mauka of the H-1 Freeway. The topography of each of the 10 parcels is described below.

AR00027078

The topography of Parcel A ranges from approximately 150 feet above mean sea level (MSL) at Farrington Highway to approximately 210 feet MSL at the H-1 Freeway. The slope of Parcel A is 3 percent.

The topography of Parcel B ranges from approximately 170 feet MSL at the southwestern boundary (at Farrington Highway) to approximately 205 feet MSL at its northwestern boundary (at the H-1 Freeway). The topography of Parcel B at the southeastern boundary (at Farrington Highway) is approximately 75 feet MSL and approximately 175 feet MSL at the northeastern boundary (at the H-1 Freeway). The slope of Parcel B is between 1.9 percent and 3.2 percent.

The topography of Parcel C ranges from approximately 65 feet MSL at its southern boundary to approximately 175 feet MSL at Farrington Highway. The slope of Parcel C is 1.4 percent. A ravine and steep, east-facing slope are located on the eastern boundary of the Parcel C, along Old Fort Weaver Road.

The topography of Parcel D1 ranges from approximately 10 feet MSL at its northern boundary to approximately 40 feet MSL at its northern boundary. The central portion of Parcel D1 is 25 feet MSL. The slope of Parcel D1 is 1.2 percent. Parcel D2 ranges from 0 feet at its northern boundary to 35 feet MSL at its southern boundary with a slope of 1.1 percent.

The topography of Parcels E1, E2 and E3 ranges from approximately 410 feet MSL at their southern boundaries to 415, 430 and 415, respectively at their northern boundaries. The slope of parcel E1 is 2.8 percent, the slope of E2 is 3.5 percent, and the slope of E3 is 3.9 percent.

The topography of Parcel F runs with an east-west slope with an elevation of 240 feet MSL on the western boundary and an elevation of 205 on the eastern edge. The center of the parcel is at an elevation of 220 feet. Parcel F has a slope of 3.49 percent on the east-west axis.

Parcel G is very small and located along the makai edge of Parcel C, bordering the 'Ewa Villages Golf Course. The slope of Parcel G is approximately 1.4 percent.

The entire Petition Area has been historically utilized for sugarcane cultivation and large portions are currently utilized for agricultural production. As such, the Petition Area has been extensively modified with dirt roadways, various irrigation systems, and other appurtenant agricultural structures.

AR00027079

Anticipated Impacts and Mitigation Measures

The topography of the Petition Area is mostly gently sloping (and highly accessible) and provides adequate slope for drainage. The Petition Area will be modified with infrastructure improvements and urban structures for residential, commercial, industrial, recreational and educational uses. The Petition Area will include drainage detention basins, open space buffers, parks and some undeveloped areas. Most of the developed areas will be extensively landscaped, which will minimize the potential for soil erosion. Compared to existing conditions in which the land is vacant or used for agricultural production, the proposed drainage system for the Project will provide better control and management of surface runoff during intense storms.

All grading operations will be conducted in accordance with dust, erosion control, and other requirements of the City and County of Honolulu's grading ordinance. All construction activities must comply with the relevant provisions regulating Fugitive Dust set forth under Section 11-60.1-33, HAR. A grading permit is required to modify the topography, and additionally, a National Pollutant Discharge Elimination System (NPDES) permit will be required prior to construction to address non-point source discharges.

3.3 SOILS

Existing Conditions

Three soil suitability studies have been prepared for lands in Hawai'i. The principal focus of these studies is to describe the physical attributes and relative productivity of different land types for agricultural production within the State of Hawai'i. The three studies are the U.S. Department of Agriculture (USDA) *Natural Resources Conservation Service Soil Survey*, the University of Hawai'i Land Study Bureau *Detailed Land Classification*, and the State of Hawai'i Department of Agriculture's *Agricultural Lands of Importance to the State of Hawaii* (ALISH).

Natural Resources Conservation Service Soil Survey. The Petition Area includes several different soil types, as classified by the Natural Resources Conservation Service. Table 3.1 lists these soil types and their potential for erosion.

AR00027080

Table 3.1. Soil Types and Erosion Potential

SOIL TYPE	EROSION POTENTIAL
'Ewa Silty Clay Loam, 3-6% Slopes	Slight
Honouliuli Clay, 0-2% Slopes	No More Than Slight
Honouliuli Clay, 2-6% Slopes	Slight
Kaloko Clay, Noncalcareous Variant	None-Slight
Kawaihāpai Clay Loam, 0-2% Slopes	No More than Slight
Kolekole Silty Clay Loam 6-12% Slopes	Moderate
Kolekole Silty Clay Loam 12-25% Slopes	Moderate-Severe
Kunia Silty Clay, 0-3% Slopes	No More than Slight
Kunia Silty Clay, 3-8% Slopes	Slight
Kunia Silty Clay, 8-15% Slopes	Moderate
Moloka'i Silty Clay Loam, 3-7% Slopes	Slight-Moderate
Moloka'i Silty Clay Loam, 7-15% Slopes	Moderate
Waialua Silty Clay, 0-3% Slopes	No More than Slight
Waipahu Silty Clay, 0-2% Slopes	None-Slight
Waipahu Silty Clay, 2-6% Slopes	Slight
Waipahu Silty Clay, 6-12% Slopes	Moderate
Wahiawā Silty Clay Loam 0-3% Slopes	Slight

Figure 3.1: Natural Resources Conservation Service Soil Survey shows the distribution of soils within the Petition Area.

Land Study Bureau Detailed Land Classification. The *Detailed Land Classification* (1965 through 1972) series was produced for each island by the Land Study Bureau (LSB) of the University of Hawai'i. The intent of this series of reports was to develop a land inventory and productivity evaluation based on statewide standards of crop yields and levels of management.

A five-class productivity rating is applied using the letters A, B, C, D and E, with A representing the class of highest productivity and E the lowest. Most of the soils within the Petition Area are rated B (See Figure 3.2: Land Study Bureau). Other soils are rated A, with fewer soils rated C, D and E. These soil ratings reflect the Petition Area's past and present use for agricultural production under irrigated conditions.

Agricultural Lands of Importance to the State of Hawaii. *The Agricultural Lands of Importance to the State of Hawaii* (ALISH) (1977) system classifies lands that are important to agriculture in Hawai'i as Prime, Unique, or Other Agricultural Land, with Prime Agricultural Land representing the class of greatest importance and Other Agricultural Land the least. Most of the Petition Area includes soils identified as Prime Agricultural Land, which is defined as "land best suited for the production of food, feed, forage, and fiber crops." The remaining lands are identified as Other Agricultural Land (which is important to agriculture in Hawai'i but exhibits properties that exclude it from the Prime

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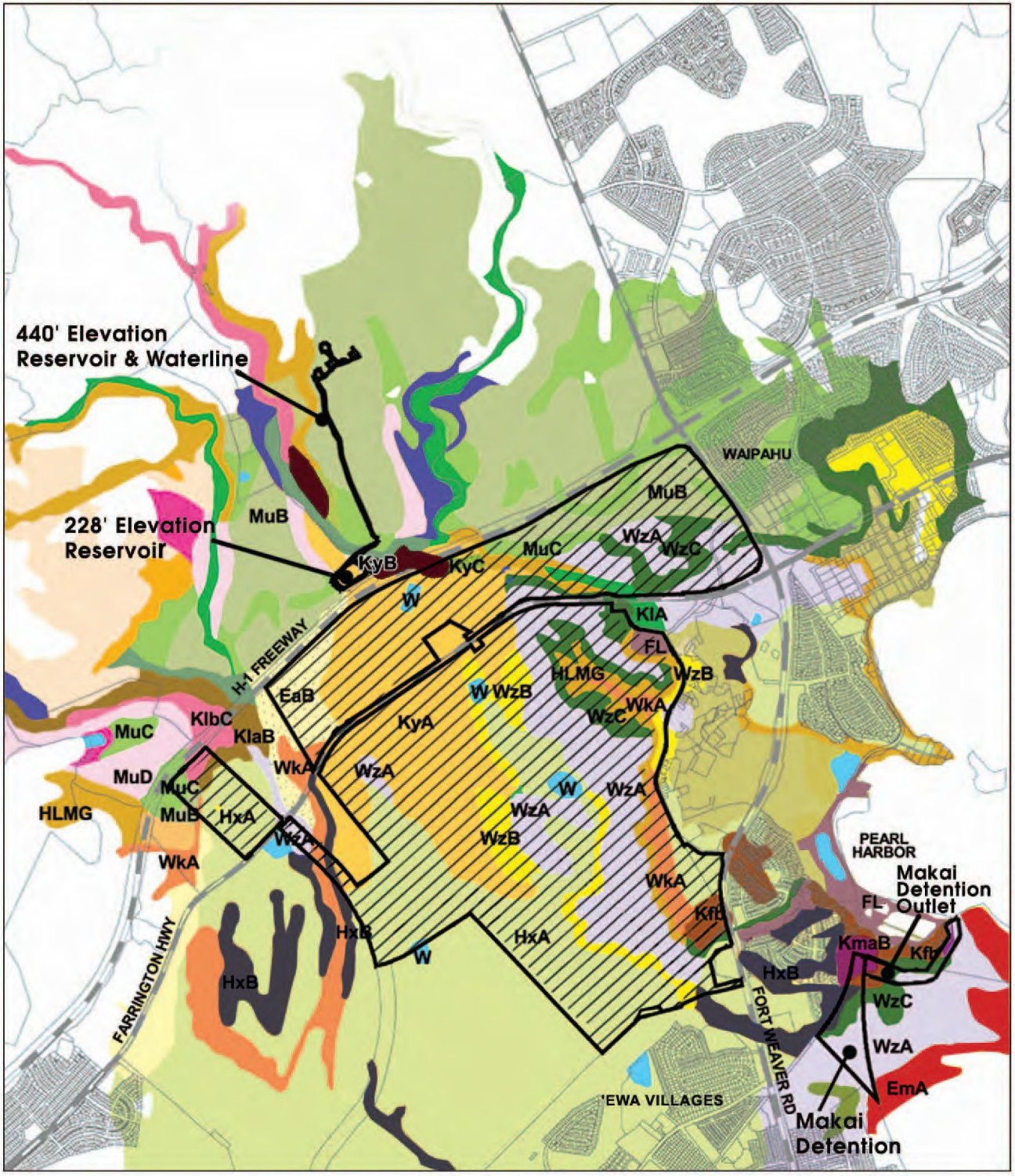

LEGEND

- Project Site Boundary
- Petition Area

Soil Types

- Eab: Ewa Silty Clay Loam, 3-6% Slopes
- EmA: Ewa Silty Clay Loam, Moderately Shallow, 0-2% Slopes
- FL: Fill Land Mixed
- HLMG: Helemano Silty Clay, 30-90% Slopes
- HxA: Honouliuli Clay, 0-2% Slopes
- HxB: Honouliuli Clay, 2-6% Slopes
- Kfb: Kaloko Clay, noncalcareous Variant
- KlA: Kawaihapai Clay Loam, 0-2% Slopes
- KlaB: Kawaihapai Stony Clay Loam, 2-6% Slopes
- KlbC: Kawaihapai Very Stony Clay Loam, 0-15% Slopes
- KmaB: Keaau Stony Clay, 2-6% Slopes
- KyA: Kunia Silty Clay, 0-3% Slopes
- KyB: Kunia Silty Clay, 3-8% Slopes
- KyC: Kunia Silty Clay, 8-15% Slopes
- MuB: Molokai Silty Clay Loam, 3-7% Slopes
- MuC: Molokai Silty Clay Loam, 7-15% Slopes
- MuD: Molokai Silty Clay Loam, 15-25% Slopes
- rRK: Rock Land
- WkA: Waialua Silty Clay, 0-3% Slopes
- WzA: Waipahu Silty Clay, 0-2% Slopes
- WzB: Waipahu Silty Clay, 2-6% Slopes
- WzC: Waipahu Silty Clay, 6-12% Slopes
- W: Water

Source: U.S. Department of Agriculture Natural Resources Conservation Service (1995)

Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 3.1: Natural Resources Conservation Service Soil Survey Map

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 3,000 6,000

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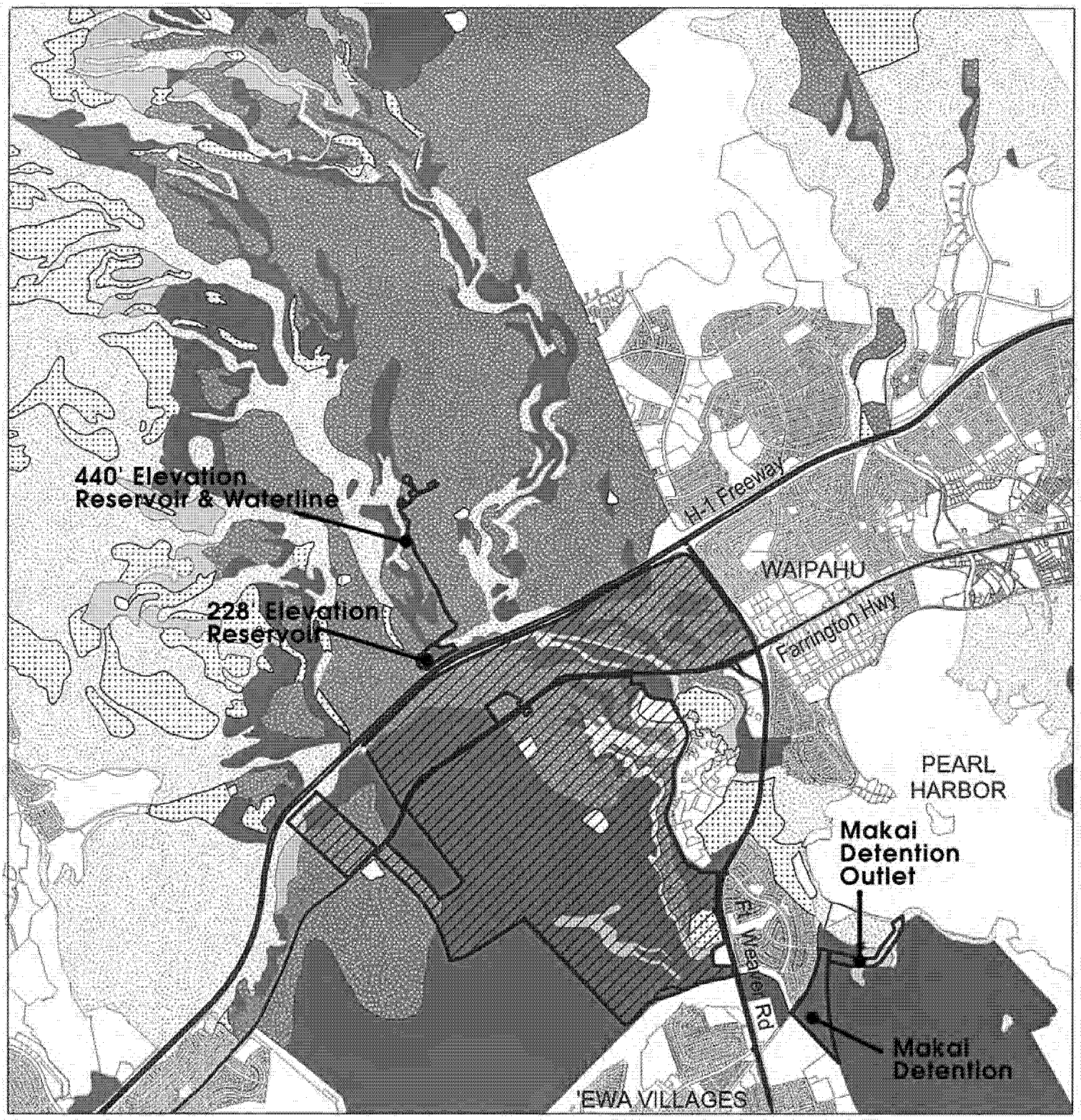

LEGEND

- Project Site Boundary
- Petition Area

Soil Classification

- A (Excellent)
- B (Good)
- C (Fair)
- D (Poor)
- E (Very Poor)
- Not Classified

Source: Land Study Bureau (1967)

Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 3.2: Land Study Bureau Land Classification

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 3,500 7,000

PBR HAWAII & ASSOCIATES, INC.

or Unique Agricultural Land classifications) or are not classified by the ALISH system (See Figure 3.3: Agricultural Lands of Importance to the State of Hawaii).

Anticipated Impacts and Mitigation Measures

During project construction, there is a potential for soil loss through the generation of dust and water-borne soil erosion as areas are graded. All grading operations will be conducted in accordance with dust and erosion control and other requirements of the City and County of Honolulu Grading Ordinance and all applicable provisions regulating Fugitive Dust set forth under Section 11-60.1-33, HAR regarding. A NPDES permit will also be required prior to construction to address construction-related runoff. Additionally, a watering program will be implemented during construction to minimize soil loss through fugitive dust emission. During the public review period, the Department of Health (DOH) Clean Air Branch (CAB) recommended that a dust control management be prepared. The DOH CAB also provided additional examples of measures that can be implemented during construction:

- where possible, for areas involving mixed land uses, buffer zones be established to alleviate potential dust nuisance problems;
- planning the different phases of construction, focusing on minimizing the amount of dust-generating materials and activities, centralizing on-site vehicular traffic routes, and locating potential dust-generating equipment in areas of the least impact;
- providing an adequate water resource and watering program at the site prior to start-up of construction activities;
- landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;
- minimizing dust from shoulders and access roads;
- providing adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and
- controlling dust from debris being hauled away from the project site.

In addition, during the public review period, the Office of Hawaiian Affairs wrote: OHA recommends cleaning job-site construction equipment and establishing groundcover as quickly as possible after grading with native or endemic drought tolerant species. In addition to landscaping and watering programs, other mitigation measures suggested include:

- Early construction of drainage control features;
- Construction of temporary sediment basins to trap silt, where needed;
- Use of temporary berms and cut-off ditches where needed; and
- Use of temporary silt fences (coir works well) or straw bales to trap silt.

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After construction, landscaping and drainage improvements will provide permanent post-construction pollution control measures and minimize the potential for soil erosion. Since much of the Petition Area presently consists of cultivated crops, exposed soil, and scrub vegetation, overall soil loss will likely be reduced significantly after development compared to previous and current conditions in which the land is used for agricultural production.

3.4 AGRICULTURAL IMPACT

Existing Conditions

The approximately 1,553.844 acre Petition Area was cultivated in sugarcane from the late 1800s to 1995. Currently, the majority of the Petition Area is leased or subleased to Aloun Farm, Inc., Fat Law's Farm, Sugarland Farm, Inc. and Syngenta Seeds, Inc. (See Figure 2.3: Current Lessees). These existing leases are listed in Table 2.1 of Section 2.1.4.

An Agricultural Impact Analysis had been prepared by Decision Analysts Hawaii, Inc. and is included as Appendix A. A summary of the studies findings are listed below.

Anticipated Impacts and Mitigation Measures

The creation of the Ho'opili project will require that the approximately 1,553.844 acre Petition Area be withdrawn from agricultural use. The project will result in a direct loss of approximately 1,497 acres of agricultural land being leased for various agricultural operations. This amounts to less than one percent of the approximately 160,000 acres of agricultural land that remain available throughout the State of Hawai'i. On the island of O'ahu, approximately 10,900 acres of agricultural land would remain available in Kunia and the North Shore. During the Draft EIS public review period, the State Department of Agriculture commented that the 1,497 acres of leased agricultural land in the project site is 13.7% of the 10,900 acres of farm land reported to be available on Oahu (3,150 acres in Kunia and 7,750 acres in the North Shore).

The Petition Area is currently in the State Agricultural District (See Figure 2.4: State Land Use District). However, the *Ewa Development Plan* designates the Petition Area as Low and Medium Density Residential, High Density Residential, Agricultural Land Preservation, Parks, and Transit Node (High Density Residential and Commercial) and Future Intermediate School (See Figure 2.5: Ewa Development Plan). D.R. Horton filed a petition (AO6-771) with the State Land Use Commission to reclassify the Petition Area to the Urban District. The petition to reclassify the Petition Area is consistent with the standards for determining boundaries of the Urban District pursuant to Section 15-15-18, HAR.

The Ewa DP and *Kapolei Long Range Master Plan* (See Figure 3.4: Kapolei Area Long Range Master Plan) have long planned for new development in the Petition Area,

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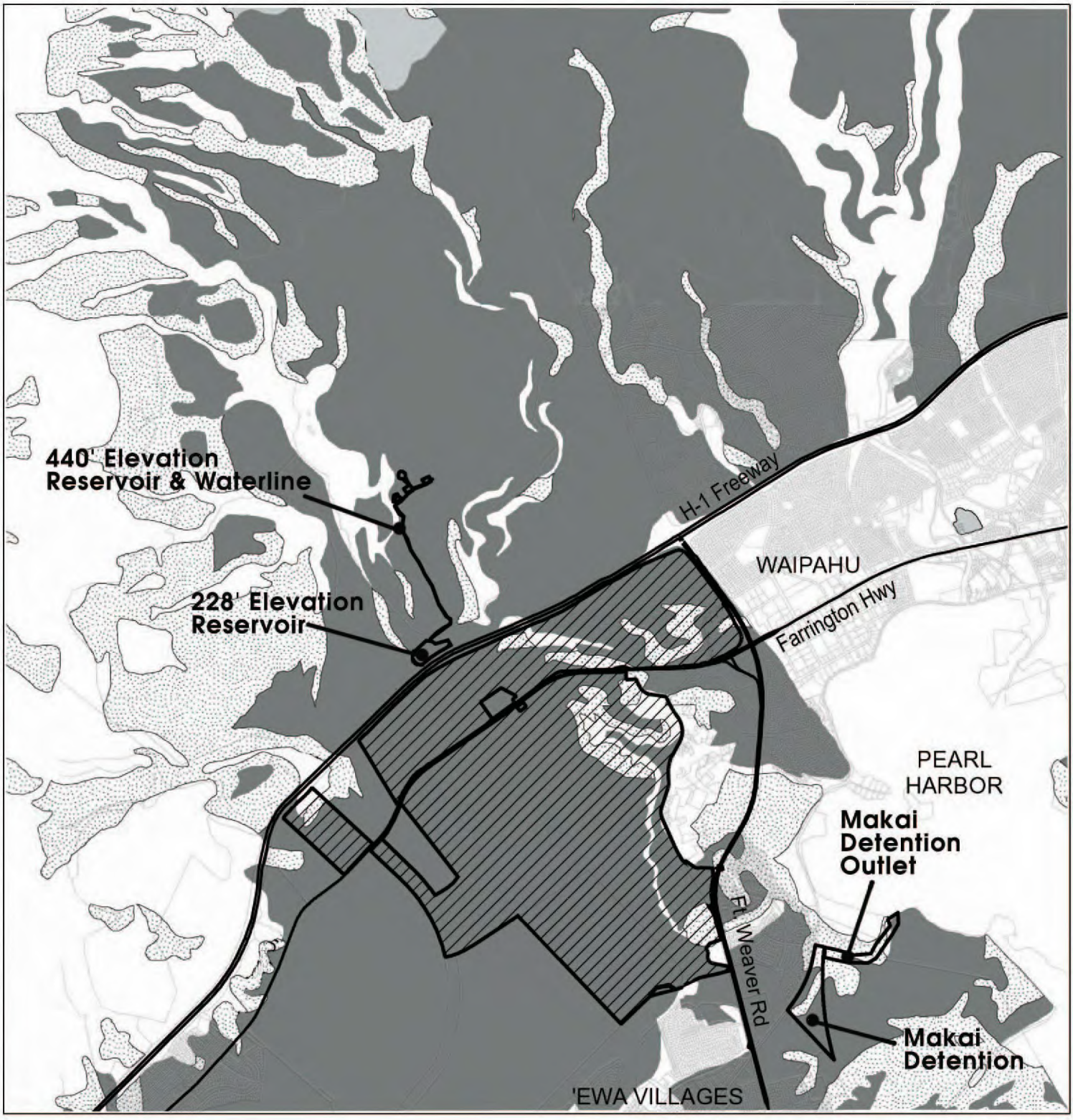

LEGEND

- Project Site Boundary
- Petition Area
- Prime Agricultural Lands
- Unique Agricultural Lands
- Other Agricultural Lands
- Unclassified Agricultural Lands

Source: State Dept. of Agriculture (1977).
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 3.3: Agricultural Lands of Importance to the State of Hawaii (ALISH)

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)
0 3,500 7,000

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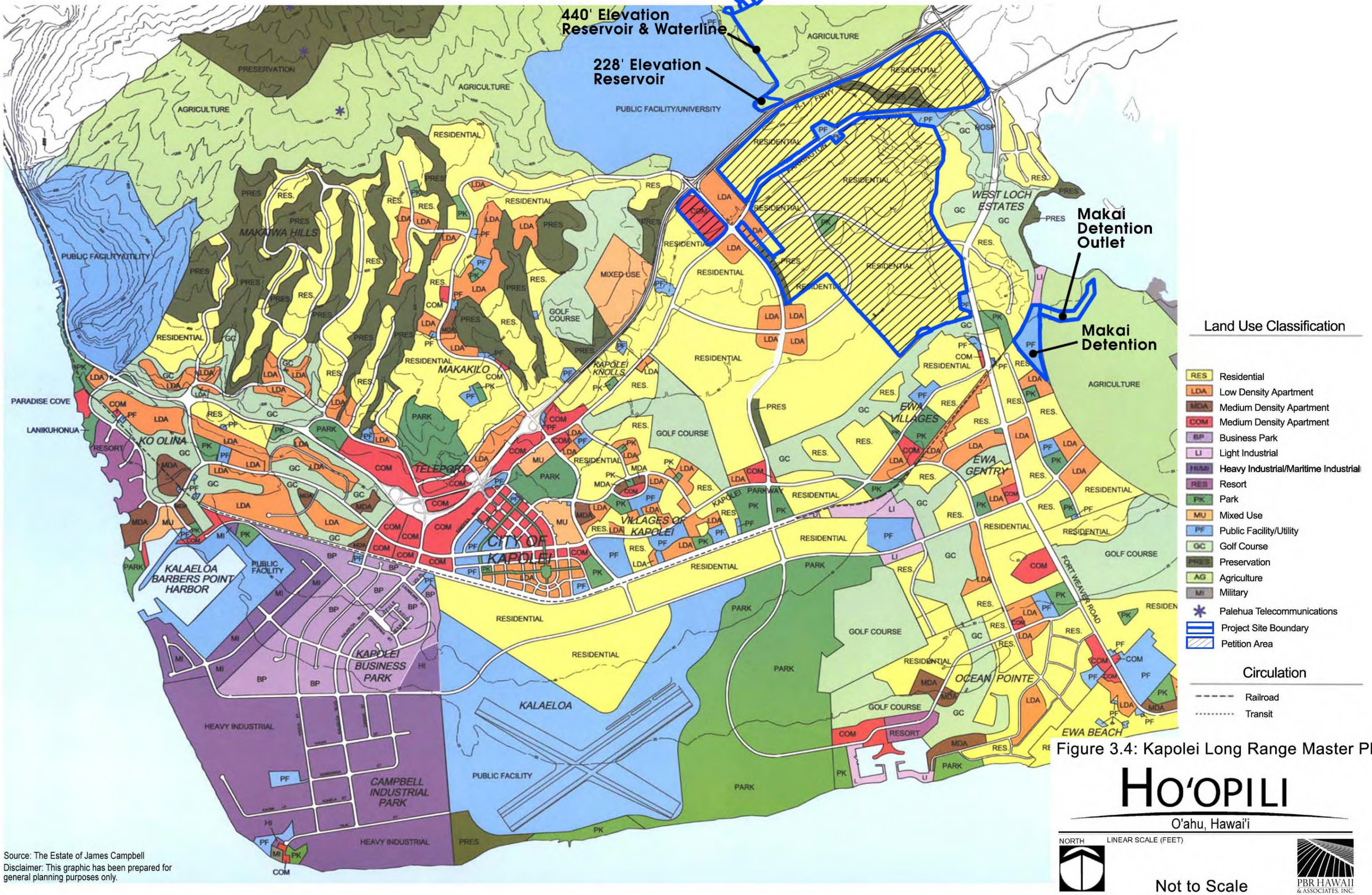

Source: The Estate of James Campbell
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Figure 3.4: Kapolei Long Range Master Plan

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

Not to Scale

PBR HAWAII & ASSOCIATES, INC.

AR00027087

including transit, and as such, tenants have been fully aware, for quite some time, that the proposed Petition Area would be used to accommodate future development in the region. The current tenants entered into lease agreements acknowledging the Petitioner's plans for future development. In return, the Petitioner set lease rents and water rates favorable for agricultural operations. In addition, the Petitioner continues to work on the eventual relocation of the largest tenant, Aloun Farm, Inc., to other farm areas in Central O'ahu and the North Shore, even though construction is not expected to start until the final quarter of 2009 at the earliest, with an estimated completion date of 2030.

Since the Petitioner intends to develop the project in phases, it will only withdraw land from the leases on an as-needed basis for construction and development and as provided for in agreements with the individual lessees. Within the Petition Area, lands will gradually be withdrawn from agricultural production for residential, commercial, and educational uses.

Potential temporary nuisance issues related to agricultural cultivation in close proximity to newly built homes could arise as portions of the Ho'opili project are developed. To mitigate these potential impacts, mitigation measures include:

- To the extent possible – and subject to transit alignment, water and other infrastructure improvements – phase the development of homes and coordinate agricultural leases to provide wide separations between homes and upwind agricultural activities.
- For each development phase of Ho'opili and projects on adjoining State land, require agricultural tenants to provide a buffer of fallow fields and berms upwind of the homes before the homes are occupied.
- As necessary, limit agricultural activities (restricted hours of operation, restricted plowing and use of chemicals on windy days, etc.) so as to avoid or minimize nuisance problems.
- Inform home buyers in the area that they will be living near agricultural activities, as long as agricultural activity continues in the area.

Upon full build-out of the Ho'opili project, approximately $6 million per year in revenues, an average of about 80 jobs and $1.7 million per payroll will be displaced from the Petition Area. <u>According to comments received from the State Department of Agriculture during the Draft EIS public review period, "the $6 million in farmgate revenues is about 4.4% of Oahu revenue from sales of all crops (2005 Statistics of Hawaii Agriculture, page 12), or 15.4% of the farmgate value of vegetables and melons produced on Oahu (ibid., page 11). The farm worker employment of 77 people represents about 3.7% of all the farm workers on Oahu (ibid, page 87)."</u> Affected lessees are anticipated to be able to secure replacement lands, therefore, enabling them to maintain prior levels of production, sales revenues, employment and payroll. Should sufficient replacement land not be available on the island of O'ahu, then other options include the relocation of agricultural businesses to Neighbor Islands with available agricultural land.

AR00027088

Agricultural operations may have to adjust for different agronomic conditions in the replacement lands, preparing soils and irrigation systems for specific crops, and moving offices and cooling and packing facilities. Since the affected diversified crop operations can be flexible with regard to their sizes, it is anticipated that they will survive regardless of the amount of replacement land they lease in the future.

The loss of agricultural production from the project and other projects through ought the State of Hawai'i are expected to be offset by:

- Agricultural businesses maintaining their current levels of operation and production by leasing replacement lands in Kunia and/or the North Shore, and possibly cultivating their remaining lands more intensively.
- Agricultural operations relocating all or portions of their operations to a Neighbor Island.
- Other agricultural operations on O'ahu and the Neighbor Islands increasing their production.
- A combination of the three.

As such, statewide agricultural production, revenues, employment or payroll are not anticipated to be adversely affected.

Various mitigation measures recommended to contribute to the successful relocation of affected businesses by the proposed project include: addressing water issues that limit crop production on the North Shore where most available cultivable land lands on O'ahu are located and providing sufficient time to make necessary improvements and arrangements for the relocations. The recommended mitigation measures include:

- Upgrading the Wahiawā Wastewater Treatment Plant (WWTP) to treat wastewater to the State's R-1 standard, or eliminate discharging wastewater into the Wahiawā Reservoir.
- Repair of the Wahiawā Irrigation System (WIS)
- Phase future development projects to maintain agricultural operations in 'Ewa for as long as possible.
- Continue supporting current tenants by providing lands for cultivation at below market rates.
- Continue supporting current tenants by phasing construction to allow agricultural operations as long as possible and to minimize nuisance complaints.

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3.5 GROUNDWATER RESOURCES/HYDROLOGY

Existing Conditions

The 'Ewa region of O'ahu overlies the Southern O'ahu Basin Aquifer (SOBA), a designated Sole Source Aquifer. Drinking water supply is drawn from this aquifer in the volcanic formation at depth. According to Tom Nance Water Resource Engineering, the piezometric head of this aquifer, which is inland and directly beneath the Ho'opili site, is about 18 feet above sea level.

The gently sloping topography of the 'Ewa Plain is comprised of terrestrial alluvium, which is made up of clay and mud eroded from volcanic rock. The terrestrial alluvium is inter-layered with coral limestone deposited during periods when the area was covered by the ocean. This geologic feature is commonly referred to as "caprock." The caprock overlies these volcanics to the near vicinity of Farrington Highway. In cross section, the caprock is wedge-shaped. It is about 1,000 feet thick at the shoreline and tapers to just a few tens of feet thick in the vicinity of Farrington Highway. It is comprised primarily of limestone and marl on its seaward half (makai of OR&L Railroad right-of-way) and primarily terrestrial alluvium inland of the OR&L Railroad right-of-way. ~~The caprock is located makai of the H-1 Freeway and is approximately 1,000 feet thick near the shoreline.~~

Brackish to saline basal groundwater exists in the upper limestone layer of the caprock. According to Tom Nance Water Resource Engineering, its water level is 1.0 to 1.5 feet above sea level. It is referred to as the caprock aquifer, but it is not present through the entire caprock formation. It is limited to the upper limestone layer. All water in the caprock formation below the thin lens in the upper limestone layer is saltwater. Water in the caprock is too saline to be used for safe drinking water.

Leakage upward from the higher head, volcanic aquifer into the caprock formation does occur, but according to Tom Nance Water Resource Engineering, it is limited to the inland margin of the caprock. This rate of upward leakage is a function of geology and the piezometric head in the volcanics. It is not influenced by the much lower water level in the upper limestone layer of the caprock.

The current irrigation allocation for the Petition Area is 8.0 million gallons per day (MGD). The average irrigation use is approximately 2.0 to 3.0 million gallons per day (MGD), depending on the time of the year.

The potential for surface water contamination under the caprock is low due to artesian conditions and the relatively impermeable caprock. Infiltration of surface water mauka of the caprock could cause contamination to the safe drinking ground water resource since the caprock is no longer present to function as a barrier in this area. Hydrological modeling predicts that the salinity of the caprock aquifer will increase as fresh water recharge declines with the reduction in sugarcane irrigation.

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DOH has established the Underground Injection Control (UIC) line at North Hanson Road (south of the Petition Area). The primary purpose of the UIC line is to protect potential sources of safe drinking water by not allowing wastewater injection wells or cesspools mauka of the line. The Petition Area is situated mauka of the UIC line.

A well-defined stream channel is the only existing hydrological feature within the Petition Area. Honouliuli Stream channel acts as the primary channel for runoff from part of the Petition Area and drainage of the watershed upstream. Runoff waters and discharge waters from the BWS tanks upstream pass through the site in this stream channel. Within the Petition Area, surface water in the channel does not appear to be connected to the groundwater.

The Honouliuli Stream discharges into the Pacific Ocean at West Loch, Pearl Harbor. The mouth of the stream is located at the western border of the West Loch Golf Course. Fishponds, small feeder channels, and tidal flats were observed near the mouth of the stream.

Anticipated Impacts and Mitigation Measures

The total average daily source requirement for ultimate build-out is estimated at 3.9 MGD. The present agricultural use of the Petition Area provides recharge to the alluvial portion of the caprock from excess applied irrigation water. This irrigation return eventually moves into the aquifer in the upper limestone layer of the caprock, becoming a portion of its recharge, albeit a relatively small portion. According to Tom Nance Water Resource Engineering, development of the Ho'opili project will diminish this small component of the recharge to some extent, but will have an immeasurable impact on water level in the upper limestone layer.

The project is not expected to impact groundwater resources, as the caprock acts as a barrier to the drinking water in the Petition Area. The caprock in 'Ewa, around Pearl Harbor, and in Honolulu, does function to retard seawater intrusion into the drinking water aquifer in the volcanics. According to Tom Nance Water Resource Engineering, it is an incredibly important contribution to the availability of drinking water which comes about due to the mostly impermeable contact surface between the volcanics and the overlying caprock. It is not due to the water level in the caprock.

Both the drinking water aquifer in the volcanics and the bracksish to saline aquifer in the caprock's upper limestone layer are in hydraulic contact with seawater nearshore and offshore. Sea level changes, whether weeks or months long due to large scale whether phenomena in the Pacific or a longer term sea level rise, does cause both aquifers to rise or fall accordingly. According to Tom Nance Water Resource Engineering, the Ho'opili project will have no impact on sea level changes.

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Although the Petition Area is situated mauka of the UIC line, no injection wells or cesspools will be installed (since the project's wastewater collection system will eventually connect to the Honouliuli Wastewater Treatment Facility), and any runoff or wastewater disposal required for the project will be managed in full compliance with State Department of Health (DOH) regulations. Irrigation for landscaping will utilize brackish water from the 'Ewa caprock and/or treated effluent (R-1 quality) from the City and County of Honolulu's Honouliuli Wastewater Treatment Facility (if available) to facilitate the recharge of caprock water and to reduce the demand for safe drinking water from the BWS system.

Probably like any other region where a directed growth policy is in place. O'ahu has a finite supply of potable quality groundwater, meaning development using additional groundwater will eventually result in the need for desalination. The proposed project is not unique in this regard. BWS has long range plans to develop a desalination plant at the makai end of Campbell Industrial Park to ultimately meet the island's needs.

Regional drainage plans call for storm runoff from Kalo'i Gulch mauka of the H-1 Freeway to be diverted to the east side of North-South Road (planned for completion in 2008), within a portion of the North-South Road right-of-way. Proposed drainage improvements within the Petition Area include on-site detention and retention basins, which will promote on-site infiltration of surface water and facilitate groundwater recharge. Parcel D1 will also be used for off-site drainage. The project will meet storm water quality requirements of the Rules Relating to Storm Drainage Standards through the use of detention basins and structural methods including Stormceptor® type drain manholes.

There are presently no plans for uses within Honouliuli Stream that are expected to require a permit from the U.S. Army Corps of Engineers. Additionally, there are presently no proposed uses expected to obstruct flows within Honouliuli Stream flood hazard zones.

3.6 NATURAL HAZARDS

Existing Conditions

Natural hazards include events such as tsunami, earthquakes, floods, hurricanes, soil slippage, and volcanic hazards. Of these natural hazards, the Petition Area may be subject to hurricanes and earthquakes in the future. However, the Petition Area is not naturally more prone to hurricanes and earthquakes than any other areas on O'ahu.

The Federal Emergency Management Agency (FEMA) classifies flood hazard zones as part of the Flood Insurance Program for the City and County of Honolulu. According to the Flood Insurance Rate Map (FIRM), the majority of lands within the Petition Area are in Zone D (See Figure 3.5: Flood Insurance Rate Map). A very small portion of Parcel C near

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Honouliuli Stream is located in Zone AE and Zone X. A portion of Parcel B around Honouliuli Stream is located in Zone A and Zone X. These flood zones are described in Table 3.2 below.

Table 3.2. FIRM Designations

ZONE	DESCRIPTION
A	Areas inundated by 1 percent annual chance flooding, for which no base flood elevations have been determined
AE	Areas inundated by 1 percent annual chance flooding, for which base flood elevations have been determined
X	Areas outside of the 0.2 percent annual chance floodplain
D	Areas of undetermined, but possible, flood hazards

During the public review period, the State Department of Land and Natural Resources Engineering Division confirmed the flood zone designations affecting the Petition Area and wrote that: "The National Flood Insurance Program does not have any regulations for developments within Zone X, however, it does regulate developments within Zone A and AE…Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken…Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:…Mr. Robert Sumitomo at (808) 768-8096 or Mr. Mario Siu Li at (808) 768-8098 of the City and County of Honolulu, Department of Planning and Permitting…" While it is highly unlikely that any development will be proposed on lands designated Zone A or AE, the Petitioner will continue to coordinate with the Department of Planning and Permitting to discuss project-related issues, including the City's local flood ordinance."

Anticipated Impacts and Mitigation Measures

The project is not expected to exacerbate any natural hazards. Potential damage from hurricanes and earthquakes will be mitigated by compliance with the Uniform Building Code adopted by the City and County of Honolulu. All structures will be constructed for protection from earthquakes and tropical hurricanes. The potential for soil slippage will be mitigated by over-excavation and other construction methods.

During the public review period of the Draft EIS, the State Civil Defense (SCD) commented that "the developer install at least three outdoor warning sirens… At the present time SCD personnel recommends that the minimum-size siren have a sound rating

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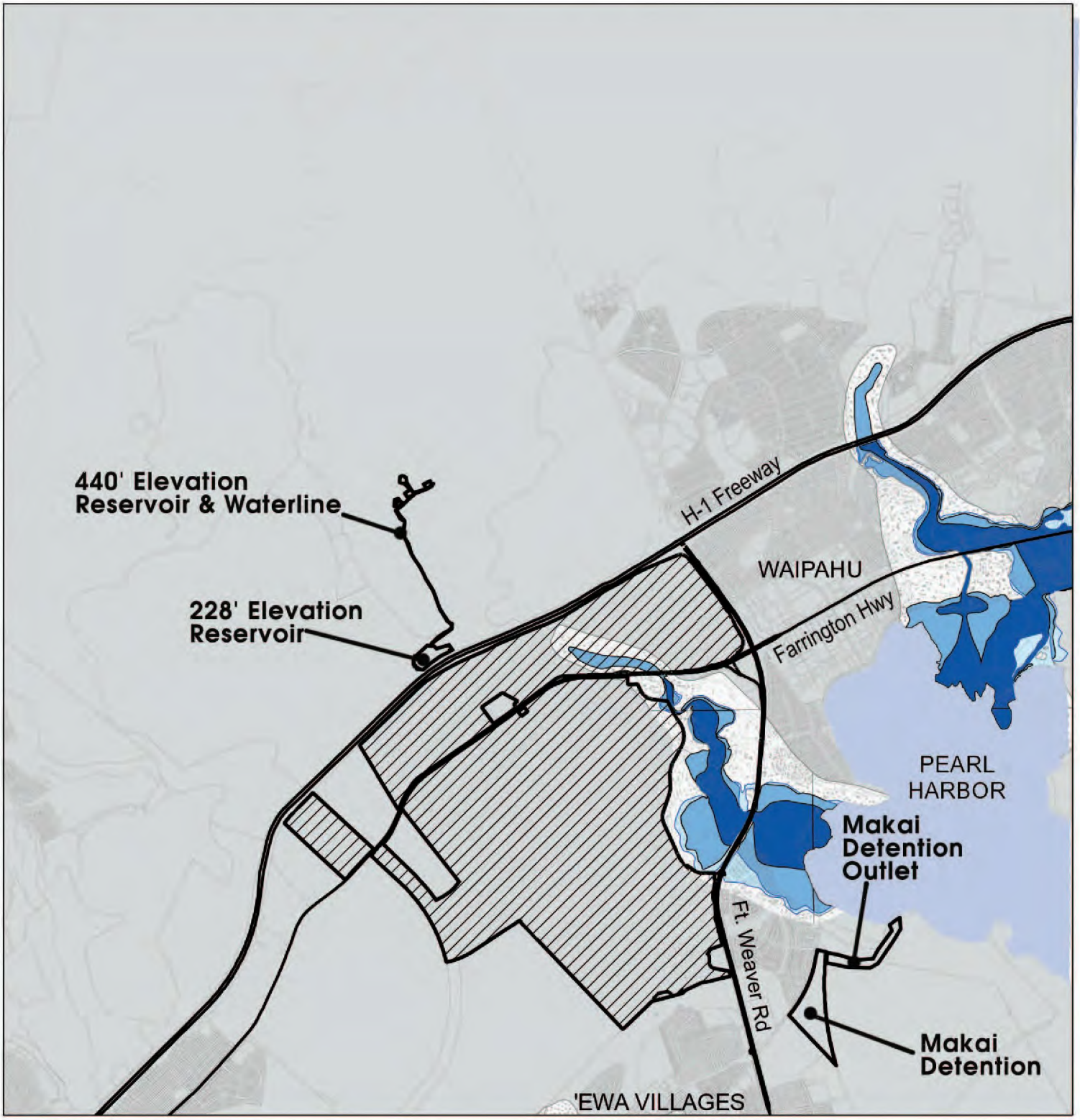

LEGEND

- Project Site Boundary
- Petition Area
- Waterbody
- Zone AE: Floodway
- Zone A: 100-Year Floodplain
- Zone X500: 500-Year Floodplain
- Zone X: Outside Floodplain/Minimal Flooding Area
- Zone D: Undetermined Flood Hazards

Source: Federal Emergency Management Agency
Flood Insurance Rate Maps (Panels 220 & 310, 2005)
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 3.5: Flood Insurance Rate Map

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)
0 3,500 7,000

PBR HAWAII & ASSOCIATES, INC.

of 121-decibels @ 100 feet, omni-directional and solar powered." SCD also noted that "As the development plans are finalized, State Civil Defense (SCD) will be better able to define the placement and size of the sirens." The Petitioner will continue to coordinate with the SCD as development plans are finalized to be better able to define the placement and size of the sirens.

3.7 FLORA

Existing Conditions

The Project Area consists of 10 distinct parcels of land (See Figure 1.5: Parcels Map). Parcels A, B, C, D1, D2 and G are situated makai of the H-1 Freeway while Parcels E1, E2, E3 and F are situated mauka of the H-1 Freeway. Botanical resources surveys of the Project Area were conducted by LeGrande Biological Surveys, Inc., in January, May and August 2006. The primary objectives of these studies were to: 1) prepare a general description of the vegetation on the Project Area; 2) provide an inventory the flora; and 3) search for and identify threatened and endangered species as well as species of concern. This report is included in Appendix B.

According to the botanical survey reports, most of the Project Area is currently plowed and devoid of trees and brush. Other lands within the Project Area are uncultivated brushland/or pastureland. The vegetation is typical of agriculturally cultivated cropland/or highly disturbed weedy areas. Little of the original native vegetation remains after over a century of intensive sugarcane agriculture and periodic burning. Native species have been replaced by aggressive non-native plant species. No federally listed endangered or threatened native plants, or candidate endangered species, were encountered on the property. Additionally, no wetlands occur on the property. Findings of the botanical resources surveys are summarized below.

Main Parcels (Parcels A, B, C and G)

Parcel A

Located between H-1 Freeway and Farrington Highway west of Palehua Road, the majority of the parcel is either in cleared land/or active corn (*Zea mays*) cultivation. The edges of Parcel A are dominated by weedy species such as castor bean (*Ricinus communis*), lion's ear (*Leonotis nepetifolia*), partridge pea (*Chamaecrista nictitans*), and kikania (*Xanthium strumarium* var. *canadense*). In addition, a small distribution of kiawe (*Prosopis pallida*) and opiuma (*Pithecelobium dulce*) trees are scattered along the top of Hunehune Gulch.

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Parcel B

Located between H-1 Freeway and Farrington Highway with Fort Weaver Road bordering the parcel to the east, the majority of Parcel B is in active corn cultivation. Edges of fields are largely dominated by weedy shrubs such as koa haole (*Leucaena leucocephala*), Christmas berry (*Schinus terebinthifolius*), sourbush (*Pluchea carolinensis*), castor bean, and guinea grass (*Panicum maximum*). Honouliuli Gulch, which runs northwest-southeast through Parcel B, is largely dominated by koa haole, guinea grass, kukui (*Aleurites moluccana*), kiawe, pride of India (*Melia azerdarach*), and autograph tree (*Clusia rosea*). At the bottom of Honouliuli Gulch, koali ai (*Ipomoea cairica*), little bell (*Ipomoea triloba*), primrose willow (*Ludwigia octovalvis*), love-in-a-mist (*Passiflora foetida*), and comb hyptis (*Hyptis pectinata*) were observed.

An Aloun Farm, Inc.'s baseyard is also located within Parcel B. Various crops were observed on the site including citrus (*Citrus sp.*), noni (*Morinda citrifolia*), kalo (*Colocasia esculenta*), yellow Poinciana (*Peltophorum pterocarpum*), sugarcane (*Saccharum officinarum*), and lemon grass (*Cymbopogon citrates*). Along Farrington Highway, the vegetation is largely dominated by kiawe and monkeypod (*Samanea saman*) trees and bougainvillea (*Bougainvillea sp.*) scattered throughout the length of Parcel B.

Parcels C and G

Parcels C and G are bordered by Farrington Highway to the north, Old Fort Weaver Road to the east, Mango Tree Road to the south, and the planned North-South Road to the west. A large portion of the property is currently under cultivation of corn, melons (*Cucumis sp.*), basil (*Ocimum sp.*), and bananas. Three indigenous plant species were observed on the property: 'ilima (*Sida fallax*), 'uhaloa (*Waltheria indica*) and pōpolo (*Solanum americanum*).

A cliff of approximately 20-30 feet high runs along the eastern boundary of Parcel C. The majority of the cliff area is dominated by kiawe and guinea grass. Indigenous plant species such as 'ilima, 'uhaloa and pōpolo can be found along the top of cliff.

The southern section of site between Old Fort Weaver Road and the cliff contains areas that are in active agricultural cultivation. Basil, cucumber (*Cucumis sativus*) and horseradish tree (*Moringa oleifera*) can be found growing at this particular operation. Coconut trees (*Cocos nucifera*), papaya (*Carica papaya*) and bamboo (*Bambusa sp.*) can also be observed growing around this lessee's facilities.

New 440 Tank, Transmission Line, & New 228 Tank Site (Parcels E2, E3, and F)

The majority of the property, located north of H-1 Freeway and proposed for the Reservoir and Waterline, consists of either a dirt roadway or uncultivated fields.

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At the lower elevation (220 feet) site, an additional water tank is proposed to be constructed west of an existing water tank. The graded areas are dominated by weed plant species including buffelgrass, guinea grass, beggar tick, sourbush (*Pluchea carolinensis*), castor bean (*Ricinus communis*), and koa haole.

A dirt roadway, where the proposed waterline is to be constructed along, connecting the lower water tank site to the upper tank site is dominated by weedy plant species such as castor bean, koa haole, boerhavia (*Boerhavia coccine*a), Australian saltbush (*Atriplex semibaccata)*, spiny amaranth, khaki weed (*Alternanthera pungens*), and Mexican poppy (*Argemone mexicana*). One indigenous plant species, 'uhaloa, was observed along the dirt roadway.

The upper elevation (440 feet) site is proposed for the construction of two water tanks. The property, located adjacent to an existing HECO substation, is an uncultivated pineapple field largely dominated by pineapple (*Ananas comosus*) and balsam pear (*Momordica charantia*) vines. African tulip, Christmas berry (*Schinus terebinthifolius*), and dogtail (*Buddleia asiatica*) were also spotted throughout the field. Autograph trees (*Clusia rosea*) and tropical coral trees (*Erythrina variegate*) were observed along the HECO substation perimeter fence. One indigenous plant species, pōpolo, was observed within the upper elevation site.

Makai Detention Site (Parcels D1 and D2)

The majority of the property is either in active cultivation or uncultivated fields. The uncultivated lands are largely dominated by weedy plant species such as koa haole, guinea grass, and other weedy plant species. Two indigenous plant species, 'ilima and 'uhaloa were observed at the property.

Due to access issues that prevented the botanical consultants from surveying the detention parcel that terminates in Pearl Harbor (Parcel D2), the property was observed from a nearby footpath and appears to be dominated by kiawe.

Anticipated Impacts and Mitigation Measures

None of the plant species which occurred on the Petition Area are considered a threatened ~~and~~ or endangered species or a species of concern. During the public review period, the State Department of Land and Natural Resources, Division of Forestry and Wildlife wrote that it had no objections to the proposed project.

The Hawaii Biodiversity and Mapping Program (HBMP) supplied historical and present locations of known threatened and endangered plant species within the Petition Area for review. The only rare plant mapped near the Petition Area was the ko'oloa'ula (*Abutilon menziesii*) population at the southern end of North-South Road. There were no threatened or endangered plants mapped within the Petition Area itself. *A. menziesii* is protected by

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both the federal Endangered Species Act of 1973, as amended, and Chapter 195D, HRS, as amended. *A. menziesii* is a shrub of the mallow family, growing six to eight feet tall, with coarsely toothed, silvery, heart-shaped leaves that are about one to three inches long. Flowers are medium red to dark red and less than an inch in diameter. It has been sold as an ornamental plant at local nurseries in the past under the name "Red 'ilima." Other extant populations of ko'oloa'ula currently exist on Lāna'i and Maui.

As part of the environmental planning for North-South Road and a portion of Kapolei Parkway, a *Habitat Conservation Plan for Abutilon menziesii at Kapolei* was finalized in March 2004. Mitigation measures have already been specified for these populations of *A. menziesii* related to construction of North-South Road. Although a concerted effort was made in surveying for ko'oloa'ula, no plants were observed on the property. As such, the proposed project is not expected to have a significant negative impact on the botanical resources in this part of O'ahu.

Native and indigenous vegetation will be considered in the selection of plant materials when a landscaping master plan is prepared.

3.8 FAUNA

Existing Conditions

The Project Area consists of 10 distinct parcels of land (See Figure 1.5: Parcels Map). Parcels A, B, C, D1, D2 and G are situated makai of the H-1 Freeway while Parcels E1, E2, E3 and F are situated mauka of the H-1 Freeway. Faunal resources surveys of the Project Area were conducted by Rana Productions, Ltd., in July, August and September 2006 (See Appendix C). The primary objectives of these studies were to: 1) prepare a general description of the Project Area; 2) to determine if there were any avian or mammalian species currently listed as endangered, threatened or proposed for listing under either Federal or State of Hawai'i endangered species statutes; and 3) provide information on the relative abundance of avian species within the various parcels.

Main Parcels (Parcels A, B, C and G)

Parcel A is located between H-1 Freeway and Farrington Highway west of Palehua Road. Parcel B is located between H-1 Freeway and Farrington Highway with Fort Weaver Road bordering the parcel to the east. Honouliuli Gulch runs northwest-southeast through Parcel B. Parcel C is bordered by Farrington Highway to the north, Old Fort Weaver Road to the east, Mango Tree Road to the south, and the planned North-South Road to the west. A cliff of approximately 20-30 feet high runs along the eastern boundary of Parcel C. Parcel G is surrounded by Parcel C and abuts Mango Tree Road.

The majority of the "Main Parcels" are made up of former sugar cane land, some of which is barren and some of which is under active cultivation with crops such as corn and

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bananas. The habitat on all of the parcels is almost completely dominated by alien plant species. Mammalian surveys using both direct visual or auditory and detection of indirect of evidence (tracks, scat or sign) revealed only alien species, including house mouse (*Mus musculus domesticus*), dog (*Canis f. familiaris*), mongoose (*Herpestes a. auropunctatus*), horse (*Equus c. caballus*) and cat (*Felis catus*). The lone listed terrestrial mammalian species, Hawaiian hoary bat (*Lasiurus cinereus semotus*) was not detected during the course of the faunal surveys.

Twenty-four avian species were recorded during the survey of the main parcels, including two indigenous migratory shorebird species, the Pacific Golden Plover (*Pluvialis fulva*) and Ruddy Turnstone (*Arenaria interpres*). The remaining 22 species are alien and include pheasants, partridges, herons, pigeons and doves, bulbuls, larks, starlings, sparrows, mockingbirds and finches. While not observed during the survey, the Short-eared Owl, or Pueo (*Asio fammeus sandwichensis*) is known to exist in the 'Ewa region, and may be present in the area. The State of Hawai'i lists the O'ahu population of the Pueo as an endangered species, while the federal statute does not.

The site does not contain any unique habitat, and modification of any or all of the habitat present will have no deleterious effect on any mammalian or avian species currently listed as endangered or threatened, or proposed for listing under either the federal or state endangered species statutes.

New 440 Tank, Transmission Line, & New 228 Tank Site (Parcels E2, E3 and F)

The majority of the property, located north of H-1 Freeway and proposed for the Reservoir and Waterline, consists of either a dirt roadway or uncultivated fields. The upper elevation (440 feet) site is proposed for the construction of two water tanks and 5,600 feet of transmission lines. The property is located adjacent to an existing HECO substation and contains two existing BWS water tanks and a transmission line. The proposed location of the 440 tank is a former pineapple field, now fallow. The entire site is dominated by alien plant species.

Three alien mammalian species were found: dogs, cats and mongooses. The endangered Hawaiian Hoary Bat was not observed.

Thirteen different avian species were observed, including the indigenous migratory shorebird species, Pacific Golden Plover. While not observed, the Pueo may be present in the area. The remaining 12 species are alien species, including: finches, pheasants, partridges, herons, pigeons and doves, bulbuls, starlings, mynas, cardinals and finches. The Common Waxbill (*Estrilda astrid*), Zebra Dove (*Geopelia striata*) and Japanese White-eye (*Zosterops japonicus*) accounted for about 40% of the total number of avian species recorded. Diversity and density were relatively low, not surprising given the severely diminished habitat on most of the site.

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Among mammalian species, it is likely that the house mouse and rats are present, although not observed. Rats and mice are deleterious to native ecosystems and to the faunal species that depend on them for their survival.

The site does not contain any unique habitat. Modification along the dirt road or in the area designated for the reservoirs and accessory facilities will have no deleterious effect on any mammalian or avian species currently listed as endangered or threatened, or proposed for listing under either the federal or state endangered species statutes.

Makai Detention Site (Parcels D1 and D2)

This site is east of Fort Weaver Road and south of the Honouliuli Unit of the Pearl Harbor National Wildlife Refuge. It is transected by the former OR&L railway line. A storm water detention basin is proposed to be located on the northern third of the site. The southern third is in active cultivation with corn and tomatoes. Vegetation on the site is almost completely dominated by alien species.

There were three alien mammalian species found: dog, cat and mongoose.

Twenty different avian species were recorded, 17 of which are alien. The Common Waxbill, Zebra Dove and Spotted Dove (*Streptopelia chinensis*) accounted for nearly half of the birds sighted. Other alien species included pheasants, partridges, herons, pigeons and doves, bulbuls, starlings, sparrows and mockingbirds.

The three indigenous species include the Black-crowned Night-Heron (*Nycticorax nycticorax hoactli*), a resident indigenous breeding species, and the Pacific Golden-Plover and Ruddy Turnstone, indigenous migratory shorebirds that breed in the Arctic. While not observed during this survey, the Pueo has been observed in the past in the nearby National Wildlife Refuge and may be present in the area.

Four waterbird species are currently listed as endangered under both the State and Federal statutes. The endangered water bird species consist of the Hawaiian Duck x Mallard hybrids (*Anas wyvilliana x platyrhynchos*), Common Moorhen (*Gallinula choropus sandvicensis*), Hawaiian Coot (*Fulica alai*) and Black-necked Stilt (*Himantopus mexicanus knudseni*). These species breed in the Honouliuli Unit of the National Wildlife Refuge, less than a sixth of a mile (250 meters) north of Parcels D1 and D2, and are regularly encountered on the golf course to the northwest. While the planned detention basin is located near the Refuge, there is no suitable habitat for these waterbirds. According to Bills Engineering, the project civil engineer, the makai drainage will rarely contain standing water.

During the public review period, the Land Use Commission requested an assessment of arthropods on the Petition Area. A survey of arthropods on the Petition Area was conducted on May 9, 2008 by Dr. Gregory Brenner of Pacific Analytics, L.L.C. The

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primary objectives of the survey were to: provide a general description of the arthropod fauna of the Petition Area; evaluate the habitats (if any); and search and assess the potential for threatened or endangered arthropod species as well as species of concern. According to Dr. Brenner, the arthropod species that were collected during the study would be considered typical of what would be found in lowland sites with little or no native vegetation and disturbed by agricultural operations. No species were found that are locally unique to the site. A copy of the assessment is attached to this EIS as Appendix R.

There is no expected deleterious effect on faunal species from the proposed project development. The site does not contain any unique habitat, and any modification will have no deleterious impact on any species currently listed as endangered or threatened, or proposed for listing under either the federal or state endangered species statutes.

Anticipated Impacts and Mitigation Measures

The mammalian and avian species currently found within the Project Area are by and large alien species. All of the mammalian species identified are alien and only three of the avian species present are indigenous. A variety of rats and mice are present in some locations, and are strongly suspected to be present in other areas. The endangered Hawaiian Hoary bat was not detected during the course of the faunal surveys.

The majority of the sites surveyed within the Project Area are lands formerly cultivated in sugarcane or pineapple, having led to high degrees of disturbance or destruction of native habitat. Current habitats are deemed "depauperate" (severely diminished) by the biological consultant. Some of the sites are currently under partial cultivation, but those habitats likewise have been severely degraded. During the public review period, the State Department of Land and Natural Resources, Division of Forestry and Wildlife wrote that it had no objections to the proposed project.

The notable exceptions to the above are the four endangered waterbird species which currently inhabit the National Wildlife Refuge located north of Parcels D1 and D2. These birds may utilize the proposed detention basin if sufficient water collects to allow ponding. There may be periodic disturbance to the waterbird species if temporary construction occurs within the proposed detention basin (to enlarge it) or if an outlet is allowed. As previously noted, the waterbirds breed in the Honouliuli Unit of the National Wildlife Refuge, less than a sixth of a mile (250 meters) north of Parcels D1 and D2. While the planned detention basin is located near the Refuge, there is no suitable habitat for these waterbirds. According to Bills Engineering, the project civil engineer, the makai drainage will rarely contain standing water.

At the present time there is no federal nexus associated with this project, because it does not appear that the U.S. Navy will permit access or grant an easement for an outlet from the proposed makai drainage retention basin. If and when this component of the

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proposed development moves forward, the Petitioner will consult with both the U.S. Fish and Wildlife Service and the State of Hawai'i Division of Forestry and Wildlife to ensure that the construction and operation of the detention basin does not result in deleterious impacts to any species currently listed as endangered, threatened or proposed for listing under either federal or State of Hawai'i endangered species statutes.

Otherwise, ~~I~~impacts to the other existing mammalian and avian species and their habitats are expected to be minimal. Disturbance and displacement of individual alien species is likely to occur as construction and development infill takes place. The disturbance will be of a temporary nature. No mitigation measures are proposed for any faunal species detected during the course of the faunal surveys.

The results of the arthropod survey at the Petition Area (See Appendix R) indicate that there are no special concerns or legal constraints related to invertebrate resources in the Petition Area. No invertebrate species listed as endangered, threatened or that are currently proposed for listing under either federal or State of Hawai'i endangered species statutes are known to exist on the project site.

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4.0

Assessment of the Human Environment, Potential Impacts, & Mitigation Measures

4.0 ASSESSMENT OF THE HUMAN ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES

This section describes the existing human environment associated with the Petition Area and the project's potential impacts that may result from proposed development. Mitigation measures are proposed to address the project's potential project impacts.

4.1 ARCHAEOLOGICAL AND HISTORIC RESOURCES

Existing Conditions

An archaeological inventory survey report for the Project Area was conducted in February 2006 by Cultural Surveys Hawai'i Inc. (CSH). This report is included in Appendix D.

Five historic properties (SIHP Nos. 50-80-12-4344, 4345, 4346, 4347, and 4348) were documented during Cultural Surveys Hawai'i's archaeological inventory survey of the Petition Area. All five historic properties have been assessed as eligible for the State Register of Historic Places under Criteria C and D, except for Site 4344, which is only eligible under criterion D. The State Historic Preservation Division (SHPD) concurs with these significance assessments. All five historic properties are located in the vicinity of Old Fort Weaver Road) (See Figure 4.1: Historical Sites).

SIHP Nos. 50-80-12-4344. A survey conducted by CSH in 1990 identified three iron pipe features, including a tall metal post and two welded pipe constructions, located in the vicinity of the Drivers/Stable Villages. The age and function of these features elucidate out record of plantation life in 'Ewa. A more recent inventory study conducted by CSH in 2005 could not locate the previously identified features as the area had been bulldozed and the features destroyed. However, four additional plantation infrastructure features adjacent to Honouliuli Gulch were identified. These features were added to the site description, and will not affect the significance and recommendation for this site ("no preservation").

SIHP Nos. 50-80-12-4345 (Ewa Plantation Railroad Berm). The Ewa Plantation Company operated an approximately 30-mile private railroad from 1890 – 1947 for the primary purpose of the transport of sugar cane. While the railroad runs throughout the Petition Area, a particularly good section of railroad can be found in the northeastern portion of the Petition Area in the mouth of a dry stream valley. A railroad berm runs on both sides of the valley access road with well-preserved facings approximately 2 meters in height. The archaeological consultant recommended that the railroad berm be preserved through incorporating the feature into the development of the project where feasible.

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SIHP Nos. 50-80-12-4346 (Northern Pumping Station). A survey conducted by CSH in 1990 previously determined the site's significance under Criteria C and D. The site consists of a pumping station with a deep rectangular basalt block, faced wall. The site is believed to pre-date 1928. An adjacent single pump house, which has an exterior or corrugated sheet metal panel construction, is located nearby. The archaeological consultant recommended that the well be preserved and that issues of significance and proper historic documentation be resolved with the SHPD office in advance of any development in the area to avoid adverse impacts. A preservation plan has been drafted and will be submitted to SHPD for review and comments.

SIHP Nos. 50-80-12-4347 (Central Pumping Station). A survey conducted by CSH in 1990 previously determined the site's significance under Criteria C and D. The site consists of a pumping station with a deep rectangular basalt block, faced wall. The site is believed to pre-date 1928. Eight features related to and in the immediate vicinity of the well include a number of small architectural and/or industrial features. The archaeological consultant recommended that the well and portions of the site be preserved. The significance of the site would be evaluated after an assessment of the significance of the architectural features and the assessment of the significance of the 'Ewa Village area. A preservation plan has been drafted and will be submitted to SHPD for review and comments.

SIHP Nos. 50-80-12-4348 (Southern Pumping Station). A survey conducted by CSH in 1990 previously determined the site's significance under Criteria C and D. The site consists of a pumping station with a deep rectangular basalt block, faced wall. The site is believed to be constructed shortly after 1928. An adjacent single pump house, which has an exterior or corrugated sheet metal panel construction, is located nearby. The archaeological consultant recommended that the well be preserved and that issues of significance and proper historic documentation be resolved with SHPD in advance of any development in the area to avoid adverse impacts. A preservation plan has been drafted and will be submitted to SHPD for review and comments.

Research of earlier maps indicates four areas of interest: the Honouliuli taro lands, Kapalani Church, Pipe Line Village and Drivers/Stable Villages. All are located in the vicinity of Old Fort Weaver Road, well below from the main development area.

The Honouliuli taro lands were probably nineteenth century (and earlier) Hawaiian habitation and agricultural area. However, no surface or subsurface remains were found during the 2005 inventory survey. CSH has determined that no additional testing is necessary. However, CSH is recommending on-call/on-site archaeological monitoring during any future development in this area. SHPD concurs with this recommendation.

The Kapalani Church was a nineteenth century Hawaiian Catholic Church, schoolhouse and possible cemetery area. Pipeline Village and the Drivers/Stable Villages were early twentieth century immigrant plantation habitation camps. No surface or subsurface

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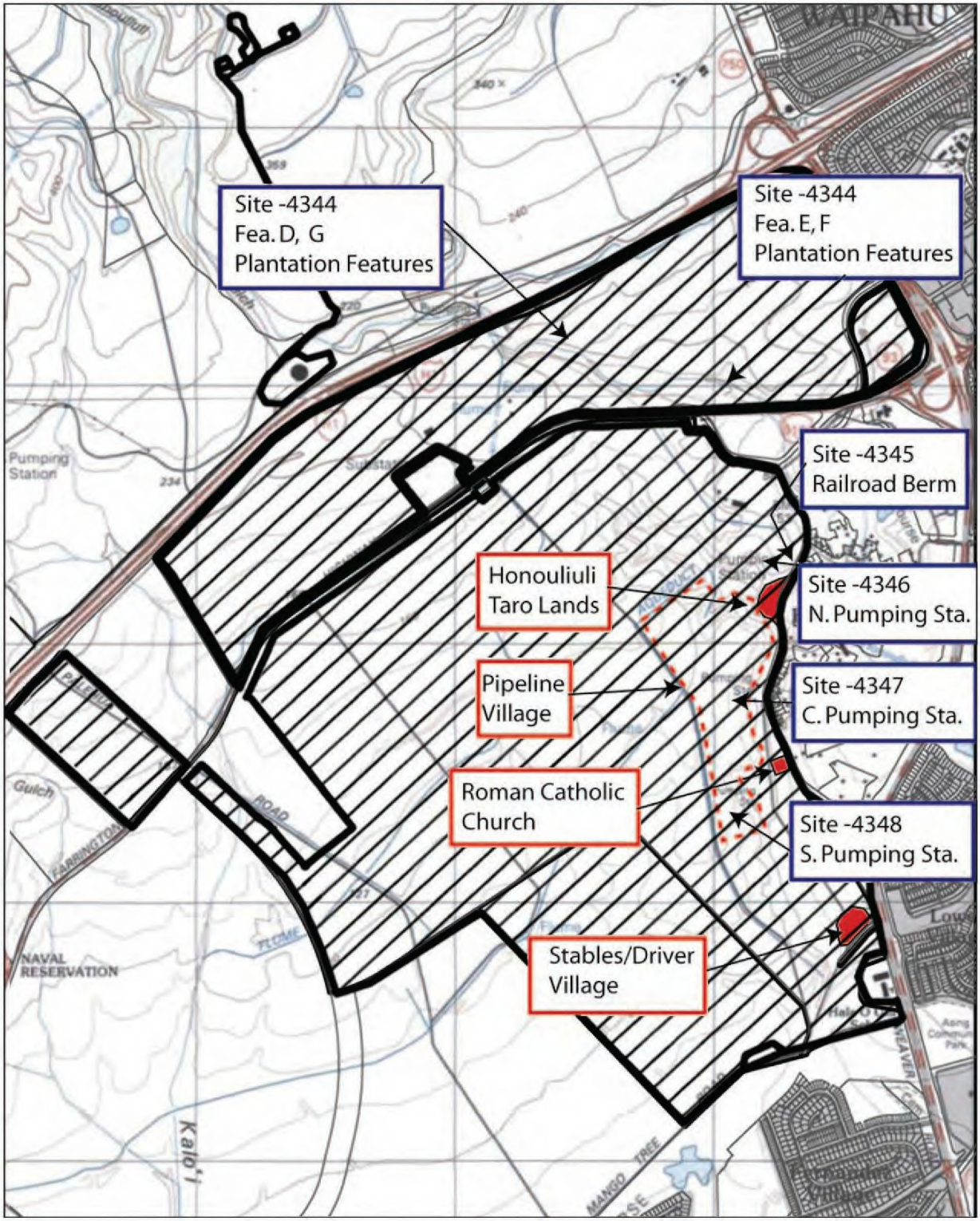

LEGEND

Petition Area

Figure 4.1: Historical Sites

HOʻOPILI

O'ahu, Hawai'i

NORTH

Not to Scale

Source: Cultural Surveys Hawai'i
Disclaimer: This graphic has been prepared for general planning purposes only.

PBR HAWAII & ASSOCIATES, INC.

remains were found during the 2005 inventory survey. CSH has determined that no additional inventory survey is necessary. However, CSH is recommending on-call/on-site archaeological monitoring during any future development in this area. SHPD concurs with this recommendation.

In summary, SHPD concurs with the consulting archaeologist's (Cultural Surveys Hawai'i Inc.) mitigation recommendations, which include: (1) no further archaeological work at Site 4344, (2) preservation of Sites 4345, 4346, 4347, and 4348, and (3) archaeological monitoring in the vicinity of the four areas of historic habitation (Honouliuli taro lands, Kapalani Catholic Church, Pipeline Village, and Drivers/Stable Village).

Anticipated Impacts and Mitigation Measures

According to SHPD, the archaeological inventory survey report is now accepted in fulfillment of Sections 13-284 and 13-276, HAR (See Appendix E). A preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for their review and approval. All five sites are located near Old Fort Weaver Road and well away (and below the bluff) from the main Petition Area. Should any archaeologically significant artifacts, bones, or other indicators of previous on-site activity be uncovered during construction, work will stop immediately and the Department of Land and Natural Resources, Historic Preservation Division (SHPD) will be notified in accordance with applicable regulations.

4.2 CULTURAL RESOURCES

Existing Conditions

A cultural impact assessment for the Project Area was conducted in December 2006 by Cultural Surveys Hawai'i Inc. (CSH). This report is included in full in Appendix F. A summary is presented below.

The Petition Area is located in the ahupua'a of Honouliuli, in the 'Ewa district on the island of O'ahu. Honouliuli, translated as "dark water" or "blue harbor," is the largest ahupua'a in the moku (district) of 'Ewa. Honouliuli consists of lands stretching from the western boundary of Pu'uloa (Pearl Harbor) to the 'Ewa/Wai'anae district boundary.

Honouliuli is associated with a number of legendary accounts. Many of these concern the actions of gods or demi-gods such as Kāne, Kanaloa, Māui, Kamapua'a, the reptile deity (mo'o) Maunauna, the shark deity Ka'ahupāhau, and the demigod hero Palila. While there are several references to chiefly lineages and references to the ruling chiefs Hilo-a-Lakapu and Kūali'i, there is no clear reference to powerful chiefs living permanently in Honouliuli.

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The accessibility of Honouliuli lands, including the proposed Project Area, to the Hawaiians for gathering or other cultural purposes was radically curtailed during the second half of the nineteenth century. By the 1870s, herds of cattle grazing across the 'Ewa Plain probably denuded the landscape of much of the native vegetation. Subsequently, during the last decade of the nineteenth century, the traditional Hawaiian landscape was further distorted by the introduction and rapid development of commercial sugar cane cultivation. Throughout the twentieth century, sugar cane cultivation was the dominating land use activity within the Petition Area and surrounding areas. Sugar cane cultivation, and the sense that most of the Ewa plain was private property, restricted access inside the Petition Area and surrounding areas to employees of 'Ewa Plantation.

Previous Settlements

There are three areas of early settlement in the Honouliuli ahupua'a: the extensive limestone plain with recurrent use as habitation for fishermen and gatherers and sometime gardeners; the uplands around Pu'uku'ua associated with kauwā (slave or servant) residences but probably used for agriculture and forest resources; and the rich cultivated lands of the Honouliuli 'ili (subdivision of an ahupua'a) for extensive wetland taro and clearly the ahupua'a population center. These irrigated lands are centered around the west side of Pearl Harbor at Honouliuli Stream and its broad outlet into West Loch.

Consultation

Hawaiian organizations, government agencies, community members, and cultural and lineal descendants with ties to 'Ewa were contacted to: (1) identify potentially knowledgeable individuals with cultural expertise and knowledge of the Petition Area and its surroundings, and (2) identify cultural concerns and potential impacts within the Petition Area. An effort was made to locate informants with ties to 'Ewa and neighboring ahupua'a who live, or had lived in the region or who, in the past, used the area for traditional and cultural purposes. For this assessment, Arline Eaton, Richard Hirata, Richard Oshiro, Kenneth Soma, Charles Nakamatsu and other kūpuna were interviewed. They mentioned that in the past there was traditional gathering of taro and salt, along with fish such as pāpio, mullet, as well as oysters, clams and a variety of crab along the banks of Pearl Harbor. They all referred to this area of rich marine resources as Chocolate Beach and Three Stones (along Pearl Harbor). The people contacted were not aware of any on-going cultural practices, archaeological sites, trails, or burials within the Petition Area. Most of the people contacted mentioned that the Petition Area was heavily altered by plantation activities.

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Conclusion

While Honouliuli is associated with a number of legendary accounts involving gods, demi-gods and chiefly lineages, there is no clear reference to powerful chiefs living permanently in Honouliuli. Access to Honouliuli lands, including the Petition Area, by Hawaiians for gathering or other cultural purposes was radically curtailed during the second half of the nineteenth century. Herds of cattle grazing across the 'Ewa Plain likely denuded the landscape, which was subsequently further distorted by the introduction and rapid development of commercial sugar cane cultivation. Throughout the twentieth century, sugar cane cultivation was the dominating land use activity. These two factors give evidence of the area's decline as a population center, and the disappearance of reasons to access it.

Based on results of the consultation process, the evidence from Land Court Awards (LCAs) and lack of resources, the vast majority of the Petition Area was utilized less intensively during traditional times. Based on this evidence, no contemporary or continuing cultural practices occur within the Petition Area at present.

Anticipated Impacts and Mitigation Measures

The Petition Area was used for ranching and the production of commercial sugar, and portions of the property continue to be used for agricultural purposes under short-term agreements. Ranching and sugar cane production would have most likely destroyed any cultural resources on the property. Subsurface historic properties associated with former traditional Hawaiian activities in the project area, such as artifacts, cultural layers or burials, may be present despite the decades of destructive modern activities. The Project Area is approximately 600m (approximately 2,000 feet) back from the coast. Therefore, access to marine resources will not be affected.

As a precautionary measure, personnel involved in construction or development activities will be informed of the possibility of inadvertent cultural or skeletal finds, and will cease work immediately, secure the area and notify the proper authorities in the event of such discoveries.

Currently, no contemporary or continuing cultural or traditional practices occur within the proposed Petition Area. Therefore, no impacts are expected and no mitigation measures are planned.

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4.3 NOISE

Existing Conditions

An environmental noise assessment report for the Petition Area was conducted in February 2008 by D.L. Adams Associates, Ltd. This report is included in Appendix G.

The Ho'opili project is currently exposed to varying daytime ambient noise levels, depending on the proximity to major roadways. The areas adjacent to H-1 Freeway and Farrington Highway experience high ambient noise levels during peak traffic hours. Ambient noise levels range from 59 to 72 dBA adjacent to the H-1 Freeway and 44 to 59 dBA adjacent to Farrington Highway. The ambient noise environment is relatively low in areas that are far from the major roadways, where ambient noise levels range from 37 to 60 dBA. The dominant noise sources are traffic, birds, wind, occasional distant aircraft flyovers and farm equipment.

Aircraft activity in the vicinity of the 'Ewa area generated from the Kalaeloa Airport and Honolulu International Airport may be audible at the Ho'opili project. In its comments on the Draft EISPN, the State DOT wrote that single-event noise may occur from potential overflights of aircraft or under certain weather/atmospheric conditions, particularly from aircraft approaching or departing Kalaeloa Airport. However, the overflights of aircraft are infrequent and the Ho'opili project is located well outside of the 55 dBA noise contour for both airports. Even when no aircraft is flying near the Petition Area, noise is generated by traffic on adjacent roadways, including the H-1 Freeway, Farrington Highway, Kunia Road and Fort Weaver Road. Wind through vegetation and birds also generate noise within the Petition Area.

Anticipated Impacts and Mitigation Measures

Construction Noise

Noise will be generated by construction and earth-moving equipment during the project's development. However, over the life of the project, depending where development will occur, construction noise will be relatively short-term, occur only during daytime hours, and comply with ~~DOH noise regulations~~ Chapter 11-46, HAR (Community Noise Control). Noise impacts will only be heard on margins of the Petition Area that border sensitive land uses, such as existing residential uses on the eastern boundary (minimal development is currently contemplated along Old Fort Weaver Road) and the southern boundary (buffered by the 'Ewa Villages Golf Course) of the Petition Area. In general, the Petition Area is surrounded by roads or open space; thus there are relatively few current residents that would be impacted by construction noise. There are no adjacent schools or hospitals to the Petition Area.

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If construction noise is expected to exceed DOH's maximum permissible property line noise levels, a permit will be obtained from the DOH to allow the operation of vehicles, construction equipment, power tools, et cetera. Additionally, construction equipment, vehicles or devices will be equipped with mufflers, as necessary.

Operational Noise

Over the long-term operation of the project, several new noise generating activities (such as new land uses, additional traffic) will be introduced, which are not currently present; and introduced new residents to ongoing noise generating activities (such as aircraft noise, future traffic without the project on surrounding roads, transit).

The proposed land uses may include noise generating activities which could impact future residents. The proposed land use plan was designed to acknowledge that the only neighboring residential areas are located along Old Fort Weaver Road below a bluff where most of the Petition Area is located. Thus, no new residential is currently being proposed in this area. Proposed land uses closest to Honouliuli include a natural park area and medical-related office use.

The project is designed to have higher densities than the existing Villages of Kapolei, and as such, will present similar ambient noise conditions as might be expected where a mix of multi-family residential and commercial uses occur. Noise mitigation measures will be incorporated into the project design to prevent such impacts, such as installing landscaping, and installing mufflers and/or erecting barriers around noisy mechanical equipment (such as air conditioning). Consideration will be given to the layout of the commercial areas to meet State Department of Health noise regulations and reduce the noise impact. It is expected that the Petitioner will likely include restrictions on hours of operations on commercial uses in order to minimize the impact of potential noise producing uses such as bars and nightclubs or indoor recreational land uses. Project activities will comply with Chapter 11-46, HAR (Community Noise Control).

Increases in peak hour traffic noise along Fort Weaver Road due to the project are estimated to be less than 1 dB. Increases in peak hour traffic noise along Old Fort Weaver Road due to the project are estimated to be between 3 and 8 dB. This is acknowledged to be a significant increase for homes currently located along Old Fort Weaver Road impacting approximately 35 homes.

Vehicular traffic noise from the H-1 Freeway and from Farrington Highway and Fort Weaver Road may significantly impact the proposed development. The developer will take appropriate measures in the design, layout and construction facilities in these areas to minimize or mitigate such that exterior noise. These steps may include but are not limited to: air conditioning facilities to reduce ambient noise levels, and traffic noise mitigation measures, such as an earthen berm or noise barrier wall. The developer proposes to notify

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all buyers within 120 feet of the H-1 Freeway, Farrington Highway and Fort Weaver Road that they may experience exterior noise levels of 67 dBA or greater.

Aircraft noise due to operations at nearby Kalaeloa Airport and the Honolulu International Airport may be audible at the project site. However, flights directly above the site are infrequent and the project site is outside of the Ldn 55 noise contour for both airports. Therefore, a significant noise impact due to aircraft noise is not expected. However, per the comments made by the State Department of Transportation during the Draft EIS public review period, prospective occupants will be made aware of the potential for such occurrences.

The proposed alignments of the future Honolulu rail transit system run along Farrington Highway and North-South Road (or possibly diagonally though the Petition Area) and may include two transit stations. The developer proposes to notify all buyers along the proposed transit alignment and nearby the transit stations that they can expect to experience noise from the transit guideway and/or transit stations during the hours the transit system will be in operation.

Exterior noise levels at two school sites (H-1 Freeway/Kunia Road and Farrington Highway) will exceed the Hawaii State Board of Education (BOE) Policy 6700 noise limit of L10 = 65 dBA (before mitigation). During the Draft EIS public review period, the DOE commented that schools should not be located at sites where noise levels exceed 65 dBA. Policy 6700 requires that air conditioning be provided to schools that are exposed to exterior noise levels in excess of the noise limit. The layout and construction of the school should be carefully designed such that exterior noise will not disturb learning activities and interfere with speech intelligibility. To reduce ambient noise levels at the school site, traffic noise mitigation measures may also be necessary, such as an earthen berm or noise barrier wall, or siting the buildings along high noise-generating roadways to essentially serve as noise barriers.

4.4 AIR QUALITY

An Air Quality Study for the Petition Area was conducted in February 2008 by B.D. Neal & Associates to describe the existing air quality in the Petition Area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed project. The study also discussed proposed measures to mitigate impacts by the project. This report is included in Appendix H.

Existing Conditions

Air Quality Standards. Both Federal and State standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. State air quality standards are comparable to the Federal

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standards, except those for nitrogen dioxide and carbon monoxide, which are more stringent than the Federal standards.

Climate. Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the 'Ewa area is very much affected by its leeward and coastal situation. Winds are predominantly trade winds from the east-northeast except for occasional periods when Kona storms may generate strong winds from the south or when the trade winds are weak and landbreeze-seabreeze circulation may develop. Wind speeds typically vary between about 5 to 15 miles per hour proving relatively good ventilation much of the time. Temperatures in the leeward O'ahu area are generally very moderate with average daily temperatures ranging from about 65 degrees Fahrenheit (F) to 84 degrees F.

The extreme minimum temperature recorded at the nearby (former) 'Ewa Plantation is 47 degrees F, while the extreme maximum temperature is 93 degrees F. This are of O'ahu is one of the drier locations in the state with rainfall often highly variable from one year to the next. Monthly rainfall has been measured to vary from as little as a trace to as much as 15 inches. Average annual rainfall amounts to about 21 inches with summer months being the driest.

Existing Pollution Sources. Air quality in the Petition Area is mostly affected by air pollutants from motor vehicles, industrial sources, agricultural operations and to a lesser extent natural sources. Much of the particulate emissions on O'ahu originate from area sources, such as the mineral products industry and agriculture. Sulfur oxides are emitted almost exclusively by point sources, such as power plants and refineries. Nitrogen oxides emissions emanate predominantly from industrial point sources, although area sources (mostly motor vehicle traffic) also contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources. Based on previous emission inventories that have been reported for O'ahu, emissions of particulate and nitrogen oxides may have increased during the past ten years, while emissions of sulfur oxides, carbon monoxide, and hydrocarbons have probably declined.

The H-1 Freeway is a major arterial roadway that presently carries moderate to heavy levels of vehicle traffic during peak traffic hours. Emissions from motor vehicles using this roadway, primarily nitrogen oxides and carbon monoxide, will tend to be carried away from the Petition Area by the prevailing winds.

Several sources of industrial air pollution are located in the Campbell Industrial Park, which is located six miles from the Petition Area toward the southwest. Industries currently operating at Campbell Industrial Park include the Chevron and BHP refineries, the Honolulu Program of Waste Energy Recovery (H-POWER) facility, Kalaeloa Partners, Applied Energy Services, Hawaiian Cement and others. The Hawaiian Electric Company, Inc. (HECO) Waiau Generating Station is located a few miles to the south at Pearl City.

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These industries emit large amounts of sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide and other air pollutants; however, prevailing winds from the east or northeast carry these emissions away from the Petition Area most of the time.

Until recently, air pollution in the Petition Area originating from agricultural sources could mainly be attributed to sugar cane operations in the 'Ewa area and to pineapple cultivation in the central O'ahu area. Emissions from both the sugar mill and the canefield operations in the area have now been eliminated with the closure of Oahu Sugar Company, Ltd. (OSCo). Much of the former sugarcane lands are currently being used as pastureland or for diversified agriculture. Also, pineapple cultivation has been significantly reduced. Therefore, air pollution from agricultural sources in the Petition Area has been substantially reduced over the course of the past several years.

Natural sources of air pollution emissions that could also affect the Petition Area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind blown dust and perhaps distant volcanoes on the island of Hawai'i.

Summary of Existing Air Quality Conditions. The present air quality of the Petition Area appears to be relatively good based on nearby air quality monitoring data.

Based on air quality data from the nearest monitoring stations operated by DOH, it appears likely that the State Ambient Air Quality Standards (AAQS) for sulfur dioxide, nitrogen dioxide, ozone, and lead are currently being met at the Petition Area. Concentrations of particulate matter normally comply with State and Federal standards, except occasionally on New Years Day (fireworks activity). While carbon monoxide measurements at the Kapolei monitoring station suggest that concentrations are within the State and Federal standards, local "hot spots" may exist near traffic-congested intersections.

Anticipated Impacts and Mitigation Measures

It may be inevitable that some short- and/or long-term impacts on air quality will occur either directly or indirectly as a result of project construction and use.

Short-term Impacts and Mitigation. Short-term direct and indirect impacts on air quality will likely occur during the project construction phase. Two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction include: 1) fugitive dust from vehicle movement and soil excavation; and 2) exhaust emissions from on-site construction equipment. Exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may affect air quality during the construction period.

State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented

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to ensure compliance with State regulations. Fugitive dust emissions can be controlled to a large extent by watering active work areas, using wind screens, keeping adjacent paved roads clean and covering open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically stabilizing inactive areas that have been worked. Paving and landscaping of Project Areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary can help to evaluate the effectiveness of the dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

All construction activities on the project site will comply with State Air Pollution Control regulations and the provisions of Section 11-60.1-33, HAR, on Fugitive Dust. An effective dust control plan for the construction phase will be implemented, and particular care will be taken when construction activities take place near existing homes, businesses or highways.

Long-term Impacts and Mitigation. After construction, motor vehicles traveling to and from the proposed development will result in a long-term increase in air pollution emissions in the Petition Area.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with the project, computerized emission and atmospheric dispersion models were used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Maximum carbon monoxide concentrations typically coincide with peak traffic periods; therefore, air quality impacts were assessed during the morning and afternoon peak traffic periods evaluated by the traffic study (See Section 4.8.1 and Appendix H). Air quality analyses were conducted for the following intersections:

- Farrington Highway at Fort Weaver Road (Northbound Ramps);
- Farrington Highway at Leokū Street;
- Fort Weaver Road at Old Fort Weaver Road;
- Fort Weaver Road at Renton Road;
- Farrington Highway at Fort Barrette Road;
- North-South Road at H-1 Freeway (Eastbound Ramps);
- North-South Road at Farrington Highway; and
- North-South Road at Kapolei Parkway.

For the Ho'opili project, four scenarios were selected for the carbon monoxide modeling study: 1) Year 2007: Existing Conditions; 2) Year 2030: Without the Project; 3) Year 2030: With the Project and With the Transit Corridor; and 4) Year 2030: With the Project and Without the Transit Corridor.

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In the Year 2007: Existing Conditions Scenario, the highest worst-case one-hour concentration was predicted to occur during the morning near the intersection of Fort Weaver Road and Renton Road. A value of 12.1 milligrams per cubic meter (mg/m3) was predicted to occur at this location and time. Peak-hour worst-case values at the other locations and times studied for this scenario ranged between 4.6 and 11.0 mg/m3. All projected worse-case concentrations for this scenario complied with Federal standards; however, concentrations exceeded the more stringent State standards at two locations in the Petition Area (Fort Weaver Road at Renton Road and Fort Weaver Road at Old Fort Weaver Road).

In the Year 2030: Without the Project Scenario, the highest worst-case one-hour concentration was predicted to occur during the morning at the intersection of Farrington Highway and Fort Barrette Road. A value of 7.7 mg/m3 was predicted to occur at this location and time. Peak-hour worst-case values at the other locations and times ranged between 3.2 and 7.4 mg/m3. All projected worst-case concentrations for this scenario remained within the State and Federal standards.

In the Year 2030: With the Project and With the Transit Corridor Scenario, the highest worst-case one-hour carbon monoxide concentration was predicted to occur during the morning at the intersection of the North-South Road and Farrington Highway. A value of 8.2 mg/m3 was predicted to occur at this location and time. Peak-hour worst-case values at the other locations and times ranged between 4.6 and 7.8 mg/m3. All projected worst-case concentrations for this scenario remained within the State and Federal standards.

In the Year 2030: With the Project and Without the Transit Corridor Scenario, the predicted worst-case one-hour concentration continued to remain the same or increase slightly compared to the alternative with the project and with the transit corridor. Peak-hour worst-case values for this scenario ranged between 4.6 and 8.9 mg/m3. Although the predicted concentrations increased somewhat in this alternative, the values remained within the State and Federal standards.

Several assumptions were made concerning both traffic movement and worst-case meteorological conditions in this air quality analysis. The analysis assumed a wind speed of one meter per second with a steady direction for one hour will occur. A steady wind of one meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of two meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above.

Based on the air quality modeling results, worst-case carbon monoxide concentrations in the future with the project should be lower (better) than the existing levels and within the Federal and State standards.

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Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Based on the estimated demand levels and emission rates involved, any impacts will likely be negligible.

4.5 MAN-MADE HAZARDS

Existing Conditions

The Petition Area was historically in sugar cane cultivation until relatively recent times. The only known man-made hazardous site related to sugar cane cultivation in the vicinity was a fertilizer/pesticide mixing plant located on the adjacent DHHL property, and not within the Petition Area.

The State of Hawaii Department of Health (DOH) currently assesses the potential of hazards of former agricultural lands on human health based on known historic uses.

Anticipated Impacts and Mitigation Measures

On March 13, 2008, in an interdepartmental memorandum from the DOH Hazard Evaluation & Emergency Response Office (HEER) to the DOH Environmental Planning Office, HEER wrote: "The land under consideration for development of the Ho'opili Project mixed residential/commercial community was formerly used to grow sugar cane. The Draft EIS acknowledges the presence of potential contamination, and investigative work is being coordinated with the HEER Office." The Petitioner is working with DOH on a sampling methodology to determine the presence and levels of certain pesticides. Subsequent actions will be based on the results of the sampling.

Based on sampling done on the adjacent DHHL property, no impacts from pesticide use on the former sugar cane cultivation of the Petition Area are anticipated. Since the Ewa Plain was once mostly under sugar cultivation and large areas have subsequently been developed for residential use without any apparent ill effects, it is anticipated that future residents in the Petition Area will not be exposed to unacceptable levels of pesticides from past or present agricultural activities. During the public review period, the HEER recommended that soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The scope of the investigative work is currently being coordinated with the HEER Office to ensure that the study will be carried out in the most efficient and effective manner possible.

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4.6 VISUAL RESOURCES

Existing Conditions

The Petition Area is located in 'Ewa (the area roughly bounded by the H-1 Freeway to the north, Kapolei Golf Course, Kapolei Middle School and the Villages of Kapolei to the west, 'Ewa Villages to the south, and Honouliuli and Fort Weaver Road to the east). Most of 'Ewa is mostly open and is being cultivated. The major man-made features in 'Ewa besides roads (such as Farrington Highway and the North-South Road – under construction) are HECO's transformer station along Farrington Highway and its overhead 138kV powerlines and supporting tower structures crossing the H-1 Freeway, and running along Farrington Highway and North-South Road.

As is the case with the rest of 'Ewa, Parcels A, B and C of the Petition Area are presently undergoing various forms of diversified agriculture. A portion of the Petition Area is being developed during the construction of North-South Road (construction on-going). Views of the Wai'anae Mountains and Diamond Head are offered from certain locations of the project site. However, since most of the Petition Area is being actively cultivated, the public does not have the opportunity to experience these views. The most heavily traveled roadways in the vicinity of the site are the H-1 Freeway and Fort Weaver Road. In fact, as DPP noted in their comments on the EISPN, the *Ewa Development Plan* Open Space Map shows that "panoramic views" of the property are available from these roadways. While nearly all of the Petition Area is lower in elevation than the H-1 Freeway, views makai from H-1 Freeway are infrequent along the stretch of the freeway between where Kunia Road and Palehua Road cross the freeway. In some sections of the H-1 Freeway, it appears that the freeway was cut across slopes and/or the makai shoulder of the freeway was graded with berms. At posted freeway speeds of 60 miles per hour, viewing the Petition Area while driving is hazardous.

Most of the Petition Area is higher in elevation than Fort Weaver Road, but lower in elevation than the H-1 Freeway.

The most visible portion of the Petition Area from either the H-1 Freeway and/or Kunia Road/Fort Weaver Road is located near the intersection of the H-1 Freeway and Kunia Road or from Farrington Highway.

Anticipated Impacts and Mitigation Measures

The visual appearance of the Petition Area as well as the rest of 'Ewa (including the Kroc Center, UHWO and DHHL East Kapolei Development Parcel 2) will change from vacant scrub and cultivated vegetation to a landscaped mixed-use community with parks and open space. The HHCTC project, a possible transit maintenance and storage facility, transit-oriented development, project landscaping, and the project's architectural design will set the visual character of the Petition Area.

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Field visits were conducted from various points along the H-1 Freeway and Fort Weaver Road where "panoramic views" have been identified in the *Ewa Development Plan* Open Space Map.

West Loch Golf Course presents a large stretch of open space on the western side of Fort Weaver Road and views of the Ho'opili development (which will be at a higher elevation than Fort Weaver Road) will be available along this portion of the Fort Weaver Road, although the proposed Ho'opili development will be approximately 2,000 feet away. Planting trees along the eastern edge of the Petition Area will provide a landscaped character of the Ho'opili project, and serve to mitigate visual impacts along Fort Weaver Road.

Currently, when traveling from the Wai'anae direction of the H-1 Freeway near Exit 5 (East) Kunia Road/'Ewa/Waipahu, drivers have an unobstructed panoramic view towards the Ko'olau Mountains, Pearl City, Pearl Harbor, 'Ewa and the Pacific Ocean. The Petition Area, which will be located at a lower elevation than the freeway, will be visible from the freeway; and the visual character will change from open space to a planned development community. However, drivers' views towards the Ko'olau Mountains, Pearl City, Pearl Harbor, 'Ewa and the Pacific Ocean will likely remain unobstructed.

When traveling from further west along the H-1 Freeway, views towards the project site vary as certain segments of the H-1 Freeway contain berms and dense vegetation that obstruct views. While nearly all of the Petition Area is lower in elevation than the H-1 Freeway, views makai from H-1 Freeway are infrequent along the stretch of the H-1 Freeway between where Kunia Road and Palehua Road cross the H-1 Freeway. One unobstructed viewing opportunity will be the stretch of the H-1 Freeway crossing Honouliuli Gulch. Since the Petition Area will be located at a slightly lower elevation than the H-1 Freeway, this portion of the Ho'opili project will be highly visible. Careful attention to the architectural character and landscape architectural design of this portion (and the remainder) of the Petition Area will mitigate the impacts to existing views.

4.7 SOCIAL-ECONOMIC CHARACTERISTICS

A Social Impact Assessment for the Petition Area was conducted in November 2007 by Belt Collins Hawaii Ltd. This report is included in Appendix I. A Market Assessment for the Petition Area was conducted in March 2007 by Mikiko Corporation. This report is included in Appendix J. In addition, an Economic and Fiscal Impact Assessment for the Project was conducted in August 2007 by Mikiko Corporation. This report is included in Appendix K.

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4.7.1 History of the Ewa Development Plan Area

Prior to the 1970s, the island economy depended on a mix of tourism, military activity, construction, and plantation agriculture. In Ewa, the roles of the military and plantation agriculture in the region's economy has declined (Barbers Point Naval Air Station and Oahu Sugar Company). For the region surrounding Ho'opili, this evolution of the region's economy has been important.

The Oahu Sugar Company, which had used much of the 'Ewa Plain for sugar cultivation, ceased operations by 1995. The land became available for urban development, families in Waipahu and 'Ewa Villages lost a major source of income, and many older workers retired. 'Ewa became a truck farming area using the land and water released from sugar cultivation, with Aloun Farm, Inc. emerging as the island's leading producer of vegetables. The Kapolei area was designated as O'ahu's "Second City" decades ago. James Campbell Industrial Park was created as the island's leading heavy industrial area. The industrial park has seen significant recent growth, including construction of a new Honolulu Advertiser printing plant. The Kapolei urban center was slower to develop but has boomed since 2000. Commercial and residential areas began to be built in the 1990s. In addition, Kapolei has office buildings that accommodate State, City, and the private sector workers, as well as extensive retail areas. The major landowner in the region, James Campbell Company LLC, reports nearly 25,000 jobs in the area, expecting that number to grow to about 65,000 by 2025. Kalaeloa Harbor (formerly Barbers Point Harbor), a deep draft harbor, is nearby. The harbor and the Industrial Park are included in Foreign Trade Zone No. 9.

The Kapolei urban center was slower to develop but has boomed since 2000. Commercial and residential areas began to be built in the 1990s. Located within the *Ewa Development Plan Area*, Ko 'Olina now includes a hotel, a time share resort, high-end vacation homes and condos; a marina has been built and is in use. Residents are now served by a public library, local police and fire stations, a satellite city hall office and other governmental agencies. There is a variety of housing types in 'Ewa, including senior housing, as well as public and private schools and preschools. 'Ewa has one of O'ahu's largest private recreation area, Hawaiian Waters Adventure Park, in addition to community parks and golf courses. The City's transit plans call for a fixed guideway alignment serving the 'Ewa area.

4.7.2 Population

Existing Conditions

According to the City and County of Honolulu Department of Planning and Permitting (DPP), the year 2006 population of the *Ewa Development Plan* Area (Ewa DPA) was 86,000 (DPP, 2006). This comprised an increase of 25.1 percent from its 2000 population of 68,718. The DPP expects the population of the Ewa DPA to increase to 180,200 by the year 2030. In comparison, the population for the City and County of Honolulu as a whole

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increased only 3.8 percent from 876,156 to 909,863 between 2000 and 2006. The City and County of Honolulu is expected to experience a population growth of 27.5 percent (241,144 persons) from 876,156 to 1,117,300 total residents during the same 30-year period.

The Petition Area is presently undeveloped and contains cultivated fields for diversified agriculture, pasturage, and agricultural research, and fallow fields formerly used for sugar cane cultivation. There are no residents currently residing within the Petition Area.

Anticipated Impacts and Mitigation Measures

The Ho'opili project will provide up to 11,750 units. Assuming the O'ahu 2000 average size of households of just less than 3 persons per household, the Ho'opili project would have an overall population of approximately 35,290 residents. The majority of the population moving into the Ho'opili project is expected to come from O'ahu residents relocating from other areas of the island. By 2030, employment opportunities at the project are projected to increase in-migration to the island of O'ahu by approximately 2,170 residents, with 1,020 residents from out-of-State. In addition, its residential opportunities could attract some 660 new county residents of which 430 might also be new to the State.

'Ewa has been identified as a development plan area into which new housing and population are to be encouraged. The population increase is therefore consistent with the City and County of Honolulu's policy to direct future growth to this region. With the population of the Ho'opili project mainly consisting of O'ahu residents that have relocated from other parts of the island, this increase in population has already been incorporated into the City and County of Honolulu's growth projection, and as such, no mitigation measures are foreseen for the proposed project.

4.7.3 Housing

Existing Conditions

A Market Assessment for the Petition Area was conducted in March 2007 by Mikiko Corporation. This report is summarized below and included in Appendix J.

Currently, O'ahu is experiencing a shortage of suitable housing units, with an estimated pent-up demand for approximately 17,000 units. Based on projected growth patterns, O'ahu will need more about 98,000 more housing units by the year 2030, including the 17,000 currently estimated as pent-up demand.

Anticipated Impacts and Mitigation Measures

Over the next 20 years, the Ewa DPA is expected to experience a faster growth rate than any other area of O'ahu. The Ewa DPA accounted for 20,797 housing units in 2000 and

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the housing supply is projected to triple by 2030 to 60,552 housing units. By 2000, its residential areas were largely inhabited by young families. In the newer subdivisions, home ownership is much higher than for O'ahu as a whole, but the rental inventory for low-income families in 'Ewa remains low. To accommodate the projected growth, 34,600 housing units will be needed in this DPA between 2000 and 2025. With most of O'ahu's new housing stock being planned for development in the 'Ewa and Central O'ahu regions of the island, this trend is expected to continue over the next several decades to accommodate the anticipated population growth and housing demand on O'ahu. The 'Ewa region offers the island's major opportunity for home ownership at relatively reasonable prices because of lower land costs. The Ho'opili project will provide up to 11,750 housing units which could represent a partial solution to O'ahu's current housing shortage.

O'ahu is also experiencing a need for housing for middle-income families. By developing new housing for the middle-income group, Ho'opili responds to that need. Moreover, new housing construction will help to limit price increases for both new and resale housing by increasing new housing stock.

The majority of Ho'opili's 11,750 residential units would consist of for-sale multi-family homes. The Project will also include for-sale single-family units and multi-family rental units. Ho'opili's single-family units would be developed at approximately 5- to 8-units per net acre. Multi-family units will range from low-rise townhome units at approximately 10- to 14-units per acre, to mid-rise development at 30- to 50-units per acre.

The proposed housing will be in neighborhoods that integrate low- and medium-density or medium- and high-density residential areas. As a result, Ho'opili will cater to a range of income levels. In accordance with the City and County of Honolulu's affordable housing guidelines, up to 30 percent of the total number of units are expected to be developed as affordable housing units. Details of the affordable housing program in the Ho'opili project that pertain to the regulations and programs of the City and County of Honolulu will be coordinated with the County prior to development.

Affordable housing unit pricing will need to be coordinated with City and County of Honolulu departments, as pricing will be based on then-prevailing County rules and market conditions. The project is in the planning process so there may be an opportunity to identify a few house lots throughout the proposed project for the development of group homes for persons with special needs.

Ho'opili may be compared to Hawai'i Kai and Mililani, planned communities that have become home to thousands of O'ahu residents who, as they age, choose to grow older within their communities rather than move to other neighborhoods. In addition to home ownership opportunities, the project will provide commercial, educational, and recreational opportunities which will enable residents the opportunity to live, work, learn, play, and shop within the community.

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4.7.4 Economic Impacts

Existing Conditions

Presently, the Petition Area generates revenue in the form of rent from Aloun Farm Inc., Sugarland Farms, Inc., Rocker G. Livestock, Larry G. Jefts, Garst Seed Company, Roberts Hawaii, School Bus, Inc., and the Hawaii Agricultural Research Center; sales taxes from the sale of produce; and income taxes from employees of the various lessees. The current approximate annual real property tax revenue paid to the City and County of Honolulu for the Petition Area is approximately $51,000.

Anticipated Impacts and Mitigation Measures

The Petitioner estimates that the development of the Ho'opili project will cost approximately $4.6 billion (in Year 2007 dollars), spent over the project timeline of 2009 – 2030.

The Petitioner is committed to provide or finance its share of infrastructure and facility improvements to support the Ho'opili project. The Petitioner continues to coordinate with major planning and development efforts by other regional developers, such as UHWO, DHHL and HCDA. Meetings among regional developers, as well as with County and State agencies, have been held on a regular and frequent basis to discuss the shared infrastructure and facility improvements. The project will require some commitment of State funds and resources. The State and County will have to extend additional public services for the proposed project, these include: repair and maintenance of roads, water systems, sewer systems, drainage systems and parks; transit, police, fire protection and emergency medical services; and schools.

The cost of the aforementioned public services will be offset by the revenues to the State and County that will be generated by the project. During construction, the project will generate excise taxes via the sale of building supplies and equipment, and on professional services. It will also generate income taxes from those involved in the construction of the project. At full build out, the project will include the development of residential, commercial, and industrial land that will generate property taxes and sales taxes each time a property is resold. The project will perpetually generate income, conveyance, and other taxes for the State, and property and other taxes for the County.

The project's most significant fiscal impact would be the higher real property taxes that would be generated compared to those currently paid. In Year 2007 dollars, the Ho'opili project is projected to generate an additional $7.7 million in real property tax revenues in 2015, or $29.1 million on an annual basis upon the project's completion in 2030. These real property tax collections will continue after 2030.

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In addition to real property taxes, the City and County of Honolulu obtains liquid fuel, utility franchise, motor vehicle weight, and other license and permit fees from residents and businesses. The Ho'opili project anticipates approximately $0.6 million in additional City and County of Honolulu revenues by 2030. Also upon completion, the project could generate approximately $2.1 million per year in additional Gross Excise Tax revenues to the State. As illustrated in Exhibit 5-2 of Appendix K, additional taxes earned by the City and County of Honolulu as a result of the Ho'opili project are estimated at $8.7 million in 2015, or $31.1 million per year by 2030 and thereafter.

4.7.5 Employment

Existing Conditions

The civilian workforce in the Ewa DPA was modest in 2000, totaling about 15,000 employees. With the closure of the Naval Air Station (NAS) Barbers Point, the largest job cluster in the Ewa DPA was in education and health services. Since then, the island economy has grown steadily. The island of O'ahu and the State of Hawai'i have emerged with much lower unemployment rates compared to the rest of the nation. Unemployment continues at very low rates (2.6% as of September 2007) and state tax revenues grew by 11% in FY2006 compared to the previous year. The healthy economy is visible in new store openings, construction in industrial areas, and investment by U.S. mainland real estate investors in industrial and commercial properties in the region.

Presently, the Petition Area produces employment and income in the form of short-term agricultural and other leases. Sugarland Farms and Aloun Farm, Inc. hold the major leases on portions of the Ho'opili property and sublease to additional farmers growing mainly truck crops that are sold in Honolulu markets.

Anticipated Impacts and Mitigation Measures

As development proceeds, existing agricultural operations will have to relocate off-site. Eventually, approximately 80 agricultural-related jobs and $1.7 million per payroll will be ultimately be lost from the Petition Area, but the jobs and the agricultural operations will likely relocate to other locations on O'ahu, which has many other acres of former sugar cane and pineapple lands. Moreover, many more employment opportunities will be gained in different job sectors.

According to projections by Decision Analysts Hawaii, Inc. job growth in the Kapolei region will increase by nearly 160% over the next 20 years. Since the 2000 Census, jobs in the Kapolei region grew by 32 percent to nearly 25,000 in 2005. Reflecting the enormous growth that is expected to drive Kapolei's planned expansion, the projections show that jobs will increase to nearly 65,000 by 2025. The project will generate direct, indirect, and induced jobs both within the Petition Area and on an island-wide basis. These jobs will occur both during construction and after construction as operational employment.

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The project is expected to generate approximately 66,600 full-time equivalent (FTE) person-years of development related jobs during the construction phase of the project. The project will generate direct jobs via on-site retail and office facilities at Ho'opili's business park. Excluding those jobs that may relocate to Ho'opili from elsewhere in the State, approximately ~~680~~ 1,550 net new jobs are expected to be created (by 2030) through direct employment associated with the project. In addition, the project will generate indirect jobs via the supply of goods and services. Applying State employment multipliers to the project, approximately 870 jobs will be created through indirect employment associated with the project.

At full build out, employment associated with the Petition Area ~~employment~~ is expected to account for approximately 7,000 ~~1,550 net~~ new jobs. Consistent with the Ewa DP and the *Kapolei Area Long Range Master Plan*, the new jobs will generate employment in 'Ewa to reduce the need for residents traveling to downtown Honolulu for work-related purposes.

4.8 INFRASTRUCTURE AND UTILITIES

Within the Petition Area, there are no significant on-site infrastructure facilities (such as a water reservoir or a wastewater treatment plant). Extensive on-site and off-site improvements will be made, including roadways; water storage and transmission facilities; wastewater collection lines, and electrical/communication systems. Bills Engineering Inc. prepared preliminary engineering and drainage reports for the proposed project. Key elements of the reports are summarized in the following sections.

4.8.1 Transportation

A traffic impact analysis report (TIAR) for the project was prepared by Wilbur Smith & Associates (WSA) in February 2008 to identify existing traffic conditions. This report is included in Appendix L.

Existing Conditions

Existing Roadways

The following provides a brief discussion of the existing regional roadway network in the vicinity of the Petition Area.

H-1 Freeway (H-1) (State-owned/maintained). H-1 stretches east-west through Central Honolulu and the 'Ewa District. It provides connections of the Petition Area to areas outside of 'Ewa. East of the Waiawa interchange, it provides five lanes of travel in each direction. Between the Waiawa and Kunia interchanges, the freeway provides four lanes

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of travel in each direction. West of the Kunia interchange, the freeway has three travel lanes in each direction.

H-2 Freeway (H-2) (State-owned/maintained). H-2 extends north-south through Central O'ahu and connects to the H-1 Freeway. It provides four lanes of travel in each direction from Waiawa interchange to Mililani, where it narrows to two lanes of travel in each direction.

Farrington Highway (City-owned/maintained). Farrington Highway extends east-west, parallel to the H-1 Freeway, and provides access to the Petition Area. It provides four lanes of travel in each direction from the Kamehameha interchange to Old Fort Weaver Road. Farrington Highway extends westward with one travel lane in each direction to the Villages of Kapolei where it widens to provide two lanes of travel in each direction from Kapolei Golf Course Road into the City of Kapolei. Farrington Highway provides one travel lane in each direction in the vicinity of the Petition Area. The City and County of Honolulu has plans for the widening of Farrington Highway to two lanes in each direction with a right-of-way width of 100 feet between the Kapolei Golf Course and Fort Weaver Road. The widening of Farrington Highway has long been planned and is a transportation facility on the Oahu Regional Transportation Plan (ORTP).

Kamehameha Highway (State-owned/maintained). Kamehameha Highway extends north-south to accommodate traffic traveling from the north and south shores of O'ahu. It is a four-lane highway, with separate left- and right-turn lanes at Waipahu Street, Lumi'au'au Street, Lumi'aina Street, Waipi'o Uka Street, and Ka Uka Boulevard intersection.

The following provides a brief discussion of the existing local roadway system in the vicinity of the Petition Area.

Fort Weaver Road (State-owned/maintained). This roadway extends north-south, connecting the H-1 Freeway with the Farrington Highway. North of Farrington Highway, Fort Weaver Road becomes Kunia Road. Fort Weaver Road serves as a six-lane expressway between the H-1 Freeway and Laulaunui Street. The roadway serves as a four-lane main arterial roadway with a median divider and left turn lanes at cross streets from Farrington Highway to North Road. This road is currently undergoing a widening project.

Fort Barrette Road (City-owned/maintained). This roadway extends north-south, connecting the Kalaeloa Redevelopment Area and Makakilo, and provides access to Farrington Highway and H-1 Freeway. Makai of Farrington Highway to Franklin D. Roosevelt Avenue, Fort Barrette Road serves as a two-lane divided roadway. Mauka of Farrington Highway, it serves as a four-lane divided roadway.

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Old Fort Weaver Road (City-owned/maintained). This two-lane roadway provides access to Farrington Highway and Fort Weaver Road.

Laulaunui Street (City-owned/maintained). This four-lane minor arterial roadway extends east-west between Kaihuopalai Street and Laulaunui Lane.

Leokū Street (City-owned/maintained). This two- to four-lane minor roadway extends north-south between Waipahu Street and Leokane Street.

Kunia Road (State-owned/maintained). This roadway is an extension of Fort Weaver Road north from Farrington Highway and the H-1 Freeway Interchange to provide access into Central O'ahu.

Kupuna Loop (City-owned/maintained). This four lane looped arterial roadway provides direct access with Kunia Road at both its origin and terminus.

Renton Road (City-owned/maintained). This two- to four-lane minor arterial roadway extends east-west, connecting Fort Weaver Road, Kapolei Parkway and Franklin D. Roosevelt Avenue.

Roads Under Construction

The State Department of Transportation is constructing the North-South Road along the eastern boundary of the UHWO campus site. With a 128-foot right-of-way, North-South Road will include three vehicular lanes with paved shoulders in each direction, a 28-foot-wide median that could accommodate an exclusive transit corridor, and sidewalks on both sides of the road. A new interchange with the H-1 Freeway is currently being constructed. North-South Road will connect the 'Ewa Beach and 'Ewa Marina areas with the H-1 Freeway (requiring the completion of 0.7 miles of Kapolei Parkway through Varona Village).

Public Transit

Oahu Transit Services, Inc. under contract to the City and County of Honolulu provides TheBus fixed-route service to the communities adjacent to and in the general vicinity of the proposed Ho'opili project. These routes include both suburban trunk routes and express routes. TheBus operates seven bus lines that directly serve the proposed Project and its immediate vicinity. In addition, TheBoat provides express ocean-bound ferry service between Kalaeloa and Honolulu Harbors. The existing public transit system and proposed improvements are discussed in more detail in Section 4.9.6 of this Draft EIS.

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Existing (2006) Traffic

Currently, neither the City and County of Honolulu nor the State of Hawai'i have guidelines for identifying the transportation impacts caused by a project. However, WSA consulted with DOT Highways Division, DTS and DPP Traffic Branch on the methodology for the TIAR. For the purposes of this TIAR, certain thresholds were identified to analyze the project's transportation impacts at intersections, freeway segments and ramp-freeway junctions in the vicinity of the Ho'opili project. These guidelines are presented below.

Intersections

- A project would cause a transportation impact at an intersection if it degrades the Level of Service (LOS)[1] of the intersection LOS to E or worse (with A being the best and F being the worst).
- A project would cause a transportation impact at an intersection operating at LOS E or F if it degrades the volume-to-capacity ratio of the intersection by more than 10 percent.

Freeway Segments

- A project would cause a transportation impact at a freeway segment if it degrades the LOS of the freeway segment to LOS E or worse.

Ramp-Freeway Junctions

- A project would cause a transportation impact at a ramp-freeway junction if it degrades the LOS of the ramp-freeway to LOS E or worse.

Existing (2006) Intersection Operating Conditions

Existing intersection operating conditions in the vicinity of the project were conducted in April 2006. The AM peak hour of traffic occurred between 6:00 AM to 8:00 AM, and the PM peak hour of traffic occurred between 3:00 PM to 5:00 PM, respectively. A total of 12 intersections were analyzed of which nine are signalized, and three are Two-Way Stop-Controlled (TWSC) intersections. Under existing AM peak hour conditions, 7 of the 12 intersections operated at what the traffic engineering consultant considers an acceptable Level of Service (LOS) D or better.

Similar to the AM peak hour conditions, the existing PM peak hour conditions reveal that five intersections operate at an unacceptable LOS E or F.

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[1] Operations of the study intersections were evaluated using Level of Service (LOS) calculations. LOS is a qualitative description of the performance of an intersection based on the average delay per vehicle. Intersection levels of service range from LOS A, which indicates free flow or excellent conditions with short delays, to LOS F, which indicates congested or overloaded conditions with extremely long delays. LOS for signalized intersections was calculated using the Highway Capacity Manual 2000 (HCM 2000) methodology. The LOS is based on the average delay (in seconds per vehicle) for the various movements within the intersection. A combined weighted average delay and LOS are presented for each of the signalized intersections. The average delay for signalized intersections was calculated using the Synchro analysis software.

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Existing (2006) Freeway Segment Operating Conditions

Roadway and traffic control information was obtained during AM and PM peak hours of traffic for 10 existing freeway segments on April 2006. Existing mainline freeway characteristic including the number of lanes, volumes, and posted speed limits were used to calculate the levels of service. The results of the existing freeway segment analysis using *Highway Capacity Software* (HCS) indicate that under existing AM peak hour conditions, 9 of the 10 freeway segments operate at what the traffic engineering consultant considers an acceptable LOS D or better. Freeway segment, H-1 Eastbound (west of Pāiwa Street) operated at an unacceptable LOS E.

Under existing PM peak hour conditions, 8 of the 10 freeway segments operate at what the traffic engineering consultant considers an acceptable LOS D or better. Freeway segments, H-1 Westbound (west of Pāiwa Street) and H-1 Westbound (east of Kamehameha Highway) operated at an unacceptable LOS E.

Existing (2006) Ramp-Freeway Junction Operating Conditions

Roadway and traffic control information was obtained during AM and PM peak hours of traffic for existing ramp-freeway junctions on April 2006. Similar to the existing freeway segment analysis, HCS software was used to analyze the operating conditions of the existing ramp-freeway junctions. Under existing AM peak hour conditions, four ramp-freeway junctions operated at what the traffic engineering consultant considers an acceptable LOS D or better.

Under existing PM peak hour conditions, two ramp-freeway junctions operated at what the traffic engineering consultant considers an acceptable LOS C. Ramp-freeway junctions, H-1/Fort Weaver Road (Westbound Off-Ramp) and H-1/Fort Weaver Road (Westbound Loop Off-Ramp), operated at an unacceptable LOS F.

Future Baseline Traffic Conditions (without Ho'opili project)

Full development of the Ho'opili project is expected to occur by 2030. As such, traffic volumes for year 2030 conditions were estimated based on the forecasts provided by the 2030 Oahu Metropolitan Planning Organization (OMPO) Transportation Model. This approach resulted in a cumulative impact assessment for future conditions and other anticipated developments expected by year 2030 near the Ho'opili project (such as UHWO, DHHL East Kapolei Development Parcel 2, and the Kroc Center) plus the expected growth in housing and employment for the remainder of the 'Ewa region. To identify the operating conditions of the future transportation network located in the vicinity of the project, a 2030 Baseline Conditions (without the project) analysis was prepared to compare traffic impacts under with and without project conditions.

The traffic study conducted for the UHWO campus (prepared by PB Americas, Inc.)

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indicates that several major roadways would be improved between 2009 and 2025 including: The widening of H-1 Freeway and Farrington Highway, a new North-South Road, a new interchange at H-1 Freeway and connection to the completed Kapolei Parkway. In addition, the 2030 Oahu Regional Transportation Plan (ORTP), mentions that the high-occupancy vehicle (HOV) lanes on H-1 Freeway are planned to be extended from Waiawa Interchange (H-1/H-2 Freeway Merge) to the Makakilo Interchange. Roadway improvements anticipated by Year 2025 include the widening of Fort Barrette Road and Fort Weaver Road, the completion of the East-West Connector Road, and additional internal roadways proposed by Ho'opili and DHHL East Kapolei Development Parcel 1 (See Figure 4.2: 'Ewa Regional Transportation Plan).

The UHWO traffic study also reported that a review of the Ewa Highway Master Plan would include the inclusion of a loop ramp at the North-South Road Interchange. Furthermore, if right-of-way (ROW) is available acceleration and deceleration lanes lengths may be increased. As such, the above improvements were assumed to be in place by 2030.[2]

The Ho'opili project borders Farrington Highway which is a transportation facility on the ORTP. The Petitioner will coordinate with the City and County of Honolulu Department of Design and Construction (DDC) regarding the expanded right-of-way required for the City and County of Honolulu's long-planned widening of Farrington Highway, as well as improvements to the highway (such as turning lanes) which are needed to mitigate traffic that can be directly attributed to the proposed development.

The Petitioner will continue to coordinate with DOT on the planning of the H-1 Freeway/North-South Road Interchange. Bicycle facilities not located within State highway right-of-ways and City and County of Honolulu dedicable roadways will be privately-owned and maintained by a community association.

Projected Intersection Operating Conditions

During the AM peak hour, 17 of the 19 study intersections would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (LOS D or better) (See Table 4.1). Intersections operating at what the traffic engineering consultant identifies as unacceptable traffic conditions (LOS E or worse) include: Fort Weaver Road/Renton Road and Farrington Highway/Fort Barrette Road. During the PM peak hour, 16 of the 19 study intersections would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.2). The traffic engineering consultant identified the following intersections as operating at unacceptable traffic conditions: Fort Weaver Road/Renton Road; Farrington Highway/West Old Fort Weaver Road; and Farrington Highway/Fort Barrette Road.

[2] Based on feedback from DOT, 1) A Diamond (not a "clover leaf") interchange is being planned at the North-South Road/H-1 Interchange; and 2) The WSA traffic analysis did not assume that the loop ramp will be in place by 2030.

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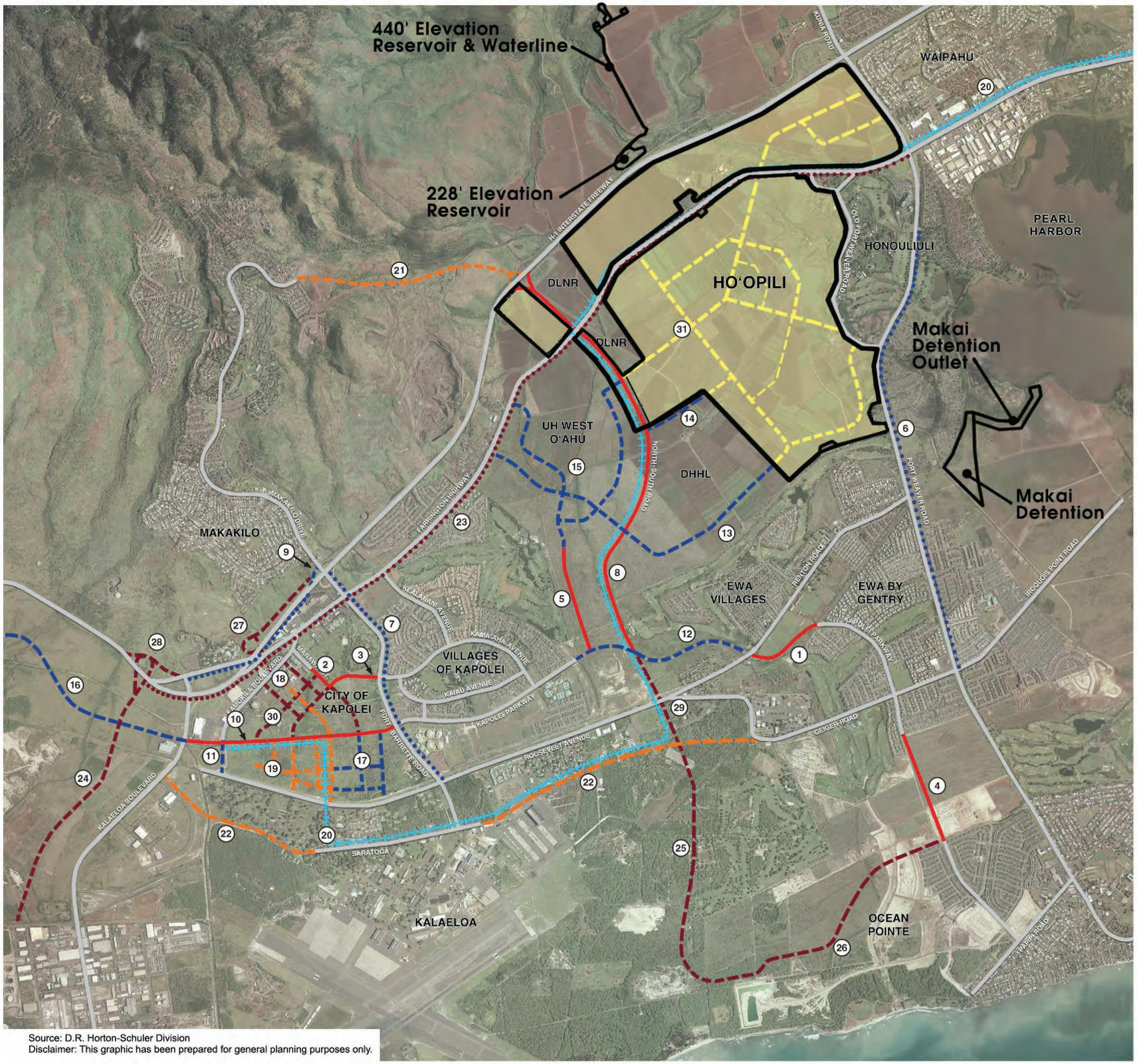

Source: D.R. Horton-Schuler Division
Disclaimer: This graphic has been prepared for general planning purposes only.

2006

1. **Kapolei Parkway between Renton Rd. and Kolowaka Dr.**
   New Road - Completed
   ORTP 30 Year Plan: www.oahumpo.org/ortpIndex.html
2. **Manawai Eastern Extension to Ft. Barrette Rd.**
   New Road - Completed
   ORTP 30 Year Plan: www.oahumpo.org/ortpIndex.html
3. **Kama'aha Ave. Extension to Ft. Barrette Rd.**
   New Road - Completed
   Honolulu Advertiser 7/26/06 & Campbell FYI Oct 2006
4. **Kapolei Parkway South of Geiger Rd.**
   New Road - Under Construction
   Honolulu Star-Bulletin 9/28/06
5. **DHHL Road between UH West O'ahu & Kapolei Parkway**
   New Road - Under Construction
   Honolulu Advertiser 9/11/06

2007-2009

6. **Ft. Weaver Rd. between 'A'awa Dr. and Geiger Rd.**
   Widening Begins 2006
   Honolulu Advertiser 9/4/06
7. **Ft. Barrette Rd. between H-1 and Roosevelt Ave.**
   Widening Begins 2008
   Campbell- Kapolei FYI March 2006 www.kapolei.com
8. **North-South Rd. between H-1 and Future Kapolei Parkway**
   New Road - Under Construction
   Campbell- Kapolei FYI August 2006 www.kapolei.com
9. **Kapolei Interchange at H-1 and Makakilo Dr.**
   New Road - In Design
   Honolulu Advertiser 7/26/06
10. **Kapolei Parkway west of Ft. Barrette Rd.**
    New Road - Under Construction
    DR Horton-Schuler Homes/Campbell- Kapolei FYI August 2006 www.kapolei.com
11. **Kamokila Extension**
    New Road - In Design
    Honolulu Advertiser 7/31/06
12. **Kapolei Parkway west of Renton Rd.**
    Out to Bid
    Confirmed w/DPP 1/31/07
13. **East-West Rd. from Ho'opili to Farrington Hwy.**
    New Road - In Plan
    Honolulu Advertiser 9/11/06 & PBR HAWAII
14. **DHHL mauka east-west connection to North-South Rd.**
    New Road - In Plan
    Department of Hawaiian Home Lands (DHHL)
15. **UH West O'ahu roads south of Farrington Hwy.**
    New Road - In Plan
    PBR HAWAII
16. **Kapolei Parkway from Kalaeloa Blvd. to Ko Olina.**
    New Road - In Plan
    Kapolei Master Plan: www.kapolei.com/Business/maps.htm
17. **Mehana Streets Phase One, west of Ft. Barrette Rd.**
    New Road - In Plan
    DR Horton-Schuler Homes

2010-2015

18. **Wakea St. between Farrington Hwy. & Roosevelt Ave.**
    New Road - In Plan
    Kapolei Master Plan: www.kapolei.com/Business/maps.htm
19. **Mehana Streets Phase Two, south of Kapolei Parkway**
    New Road - In Plan
    DR Horton-Schuler Homes
20. **Rail Transit along Farrington Hwy. & North-South Rd.**
    New Road - In Plan
    City & County of Honolulu
21. **Makakilo Connector between Makakilo Dr. and H-1**
    New Road - In Plan
    ORTP 30 Year Plan: www.oahumpo.org/ortpIndex.html
22. **Saratoga Realignment from Kalaeloa Blvd. to Geiger Rd.**
    New Road - In Plan
    Kalaeloa Master Plan: www.hcdaweb.org

2016-Beyond

23. **Farrington Hwy. between Ft. Weaver Rd. to Palailai Interchange**
    Widening - In Plan
    Star-Bulletin 2/19/06
24. **Hanua St. H-1 to Malakole St.**
    New Road - In Plan
    Star-Bulletin 2/19/06
25. **Keone'ula Rd. continuation of North-South Rd. through Kalaeloa**
    New Road - In Plan
    Kalaeloa Master Plan: www.hcdaweb.org
26. **Keone'ula Rd. to Ocean Pointe continuation of North-South Rd.**
    New Road - In Plan
    Kalaeloa Master Plan: www.hcdaweb.org
27. **Kapolei Interchange alternate northern route to Makakilo Dr.**
    New Road - In Plan
    Honolulu Advertiser 9/27/06
28. **Palailai Interchange at Hanua St. and H-1**
    New Road - In Plan
    ORTP & Honolulu Advertiser 9/27/06
29. **North South Rd. between Future Kapolei Parkway and Roosevelt Ave.**
    New Road - In Plan
    'Ewa Development Plan
30. **City of Kapolei Streets**
    New Road - In Plan
    Kapolei Master Plan: www.kapolei.com/Business/maps.htm
31. **Ho'opili Roads**
    New Roads - In Plan

Roads within Ho'opili will be phased in accordingly.

LEGEND

- Project Site Boundary
- Petition Area
- Existing Roads
- Completed/Under Construction (Present)
- Proposed Roads (2007-2009)
- Proposed Improvements (2007-2009)
- Proposed Roads (2010-2015)
- Proposed Roads (2016-Beyond)
- Proposed Improvements (2016-Beyond)
- Rail
- Ho'opili Roads

Figure 4.2: 'Ewa Regional Transportation Plan

HO'OPILI
O'ahu, Hawai'i

NORTH
LINEAR SCALE (FEET)
0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

Table 4.1. Year 2030 Baseline AM Peak Hour Intersection Operations

Intersection	Control	Year 2030 Without Project	
		Delay	LOS
External Intersections			
Kunia Rd./Kunia Loop	Signal	12.8	B
Kunia Rd./H-1 WB On-Ramp*	TWSC	3.3	A
Kunia Rd./H-1 EB Ramps	Signal	8.9	A
Farrington Hwy./Fort Weaver Rd. SB Ramps	Signal	5.2	A
Farrington Hwy./Fort Weaver Rd. NB Ramps	Signal	3.0	A
Farrington Hwy./Leoku St.	Signal	18.0	B
Fort Weaver Rd./Laulaunui St.	Signal	29.8	C
Fort Weaver Rd./Old Fort Weaver Rd.	Signal	16.7	B
Fort Weaver Rd./Renton Rd.	Signal	**78.1**	**E**
Farrington Hwy./East Old Fort Weaver Rd.**	TWSC	16.4	C
Farrington Hwy./West Old Fort Weaver Rd.**	TWSC	22.0	C
Farrington Hwy./Fort Barrette Rd.	Signal	**62.7**	**E**
North-South Rd./H-1 WB Ramps	Signal	32.4	C
North-South Rd./H-1 EB Ramps	Signal	38.1	D
North-South Rd./Farrington Hwy	Signal	35.2	D
North-South Rd./North UH Connector	Signal	7.3	A
North-South Rd./East-West Road	Signal	27.0	C
North-South Rd./Kapolei Pkwy.	Signal	34.8	C
East-West Rd./Old Fort Weaver Rd.	Signal	22.3	C

Notes:
* - This location is stop-controlled under existing conditions, but is signalized under 2030 conditions.
** - This location is stop-controlled under 2030 conditions, but is signalized under 2030 plus project
TWSC – Two-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

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Table 4.2. Year 2030 Baseline PM Peak Hour Intersection Operations

Intersection	Control	Year 2030 Without Project	
		Delay	LOS
External Intersection			
Kunia Rd./Kunia Loop	Signal	17.1	B
Kunia Rd./H-1 WB On-Ramp*	TWSC	14.1	B
Kunia Rd./H-1 EB Ramps	Signal	8.8	A
Farrington Hwy./Fort Weaver Rd. SB Ramps	Signal	14.0	B
Farrington Hwy./Fort Weaver Rd. NB Ramps	Signal	8.0	A
Farrington Hwy./Leoku St.	Signal	47.4	D
Fort Weaver Rd./Laulaunui St.	Signal	26.3	C
Fort Weaver Rd./Old Fort Weaver Rd.	Signal	45.0	D
Fort Weaver Rd./Renton Rd.	Signal	**63.4**	**E**
Farrington Hwy./East Old Fort Weaver Rd.**	TWSC	32.0	D
Farrington Hwy./West Old Fort Weaver Rd.**	TWSC	**55.4**	**F**
Farrington Hwy./Fort Barrette Rd.	Signal	**67.5**	**E**
North-South Rd./H-1 WB Ramps	Signal	25.6	C
North-South Rd./H-1 EB Ramps	Signal	15.7	B
North-South Rd./Farrington Hwy	Signal	35.8	D
North-South Rd./North UH Connector	Signal	13.5	B
North-South Rd./East-West Road	Signal	28.6	C
North-South Rd./Kapolei Pkwy.	Signal	54.2	D
East-West Rd./Old Fort Weaver Rd.	Signal	20.6	C

Notes:
* - This location is stop-controlled under existing conditions, but is signalized under 2030 conditions.
** - This location is stop-controlled under 2030 conditions, but is signalized under 2030 plus project
TWSC – Two-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

Projected Freeway Segment Operating Conditions

During the AM peak hour, 6 of the 10 freeway segments studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions. During the PM peak hour as well, 6 of the 10 study freeway segments would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.3). Under 2030 Baseline Conditions (without the project), cumulative traffic impacts occur at a total of eight freeway segments.

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Table 4.3. Year 2030 Baseline Peak Hour Freeway Segment Operations

Freeway	Segment	Year 2030 Without Project		
		Volume	Density	LOS
AM Peak				
H-1 EB	S/O Makakilo Dr.	5434	**37.8**	**E**
H-1 EB	W/O Kunia Rd.	8197	**>45**	**F**
H-1 EB	W/O Paiawa St.	9906	**43.4**	**E**
H-1 EB	E/O Kamehameha Hwy.	7512	**38.8**	**E**
H-2 NB	At Ka Uka Blvd.	3184	21.3	C
H-1 WB	S/O Makakilo Dr.	3259	21.8	C
H-1 WB	W/O Kunia Rd.	3735	18.3	C
H-1 WB	W/O Paiawa St.	4366	16.6	B
H-1 WB	E/O Kamehameha Hwy.	3069	20.5	C
H-2 SB	At Ka Uka Blvd.	6273	30.7	D
PM Peak				
H-1 EB	S/O Makakilo Dr.	4680	31.3	D
H-1 EB	W/O Kunia Rd.	5833	28.5	D
H-1 EB	W/O Paiawa St.	7137	27.2	D
H-1 EB	E/O Kamehameha Hwy.	4249	28.4	D
H-2 NB	At Ka Uka Blvd.	6220	**>45**	**F**
H-1 WB	S/O Makakilo Dr.	6365	**>45**	**F**
H-1 WB	W/O Kunia Rd.	7860	**43.3**	**E**
H-1 WB	W/O Paiawa St.	7931	25.2	C
H-1 WB	E/O Kamehameha Hwy.	7766	**42.2**	**E**
H-2 SB	At Ka Uka Blvd.	4616	22.5	C

Notes:
Density is given in pc/mi/ln.
Bold type indicates LOS E or F

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

Projected Ramp-Freeway Junction Operating Conditions

During the AM peak hour, 7 of the 10 ramp-freeway junctions studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions. During the PM peak hour, 7 of the 10 ramp-freeway junctions studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.4). In considering both AM and PM peak hours under 2030 Baseline Conditions (without the project), cumulative traffic impacts occur at a total of six ramp junctions.

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Table 4.4. Year 2030 Baseline Ramp-Freeway Junction Operations

Location	Ramp	Year 2030 Without Project	
		Delay*	LOS
AM Peak			
H-1/Fort Weaver Road	WB Off-Ramp	16.0	B
H-1/Fort Weaver Road	WB Loop Off-Ramp	1.3	A
H-1/Fort Weaver Road	WB On-Ramp	15.0	B
H-1/Fort Weaver Road	EB Off-Ramp	37.4	**E**
H-1/Fort Weaver Road	EB On-Ramp	24.8	**F**
H-1/Fort Weaver Road	EB Loop On-Ramp	26.3	**F**
H-1/North-South Road	WB Off-Ramp	20.3	C
H-1/North-South Road	WB On-Ramp	13.5	B
H-1/North-South Road	EB Off-Ramp	25.0	C
H-1/North-South Road	EB On-Ramp	28.8	D
PM Peak			
H-1/Fort Weaver Road	WB Off-Ramp	38.0	**F**
H-1/Fort Weaver Road	WB Loop Off-Ramp	19.9	**F**
H-1/Fort Weaver Road	WB On-Ramp	26.0	C
H-1/Fort Weaver Road	EB Off-Ramp	28.8	D
H-1/Fort Weaver Road	EB On-Ramp	18.3	B
H-1/Fort Weaver Road	EB Loop On-Ramp	20.4	C
H-1/North-South Road	WB Off-Ramp	41.1	**F**
H-1/North-South Road	WB On-Ramp	27.7	C
H-1/North-South Road	EB Off-Ramp	21.0	C
H-1/North-South Road	EB On-Ramp	17.0	B

Notes:
* - Lower density does not necessarily indicate a lower LOS. This is because the LOS is calculated based upon a number of factors including: merge influence area, length of the acceleration lane, etc. See Appendix F for the HCM methodology used to calculate the LOS
Density is presented in pc/mi/ln
DEC - Demand Exceeds Capacity
Bold type indicates LOS F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

Proposed Project

There are several major transportation projects that have been long-planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the first segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area.

The Ho'opili project has been planned assuming that the above major transportation projects would be in place. In addition, the Conceptual Land Use Plan reflects the desire for a community that is "complete" with: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents. Implementation of the Plan will allow residents the ability to live, work, learn, play, and shop within Ho'opili, reducing the need to use personal motor vehicles

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on regional roadways. Ho'opili's planning consultant, Van Meter Williams Pollack, in consultation with Charlier & Associates, was primarily responsible for the design of Ho'opili's internal roadway system which emphasized Traditional Neighborhood Design principles such as facilitating pedestrian access and connectivity (to UHWO and DHHL East Kapolei Development Parcel 2, and to the above major transportation projects).

To accommodate connectivity, the Ho'opili project would include the construction of numerous internal roadways to accommodate on-site circulation (See Figure 4.3: Internal Roadways). A description of the proposed internal street network is included below.

First Avenue. This east-west avenue connector street runs from Second Avenue to A Street.

Second Avenue. This east-west avenue connector street runs from Fort Weaver Road to Farrington Highway.

Third Avenue. This east-west avenue connector street runs from Fort Weaver Road to Second Avenue.

Fourth Avenue. This east-west avenue connector street runs between Parkway and C Street.

Fifth Avenue. This north-south avenue connector street runs between Parkway and B Street.

A Street. This north-south street runs between First Avenue and East-West Road.

B Street. This north-south street runs between Farrington Highway and East-West Road.

C Street. This east-west street runs between Fort Weaver Road and Parkway

D Street. This north-south street runs between Second Avenue and Farrington Highway.

E Street. This north-south street runs between Second Avenue and Farrington Highway.

Vehicular access to the Ho'opili project would be made possible via multiple entry points. From the north, vehicles would approach the project from the Kunia Road/H-1 Interchange and have access to the site at the intersections of Fort Weaver Road/Second Avenue and Fort Weaver Road/Third Avenue. Access to the Ho'opili project from the south would be provided from the intersections of North-South Road/East-West Connector Road and Fort Weaver Road/C Street. From the west, vehicles would approach the Ho'opili project from the Farrington Highway/North-South Road intersection and gain access to the site at the intersection of Farrington Highway/B Street. From the east, vehicles would have opportunities to enter the Ho'opili project at the following access

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points along Farrington Highway: Farrington Highway/Second Avenue, Farrington Highway/West Old Fort Weaver Road and Farrington Highway/East Old Fort Weaver Road.

Due to the size and nature of the Ho'opili project, the Petitioner will coordinate closely with the City and County of Honolulu to identify possibilities for future expansion of the bus service in the vicinity of the project including on the above proposed internal transportation network. This is likely to occur with or without the implementation of the HHCTC project. It is assumed that the locations of bus stops and shelters in relation to schools, commercial and residential facilities in the area will be used to determine appropriate bus stop locations. To enhance connectivity, bus stops should be sited along pedestrian/bicycle paths.

The proposed project has been designed to reduce future residents' reliance on private motorized vehicles through the following measures:

- Ho'opili is the first new project designed to ~~embrace~~ support the City and County of Honolulu's high-capacity transit (elevated, fixed-guideway) corridor and station(s) (and a possible transit maintenance and storage facility);
- the Petition Area is large enough to be designed and offer a full range of mixed land uses, including a wide range of places of live, work, shop, recreate and learn and will aspire to achieve a job-housing balance;
- Ho'opili is designed to maximize connectivity (transit, pedestrian, bicycle and vehicular) with surrounding streets and communities (including DHHL and UHWO), while minimizing cul-de-sacs and dead-end streets;
- Ho'opili will be designed to take advantage of the relative flatness of the site and proximity to UHWO by designing streets and grade-separated multi-modal pathways for walking and bicycling; and
- the Petitioner will seek to implement other transportation management and transportation demand management (TDM) strategies (such as requesting that the State/County consider extending or instituting contra-flow of major transportation corridors during a.m. and p.m. peak travel times).

The most important TDM strategy is that the project is designed to ~~embrace~~ support both rail and bus transit and the project is proposed to have mixed uses over most of the entire Petition Area.

Anticipated Impacts

The City and County of Honolulu is planning for a high-capacity transit corridor project between Kapolei and the University of Hawai'i at Mānoa (UH Mānoa). The Honolulu High-Capacity Transit Corridor Project (HHCTCP) has evaluated transit alternatives for the 23-mile long corridor between Kapolei and UH Mānoa. The City and County of Honolulu will now undertake preliminary engineering and is in the process of preparing the

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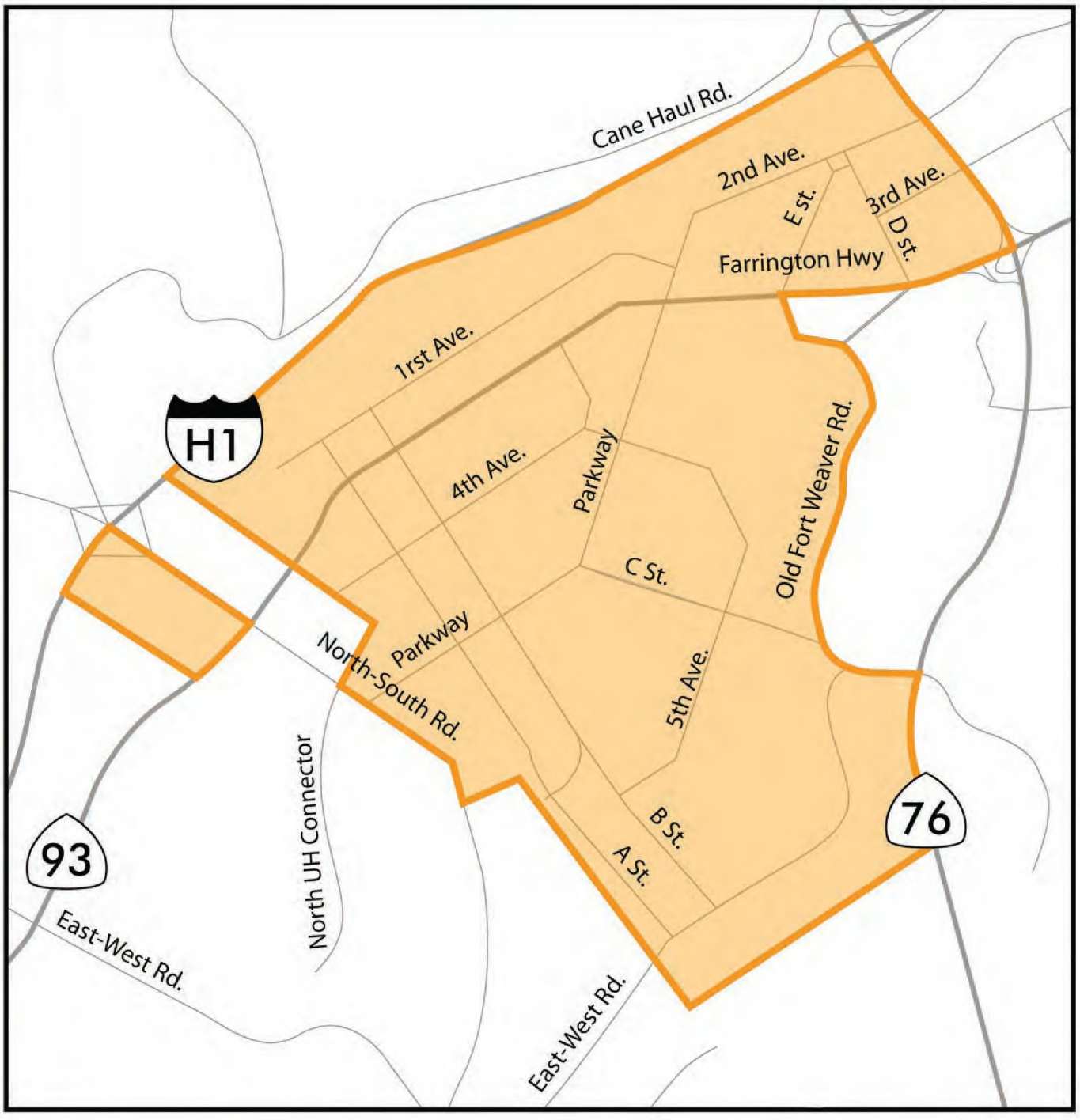

Figure 4.3: Internal Roadways

HO'OPILI

O'ahu, Hawai'i

NORTH

Not to Scale

PBR HAWAII & ASSOCIATES, INC.

Source: Wilber Smith Associates
Disclaimer: This graphic has been prepared for general planning purposes only.

environmental impact statement for the Locally Preferred Alternative (LPA). As the first project, the City Council selected a minimum operable segment (MOS) that will begin near the Kroc Center on North-South Road to Farrington Highway, through Waipahu, Pearl City, Aiea, and via Salt Lake Boulevard through downtown Honolulu to Ala Moana Center. As of this writing, we understand that the portion of the alignment between the Kroc Center and Waipahu, the location of the transit maintenance and storage facility, and the location of potential transit stations are being finalized.

Two possible HHCTC alignments through Ho'opili have been discussed with at least one station proposed within Ho'opili. If required for the transit project, the Petitioner will coordinate with DTS regarding the possibility of allocating a portion of the project lands for a potential high-capacity transit maintenance and storage facility.

High-capacity transit will be one component of a multi-modal alternative that will provide a balanced transportation system in the Petition Area. The City and County of Honolulu ~~Oahu Transit Service~~ operates TheBus and TheBoat on a supply and demand basis, subject to the availability of resources. Section 4.9.6 contains a more detailed description of transit related issues.

In addition to projecting 2030 Baseline Conditions (without the project), the traffic impact analysis report prepared for the Ho'opili project focused on projecting future transportation conditions with the anticipation of the City's proposed transit corridor project (Scenario A: With Transit Corridor). However, an in-depth analysis of future conditions without the proposed transit corridor project was also conducted to identify additional traffic impact and improvement actions in the event that the proposed transit corridor project does not extend to Ho'opili in 2030 (Scenario B: Without Transit Corridor). Each scenario's ("With Transit Corridor" and "Without Transit Corridor") impacts to "level of service" (LOS) was compared to 2030 Baseline Conditions for AM and PM peak hour intersection operations, peak hour H-1 Freeway segment operations, and ramp-H-1 Freeway junction operations. The three scenarios studied then were:

2030 Baseline Conditions Without (the Ho'opili) Project. Under this scenario, projected future transportation improvements were assumed to be in place by 2030 under without the project conditions. Future traffic volumes were obtained from the Year 2030 Oahu Metropolitan Planning Organization (OMPO) Transportation Model.

2030 Baseline Conditions With (the Ho'opili) Project, Scenario A: With Transit Corridor. Under this scenario, it is assumed that the Honolulu High Capacity Transit Corridor (HHCTC) is constructed and would pass through the Ho'opili project. The presence of a transit corridor within the Ho'opili project would affect the number of vehicle-trips generated by the proposed project land uses. The transit facility would attract an increase in the portion of the person-trips generated from the Ho'opili project; thus increasing the project-related transit trips and reducing the project-related vehicle trips. Thus a transit

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reduction factor was applied while developing the project trip generation under this scenario.

The proposed transit alignment would run diagonally through the Ho'opili project along the UHWO Internal Road B, turn down into the median of North-South Road, and stop at the Kroc Center in the median of North-South Road. The median would follow the grass-lined channel of the realigned Kalo'i Gulch. Two transit stations are assumed within Ho'opili, the exact locations of which are still being determined. It should be noted that increased ridership is likely to occur depending on the location of the transit stations, particularly based on the density of the area surrounding the transit station.

2030 Baseline Conditions With (the Ho'opili) Project, Scenario B: Without Transit Corridor. Under this scenario, it is assumed that the HHCTC is either not constructed by 2030 or is not passing through the Ho'opili project. In this scenario, no transit reduction factor was applied while developing the project trip generation.

All of the impacts described for each of the following scenarios assume the cumulative impact of surrounding projects (such as UHWO and DHHL East Kapolei Development Parcel 2), in operation by 2030.

2030 Baseline Conditions With (the Ho'opili) Project, Scenario A: With Transit Corridor – Projected Intersection Operating Conditions

During the AM peak hour, 22 of the 26 intersections studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (LOS D or better) (See Table 4.5). During the PM peak hour, 17 of the 26 study intersections would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.6). Out of the four intersections operating at an unacceptable traffic condition during the AM peak hour, all four intersections also operate at an unacceptable level during the PM peak hour. Therefore under Scenario A: With Transit Corridor, the Ho'opili project would result in cumulative traffic impacts at a total of nine intersections during one or both of the peak traffic hours.

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Table 4.5. Year 2030 AM Peak Hour Intersection Operations

Intersection	Control	Year 2030 Without Project		Year 2030 with Scenario A		Impact	Year 2030 with Scenario B		Impact
		Delay	LOS	Delay	LOS		Delay	LOS	
External Intersections									
Kunia Rd./Kunia Loop	Signal	12.8	B	15.7	B	No	17.9	B	No
Kunia Rd./H-1 WB On-Ramp*	TWSC	3.3	A	4.5	A	No	4.5	A	No
Kunia Rd./H-1 EB Ramps	Signal	8.9	A	8.4	A	No	8.4	A	No
Farrington Hwy./Fort Weaver Rd. SB Ramps	Signal	5.2	A	9.9	A	No	10.3	B	No
Farrington Hwy./Fort Weaver Rd. NB Ramps	Signal	3.0	A	25.4	C	No	38.4	D	No
Farrington Hwy./Leoku St.	Signal	18.0	B	19.2	B	No	23.6	C	No
Fort Weaver Rd./Laulaunui St.	Signal	29.8	C	42.6	D	No	53.9	D	No
Fort Weaver Rd./Old Fort Weaver Rd.	Signal	16.7	B	**176.6**	**F**	**Yes**	**268.8**	**F**	**Yes**
Fort Weaver Rd./Renton Rd.	Signal	**78.1**	**E**	**111.8**	**F**	**Yes**	**114.8**	**F**	**Yes**
Farrington Hwy./East Old Fort Weaver Rd.**	TWSC	16.4	C	31.4	C	No	40.1	D	No
Farrington Hwy./West Old Fort Weaver Rd.**	TWSC	22.0	C	17.2	B	No	24.8	C	No
Farrington Hwy./Fort Barrette Rd.	Signal	**62.7**	**E**	**75.9**	**E**	**Yes**	**71.6**	**E**	**Yes**
North-South Rd./H-1 WB Ramps	Signal	32.4	C	42.2	D	No	**99.4**	**F**	**Yes**
North-South Rd./H-1 EB Ramps	Signal	38.1	D	30.0	C	No	37.3	D	No
North-South Rd./Farrington Hwy	Signal	35.2	D	**76.7**	**E**	**Yes**	**105.4**	**F**	**Yes**
North-South Rd./North UH Connector	Signal	7.3	A	38.6	D	No	33.4	C	No
North-South Rd./East-West Road	Signal	27.0	C	37.0	D	No	40.8	D	No
North-South Rd./Kapolei Pkwy.	Signal	34.8	C	43.1	D	No	**62.7**	**E**	**Yes**
East-West Rd./Old Fort Weaver Rd.	Signal	22.3	C	14.3	B	No	14.1	B	No
Internal Intersections									
Farrington Hwy./B St.	Signal	-	-	30.2	C	N/A	30.6	C	N/A
East-West Rd./A St.	Signal	-	-	21.0	C	N/A	24.6	C	N/A
Farrington Hwy./Parkway/2nd Ave.	Signal	-	-	33.0	C	N/A	33.2	C	N/A
Kunia Rd./2nd Ave.	OWSC	-	-	0.0	A	N/A	0.0	A	N/A
Kunia Rd./3rd Ave.	OWSC	-	-	11.9	B	N/A	12.3	B	N/A
East-West Rd./B St.	Signal	-	-	27.3	C	N/A	23.9	C	N/A
Farrington Hwy./Project Access Road to NW Parcel at North-South Road	Signal	-	-	17.8	B	N/A	18.3	B	N/A

Notes:
* - This location is stop-controlled under existing conditions, but is signalized under 2030 conditions.
** - This location is stop-controlled under 2030 conditions, but is signalized under 2030 plus project conditions.
TWSC – Two-way Stop-Control
OWSC - All-way Stop-Control
Signal – Traffic Signal
N/A - Not Applicable
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

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Table 4.6. Year 2030 PM Peak Hour Intersection Operations

Intersection	Control	Year 2030 Without Project		Year 2030 with Scenario A		Impact	Year 2030 with Scenario B		Impact
		Delay	LOS	Delay	LOS		Delay	LOS	
External Intersection									
Kunia Rd./Kunia Loop	Signal	17.1	B	36.8	D	No	40.1	D	No
Kunia Rd./H-1 WB On-Ramp*	TWSC	14.1	B	18.6	B	No	15.4	B	No
Kunia Rd./H-1 EB Ramps	Signal	8.8	A	11.3	B	No	19.4	B	No
Farrington Hwy./Fort Weaver Rd. SB Ramps	Signal	14.0	B	10.0	B	No	9.4	A	No
Farrington Hwy./Fort Weaver Rd. NB Ramps	Signal	8.0	A	**134.2**	**F**	**Yes**	**221.0**	**F**	**Yes**
Farrington Hwy./Leoku St.	Signal	47.4	D	**61.9**	**E**	**Yes**	**57.6**	**E**	**Yes**
Fort Weaver Rd./Laulaunui St.	Signal	26.3	C	44.9	D	No	**56.3**	**E**	**Yes**
Fort Weaver Rd./Old Fort Weaver Rd.	Signal	45.0	D	**289.5**	**F**	**Yes**	**322.9**	**F**	**Yes**
Fort Weaver Rd./Renton Rd.	Signal	**63.4**	**E**	**125.3**	**F**	**Yes**	**130.6**	**F**	**Yes**
Farrington Hwy./East Old Fort Weaver Rd.**	TWSC	32.0	D	20.6	C	No	40.9	D	No
Farrington Hwy./West Old Fort Weaver Rd.**	TWSC	**55.4**	**F**	25.9	C	No	30.5	C	No
Farrington Hwy./Fort Barrette Rd.	Signal	**67.5**	**E**	**74.4**	**E**	**Yes**	**67.0**	**E**	**Yes**
North-South Rd./H-1 WB Ramps	Signal	25.6	C	38.2	D	No	54.0	D	No
North-South Rd./H-1 EB Ramps	Signal	15.7	B	**87.5**	**F**	**Yes**	**105.4**	**F**	**Yes**
North-South Rd./Farrington Hwy	Signal	35.8	D	**136.3**	**F**	**Yes**	**117.1**	**F**	**Yes**
North-South Rd./North UH Connector	Signal	13.5	B	49.0	D	No	50.3	D	No
North-South Rd./East-West Road	Signal	28.6	C	43.1	D	No	45.9	D	No
North-South Rd./Kapolei Pkwy.	Signal	54.2	D	**58.5**	**E**	**Yes**	**68.3**	**E**	**Yes**
East-West Rd./Old Fort Weaver Rd.	Signal	20.6	C	**62.6**	**E**	**Yes**	13.6	B	No
Internal Intersection									
Farrington Hwy./B St.	Signal	-	-	41.7	D	N/A	38.4	D	N/A
East-West Rd./A St.	Signal	-	-	17.5	B	N/A	26.2	C	N/A
Farrington Hwy./Parkway/2nd Ave.	Signal	-	-	**71.1**	**E**	N/A	42.8	D	N/A
Kunia Rd./2nd Ave.	OWSC	-	-	0.0	A	N/A	0.0	A	N/A
Kunia Rd./3rd Ave.	OWSC	-	-	0.0	A	N/A	0.0	A	N/A
East-West Rd./B St.	Signal	-	-	46.6	D	N/A	**60.8**	**E**	N/A
Farrington Hwy./Project Access Road to NW Parcel at North-South Road	Signal	-	-	16.3	B	N/A	17.0	B	N/A

Notes:
* - This location is stop-controlled under existing conditions, but is signalized under 2030 conditions.
** - This location is stop-controlled under 2030 conditions, but is signalized under 2030 plus project conditions.
TWSC – Two-way Stop-Control
OWSC - All-way Stop-Control
Signal – Traffic Signal
N/A - Not Applicable
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

AR00027142

2030 Baseline Conditions With (the Ho'opili) Project, Scenario A: With Transit Corridor – Projected Freeway Segment Operating Conditions

During the AM peak hour, 6 of the 10 freeway segments studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions. During the PM peak hour, 3 of the 10 study freeway segments would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.7). Under Scenario A: With Transit Corridor, the Ho'opili project would result in cumulative traffic impacts at a total of five freeway segments.

Table 4.7. Year 2030 Peak Hour Freeway Segment Operations

Freeway	Segment	Year 2030 Without Project			Year 2030 with Scenario A			Year 2030 with Scenario B		
		Volume	Density	LOS	Volume	Density	LOS	Volume	Density	LOS
AM Peak										
H-1 EB	S/O Makakilo Dr.	5434	**37.8**	**E**	5892	**43.9**	**E**	5928	**44.5**	**E**
H-1 EB	W/O Kunia Rd.	8197	**>45**	**F**	9143	**>45**	**F**	9217	**>45**	**F**
H-1 EB	W/O Paiawa St.	9906	**43.4**	**E**	11906	**>45**	**F**	12062	**>45**	**F**
H-1 EB	E/O Kamehameha Hwy.	7512	**38.8**	**E**	8435	**>45**	**F**	8507	**>45**	**F**
H-2 NB	At Ka Uka Blvd.	3184	21.3	C	3597	24.1	C	3629	24.3	C
H-1 WB	S/O Makakilo Dr.	3259	21.8	C	3756	25.1	C	3794	25.4	C
H-1 WB	W/O Kunia Rd.	3735	18.3	C	4491	21.9	C	4549	22.2	C
H-1 WB	W/O Paiawa St.	4366	16.6	B	5858	22.3	C	5974	22.8	C
H-1 WB	E/O Kamehameha Hwy.	3069	20.5	C	3757	25.1	C	3811	25.5	C
H-2 SB	At Ka Uka Blvd.	6273	30.7	D	6581	32.5	D	6605	32.6	D
PM Peak										
H-1 EB	S/O Makakilo Dr.	4680	31.3	D	5334	**36.7**	**E**	5392	**38.7**	**E**
H-1 EB	W/O Kunia Rd.	5833	28.5	D	6891	34.5	D	6985	**35.1**	**E**
H-1 EB	W/O Paiawa St.	7137	27.2	D	9139	**37.0**	**E**	9309	**38.2**	**E**
H-1 EB	E/O Kamehameha Hwy.	4249	28.4	D	5173	**35.2**	**E**	5251	**35.9**	**E**
H-2 NB	At Ka Uka Blvd.	6220	**>45**	**F**	6663	**>45**	**F**	6668	**>45**	**F**
H-1 WB	S/O Makakilo Dr.	6365	**>45**	**F**	7022	**>45**	**F**	7080	**>45**	**F**
H-1 WB	W/O Kunia Rd.	7860	**43.3**	**E**	8875	**>45**	**F**	8964	**>45**	**F**
H-1 WB	W/O Paiawa St.	7931	25.2	C	10131	32.9	D	10317	33.7	D
H-1 WB	E/O Kamehameha Hwy.	7766	**42.2**	**E**	8781	**>45**	**F**	8867	**>45**	**F**
H-2 SB	At Ka Uka Blvd.	4616	22.5	C	5070	24.8	C	5108	25	C

Notes:
Density is given in pc/mi/ln.
Bold type indicates LOS E or F

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

2030 Baseline Conditions With (the Ho'opili) Project, Scenario A: With Transit Corridor – Projected Ramp-Freeway Junction Operating Conditions

During the AM peak hour, 7 of the 10 ramp-freeway junctions studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions. During the PM peak hour, 7 of the 10 ramp-freeway junctions studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.8). In considering both AM and PM peak hours, the Ho'opili project would significantly affect traffic conditions at a total of five ramp junctions.

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Table 4.8. Year 2030 Ramp-Freeway Junction Operations

Location	Ramp	Year 2030 Without Project		Year 2030 with Scenario A		Year 2030 with Scenario B	
		Delay*	LOS	Delay	LOS	Delay	LOS
AM Peak							
H-1/Fort Weaver Road	WB Off-Ramp	16.0	B	16.0	B	16.0	B
H-1/Fort Weaver Road	WB Loop Off-Ramp	1.3	A	8.2	A	9.6	A
H-1/Fort Weaver Road	WB On-Ramp	15.0	B	15.7	B	15.7	B
H-1/Fort Weaver Road	EB Off-Ramp	37.4	**E**	38.9	**F**	39.0	**F**
H-1/Fort Weaver Road	EB On-Ramp	24.8	**F**	36.1	**F**	37.7	**F**
H-1/Fort Weaver Road	EB Loop On-Ramp	26.3	**F**	26.3	**F**	26.3	**F**
H-1/North-South Road	WB Off-Ramp	20.3	C	26.3	C	26.9	C
H-1/North-South Road	WB On-Ramp	13.5	B	16.9	B	17.2	B
H-1/North-South Road	EB Off-Ramp	25.0	C	29.1	D	29.6	D
H-1/North-South Road	EB On-Ramp	28.8	D	38.3	**F**	37.4	**F**
PM Peak							
H-1/Fort Weaver Road	WB Off-Ramp	38.0	**F**	38.0	**F**	38.0	**F**
H-1/Fort Weaver Road	WB Loop Off-Ramp	19.9	**F**	30.7	**F**	33.0	**F**
H-1/Fort Weaver Road	WB On-Ramp	26.0	C	26.3	C	26.3	**F**
H-1/Fort Weaver Road	EB Off-Ramp	28.8	D	31.1	D	31.3	D
H-1/Fort Weaver Road	EB On-Ramp	18.3	B	29.3	**F**	31.3	**F**
H-1/Fort Weaver Road	EB Loop On-Ramp	20.4	C	20.4	C	20.4	C
H-1/North-South Road	WB Off-Ramp	41.1	**F**	49.3	**F**	50.2	**F**
H-1/North-South Road	WB On-Ramp	27.7	C	27.1	**F**	27.2	**F**
H-1/North-South Road	EB Off-Ramp	21.0	C	27.3	C	27.9	C
H-1/North-South Road	EB On-Ramp	17.0	B	25.8	C	26.7	C

Notes:
* - Lower density does not necessarily indicate a lower LOS. This is because the LOS is calculated based upon a number of factors including: merge influence area, length of the acceleration lane, etc. See Appendix F for the HCM methodology used to calculate the LOS for Freeway Segments.
Density is presented in pc/mi/ln
DEC - Demand Exceeds Capacity
Bold type indicates LOS F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

2030 Baseline Conditions With (the Ho'opili) Project, Scenario B: Without Transit Corridor – Projected Intersection Operating Conditions

During the AM peak hour, 20 of the 26 intersections studied, would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.5). During the PM peak hour, 17 of the 26 intersections studied, would operate under what the traffic engineering consultant identifies as acceptable traffic conditions See Table 4.6). Under Scenario B: Without Transit Corridor, in considering both AM and PM peak hours, the Ho'opili project would result in cumulative traffic impacts at a total of 10 intersections operating under unacceptable conditions.

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2030 Baseline Conditions With (the Ho'opili) Project, Scenario B: Without Transit Corridor – Projected Freeway Segment Operating Conditions

During the AM peak hour, 6 of the 10 freeway segments studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions. During the PM peak hour, 2 of the 10 study freeway segments would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.7). Under Scenario B: Without Transit Corridor, the Ho'opili project would result in cumulative traffic impacts at a total of six freeway segments.

2030 Baseline Conditions With (the Ho'opili) Project, Scenario B: Without Transit Corridor – Projected Ramp-Freeway Junction Operating Conditions.

During the AM peak hour, 8 of the 10 ramp-freeway junctions studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions. During the PM peak hour, 6 of the 10 ramp-freeway junctions studied would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.8). In considering both AM and PM peak hours, the Ho'opili project would significantly affect traffic conditions at a total of five ramp junctions.

Mitigation Measures

To mitigate against traffic impacts, roadway improvements have been identified including: 1) additional traffic lanes at intersections and/or changed usage of existing lanes; 2) by programming an alternate signal timing plans that would be in operation during specified peak commute periods; and 3) by restricting pedestrian crossing on one or more of the intersection approaches in order to allow unconstrained right-turn movement. These proposed mitigation measures were then studied and resulted in the following findings.

Under **Scenario A: With Transit Corridor with Mitigation Measures**, 25 of the 26 intersections studied during the AM peak hour, would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.9). During the PM peak hour, 22 of the 26 intersections studied, would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.10).

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Table 4.9. Scenario A: AM Peak Hour Intersection Operations with Mitigations

Intersection	Control	Year 2030 plus Project Conditions		Year 2030 with Mitigation Measures		Impact
		Delay	LOS	Delay	LOS	
External Intersections						
Kunia Rd./Kunia Loop	Signal	15.7	B	15.8	B	No
Kunia Rd./H-1 WB On-Ramp	TWSC	4.5	A	4.5	A	No
Kunia Rd./H-1 EB Ramps	Signal	8.4	A	7.7	A	No
Farrington Hwy./Fort Weaver Rd. SB Ramps	Signal	9.9	A	5.7	A	No
Farrington Hwy./Fort Weaver Rd. NB Ramps	Signal	25.4	C	13	B	No
Farrington Hwy./Leoku St.	Signal	19.2	B	19.3	B	No
Fort Weaver Rd./Laulaunui St.	Signal	42.6	D	44.2	D	No
Fort Weaver Rd./Old Fort Weaver Rd.	Signal	**176.6**	**F**	37.5	D	No
Fort Weaver Rd./Renton Rd.	Signal	**111.8**	**F**	**59.2**	**E**	**Yes**
Farrington Hwy./East Old Fort Weaver Rd.	TWSC	31.4	C	37.1	D	No
Farrington Hwy./West Old Fort Weaver Rd.	TWSC	17.2	B	18.1	B	No
Farrington Hwy./Fort Barrette Rd.	Signal	**75.9**	**E**	48.9	D	No
North-South Rd./H-1 WB Ramps	Signal	42.2	D	42.2	D	No
North-South Rd./H-1 EB Ramps	Signal	30.0	C	14.7	B	No
North-South Rd./Farrington Hwy	Signal	**76.7**	**E**	46.8	D	No
North-South Rd./North UH Connector	Signal	38.6	D	38.7	D	No
North-South Rd./East-West Road	Signal	37.0	D	35.1	D	No
North-South Rd./Kapolei Pkwy.	Signal	43.1	D	36.1	D	No
East-West Rd./Old Fort Weaver Rd.	Signal	14.3	B	20.5	C	No
Internal Intersections						
Farrington Hwy./B St.	Signal	30.2	C	30.3	C	No
East-West Rd./A St.	Signal	21.0	C	20.4	C	No
Farrington Hwy./Parkway/2nd Ave.	Signal	33.0	C	40.3	D	No
Kunia Rd./2nd Ave.	OWSC	0.0	A	0.0	A	No
Kunia Rd./3rd Ave.	OWSC	11.9	B	11.9	B	No
East-West Rd./B St.	Signal	27.3	C	32.3	C	No
Farrington Hwy./Project Access Road to NW Parcel at North-South Road	Signal	17.8	B	15.2	B	No

Notes:
* - This location is stop-controlled under existing conditions, but is signalized under 2030 conditions.
** - This location is stop-controlled under 2030 conditions, but is signalized under 2030 plus project conditions.
TWSC – Two-way Stop-Control
OWSC - All-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

AR00027146

Table 4.10. Scenario A: PM Peak Hour Intersection Operations with Mitigations

Intersection	Control	Year 2030 plus Project Conditions		Year 2030 with Mitigation Measures		Impact
		Delay	LOS	Delay	LOS	
External Intersections						
Kunia Rd./Kunia Loop	Signal	36.8	D	37.5	D	No
Kunia Rd./H-1 WB On-Ramp	TWSC	18.6	B	22.9	C	No
Kunia Rd./H-1 EB Ramps	Signal	11.3	B	8.2	A	No
Farrington Hwy./Fort Weaver Rd. SB Ramps	Signal	10.0	B	10.0	A	No
Farrington Hwy./Fort Weaver Rd. NB Ramps	Signal	**134.2**	**F**	34.7	C	No
Farrington Hwy./Leoku St.	Signal	**61.9**	**E**	**69.4**	**E**	**Yes**
Fort Weaver Rd./Laulaunui St.	Signal	44.9	D	46.1	D	No
Fort Weaver Rd./Old Fort Weaver Rd.	Signal	**289.5**	**F**	**62.8**	**E**	**Yes**
Fort Weaver Rd./Renton Rd.	Signal	**125.3**	**F**	**60.4**	**E**	**Yes**
Farrington Hwy./East Old Fort Weaver Rd.	TWSC	20.6	C	22.2	C	No
Farrington Hwy./West Old Fort Weaver Rd.	TWSC	25.9	C	20.5	C	No
Farrington Hwy./Fort Barrette Rd.	Signal	**74.4**	**E**	53.0	D	No
North-South Rd./H-1 WB Ramps	Signal	38.2	D	36.1	D	No
North-South Rd./H-1 EB Ramps	Signal	**87.5**	**F**	42.7	D	No
North-South Rd./Farrington Hwy	Signal	**136.3**	**F**	53.9	D	No
North-South Rd./North UH Connector	Signal	49.0	D	44.3	D	No
North-South Rd./East-West Road	Signal	43.1	D	40.5	D	No
North-South Rd./Kapolei Pkwy.	Signal	**58.5**	**E**	51.8	D	No
East-West Rd./Old Fort Weaver Rd.	Signal	**62.6**	**E**	16.3	B	No
Internal Intersections						
Farrington Hwy./B St.	Signal	41.7	D	40.4	D	No
East-West Rd./A St.	Signal	17.5	B	16.9	B	No
Farrington Hwy./Parkway/2nd Ave.	Signal	**71.1**	**E**	48.3	D	No
Kunia Rd./2nd Ave.	OWSC	13.9	B	0.0	B	No
Kunia Rd./3rd Ave.	OWSC	13.8	B	0.0	A	No
East-West Rd./B St.	Signal	46.6	D	59.4	**E**	**Yes**
Farrington Hwy./Project Access Road to NW Parcel at North-South Road	Signal	16.3	B	16.3	B	No

Notes:
* - This location is stop-controlled under existing conditions, but is signalized under 2030 conditions.
** - This location is stop-controlled under 2030 conditions, but is signalized under 2030 plus project conditions.
TWSC – Two-way Stop-Control
OWSC - All-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

Under **Scenario B: Without the Transit Corridor with Mitigation Measures**, 24 of the 26 intersections studied during the AM peak hour, would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.11). During the PM peak hour, 22 of the 26 intersections studied, would operate under what the traffic engineering consultant identifies as acceptable traffic conditions (See Table 4.12).

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Table 4.11. Scenario B: AM Peak Hour Intersection Operations with Mitigations

Intersection	Control	Year 2030 plus Project Conditions		Year 2030 with Mitigation Measures		Impact
		Delay	LOS	Delay	LOS	
External Intersections						
Kunia Rd./Kunia Loop	Signal	17.9	B	17.9	B	No
Kunia Rd./H-1 WB On-Ramp	TWSC	4.5	A	4.5	A	No
Kunia Rd./H-1 EB Ramps	Signal	8.4	A	8.4	A	No
Farrington Hwy./Fort Weaver Rd. SB Ramps	Signal	10.3	B	11.7	B	No
Farrington Hwy./Fort Weaver Rd. NB Ramps	Signal	38.4	D	16.0	B	No
Farrington Hwy./Leoku St.	Signal	23.6	C	19.3	B	No
Fort Weaver Rd./Laulaunui St.	Signal	53.9	D	52.0	D	No
Fort Weaver Rd./Old Fort Weaver Rd.	Signal	**268.8**	**F**	**97.2**	**F**	**Yes**
Fort Weaver Rd./Renton Rd.	Signal	**114.8**	**F**	**60.5**	**E**	No
Farrington Hwy./East Old Fort Weaver Rd.	TWSC	40.1	D	42.4	D	No
Farrington Hwy./West Old Fort Weaver Rd.	TWSC	24.8	C	20.5	C	No
Farrington Hwy./Fort Barrette Rd.	Signal	**71.6**	**E**	52.0	D	No
North-South Rd./H-1 WB Ramps	Signal	**99.4**	**F**	50.1	D	No
North-South Rd./H-1 EB Ramps	Signal	37.3	D	14.6	B	No
North-South Rd./Farrington Hwy	Signal	**105.4**	**F**	46.5	D	No
North-South Rd./North UH Connector	Signal	33.4	C	33.4	C	No
North-South Rd./East-West Road	Signal	40.8	D	41.1	D	No
North-South Rd./Kapolei Pkwy.	Signal	**62.7**	**E**	42.5	D	No
East-West Rd./Old Fort Weaver Rd.	Signal	14.1	B	19.7	B	No
Internal Intersections						
Farrington Hwy./B St.	Signal	30.6	C	31.0	C	No
East-West Rd./A St.	Signal	24.6	C	24.4	C	No
Farrington Hwy./Parkway/2nd Ave.	Signal	33.2	C	46.0	D	No
Kunia Rd./2nd Ave.	OWSC	0.0	A	0.0	A	No
Kunia Rd./3rd Ave.	OWSC	12.3	B	12.3	B	No
East-West Rd./B St.	Signal	23.9	C	28.6	C	No
Farrington Hwy./Project Access Road to NW Parcel at North-South Road	Signal	18.3	B	15.3	B	No

Notes:
* - This location is stop-controlled under existing conditions, but is signalized under 2030 conditions.
** - This location is stop-controlled under 2030 conditions, but is signalized under 2030 plus project conditions.
TWSC – Two-way Stop-Control
OWSC - All-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

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Table 4.12. Scenario B: PM Peak Hour Intersection Operations with Mitigations

Intersection	Control	Year 2030 plus Project Conditions		Year 2030 with Mitigation Measures		Impact
		Delay	LOS	Delay	LOS	
External Intersections						
Kunia Rd./Kunia Loop	Signal	40.1	D	40.8	D	No
Kunia Rd./H-1 WB On-Ramp	TWSC	15.4	B	14.2	B	No
Kunia Rd./H-1 EB Ramps	Signal	19.4	B	16.4	B	No
Farrington Hwy./Fort Weaver Rd. SB Ramps	Signal	9.4	A	8.8	A	No
Farrington Hwy./Fort Weaver Rd. NB Ramps	Signal	**221.0**	**F**	48.1	D	No
Farrington Hwy./Leoku St.	Signal	**57.6**	**E**	**66.5**	**E**	**Yes**
Fort Weaver Rd./Laulaunui St.	Signal	**56.3**	**E**	54.1	D	No
Fort Weaver Rd./Old Fort Weaver Rd.	Signal	**322.9**	**F**	**86.2**	**F**	**Yes**
Fort Weaver Rd./Renton Rd.	Signal	**130.6**	**F**	**57.1**	**E**	**Yes**
Farrington Hwy./East Old Fort Weaver Rd.	TWSC	40.9	D	37.3	D	No
Farrington Hwy./West Old Fort Weaver Rd.	TWSC	30.5	C	25.2	C	No
Farrington Hwy./Fort Barrette Rd.	Signal	**67.0**	**E**	52.9	D	No
North-South Rd./H-1 WB Ramps	Signal	54.0	D	54.1	D	No
North-South Rd./H-1 EB Ramps	Signal	**105.4**	**F**	22.0	C	No
North-South Rd./Farrington Hwy	Signal	**117.1**	**F**	**69.1**	**E**	**Yes**
North-South Rd./North UH Connector	Signal	50.3	D	51.4	D	No
North-South Rd./East-West Road	Signal	45.9	D	44.7	D	No
North-South Rd./Kapolei Pkwy.	Signal	**68.3**	**E**	48.8	D	No
East-West Rd./Old Fort Weaver Rd.	Signal	13.6	B	32.8	C	No
Internal Intersections						
Farrington Hwy./B St.	Signal	38.4	D	45.4	D	No
East-West Rd./A St.	Signal	26.2	C	32.1	C	No
Farrington Hwy./Parkway/2nd Ave.	Signal	42.8	D	47.1	D	No
Kunia Rd./2nd Ave.	OWSC	0.0	A	0.0	A	No
Kunia Rd./3rd Ave.	OWSC	0.0	A	0.0	A	No
East-West Rd./B St.	Signal	**60.8**	**E**	50.5	D	No
Farrington Hwy./Project Access Road to NW Parcel at North-South Road	Signal	17.0	B	17.0	B	No

Notes:
* - This location is stop-controlled under existing conditions, but is signalized under 2030 conditions.
** - This location is stop-controlled under 2030 conditions, but is signalized under 2030 plus project conditions.
TWSC – Two-way Stop-Control
OWSC - All-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

The traffic impacts at these locations are identified under 2030 conditions, and represent increases in cumulative traffic from other developments within and outside the study area. Therefore, the contribution of traffic from the Ho'opili project to cumulative traffic increases should be recognized, and the assignment of traffic impacts should be proportionally allocated. The following locations are proposed for improvement under Scenario A: With Transit Corridor Conditions and Scenario B: Without Transit Corridor Conditions:

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- Farrington Highway/Fort Weaver Road~~ch~~ Northbound Ramps;
- Farrington Highway/Leokū Street;
- Fort Weaver Road/Old Fort Weaver Road;
- Fort Weaver Road/Renton Road;
- Farrington Highway/Fort Barrette Road;
- North-South Road/H-1 Eastbound Ramps;
- North-South Road/Farrington Highway; and
- North-South Road/Kapolei Parkway.

Assuming that mitigation measures are implemented, the result of the analysis indicates that the Ho'opili project would result in what the traffic engineering consultant identifies as significant impacts to only one intersection under Scenario A: With Transit Corridor Scenario; this would occur at Farrington Highway/Leokū Street. Under Scenario B: Without Transit Corridor Scenario, a total of three intersections are anticipated to result in what the traffic engineering consultant identifies as significant impacts as a result of the Ho'opili project: Farrington Highway/Leokū Street, Fort Weaver Road/Old Fort Weaver Road and Fort Weaver Road/Renton Road.

One or more of the above mitigation measures may require land from State and County road rights-of-way. This EIS is intended to address the impacts of the proposed project, and in particular, what benefits or costs may result from the proposed action on State and County lands (involving mostly road right-of-ways).

As planned, the directed growth towards/urbanization in 'Ewa will add to traffic on Fort Weaver Road and Farrington Highway through the Project Area.[3] On the other hand, construction of the North-South Road and the H-1 Freeway access associated with the new roadways will help to limit congestion throughout the regional road system. New roads within the project, DHHL East Kapolei Development Parcel 2 and UHWO will provide additional connectivity between Fort Weaver Road and the North-South Road and between the UHWO and DHHL lands to the west and south of Ho'opili and Ho'opili itself.

Before Ho'opili is built, the new H-1 interchange will serve the North-South Road and Farrington Highway. This will be important for trucks to and from the Grace Pacific quarry and plant: they will travel to the new interchange, rather than along Farrington Highway past the Ho'opili site. Accordingly, urbanization along Farrington Highway east of the new interchange will have little or no impact on this truck traffic.

Eventually, rail transit could be built along North-South Road and Farrington Highway, and possibly through Ho'opili. Plans for Ho'opili have been drawn up with transit in mind, even though the exact route and placement of stations is still undecided. With

[3] For detailed quantitative analysis of the project's impact on transportation and traffic congestion, see the Traffic Impact Analysis Report (Wilbur Smith Associates 2007).

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transit, the project can further minimize dependence on automobiles by its residents. A comparison of the existing conditions with 2030 Conditions with and without the Ho'opili project can be seen in Table 4.13.

Table 4.13. Comparison of Existing Traffic and Year 2030 Traffic With and Without the Project

MORNING PEAK				INCLUDES RAIL:	INCLUDES RAIL:
#	Freeway	Segment	Existing LOS	2030 without Ho'opili	2030 with Ho'opili
1	H-1 EB	S/O Makakilo Dr.	A	E	E
2	H-1 EB	W/O Kunia Rd.	C	F	F
3	H-1 EB	W/O Pa'iwa St.	E	E	F
4	H-1 EB	E/O Kamehameha	D	E	F
5	H-2 SB	At Ka ' Uka Blvd.	D	D	D
6	H-l WB	S/O Makakilo Dr.	A	C	C
7	H-1 WB	W/O Kunia Rd.	C	C	C
8	H-1 WB	W/O Pa'iwa St.	C	B	C
9	H-l WB	E/O Kamehameha	C	C	C
10	H-2 NB	At Ka 'Uka Blvd.	B	C	C
AFTERNOON PEAK				INCLUDES RAIL:	INCLUDES RAIL:
#	Freeway	Segment	Existing LOS	2030 without Ho'opili	2030 with Ho'opili
1	H-1 EB	S/O Makakilo Dr.	B	D	E
2	H-l EB	W/O Kunia Rd.	D	D	D
3	H-1 EB	W/O Pa'iwa St.	C	D	B
4	H-l EB	E/O Kamehameha Hwy.	B	D	B
5	H-2 SB	At Ka 'Uka Blvd.	B	C	C
6	H-1 WB	S/O Makakilo Dr.	B	F	F
7	H-1 WB	W/O Kunia Rd.	C	E	F

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8	H-1 WB	W/O Pa'iwa St.	E	C	D
9	H-1 WB	E/O Kamehameha Hwy.	E	E	F
10	H-2 NB	At Ka' Uka Blvd.	C	F	F

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

Ho'opili will contribute to the 'Ewa Transportation Impact Fee program, supporting development of local roadways and easing impacts on the existing arterials.

Not factored in the above traffic impact assessment is the potential positive effect of Transportation Demand Management (TDM) strategies.

TDM strategies address traffic congestion by reducing the number of vehicle trips and the amount of vehicle miles traveled, thereby reducing overall travel demand. The aim of these strategies is focused on promoting travel alternatives such as increased transit usage, walking and bicycling to help achieve this goal. The Leeward Oahu Transportation Management Association (LOTMA) currently provides TDM services in the vicinity of the Ho'opili project. It is anticipated that the Ho'opili project will continue to support the existing programs and services in place, as well as consider additional TDM strategies as a means of managing and improving travel demand.

4.8.2 Water Supply Facilities

Existing Conditions

The Petition Area is within the BWS service area. The BWS has a 440-foot elevation system and a 228-foot elevation system. The service limit between the 440 system and the 228 system splits Parcel C of the Petition Area. A 5.0-million gallon (MG) storage tank provides storage for the 228-foot elevation system and this tank is located within Parcel F, adjacent to the H-1 Freeway. A 1.0-MG storage tank provides storage for the 440-foot elevation system and this tank is located within Parcel E, mauka of the H-1 Freeway. A 42-inch transmission line delivers water from the 440 system in Parcel E to the area adjacent to the 228 system in Parcel F. Water from both the 440 system and the 228 system pass makai of the H-1 Freeway via separate transmission lines running through the Honouliuli Gulch crossing under the H-1 Freeway. These transmission lines connect both the BWS 440 and 228 systems to developed lands below the H-1 Freeway. There are also major transmission lines in Farrington Highway corridor. The transmission lines in Farrington Highway include 30- and 36-inch lines.

There is no non-potable water system in the area. However, irrigation water for agricultural lands in the area comes from a battery of wells commonly referred to as EP 5 & 6 located within Parcel C. The average irrigation use is approximately 2.0 to 3.0 million gallons per day (MGD), depending on the time of the year.

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Anticipated Impacts and Mitigation Measures

The total average daily source requirement for ultimate build-out is estimated at 3.9 MGD. The future water demand from the proposed project is based on standard civil engineering methodology; it is possible that with the implementation of feasible water conservation appliances, future water demand from the project may be lessened. During the public review period, the BWS wrote: "The developer should also consider rain barrel catchments, water-efficient front- load washer appliances and ultra low-flow toilets." It is intended that source (well supply) would be provided by BWS from existing sources. Although BWS cannot reserve water for future projects, it has indicated that there is water available to meet the estimated water demand for the project (3.9 MGD). Water Facility Charges paid by the Petitioner will be used by the Board to assist in the source replenishment caused by the project's water demands.

New water system demands will require that the Petitioner provide system upgrades to the transmission and storage components to ensure that the system operates effectively and meets BWS standards.

It is proposed to provide water system improvements to meet the Project's water demands and dedicate the improvements to the BWS. The project will require the installation of a 5.5 MG storage tank at the BWS 440 site in Parcel E. A new 24-inch transmission line will be installed parallel to the 42-inch running between the 440 tank site and 228 tank site to allow water to be pumped up to the 440 site. The pump station will be located at the existing 228 reservoir site in Parcel F.

Water for the 228 system will come from the existing 5.0 MG tank at the Honouliuli 228 site just mauka of the H-1 Freeway (Parcel F). The storage requirement for the project (1.5 MG) does not merit construction of a new tank at the 228 site. The project will contribute Facility Charges that will be used for the construction of a new 5.0 MG tank at the Honouliuli 228 site at the appropriate time.

The existing Honouliuli Gulch crossing under H-1 Freeway may not have sufficient capacity for additional transmission lines to carry water to the project boundaries. The Petitioner has requested that the State Department of Transportation (DOT) dispose of real property rights within the State Right-of-Way (ROW) to allow an easement for water use (right to micro-tunnel and installation of a drinking waterline) under and across the H-1 Freeway (See Figure 4.4~~1~~: Preliminary Easement Map). Once construction of the waterline is complete, the waterline easement will be dedicated to the BWS. While the specific nature of improvements is not known at this time, the EIS is intended to address all current and future instances involving the use of State and/or County lands and funds relating to the Ho'opili project.

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With respect to non-potable water requirements, the project will be maximizing non-drinking usage to minimize the demand on the safe drinking water system. If a suitable supply is made available, ~~S~~street right of ways of the Ho'opili project will have underground non-drinking distribution systems. It is proposed to upgrade the existing non-drinking source (EP 5 & 6 located within Parcel C) to a BWS dedicable standard to be used as the source for the non-drinking system. It is also proposed to ultimately allow for future dedication of the non-drinking system. It is estimated that the ultimate non-drinking demand for the project will be approximately 2.1 MGD. The Petitioner will consider the use of drought tolerant/low water use plants and the implementation of xeriscaping principles for landscaping within the Ho'opili project to the extent practicable. The installation of an efficient irrigation system, possibly using drip irrigation, will be considered in the design of the project where feasible. Moisture sensors to avoid the operation of the system in the rain and if the ground has adequate moisture would be incorporated into the irrigation system, where feasible.

Another source of non-potable water is reclaimed water. The Honolulu Board of Water Supply (BWS) entered into the water recycling business in 2000 by purchasing the Honouliuli Water Reclamation Facility. Water recycling of treated wastewater effluent is one element of a broader BWS strategy to protect O'ahu's aquifers and to conserve water resources through conservation and development of new water supplies. Treated effluent from the facility is now irrigating golf courses that were once using brackish water, including West Loch, 'Ewa Villages, Hawai'i Prince, and Coral Creek. The facility is also providing recycled water (at a different level of treatment) to industries at Campbell Industrial Park.

The project will be maximizing the use of non-potable water for irrigation to minimize the impact on the source component of the BWS system. It is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies. A Conceptual Water Master Plan addressing safe drinking and non-potable water facilities has been prepared and reproduced in its entirety and attached to this EIS as Appendix M ~~will be submitted to~~ for BWS ~~for its~~ review and approval. In addition, construction drawings will be submitted to BWS for its review and approval. During the public review period of the Draft EIS, the DLNR Commission on Water Resource Management requested that "the reuse of storm water and installation of water efficient fixtures be considered" and recommended "the use of xeriscaping and the planting of drought tolerant and salt-tolerant plans to conserve water supplies."

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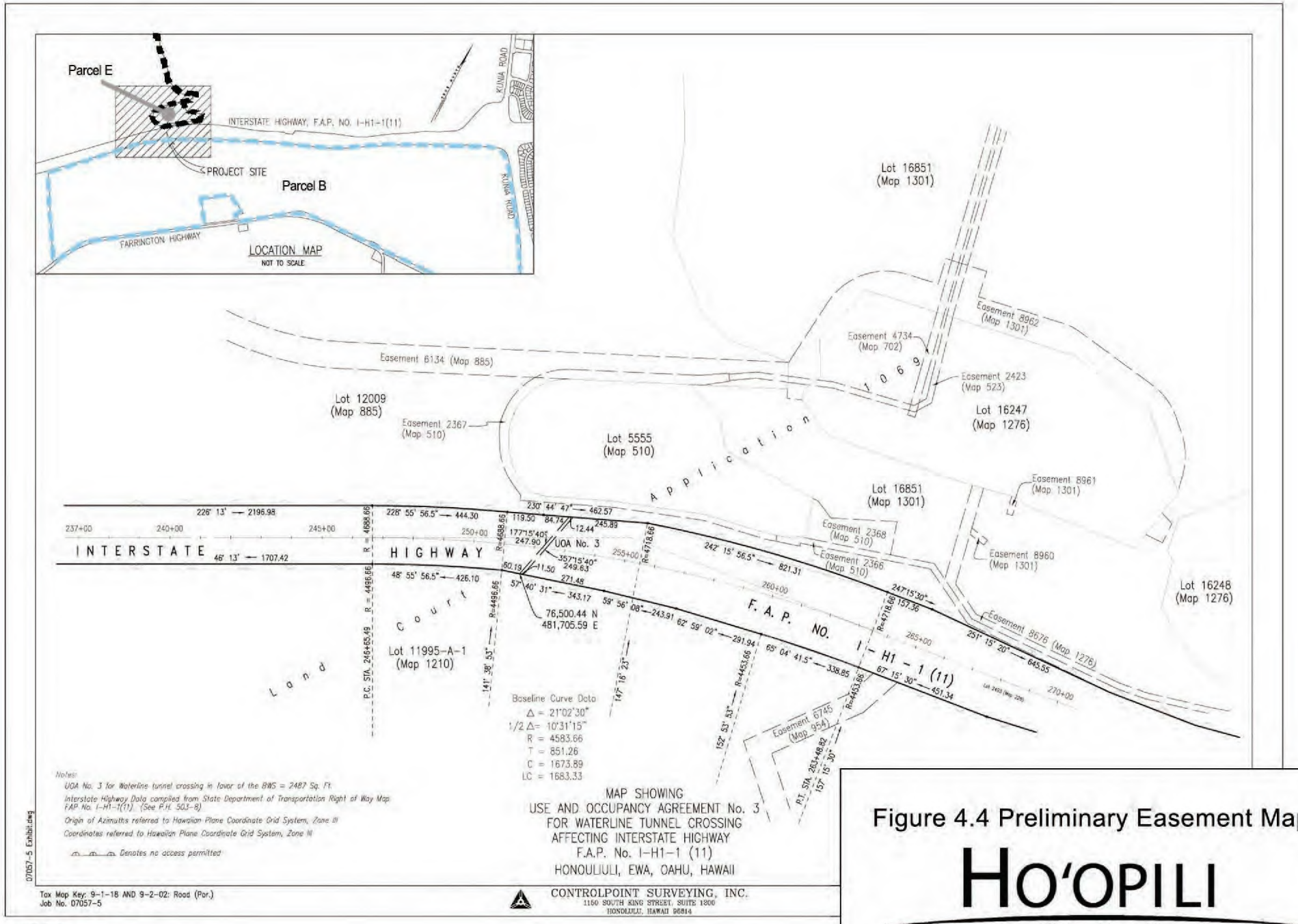

LEGEND

- Parcel E
- Parcel B

Source: CONTROLPOINT SURVEYING, INC (2008).
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 4.4 Preliminary Easement Map

HO'OPILI

O'ahu, Hawai'i

NORTH

Not To Scale

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4.8.3 Wastewater Facilities

Existing Conditions

Within the 'Ewa area, sewage is treated by the City and County of Honolulu's Honouliuli Wastewater Treatment Facility (WWTF). The treatment facility is located at the corner of North Hanson Road and Geiger Road, approximately 7,200 feet (1.4 miles) south of Parcel C. The Petition Area is upwind of the Honouliuli WWTF during predominant tradewind conditions. Based on average daily flows, the facility has a primary treatment capacity of 38 million gallons per day (MGD), with future plans to expand to 51 MGD. The primary means of disposal is through a deep ocean outfall with a design capacity of 112 MGD. The facility was recently upgraded (with the Honouliuli Water Reclamation Facility) to produce 10 MGD of R-1 quality effluent, which is suitable for irrigation reuse.

The nearest existing sewer collection system to the Petition Area is the Makakilo Interceptor/Kapolei Interceptor system located along the OR&L railroad tracks. The Department of Hawaiian Homelands (DHHL) is currently extending a collection system component from the Makakilo/Kapolei collection in a northerly direction up the North-South Road alignment to serve its land holdings in the area. The main component of the system currently being built (42-inch sewer) has been oversized to accommodate the Ho'opili project as well as the University of Hawai'i West O'ahu (UHWO) campus. The Petitioner has already contributed $2 million towards the construction and installation of the 42-inch sewer line.

The existing treatment plant capacity of the Honouliuli WWTP is 35 MGD. Current flows are approximately 27 MGD.

Anticipated Impacts and Mitigation Measures

The Ho'opili project will ultimately serve a projected 11,750 homes and commercial and retail space. This translates into an average daily sewage flow rate of 4.35 MGD.

A gravity collection system will be designed to City and County standards and ultimately dedicated to the City and County of Honolulu to serve the project. The point of connection to off-site collection systems will be at the southern boundary of Parcel C and at the common property line with DHHL. DHHL is installing a 36-inch collection system within its East Kapolei project and the collection system has been oversized to receive wastewater from the Ho'opili project (as well as from UHWO).

The Ho'opili project will consist of three sewer zones. Zone 1, located on western side of the project, will gravity flow to the Main Trunk Sewer to Honouliuli WWTP with a design average daily flow of 3.441 MGD and a design peak flow of 9.2 MGD. Zone 2, located adjacent to the east side of Zone 1 and Old Fort Weaver Road, will gravity flow to the proposed Ho'opili sewage pump station, where it will then be lifted to Zone 1. Zone 2

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has a design average daily flow of 0.448 MGD and design peak flow of 2.0 MGD. Zone 3 is located on the northeastern corner of the project, and will gravity flow to the Kunia sewage pump station, eventually connecting to the Waipahu sewage pump station. Zone 3 has a design average daily flow of 0.421 MGD and design peak flow of 1.6 MGD.

Two pump stations will be required for the project. One will generally be located at the southeastern end of Parcel C. All sewage from the eastern one-third of Parcel C will flow by gravity sewer to the subject pump station. The pump station will in turn lift the sewage to the gravity flow system on the western potion of Parcel C that ultimately connects to the 36-inch sewer line at the DHHL/Ho'opili boundary.

A second pump station will be required to serve the eastern half of Parcel B. Honouliuli Gulch bisects Parcel B and sewage from the eastern half of Parcel B will be collected by gravity sewer and directed to this pump station. The pump station will lift sewage into the gravity system within Parcel C.

An alternative for the Parcel B pump station is to connect to the existing City and County of Honolulu gravity systems within Farrington Highway corridor and ultimately connect to the Kunia and Waipahu pump stations. If this alternative is utilized there are expected upgrades to the existing gravity systems within Farrington Highway and surrounding streets as well as upgrades to both the Kunia and Waipahu Pump Stations.

Ultimate development of the Ho'opili project will exceed the capacity of the Makakilo/Kapolei Interceptors running along the OR&L railroad tracks. The Ho'opili project will participate in a future project to increase the capacity of the Makakilo/Kapolei Interceptor sewers from the intersection of North-South Road to the Honouliuli Wastewater Treatment Plant (WWTP). Options being explored are a third interceptor or complete replacement of one of the existing interceptors.

Over time the project will result in an increase in wastewater being generated than currently being generated on-site (by agricultural activities). To mitigate this effect, new collection system components consisting of gravity sewer, pump stations and relief sewers will be constructed.

The project will generate additional flow that must be treated at the Honouliuli WWTP. To mitigate the additional burden, the project will participate in the Wastewater System Facility Charge (WSFC) program and contribute funds (based on building permits) to expand the treatment plant. Land is available at the Honouliuli WWTP site to allow for expansion. The ultimate expansion of the Honouliuli WWTP is master planned to treat 51 MGD.

Preliminary contact with the City and County of Honolulu Department of Environmental Services has indicated that the sewer system has the capacity to accommodate the Project

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with a build-out beginning in four to six years and ending 15 to 20 years after. The Petition Area has always been within the service limits of the Honouliuli WWTP.

Wastewater collected from the site is eventually treated at the Honouliuli Water Reclamation Facility (WRF). The entire water recycling facility is located adjacent to the City & County of Honolulu's Honouliuli WWTP. Water recycling components include a Reuse Pump Station, a Sand Filter Structure which includes rapid mixing tanks and chemical flocculators, Ultraviolet Light (UV) Disinfection, a Microfiltration/Reverse Osmosis Building, Storage Tanks, and a Product Delivery Pump Station.

The facility currently has a capacity of 12 million gallons per day (MGD) and produces two grades of recycled water. R-1 water is used for irrigational uses, and Reverse Osmosis (RO) for industrial uses. The facility is currently capable of producing up to 10 MGD of R-1 water, which is the highest level of treatment as designated by the State Department of Health. R-1 water is currently used throughout the State of Hawai'i for golf course irrigation, landscaping, and agriculture. On the other hand, RO water is intended strictly for industrial uses such as boiler feed water, cooling tower make-up water, and process water for refineries. The facility currently has an RO capacity of 2 MGD. Both types of recycled water begin with secondary treated effluent from the Honouliuli WWTP.

The Honouliuli WRF currently supplies the City golf courses of West Loch and 'Ewa Villages with 1 MGD each of R-1 water. Recycled water is pumped to the West Loch course at night, while the 'Ewa Villages course is supplied during the day. The pumping rate to each course is 150 gallons per minute (GPM) at a pressure of 68 pounds per square inch (PSI).

All wastewater plans will conform to applicable provisions of Chapter 11-62, HAR, "Wastewater Systems," and the DOH Wastewater Branch reserves the right to review the detailed wastewater plans for conformance to applicable rules. In addition, the Petitioner will work with the Board of Water Supply and utilize recycled water for irrigation and other non-potable water purposes in the open spaces and for landscaping areas to the extent practicable.

4.8.4 Drainage Facilities

Existing Conditions

The Petition Area is within three distinct drainage basins. These are the Kalo'i drainage basin, the Honouliuli Stream drainage basin and the West Loch drainage basin. The Kalo'i Basin stretches to the top of the eastern slopes of the Wai'anae mountain range and terminates near the ocean in the vicinity of Haseko's Ocean Pointe development. The drainage basin mauka of the H-1 Freeway is 3,000 acres and generates a peak flow of 5,000 cubic feet per second (CFS). The drainage basin size increases to 4,330 acres and carries a peak flow of 8,900 CFS at the entrance to 'Ewa Villages. The mauka boundary of Ewa Villages is laterally equal to the southern boundary of Parcel C. Approximately 100

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acres of the Ho'opili project are within this watershed. Kalo'i Gulch is characterized on the USGS map as an intermittent stream.

The Honouliuli Stream drainage basin also stretches to the top of the eastern slopes of the Wai'anae mountain range. This basin contains 6,600 acres (11,200 CFS – peak flow) of drainage area mauka of the H-1 Freeway and expands to 7,880 acres (12,300 CFS – peak flow) at its connection with the West Loch of Pearl Harbor. The terminus location is in the vicinity of the West Loch Golf Course. Approximately 635 acres of the Ho'opili project are in the Honouliuli Stream drainage basin.

The West Loch drainage basin is the smallest drainage basin affecting the project. The basin upper reaches begin at the makai side of the H-1 Freeway and generally terminates at two locations at the West Loch of Pearl Harbor. One terminus is through West Loch Estates and the other is an overflow from an existing detention basin located east of Fort Weaver Road and just south of the OR&L railroad tracks (See Parcel D1 on Figure 1.5: Parcels Map). This basin contains approximately 937 acres and generates a peak flow of 2,500 CFS. The total basin is within lands that are part of the Ho'opili project.

Anticipated Impacts and Mitigation Measures

With respect to the portion of the project within the Kalo'i drainage basin, the project will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. The project will also be providing storage and detention to meet the Rules Relating to Storm Drainage Standards with respect to water quality standards. The basin size could be decreased at some time in the future when the terminus of Kalo'i basin is finalized. All developed projects discharging to the Kalo'i basin currently have discharge restrictions and these restrictions will continue until the Kalo'i basin terminus is finalized. The portions of the project within the Kalo'i drainage basin are Parcels A and the western most part of Parcel C adjacent to the North-South Roadway alignment (See Figure 4.5~~2~~: Drainage Basins). The Petitioner will continue to coordinate with County and State agencies to discuss issues within the Kalo'i Gulch Watershed.

With respect to the Honouliuli Stream drainage basin, the project will provide detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed the 10-year recurrence flow rate. This is the recognized capacity of the Honouliuli Stream channel. The project will also be providing storage and detention to meet the Rules Relating to Storm Drainage Standards with respect to water quality standards. The portions of the project within the Honouliuli Stream drainage basin are Parcels B and the northeastern part of Parcel C adjacent to Old Fort Weaver Road (See Figure 4.5~~2~~: Drainage Basins).

With respect to the West Loch drainage basin, the project intends to collect all storm water and route it to the existing detention basin located on the east side of Fort Weaver

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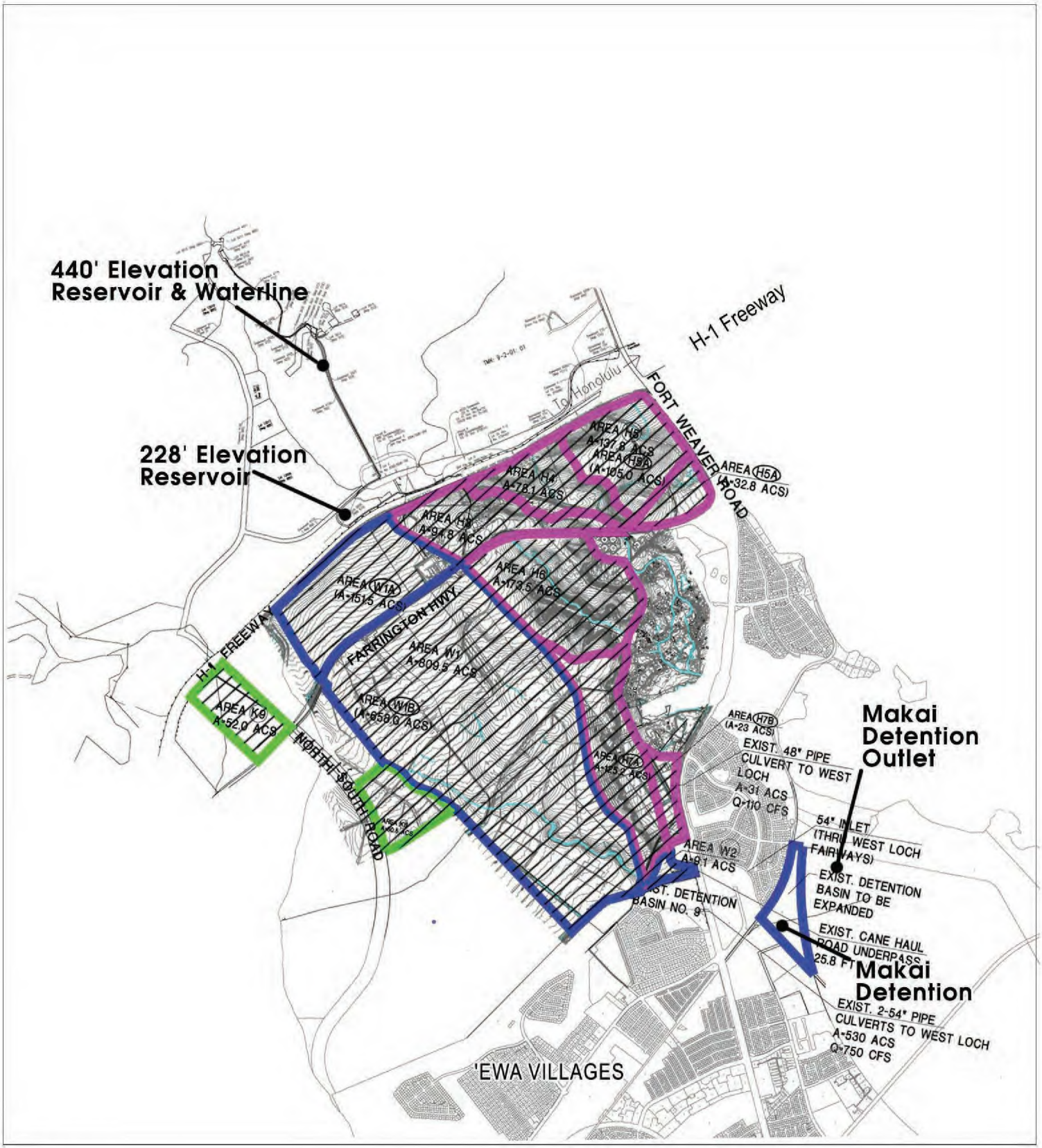

LEGEND

- Project Site Boundary
- Petition Area
- Kaloi Drainage Basin
- West Loch Drainage Basin
- Honouliuli Drainage Basin
- (K8) Drainage Basin-Existing
- (W1A) Drainage Basin-Developed

Source: Bills Engineering, Inc.
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 4.5: Drainage Basins

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)
0 3,000 6,000

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Road and south of the OR&L railroad tracks. The routing would require the installation of a concrete channel from the southeastern end of Parcel C, under Fort Weaver Road (using the existing cane haul underpass) and connecting to the existing detention basin. The basin would be expanded to ensure that the water quality storage component of the City and County of Honolulu Standards was achieved. An overflow from the detention basin would discharge to the West Loch of Pearl Harbor (See Parcel D2 on Figure 1.5: Parcels Map). The portion of the project within the West Loch drainage basin is the bulk of Parcel C (See Figure 4.5~~2~~: Drainage Basins).

The overflow from the detention basin would have to cross Navy property and permission from the Navy would be required. Initial inquiries have been made to the Navy to see if the overflow can be negotiated. Issues with the Navy include security and access in a post- "9/11" environment, Navy plans for development in the overflow corridor, and the acquisition of a maintenance commitment by the City and County of Honolulu. The concept of the overflow across Navy property is not new and was approved in concept back in the early- to mid- 1990's. Lack of action and the issues cited above are points that need to be resolved for the overflow option to move forward.

If permitted, the overflow option across Navy property will solve drainage problems occurring on Fort Weaver Road, within West Loch Estates and within portions of 'Ewa Villages by effectively collecting the storm water that currently is misdirected across these properties. However, as of this date, the Navy has rejected any considerations to allow increased runoff to cross Navy land.

The alternative drainage solution if the overflow across Navy property cannot be resolved is to construct retention basins on site holding back the total volume of a 100 year- 24 hour storm. These basins would be located on the southern portion of Parcel C.

The project will increase impervious surfaces such as roadways, roofs, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Petition Area. However, detention basins and/or retention basins are being planned and sited to detain and/or retain storm water to ensure that areas downstream of the project are not impacted. Based on comments received from the City and County of Honolulu Department of Facilities Management during the public review period, storm drainage detention and retention basins within the project site shall be privately-owned and maintained, unless particular parcels of land are dedicated to or acquired by the government. During the public review period, the State Office of Planning requested a discussion of low impact development techniques that can be incorporated into the building and site design to improve stormwater management. Table 1.1 of Low Impact Development: A Practitioner's Guide (2006) lists specific Low Impact Development (LID) best management practices (BMP's) and techniques.

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- Preservation of Undisturbed Areas: As recommended, most of the existing undisturbed areas (or uncultivated) areas will be preserved, because the gulches and steeper sloped areas are unsuitable for development. Most of the project area is highly developable, but has been highly disturbed from past and present agricultural cultivation.
- Preservation of Buffers: Naturally vegetated buffers will be defined, delineated and preserved along Honouliuli Gulch.
- Reduction of Clearing and Grading: Clearing and grading of the site will be limited to the minimum amount for the development function, road access and infrastructure.
- Locating Sites in Less Sensitive Areas: Most of the Petition Area is highly developed and does not include sensitive resource areas such floodplains, steep slopes, wetlands, mature forests or critical habitats.
- Open Space Design: While the project will be more densely developed than most of the projects in the Villages of Kapolei or the rest of 'Ewa, this project acknowledges that there are very limited areas on O'ahu left to develop and this will allow other areas in Central O'ahu, North Shore, Ko'olauloa, Ko'olaupoko and Wai'anae to remain undeveloped.
- Roadway Reduction: The proposed traditional neighborhood design and pedestrian-friendly development concept proposes more but narrower roads than a conventional development, to: 1) ensure lower vehicle speeds; 2) enhance pedestrian safety in crossing the streets; and 3) facilitate safer bicycle travel.
- Sidewalk Reduction: The proposed pedestrian-friendly and traditional neighborhood design development concept proposes meeting minimum standards for sidewalks to: 1) enhance greater pedestrian use, and 2) facilitate safer bicycle travel for children and inexperienced adult bicyclists. Impervious surfaces could be reduced by consolidating separate pedestrian and bicycle paths into multi-modal paths.
- Driveway Reduction: The proposed development will strive to minimize driveway lengths and widths to reduce overall imperviousness.
- Cul-de-sac Reduction: The proposed pedestrian-friendly, traditional neighborhood design development concept seeks to avoid cul-de-sacs to increase connectivity within the project and to surrounding communities.
- Building Footprint Reduction: The proposed transit-oriented development concept is not adverse to taller buildings to reduce the impervious footprint of buildings while recognizing the visual appearance of Kapolei.
- Parking Reduction: The proposed mixed-use, pedestrian-friendly and transit-oriented development concept is supportive of reducing the current off-street parking requirements and reducing the overall imperviousness associated with parking lots.
- Vegetated Buffer/Filter Strips: Where feasible, runoff will be directed to open space buffers to treat and control stormwater runoff from developed areas.
- Open Vegetated Channels: Where feasible, properly designed and constructed

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vegetated channels will be provided to convey runoff, but it is unlikely that will occur along streets dedicated to the City and County of Honolulu.

- Bioretention and Rain Gardens: Where feasible, bioretention and rain gardens will be provided.
- Infiltration: Where feasible, infiltration trenches, basins or leaching chambers will be provided.
- Rooftop Runoff Reduction Mitigation: Where feasible, runoff will be directed from rooftops to pervious areas.
- Stream Daylighting for Redevelopment Projects: Not applicable because there are no previously-culverted/piped streams to "daylight" to restore natural habitats.
- Tree Planting: The proposed project will include street trees, park landscaping and project landscaping to reduce stormwater runoff and provide shade.

Surface water quality can be impacted through development. Per comments received by the State Department of Health Clean Water Branch, any discharges related to project construction or operation activities shall comply with the applicable State Water Quality Standards as specified in Chapter 11-54, HAR. Further, the DOH Clean Water Branch wrote that the Hawaii Revised Statues, Subsection 342D-50(a), requires that "[n]o person, including any public body, shall discharge any water pollutants into state waters, or cause or allow any water pollutant to enter state waters except in compliance with this chapter, rules adopted pursuant to this Chapter, or a permit or variance issued by the director." The project will need to obtain NPDES permits and Grading Permits (as previously identified in the DEIS). Both required permits have substantial effort identified in their applications specifically addressing BMP issues. The substantive parts of the permitting processes focus on BMP tools and monitoring. Features will include: stabilized gravel entrances, siltation berms, diversion of storm water around work areas, use of detention basins, diversion swales, filter traps at catch basins, calculation of soils losses meeting acceptable levels and monitoring plans. BMP's are an important part of current construction practice. The project will be providing detention basins to meet City and County of Honolulu Standards for water quality treatment. Structural methods may also be used to meet water quality requirements of the Rules Relating to Storm Drainage Standards. Structural methods include the use of Stormceptor® type storm drain manholes.

4.8.5 Solid Waste Disposal Facilities

Existing Conditions

On the island of O'ahu, the majority of residential and commercial trash is disposed of at the Honolulu Program of Waste Energy Recovery (H-POWER) facility, the City and County of Honolulu's waste-to-energy plant located nearby at the Campbell Industrial Park. Approximately 600,000 tons of solid waste is processed annually at the facility, therefore, reducing the volume of solid waste going into landfills by 90 percent. Through a purchase power agreement with HECO, the H-POWER facility provides 46 megawatts (MW) of renewable energy that supplies power to between 40,000 and 45,000 homes on O'ahu on

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a daily basis. Presently, H-POWER has two boilers and one turbine/generator. A proposed third boiler would enable H-POWER to supply electricity to 20 percent more homes each year. Ash and non-processibles are transported and buried at the Waimānalo Gulch Landfill.

Waimānalo Gulch Landfill, which opened in 1989, is located northwest of the proposed Ho'opili project. While the land is owned by the City and County of Honolulu, the landfill is operated by Waste Management, Inc. The site accepts ash and residue from the H-POWER facility, industrial wastes, and non-combustible construction and demolition debris. Commercial haulers pay $72.75 per ton to dispose solid waste at the facility. During the public review period, the State Land Use Commission reported that it took action to extend the deadline to close the Waimanalo Gulch Sanitary Landfill to November 1, 2008, and the City and County of Honolulu Department of Environmental Services has plans to expand the landfill by another approximately 92.5 acres.

Anticipated Impacts and Mitigation Measures

~~Solid waste will be generated during construction and operation of the proposed Ho'opili project. The amount of waste generated during construction will vary, depending on various conditions such as the type of construction. Project construction will conform to the guidelines and objectives of Chapter 342G, HRS, *INTEGRATED SOLID WASTE MANAGEMENT*. Construction will also comply with the City and County of Honolulu's approved integrated solid waste management plans in a schedule and time frame satisfactory to the DOH.~~

~~Recycling shall be encouraged within the project including the reuse and recycling of green waste generated during construction clearing and grubbing activities, the use of recycled construction and demolition wastes and the use of materials made from recycled products, the use of locally produced compost as available for landscaping, and the provision of space for recycling bins in the detailed design of the community. As such, a construction waste recycling plan will be prepared before the start of construction.~~

~~According to Popular Mechanics, the approximate municipal solid waste generated per person per day is approximately 4.5 pounds. Assuming an average household size of 3.0 persons, at full build out, the solid waste generated by the project is estimated to average approximately 158,625 pounds per day. It should be noted that this estimate does not account for solid waste that would be recycled, which would be a considerable amount. The goal for waste management is to appropriately reduce, reuse and recycle materials, to minimize generation of solid waste and achieve diversion from landfills. As such, in conformance with Chapter 344-4(2), HRS, the project will promote the optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling.~~

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~~In the future, the H-POWER plant will need to be expanded or an increased emphasis will need to be placed on recycling to dispose of the solid waste. According to the City and County of Honolulu, approximately 15 percent of residential solid waste is recyclable newspaper, aluminum, glass, and plastic; and 25 to 30 percent is compostable yard trimming. The City and County of Honolulu is restarting its curbside pick-up recycling program. In November, 2007, two pilot curbside recycling programs began in Mililani and Hawai'i Kai. During the six to twelve month evaluation period, the City and County of Honolulu Department of Environmental Services staff will be coordinating plans for islandwide expansion.~~

On March 7, 2008, the State Land Use Commission agreed to allow the City and County of Honolulu's Waimanalo Gulch Sanitary Landfill to remain open for at least 18 more months. The City had sought a 24-month extension, through May 1, 2010.

Waste Management of Hawaii has operated the Waimanalo Gulch Sanitary Landfill as an integral part of the City's solid waste management infrastructure for approximately 20 years. The facility is heavily regulated, monitored and controlled by local, state and federal government agencies.

Before Mayor Hannemann took office, the City Council chose to keep the landfill in its current location, after evaluating a wide range of potential options.

Mayor Hannemann has noted that the recent emergency disposal of 28 tons of recalled beef at the landfill demonstrated that O'ahu will always need such a facility. However, the City and County of Honolulu is striving to decrease the amount of waste that's sent to the landfill, including: expanding the City's curbside residential recycling program; shipping at least 100,000 tons of waste to a mainland facility, and expanding the H-Power garbage-to-energy plant.

According to the U.S. Environmental Protection Agency, in 2006, individuals recycled 1.5 pounds of our individual waste generation rate of 4.6 pounds per day, for a net waste generation amount of 3.1 pounds per day. Assuming an average household size of 3.0 persons, at full build-out, the solid waste generated by the project is estimated to average approximately 109,275 pounds per day. According to the City and County of Honolulu, approximately 15 percent of residential solid waste is recyclable newspaper, aluminum, glass, and plastic; and 25 to 30 percent is compostable yard trimming. In the future, the H-POWER plant will need to be expanded or an increased emphasis will need to be placed on recycling to dispose of the solid waste.

Recycling will be encouraged within the project including the reuse and recycling of green waste generated during construction clearing and grubbing activities, the use of recycled construction and demolition wastes and the use of materials made from recycled products, the use of locally produced compost as available for landscaping, and the

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provision of space for recycling bins in the detailed design of the community. As such, a construction waste recycling plan will be prepared before the start of construction.

The City and County of Honolulu is restarting its curbside pick up recycling program. In November, 2007, two pilot curbside recycling programs began in Mililani and Hawai'i Kai. During the six to twelve month evaluation period, the City and County of Honolulu Department of Environmental Services staff will be coordinating plans for islandwide expansion.

On June 27, 2008, the Associated Press reported that Mililani and Hawai'i Kai residents have recycled 54 percent of their cans, bottles, newspapers and green waste during the city's six-month curbside recycling pilot project. City Officials with the City and County of Honolulu Department of Environmental Services (DES) are reportedly satisfied with the results and are moving forward with plans to provide some 160,000 O'ahu homes the curbside recycling service by May 2010. In the new plan, the city will collect garbage and recyclables each once a week. The DES will no longer have garbage pickup twice-weekly. A study released by DES predicts the program will divert an estimated 53,800 tons of mixed recyclables and green waste from O'ahu landfills. They plan to begin expanding the program to more communities in November 2008.

The goal for waste management is to appropriately reduce, reuse and recycle materials, to minimize generation of solid waste and achieve diversion from landfills. As such, in conformance with Chapter 344-4(2), HRS, the project will promote the optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling.

4.8.6 Electrical Facilities

Existing Conditions

Electricity for the area is currently provided by the Hawaiian Electric Company, Inc. (HECO). HECO owns and maintains a pole line along Farrington Highway that supports two 138-~~kilo volt~~ kilovolt (kV) lines and one 12.47-kV line (with provisions for a 46-kV line in the future). The pole line runs along Farrington Highway from HECO's 'Ewa Nui Substation to Palehua Road. From the 'Ewa Nui Substation, the 12.47-kV line and a 46-kV line runs along Farrington Highway to the Waipahu Interchange and up Fort Weaver Road. The line also runs along Old Fort Weaver Road to the intersection with Fort Weaver Road. A 12.47-kV line serving the West Loch area, traverses the project site makai toward the Old Fort Weaver Road. Both of the 138-kV lines turn south at Palehua Road and follow the alignment of the future North-South Road to the OR&L right-of-way. Two other 138-kV pole lines from the Kahe Power Plant pass to the north of Parcel A, mauka of the H-1 Freeway. In response to the EISPN, HECO wrote that it has "...existing facilities within the project area that will require continued access for maintenance purposes..." The Petitioner will allow HECO continued access for maintenance purposes. An existing 46-kV circuit that is supported by wood poles follows the alignment of the H-1

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Freeway. On the Honolulu-side of Pu'u Makakilo, a spur continues across the H-1 Freeway to the Pacific Concrete and Rock Substation, while the main branch of the pole line continues to parallel the H-1 Freeway alignment and heads toward the 'Ewa Nui Substation.

HECO representatives have provided easement documents and maps of existing HECO facilities that are currently encumbered by the Ho'opili project. These easements will be researched during the preliminary engineering phase of the project to determine whether the affected facility will need to be relocated.

Anticipated Impacts and Mitigation Measures

The project is initially expected to generate an electrical demand of approximately 42 megavolt amperes (MVA) for conventional development. At full build-out, the estimated electrical demand is estimated to be approximately 98 MVA (assuming a diversity factor of 70%). HECO has determined that to serve the ultimate load for the proposed development, three distribution substations, including power lines to and from them, will be needed.

The first distribution substation is proposed to be located mauka of Farrington Highway, between the 'Ewa Nui Transmission Substation and Fort Weaver Road. The second distribution substation is proposed to be located adjacent Ho'opili's main road perpendicular to North-South Road. The third distribution substation is proposed to be located between the North-South Road and the 'Ewa Nui Transmission Substation. The three substations may be relocated from the locations described above based on how development proceeds. Each distribution substation will require at least two 46-kV feeders and one or two transformers, with a third 46-kV feeder and up to four transformers total required for full-build-out of the substation. The new substation sites, each approximately 20,000 square feet in size, will be likely kept at a low profile. HECO will own/maintain the land sited for the distribution substations.

All new primary and secondary distribution lines serving the Ho'opili project will be placed underground to reduce visual impacts.

The installation of power lines and substations may require approval by the State Public Utilities Commission depending if the primary provider of electrical power is HECO or another private utility company, as well as other applicable State and County approvals and permits. In response to the EISPN, HECO wrote that it "...has no objections at this time." Also required is the use of State and County road rights-of-way for the installation of powerlines.

If HECO is primary provider of electrical power, then some of the projected demand would be offset if the solid waste generated daily by the development were burned at the City and County of Honolulu's H-POWER facility. An estimated 59 tons of solid waste

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will be produced daily by the development (assuming no recycling), and at 1 MW of electricity per 35 tons of solid waste, approximately 1.67 MW will be generated from the property. Under a purchase power agreement with HECO, the H-POWER facility provides 46 MW of renewable energy that supplies power to between 40,000 and 45,000 homes on O'ahu on a daily basis. A proposed third boiler at the facility would enable H-POWER to supply electricity to 20 percent more homes each year.

HECO is planning to build a 110-megawatt (MW) simple cycle combustion turbine generator power plant in 2009. According to the HECO website, HECO "is looking for companies to supply enough biofuel -- either ethanol or biodiesel -- to fuel HECO's new Campbell Industrial Park Generating Station planned to be in service by mid-2009. HECO reached an agreement with the State Consumer Advocate, subject to approval by the State Public Utilities Commission, to fuel this new 110-megawatt peaking plant with 100-percent, renewable biofuel. "

Based on DBEDT Strategic Industries Division's recommendations, the Petitioner's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies (including solar power and energy-efficient appliances). During the public review period the State Office of Planning requested discussion of the following: the U.S. Green Building Council's (GBC) Leadership in Energy and Environmental Design (LEED) certification; Hawaii's Green Built, and Zero-Net Energy Green Homes.

U.S. Green Building Council's (GBC) Leadership in Energy and Environmental Design (LEED) Certification - According to the GBC website: "The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria. LEED is a third party certification program and the nationally accepted benchmark for the design, construction and operation of high performance green buildings. LEED gives building owners and operators the tools they need to have an immediate and measurable impact on their buildings' performance. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality." Even though State agencies are directed to implement LEED Silver to the extent possible (under Chapter 196 of the Hawaii Revised Statutes), to date, there have only been a couple of projects built by the State of Hawai'i (Imiloa Astronomy Center, Waipahu Middle School Cafeteria, Hawai'i Gateway Energy Center) so certified.

According to the GBC website: "The LEED for Neighborhood Development Rating System integrates the principles of smart growth, urbanism and green building into the first

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national system for neighborhood design. LEED certification provides independent, third-party verification that a development's location and design meet accepted high levels of environmentally responsible, sustainable development. Currently in its pilot period, LEED for Neighborhood Development is a collaboration among USGBC, the Congress for the New Urbanism and the Natural Resources Defense Council. The pilot program is no longer accepting projects. The post-pilot version of the rating system, which will be available to the public, is expected to launch in 2009." Ho'opili is part of the LEED-ND pilot program, and it is in the early stages of working with the U.S. Green Building Council (USGBC) to obtain information required to implement LEED-ND to the extent that it is feasible and practicable.

A preliminary overview of LEED-ND features to be incorporated into the development project site include:

In order to reduce the impacts of urban sprawl, or unplanned, uncontrolled spreading of urban development into areas outside of the metropolitan region, and create more livable communities, LEED for Neighborhood Development communities include:

- locations that are closer to existing town and city centers,
- areas with good transit access, and
- sites adjacent to existing development.

LEED for Neighborhood Development emphasizes the creation of compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities (such as UHWO and DHHL East Kapolei Development 2). Research has shown that living in a mixed-use environment within walking distance of shops and services results in increased walking and biking, which improve human cardiovascular and respiratory health and reduce the risk of hypertension and obesity.

LEED for Neighborhood Development also encourages increased transportation choice and decreased automobile dependence. These two things go hand-in-hand; convenient transportation choices such as buses, trains, car pools, bicycle lanes and sidewalks, for example, are typically more available near neighborhood centers and town centers, which are also the locations that produce shorter automobile trips. All of these concepts are being incorporated into the planning of the Ho'opili project.

Hawaii Builtgreen™ Home Program - According to the DBEDT website: "The 'Hawaii BuiltGreen™ Program' is a statewide program to make it easier for builders and homeowners to design and build energy- and resource-efficient homes in Hawaii. It includes hands-on, right-here-in-Hawaii examples of what to do and how to do it, such as a real home, exhibits, seminars, and workshops." According to the Building Industry Association website, there are no Hawaii BuiltGreen™ Award-winning housing projects built by the State of Hawai'i.

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Zero-Net Energy Green Homes - According to Wikipedia: "A zero energy building (ZEB) or net zero energy building is a general term applied to a building with a net energy consumption of zero over a typical year. Zero energy buildings are gaining considerable interest as a means to cut greenhouse gas emissions and conserve energy... There are many overlapping similarities between the goals of ZEB and GB [Green Buildings]. However, the subtle differences are significant, but diminishing, as scarce knowledge becomes more widespread."

The goal of ZEB design is the reduction, and eventual elimination of, energy bills and greenhouse gas emissions using potentially complex thermal physics necessary for zero energy design.

It is unlikely that there are any net zero energy housing projects built by the State of Hawai'i.

The Petitioner is also considering the potential use of photovoltaic cells on future project buildings, where practicable. As an example, large national retailers are entering agreements with micro utility companies who arrange for solar power systems financing and sells such systems to the micro utility company's financing partner. In addition, these micro utilities design, install and maintain these photovoltaic systems per each customer's requirements. The customer pays the financing partner for the solar electricity generated over a long-term power purchase agreement. At the end of the term specified under the agreement, the customer typically has the option to renew the agreement, transfer the equipment to a new site, or purchase the system outright from the financing partner.

To reduce energy consumption from the operation of air-conditioners, the Petitioner is considering the installation of chill water lines. While the above two options are alternatives to relying on only HECO for electrical needs, it is possible that these proposed uses may still have a need for transmission line easements within, and the use of, State and County road rights-of-way.

As previously noted, portions of the HECO's 138-kV lines run through the Petition Area, along Farrington Highway and follow the alignment of the future North-South Road to the OR&L right-of-way. These lines are suspended near the tops of large, tall metal poles. According to HECO, the State of Hawaii Department of Health (DOH) recommends a prudent avoidance policy for electric and magnetic fields.

According to a HECO flyer titled Electric and Magnetic Fields (EMF), "[s]tudies disagree on EMF and health effects," therefore, HECO "designs and builds facilities to minimize EMF consistent with DOH's EMF policy[.]" Since coordination with HECO is required in designing future buildings within the Petition Area, EMF concerns will likely be addressed.

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4.8.7 Telephone/Communication Facilities

Existing Conditions

Hawaiian Telcom, which provides telephone service to the area, owns and maintains a pole line along Farrington Highway, Old Fort Weaver Road and Kunia Road. This pole line is substandard; however, Oceanic Time Warner Cable and Pacific Lightnet have an agreement with Hawaiian Telcom for use of its poles and have attached cables to extend their facilities to Kapolei. AT&T has a fiber cable buried within the southern shoulder of the existing Farrington Highway right-of-way. In addition, the Federal government owns a buried joint tactical support cable within the Farrington Highway right-of-way.

Anticipated Impacts and Mitigation Measures

The project will increase the demand for telephone/communication service in the 'Ewa region. If Hawaiian Telcom and Oceanic Time Warner Cable are the selected providers, they will need to extend their trunking facilities from Farrington Highway to serve the proposed Ho'opili project. It is possible that one or more micro-utility companies may be providing a portion or all telephone/communication services to the Petition Area and the rest of the Project Area. These telephone and communication lines (to be installed by Hawaiian Telcom, Oceanic Time Warner Cable and/or a micro-utility company), will require easements within and the use of State and County road right-of-ways. Electrical drawings of the project will be submitted to Hawaiian Telcom for its review and approval before the start of construction. There are no significant impacts to existing telephone or cable service that are anticipated, and as such, no mitigation measures are proposed for the expansion of existing service.

Due to the current location of the existing telephone pole line along Farrington Highway; Hawaiian Telcom, Oceanic Time Warner Cable, Pacific Lightnet will have to relocate their lines to either new poles or underground along Farrington Highway in the future. Similarly, another provider of telephone/communication lines to the proposed project may locate their lines to new poles along Farrington Highway. During the public review period for the EISPN, Hawaiian Telcom noted that with City and County of Honolulu's planned widening of Farrington Highway, "further review is required by Hawaiian Telcom during the design stages of the project to determine the scope of work and the associated relocation costs."

All new telephone and communication lines serving the Petition Area will be placed underground to reduce visual impacts.

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4.9 PUBLIC SERVICES AND FACILITIES

The project will increase the population of 'Ewa. As such, the demand for public services (i.e., police and fire protection, public transportation) and public facilities (i.e., schools, hospitals, parks) will increase. The project will include as many as five public school sites and approximately 210 acres of public parks and open space.

4.9.1 Educational Facilities

Existing Conditions

The following table compiled from the State Department of Education (DOE) sources lists the past and projected enrollments of public schools within the vicinity of the Petition Area.

Table 4.1~~3~~4. Public School Enrollment

SCHOOL	2006-2007 CAPACITY	2002-2003 ENROLLMENT	2003-2004 ENROLLMENT	2004-2005 ENROLLMENT	2005-2006 ENROLLMENT	2006-2007 ENROLLMENT	2007-2008 ENROLLMENT	2012 PROJECTED ENROLLMENT	2012 ENROLLMENT LESS 2006-2007 CAPACITY
Middle and High Schools – Kapolei Complex									
Kapolei High	2,015	1,356	1,928	2,162	2,333	2,341	2,285	2,302	287
Kapolei Middle	1,818	1,585	1,698	1,699	1,580	1,616	1,559	1,737	-81
Middle and High Schools – Campbell Complex									
Campbell High	2,060	1,942	1,854	2,009	2,283	2,370	2,491	2,627	567
'Ewa Makai Middle*	1400	--	--	--	--	--	--	1570	170
Ilima Intermediate	1,306	1,161	1,225	1,246	1,201	1,212	1,302	725	-581
Elementary Schools – Kapolei Complex									
Barbers Point	693	374	381	494	529	493	506	628	-265
Kapolei	1,246	1,183	1,165	1,173	1,126	1,100	1,065	905	-341
Kapolei II*	--	--	--	--	--	--	--	550	N/A
Makakilo	588	510	493	521	509	505	479	563	-25
Mauka Lani	681	589	607	582	577	580	547	598	-83

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SCHOOL	2006-2007 CAPACITY	2002-2003 ENROLLMENT	2003-2004 ENROLLMENT	2004-2005 ENROLLMENT	2005-2006 ENROLLMENT	2006-2007 ENROLLMENT	2007-2008 ENROLLMENT	2012 PROJECTED ENROLLMENT	2012 ENROLLMENT LESS 2006-2007 CAPACITY
Elementary Schools – Campbell Complex									
'Ewa	741	831	850	878	933	925	934	944	203
'Ewa Beach	728	604	594	601	665	415	365	416	-312
Holomua	1,427	1,277	1,344	1,428	1,442	1,534	1,444	1,496	69
Iroquois Point	947	513	455	464	563	653	668	573	-374
Kaimiloa	752	717	691	678	679	661	649	557	-195
Pōhākea	670	586	563	556	551	526	494	472	-198
Keone'ula	960	--	--	--	--	431	746	916	-44
* The proposed schools have yet to be constructed.									

Source: State of Hawai'i, Department of Education, October 2007

The UHWO is proposing a 12-acre elementary school site and the DHHL is proposing an elementary school site and a middle school site within its East Kapolei Development Parcel 2 project area. A 50-acre high school on DHHL land between Farrington Highway and the H-1 Freeway is under discussion.

~~For planning purposes, the DOE assumes an enrollment of 550 students per elementary school, 600 students per middle school, and 1,000 students per high school. However, in 2007, the Hawaii State Legislature passed Act 245 regarding impact fees for schools. Act 245 defines "Recent School Construction Averages" as the department's historical average acres required and enrollment capacity for elementary (K-5), middle (6-8), and high (9-12). Based on existing school construction data, the historical average design standards are as follows:~~

~~Table 4.14. Existing School Construction Data~~

~~SCHOOL TYPE~~	~~ACRES/SCHOOL~~	~~ENROLLMENT/SCHOOL~~	~~ACRES/STUDENT~~
~~Elementary School~~	~~12.5~~	~~800 students~~	~~.0156 acre~~
~~Middle School~~	~~16.5~~	~~1,500 students~~	~~.0110 acre~~
~~High School~~	~~49.0~~	~~1,600 students~~	~~.0306 acre~~

During the Draft EIS public review period, the DOE commented that "Different schools are designed for different enrollment sizes, and once schools open, enrollments change over time. Campus sizes also vary. Historical averages do not determine school design standards." The Petitioner concurs and proposes to provide a total of 90 acres throughout out the project site that can be planned by DOE for public schools. The Petitioner is working with the DOE so that the larger land area campuses are sited away from mixed-use developments. Schools fitting within a single-block can be sited in higher density areas.

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Anticipated Impacts and Mitigation Measures

The Petitioner has held frequent preliminary consultations with the DOE on the total number of public schools that need to be built within the project and their preliminary locations. While the number of schools has not been agreed upon, the project land use plan has been designed to include as many as five public school sites. The Conceptual Land Use Plan (See Figure 2.9: Conceptual Land Use Plan) shows possible locations for three elementary schools, one middle school, and one high school. In total, approximately 90 acres will be reserved for public schools and facilities to meet the demand for educational facilities in the growing 'Ewa region. The proposed schools in the Project Area will serve residents of Ho'opili and possibly some school-aged children from nearby future subdivisions in UHWO and DHHL East Kapolei Development Parcels 1 and 2. A high school will be attractive to certain~~ly attract residents~~ homebuyers from areas outside of Ho'opili. This does not include the possibility that one or two private schools may be included in Ho'opili. If a planned private school(s) is built within the project, this will increase educational choices for local families. UHWO will offer higher education opportunities for regional residents.

4.9.2 Police Protection

Existing Conditions

The proposed project is located within Honolulu Police Department (HPD) District 8, which encompasses the leeward coast and the 'Ewa Plain. There are approximately 100 field officers assigned to this district, and response time for the entire district fluctuates between five and seven minutes. In order to meet the growing needs of the 'Ewa Plain communities, in 2000, the City and County of Honolulu opened the Regional Kapolei Police Station at 1100 Kamokila Boulevard.

Anticipated Impacts and Mitigation Measures

The project will increase the population of Kapolei and the demand for police service. According to the *Ewa Development Plan*, the 'Ewa Villages Substation is planned to service the East 'Ewa region, which includes the Ho'opili project. The service date for this substation has yet to be determined. The Petitioner is proposing a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a police substation, fire station and/or emergency medical service (EMS) site. During the public review period for the EISPN, the HPD wrote that "the project should have no unanticipated impact on the facilities or operations of the Honolulu Police Department." During the public review period for the Draft EIS, the HPD wrote that "the Honolulu Police Department (HPD) will need to expand its patrol services as Ho'opili is developed... the HPD looks forward to making the best use of the public facility site proposed by the developer as planning progresses."

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4.9.3 Fire Protection

Existing Conditions

Fire protection in the *Ewa Development Plan Area* is provided by the Honolulu Fire Department (HFD) 'Ewa Beach Fire Station (an engine company), Makakilo Fire Station (an engine company), and Kapolei Fire Station (an engine and ladder company, and the Battalion 4 Headquarters). The Kapolei Fire Station located in Kapolei Business Park was completed in 1995 to serve the expanding development on the 'Ewa Plain.

Portions of the Petition Area consist of vacant scrub vegetation, which combined with the 'Ewa region's low annual rainfall, creates a potential fire hazard.

Anticipated Impacts and Mitigation Measures

The project will increase the population of 'Ewa and the demand for fire service. According to the *Ewa Development Plan*, to meet the projected population and economic growth in 'Ewa by 2020, three fire stations at 'Ewa Villages, Ko 'Olina, and Makaiwa Hills are planned, however service dates have yet to been determined. A new fire station is being planned on the DHHL East Kapolei Development Parcel 1 site near the intersection of Kapolei Parkway and North-South Road. The Petitioner is proposing a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a fire station, EMS site and/or police substation. Within the Petition Area, access for fire apparatus, water supply, and building construction will be in conformance with existing codes and standards. As such, fire apparatus road shall be designed and constructed in accordance with the Uniform Fire Code, Section 902.2.1, as amended. Water infrastructure shall be designed and installed in accordance with the Uniform Fire Code, Section 903.2, as amended. In addition, civil drawings will be submitted to HFD for its review and approval.

4.9.4 Medical Facilities

Existing Conditions

Health care services in the 'Ewa region are provided by Hawai'i Medical Center West (the nearest hospital facility), Pali Momi Medical Center, Wahiawā General Hospital, Kaiser Permanente Waipi'o Clinic, and the recently opened Kapolei Medical Park (located across the Kapolei Shopping Center at the corner of Farrington Highway and Fort Barrette Road). Other routine medical services can be obtained at major hospital facilities in urban Honolulu, about a 30-minute drive from the subject property. The City and County of Honolulu has 18 emergency medical services Advanced Life Support Ambulance units and two Rapid Response Paramedic units on O'ahu. Two of the Advanced Life Support Ambulance units are located nearby, one at the Kapolei Fire Station, the other at the Waipahu Fire Station. One of the Rapid Response Paramedic units is located at the nearby Hawai'i Medical Center West.

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Anticipated Impacts and Mitigation Measures

The project will increase the population of 'Ewa, and as such, there will be an occasional and unavoidable demand for emergency medical services. It is unlikely, however, that this demand will impact the level of service provided to other residents of O'ahu. The Petitioner is proposed a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a police substation and/or EMS site. Existing medical and healthcare facilities in the 'Ewa region and surrounding areas should be able to accommodate the anticipated increase in demand.

4.9.5 Recreational Facilities

Existing Conditions

Recreational facilities in the 'Ewa area include regional parks, community parks, neighborhood parks, and beach/shoreline parks. Regional parks are large recreational complexes. According to the City and County of Honolulu Department of Parks and Recreation (DPR), community parks serve an approximate population of 10,000 people and normally include play fields, courts, and a recreation building. Neighborhood parks serve an approximate population of 5,000 people and usually include play fields, courts, and a comfort station. Beach/shoreline parks are day use parks primarily for swimming, sunbathing, and picnicking. Existing parks in the 'Ewa area are listed in the following table.

Table 4.15. 'Ewa Parks

NAME	TYPE	SIZE (ACRES)
Barbers Point Beach Park	Beach	7.39
'Ewa Beach Community Park	Community	13.25
'Ewa Beach Park	Beach	4.88
'Ewa Mahiko Neighborhood Park	Neighborhood	6.33
Kahe Point Beach Park	Beach	4.47
Kamokila Park	Community	5.89
Kapolei Community Park	Community	12.00
Kapolei Regional Park	Regional	69.39
Makakilo Community Park	Community	8.50
Makakilo Neighborhood Park	Neighborhood	4.01
Mauka Lani Neighborhood Park	Neighborhood	4.40
One'ula Beach Park	Beach	30.00
Pu'uloa Neighborhood Park	Neighborhood	4.34
West Beach Shoreline Park, North	Beach	10.00
West Beach Shoreline Park, South	Beach	18.26
Source: *State Comprehensive Outdoor Recreation Plan*, State of Hawai'i, Department of Land and Natural Resources, May 2003		

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Anticipated Impacts and Mitigation Measures

The project includes approximately 210 acres for park and open space. The Petitioner proposes a series of parks and open spaces including a district park with active playfields, proposed to be located within the center of the Ho'opili project. In addition, a Canyon Park, located at the southeastern portion of the Ho'opili project, will provide a unique wilderness-type park alternative for residents. A Civic Plaza is envisioned as a community gathering space for outdoor concerts, farmer's markets, and other community events. Interspersed throughout the project will be "mini" (neighborhood) parks

Open space buffers are proposed to be located along the H-1 Freeway and Old Fort Weaver Road. In addition, linear parks and open space will encircle the Ho'opili project with walking/biking paths. "Mini" parks located throughout the project will be within walking distance of most residences. A regional bikeway plan has been developed in cooperation with UHWO, DHHL and HCDA. Figure 4.6~~3~~: East Kapolei Regional Bikeway Plan shows the approximate alignment of bikeways being proposed by DHHL, UHWO and the Petitioner and how they may connect to bikeways proposed by others (such as HCDA), the bike path shown on the Ewa DP Public Facilities Map, the bikeways shown on the State Bicycle Plan 2003, and park sites proposed by HCDA, DHHL, UHWO and the Petitioner, and possible transit stops (locations being finalized as of this writing). Based on comments received from the City and County of Honolulu Department of Facilities Management during the public review period, project bikeways and walkways not located within road rights-of-ways dedicated to the government will be privately-owned and maintained.

The City and County of Honolulu's Park Dedication Ordinance applies to all new residential developments and will mitigate the demand for recreational facilities. In addition, the project may include organizations that provide recreational and/or social service facilities such as the Boys and Girls Clubs and YMCAs.

The City and County of Honolulu Department of Parks and Recreation (DPR) reviewed the EISPN and Draft EIS, and wrote that it had no comments to offer at this time. As recommended in the City and County of Honolulu Department of Design and Construction (DDC), the Petitioner will meet with City officials from the Department of Planning and Permitting, DDC, and DPR at an early stage in the development's planning process to develop a conceptual plan for overall park development which is acceptable and appropriate.

4.9.6 Public Transit

Existing Conditions

Oahu Transit Services, Inc. under contract to the City and County of Honolulu provides TheBus fixed-route service to the communities adjacent to and in the general vicinity of

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the proposed Ho'opili project. These routes include both suburban trunk routes and express routes. TheBus operates seven bus lines that directly serve the proposed Project and its immediate vicinity, they include:

- **Route A City Express.** Route A operates express service that connects Waipahu and Pearlridge with Downtown and the University of Hawai'i at Mānoa. Service is provided at approximately 15 minute intervals between 4:45 AM and 10:00 PM on weekdays, and 30 minute intervals between 5:00 AM and 8:30 PM on weekends.

- **Route 41 Kapolei Transit Center.** This route serves the Villages of Kapolei areas, including a portion of the Makakilo Drive-Fort Barrette Road. Service is provided approximately at one hour intervals from about 5:00 AM to 9:00 PM, seven days a week.

- **Route 42 'Ewa Beach.** Route 42 provides service along Farrington Highway in the City of Kapolei at half-hour intervals from approximately 6:00 AM to 1:30 AM for westbound travel seven days a week. Eastbound service runs from approximately 4:00 AM to 1:00 AM also seven days a week.

- **Route 43 Waipahu Transit Center.** This route provides service along the H-1 Freeway and through the City of Waipahu, connecting Waipahu to downtown Honolulu. Service is provided seven days a week at half-hour intervals from 7:00 AM to 5:00 PM.

- **Route 81 Waipahu Express (PM)/ Downtown Express (AM).** This route provides express service at approximately 15 minute intervals from Waipahu to Downtown during the morning hours between 4:30 AM and 7:30 AM. Evening service frequency to Waipahu varies from 15 to 30 minute intervals and operates between 3:00 PM and 6:20 PM.

- **Route 91 Downtown Express (AM) / 'Ewa Beach Express (PM).** Service is provided along the H-1 Freeway connecting the Downtown to 'Ewa Beach. Eastbound service on this route runs at 20 minute intervals from 4:30 AM to 7:00 AM, connecting 'Ewa Beach to the Downtown. Westbound service to 'Ewa Beach is provided during the PM hours at 20 minute intervals beginning at 3:25 PM and concluding at 6:15 PM.

- **Route 102 Villages of Kapolei Express.** This route provides three morning Honolulu-bound trips and three afternoon return trips to the Villages of Kapolei during the peak commute periods. The route provides service along Fort Barrette Road and Farrington Highway in the Villages of Kapolei area.

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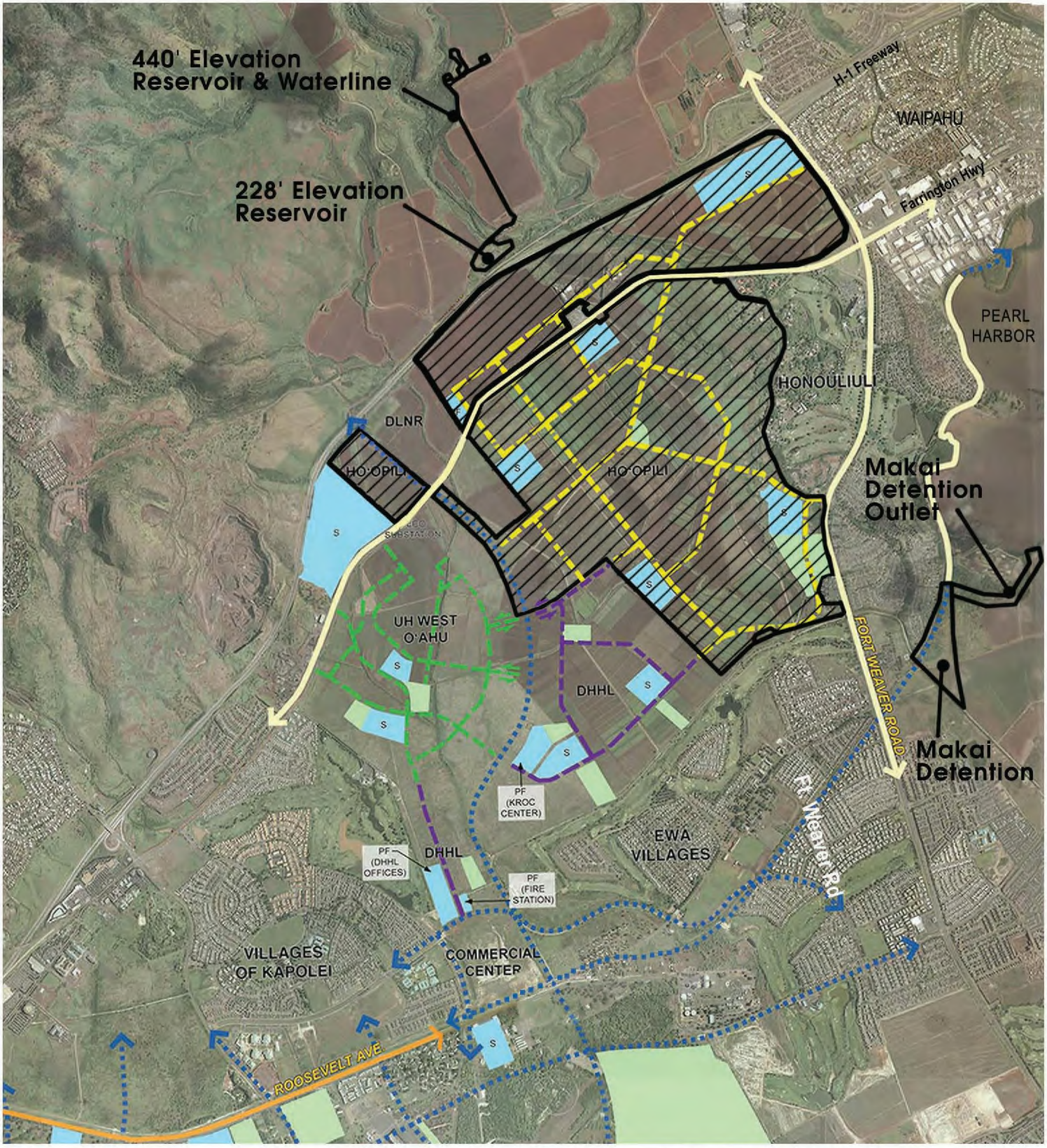

LEGEND

- Project Site Boundary
- Petition Area
- Proposed UH West O'ahu Bikeway
- Proposed Ho'opili Bikeway
- Proposed DHHL Bikeway
- Proposed Bikeway by Others
- Existing State Bike Plan
- Pearl Harbor Historic Trail and Leeward Bikeway
- Proposed Parks
- S Proposed Schools
- PF Proposed Public Facility
- Right-in / Right-out
- Right-in / Right-out

Source: State of Hawaii Department of Transportation Bicycle Plan 2000; Draft Ewa Connectivity Study 2007.

Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 4.6: East Kapolei Regional Bikeway Plan

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET) 0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

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In addition to TheBus express routes, the Leeward Oahu Transportation Management Association (LOTMA) also sponsors an express bus service along Fort Weaver Road to Honolulu with one morning and one afternoon trip.

Future Conditions

The City and County of Honolulu is planning for a high-capacity transit corridor project between Kapolei and the University of Hawai'i at Mānoa. The Honolulu High-Capacity Transit Corridor Project (HHCTCP) has evaluated transit alternatives for the 23-mile long corridor between Kapolei and UH Mānoa. On December 22, 2006, the City Council adopted Bill 79 (2006), CD2, FD2 (Ordinance 07-001) which selected the fixed guideway alternative as the Locally Preferred Alternative (LPA). The LPA route travels between Kapolei and the University of Hawai'i at Mānoa, starting at or near the intersection of Kapolei Parkway and Kalaeloa Boulevard, down Saratoga Avenue to North-South Road (green route) or along Kamokila Boulevard (yellow route), as determined by the City and County of Honolulu administration before or during preliminary engineering. The route then continues to Farrington Highway across Ft. Weaver Road, to Kamehameha Highway to Salt Lake Boulevard and Aolele Street, as determined by the City administration before or during preliminary engineering to downtown Honolulu via Dillingham Boulevard. After leaving Dillingham Boulevard, the alignment would continue along Nimitz Highway, Halekauwila Street and Kapi'olani Boulevard to UH Mānoa with a branch to Waikīkī (See Figure 4.7~~4~~: Planned High-Capacity Transit Corridor & Proposed Transit Station). The City and County of Honolulu will now undertake preliminary engineering and is in the process of preparing the environmental impact statement for the LPA. As the first project, the City Council selected a minimum operable segment (MOS) that will begin near the Kroc Center on North-South Road to Farrington Highway, through Waipahu, Pearl City, Aiea, and via Salt Lake Boulevard through downtown Honolulu to Ala Moana Center. As of this writing, we understand that the portion of the alignment between the Kroc Center and Waipahu, the location of the transit maintenance and storage facility, and the location of potential transit stations are being finalized.

Both of the possible Kapolei alignments include at least one station within the Ho'opili site. If required for the transit project, the Petitioner will coordinate with DTS regarding the possibility of allocating a portion of the project lands for a potential high-capacity transit maintenance and storage facility.

The Fixed Guideway Alternative alignments that are adjacent to the Ho'opili site would either be at-grade with limited grade crossings or on elevated structures. The fixed guideway could be as narrow as 25 feet wide. If the structures are elevated, they would be supported by six foot wide columns and the structure could be about 30 feet tall.

At this time, no decision has been made regarding the technology that would be used for the Fixed Guideway Alternative. This decision will be made at a later stage of project development. The City and County of Honolulu is preparing a Draft EIS and is in the

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process of requesting approval from the Federal Transit Administration to begin preliminary engineering (project design). Now that the City Council has selected the Fixed Guideway Alternative, the area landowners, including DHHL, UHWO and the Petitioner have been coordinating with the Department of Transportation Services in finalizing the high-capacity transit corridor alignment and location of transit stations between the Kroc Center and Waipahu. The earliest that construction could begin on a selected alternative would be 2009. Due to the size and cost of the overall project, it is likely to be built in several phases lasting several years, starting with the first project, or MOS.

Anticipated Impacts and Mitigation Measures

Ho'opili will be designed to be walkable/bikable and transit-ready. The use of public transportation will be encouraged within the Petition Area, as TheBus passes through it along Farrington Highway and transit nodes and corridors are located nearby. With several public schools and retail areas proposed, the Ho'opili Conceptual Land Use Plan is planned as a community in which residents can live, work, play, shop, and attend school. Additionally, the UHWO campus will enable 'Ewa residents to attend an institution of higher learning without commuting to Honolulu. Increased use of public transportation means fewer residents driving their own vehicles and less traffic on roadways. As the Ho'opili Project and the City of Kapolei develop over several years, east-west vehicular traffic to and from Honolulu is likely to gradually adjust as more jobs are created in Kapolei and Kalaeloa. The Petitioner will continue to coordinate with the Department of Transportation Services (DTS) in regards to the Honolulu High-Capacity Transit Corridor Project.

4.9.7 Community Services

Existing Conditions

Community services in the vicinity of the proposed Ho'opili project are listed below:

- Schools (See Section 4.9.1)
- Kapolei Police Station (See Section 4.9.2)
- Three Fire Stations in the 'Ewa Region (See Section 4.9.3)
- Churches
- Shopping Centers in Kapolei and Makakilo
- Public Libraries in Kapolei and Makakilo
- Post Offices in Kapolei and 'Ewa
- Medical Facilities (See Section 4.9.4)
- Recreational Facilities (See Section 4.9.5)
- Public Transit Facilities (See Section 4.9.6)

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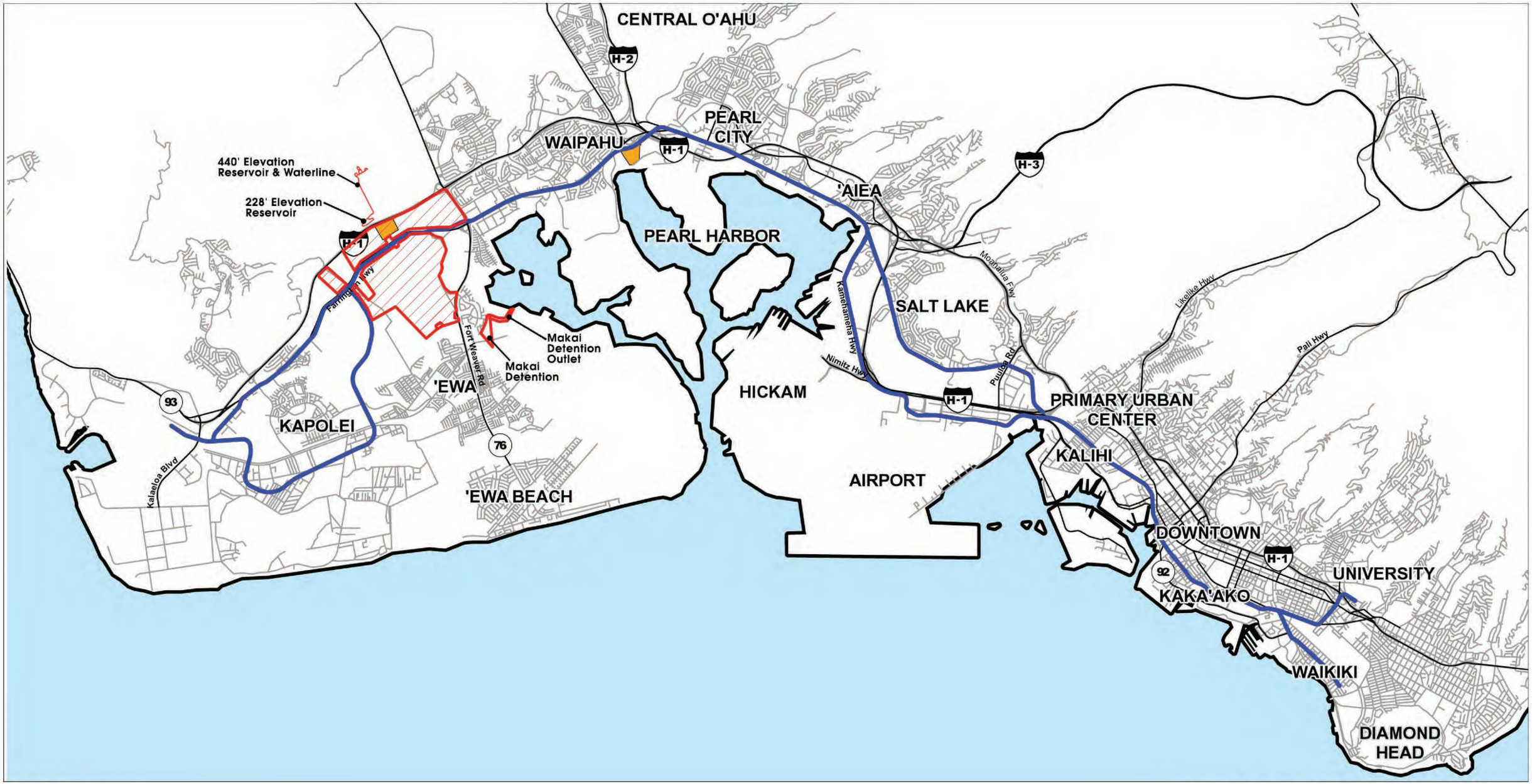

LEGEND

- Project Site Boundary
- Petition Area
- Locally Preferred Alternative
- Maintenance Site Options

Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 4.7: Planned High-Capacity Transit Corridor & Proposed Transit Station

HO'OPILI

O'ahu, Hawai'i

NORTH

Not to Scale

PBR HAWAII & ASSOCIATES, INC.

Anticipated Impacts and Mitigation Measures

The proposed Ho'opili project is not expected to adversely impact the community services in the region. The project's anticipated impacts and mitigation measures on public educational facilities, HPD and HFD facilities, medical facilities, recreational facilities, and public transit facilities were previously mentioned in this section.

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5.0
Relationship to Land Use Plans, Policies, & Controls

5.0 RELATIONSHIP TO LAND USE PLANS, POLICIES, AND CONTROLS

This section discusses the relationship of the proposed project to Federal, State, and County land use plans, policies, and controls for the 'Ewa region. Some of the land use plans, policies and guidelines are in tabular form, and are addressed with text and/or the following letter code:

S = Supportive, N/S = Not Supportive, N/A = Not Applicable.

5.1 FEDERAL

Americans with Disabilities Act. The Americans with Disabilities Act (ADA) of 1990 establishes guidelines for accessibility to buildings and facilities by individuals with disabilities. To the extent required by regulations issued by federal agencies, ADA guidelines will be applied to the Petition Area during the design and construction phases. In addition, the design of public spaces will be integrated to promote greater accessibility for persons with disabilities. It should be noted that most of the Petition Area consists of naturally moderate slopes, thus providing the potential for good accessibility.

National Pollution Discharge Elimination System. A National Pollution Discharge Elimination System (NPDES) permit, administered by the State DOH, will be required for this project. As such, an NPDES permit application will be submitted prior to Grading Permits.

5.2 STATE OF HAWAI'I

5.2.1 Environmental Impact Statement Law, Chapter 343, Hawaii Revised Statutes

This EIS has been prepared in compliance with Chapter 343, *Hawaii Revised Statutes* (HRS). Various agencies, organizations, and individuals were consulted during the pre-consultation phase for the EIS. EISPN comment letters and applicable responses are included in Section 12.0. A 45-day review period will commence upon publication of the Draft EIS in the Office of Environmental Quality Control (OEQC) *The Environmental Notice*. Comment letters on the Draft EIS and applicable responses will be provided in the Final EIS.

5.2.2 State Environmental Policy, Chapter 344, Hawaii Revised Statutes

State Environmental Policy, Chapter 344, HRS establishes a State policy to encourage productive and enjoyable harmony between people and their environment, promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of humanity, and enrich the understanding of the

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ecological systems and natural resources important to the people of Hawai'i. A discussion of the policy guidelines are listed in the table below.

Table 5.1. State Environmental Policy, Chapter 344, Hawaii Revised Statutes

State Environmental Policy, Chapter 344, Hawaii Revised Statutes	S	N/S	N/A
§344-4 Guidelines. In pursuance of the state policy to conserve the natural resources and enhance the quality of life, all agencies, in the development of programs, shall, insofar as practicable, consider the following guidelines:			
(1) POPULATION.			
(A) Recognize population impact as a major factor in environmental degradation and adopt guidelines to alleviate this impact and minimize future degradation;	X		
(B) Recognize optimum population levels for counties and districts within the State, keeping in mind that these will change with technology and circumstance, and adopt guidelines to limit population to the levels determined.	X		
Discussion: The Ho'opili project will provide up to 11,750 residential units. According to the economic/fiscal impact report, Ho'opili project would increase the overall regional population by approximately 35,290 residents. The population increase is consistent with the City and County of Honolulu's policy to direct future growth to the 'Ewa region.			
(2) LAND, WATER, MINERAL, AIR, AND OTHER NATURAL RESOURCES.			
(A) Encourage management practices which conserve and fully utilize all natural resources;	X		
(B) Promote irrigation and waste water management practices which conserve and fully utilize vital water resources;	X		
(C) Promote the recycling of waste water;	X		
(D) Encourage management practices which conserve and protect watersheds and water sources, forest, and open space areas;			X
(E) Establish and maintain natural area preserves, wildlife preserves, forest reserves, marine preserves, and unique ecological preserves;			X
(F) Maintain an integrated system of state land use planning which coordinates the state and county general plans.			X
(G) Promote the optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling so that all our wastes become utilized.	X		
Discussion: Sustainability options are being considered for the Ho'opili project.			
(3) FLORA AND FAUNA.			
(A) Protect endangered species of indigenous plants and animals and introduce new plants or animals only upon assurance of negligible ecological hazard;	X		
(B) Foster the planting of native as well as other trees, shrubs, and flowering plants compatible to the enhancement of our environment.	X		
Discussion: None of the plant species identified in the Project Area are considered a threatened or endangered species or a species of concern. A concerted effort was made in surveying for Ko'oloa'ula; however, no plants were observed on the property. As such, the Ho'opili project is not expected to have a significant impact on the botanical resources in the 'Ewa region. No endangered			

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State Environmental Policy, Chapter 344, Hawaii Revised Statutes	S	N/S	N/A
animal species were encountered during fauna surveys of the Project Area.			
(4) PARKS, RECREATION, AND OPEN SPACE.			
(A) Establish, preserve and maintain scenic, historic, cultural, park and recreation areas, including the shorelines, for public recreational, educational, and scientific uses;	X		
(B) Protect the shorelines of the State from encroachment of artificial improvements, structures, and activities;			X
(C) Promote open space in view of its natural beauty not only as a natural resource but as an ennobling, living environment for its people.	X		
Discussion: The Ho'opili project includes approximately 210 acres of parks and open space within the Petition Area. A hierarchy of open spaces will be provided throughout the Petition Area, which includes a downtown civic plaza. A district park is being planned along Old Fort Weaver Road. In addition, a significant open space and pedestrian/bicycle trail network will provide a wide variety of recreational opportunities for residents and visitors alike. A variety of open space buffers are planned along H-1 Freeway, Honouliuli Gulch, and Old Fort Weaver Road to promote the connectivity of the Ho'opili project to adjacent neighborhoods. Project landscaping, the provision of view corridors, and sensitive architectural design will set the visual character of the area.			
(5) ECONOMIC DEVELOPMENT.			
(A) Encourage industries in Hawaii which would be in harmony with our environment;			X
(B) Promote and foster the agricultural industry of the State; and preserve and conserve productive agricultural lands;			X
(C) Encourage federal activities in Hawaii to protect the environment;			X
(D) Encourage all industries including the fishing, aquaculture, oceanography, recreation, and forest products industries to protect the environment;			X
(E) Establish visitor destination areas with planning controls which shall include but not be limited to the number of rooms;			X
(F) Promote and foster the aquaculture industry of the State; and preserve and conserve productive aquacultural lands.			X
Discussion: Within the Petition Area, lands will be gradually withdrawn from agricultural production for the proposed Ho'opili project. This will result in some loss in revenues, jobs, or payroll. However, the State and Count have long planned for new development in the Petition Area, and tenants have been fully aware, for quite some time, that the proposed Petition Area would be used to accommodate for future urban development in the region.			
(6) TRANSPORTATION.			
(A) Encourage transportation systems in harmony with the lifestyle of the people and environment of the State;	X		
(B) Adopt guidelines to alleviate environmental degradation caused by motor vehicles;	X		
(C) Encourage public and private vehicles and transportation systems to conserve energy, reduce pollution emission, including noise, and provide safe and convenient accommodations for their users.	X		
Discussion: The proposed Ho'opili project is envisioned as a "complete" community where residents can live, work, learn, play, and shop within the 'Ewa region, thus alleviating traffic to other destinations in Honolulu. Since much of the morning commute from 'Ewa is towards downtown Honolulu and the University of Hawai'i at Mānoa, as Kapolei (including the proposed Ho'opili			

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State Environmental Policy, Chapter 344, Hawaii Revised Statutes	S	N/S	N/A
project) generates more employment and career opportunities, and University of Hawai'i at West O'ahu develops, the morning commute on the H-1 Freeway should lessen. Ho'opili is conveniently located near major transportation facilities, and is designed to be bus/high-capacity transit-ready with a vast, interconnected internal street grid that provides numerous ways of getting around by rail transit, bus, walking, bicycle and car. The Ho'opili project will reduce commuting time and distances for residents in the 'Ewa region. The Ho'opili mixed-use community contains a series of neighborhoods with a myriad of uses including residential, retail, office, and light industrial which would reduce the necessity to travel outside of the region. Within the petition area, pedestrian walkways and bicycle lanes will encourage non-motorized forms of transportation and reduce fossil fuel consumption.			
(7) ENERGY.			
(A) Encourage the efficient use of energy resources.	X		
Discussion: Project buildings, activities, and site grounds are planned to be designed with energy-saving considerations, and the project will be consistent with State's objective to promote cost-effective energy conservation through the adoption of energy-efficient practices and technologies. Given the natural climate, the project may be suited for the use of renewable energy technologies including photovoltaics. In addition, based on the Department of Business, Economic Development & Tourism (DBEDT), Strategic Industries Division's recommendations, Ho'opili's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies.			
(8) COMMUNITY LIFE AND HOUSING.			
(A) Foster lifestyles compatible with the environment; preserve the variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods which reflect the culture and mores of the community;	X		
(B) Develop communities which provide a sense of identity and social satisfaction in harmony with the environment and provide internal opportunities for shopping, employment, education, and recreation;	X		
(C) Encourage the reduction of environmental pollution which may degrade a community;	X		
(D) Foster safe, sanitary, and decent homes;	X		
(E) Recognize community appearances as major economic and aesthetic assets of the counties and the State; encourage green belts, plantings, and landscape plans and designs in urban areas; and preserve and promote mountain-to-ocean vistas.	X		
Discussion: The proposed Ho'opili project is envisioned as a "complete" community, where residents can live, work, learn, play, and shop. The project would include a mixed-use community that would complete and connect 'Ewa with the surrounding communities. Originating from the common vision and values of a community-driven planning effort, the conceptual plan contains a series of neighborhoods with a mix of uses including residential, retail, office and light industrial. Included in this mix are a series of parks, schools, public buildings and community centers which act as a focus and help define the identity of each neighborhood. Ho'opili will be connected to the surrounding 'Ewa District by a network of streets and bicycle paths which allow a variety of circulation options for residents and visitors. In the geographical center of the site there is a public square or Civic Plaza that is surrounded by higher density housing			

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State Environmental Policy, Chapter 344, Hawaii Revised Statutes	S	N/S	N/A
development and mixed-use buildings. Housing intensity transitions to lower density small lot single-family homes along the eastern and southern peripheries of the site. A significant open space and pedestrian/bicycle trail network provides a wide variety of recreational opportunities for residents and other members of the 'Ewa community. Ho'opili will incorporate traditional Hawaiian building styles with a modern, contemporary aesthetic and will reflect the landscape and climate. Sustainability options are being considered for the Ho'opili project.			
§(9) EDUCATION AND CULTURE.			
(A) Foster culture and the arts and promote their linkage to the enhancement of the environment;	**X**		
(B) Encourage both formal and informal environmental education to all age groups.			**X**
Discussion: While the residential population within Kapolei has grown as planned, it lacks much of the culture and the arts which are available within the Primary Urban Center. The Ho'opili project is planned to include a series of parks, schools, public buildings and community centers which act as a focus and help define the identity of each neighborhood.			
(10) CITIZEN PARTICIPATION.			
(A) Encourage all individuals in the State to adopt a moral ethic to respect the natural environment; to reduce waste and excessive consumption; and to fulfill the responsibility as trustees of the environment for the present and succeeding generations; and	**X**		
(B) Provide for expanding citizen participation in the decision making process so it continually embraces more citizens and more issues.			**X**
Discussion: Recycling shall be encouraged within the project including the reuse and recycling of green waste generated during construction clearing and grubbing activities, the use of recycled construction and demolition wastes and the use of materials made from recycled products, the use of locally produced compost as available for landscaping, and the provision of space for recycling bins in the detailed design of the community. The City and County of Honolulu is restarting its curbside pick up recycling program. In November, 2007, two pilot curbside recycling programs began in Mililani and Hawai'i Kai. During the six- to twelve-month evaluation period, the City and County of Honolulu Department of Environmental Services staff will be coordinating plans for island-wide expansion. On June 27, 2008, the Associated Press reported that Mililani and Hawai'i Kai residents have recycled 54 percent of their cans, bottles, newspapers and green waste during the city's six-month curbside recycling pilot project. City Officials with the City and County of Honolulu Department of Environmental Services (DES) are reportedly satisfied with the results and are moving forward with plans to provide some 160,000 O'ahu homes the curbside recycling service by May 2010. In the new plan, the city will collect garbage and recyclables each once a week. The DES will no longer have garbage pickup twice-weekly. A study released by DES predicts the program will divert an estimated 53,800 tons of mixed recyclables and green waste from O'ahu landfills. They plan to begin expanding the program to more communities in November 2008.			

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5.2.3 State Land Use Law, Chapter 205, Hawaii Revised Statutes

The *State Land Use Law* (Chapter 205, HRS) establishes the State Land Use Commission (LUC) and designates all lands in the State of Hawai'i into four districts: Urban, Rural, Agricultural, and Conservation.

The Petition Area is within the State Agricultural District (See Figure 2.4: State Land Use District). As such, a State Land Use District Boundary Amendment will be sought to change the site from the Agricultural District to the Urban District.

The LUC's decision making criteria for petitions for reclassification of district boundaries can be found in Section 205-17, HRS, and Section 15-15-77, HAR. Additionally, Section 15-15-18, HAR contains standards used in determining the Urban district. The following table is an analysis of how the project conforms to these criteria and standards.

Table 5.2. State Land Use Law Chapter 205, Hawaii Revised Statutes, Section 15-15-77, Hawaii Administrative Rules

State Land Use Law Chapter 205, Hawaii Revised Statutes, Section 15-15-77, Hawaii Administrative Rules	S	N/S	N/A
LAND USE COMMISSION DECISION MAKING CRITERIA			
HRS §205-17 Land use commission decision making criteria. In its review of any petition for reclassification of district boundaries pursuant to this chapter, the commission shall specifically consider the following:			
(1) The extent to which the proposed reclassification conforms to the applicable goals, objectives, and policies of the Hawaii state plan and relates to the applicable priority guidelines of the Hawaii state plan and the adopted functional plans;	X		
(2) The extent to which the proposed reclassification conforms to the applicable district standards;	X		
(3) The impact of the proposed reclassification on the following areas of state concern:	X		
(A) Preservation or maintenance of important natural systems or habitats;	X		
(B) Maintenance of valued cultural, historical, or natural resources;	X		
(C) Maintenance of other natural resources relevant to Hawaii's economy, including, but not limited to, agricultural resources;	X		
(D) Commitment of state funds and resources;	X		
(E) Provision of employment opportunities and economic development; and	X		
(F) Provision for housing opportunities for all income groups, particularly the low, low-moderate, and gap groups; and	X		
(4) The representations and commitments made by the petitioner in securing a boundary change.	X		
Discussion: In accordance with Commission Rule § 15-15-77, HAR, and HRS § 205-4(h), and based upon information included in this EIS the district boundary amendment requested by the Petitioner is reasonable, not violative of HRS § 205-2, as amended, and is consistent with the provisions of HRS §§			

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State Land Use Law Chapter 205, Hawaii Revised Statutes, Section 15-15-77, Hawaii Administrative Rules	S	N/S	N/A
205-16, 205-17 and 205A-2 and Chapter 226, as amended. The Petitioner will seek an Order Amending the Land Use District Boundary of the Petition Area from the Agricultural District to the Urban District.			
HAR §15-15-77 Decision-making criteria for boundary amendments.			
(a) The commission shall not approve an amendment of a land use district boundary unless the commission finds upon the clear preponderance of the evidence that the proposed boundary amendment is reasonable, not violative of section 205-2, HRS, and consistent with the policies and criteria established pursuant to sections 205-16, 205-17, and 205A-2, HRS.	X		
(b) In its review of any petition for reclassification of district boundaries pursuant to this chapter, the commission shall specifically consider the following:	X		
(1) The extent to which the proposed reclassification conforms to the applicable goals, objectives, and policies of the Hawaii state plan and relates to the applicable priority guidelines of the Hawaii state plan and the adopted functional plans;	X		
(2) The extent to which the proposed reclassification conforms to the applicable district standards;	X		
(3) The impact of the proposed reclassification on the following areas of state concern;	X		
(A) Preservation or maintenance of important natural systems or habitats;	X		
(B) Maintenance of valued cultural, historical, or natural resources;	X		
(C) Maintenance or other natural resources relevant to Hawaii's economy including, but not limited to agricultural resources;	X		
(D) Commitment of state funds and resources;	X		
(E) Provision for employment opportunities and economic development; and	X		
(F) Provision for housing opportunities for all income groups, particularly the low, low-moderate, and gap groups;	X		
(4) In establishing the boundaries of the districts in each county, the commission shall give consideration to the general plan of the county in which the land is located;	X		
(5) The representations and commitments made by the petitioner in securing a boundary change, including a finding that the petitioner has the necessary economic ability to carry out the representations and commitments relating to the proposed use or development; and	X		
(6) Lands in intensive agricultural use for two years prior to date of filing of a petition or lands with a high capacity for intensive agricultural use shall not be taken out of the agricultural district unless the commission finds either that the action:	X		
(A) Will not substantially impair actual or potential agricultural production in the vicinity of the subject property or in the county or State; or			X
(B) Is reasonably necessary for urban growth.	X		
(c) Amendments of a land use district boundary in conservation districts involving land areas fifteen acres or less shall be determined by the commission pursuant to this subsection and section 205-3.1, HRS.			X
(d) Amendments of land use district boundary in other than conservation districts involving land areas fifteen acres or less shall be determined by the			X

State Land Use Law Chapter 205, Hawaii Revised Statutes, Section 15-15-77, Hawaii Administrative Rules	S	N/S	N/A
appropriate county land use decision-making authority for the district.			
(e) Amendments of a land use district boundary involving land areas greater than fifteen acres shall be determined by the commission, pursuant to this subsection and section 205-3.1, HRS.	X		
Discussion: The proposed action is consistent with the standards for determining boundaries of the Urban district pursuant to HAR § 15-15-18. Reclassification of the Petition Area to the Urban District and the subsequent City and County of Honolulu Change of Zone Application would permit the Petition Area to conform to the surrounding land uses and would permit the low-to medium-density residential uses and recreational development.			
STANDARDS FOR DETERMINING URBAN DISTRICT BOUNDARIES			
HAR §15-15-18 Standards for determining "U" urban district boundaries. Except as otherwise provided in this chapter, in determining the boundaries for the "U" urban district, the following standards shall be used:			
(1) It shall include lands characterized by "city-like" concentrations of people, structures, streets, urban level of services and other related land uses;	X		
(2) It shall take into consideration the following specific factors:	X		
(A) Proximity to centers of trading and employment except where the development would generate new centers of trading and employment;	X		
(B) Availability of basic services such as schools, parks, wastewater systems, solid waste disposal, drainage, water, transportation systems, public utilities, and police protection; and	X		
(C) Sufficient reserve areas for foreseeable urban growth;	X		
(3) It shall include lands with satisfactory topography, drainage, and reasonably free from the danger of any flood, tsunami, unstable soil condition, and other adverse environmental effects;	X		
(4) Land contiguous with existing urban areas shall be given more consideration than non-contiguous land, and particularly when indicated for future urban use on state or county general plans;	X		
(5) It shall include lands in appropriate locations for new urban concentrations and shall give consideration to areas of urban growth as shown on the state and county general plans;	X		
(6) It may include lands which do not conform to the standards in paragraphs (1) to (5):	X		
(A) When surrounded by or adjacent to existing urban development; and	X		
(B) Only when those lands represent a minor portion of this district;			X
(7) It shall not include lands, the urbanization of which will contribute toward scattered spot urban development, necessitating unreasonable investment in public infrastructure or support services; and	X		
(8) It may include lands with a general slope of twenty per cent or more if the commission finds that those lands are desirable and suitable for urban purposes and that the design and construction controls, as adopted by any federal, state, or county agency, are adequate to protect the public health, welfare and safety, and the public's interests in the aesthetic quality of the landscape.			X
Discussion: The Ho'opili project is consistent with the standards for determining boundaries of the Urban District pursuant to Section 15-15-18, HAR, and as such, a State Land Use District Boundary Amendment will be sought to change the site from the Agricultural District to the Urban District. The			

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State Land Use Law Chapter 205, Hawaii Revised Statutes, Section 15-15-77, Hawaii Administrative Rules	S	N/S	N/A
majority of adjacent lands that surround the Petition Area are within the Urban District. Existing residential developments include: Waipahu Town to the northeast; Honouliuli and West Loch Estates to the east; and 'Ewa Villages and 'Ewa Villages Golf Course to the south. Vacant lands to the west are slated for future development by UHWO and DHHL. The lands to the north of the Petition Area are within the Agricultural State Land Use District, and are mauka of the City and County of Honolulu's Ewa DP Urban Growth Boundary. The Petition Area lies within the City and County of Honolulu's Ewa DP Urban Growth Boundary, and as such, reclassification of the Petition Area to the Urban District and subsequent City and County of Honolulu Change of Zone application would permit the Petition Area to conform to the surrounding land uses and would permit the low-to medium-density residential uses and recreational development. Urbanization of 'Ewa is further assumed by the City and County of Honolulu through the planning of HHCTC alignment through the Petition Area.			

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5.2.4 Coastal Zone Management Program, Chapter 205A, Hawaii Revised Statutes

All lands of the State of Hawai'i are included within the Coastal Zone Management (CZM) Area as defined in Chapter 205A, HRS. As such, the Petition Area is within the CZM Area; however, it is not located along a shoreline.

The objectives and policies of the CZM Program are discussed in the table below.

Table 5.3. Coastal Zone Management Act, Chapter 205A, Hawaii Revised Statutes

Coastal Zone Management Act, Chapter 205A, Hawaii Revised Statutes	S	N/S	N/A
RECREATIONAL RESOURCES			
Objective			
(A) Provide coastal recreational opportunities accessible to the public.			
Policies			
(A) Improve coordination and funding of coastal recreational planning and management; and			X
(B) Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:			X
(i) Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;			X
(ii) Requiring replacement of coastal resources having significant recreational value including, but not limited to, surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;			X
(iii) Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;			X
(iv) Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;			X
(v) Ensuring public recreational uses of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;			X
(vi) Adopting water quality standards and regulating point and nonpoint sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;			X
(vii) Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and			X
(viii) Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, and county authorities; and crediting such dedication against the requirements of section 46-6.			X
Discussion: The majority of the Ho'opili project is located in Zone D, areas in which flood hazards			

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Coastal Zone Management Act, Chapter 205A, Hawaii Revised Statutes	S	N/S	N/A
are undetermined (See Figure 3.5: Flood Insurance Rate Map). A very small portion of Parcel C within Honouliuli Stream is located in Zone AE and X. A portion of Parcel B within Honouliuli Stream is located in Zone A and Zone X. However, with the proposed development and associated drainage improvements, surface flows will be better managed. With respect to the portion of the project within the Kalo'i drainage basin, the project will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. With respect to the Honouliuli Stream drainage basin, the project will provide detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed the 10-year recurrence flow rate. With respect to the West Loch drainage basin, the project intends to collect all storm water and route it to the existing detention basin located on the east side of Fort Weaver Road and south of the OR&L railroad tracks. Off-site drainage improvements will comply with all applicable governmental rules and regulations. Since the property is located inland, the project is not anticipated to impact access to coastal resources.			
HISTORIC RESOURCES			
Objective			
(A) Protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.			
Policies			
(A) Identify and analyze significant archaeological resources;	**X**		
(B) Maximize information retention through preservation of remains and artifacts or salvage operations; and	**X**		
(C) Support state goals for protection, restoration, interpretation, and display of historic resources.	**X**		
Discussion: According to SHPD, the archaeological inventory survey report is now accepted in fulfillment of Sections 13-284 and 13-276, HAR (See Appendix E). A preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for its review and approval.			
SCENIC AND OPEN SPACE RESOURCES			
Objective			
(A) Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.			
Policies			
(A) Identify valued scenic resources in the coastal zone management area;			**X**
(B) Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;			**X**
(C) Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and			**X**
(D) Encourage those developments that are not coastal dependent to locate in inland areas.			**X**
Discussion: The Ho'opili project is located outside of the Special Management Area. As such, coastal scenic resources will not be significantly affected by the development. Open space buffers are proposed to be located along the H-1 Freeway and Old Fort Weaver Road. In addition, linear parks and open space will encircle the Ho'opili project with walking/biking paths.			
COASTAL ECOSYSTEMS			
Objective			

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Coastal Zone Management Act, Chapter 205A, Hawaii Revised Statutes	S	N/S	N/A
(A) Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.			
Policies			
(A) Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;			X
(B) Improve the technical basis for natural resource management;			X
(C) Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;			X
(D) Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and			X
(E) Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures.			X
Discussion: The Ho'opili project does not front the natural shoreline. With respect to the portion of the project within the Kalo'i drainage basin, the project will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. With respect to the Honouliuli Stream drainage basin, the project will provide detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed the 10-year recurrence flow rate. With respect to the West Loch drainage basin, the project intends to collect all storm water and route it to the existing detention basin located on the east side of Fort Weaver Road and south of the OR&L railroad tracks.			
ECONOMIC USES			
Objective			
(A) Provide public or private facilities and improvements important to the State's economy in suitable locations.			
Policies			
(A) Concentrate coastal dependent development in appropriate areas;			X
(B) Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor industry facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and			X
(C) Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:			X
(i) Use of presently designated locations is not feasible;			X
(ii) Adverse environmental effects are minimized; and			X
(iii) The development is important to the State's economy.			X
Discussion: The Ho'opili project will provide various employment opportunities in the rapidly growing 'Ewa region. The project is located mauka of the shoreline and does not propose any coastal-dependent development. The land uses planned for the project are well inland of coastal areas, and coastal resources will not be affected. Visual impacts will be minimized, as the proposed development will be integrated with the surrounding topography, to the extent possible.			
COASTAL HAZARDS			

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Coastal Zone Management Act, Chapter 205A, Hawaii Revised Statutes	S	N/S	N/A
Objective			
(A) Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.			
Policies			
(A) Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;			X
(B) Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint source pollution hazards;			X
(C) Ensure that developments comply with requirements of the Federal Flood Insurance Program; and			X
(D) Prevent coastal flooding from inland projects.			X
Discussion: The Ho'opili project will be designed and constructed in compliance with all applicable Federal, State, and County environmental protection, design, and building standards and regulations, including the Federal Flood Insurance Program. Drainage systems, in compliance with applicable State and County rules and regulations, will mitigate the existing flood hazard potential.			
MANAGING DEVELOPMENT			
Objective			
(A) Improve the development review process, communication, and public participation in the management of coastal resources and hazards.			
Policies			
(A) Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;			X
(B) Facilitate timely processing of applications for development permits and resolve overlapping or conflicting permit requirements; and			X
(C) Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life cycle and in terms understandable to the public to facilitate public participation in the planning and review process.			X
Discussion: No coastal areas or resources are expected to be affected by the proposed development. Applications for required land use entitlements for the proposed project will be reviewed by State and County agencies. Individuals, community groups (such as the Ho'opili Community Task Force), and appropriate County agency personnel have been consulted about the proposed project, and comments received have been incorporated into the planning process and into this document.			
PUBLIC PARTICIPATION			
Objective			
(A) Stimulate public awareness, education, and participation in coastal management.			
Policies			
(A) Promote public involvement in coastal zone management processes;			X
(B) Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and/or organizations concerned with coastal issues, developments, and government activities; and			X
(C) Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts.			X
Discussion: The proposed project is not anticipated to impact coastal resources, nevertheless, the			

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Coastal Zone Management Act, Chapter 205A, Hawaii Revised Statutes	S	N/S	N/A
Petitioner has consulted with various West O'ahu community groups in the formulation of the Ho'opili master plan. This planning effort produced a community-driven vision for the proposed development.			
BEACH PROTECTION			
Objective			
(A) Protect beaches for public use and recreation.			
Policies			
(A) Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;			X
(B) Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities; and			X
(C) Minimize the construction of public erosion-protection structures seaward of the shoreline.			X
Discussion: The Petition Area is not located on or near a beach, nor will it impact coastal resources.			
MARINE RESOURCES			
Objective			
(A) Promote the protection, use, and development of marine and coastal resources to assure their sustainability.			
Policies			
(A) Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;			X
(B) Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;			X
(C) Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;			X
(D) Promote research, study, and understanding of ocean processes, marine life, and other ocean resources in order to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and			X
(E) Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources.			X
Discussion: Since the Petition Area is located away from the shoreline, no coastal or marine resources will be impacted.			

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5.2.5 Hawaii State Plan, Chapter 226, Hawaii Revised Statutes

The *Hawaii State Plan* (Chapter 226, HRS), which serves as a guide for the long-range growth and development of the State, establishes a set of goals, objectives, policies, and priorities for the State. The *Hawaii State Plan* can be divided into three parts: Part I (Overall Theme, Goals, Objectives and Policies); Part II (Planning, Coordination and Implementation); and Part II (Priority Guidelines). The project's conformance to the *Hawaii State Plan* is listed below in Tables 5.4 and 5.5.

Table 5.4. Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies

Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
HRS § 226-1: Findings and Purpose			
HRS § 226-2: Definitions			
HRS § 226-3: Overall Theme			
HRS § 226-4: State Goals. In order to guarantee, for the present and future generations, those elements of choice and mobility that insure that individuals and groups may approach their desired levels of self-reliance and self-determination, it shall be the goal of the State to achieve:			
1) A strong, viable economy, characterized by stability, diversity and growth that enable fulfillment of the needs and expectations of Hawaii's present and future generations.	X		
2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.	X		
3) Physical, social and economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring and of participation in community life.	X		
Discussion: The proposed project is consistent with the State's goal to insure economic stability, diversity, and growth for present and future generations. The Ho'opili project will provide various housing and employment opportunities for the rapidly growing 'Ewa region, which will in turn, relieve development pressures from other areas of O'ahu, particularly the Primary Urban Center, and rural areas such as Wai'anae, North Shore, Ko'olau Loa and Ko'olau Poko.			
HRS § 226-5: Objectives and policies for population.			
(a) It shall be the objective in planning for the State's population to guide population growth to be consistent with the achievement of physical, economic and social objectives contained in this chapter;			
(b) To achieve the population objective, it shall be the policy of this State to:			
(1) Manage population growth statewide in a manner that provides increased opportunities for Hawaii's people to pursue their physical, social and economic aspirations while recognizing the unique needs of each County.	X		
(2) Encourage an increase in economic activities and employment opportunities on the neighbor islands consistent with community needs and desires.			X
(3) Promote increased opportunities for Hawaii's people to pursue	X		

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
their socio-economic aspirations throughout the islands.			
(4) Encourage research activities and public awareness programs to foster an understanding of Hawaii's limited capacity to accommodate population needs and to address concerns resulting from an increase in Hawaii's population.			X
(5) Encourage federal actions and coordination among major governmental agencies to promote a more balanced distribution of immigrants among the states, provided that such actions do not prevent the reunion of immediate family members.			X
(6) Pursue an increase in federal assistance for states with a greater proportion of foreign immigrants relative to their state's population.			X
(7) Plan the development and availability of land and water resources in a coordinated manner so as to provide for the desired levels of growth in each geographic area.	X		
Discussion: According to the City and County of Honolulu Department of Planning and Permitting (DPP), the year 2006 population of the *Ewa Development Plan Area* (DPA) was 86,000 (DPP, 2006). This represented an increase of 25.1 percent from its 2000 population of 68,718. The DPP expects the population of the Ewa DPA to increase to 180,200 by the year 2030. In comparison, the population for the City and County of Honolulu as a whole increased only 3.8 percent from 876,156 to 909,863 between 2000 and 2006. The City and County of Honolulu is expected to experience a population growth of 27.5 percent (241,144 persons) from 876,156 to 1,117,300 total residents during the same 30-year period (2000 to 2030). Besides providing substantial housing opportunities for the 'Ewa region, the Ho'opili project also supports the State's population distribution policies.			
HRS § 226-6: Objectives and policies for the economy in general.			
(a) Planning for the State's economy in general shall be directed toward achievement of the following objectives:			
(1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.	X		
(2) A steadily growing and diversified economic base that is not overly dependent on a few industries, and includes the development and expansion of industries on the neighbor islands.	X		
(b) To achieve the general economic objectives, it shall be the policy of this State to:			
(1) Expand Hawaii's national and international marketing, communication, and/or organizational ties, to increase the State's capacity to adjust to and capitalize upon economic changes and opportunities occurring outside the State.			X
(2) Promote Hawaii as an attractive market for environmentally and socially sound investment activities that benefit Hawaii's people.			X
(3) Seek broader outlets for new or expanded Hawaii business investments.			X
(4) Expand existing markets and penetrate new markets for Hawaii's products and services.	X		
(5) Assure that the basic economic needs of Hawaii's people are maintained in the event of disruptions in overseas transportation.			X
(6) Strive to achieve a level of construction activity responsive to, and consistent with, state growth objectives.	X		
(7) Encourage the formation of cooperatives and other favorable			X

Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
marketing arrangements at the local or regional level to assist Hawaii's small scale producers, manufacturers, and distributors.			
(8) Encourage labor-intensive activities that are economically satisfying and which offer opportunities for upward mobility.			X
(9) Foster greater cooperation and coordination between the government and private sectors in developing Hawaii's employment and economic growth opportunities.	X		
(10) Stimulate the development and expansion of economic activities which will benefit areas with substantial or expected employment problems.	X		
(11) Maintain acceptable working conditions and standards for Hawaii's workers.	X		
(12) Provide equal employment opportunities for all segments of Hawaii's population through affirmative action and nondiscrimination measures.	X		
(13) Encourage businesses that have favorable financial multiplier effects within Hawaii's economy.	X		
(14) Promote and protect intangible resources in Hawaii, such as scenic beauty and the aloha spirit, which are vital to a healthy economy.	X		
(15) Increase effective communication between the educational community and the private sector to develop relevant curricula and training programs to meet future employment needs in general, and requirements of new, potential growth industries in particular.			X
(16) Foster a business climate in Hawaii--including attitudes, tax and regulatory policies, and financial and technical assistance programs--that is conducive to the expansion of existing enterprises and the creation and attraction of new business and industry.			X
Discussion: The Ho'opili project will provide for a diverse range of direct and indirect employment and economic opportunities for Hawai'i residents, both during and after project construction. Short-term construction-related jobs as well as permanent long-term operational jobs will be offered, increasing employment throughout the 'Ewa region and State. With greater employment and economic opportunities, the overall living standards and lifestyles will be enhanced for area residents, who will be able to live, work, learn, play, and shop within the Second City.			
HRS § 226-7: Objectives and policies for the economy - agriculture			
(a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:			
(1) Viability of Hawaii's sugar and pineapple industries.			X
(2) Growth and development of diversified agriculture throughout the State.		X	
(3) An agriculture industry that continues to constitute a dynamic and essential component of Hawaii's strategic, economic, and social well-being.			X
(b) To achieve the agriculture objectives, is shall be the policy of this State to:			
(1) Establish a clear direction for Hawaii's agriculture through stakeholder commitment and advocacy.			X
(2) Encourage agriculture by making best use of natural resources.			X
(3) Provide the governor and the legislature with information and			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
options needed for prudent decision making for the development of agriculture.			
(4) Establish strong relationships between the agricultural and visitor industries for mutual marketing benefits.			X
(5) Foster increased public awareness and understanding of the contributions and benefits of agriculture as a major sector of Hawaii's economy.			X
(6) Seek the enactment and retention of federal and state legislation that benefits Hawaii's agricultural industries.			X
(7) Strengthen diversified agriculture by developing an effective promotion, marketing, and distribution system between Hawaii's producers and consumer markets locally, on the continental United States, and internationally.			X
(8) Support research and development activities that provide greater efficiency and economic productivity in agriculture.			X
(9) Enhance agricultural growth by providing public incentives and encouraging private initiatives.			X
(10)Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.			X
(11) Increase the attractiveness and opportunities for an agricultural education and livelihood.			X
(12)Expand Hawaii's agricultural base by promoting growth and development of flowers, tropical fruits and plants, livestock, feed grains, forestry, food crops, aquaculture, and other potential enterprises.			X
(13)Promote economically competitive activities that increase Hawaii's agricultural self-sufficiency.			X
(14)Promote and assist in the establishment of sound financial programs for diversified agriculture.			X
(15)Institute and support programs and activities to assist the entry of displaced agricultural workers into alternative agricultural or other employment.			X
(16)Facilitate the transition of agricultural lands in economically nonfeasible agricultural production to economically viable agricultural uses.			X

Discussion: The agricultural policies are predominantly not applicable to the Ho'opili project. These policies were developed prior to the contraction of the sugarcane and pineapple industries, and as such, in the post "plantation" era, there is an abundant supply of land available for diversified agriculture.

The Ho'opili project lies within the State Agricultural District (See Figure 2.4: State Land Use District). As such, a State Land Use District Boundary Amendment will be sought to change the site from the Agricultural District to the Urban District. The proposed State Land Use District Boundary Amendment is consistent with the standards for determining boundaries of the Urban District as the majority of adjacent lands that surround the Petition Area are within the Urban District. The Petition Area lies within the City and County of Honolulu's Ewa DP Urban Growth Boundary, and as such, reclassification of the Petition Area to the Urban District and subsequent City and County of Honolulu Change of Zone application would permit the Petition Area to conform to the surrounding land uses and would permit the low- to medium-density residential uses.

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
HRS § 226-8: Objectives and policies for the economy – visitor industry			
(a) Planning for the State's economy with regard to the visitor industry shall be directed towards the achievement of the objective of a visitor industry that constitutes a major component of steady growth for Hawaii's economy.			
(b) To achieve the visitor industry objective, it shall be the policy of this State to:			
(1) Support and assist in the promotion of Hawaii's visitor attractions and facilities.			X
(2) Ensure that visitor industry activities are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people.			X
(3) Improve the quality of existing visitor destination areas.			X
(4) Encourage cooperation and coordination between the government and private sectors in developing and maintaining well-designed, adequately serviced visitor industry and related developments which are sensitive to neighboring communities and activities.			X
(5) Develop the industry in a manner that will continue to provide new job opportunities and steady employment for Hawaii's people.			X
(6) Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the visitor industry.			X
(7) Foster a recognition of the contribution of the visitor industry to Hawaii's economy and the need to perpetuate the aloha spirit.			X
(8) Foster an understanding by visitors of the aloha spirit and of the unique and sensitive character of Hawaii's cultures and values.			X
Discussion: While the State's policies related to the economy and visitor industry are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives.			
HRS § 226-9: Objective and policies for the economy – federal expenditures			
(a) Planning for the State's economy with regard to federal expenditures shall be directed towards achievement of the objective of a stable federal investment base as an integral component of Hawaii's economy.			
(b) To achieve the federal expenditures objective, it shall be the policy of this State to:			
(1) Encourage the sustained flow of federal expenditures in Hawaii that generates long-term government civilian employment.			X
(2) Promote Hawaii's supportive role in national defense.			X
(3) Promote the development of federally supported activities in Hawaii that respect state-wide economic concerns, are sensitive to community needs, and minimize adverse impacts on Hawaii's environment.			X
(4) Increase opportunities for entry and advancement of Hawaii's people into federal government service.			X
(5) Promote federal use of local commodities, services, and facilities available in Hawaii.			X
(6) Strengthen federal-state-county communication and coordination in all federal activities that affect Hawaii.			X
(7) Pursue the return of federally controlled lands in Hawaii that are not required for either the defense of the nation or for other purposes of national importance, and promote the mutually beneficial exchanges of land between federal agencies, the State,			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
and the counties.			
Discussion: While the State's policies related to the economy and federal expenditures are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives.			
HRS § 226-10: Objectives and policies for the economy – potential growth activities.			
(a) Planning for the State's economy with regard to potential growth activities shall be directed towards achievement of the objective of development and expansion of potential growth activities that serve to increase and diversify Hawaii's economic base.			
(b) To achieve the information industry objective, it shall be the policy of this State to:			
(1) Facilitate investment and employment in economic activities that have the potential for growth such as diversified agriculture, aquaculture, apparel and textile manufacturing, film and television production, and energy and marine-related industries.			X
(2) Expand Hawaii's capacity to attract and service international programs and activities that generate employment for Hawaii's people.			X
(3) Enhance and promote Hawaii's role as a center for international relations, trade, finance, services, technology, education, culture, and the arts.			X
(4) Accelerate research and development of new energy-related industries based on wind, solar, ocean, and underground resources and solid waste.			X
(5) Promote Hawaii's geographic, environmental, social, and technological advantages to attract new economic activities into the State.			X
(6) Provide public incentives and encourage private initiative to attract new industries that best support Hawaii's social, economic, physical, and environmental objectives.			X
(7) Increase research and the development of ocean-related economic activities such as mining, food production, and scientific research.			X
(8) Develop, promote, and support research and educational and training programs that will enhance Hawaii's ability to attract and develop economic activities of benefit to Hawaii.			X
(9) Foster a broader public recognition and understanding of the potential benefits of new, growth-oriented industry in Hawaii.			X
(10)Encourage the development and implementation of joint federal and state initiatives to attract federal programs and projects that will support Hawaii's social, economic, physical, and environmental objectives.			X
Discussion: While the State's policies related to the economy and potential growth activities are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives.			
HRS § 226-10.5: Objectives and policies for the economy – information industry			
(a) Planning for the State's economy with regard to the information industry shall be directed toward the achievement of the objective of positioning Hawaii as the leading dealer in information businesses and services in the Pacific Rim.			
(b) To achieve the information industry objective, it shall be the policy of this State to:			
(1) Encourage the continued development and expansion of the telecommunications infrastructure serving Hawaii to accommodate			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
future growth in the information industry;			
(2) Facilitate the development of new business and service ventures in the information industry which will provide employment opportunities for the people of Hawaii;			X
(3) Encourage greater cooperation between the public and private sectors in developing and maintaining a well- designed information industry;			X
(4) Ensure that the development of new businesses and services in the industry are in keeping with the social, economic, and physical needs and aspirations of Hawaii's people;			X
(5) Provide opportunities for Hawaii's people to obtain job training and education that will allow for upward mobility within the information industry;			X
(6) Foster a recognition of the contribution of the information industry to Hawaii's economy; and			X
(7) Assist in the promotion of Hawaii as a broker, creator, and processor of information in the Pacific.			X
Discussion: While the State's policies related to the economy and information industry are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives.			
HRS § 226-11: Objectives and policies for the physical environment – land-based, shoreline, and marine resources.			
(a) Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.			
(1) Prudent use of Hawaii's land-based, shoreline, and marine resources.	X		
(2) Effective protection of Hawaii's unique and fragile environmental resources.			X
(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:			
(1) Exercise an overall conservation ethic in the use of Hawaii's natural resources.	X		
(2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.	X		
(3) Take into account the physical attributes of areas when planning and designing activities and facilities.	X		
(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.	X		
(5) Consider multiple uses in watershed areas, provided such uses do not detrimentally affect water quality and recharge functions.			X
(6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.	X		
(7) Provide public incentives that encourage private actions to protect significant natural resources from degradation or unnecessary depletion.			X
(8) Pursue compatible relationships among activities, facilities, and natural resources.	X		

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
(9) Promote increased accessibility and prudent use of inland and shoreline areas for public recreational, educational, and scientific purposes.	X		
Discussion: Most new development on O'ahu is being directed toward the 'Ewa region, as its physical attributes are compatible with urban development. The physical, environmental, and cultural attributes of the proposed project site are compatible with the land uses proposed. This EIS identifies existing natural and physical site conditions (i.e., slope, soils, drainage characteristics, archaeological sites, flora and fauna, public services and infrastructure) and potential impacts resulting from the Ho'opili project, and proposes measures to mitigate potential impacts.			
HRS § 226-12: Objectives and policies for the physical environment – scenic, natural beauty, and historic resources.			
(a) Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.			
(b) To achieve the scenic, natural beauty, and historic resources objectives, it shall be the policy of this State to:			
(1) Promote the preservation and restoration of significant natural and historic resources.	X		
(2) Provide incentives to maintain and enhance historic, cultural, and scenic amenities.	X		
(3) Promote the preservation of views and vistas to enhance the visual and aesthetic enjoyment of mountains, ocean, scenic landscapes, and other natural features.	X		
(4) Protect those special areas, structures, and elements that are an integral and functional part of Hawaii's ethnic and cultural heritage.	X		
(5) Encourage the design of developments and activities that complement the natural beauty of the islands.	X		
Discussion: The archaeological inventory survey report has been accepted by SHPD in fulfillment of Section 13-284 and 13-276, HAR (See Appendix E). A preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for its review and approval. Should any archaeologically significant artifacts, bones, or other indicators of previous on-site activity be uncovered during the construction phases of development, construction will halt and archaeological resources will be treated in strict compliance with the requirements of the DLNR. Due to the flat topography of the property and adjacent lands, existing views across the site are possible only from surrounding elevated areas such as breaks along the high speed H-1 Freeway. It is acknowledged that the project will alter the character of the existing landscape from open, cultivated fields to long-planned urban development bisected by elevated rail transit. However, similar plans are being proposed by both UHWO and DHHL on surrounding lands..			
HRS § 226-13: Objectives and policies for the physical environment – land, air, and water quality.			
(a) Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:			
(1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.	X		
(2) Greater public awareness and appreciation of Hawaii's environmental resources.	X		
(b) To achieve the land, air, and water quality objectives, it shall be the policy of this State to:			

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
(1) Foster educational activities that promote a better understanding of Hawaii's limited environmental resources.			X
(2) Promote the proper management of Hawaii's land and water resources.	X		
(3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.	X		
(4) Encourage actions to maintain or improve aural and air quality levels to enhance the health and well-being of Hawaii's people.	X		
(5) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.	X		
(6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.	X		
(7) Encourage urban developments in close proximity to existing services and facilities.	X		
(8) Foster recognition of the importance and value of the land, air, and water resources to Hawaii's people, their cultures and visitors.			X
Discussion: The Petitioner recognizes the importance of complying with applicable Federal, State, and County regulations relating to the area's land, air, and water resources. The project is not anticipated to have direct long-term impacts on the quality of land, air, and water resources. Drainage systems, in compliance with applicable State and County rules and regulations, will mitigate the existing flood hazard potential. The potential flood hazard on the property will be mitigated by the development of a system of detention facilities that comply with County drainage regulations. The occurrence of natural hazards such as hurricane, earthquake, and volcanic eruption exist, but are no more likely to affect the property than any other location in the 'Ewa region. The Ho'opili project is surrounded by or in close proximity to existing and planned developments, services and facilities. It is situated between H-1 Freeway (north) and Mango Tree Road (south), and between the planned North-South Road (west) and Old Fort Weaver Road (east). Existing urban uses occur to the south ('Ewa Villages) and east (Honouliuli). New development is planned and/or being constructed to the west (UHWO and DHHL). All new infrastructure and infrastructure improvements will be sized and engineered to accommodate the proposed development.			
HRS § 226-14: Objective and policies for facility systems – in general			
(a) Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.			
(b) To achieve the general facility systems objective, it shall be the policy of this State to:			
(1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with state and county plans.	X		
(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.	X		
(3) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.	X		
(4) Pursue alternative methods of financing programs and projects and cost-saving techniques in the planning, construction, and	X		

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
maintenance of facility systems.			
Discussion: The Ho'opili project will comply with State and County rules and regulations regarding facility system objectives.			
HRS § 226-15: Objectives and policies for facility systems – solid and liquid wastes.			
(a) Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives:			
(1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.	X		
(2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas.	X		
(b) To achieve the solid and liquid waste objectives, it shall be the policy of this State to:			
(1) Encourage the adequate development of sewerage facilities that complement planned growth.	X		
(2) Promote re-use and recycling to reduce solid and liquid wastes and employ a conservation ethic.	X		
(3) Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.			X
Discussion: A gravity wastewater collection system will be designed to City and County standards and ultimately dedicated to the County to serve the project. The point of connection to off-site collection systems will be at the southern boundary of Parcel C and at the common property line with DHHL. The wastewater will be conveyed to Honouliuli WWTP, and therefore, to mitigate the additional burden, the project will participate in the WSFC program and contribute funds to expand the treatment plant. Regarding solid waste, the City and County of Honolulu is restarting its curbside pick up recycling program. In November 2007, two pilot curbside recycling programs began in Mililani and Hawai'i Kai. During the six to twelve month evaluation period, the City and County of Honolulu Department of Environmental Services staff will be coordinating plans for island wide expansion. On June 27, 2008, the Associated Press reported that Mililani and Hawai'i Kai residents have recycled 54 percent of their cans, bottles, newspapers and green waste during the city's six-month curbside recycling pilot project. City Officials with the City and County of Honolulu Department of Environmental Services (DES) are reportedly satisfied with the results and are moving forward with plans to provide some 160,000 O'ahu homes the curbside recycling service by May 2010. In the new plan, the city will collect garbage and recyclables each once a week. The DES will no longer have garbage pickup twice-weekly. A study released by DES predicts the program will divert an estimated 53,800 tons of mixed recyclables and green waste from O'ahu landfills. They plan to begin expanding the program to more communities in November 2008.			
HRS § 226-16: Objectives and policies for facility systems – water.			
(a) Planning for the State's facility systems with regard to water shall be directed towards achievement of the objective of the provision of water to adequately accommodate domestic, agricultural, commercial, industrial, recreational, and other needs within resource capacities.			
(b) To achieve the facility systems water objective, it shall be the policy of this State to:			
(1) Coordinate development of land use activities with existing and potential water supply.	X		
(2) Support research and development of alternative methods to meet			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
future water requirements well in advance of anticipated needs.			
(3) Reclaim and encourage the productive use of runoff water and wastewater discharges.	X		
(4) Assist in improving the quality, efficiency, service, and storage capabilities of water systems for domestic and agricultural use.	X		
(5) Support water supply services to areas experiencing critical water problems.	X		
(6) Promote water conservation programs and practices in government, private industry, and the general public to help ensure adequate water to meet long-term needs.	X		

Discussion: The total average daily source requirement for ultimate build-out is estimated at 3.9 MGD. The future water demand from the proposed project is based on standard civil engineering methodology; it is possible that with the implementation of feasible water conservation appliances, future water demand from the project may be lessened. During the public review period, the BWS wrote: "The developer should also consider rain barrel catchments, water-efficient front- load washer appliances and ultra low-flow toilets." It is intended that source (well supply) would be provided by BWS from existing sources. Although BWS cannot reserve water for future projects, it has indicated that there is water available to meet the estimated water demand for the project (3.9 MGD). Water Facility Charges paid by the Petitioner will be used by the Board to assist in the source replenishment caused by the project's water demands.

New water system demands will require that the Petitioner provide system upgrades to the transmission and storage components to ensure that the system operates effectively and meets BWS standards. These upgrades are described in detail in Section 4.8.2 of this EIS.

With respect to non-potable water requirements, the project will be maximizing non-drinking water usage to minimize the demand on the safe drinking water system. If a suitable supply is made available, ~~S~~street right of ways of the Ho'opili project will have underground non-drinking water distribution systems. It is proposed to upgrade the existing non-drinking water source (EP 5 & 6 located within Parcel C) to a BWS dedicable standard to be used as the source for the non-drinking system. It is also proposed to ultimately allow for future dedication of the non-drinking water system. It is estimated that the ultimate non-drinking water demand for the project will be approximately 2.1 MGD. The Petitioner will consider the use of drought tolerant/low water use plants and the implementation of xeriscaping principles for landscaping within the Ho'opili project to the extent practicable. The installation of an efficient irrigation system, possibly using drip irrigation, will be considered in the design of the project where feasible. Moisture sensors to avoid the operation of the system in the rain and if the ground has adequate moisture would be incorporated into the irrigation system, where feasible.

Another source of non-potable water is reclaimed water. The Honolulu Board of Water Supply (BWS) entered into the water recycling business in 2000 by purchasing the Honouliuli Water Reclamation Facility. Water recycling is one element of a broader BWS strategy to protect O'ahu's aquifers and to conserve water resources through conservation and development of new water supplies. The facility is now irrigating golf courses that were once using brackish water, including West Loch, 'Ewa Villages, Hawai'i Prince, and Coral Creek. The facility is also providing recycled water (at a different level of treatment) to industries at Campbell Industrial Park. The project's main source of non-potable water is still intended to be the caprock aquifer (EP 5 & 6), but the potential use of reclaimed water is being identified as an alternate option.

The project will be maximizing the use of non-potable water for irrigation to minimize the impact

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
on the source component of the BWS system. It is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies. A Conceptual Water Master Plan addressing safe drinking and non-potable water facilities has been prepared and reproduced in its entirety and attached to this EIS as Appendix M ~~will be submitted to~~ for BWS ~~for its~~ review and approval. In addition, construction drawings will be submitted to BWS for its review and approval. During the public review period of the Draft EIS, the DLNR Commission on Water Resource Management requested that "the reuse of storm water and installation of water efficient fixtures be considered" and recommended "the use of xeriscaping and the planting of drought tolerant and salt-tolerant plans to conserve water supplies."			
HRS § 226-17: Objectives and policies for facility systems – transportation.			
(a) Planning for the State's facility systems with regard to transportation shall be directed toward the achievement of the following objectives, giving due consideration to all:			
(1) An integrated multi-modal transportation system that services statewide needs and promotes the efficient, economical, safe, and convenient movement of people and goods.	X		
(2) A statewide transportation system that is consistent with and will accommodate planned growth objectives throughout the State.	X		
(b) To achieve the transportation objectives, it shall be the policy of this State to:			
(1) Design, program, and develop a multi-modal system in conformance with desired growth and physical development as stated in this chapter;	X		
(2) Coordinate state, county, federal, and private transportation activities and programs toward the achievement of statewide objectives;			X
(3) Encourage a reasonable distribution of financial responsibilities for transportation among participating governmental and private parties;	X		
(4) Provide for improved accessibility to shipping, docking, and storage facilities;			X
(5) Promote a reasonable level and variety of mass transportation services that adequately meet statewide and community needs;	X		
(6) Encourage transportation systems that serve to accommodate present and future development needs of communities;	X		
(7) Encourage a variety of carriers to offer increased opportunities and advantages to interisland movement of people and goods;			X
(8) Increase the capacities of airport and harbor systems and support facilities to effectively accommodate transshipment and storage needs;			X
(9) Encourage the development of transportation systems and programs which would assist statewide economic growth and diversification;	X		
(10)Encourage the design and development of transportation systems sensitive to the needs of affected communities and the quality of Hawaii's natural environment;	X		
(11)Encourage safe and convenient use of low-cost, energy-efficient, non-polluting means of transportation;	X		
(12)Coordinate intergovernmental land use and transportation planning activities to ensure the timely delivery of supporting transportation			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
infrastructure in order to accommodate planned growth objectives; and			
(13)Encourage diversification of transportation modes and infrastructure to promote alternate fuels and energy efficiency.	X		
Discussion: The proposed project has been designed to accommodate an integrated multi-modal transportation system, including high capacity (elevated rail) transit, bus, automobile, bicycle and pedestrian modes of travel.			
HRS § 226-18: Objectives and policies for facility systems – energy.			
(a) Planning for the State's facility systems with regard to energy shall be directed toward the achievement of the following objectives, giving due consideration to all:			
(1) Dependable, efficient, and economical statewide energy systems capable of supporting the needs of the people;	X		
(2) Increased energy self-sufficiency where the ratio of indigenous to imported energy use is increased;	X		
(3) Greater energy security in the face of threats to Hawaii's energy supplies and systems; and			X
(4) Reduction, avoidance, or sequestration of greenhouse gas emissions from energy supply and use.	X		
(b) To achieve the energy objectives, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable energy services to accommodate demand.			
(c) To further achieve the energy objectives, it shall be the policy of this State to:			
(1) Support research and development as well as promote the use of renewable energy sources;			X
(2) Ensure that the combination of energy supplies and energy-saving systems is sufficient to support the demands of growth;			X
(3) Base decisions of least-cost supply-side and demand-side energy resource options on a comparison of their total costs and benefits when a least-cost is determined by a reasonably comprehensive, quantitative, and qualitative accounting of their long-term, direct and indirect economic, environmental, social, cultural, and public health costs and benefits;			X
(4) Promote all cost-effective conservation of power and fuel supplies through measures including:	X		
(A) Development of cost-effective demand-side management programs;	X		
(B) Education; and	X		
(C) Adoption of energy-efficient practices and technologies;	X		
(5) Ensure to the extent that new supply-side resources are needed, the development or expansion of energy systems utilizes the least-cost energy supply option and maximizes efficient technologies;			X
(6) Support research, development, and demonstration of energy efficiency, load management, and other demand-side management programs, practices, and technologies;			X
(7) Promote alternate fuels and energy efficiency by encouraging diversification of transportation modes and infrastructure;	X		
(8) Support actions that reduce, avoid, or sequester greenhouse gases in utility, transportation, and industrial sector applications; and	X		
(9) Support actions that reduce, avoid, or sequester Hawaii's			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
greenhouse gas emissions through agriculture and forestry initiatives.			

Discussion: Sustainability options are being considered for the Ho'opili project.

Project buildings, activities, and site grounds are planned to be designed with energy-saving considerations, and the project will strive to be consistent with the State's objective to promote cost-effective energy conservation through the adoption of energy-efficient practices and technologies. Due to the sunny climate, the project will be suited for the use of renewable energy technologies including photovoltaics. During the public review period, the Office of Hawaiian Affairs wrote: "…OHA recommends the use of not only photovoltaic cells but also small wind harvesting electrical generation for peripheral uses such as parking lot lighting."

According to the American Wind Energy Association, small wind energy systems typically range from $3,000 to $5,000 for every kW (kilowatt) of generating capacity, or about $40,000 for a 10 kW system (installed). According to the Hawaiian Electric Company (HECO), wind generation energy resources typically cost approximately $.08 to $.11/kW per hour, however these rates apply to larger wind systems (wind farms) as opposed to individual wind systems whose rates are not readily available by HECO.

Photovoltaic (PV) systems range in price from $8,250 for a one-kW system to more than $40,000 for a five-kW system. According to HECO, internal estimates for photovoltaic (PV) energy resources typically cost approximately $.30 to $.40/kW per hour.

The average energy consumption by a single-family residence in Hawai'i is approximately 600 kW per hour. According to HECO, "Non-firm sources, such as wind and solar, are called "as-available" resources and must be backed up by firm generation to ensure electricity is available when customers need it -- 24 hours a day, regardless of whether the wind is blowing or the sun is shining."

"In addition to not being available 24-hours-a-day, the variability of wind, typical of the trade winds in Hawaii, can cause power problems. It can affect the quality of power produced. Today, a lot of sensitive electronic equipment can be damaged or disrupted by the variability of power produced from sources like the wind. These fluctuations can also place a big strain on the utility's fossil fuel generators if they have to kick in and meet the demand for electricity when the wind power is suddenly not available."

Even when "as-available" resources are available, HECO still needs to cut back on "as-available" renewable energy sources during off-peak periods of electricity use. This is due to scenarios where customer demand for power drops too low, generation must be turned off to cut back on power production. Otherwise, the electric system could potentially overload and become unstable. Furthermore, fossil-fuel generation can only be reduced so much. This on-and-off cycling could lead to damage and accelerated deterioration of fossil-fuel generators. It also causes the generators to burn more fuel than necessary which leads to an increased cost of electricity.

In June 2008, Governor Lingle signed SB 644 which requires that solar water heaters be required before issuance of a building permit on or after January 2010 for single-family residences.

In addition, based on the Department of Business, Economic Development & Tourism (DBEDT), Strategic Industries Division's recommendations, Ho'opili's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies.			
HRS § 226-18.5: Objectives and policies for facility systems—telecommunications.			
(a) Planning for the State's telecommunications facility systems shall be directed towards the achievement of dependable, efficient, and economical statewide telecommunications systems capable of supporting the needs of the people.			
(b) To achieve the telecommunications objective, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable telecommunications services to accommodate demand.			
(c) To further achieve the telecommunications objective, it shall be the policy of this State to:			
(1) Facilitate research and development of telecommunications systems and resources;			X
(2) Encourage public and private sector efforts to develop means for adequate, ongoing telecommunications planning;			X
(3) Promote efficient management and use of existing telecommunications systems and services; and	X		
(4) Facilitate the development of education and training of telecommunications personnel.			X
Discussion: While the State's policies related to telecommunication systems are not directly applicable to the Ho'opili project, the Petitioner will incorporate the latest technologies in telecommunications as an amenity to attract buyers to the project, and it is likely that competing telecommunications companies will offer updated services in order to attract customers.			
HRS § 226-19: Objectives and policies for socio-cultural advancement – housing.			
(a) Planning for the State's socio-cultural advancement with regard to housing shall be directed toward the achievement of the following objectives:			
(1) Greater opportunities for Hawaii's people to secure reasonably priced, safe, sanitary, and livable homes, located in suitable environments that satisfactorily accommodate the needs and desires of families and individuals, through collaboration and cooperation between government and nonprofit and for-profit developers to ensure that more affordable housing is made available to very low-, low- and moderate-income segments of Hawaii's population.	X		
(2) The orderly development of residential areas sensitive to community needs and other land uses.	X		
(3) The development and provision of affordable rental housing by the State to meet the housing needs of Hawaii's people.	X		
(b) To achieve the housing objectives, it shall be the policy of this State to:			
(1) Effectively accommodate the housing needs of Hawaii's people.	X		
(2) Stimulate and promote feasible approaches that increase housing choices for low-income, moderate-income, and gap-group households.	X		
(3) Increase homeownership and rental opportunities and choices in terms of quality, location, cost, densities, style, and size of housing.	X		
(4) Promote appropriate improvement, rehabilitation, and maintenance of existing housing units and residential areas.			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
(5) Promote design and location of housing developments taking into account the physical setting, accessibility to public facilities and services, and other concerns of existing communities and surrounding areas.	X		
(6) Facilitate the use of available vacant, developable, and underutilized urban lands for housing.	X		
(7) Foster a variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods that reflect the culture and values of the community.	X		
(8) Promote research and development of methods to reduce the cost of housing construction in Hawaii.			X
Discussion: The Ho'opili project will construct up to 11,750 residential units of varying housing product types. The Project will consist of for-sale single-family units and multi-family units, with multi-family rental units also available. In accordance with the City and County of Honolulu's affordable housing guidelines, up to 30 percent of the total number of units are expected to be developed as affordable housing units. Details of the affordable housing program in the Ho'opili project that pertain to the regulations and programs of the City and County of Honolulu will be coordinated with the County prior to development. The Ho'opili Conceptual Land Use Plan reflects the desire for a community that provides: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents. The proposed project is envisioned as a new kind of development, one that improves the quality of people's lives by allowing them to live, work, learn, shop and play in their own community.			
HRS § 226-20: Objectives and policies for socio-cultural advancement – health			
(a) Planning for the State's socio-cultural advancement with regard to health shall be directed towards achievement of the following objectives:			
(1) Fulfillment of basic individual health needs of the general public.			X
(2) Maintenance of sanitary and environmentally healthful conditions in Hawaii's communities.	X		
(b) To achieve the health objectives, it shall be the policy of this State to:			
(1) Provide adequate and accessible services and facilities for prevention and treatment of physical and mental health problems, including substance abuse.			X
(2) Encourage improved cooperation among public and private sectors in the provision of health care to accommodate the total health needs of individuals throughout the State.			X
(3) Encourage public and private efforts to develop and promote statewide and local strategies to reduce health care and related insurance costs.			X
(4) Foster an awareness of the need for personal health maintenance and preventive health care through education and other measures.			X
(5) Provide programs, services, and activities that ensure environmentally healthful and sanitary conditions.	X		
(6) Improve the State's capabilities in preventing contamination by pesticides and other potentially hazardous substances through increased coordination, education, monitoring, and enforcement.	X		
Discussion: The Ho'opili project will provide solid waste and wastewater services to ensure maintenance of public health standards. The Petitioner is coordinating with State DOH to develop			

Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
a methodology for the testing of the soils of the Petition Area and the surrounding UHWO site to determine the presence or absence of dioxin in the underlying soils from previous sugar cultivation in the area.			
HRS § 226-21: Objectives and policies for socio-cultural advancement – education.			
(a) Planning for the State's socio-cultural advancement with regard to education shall be directed towards achievement of the objective of the provision of a variety of educational opportunities to enable individuals to fulfill their needs, responsibilities, and aspirations.			
(b) To achieve the education objectives, it shall be the policy of this State to:			
(1) Support educational programs and activities that enhance personal development, physical fitness, recreation, and cultural pursuits of all groups.			X
(2) Ensure the provision of adequate and accessible educational services and facilities that are designed to meet individual and community needs.	X		
(3) Provide appropriate educational opportunities for groups with special needs.	X		
(4) Promote educational programs which enhance understanding of Hawaii's cultural heritage.			X
(5) Provide higher educational opportunities that enable Hawaii's people to adapt to changing employment demands.			X
(6) Assist individuals, especially those experiencing critical employment problems or barriers, or undergoing employment transitions, by providing appropriate employment training programs and other related educational opportunities.			X
(7) Promote programs and activities that facilitate the acquisition of basic skills, such as reading, writing, computing, listening, speaking, and reasoning.	X		
(8) Emphasize quality educational programs in Hawaii's institutions to promote academic excellence.	X		
(9) Support research programs and activities that enhance the education programs of the State.			X
Discussion: The Ho'opili project could include as many as five public school sites, as well as parks, open space and facilities for walking and biking. Approximately 90 acres will be reserved for public schools and facilities to meet the demand for educational facilities in the growing 'Ewa region. In addition, there is a possibility that one or two private schools may be included in the project.			
HRS § 226-22: Objective and policies for socio-cultural advancement – social services			
(a) Planning for the State's socio-cultural advancement with regard to social services shall be directed towards the achievement of the objective of improved public and private social services and activities that enable individuals, families, and groups to become more self-reliant and confident to improve their well-being.			
(b) To achieve the social service objective, it shall be the policy of the State to:			
(1) Assist individuals, especially those in need of attaining a minimally adequate standard of living and those confronted by social and economic hardship conditions, through social services and activities within the State's fiscal capacities.			X
(2) Promote coordination and integrative approaches among public	X		

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
and private agencies and programs to jointly address social problems that will enable individuals, families, and groups to deal effectively with social problems and to enhance their participation in society.			
(3) Facilitate the adjustment of new residents, especially recently arrived immigrants, into Hawaii's communities.			X
(4) Promote alternatives to institutional care in the provision of long-term care for elder and disabled populations.			X
(5) Support public and private efforts to prevent domestic abuse and child molestation, and assist victims of abuse and neglect.			X
(6) Promote programs which assist people in need of family planning services to enable them to meet their needs.			X
Discussion: While the State's policies related to social services are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives. Pursuant to the City and County of Honolulu's affordable housing requirement, thirty percent of the project's residential units will be affordable.			
HRS § 226-23: Objectives and policies for socio-cultural advancement – leisure.			
(a) Planning for the State's socio-cultural advancement with regard to leisure shall be directed towards the achievement of the objective of the adequate provision of resources to accommodate diverse cultural, artistic, and recreational needs for present and future generations.			
(b) To achieve the leisure objectives, it shall be the policy of this State to:			
(1) Foster and preserve Hawaii's multi-cultural heritage through supportive cultural, artistic, recreational, and humanities-oriented programs and activities.			X
(2) Provide a wide range of activities and facilities to fulfill the cultural, artistic, and recreational needs of all diverse and special groups effectively and efficiently.			X
(3) Enhance the enjoyment of recreational experiences through safety and security measures, educational opportunities, and improved facility design and maintenance.			X
(4) Promote the recreational and educational potential of natural resources having scenic, open space, cultural, historical, geological, or biological values while ensuring that their inherent values are preserved.	X		
(5) Ensure opportunities for everyone to use and enjoy Hawaii's recreational resources.	X		
(6) Assure the availability of sufficient resources to provide for future cultural, artistic, and recreational needs.	X		
(7) Provide adequate and accessible physical fitness programs to promote the physical and mental well-being of Hawaii's people.	X		
(8) Increase opportunities for appreciation and participation in the creative arts, including the literary, theatrical, visual, musical, folk, and traditional art forms.			X
(9) Encourage the development of creative expression in the artistic disciplines to enable all segments of Hawaii's population to participate in the creative arts.			X
(10)Assure adequate access to significant natural and cultural resources in public ownership.	X		

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
Discussion: The Petitioner will comply with the City and County of Honolulu's Park Dedication Ordinance. The Ho'opili project includes approximately 210 acres for park and open space. The Petitioner proposes a series of parks and open spaces including a district park with active playfields, proposed to be located within the center of the Ho'opili project. In addition, a Canyon Park, located at the southeastern portion of the Ho'opili project, can provide a unique wilderness-type park alternative for residents. A Civic Plaza is envisioned as a community gathering space for outdoor concerts, farmer's markets, and other community events. Interspersed throughout the project will be "mini" (neighborhood) parks. The project is envisioned to integrate an extensive network of open space and walking/biking paths.			
HRS § 226-24: Objective and policies for socio-cultural advancement – individual rights and personal well-being.			
(a) Planning for the State's socio-cultural advancement with regard to individual rights and personal well-being shall be directed towards achievement of the objective of increased opportunities and protection of individual rights to enable individuals to fulfill their socio-economic needs and aspirations.			
(b) To achieve the individual rights and personal well-being objective, it shall be the policy of this State to:			
(1) Provide effective services and activities that protect individuals from criminal acts and unfair practices and that alleviate the consequences of criminal acts in order to foster a safe and secure environment.			X
(2) Uphold and protect the national and state constitutional rights of every individual.			X
(3) Assure access to, and availability of, legal assistance, consumer protection, and other public services which strive to attain social justice.			X
(4) Ensure equal opportunities for individual participation in society.			X
Discussion: While the State's policies related to an individual's rights and personal well-being are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives.			
HRS § 226-25: Objectives and policies for socio-cultural advancement – culture.			
(a) Planning for the State's socio-cultural advancement with regard to culture shall be directed toward the achievement of the objective of enhancement of cultural identities, traditions, values, customs, and arts of Hawaii's people.			
(b) To achieve the culture objective, it shall be the policy of this State to:			
(1) Foster increased knowledge and understanding of Hawaii's ethnic and cultural heritages and the history of Hawaii.			X
(2) Support activities and conditions that promote cultural values, customs, and arts that enrich the lifestyles of Hawaii's people and which are sensitive and responsive to family and community needs.			X
(3) Encourage increased awareness of the effects of proposed public and private actions on the integrity and quality of cultural and community lifestyles in Hawaii.			X
(4) Encourage the essence of the aloha spirit in people's daily activities to promote harmonious relationships among Hawaii's people and visitors.			X
Discussion: While the State's policies related to culture are not directly applicable to the Ho'opili			

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
project, the Petitioner supports the State's objectives. The project is not anticipated to have an adverse impact of Hawaiian culture, practices, and traditions, and may include some area within the Canyon Park for Hawaiian cultural practices such as the practice of hula.			
HRS § 226-26: Objectives and policies for socio-cultural advancement – public safety.			
(a) Planning for the State's socio-cultural advancement with regard to public safety shall be directed towards the achievement of the following objectives:			
(1) Assurance of public safety and adequate protection of life and property for all people.			X
(2) Optimum organizational readiness and capability in all phases of emergency management to maintain the strength, resources, and social and economic well-being of the community in the event of civil disruptions, wars, natural disasters, and other major disturbances.			X
(3) Promotion of a sense of community responsibility for the welfare and safety of Hawaii's people.			X
(b) To achieve the public safety objectives, it shall be the policy of this State to:			
(1) Ensure that public safety programs are effective and responsive to community needs.			X
(2) Encourage increased community awareness and participation in public safety programs.			X
(c) To further achieve public safety objectives related to criminal justice, it shall be the policy of this State to:			
(1) Support criminal justice programs aimed at preventing and curtailing criminal activities.			X
(2) Develop a coordinated, systematic approach to criminal justice administration among all criminal justice agencies.			X
(3) Provide a range of correctional resources which may include facilities and alternatives to traditional incarceration in order to address the varied security needs of the community and successfully reintegrate offenders into the community.			X
(d) To further achieve public safety objectives related to emergency management, it shall be the policy of this State to:			
(1) Ensure that responsible organizations are in a proper state of readiness to respond to major war-related, natural, or technological disasters and civil disturbances at all times.			X
(2) Enhance the coordination between emergency management programs throughout the State.			X
Discussion: While the State's policies related to culture are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives. The proposed project is located within Honolulu Police Department (HPD) District 8, which encompasses the leeward coast and the 'Ewa Plain. In order to meet the growing needs of the 'Ewa Plain communities, in 2000, the City and County of Honolulu opened the Regional Kapolei Police Station at 1100 Kamokila Boulevard. Fire protection in the *Ewa Development Plan Area* is provided by the Honolulu Fire Department (HFD) 'Ewa Beach Fire Station (an engine company), Makakilo Fire Station (an engine company), and Kapolei Fire Station (an engine and ladder company, and the Battalion 4 Headquarters). The Kapolei Fire Station located in Kapolei Business Park was completed in 1995 to serve the			

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part I. Overall Theme, Goals, Objectives and Policies	S	N/S	N/A
expanding development on the 'Ewa Plain. According to the *Ewa Development Plan*, to meet the projected population and economic growth in 'Ewa by 2020, three fire stations at 'Ewa Villages, Ko 'Olina, and Makaiwa Hills are planned; however, service dates have yet to been determined.			
HRS § 226-27: Objectives and policies for socio-cultural advancement – government.			
(a) Planning the State's socio-cultural advancement with regard to government shall be directed towards the achievement of the following objectives:			
(1) Efficient, effective, and responsive government services at all levels in the State.			X
(2) Fiscal integrity, responsibility, and efficiency in the state government and county governments.			X
(b) To achieve the government objectives, it shall be the policy of this State to:			
(1) Provide for necessary public goods and services not assumed by the private sector.			X
(2) Pursue an openness and responsiveness in government that permits the flow of public information, interaction, and response.			X
(3) Minimize the size of government to that necessary to be effective.			X
(4) Stimulate the responsibility in citizens to productively participate in government for a better Hawaii.			X
(5) Assure that government attitudes, actions, and services are sensitive to community needs and concerns.			X
(6) Provide for a balanced fiscal budget.			X
(7) Improve the fiscal budgeting and management system of the State.			X
(8) Promote the consolidation of state and county governmental functions to increase the effective and efficient delivery of government programs and services and to eliminate duplicative services wherever feasible.			X
Discussion: While the State's policies related to government are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives.			

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Table 5.5. Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines

Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
HRS § 226-101: Purpose. The purpose of this part is to establish overall priority guidelines to address areas of statewide concern.			
HRS § 226-102: Overall direction. The State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in five major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, and quality education.			
HRS § 226-103: Economic priority guidelines.			
(a) Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawaii's people and achieve a stable and diversified economy:			
(1) Seek a variety of means to increase the availability of investment capital for new and expanding enterprises.			
(A) Encourage investments which:			
(i) Reflect long term commitments to the State;			X
(ii) Rely on economic linkages within the local economy;			X
(iii) Diversify the economy;			X
(iv) Reinvest in the local economy;			X
(v) Are sensitive to community needs and priorities; and	X		
(vi) Demonstrate a commitment to provide management opportunities to Hawaii residents.			X
(2) Encourage the expansion of technological research to assist industry development and support the development and commercialization of technological advancements.			X
(3) Improve the quality, accessibility, and range of services provided by government to business, including data and reference services and assistance in complying with governmental regulations.			X
(4) Seek to ensure that state business tax and labor laws and administrative policies are equitable, rational, and predictable.			X
(5) Streamline the building and development permit and review process, and eliminate or consolidate other burdensome or duplicative governmental requirements imposed on business, where public health, safety and welfare would not be adversely affected.			X
(6) Encourage the formation of cooperatives and other favorable marketing or distribution arrangements at the regional or local level to assist Hawaii's small-scale producers, manufacturers, and distributors.			X
(7) Continue to seek legislation to protect Hawaii from transportation interruptions between Hawaii and the continental United States.			X
(8) Provide public incentives and encourage private initiative to develop and attract industries which promise long-term growth potentials and which have the following characteristics:			X
(A) An industry that can take advantage of Hawaii's unique location and available physical and human resources.			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
(B) A clean industry that would have minimal adverse effects on Hawaii's environment.			X
(C) An industry that is willing to hire and train Hawaii's people to meet the industry's labor needs at all levels of employment.			X
(D) An industry that would provide reasonable income and steady employment.			X
(9) Support and encourage, through educational and technical assistance programs and other means, expanded opportunities for employee ownership and participation in Hawaii business.			X
(10)Enhance the quality of Hawaii's labor force and develop and maintain career opportunities for Hawaii's people through the following actions:			X
(A) Expand vocational training in diversified agriculture, aquaculture, information industry, and other areas where growth is desired and feasible.			X
(B) Encourage more effective career counseling and guidance in high schools and post-secondary institutions to inform students of present and future career opportunities.			X
(C) Allocate educational resources to career areas where high employment is expected and where growth of new industries is desired.			X
(D) Promote career opportunities in all industries for Hawaii's people by encouraging firms doing business in the State to hire residents.			X
(E) Promote greater public and private sector cooperation in determining industrial training needs and in developing relevant curricula and on- the-job training opportunities.			X
(F) Provide retraining programs and other support services to assist entry of displaced workers into alternative employment.			X
Discussion: While the State's policies related to are broader than the Ho'opili project, the Petitioner supports the State's objectives, and envisions that the proposed project along with UHWO and DHHL East Kapolei will enhance Kapolei as the "Second City" on O'ahu, and relieve the development pressure caused by Central Business District, on traffic, office rents, et cetera.			
(b) Priority guidelines to promote the economic health and quality of the visitor industry:			
(1) Promote visitor satisfaction by fostering an environment which enhances the Aloha Spirit and minimizes inconveniences to Hawaii's residents and visitors.			X
(2) Encourage the development and maintenance of well-designed, adequately serviced hotels and resort destination areas which are sensitive to neighboring communities and activities and which provide for adequate shoreline setbacks and beach access.			X
(3) Support appropriate capital improvements to enhance the quality of existing resort destination areas and provide incentives to encourage investment in upgrading, repair, and maintenance of visitor facilities.			X
(4) Encourage visitor industry practices and activities which respect, preserve, and enhance Hawaii's significant natural, scenic, historic, and cultural resources.			X
(5) Develop and maintain career opportunities in the visitor industry for Hawaii's people, with emphasis on managerial positions.			X

Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
(6) Support and coordinate tourism promotion abroad to enhance Hawaii's share of existing and potential visitor markets.			X
(7) Maintain and encourage a more favorable resort investment climate consistent with the objectives of this chapter.			X
(8) Support law enforcement activities that provide a safer environment for both visitors and residents alike.			X
(9) Coordinate visitor industry activities and promotions to business visitors through the state network of advanced data communication techniques.			X
Discussion: While the State's policies related to the visitor industry are not directly applicable to the Ho'opili project, the Petitioner supports the State's objectives.			
(c) Priority guidelines to promote the continued viability of the sugar and pineapple industries:			
(1) Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries.			X
(2) Continue efforts to maintain federal support to provide stable sugar prices high enough to allow profitable operations in Hawaii.			X
(3) Support research and development, as appropriate, to improve the quality and production of sugar and pineapple crops.			X
Discussion: The above guidelines are predominantly not applicable to the Ho'opili project. These policies were developed prior to the contraction of the sugarcane and pineapple industries, and as such, in the post "plantation" era, there is an abundant supply of land available for the sugar and pineapple industries, however, their viability is dependent on many factors, such as cheaper cost of production overseas.			
(d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:			
(1) Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands.			X
(2) Assist in providing adequate, reasonably priced water for agricultural activities.			X
(3) Encourage public and private investment to increase water supply and to improve transmission, storage, and irrigation facilities in support of diversified agriculture and aquaculture.			X
(4) Assist in the formation and operation of production and marketing associations and cooperatives to reduce production and marketing costs.			X
(5) Encourage and assist with the development of a waterborne and airborne freight and cargo system capable of meeting the needs of Hawaii's agricultural community.			X
(6) Seek favorable freight rates for Hawaii's agricultural products from interisland and overseas transportation operators.			X
(7) Encourage the development and expansion of agricultural and aquacultural activities which offer long-term economic growth potential and employment opportunities.			X
(8) Continue the development of agricultural parks and other programs to assist small independent farmers in securing agricultural lands and loans.			X
(9) Require agricultural uses in agricultural subdivisions and closely monitor the uses in these subdivisions.			X

Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
(10) Support the continuation of land currently in use for diversified agriculture.			X
Discussion: The agricultural policies are predominantly not applicable to the Ho'opili project. These policies were developed prior to the contraction of the sugarcane and pineapple industries, and as such, in the post "plantation" era, there is an abundant supply of land available for diversified agriculture. The Ho'opili project lies within the State Agricultural District (See Figure 2.4: State Land Use District). As such, a State Land Use District Boundary Amendment will be sought to change the site from the Agricultural District to the Urban District. The proposed State Land Use District Boundary Amendment is consistent with the standards for determining boundaries of the Urban District as the majority of adjacent lands that surround the Petition Area are within the Urban District. The Petition Area lies within the City and County of Honolulu's Ewa DP Urban Growth Boundary, and as such, reclassification of the Petition Area to the Urban District and subsequent City and County of Honolulu Change of Zone application would permit the Petition Area to conform to the surrounding land uses and would permit the low- to medium-density residential uses.			
(e) Priority guidelines for water use and development:			
(1) Maintain and improve water conservation programs to reduce the overall water consumption rate.	X		
(2) Encourage the improvement of irrigation technology and promote the use of nonpotable water for agricultural and landscaping purposes.			X
(3) Increase the support for research and development of economically feasible alternative water sources.			X
(4) Explore alternative funding sources and approaches to support future water development programs and water system improvements.	X		
Discussion: The project will be maximizing the use of non-potable water (both from brackish water sources, as well as reclaimed water) for irrigation to minimize the impact on the source component of the BWS system. It is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies. Low-flow water fixtures and where possible, other water conservation measures will be designed and implemented as part of the proposed development.			
(f) Priority guidelines for energy use and development:			
(1) Encourage the development, demonstration, and commercialization of renewable energy sources.	X		
(2) Initiate, maintain, and improve energy conservation programs aimed at reducing energy waste and increasing public awareness of the need to conserve energy.	X		
(3) Provide incentives to encourage the use of energy conserving technology in residential, industrial, and other buildings.	X		
(4) Encourage the development and use of energy conserving and cost-efficient transportation systems.	X		
Discussion: Based on DBEDT Strategic Industries Division's recommendations, the Petitioner's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies (including solar power and energy-			

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
efficient appliances). The Petitioner is also considering, where practicable, the potential of another source of electrical power. Currently there are businesses that will install photovoltaic panels on the roofs of buildings at no initial cost in return for set rates for electricity.			
(g) Priority guidelines to promote the development of the information industry:			
(1) Establish an information network that will serve as the catalyst for establishing a viable information industry in Hawaii.			X
(2) Encourage the development of services such as financial data processing, a products and services exchange, foreign language translations, telemarketing, teleconferencing, a twenty-four-hour international stock exchange, international banking, and a Pacific Rim management center.			X
(3) Encourage the development of small businesses in the information field such as software development, the development of new information systems and peripherals, data conversion and data entry services, and home or cottage services such as computer programming, secretarial, and accounting services.			X
(4) Encourage the development or expansion of educational and training opportunities for residents in the information and telecommunications fields.			X
(5) Encourage research activities, including legal research in the information and telecommunications fields.			X
(6) Support promotional activities to market Hawaii's information industry services.			X
Discussion: While the State's policies related to the information industry are broader than the Ho'opili project, the Petitioner supports the State's objectives, and would welcome the opportunity to work with both UHWO and area high schools to attract such businesses, train students and provide jobs to high school and UHWO graduates.			
HRS § 226-104: Population growth and land resources priority guidelines.			
(a) Priority guidelines to effect desired statewide growth and distribution:			
(1) Encourage planning and resource management to insure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawaii's people.	X		
(2) Manage a growth rate for Hawaii's economy that will parallel future employment needs for Hawaii's people.			X
(3) Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State.	X		
(4) Encourage major state and federal investments and services to promote economic development and private investment to the neighbor islands, as appropriate.			X
(5) Explore the possibility of making available urban land, low-interest loans, and housing subsidies to encourage the provision of housing to support selective economic and population growth on the neighbor islands.			X
(6) Seek federal funds and other funding sources outside the State for research, program development, and training to provide future			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
employment opportunities on the neighbor islands.			
(7) Support the development of high technology parks on the neighbor islands.			X
(b) Priority guidelines for regional growth distribution and land resource utilization:			
(1) Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures, and away from areas where other important benefits are present, such as protection of important agricultural land/or preservation of lifestyles.	X		
(2) Make available marginal or nonessential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.		X	
(3) Restrict development when drafting of water would result in exceeding the sustainable yield or in significantly diminishing the recharge capacity of any groundwater area.			X
(4) Encourage restriction of new urban development in areas where water is insufficient from any source for both agricultural and domestic use.			X
(5) In order to preserve green belts, give priority to state capital-improvement funds which encourage location of urban development within existing urban areas except where compelling public interest dictates development of a noncontiguous new urban core.	X		
(6) Seek participation from the private sector for the cost of building infrastructure and utilities, and maintaining open spaces.	X		
(7) Pursue rehabilitation of appropriate urban areas.			X
(8) Support the redevelopment of Kakaako into a viable residential, industrial, and commercial community.			X
(9) Direct future urban development away from critical environmental areas or impose mitigating measures so that negative impacts on the environment would be minimized.	X		
(10) Identify critical environmental areas in Hawaii to include but not be limited to the following: watershed and recharge areas; wildlife habitats (on land and in the ocean); areas with endangered species of plants and wildlife; natural streams and water bodies; scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources.	X		
(11) Identify all areas where priority should be given to preserving rural character and lifestyle.			X
(12) Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.	X		
(13) Protect and enhance Hawaii's shoreline, open spaces, and scenic resources.	X		
Discussion: The Petition Area is currently in the State Agricultural District (See Figure 2.4: State Land Use District). The proposed State Land Use District Boundary Amendment is consistent with the standards for determining boundaries of the Urban District pursuant to Section 15-15-18, HAR.			

Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
The majority of adjacent lands that surround the Petition Area are within the Urban District. Existing residential developments include: Waipahu Town to the northeast; Honouliuli and West Loch Estates to the east; and 'Ewa Villages and 'Ewa Villages Golf Course to the south. Vacant lands to the west are slated for future development by UHWO and DHHL. The lands to north of the Petition Area are within the Agricultural State Land Use District, but fall outside of the City and County of Honolulu's Ewa DP Urban Growth Boundary. As previously state, the Petition Area lies within the City and County of Honolulu's Ewa DP Urban Growth Boundary, and as such, reclassification of the Petition Area to the Urban District and subsequent City and County of Honolulu Change of Zone application would permit the Petition Area to conform to the surrounding land uses and would permit the low-to medium-density residential uses and recreational development. According to the City and County of Honolulu Department of Planning and Permitting (DPP), the year 2006 population of the *Ewa Development Plan Area* (DPA) was 86,000 (DPP, 2006). This comprised an increase of 25.1 percent from its 2000 population of 68,718. The DPP expects the population of the Ewa DPA to increase to 180,200 by the year 2030. In comparison, the population for the City and County of Honolulu as a whole increased only 3.8 percent from 876,156 to 909,863 between 2000 and 2006. The City and County of Honolulu is expected to experience a population growth of 27.5 percent (241,144 persons) from 876,156 to 1,117,300 total residents during the same 30-year period. Besides providing substantial housing opportunities for the 'Ewa region, the Ho'opili project also supports the State's population distribution policies. This EIS identifies existing natural and physical site conditions (i.e., slope, soils, drainage characteristics, archaeological sites, flora and fauna, public services and infrastructure) and potential impacts resulting from the Ho'opili project, and proposes several measures to mitigate potential impacts.			
HRS § 226-105: Crime and criminal justice. Priority guidelines in the area of crime and criminal justice:			
(1) Support law enforcement activities and other criminal justice efforts that are directed to provide a safer environment.			**X**
(2) Target state and local resources on efforts to reduce the incidence of violent crime and on programs relating to the apprehension and prosecution of repeat offenders.			**X**
(3) Support community and neighborhood program initiatives that enable residents to assist law enforcement agencies in preventing criminal activities.			**X**
(4) Reduce overcrowding or substandard conditions in correctional facilities through a comprehensive approach among all criminal justice agencies which may include sentencing law revisions and use of alternative sanctions other than incarceration for persons who pose no danger to their community.			**X**
(5) Provide a range of appropriate sanctions for juvenile offenders, including community-based programs and other alternative sanctions.			**X**
(6) Increase public and private efforts to assist witnesses and victims of crimes and to minimize the costs of victimization.			**X**
Discussion: While the State's policies related to crime and criminal justice are more under the purview of either law enforcement agencies or private neighborhood watch-type programs, the Petitioner supports the State's objectives.			

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
HRS § 226-106: Affordable housing. Priority guidelines for the provision of affordable housing:			
(1) Seek to use marginal or nonessential agricultural land and public land to meet housing needs of low- and moderate-income and gap-group households.			X
(2) Encourage the use of alternative construction and development methods as a means of reducing production costs.			X
(3) Improve information and analysis relative to land availability and suitability for housing.			X
(4) Create incentives for development which would increase home ownership and rental opportunities for Hawaii's low- and moderate-income households, gap-group households, and residents with special needs.	X		
(5) Encourage continued support for government or private housing programs that provide low interest mortgages to Hawaii's people for the purchase of initial owner- occupied housing.			X
(6) Encourage public and private sector cooperation in the development of rental housing alternatives.	X		
(7) Encourage improved coordination between various agencies and levels of government to deal with housing policies and regulations.	X		
(8) Give higher priority to the provision of quality housing that is affordable for Hawaii's residents and less priority to development of housing intended primarily for individuals outside of Hawaii.	X		
Discussion: While the Ho'opili project does not create incentives to encourage affordable housing, it does plan to implement the City and County of Honolulu's existing affordable housing requirements in the construction of affordable housing units. As such, up to 30 percent of the total number of units are expected to be developed as affordable housing units. Details of the affordable housing program in the Ho'opili project that pertain to the regulations and programs of the City and County of Honolulu will be coordinated with the County prior to development.			
HRS § 226-107: Quality education. Priority guidelines to promote quality education:			
(1) Pursue effective programs which reflect the varied district, school, and student needs to strengthen basic skills achievement;			X
(2) Continue emphasis on general education "core" requirements to provide common background to students and essential support to other university programs;			X
(3) Initiate efforts to improve the quality of education by improving the capabilities of the education work force;			X
(4) Promote increased opportunities for greater autonomy and flexibility of educational institutions in their decision-making responsibilities;			X
(5) Increase and improve the use of information technology in education by the availability of telecommunications equipment for:			X
(A) The electronic exchange of information;			X
(B) Statewide electronic mail; and			X
(C) Access to the Internet.			X
Encourage programs that increase the public's awareness and understanding of the impact of information technologies on our lives;			X

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Hawaii State Plan, Chapter 226, Hawaii Revised Statutes – Part III. Priority Guidelines	S	N/S	N/A
(6) Pursue the establishment of Hawaii's public and private universities and colleges as research and training centers of the Pacific;			X
(7) Develop resources and programs for early childhood education;			X
(8) Explore alternatives for funding and delivery of educational services to improve the overall quality of education; and			X
(9) Strengthen and expand educational programs and services for students with special needs.			X
Discussion: While the State's policies related to quality education are directed more towards public and private educational providers, the Petitioner supports the State's objectives, especially regarding the development of UHWO and setting aside land for public schools.			

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5.2.6 Hawaii State Functional Plans

The *Hawaii State Plan* is primarily guided by the *State Functional Plans* (Chapter 226, HRS) and implemented by the Department of Budget and Finance and the State LUC. *State Functional Plans* are prepared by various state agencies to serve as the primary implementing vehicle for the goals, objectives, and policies of the *Hawaii State Plan*. A brief description on how the proposed project complies with the *State Functional Plans* is listed in the table below.

Table 5.6. Hawaii State Functional Plans

Hawaii State Functional Plans		S	N/S	N/A
AGRICULTURE FUNCTIONAL PLAN				
Objective A:	Achievement of increased agricultural production and growth through cultural and management practices.		X	
Objective B:	Achievement of an orderly agricultural marketing system through product promotion and industry organization.		X	
Objective C:	Achievement of increased consumption of and demand for Hawaii's agricultural products through consumer education and product quality.		X	
Objective D:	Achievement of optimal contribution by agriculture to the State's economy.		X	
Objective E:	Achievement of adequate capital, and knowledge of its proper management, for agricultural development.		X	
Objective F:	Achievement of increased agricultural production and growth through pest and disease controls.		X	
Objective G:	Achievement of effective protection and improved quality of Hawaii's land, water, and air.		X	
Objective H:	Achievement of productive agricultural use of lands most suitable and needed for agriculture.		X	
Objective I:	Achievement of efficient and equitable provision of adequate water for agricultural use.		X	
Objective J:	Achievement of maximum degree of public understanding and support of agriculture in Hawaii.		X	
Objective K:	Achievement of adequate supply of properly trained labor for agricultural needs.		X	
Objective L:	Achievement of adequate transportation services and facilities to meet agricultural needs.		X	
Objective M:	Achievement of adequate support services and infrastructure to meet agricultural needs.		X	
Discussion: The Ho'opili project is currently within the State Agricultural District (See Figure 2.4: State Land Use District). However, the *Ewa Development Plan* designates the Petition Area as Low and Medium Density Residential, High Density Residential, Agricultural Land Preservation, Parks, and Transit Node (High Density Residential and Commercial) and Future Intermediate School (See Figure 2.5: Ewa Development Plan). Currently, the Petitioner is in the process of filing a petition with the State Land Use Commission to reclassify the Petition Area to the Urban District. The petition for reclassification is consistent with the standards for determining boundaries of the Urban District pursuant to Section 15-15-18, HAR.				

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Hawaii State Functional Plans		S	N/S	N/A
The project is intended to be developed through 2030, and as such, the Petitioner will only withdraw land from the leases on an as needed basis for construction and development and as provided for in agreements with the individual lessees. Within the Petition Area, lands will gradually be withdrawn from agricultural production for residential, commercial, and educational uses.				
CONSERVATION LANDS FUNCTIONAL PLAN				
Objective IA:	Establishment of data bases for inventories of existing lands and resources.			X
Objective IB:	Establishment of criteria for management of land and natural resources.			X
Objective IIA:	Establishment of plans for natural resources and land management.			X
Objective IIB:	Protection of fragile or rare natural resources.			X
Objective IIC:	Enhancement of natural resources.			X
Objective IID:	Appropriate development of natural resources.			X
Objective IIE:	Promotion and marketing of appropriate natural resources designated for commercial development.			X
Objective IIF:	Increase enforcement of land and natural resource use laws and regulations.			X
Objective IIIA:	Develop and implement conservation education programs for the general public and visitors.			X
Objective IIIB:	Increase access to land and natural resource data by the public and increase cooperation between agencies by making access to land and natural resource information more efficient.			X
Discussion: The objectives and policies in this plan do not apply to the Ho'opili project, since the property is not located within the State Conservation District (See Figure 2.4: State Land Use District).				
EDUCATION FUNCTIONAL PLAN				
Objective A(1):	**Academic Excellence.** Emphasize quality educational programs in Hawaii's institutions to promote academic excellence.	X		
Objective A(2):	**Basic Skills.** Promote programs and activities that facilitate the acquisition of basic skills, such as reading, writing, computing, listening, speaking, and reasoning. Pursue effective programs which reflect the varied district, school, and student needs to strengthen basic skills achievement.			X
Objective A(3):	**Education Workforce.** Initiate efforts to improve the quality of education by improving the capabilities of the education workforce.	X		
Objective A(4):	**Services and Facilities.** Ensure the provision of adequate and accessible educational services and facilities that are designed to meet individual and community needs.	X		
Objective B(1):	**Alternatives for Funding and Delivery.** Explore alternatives for funding and delivery of educational services to improve the overall quality of education.			X
Objective B(2):	**Autonomy and flexibility.** Promote increased opportunities for greater autonomy and flexibility of educational institutions in their decision-making responsibilities.			X
Objective B(3):	**Increased Use of Technology.** Increase and improve the use information technology in education and encourage programs			X

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Hawaii State Functional Plans		S	N/S	N/A
	which increase the public's awareness and understanding of the impact of information technologies on our lives.			
Objective B(4):	**Personal Development.** Support education programs and activities that enhance personal development, physical fitness, recreation, and cultural pursuits of all groups.	X		
Objective B(5):	**Students with Special Needs.** Provide appropriate educational opportunities for groups with special needs.	X		
Objective C(1):	**Early Childhood Education.** Develop resources and programs for early childhood education.			X
Objective C(2):	**Hawaii's Cultural Heritage.** Promote educational programs which enhance understanding of Hawaii's cultural heritage.			X
Objective C(3):	**Research Programs and [Communication] Activities.** Support research programs and activities that enhance the education programs of the State.			X
Discussion: The Ho'opili project will provide as many as five public school sites (including elementary, middle and high school sites). Approximately 90 acres will be reserved for public schools and facilities to meet the demand for educational facilities in the growing 'Ewa region. In addition, there is a possibility that one or two private schools may be included in the project. Approximately seven acres have been set aside on the conceptual land use plan for one private school.				
EMPLOYMENT FUNCTIONAL PLAN				
Objective A:	Improve the qualifications of entry-level workers and their transition to employment.			X
Objective B:	Develop and deliver education, training and related services to ensure and maintain a quality and competitive workforce.	X		
Objective C:	Improve labor exchange.			X
Objective D:	Improve the quality of life for workers and families.	X		
Objective E:	Improve planning of economic development, employment and training activities	X		
Discussion: The Ho'opili project will provide for a diverse range of direct and indirect employment and economic opportunities for Hawai'i residents, both during and after project construction. Short-term construction-related jobs as well as permanent long-term operational jobs will be offered, increasing employment throughout the 'Ewa region and State. With greater employment and economic opportunities, the overall living standards and lifestyles will be enhanced for area residents, who will be able to live, work, learn, play, and shop within the Second City. For entry-level workers, availability of workforce housing and affordable transportation are key factors in achieving a desired lifestyle. The Ho'opili project is designed to be transit-ready, with higher-density housing, and employment and shopping opportunities proposed around the transit station(s). The entire project is mixed-use with live-work housing, allowing residents to rely less on automobile ownership costs and long commutes to achieve a desired lifestyle.				
ENERGY FUNCTIONAL PLAN				
Objective A:	Moderate the growth in energy demand through conservation and energy efficiency.	X		
Objective B:	Displace oil and fossil fuels through alternate and renewable energy resources.			X
Objective C:	Promote energy education and legislation.			X
Objective D:	Support and develop an integrated approach to energy development and management.			X
Objective E:	Ensure State's abilities to implement energy emergency actions			X

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Hawaii State Functional Plans		S	N/S	N/A
	immediately in event of fuel supply disruptions. Ensure essential public services are maintained and provisions are made to alleviate economic and personal hardships which may arise.			
Discussion: The Ho'opili project will provide various housing and employment opportunities for the rapidly growing 'Ewa region, which will in turn, reduce the number of energy-consuming commuter trips other areas of O'ahu, particularly downtown Honolulu. Where feasible, project buildings, activities, and site grounds are intended to be designed with energy-saving considerations. Given the natural climate, the project may be suited for the use of renewable energy technologies including photovoltaics.				
HEALTH FUNCTIONAL PLAN				
Objective 1:	Health promotion and disease prevention. Reduction in the incidence, morbidity and mortality associated with preventable and controllable conditions.			**X**
Objective 2:	Prevention and control of communicable diseases. Reduction in the incidence, morbidity, and mortality associated with infectious and communicable diseases.			**X**
Objective 3:	Health needs of special populations with impaired access to health care. Increased availability and accessibility of health services for groups with impaired access to health care programs.			**X**
Objective 4:	Community hospitals system. Development of a community hospital system which is innovative, responsive and supplies high quality care to the constituencies it serves.			**X**
Objective 5:	Environmental programs to protect and enhance the environment. Continued development of new environmental protection and health services programs to protect, monitor, and enhance the quality of life in Hawaii.			**X**
Objective 6:	DOH leadership. To improve the Department of Health's ability to meet the public health need of the State of Hawaii in the most appropriate, beneficial and economical way possible.			**X**
Discussion: While the objectives of the Human Services Functional Plan are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives and the Department of Health's Healthy Hawai'i Initiative by planning Ho'opili to be easily accessible by walking and bicycle. The site is mostly relatively flat and has been designed to maximize connectivity to surrounding projects such as UHWO and DHHL lands by providing more streets than a conventional development. The higher capacity streets will include grade-separated, multi-purpose walk/bike paths, while smaller streets will allow experienced bicyclist to travel on the roadway, and less-experienced bicyclists to travel on sidewalks. A regional bikeway plan has been developed in cooperation with UHWO, DHHL and HCDA. Figure 2.8: Proposed Circulation Plan shows the approximate alignment of bikeways being proposed by DHHL, UHWO and the Petitioner and how they may connect to bikeways proposed by others (such as HCDA), the bike path shown on the Ewa DP Public Facilities Map, the bikeways shown on the State Bicycle Plan 2003, and park sites proposed by HCDA, DHHL, UHWO and the Petitioner, and possible transit stops (locations being finalized as of this writing). The project will increase the population of 'Ewa, and as such, there will be an occasional and unavoidable demand for emergency medical services. However, existing medical and healthcare facilities in the 'Ewa region and surrounding areas should be able to accommodate the anticipated increase in demand.				
HIGHER EDUCATION FUNCTIONAL PLAN				
Objective A:	A number and variety of postsecondary education institutions			**X**

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Hawaii State Functional Plans		S	N/S	N/A
	sufficient to provide the diverse range of programs required to satisfy individual and societal needs and interests.			
Objective B:	The highest level of quality, commensurate with its mission and objectives, of each educational, research, and public service program offered in Hawaii by an institution of higher education.			X
Objective C:	Provide appropriate educational opportunities for all who are willing and able to benefit from postsecondary education.			X
Objective D:	Provide financing for postsecondary education programs sufficient to ensure adequate diversity, high quality, and wide accessibility.			X
Objective E:	Increase program effectiveness and efficiency through better coordination of educational resources.			X
Discussion: While the Higher Education Functional Plan's objectives are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives, by coordinating with UHWO (and DHHL) on infrastructure shared by two or more parties, and issues such as the HHCTC project and prioritizing regional roadway improvements.				
HISTORIC PRESERVATION FUNCTIONAL PLAN				
Objective A:	Identification of historic properties.	X		
Objective B:	Protection of historic properties.	X		
Objective C:	Management and treatment of historic properties.	X		
Objective D:	Provision of adequate facilities to preserve historic resources.	X		
Objective E:	The establishment of programs to collect and conserve historic records, artifacts, and/or oral histories and to document and perpetuate traditional arts, skills, and culture.			X
Objective F:	Provision of better access to historic information.			X
Objective G:	Enhancement of skills and knowledge needed to preserve historical resources.			X
Discussion: An archaeological inventory survey report is now accepted in fulfillment of Chapters 13-284 and 13-276, HAR (See Appendix E). A preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for its review and approval. Should any archaeologically significant artifacts, bones, or other indicators of previous on-site activity be uncovered during construction, work will stop immediately and SHPD will be notified in accordance with applicable regulations.				
HOUSING FUNCTIONAL PLAN				
Objective A:	Homeownership for at least sixty percent, or roughly 248,500 households by the year 2000.			X
Objective B:	Sufficient amount of affordable rental housing units by the year 2000 so as to increase the State's rental vacancy rate to at least 3%, with priority given to increasing the supply of units affordable to very low and lower income households.	X		
Objective C:	Increased development of rental housing units for the elderly and other special need groups to afford them an equal access to housing.	X		
Objective D:	Preservation of existing public and private housing stock.			X
Objective E:	Acquire and designate land suitable for housing development in sufficient amount to locate the deficit in housing units by the year 2000.	X		
Objective F:	Maintain a statewide housing data system for use by public and			X

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Hawaii State Functional Plans		S	N/S	N/A
	private agencies engaged in the provision of housing.			
Discussion: The Ho'opili project will construct up to 11,750 residential units of varying housing product types. The Project will consist of for-sale single-family units and multi-family units, with multi-family rental units also available. In accordance with the City and County of Honolulu's affordable housing guidelines, up to 30 percent of the total number of units are expected to be developed as affordable housing units. Details of the affordable housing program in the Ho'opili project that pertain to the regulations and programs of the City and County of Honolulu will be coordinated with the County prior to development.				
HUMAN SERVICES FUNCTIONAL PLAN				
Objective A:	To sustain and improve current elder abuse and neglect services.			X
Objective B:	To increase cost-effective, high quality home and community based services.			X
Objective C:	To increase home-based services to keep children in their homes and to increase placement resources for those children who must be temporarily or permanently removed from their homes, due to abuse or neglect.			X
Objective D:	To address factors that contribute to child abuse and other forms of family violence.			X
Objective E:	To provide affordable, accessible, and quality child care.			X
Objective G:	To provide AFDC recipients with a viable opportunity to become independent of the welfare system.			X
Objective H:	To facilitate client access to human services.			X
Objective I:	To eliminate organizational barriers which limit client access to human services.			X
Discussion: While the objectives of the Human Services Functional Plan are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives. The Petitioner has consulted with various private providers such as the Salvation Army (Kroc Center), Child & Family Services, and the Boys and Girls Club.				
RECREATION FUNCTIONAL PLAN				
Objective I.A:	Address the problem of saturation of the capacity of beach parks and near shore waters.			X
Objective I.B:	Reduce the incidence of ocean recreation accidents.			X
Objective I.C:	Resolve conflicts between different activities at heavily used ocean recreation areas.			X
Objective I.D:	Provide adequate boating facilities. Balance the demand for boating facilities against the need to protect the marine environment from potential adverse impacts.			X
Objective II.A:	Plan, develop, and promote recreational activities and facilities in mauka and other areas to provide a wide range of alternatives.	X		
Objective II.B:	Meet special recreation needs of the elderly, the disabled, woman, single-parent families, immigrants, and other groups.			X
Objective II.C:	Improve and expand the provision of recreation facilities in urban areas and local communities.	X		
Objective III.A:	Prevent the loss of access to shoreline and upland recreation areas due to new developments.			X
Objective III.B:	Resolve the problem of landowner liability that seriously hampers public access over private lands.			X

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Hawaii State Functional Plans		S	N/S	N/A
Objective III.C:	Increase access to State Forest Reserve lands over federal property, leased State lands, and other government lands.			X
Objective III.D:	Acquire, develop, and manage additional public accessways.			X
Objective IV.A:	Promote a conservation ethic in the use of Hawaii's recreational resources.			X
Objective IV.B:	Prevent degradation of the marine environment.			X
Objective IV.C:	Improve the State's enforcement capabilities.			X
Objective IV.D:	Mitigate adverse impacts of tour helicopters on the quality of recreational experiences in wilderness areas.			X
Objective V.A:	Properly maintain existing parks and recreation areas.			X
Objective V.B:	Promote interagency coordination and cooperation to facilitate sharing of resources, joint development efforts, clarification of responsibilities and jurisdictions, and improvements in enforcement capabilities.	X		
Objective V.C:	Assure adequate support for priority outdoor recreation programs and facilities.	X		
Objective VI.A:	Increase recreational access and opportunities in Hawaii's wetlands.			X
Objective VI.B:	Develop an adequate information base to assist the County planning departments and other regulatory agencies in make decisions regarding wetlands.			X
Objective VI.C:	Assure the protection of the most valuable wetlands in the state.			X
Discussion: The Ho'opili project includes approximately 210 acres for park and open space. The Petitioner proposes a series of parks and open spaces including a district park with active playfields, proposed to be located within the center of the Ho'opili project. In addition, a Canyon Park, located at the southeastern portion of the Ho'opili project, will provide a unique wilderness-type park alternative for residents. A Civic Plaza is envisioned as a community gathering space for outdoor concerts, farmer's markets, and other community events. Interspersed throughout the land use plan is "mini" (neighborhood) parks. The Petitioner consults with UHWO and DHHL on at least a monthly basis and is aware of DPP's requirements for street sections and planting strips (linear greenbelts) for the adjoining landowners and what precedents may have been established for Ho'opili. The Ho'opili project will be designed to facilitate bicycle and pedestrian connectivity between projects. Figure 2.8: Proposed Circulation Plan shows the approximate alignment of bikeways being proposed by DHHL, UHWO and the Petitioner and how they may connect to bikeways proposed by others (such as HCDA), the bike path shown on the Ewa DP Public Facilities Map, the bikeways shown on the State Bicycle Plan 2003, and park sites proposed by HCDA, DHHL, UHWO and the Petitioner, and possible transit stops (locations being finalized as of this writing).				
TOURISM FUNCTIONAL PLAN				
Objective I.A:	Development, implementation and maintenance of policies and actions which support the steady and balanced growth of the visitor industry.			X
Objective II.A:	Development and maintenance of well-designed visitor facilities and related developments which are sensitive to the environment, sensitive to neighboring communities and activities, and adequately serviced by infrastructure and support services.			X
Objective III.A:	Enhancement of respect and regard for the fragile resources which comprise Hawaii's natural and cultural environment.			X

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Hawaii State Functional Plans		S	N/S	N/A
	Increased preservation and maintenance efforts.			
Objective IV.A:	Support of Hawaii's diverse range of lifestyles and natural environment.			X
Objective IV.B:	Achievement of mutual appreciation among residents, visitors, and the visitor industry.			X
Objective V.A:	Development of a productive workforce to maintain a high quality visitor industry.			X
Objective V.B:	Enhancement of career and employment opportunities in the visitor industry.			X
Objective VI.A:	Maintenance of a high customer awareness of Hawaii as a visitor destination in specific desired market segments.			X
Discussion: While the objectives of the Tourism Functional Plan are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives.				
TRANSPORTATION FUNCTIONAL PLAN				
Objective I.A:	Expansion of the transportation system.	X		
Objective I.B:	Reduction of travel demand through zoning and decentralization initiatives.	X		
Objective I.C:	Management of existing transportation systems through a program of transportation systems management (TSM).			X
Objective I.D:	Identification and reservation of lands and rights-of-way required for future transportation improvements.	X		
Objective I.E:	Planning and designing State highways to enhance inter-regional mobility.			X
Objective I.F:	Improving and enhancing transportation safety.			X
Objective I.G:	Improved transportation maintenance programs.			X
Objective I.H:	Ensure that transportation facilities are accessible to people with disabilities.	X		
Objective II.A:	Development of a transportation infrastructure that supports economic development initiatives.	X		
Objective III.B:	Expansion of revenue bases for transportation improvements.	X		
Objective IV.A:	Providing educational programs.			X
Discussion: The Ho'opili project will generate traffic on local, collector, and regional roads. However, continued development of Kapolei as the Second City and construction of the UHWO campus will help alleviate traffic from leeward and central areas of O'ahu to Honolulu. The Petition Area will be designed to include residential, commercial, recreational, educational, and walking/biking facilities, enabling residents to live, work, play, shop, and learn within the community, thus helping to decentralizing traffic towards the Central Business District in Honolulu. There are several major transportation projects that have been long-planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the segment of the proposed Honolulu High-Capacity Transit Corridor project through the Project Area.				
WATER RESOURCES DEVELOPMENT FUNCTIONAL PLAN				
Objective A:	Enunciate State water policy and improve management framework.	X		

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Hawaii State Functional Plans		S	N/S	N/A
Objective B:	Maintain the long-term availability of freshwater supplies, giving consideration to the accommodation of important environmental values.	**X**		
Objective C:	Improve management of floodplains.	**X**		
Objective D:	Assure adequate municipal water supplies for planned urban growth.	**X**		
Objective E:	Assure the availability of adequate water for agriculture.			**X**
Objective F:	Encourage and coordinate with other water programs the development of self-supplied industrial water and the production of water-based energy.			**X**
Objective G:	Provide for the protection and enhancement of Hawaii's freshwater and estuarine environment.	**X**		
Objective H:	Improve State grant and loan procedures for water program and projects.			**X**
Objective I:	Pursue water resources data collection and research to meet changing needs.			**X**

Discussion: The Ho'opili project is not expected to impact groundwater resources, as the caprock acts as a barrier to the drinking water in the Project Area. Any runoff or wastewater disposal required for the project will be managed in full compliance with State Department of Health (DOH) regulations.

The project will be maximizing non-potable water usage (via non-potable wells and reclaimed water) to minimize the demand on the potable (i.e., drinking water) system. If a suitable supply is made available, ~~S~~street rights-of-way of the Ho'opili project will have underground non-potable water distribution systems. In addition, it is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies. It is estimated that the ultimate non-potable water demand for the project will be approximately 2.1 MGD.

Although the City and County of Honolulu's Board of Water Supply (BWS) cannot reserve water for future projects, it has indicated that there is water available to meet the estimated water demand for the project (3.9 MGD). Water Facility Charges paid by the Petitioner will be used by the Board to assist in the source replenishment caused by the project's water demands.

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5.3 CITY AND COUNTY OF HONOLULU

5.3.1 General Plan

As required by the City Charter, the *General Plan* for the City and County of Honolulu establishes long-range objectives focusing on the social, economic, environmental, and design objectives for the general welfare and prosperity of the residents of O'ahu. The *General Plan* also establishes broad policies designed to achieve the objectives. Objectives and policies of the *General Plan* are discussed in the table below.

Table 5.7. City and County of Honolulu General Plan – Objectives and Policies

City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
POPULATION				
Objective A: To control the growth of Oahu's resident and visitor populations in order to avoid social, economic, and environmental disruptions.				
Policy 1:	Participate in State and Federal programs which seek to develop social, economic, legal, and environmental controls over population growth.			X
Policy 2:	Seek a balance between the rate of in-migration and the rate of out-migration by reducing in-migration.			X
Policy 3:	Support Federal policies providing for a more even distribution of immigrants throughout the country.			X
Policy 4:	Seek to maintain a desirable pace of physical development through City and County regulations.			X
Policy 5:	Encourage family planning.			X
Policy 6:	Publicize the desire of the City and County to limit population growth.			X
Objective B: To plan for future population growth.				
Policy 1:	Allocate efficiently the money and resources of the City and County in order to meet the needs of Oahu's anticipated future population.			X
Policy 2:	Provide adequate support facilities to accommodate future growth in the number of visitors to Oahu.			X
Objective C: To establish a pattern of population distribution that will allow the people of Oahu to live and work in harmony.				
Policy 1:	Facilitate the full development of the primary urban center.			X
Policy 2:	Encourage development within the secondary urban center at Kapolei and the Ewa and Central Oahu urban-fringe areas to relieve developmental pressures in the remaining urban-fringe and rural areas and to meet housing needs not readily provided in the primary urban center.	X		
Policy 3:	Manage physical growth and development in the urban-fringe and rural areas so that: (a) An undesirable spreading of development is prevented; and (b) Their population densities are consistent with the character of development and environmental qualities desired for such areas.	X		

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 4:	(Amended, Resolution 02-205, CD1): Direct growth according to Policies 1, 2, and 3 above by providing land development capacity and needed infrastructure to seek a 2025 distribution of Oahu's residential population	**X**		
Discussion: According to the City and County of Honolulu Department of Planning and Permitting (DPP), the year 2006 population of the *Ewa Development Plan Area* (Ewa DPA) was 86,000 (DPP, 2006). This represented an increase of 25.1 percent from its 2000 population of 68,718. The DPP expects the population of the Ewa DPA to increase to 180.200 by the year 2030. In comparison, the population for the City and County of Honolulu as a whole increased only 3.8 percent from 876,156 to 909,863 between 2000 and 2006. The City and County of Honolulu is expected to experience a population growth of 27.5 percent (241,144 persons) from 876,156 to 1,117,300 total residents during the same 30-year period. Besides providing substantial housing opportunities for the 'Ewa region, the Ho'opili project also supports the State's population distribution policies. The Ho'opili project will provide up to 11,750 units. Assuming the O'ahu 2000 average size of households, the Ho'opili project would increase the overall population by approximately 35,290 residents. The majority of the population moving into the Ho'opili project is expected to come from O'ahu residents relocating from other areas of the island. The population increase is consistent with the City and County of Honolulu's policy to direct future growth to the 'Ewa region. With the population of the Ho'opili project mainly consisting of O'ahu residents that have relocated from other parts of the island, this increase in population has already been incorporated into the City and County of Honolulu's growth projection.				
ECONOMIC ACTIVITY				
Objective A: To promote employment opportunities that will enable all the people of Oahu to attain a decent standard of living.				
Policy 1:	Encourage the growth and diversification of Oahu's economic base.	**X**		
Policy 2:	Encourage the development of small businesses and larger industries, which will contribute to the economic and social well-being of Oahu residents.			**X**
Policy 3:	Encourage the development in appropriate locations on Oahu of trade, communications, and other industries of a nonpolluting nature.	**X**		
Policy 4:	Encourage the development of local, national, and world markets for the products of Oahu-based industries.			**X**
Policy 5:	Encourage the wider distribution of available employment opportunities through such methods as shortening the work-week and reducing the use of overtime.			**X**
Policy 6:	Encourage the continuation of a significant level of Federal employment on Oahu.			**X**
Discussion: This particular objective is mostly directed to governmental agencies and is not directly applicable to the Petition Area. However, it is believed that providing light industrial and business park lands within Ho'opili, near UHWO, will attract high-tech industries, thus diversifying O'ahu's economic base. Providing opportunities for trade, communications, and other industries of a nonpolluting nature in 'Ewa enhances the City of Kapolei as a major employment center.				
Objective B: To maintain the viability of Oahu's visitor industry.				
Policy 1:	Provide for the long-term viability of Waikiki as Oahu's primary resort area by giving the area priority in visitor industry related public expenditures.			**X**
Policy 2:	Provide for a high quality and safe environment for visitors and			**X**

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
	residents in Waikiki.			
Policy 3:	Encourage private participation in improvements to facilities in Waikiki.			**X**
Policy 4:	Prohibit major increases in permitted development densities in Waikiki.			**X**
Policy 5:	Prohibit further growth in the permitted number of hotel and resort condominium units in Waikiki.			**X**
Policy 6:	Permit the development of secondary resort areas in West Beach, Kahuku, Makaha, and Laie.			**X**
Policy 7:	Manage the development of secondary resort areas in a manner which respects existing lifestyles and the natural environment, and avoids substantial increases in the cost of providing public services in the area.			**X**
Policy 8:	Preserve the well-known and widely publicized beauty of Oahu for visitors as well as residents.			**X**
Policy 9:	Encourage the visitor industry to provide a high level of service to visitors.			**X**
Discussion: This particular objective is not relevant to the proposed project as is best directed public and private tourism-related agencies and companies such as the Hawaii Tourism Authority, DBEDT, the Waikiki Improvement Association, DPP, Visitor Aloha Society of Hawaii, Ko 'Olina Resort, et cetera.				
Objective C: To maintain the viability of agriculture on Oahu.				
Policy 1:	Assist the agricultural industry to ensure the continuation of agriculture as an important source of income and employment.			**X**
Policy 2:	Support agricultural diversification in all agricultural areas on Oahu.			**X**
Policy 3:	Support the development of markets for local products, particularly those with the potential for economic growth.			**X**
Policy 4:	Provide sufficient agricultural land in Ewa, Central Oahu, and the North Shore to encourage the continuation of sugar and pineapple as viable industries.			**X**
Policy 5:	Maintain agricultural land along the Windward, North Shore, and Waianae coasts for truck farming, flower growing, aquaculture, livestock production, and other types of diversified agriculture.			**X**
Policy 6:	Encourage the more intensive use of productive agricultural land.			**X**
Policy 7:	Encourage the use of more efficient production practices by agriculture, including the efficient use of water.			**X**
Policy 8:	Encourage the more efficient use of non-potable water for agricultural use.			**X**
Discussion: The above objective and policies are best directed towards public agencies such as the Department of Agriculture to implement. Over time, the development of the Petition Area will result in the ultimate termination of nearly all of the cultivation that occurs on the property; however, there is an ample supply of land suitable for diversified agriculture on O'ahu and the State of Hawai'i. This includes land in 'Ewa, mauka of the H-1 Freeway, Kunia, Wahiawā and the North Shore.				
Objective D: To make full use of the economic resources of the sea.				
Policy 1:	Assist the fishing industry to maintain its viability.			**X**
Policy 2:	Encourage the development of aquaculture, ocean research, and other ocean- related industries.			**X**

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Policy 3:	Focus the development of ocean related economic activities in the Northwestern Hawaiian Islands on those which are compatible with preserving the area's unique environmental, marine, and wildlife assets.			X
Discussion: This particular objective is not relevant to the proposed project.				
Objective E: To prevent the occurrence of large-scale unemployment.				
Policy 1:	Encourage the training and employment of present residents for currently available and future jobs.			X
Policy 2:	Make full use of State and Federal employment and training programs.			X
Policy 3:	Encourage the provision of retraining programs for workers in industries with planned reductions in their labor force.			X
Discussion: This particular objective is probably best directed towards the Department of Labor and Industrial Relations or larger employers who anticipate cutting back their workforce.				
Objective F: To increase the amount of Federal spending on Oahu.				
Policy 1:	Take full advantage of Federal programs and grants which will contribute to the economic and social well being of Oahu's residents.			X
Policy 2:	Encourage the Federal government to pay for the cost of public services used by Federal agencies.			X
Policy 3:	Encourage the Federal government to lease new facilities rather than construct them on tax exempt public land.			X
Policy 4:	Encourage the military to purchase locally all needed services and supplies which are available on Oahu.			X
Discussion: This particular objective is not relevant to the proposed project.				
Objective G: To bring about orderly economic growth on Oahu.				
Policy 1:	Direct major economic activity and government services to the primary urban center and the secondary urban center at Kapolei.	X		
Policy 2:	Permit the moderate growth of business centers in the urban-fringe areas.	X		
Policy 3:	Maintain sufficient land in appropriately located commercial and industrial areas to help ensure a favorable business climate on Oahu.	X		
Policy 4:	Encourage the continuation of a high level of military-related employment in the Hickam-Pearl Harbor, Wahiawa, Kailua-Kaneohe, and Ewa areas.			X
Discussion: The project will generate direct, indirect, and induced jobs both within the Petition Area and on an island-wide basis. These jobs will occur both during construction and after construction as operational employment. At full build out (2030), employment associated with the Petition Area ~~employment~~ is expected to account for approximately 7,000 ~~1,550 net~~ new jobs. Consistent with the Ewa DP and the *Kapolei Area Long Range Master Plan*, the new jobs will generate employment near the City of Kapolei to reduce the need for residents traveling to downtown Honolulu for work-related purposes.				
NATURAL ENVIRONMENT				
Objective A: To protect and preserve the natural environment.				
Policy 1:	Protect Oahu's natural environment, especially the shoreline, valleys, and ridges, from incompatible development.	X		
Policy 2:	Seek the restoration of environmentally damaged areas and natural resources.			X

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 3:	Retain the Island's streams as scenic, aquatic, and recreation resources.	X		
Policy 4:	Require development projects to give due consideration to natural features such as slope, flood and erosion hazards, water-recharge areas, distinctive land forms, and existing vegetation.	X		
Policy 5:	Require sufficient setbacks of improvements in unstable shoreline areas to avoid the future need for protective structures.			X
Policy 6:	Design surface drainage and flood-control systems in a manner, which will help preserve their natural settings.	X		
Policy 7:	Protect the natural environment from damaging levels of air, water, and noise pollution.	X		
Policy 8:	Protect plants, birds, and other animals that are unique to the State of Hawaii and the Island of Oahu.			X
Policy 9:	Protect mature trees on public and private lands and encourage their integration into new developments.			X
Policy 10:	Increase public awareness and appreciation of Oahu's land, air, and water resources.			X
Policy 11:	Encourage the State and Federal governments to protect the unique environmental, marine, and wildlife assets of the Northwestern Hawaiian Islands.			X
Discussion: The Petition Area presents little in the way of natural environment except within the confines of Honouliuli Stream or the steep slopes/cliffs on the Old Fort Weaver Road side of the property. The vast remainder of the Petition Area was heavily modified by Oahu Sugar Company when it was in operation and cultivating the land with sugar cane. No development is proposed within Honouliuli Stream or on the steep slopes towards the eastern side of the Petition Area.				
Objective B: To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.				
Policy 1:	Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shoreline, fishponds, and bays; and reefs and offshore islands.	X		
Policy 2:	Protect Oahu's scenic views, especially those seen from highly developed and heavily traveled areas.	X		
Policy 3:	Locate roads, highways, and other public facilities and utilities in areas where they will least obstruct important views of the mountains and the sea.	X		
Policy 4:	Provide opportunities for recreational and educational use and physical contact with Oahu's natural environmental.	X		
	(11) Identify all areas where priority should be given to preserving rural character and lifestyle.			X
	(12) Utilize Hawai'i's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.	X		
	(13) Protect and enhance Hawai'i's shoreline, open spaces, and scenic resources.	X		
Discussion: The only major resources in the vicinity of the Petition Area are the ocean and the Wai'anae and Ko'olau mountain ranges. The most heavily traveled roads in the vicinity of the				

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project site are Fort Weaver Road and the H-1 Freeway. A vast majority of the project site is not visible from Fort Weaver Road, because it is set back and 30 to 40 feet higher than Fort Weaver Road. Since the Petition Area is west of Fort Weaver Road, development of the Petition Area will not obstruct views of the Ko'olau Mountains from either Fort Weaver (or the H-1 Freeway). The development of the Petition Area will also not likely obstruct views of the Wai'anae Mountain range. There are presently no views towards the ocean from the portion of Fort Weaver Road between the H-1 Freeway and the Child and Family Services Complex (near the southeast corner of the Petition Area). There are occasional views towards the ocean and Diamond Head in the far distance across the project site from the high-speed H-1 Freeway. Development of the Petition Area may alter these views, but it should be noted that views of 'Ewa, in its present, is not just of agricultural fields but also of a major electrical substation site, as well as 138kV lines mounted on tall metal poles. Also, the City and County of Honolulu is proposing an elevated rail transit system as part of the HHCTC project through the project site and along North-South Road.				
HOUSING				
Objective A: To provide decent housing for all the people of Oahu at prices they can afford.				
Policy 1:	Develop programs and controls, which will provide decent homes at the least possible cost.			X
Policy 2:	Streamline approval and permit procedures for housing and other development projects.			X
Policy 3:	Encourage innovative residential development, which will result in lower costs, added convenience and privacy, and the more efficient use of streets and utilities.	X		
Policy 4:	Establish public, and encourage private, programs to maintain and improve the condition of existing housing.			X
Policy 5:	Make full use of State and Federal programs that provide financial assistance for low- and moderate-income homebuyers.			X
Policy 6:	Expand local funding mechanisms available to pay for government housing programs.			X
Policy 7:	Provide financial and other incentives to encourage the private sector to build homes for low and moderate- income residents.	X		
Policy 8:	Encourage and participate in joint public- private development of low- and moderate- income housing.			X
Policy 9:	Encourage the preservation of existing housing which is affordable to low- and moderate-income persons.			X
Policy 10:	Promote the construction of affordable dwellings, which take advantage of Oahu's year-round moderate climate.	X		
Policy 11:	Encourage the construction of affordable homes within established low-density communities by such means as "ohana" units, duplex dwellings, and cluster development.			X
Policy 12:	Encourage the production and maintenance of affordable rental housing.	X		
Policy 13:	Encourage the provision of affordable housing designed for the elderly and the handicapped.	X		
Policy 14:	Encourage equitable relationships between landowners and leaseholders, between landlords and tenants, and between condominium developers and owners.			X
Discussion: While this particular objective is mostly directed to governmental agencies, the Petitioner supports the above *General Plan's* objectives and policies and in accordance with the City and County of Honolulu's affordable housing guidelines, by planning up to 30 percent of the total				

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number of units as affordable housing units. Details of the affordable housing program in the Ho'opili project that pertain to the regulations and programs of the City and County of Honolulu will be coordinated with the County prior to development.				
Objective B: To reduce speculation in land and housing.				
Policy 1:	Encourage the State government to coordinate its urban-area designations with the developmental policies of the City and County.			X
Policy 2:	Discourage private developers from acquiring and assembling land outside of areas planned for urban use.	X		
Policy 3:	Seek public benefits from increases in the value of land owing to City and State developmental policies and decisions.			X
Policy 4:	Require government-subsidized housing to be delivered to appropriate purchasers and renters.			X
Policy 5:	Prohibit the selling or renting of government-subsidized housing for large profits.			X
Discussion: While this particular objective is mostly directed to governmental agencies, the Petitioner supports the above *General Plan's* objectives and policies by proposing development on land long-planned for urban use, and well within (and makai of) the Urban Growth Boundary as shown on the current *Ewa Development Plan* Land Use Map.				
Objective C: To provide the people of Oahu with a choice of living environments which are reasonably close to employment, recreation, and commercial centers and which are adequately served by public utilities.				
Policy 1:	Encourage residential developments that offer a variety of homes to people of different income levels and to families of various sizes.	X		
Policy 2:	Encourage the fair distribution of low- and moderate-income housing throughout the Island.	X		
Policy 3:	Encourage residential development near employment centers.	X		
Policy 4:	Encourage residential development in areas where existing roads, utilities, and other community facilities are not being used to capacity.	X		
Policy 5:	Discourage residential development where roads, utilities, and community facilities cannot be provided at a reasonable cost.			X
Policy 6:	Preserve older communities through self-help, housing-rehabilitation, improvement districts, and other governmental programs.			X
Discussion: The Ho'opili project will construct up to 11,750 residential units of varying product types. The Project will consist of for-sale single-family units and multi-family units, with multi-family rental units also available. In accordance with the City and County of Honolulu's affordable housing guidelines, up to 30 percent of the total number of units are expected to be developed as affordable housing units. The proposed project is envisioned as a new kind of development, one that improves the quality of people's lives by allowing them to live, work, learn, shop and play in their own community.				
TRANSPORTATION AND UTILITIES				
Objective A: To create a transportation system which will enable people and goods to move safely, efficiently, and at a reasonable cost, serve all people, including the poor, the elderly, and the physically handicapped; and offer a variety of attractive and convenient modes of travel.				
Policy 1:	Develop and maintain an integrated ground-transportation system consisting of the following elements and their primary	X		

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
	purposes:			
	a) Public transportation-for travel to and from work, and travel within Central Honolulu;			X
	b) Roads and highways-for commercial traffic and travel in non-urban areas;			X
	c) Bikeways-for recreational activities and trips to work, schools, shopping centers, and community facilities; and	X		
	d) Pedestrian walkways-for getting around Downtown and Waikiki, and for trips to schools, parks, and shopping centers.	X		
Policy 2:	Provide transportation services to people living within the Ewa, Central Oahu, and Pearl City-Hawaii Kai corridors primarily through a mass transit system including exclusive right-of-way rapid transit and feeder-bus components as well as through the existing highway system with limited improvements as may be appropriate.	X		
Policy 3:	Provide transportation services outside the Ewa, Central Oahu, and Pearl City-Hawaii Kai corridors primarily through a system of express- and feeder-buses as well as through the highway system with limited to moderate improvements sufficient to meet the needs of the communities being served.			X
Policy 4:	Improve transportation facilities and services in the Ewa corridor and in the trans-Ko'olau corridors to meet the needs of Ewa and Windward communities.	X		
Policy 5:	Improve roads in existing communities to reduce congestion and eliminate unsafe conditions.			X
Policy 6:	Consider both environmental impact as well as construction and operating costs as important factors in planning alternative nodes of transportation.	X		
Policy 7:	Promote the use of public transportation as a means of moving people quickly and efficiently, of conserving energy, and of guiding urban development.	X		
Policy 8:	Make available transportation services to people with limited mobility: the young, the elderly, the handicapped, and the poor.			X
Policy 9:	Promote programs to reduce dependence on the use of automobiles.			X
Policy 10:	Discourage the inefficient use of the private automobile, especially in congested corridors and during peak- hours.	X		
Policy 11:	Make public, and encourage private, improvements to major walkway systems.	X		
Policy 12:	Encourage the provision of separate aviation facilities for small civilian aircraft.			X
Policy 13:	Facilitate the development of a second deep-water harbor to relieve congestion in Honolulu Harbor.			X
Discussion: There are several major transportation projects that have been long-planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and				

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
the segment of the proposed Honolulu High-Capacity Transit Corridor project through the Project Area. The proposed project has been designed to reduce future residents' reliance on private motorized vehicles through the following measures: • Ho'opili is the first new project designed to ~~embrace~~ support high-capacity transit (elevated, fixed-guideway) corridor and station(s); • the Petition Area is large enough to be designed and offer a full range of mixed land uses, including a wide range of places of live, work, shop, recreate and learn and will aspire to achieve a job-housing balance; • Ho'opili is designed to maximize connectivity (transit, pedestrian, bicycle and vehicular) with surrounding streets and communities (including DHHL and UHWO), while minimizing cul-de-sacs and dead-end streets; • Ho'opili will be designed to take advantage of the relatively flatness of the site and proximity to UHWO by designing streets and grade-separated multi-modal pathways for walking and bicycling; and • the Petitioner will seek to implement other transportation management and transportation demand management (TDM) strategies (such as requesting that the State/County consider extending or instituting contra-flow of major transportation corridors during a.m. and p.m. peak travel times). The most important TDM strategy is that the project is designed to ~~embrace~~ support both rail and bus transit and the project is proposed to have mixed uses over most of the entire Petition Area.				
Objective B: To meet the needs of the people of Oahu for an adequate supply of water and for environmentally sound systems of waste disposal.				
Policy 1:	Develop and maintain an adequate supply of water for both residents and visitors.			**X**
Policy 2:	Develop and maintain an adequate supply of water for agricultural and industrial needs.			**X**
Policy 3:	Encourage the development of new technology, which will reduce the cost of providing water and the cost of waste disposal.			**X**
Policy 4:	Encourage a lowering of the per-capita consumption of water and the per-capita production of waste.	**X**		
Policy 5:	Provide safe, efficient, and environmentally sensitive waste-collection and waste-disposal services.	**X**		
Policy 6:	Support programs to recover resources from solid-waste and recycle wastewater.	**X**		
Policy 7:	Require the safe disposal of hazardous waste.			**X**

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Discussion: The Petitioner has identified in the Water Master Plan the source requirement to support the project, including allotting adequate water supply for its existing agricultural lessees, as long as they are operating on the Petition Area. The Petitioner will equip the homes it constructs with appliances and fixtures that encourage a lower per capita consumption of water. The Petitioner will assume the City and County of Honolulu will extend its curbside recycling services into the Petition Area and will design its streets accordingly. The Petitioner will be maximizing non-drinking usage to minimize the demand on the safe drinking water supply. If a suitable supply is made available, ~~S~~street right of ways of the Ho'opili project will have underground non-potable water distribution systems. It is proposed to upgrade the existing non-drinking source (EP 5 & 6 located within Parcel C) to a BWS dedicable standard to be used as the source for the non-drinking system. It is also proposed to ultimately allow for future dedication of the non-drinking system. It is estimated that the ultimate non-drinking demand for the project will be approximately 2.1 MGD. The Petitioner will consider the use of drought tolerant/low water use plants and the implementation of xeriscaping principles for landscaping within the Ho'opili project to the extent practicable. The installation of an efficient irrigation system, possibly using drip irrigation, will be considered in the design of the project where feasible. Moisture sensors to avoid the operation of the system in the rain and if the ground has adequate moisture would be incorporated into the irrigation system, where feasible. Another source of non-potable water is reclaimed water. The Honolulu Board of Water Supply (BWS) entered into the water recycling business in 2000 by purchasing the Honouliuli Water Reclamation Facility. Water recycling of treated wastewater effluent is one element of a broader BWS strategy to protect O'ahu's aquifers and to conserve water resources through conservation and development of new water supplies. Treated effluent from the facility is now irrigating golf courses that were once using brackish water, including West Loch, 'Ewa Villages, Hawai'i Prince, and Coral Creek. The facility is also providing recycled water (at a different level of treatment) to industries at Campbell Industrial Park. The project will be maximizing the use of non-potable water for irrigation to minimize the impact on the drinking water source component of the BWS system. It is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies.				
Objective C: To maintain a high level of service for all utilities.				
Policy 1:	Maintain existing utility systems in order to avoid major breakdowns.			**X**
Policy 2:	Provide improvements to utilities in existing neighborhoods to reduce substandard conditions.			**X**
Policy 3:	Plan for the timely and/or orderly expansion of utility systems.			**X**
Policy 4:	Increase the efficiency of public utilities by encouraging a mixture of uses with peak periods of demand occurring at different times of the day.			**X**
Discussion: While this particular objective is mostly directed to public utility companies, the Petitioner supports the above *General Plan's* objectives and policies by coordinating with companies such as HECO and other energy providers in the planning stage of the project.				
Objective D: To maintain transportation and utility systems which will help Oahu continue to be a desirable place to live and visit.				
Policy 1:	Give primary emphasis in the capital-improvement program to the maintenance and improvement of existing roads and utilities.			**X**

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 2:	Use the transportation and utility systems as a means of guiding growth and the pattern of land use on Oahu.			X
Policy 3:	Encourage the study and use of telecommunications as an alternative to conventional transportation facilities.			X
Policy 4:	Evaluate the social, economic, and environmental impact of additions to the transportation and utility systems before they are constructed.	X		
Policy 5:	Require the installation of underground utility lines wherever feasible.	X		
Policy 6:	Seek improved taxing powers for the City and County in order to provide a more equitable means of financing transportation and utility services.			X
Discussion: There are several major transportation projects that have been long-planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the segment of the proposed Honolulu High-Capacity Transit Corridor project through the Project Area. While the specific nature of transportation and utility system improvements is not known at this time, this EIS is intended to address all current and future instances involving the use of State and/or County lands and funds relating to the Ho'opili project. To minimize visual impacts, all utility lines will be underground except those that have already been installed by HECO, BWS and other public or private utility companies. The Petitioner is very interested in utilizing Community Facilities District (CFD) financing as a means to pay for required transportation and other infrastructure improvements.				
ENERGY				
Objective A: To maintain an adequate, dependable, and economical supply of energy for Oahu residents.				
Policy 1:	Develop and maintain a comprehensive plan to guide and coordinate energy conservation and alternative energy development and utilization programs on Oahu.			X
Policy 2:	Establish economic incentives and regulatory measures which will reduce Oahu's dependence on petroleum as its primary source of energy.			X
Policy 3:	Support programs and projects which contribute to the attainment of energy self-sufficiency on Oahu.			X
Policy 4:	Promote and assist efforts to establish adequate petroleum reserves within Hawaii's boundaries.			X
Policy 5:	Give adequate consideration to environmental, public health, and safety concerns, to resource limitations, and to relative costs when making decisions concerning alternatives for conserving energy and developing natural energy resources.	X		
Policy 6:	Work closely with the State and Federal governments in the formulation and implementation of all City and County energy-			X

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
	related programs.			
Discussion: Nearly all of the above policies are best directed to public or private agencies which provide energy, however the Petitioner is supportive of developing natural energy resources. The Petitioner is considering the potential of developing another source of electrical power.				
Objective B: To conserve energy through the more efficient management of its use.				
Policy 1:	Ensure that the efficient use of energy is a primary factor in the preparation and administration of land use plans and regulations.	X		
Policy 2:	Provide incentives and, where appropriate, mandatory controls to achieve energy-efficient siting and design of new developments.			X
Policy 3:	Carry out public, and promote private, programs to more efficiently use energy in existing buildings and outdoor facilities.	X		
Policy 4:	Promote the development of an energy-efficient transportation system.	X		
Discussion: Nearly all of the above policies are best directed to public or private agencies which provide expertise on energy conservation, however, the Petitioner is supportive of conserving energy resources. Based on DBEDT Strategic Industries Division's recommendations, the Petitioner's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies (including solar power and energy-efficient appliances). The project will provide various housing and employment opportunities for the rapidly growing 'Ewa region, which will, in turn, reduce the number energy-consuming commuter trips to other areas of O'ahu, particularly downtown Honolulu				
Objective C: To fully utilize proven alternative sources of energy.				
Policy 1:	Encourage the use of commercially available solar energy systems in public facilities, institutions, residences, and business developments.	X		
Policy 2:	Support the increased use of operational solid waste energy recovery and other biomass energy conversion systems.			X
Discussion: Based on DBEDT Strategic Industries Division's recommendations, the Petitioner's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies (including solar power and energy-efficient appliances). The Petitioner is supportive of plans to both expand H-Power (solid waste energy recovery) and HECO's planned power plant that would burn biomass as fuel.				
Objective D: To develop and apply new, locally available energy resources.				
Policy 1:	Support and participate in research, development, demonstration, and commercialization programs aimed at producing new, economical, and environmentally sound energy supplies from:			X
	a) solar insulation;	X		
	b) biomass energy conversion;			X
	c) wind energy conversion;			X
	d) geothermal energy; and			X
	e) ocean thermal energy conversion.			X

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 2:	Secure State and Federal support of City and County efforts to develop new sources of energy.			**X**
Discussion: Nearly all of the above policies are best directed to public or private agencies which provide energy, however the Petitioner is supportive of developing natural energy resources. The Petitioner is considering the potential of developing another source of electrical power.				
Objective E: To establish a continuing energy information program.				
Policy 1:	Supply citizens with the information they need to fully understand the potential supply, cost, and other problems associated with Oahu's dependence on imported petroleum.			**X**
Policy 2:	Foster the development of an energy conservation ethic among Oahu residents.			**X**
Policy 3:	Keep consumers informed about available alternative energy sources and their costs and benefits.			**X**
Policy 4:	Provide information concerning the impact of public and private decisions on future energy use.			**X**
Discussion: While this particular objective is mostly directed to public utility companies and agencies such as DBEDT, the Petitioner supports the above *General Plan*'s objectives and policies.				
PHYSICAL DEVELOPMENT AND URBAN DESIGN				
Objective A: To coordinate changes in the physical environment of Oahu to ensure that all new developments are timely, well-designed, and appropriate for the areas in which they will be located.				
Policy 1:	Plan for the construction of new public facilities and utilities in the various parts of the Island according to the following order of priority: first, in the primary urban center; second, in the secondary urban center at Kapolei; and third, in the urban-fringe and rural areas.	**X**		
Policy 2:	Coordinate the location and timing of new development with the availability of adequate water supply, sewage treatment, drainage, transportation, and public safety facilities.	**X**		
Policy 3:	Phase the construction of new developments so that they do not require more regional supporting services than are available.	**X**		
Policy 4:	Require new developments to provide or pay the cost of all essential community services, including roads, utilities, schools, parks, and emergency facilities that are intended to directly serve the development.	**X**		
Policy 5:	Provide for more compact development and intensive use of urban lands where compatible with the physical and social character of existing communities.	**X**		
Policy 6:	Encourage the clustering of developments to reduce the cost of providing utilities and other public services.	**X**		
Policy 7:	Locate new industries and new commercial areas so that they will be well related to their markets and suppliers, and to residential areas and transportation facilities.	**X**		
Policy 8:	Locate community facilities on sites that will be convenient to the people they are intended to serve.	**X**		
Policy 9:	Exclude from residential areas, uses which are major sources of noise and air pollution.	**X**		
Policy 10:	Establish danger zones to exclude incompatible uses from hazardous areas surrounding airfields, electromagnetic-radiation sources, and storage places for fuel and explosives.			**X**

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 11:	Prohibit new airfields, electromagnetic-radiation sources, and storage places for fuel and explosives from locating on sites where they will endanger or disrupt nearby communities.			X
Discussion: The Petition Area is located within the secondary urban center. The Petitioner has been coordinating with other 'Ewa developments to jointly develop adequate water storage and transmission, wastewater collection lines, connecting streets and bikeways, high capacity transit corridors and other infrastructure. As UHWO and DHHL will be developed before Ho'opili, much of the jointly developed off-site infrastructure will be in place before the Petition Area will be able to secure the necessary major land use approvals. Ho'opili has been designed to accommodate long-planned regional roadways, the HHCTC alignment, the proposed East-West Connector Road, land for five public schools, park land to meet park dedication requirements, and land for either a fire, a police and/or an emergency center. As the last major landholding within the Urban Growth Boundary, the Petitioner understands that there is not much developable land on O'ahu and Ho'opili will represent more compact development and intensive use of urban land than other projects in 'Ewa. While Ho'opili will be a mixed use development, no heavy industrial is proposed or uses which are major sources of noise and air pollution.				
Objective B: To develop Honolulu (Waialae-Kahala to Halawa), Aiea, and Pearl City as the Island's primary urban center.				
Policy 1:	Stimulate development in the primary urban center by means of the City and County's capital improvement program and State and Federal grant and loan programs.			X
Policy 2:	Provide for the expanded development of low-rise multi-unit housing.			X
Policy 3:	Encourage the establishment of mixed-use districts with appropriate design and development controls to insure an attractive living environment and compatibility with surrounding land uses.			X
Policy 4:	Provide downtown Honolulu and other major business centers with a well-balanced mixture of uses.			X
Policy 5:	Encourage the development of attractive residential communities in downtown and other business centers.			X
Policy 6:	Maintain and improve downtown as the financial and office center of the Island, and as a major retail center.			X
Policy 7:	Provide for the continued viability of the Hawai'i Capital District as a center of government activities and as an attractive park-like setting in the heart of the City.			X
Policy 8:	Foster the development of Honolulu's waterfront as the State's major port and maritime center, as a people- oriented mixed-use area, and as a major recreation area.			X
Policy 9:	Facilitate the redevelopment of Kakaako as a major residential, as well as commercial and light industrial area.			X
Discussion: This particular objective and accompanying policies are not relevant to the proposed project.				
Objective C:	To develop a secondary urban center in Ewa with its nucleus in the Kapolei area.			
Policy 1:	Allocate funds from the City and County's capital-improvement program for public projects that are needed to facilitate development of the secondary urban center at Kapolei.			X
Policy 2:	Encourage the development of a major residential, commercial, and employment center within the secondary urban center at Kapolei.	X		

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 3:	Encourage the continuing development of Barbers Point as a major industrial center.			**X**
Policy 4:	Coordinate plans for the development of the secondary urban center at Kapolei with the State and Federal governments and with the sugar industry.	**X**		
Policy 5:	Cooperate with the State and Federal governments in the development of a deep water harbor at Barbers Point.			**X**
Policy 6:	Encourage the development of the Ewa Marina Community as a major residential and recreation area emphasizing recreational boating activities through the provision of a major marina and a related maritime commercial center containing light-industrial, commercial, and visitor accommodation uses.			**X**
Discussion: Ho'opili involves mixed-use development (including residential, commercial and employment) within the secondary urban center. The Petitioner has consistently sought to communicate and coordinate with Federal, State and County agencies on various issues such as the concurrency of required infrastructure improvements, schools and the HHCTC alignment.				
Objective D: To maintain those development characteristics in the urban-fringe and rural areas which make them desirable places to live.				
Policy 1:	Develop and maintain urban fringe areas as predominantly residential areas characterized by generally low rise, low density development which may include significant levels of retail and service commercial uses as well as satellite institutional and public uses geared to serving the needs of households.	**X**		
Policy 2:	Coordinate plans for developments within the Ewa and Central Oahu urban-fringe areas with the State and Federal governments and with the sugar, pineapple, and other emerging agricultural industries.	**X**		
Policy 3:	Establish a green belt in the Ewa and Central Oahu areas of Oahu in the Development Plans.	**X**		
Policy 4:	Maintain rural areas as areas which are intended to provide environments supportive of lifestyle choices which are dependent on the availability of land suitable for small to moderate size agricultural pursuits, a relatively open and scenic setting, and/or a small town, country atmosphere consisting of communities which are small in size, very low density and low rise in character, and may contain a mixture of uses.			**X**
Discussion: The proposed project is generally supportive of Objective D, Policy 1 except that since developable land area on O'ahu is very scarce, Ho'opili will be predominately residential, but most of the units are envisioned to be multi-family and thus cannot not be characterized as being "generally low rise, low density development..."The Petitioner has been coordinating with County, State and Federal agencies, as well as neighboring proposed projects (such as UHWO, and DHHL East Kapolei Development Parcels 1 and 2, and Kalaeloa) early in the planning process. Ho'opili has been designed to include major green belts through and around portions of the Petition Area.				
Objective E: To create and maintain attractive, meaningful, and stimulating environments throughout Oahu.				
Policy 1:	Prepare and maintain a comprehensive urban-design plan for the Island of Oahu.			**X**
Policy 2:	Integrate the City and County's urban-design plan into all levels of physical planning and developmental controls.			**X**

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 3:	Encourage distinctive community identities for both new and existing districts and neighborhoods.	X		
Policy 4:	Require the consideration of urban-design principles in all development projects.			X
Policy 5:	Require new developments in stable, established communities and rural areas to be compatible with the existing communities and areas.	X		
Policy 6:	Provide special design standards and controls that will allow more compact development and intensive use of lands in the primary urban center.			X
Policy 7:	Promote public and private programs to beautify the urban and rural environments.			X
Policy 8:	Preserve and maintain beneficial open space in urbanized areas.	X		
Policy 9:	Design public structures to meet high aesthetic and functional standards and to complement the physical character of the communities they will serve.			X
Policy 10:	Establish a review process to evaluate the design of major development projects.			X
Discussion: Ho'opili will be designed to acknowledge its role as the "gateway" to the Secondary Urban Center, while acknowledging and reflecting the character of Kapolei, 'Ewa Villages and the proposed UH West O'ahu. The Petition Area is large enough to consist of a number of smaller neighborhoods, roughly delineated by a comfortable walking distance from the center of each neighborhood. It is possible then, that each neighborhood will be designed with a distinctive character, but eventually will assuredly develop its own unique character. The project will include open space including along the H-1 Freeway and along the bluffs paralleling Old Fort Weaver Road.				
Objective F: To promote and enhance the social and physical character of Oahu's older towns and neighborhoods.				
Policy 1:	Encourage new construction to complement the ethnic qualities of the older communities of Oahu.			X
Policy 2:	Encourage, wherever desirable, the rehabilitation of existing substandard structures.			X
Policy 3:	Provide and maintain roads, public facilities, and utilities without damaging the character of older communities.			X
Policy 4:	Seek the satisfactory relocation of residents before permitting their displacement by new development, redevelopment, or neighborhood rehabilitation.			X
Discussion: This particular objective and accompanying policies related to O'ahu's older towns and neighborhoods is not relevant to the proposed project.				
PUBLIC SAFETY				
Objective A: To prevent and control crime and maintain public order.				
Policy 1:	Provide a safe environment for residents and visitors on Oahu.	X		
Policy 2:	Provide adequate criminal justice facilities and staffing for City and County law- enforcement agencies.			X
Policy 3:	Emphasize improvements to police and prosecution operations which will result in a higher proportion of wrongdoers who are arrested, convicted, and punished for their crimes.			X
Policy 4:	Keep the public informed of the nature and extent of criminal activity on Oahu.			X
Policy 5:	Establish and maintain programs to encourage public			X

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
	cooperation in the prevention and solution of crimes.			
Policy 6:	Seek the help of State and Federal law- enforcement agencies to curtail the activities of organized crime syndicates on Oahu.			X
Policy 7:	Conduct periodic reviews of criminal laws to ensure their relevance to the community's needs and values.			X
Policy 8:	Cooperate with other law-enforcement agencies to develop new methods of fighting crime.			X
Policy 9:	Encourage the improvement of rehabilitation programs and facilities for criminals and juvenile offenders.			X
Discussion: This particular objective and accompanying policies are mostly directed to law enforcement and other governmental agencies, however, the concept of "defensible space" will be incorporated into the design of Ho'opili.				
Objective B: To protect the people of Oahu and their property against natural disasters and other emergencies, traffic and fire hazards, and unsafe conditions.				
Policy 1:	Keep up-to-date and enforce all City and County safety regulations.			X
Policy 2:	Require all developments in areas subject to floods and tsunamis to be located and constructed in a manner that will not create any health or safety hazard.			X
Policy 3:	Participate with State and Federal agencies in the funding and construction of flood-control projects.			X
Policy 4:	Cooperate with State and Federal agencies to provide tsunami warning and protection for Oahu.			X
Policy 5:	Cooperate with State and Federal agencies to provide protection from war, civil disruptions, and other major disturbances.			X
Policy 6:	Reduce hazardous traffic conditions.	X		
Policy 7:	Provide adequate fire protection and effective fire prevention programs.			X
Policy 8:	Provide adequate search and rescue and disaster response services.			X
Policy 9:	Design safe and secure public buildings.			X
Policy 10:	Provide adequate staff to supervise activities at public facilities.			X
Policy 11:	Develop civil defense plans and programs to protect and promote public health, safety and welfare of the people.			X
Policy 12:	Provide educational materials on civil defense preparedness, fire protection, traffic hazards and other unsafe conditions.			X
Discussion: This particular objective and accompanying policies are mostly directed to civil defense and other governmental agencies. It should be noted that the areas to be developed within the Petition Area are not subject to floods or tsunamis. Of the existing roads in the area, Farrington Highway is often cited for the frequency of accidents and has long been planned for widening. The Petitioner is supportive of this long-planned widening and is aware that this widening will require condemnation of land from the Petition Area.				
HEALTH AND EDUCATION				
Objective A: To protect the health of the people of Oahu.				
Policy 1:	Encourage the provision of health-care facilities that are accessible to both employment and residential centers.			X
Policy 2:	Encourage prompt and adequate ambulance and first-aid services in all areas of Oahu.			X
Policy 3:	Coordinate City and County health codes and other regulations			X

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
	with State and Federal health codes to facilitate the enforcement of air-, water-, and noise-pollution controls.			
Discussion: This particular objective and accompanying policies are mostly directed to private health care providers and other governmental agencies, however, the Petition Area is located near the Hawai'i Medical Center West. The City and County of Honolulu has 18 emergency medical services Advanced Life Support Ambulance units and two Rapid Response Paramedic units on O'ahu. Two of the Advanced Life Support Ambulance units are located nearby, one at the Kapolei Fire Station, the other at the Waipahu Fire Station. One of the Rapid Response Paramedic units is located at the nearby Hawai'i Medical Center West.				
Objective B: To provide a wide range of educational opportunities for the people of Oahu.				
Policy 1:	Support education programs that encourage the development of employable skills.			X
Policy 2:	Encourage the provision of informal educational programs for people of all age groups.			X
Policy 3:	Encourage the after-hours use of school buildings, grounds, and facilities.			X
Policy 4:	Encourage the construction of school facilities that are designed for flexibility and high levels of use.			X
Policy 5:	Facilitate the appropriate location of learning institutions from the preschool through the university levels.	X		
Discussion: This particular objective and accompanying policies are mostly directed to the State Department of Education and other governmental agencies. The Petitioner has met with State Department of Education staff to review the proposed location of public school sites (elementary, middle and high) throughout Ho'opili.				
Objective C: To make Honolulu the center of higher education in the Pacific.				
Policy 1:	Encourage continuing improvement in the quality of higher education in Hawaii.			X
Policy 2:	Encourage the development of diverse opportunities in higher education.			X
Policy 3:	Encourage research institutions to establish branches on Oahu.			X
Discussion: This particular objective and accompanying policies are mostly directed to public and private institutions of higher learning, however, the Petitioner is very supportive of UHWO and its plans for a new campus adjoining Ho'opili.				
CULTURE AND RECREATION				
Objective A: To foster the multiethnic culture of Hawaii.				
Policy 1:	Encourage the preservation and enhancement of Hawaii's diverse cultures.			X
Policy 2:	Encourage greater public awareness, understanding, and appreciation of cultural heritage and contributions to Hawaii made by the City's various ethnic groups.			X
Policy 3:	Encourage opportunities for better interaction among people with different ethnic, social, and cultural backgrounds.			X
Policy 4:	Encourage the protection of the ethnic identities of the older communities of Oahu.			X
Discussion: This particular objective and accompanying policies are mostly directed to governmental agencies.				
Objective B: To protect Oahu's cultural, historic, architectural, and archaeological resources.				
Policy 1:	Encourage the restoration and preservation of early Hawaiian structures, artifacts, and landmarks.			X

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 2:	Identify, and to the extent possible, preserve and restore buildings, sites, and areas of social, cultural, historic, architectural, and archaeological significance.	X		
Policy 3:	Cooperate with the State and Federal governments in developing and implementing a comprehensive preservation program for social, cultural, historic, architectural, and archaeological resources.	X		
Policy 4:	Promote the interpretive and educational use of cultural, historic, architectural, and archaeological sites, buildings, and artifacts.	X		
Policy 5:	Seek public and private funds, and public participation and support, to protect social, cultural, historic, architectural, and archaeological resources.			X
Policy 6:	Provide incentives for the restoration, preservation, and maintenance of social, cultural, historic, architectural, and archaeological resources.			X
Discussion: Five historic properties (SIHP Nos. 50-80-12-4344, 4345, 4346, 4347, and 4348) were documented during Cultural Surveys Hawai'i's archaeological inventory survey of the Petition Area. All five historic properties have been assessed as eligible for the State Register of Historic Places under Criteria C and D, except for Site 4344, which is only eligible under criterion D. The State Historic Preservation Division (SHPD) concurs with these "significance" assessments. SHPD also concurs with the consulting archaeologist's (Cultural Surveys Hawai'i) mitigation recommendations, which include: (1) no further archaeological work at Site 4344, (2) preservation of Sites 4345, 4346, 4347, and 4348, and (3) archaeological monitoring in the vicinity of the four areas of historic habitation (Honouliuli taro lands, Kapalani Catholic Church, Pipeline Village, and Drivers/Stable Village). A preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for its review and approval.				
Objective C: To foster the visual and performing arts.				
Policy 1:	Encourage and support programs and activities for the visual and performing arts.			X
Policy 2:	Encourage creative expression and access to the arts by all segments of the population.			X
Policy 3:	Provide permanent art in appropriate City public buildings and places.			X
Discussion: This particular objective and accompanying policies are mostly directed to governmental agencies that support visual and performing arts.				
Objective D: To provide a wide range of recreational facilities and services that are readily available to all residents of Oahu.				
Policy 1:	Develop and maintain community-based parks to meet the needs of the different communities on Oahu.	X		
Policy 2:	Develop and maintain a system of regional parks and specialized recreation facilities.			X
Policy 3:	Develop and maintain urban parks, squares, and beautification areas in high-density urban places.	X		
Policy 4:	Encourage public and private botanic and zoological parks on Oahu to foster an awareness and appreciation of the natural environment.			X
Policy 5:	Encourage the State to develop and maintain a system of natural resource-based parks, such as beach, shoreline, and mountain parks.			X

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City and County of Honolulu General Plan – Objectives and Policies		S	N/S	N/A
Policy 6:	Provide convenient access to all beaches and inland recreation areas.			X
Policy 7:	Provide for recreation programs which serve a broad spectrum of the population.			X
Policy 8:	Encourage ocean and water-oriented recreation activities that do not adversely impact on the natural environment.			X
Policy 9:	Require all new developments to provide their residents with adequate recreation space.	X		
Policy 10:	Encourage the private provision of recreation and leisure-time facilities and services.	X		
Policy 11:	Encourage the after-hours, weekend, and summertime use of public schools facilities for recreation.			X
Policy 12:	Provide for safe and secure use of public parks, beaches, and recreation facilities.			X
Policy 13:	Encourage the safe use of Oahu's ocean environments.			X
Policy 14:	Encourage the State and Federal governments to transfer excess and underutilized land to the City and County for public recreation use.			X
Discussion: The Ho'opili project includes approximately 210 acres for park and open space. The Petitioner proposes a series of parks and open spaces including a district park with active playfields, proposed to be located within the center of the Ho'opili project. In addition, a Canyon Park, located at the southeastern portion of the Ho'opili project, will provide a unique wilderness-type park alternative for residents. A Civic Plaza is envisioned as a community gathering space for outdoor concerts, farmer's markets, and other community events. The project has integrated an extensive network of open space and walking/biking paths. The City and County of Honolulu's Park Dedication Ordinance applies to all new residential developments and will mitigate the demand for recreational facilities.				
GOVERNMENT OPERATIONS AND FISCAL MANAGEMENT				
Objective A: To promote increased efficiency, effectiveness, and responsiveness in the provision of government services by the City and County of Honolulu.				
Policy 1:	Maintain City and County government services at the level necessary to be effective.			X
Policy 2:	Promote consolidation of State and City and County functions whenever more efficient and effective delivery of government programs and services can be achieved.			X
Policy 3:	Ensure that government attitudes, actions, and services are sensitive to community needs and concerns.			X
Policy 4:	Prepare, maintain, and publicize policies and plans which are adequate to guide and coordinate City programs and regulatory responsibilities.			X
Discussion: The above objective and policies related to fiscal integrity, responsibility, and efficiency by the City and County government in best directed to the City and County of Honolulu.				
Objective B: To ensure fiscal integrity, responsibility, and efficiency by the City and County government in carrying out its responsibilities.				
Policy 1:	Provide for a balanced budget.			X
Policy 2:	Allocate fiscal resources of the City and County to efficiently implement the policies of the General Plan and Development Plans.			X
Discussion: While the City and County of Honolulu's policies related to government operations and				

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City and County of Honolulu General Plan – Objectives and Policies	S	N/S	N/A
fiscal management are not directly applicable to the Ho'opili project, the Petitioner supports the City and County of Honolulu's objectives. The project's most significant impact would be the higher real property taxes that would be generated compared to those currently paid. The Ho'opili project is projected to generate an additional $7.7 million in real property tax values in 2015, or $29.1 million on an annual basis upon the project's completion in 2030. These real property tax collections will continue after 2030.			

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5.3.2 Ewa Development Plan

The *Ewa Development Plan* was updated and officially adopted by the City Council in August 1997 and is presently being updated. The plan presents a vision for 'Ewa's future development and provides conceptual land use plans that will serve as a policy guide for more detailed zoning maps and regulations, and public and private sector investment decisions. Provisions of the *Ewa Development Plan* are discussed in the table below.

Table 5.8. Ewa Development Plan – Objectives and Policies

Ewa Development Plan – Objectives and Policies	S	N/S	N/A
CHAPTER 1: EWA'S ROLE IN OAHU'S DEVELOPMENT PATTERN			
In support of the General Plan policies, the Ewa Development Plan:			
Provides a secondary employment center with its nucleus in the City of Kapolei to supplement the Primary Urban Center (PUC) and to divert commuter traffic from the PUC;	X		
Concentrates primary employment activities at industrial and resort areas and at government service and higher education centers around the City of Kapolei so that secondary markets are created for office and retail activities;	X		
Provides for significant residential development throughout Ewa, consistent with the General Plan to meet the needs of Oahu's citizens;	X		
Provides for a variety of housing types from affordable units and starter homes to mid-size multi-family and single-family units;	X		
Promotes diversified agriculture on prime agricultural lands along Kunia Road and surrounding the West Loch Naval Magazine in accordance with the General Plan policy to support agricultural diversification in all agricultural areas on O'ahu;			X
Provides a secondary resort area at West Beach (Ko Olina);			X
Helps relieve urban development pressures on rural and urban fringe Development Plan Areas (Waianae, North Shore, Koolau Loa, and Koolau Poko) so as to preserve the "country" lifestyle of these areas; and	X		
Provides, along with the PUC, a focus for directed and concentrated public and private infrastructure investment for growth.	X		
Discussion: The proposed project is a master-planned community ("East Kapolei") envisioned by the Ewa Development Plan. Ho'opili will be a mixed-use, transit-ready community including residential, business, and commercial areas; and transit stations, schools, and parks.			
CHAPTER 2: THE VISION FOR EWA'S FUTURE			
This vision for Ewa has two horizons. The first is a 25-year horizon, extending from the present (1995) to the year 2020. This is the horizon that was used to project likely socioeconomic change in Ewa and to assess the infrastructure and public facility needs that will have to be met over that period. The Vision to 2020. By 2020, the Ewa Development Plan Area will have experienced tremendous growth, and will have made significant progress toward providing a Secondary Urban Center for O'ahu. Population will have grown from 43,000 people in 1990 to almost 125,000. Nearly 28,000 new	X		

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
housing units will have been built in a series of master planned communities. Job growth will be equally impressive, rising from 17,000 jobs to over 64,000 in 2020. Oahu residents and visitors will be attracted to Ewa by a new university campus, the Ko Olina resort, ocean and waterfront activities at Ewa Marina, a major super regional park, and a thriving City of Kapolei which has retail and commercial establishments and private and government offices. Beyond 2020. In the course of the Development Plan revision, it became clear that there was value in looking beyond 2020 to identify what Ewa should look like when "fully" developed. Such a perspective helped identify where open space should be preserved within the urbanized area, where the rapid transit corridor should be located, and where to set the limits to development in Ewa for the foreseeable future. As such, this second horizon might be called the built-out" horizon and is probably 40 or 50 years in the future.			

Discussion: The *Ewa Development Plan* establishes six key elements to ensure that the vision statement for the 'Ewa region is achieved. The following describes those key elements that are applicable to the proposed project (See Figure 2.5: Ewa Development Plan).

Urban Growth Boundary. Although the project site is within the Agricultural State Land Use District, it is located within (and makai of) the Urban Growth Boundary of the *Ewa Development Plan* Urban Land Use Map.

Network of Open Space and Greenways. The Ho'opili project is consistent with the Ewa DP's objectives and policies to protect and preserve open space. As many as 210 acres of parks and open space will be provided within the Petition Area. An additional 30 acres will be maintained as open space and will be used for off-site drainage. Open space buffers are proposed to be located along the H-1 Freeway and Old Fort Weaver Road. In addition, linear parks and open space will encircle the Ho'opili project with walking/biking paths to create a separate but welcoming identity for the Ho'opili community. The Petitioner consults with UHWO and DHHL on at least a monthly basis and is aware of DPP's requirements for street sections and planting strips (linear greenbelts) for the adjoining landowners and what precedents may have been established for Ho'opili. The Ho'opili project will be designed to facilitate multi-modal (transit, pedestrian, bicycle and automobile) connectivity between projects and to City and County of Honolulu streets and regional roadways (where permitted). Figure 2.8: Proposed Circulation Plan shows the approximate alignment of bikeways being proposed by DHHL, UHWO and the Petitioner and how they may connect to bikeways proposed by others (such as HCDA), the bike path shown along North-South Road on the Ewa DP Public Facilities Map, the bikeways shown on the State Bicycle Plan 2003 and the City and County of Honolulu's Draft Ewa Connectivity Study, future schools and park sites proposed by HCDA, DHHL, UHWO and the Petitioner, and possible transit stops (locations being finalized as of this writing). The placement of proposed future parks will consider the opportunities for potential co-location with elementary and middle schools.

The Secondary Urban Center. The Secondary Urban Center would function as the primary employment generator for the *Ewa Development Plan* area by the year 2020. Major new employment centers are planned at the City of Kapolei, Kapolei Hale (the Kapolei Civic Center completed in 2001), Ko 'Olina, the Deep Draft Harbor, Campbell Industrial Park, Barbers Point

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A

Naval Air Station (with civilian reuse) and the UHWO campus. While the greatest percentage of the developable area of the project is contemplated for residential use, the proposed project will generate employment opportunities during the construction period as well as after build-out. The project will include significant business and commercial areas that will provide employment opportunities. The proposed community will contribute to the larger goal of developing a "self-contained" second city within the greater master-planned Kapolei area in which residents can live, work, learn, play, and shop, and will complement the City of Kapolei and 'Ewa's urban core.

Communities Designed to Support Non-automotive Travel. According to the *Ewa Development Plan*, master-planned residential communities will be designed to support pedestrian, bicycle, and public transit uses. A rapid transit corridor along Farrington Highway and the proposed North-South Road will link the City of Kapolei, Villages of Kapolei, UHWO campus, and Waipahu. The proposed project will be built along the corridor, with large areas of the project site either within walking distance of transit stations or accessible by feeder buses. As a mixed-use, transit-ready community, Ho'opili will encourage residents to walk/bicycle to schools, parks, and business and commercial areas within the community, and use public transportation to commute to areas outside of the community.

Preservation and Enhancement of Cultural Resources. The *Ewa Development Plan* states:
Ewa's Historic and Cultural Resources will be preserved and enhanced by...retaining visual landmarks and significant vistas, including:

- *Distant views of the shoreline from the H-1 Freeway above the Ewa Plain;*
- *Views of the ocean from Farrington Highway between Kahe Point and the boundary of the Waianae Development Plan Area;*
- *Views of the Waianae Range from H-1 Freeway between Kunia Road and Kalo'i Gulch and from Kunia Road;*
- *Views of na puu at Kapolei, Palailai, and Makakilo;*
- *Mauka and makai views; and*
- *Views of central Honolulu and Diamond Head.*

Views of Diamond Head and the Ko'olau Mountain Range will be created from the property, which are currently inaccessible to the public. The visual appearance of the property will change from vacant scrub and cultivated vegetation to a master-planned community with approximately 210 acres of parks and open space. The project will be designed to take advantage of the views of Wai'anae, central Honolulu, and Diamond Head.

Phased Development. The *Ewa Development Plan* originally set forth a phasing program with the objective of coordinating future development with existing and planned infrastructure. It is our understanding that the proposed update to the *Ewa Development Plan* will remove references to phasing. Ho'opili is the final non-Urban land within the Urban Growth Boundary in 'Ewa. With the planned completion of the North-South Road in 2008, the development of UHWO, planning of a residential and commercial development by DHHL, the construction of the Kroc (recreational, social services and community) Center and the planned development by Hawaii Community Development Authority in Kalaeloa, the coordination of infrastructure with development is occurring through regular and frequent meetings between the Petitioner and DHHL, UHWO and HCDA. In addition, the Petitioner meets frequently with other State and County agencies, including the Department of Planning and Permitting, the Department of Transportation Services and the Department of Education.

CHAPTER 3: LAND USE POLICIES, PRINCIPLES, AND GUIDELINES

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
3.1: OPEN SPACE PRESERVATION AND DEVELOPMENT — General Polices			
Open space will be used to:			
a) Provide long range protection for diversified agriculture on lands outside the Urban Growth Boundary,			X
b) Protect scenic views and provide recreation,	X		
c) Define the boundaries of communities,	X		
d) Provide a fire safety buffer where developed areas border "wildlands" either in preservation areas within the Urban Growth Boundary or in the State Conservation District, and			X
e) Create linkages between communities through a network of Greenways along transportation and utility corridors and drainageways.	X		
Discussion: Open space will be provided within the Petition Area to provide views and recreation, especially along the H-1 Freeway. Landscaping along linear parks with walking/biking paths will be installed to create a separate but welcoming identity for the Ho'opili community, as well as to define smaller neighborhoods. The Petitioner consults with UHWO and DHHL on at least a monthly basis and is aware of DPP's requirements for street sections and planting strips (linear greenbelts) for the adjoining landowners and what precedents may have been established for Ho'opili. The Ho'opili project will be designed to facilitate multi-modal (transit, pedestrian, bicycle and automobile) connectivity between projects and to City and County of Honolulu streets and regional roadways (where permitted). Figure 2.8: Proposed Circulation Plan shows the approximate alignment of bikeways being proposed by DHHL, UHWO and the Petitioner and how they may connect to bikeways proposed by others (such as HCDA), the bike path shown along North-South Road on the Ewa DP Public Facilities Map, the bikeways shown on the State Bicycle Plan 2003 and the City and County of Honolulu's Draft Ewa Connectivity Study, future schools and park sites proposed by HCDA, DHHL, UHWO and the Petitioner, and possible transit stops (locations being finalized as of this writing).			
3.2: REGIONAL PARKS AND RECREATION COMPLEXES — General Policies			
Regional parks and recreation complexes include the Kalaeloa Regional Park and Recreation Complex proposed for Barbers Point Naval Air Station, Kapolei Regional Park, Pu'u Palailai Park, various beach and shoreline parks, and public and private golf courses. To sustain economic, development, the City is encouraged to look towards public-private partnerships to build, and maintain new park and recreation complexes.			X
Regional Park. The new Kalaeloa Regional Park at the present Barbers Point Naval Air Station will feature a large shoreline park with beach recreation and support facilities; a wide range of activity areas including athletic fields in the mauka lands; and preserves for wildlife habitats, wetlands and endangered plant colonies. The Park will encompass mostly undeveloped lands, bordered by the shoreline on the south, the airfield and developed portions of the facility to the north and west, and the existing military golf course and future Ewa Marina golf course to the east.			X
Kapolei Regional Park is a 73-acre park which includes the Pu'u o Kapolei. The Park will serve as a defining limit for the northeastern edge of the City of Kapolei and as a visual gateway to the City. The park will provide diverse active and passive recreation within easy walking distance of both the City Center and the Villages of Kapolei.			X
Pu'u Palailai Park will be located below Makakilo, and is to be a nature park. It will offer hikers excellent views of the Ewa Plain and distant views of Honolulu and Diamond Head.			X
Two future beach parks are planned at both ends of Ko Olina. The larger			X

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park at the northern end of the resort will provide for picnicking and other passive recreation. A park at the southern end will provide direct access to one of the four swimming lagoons. A boat launching ramp, which will be available for public use, will be located adjacent to the southern park, and will provide access to the marina channel.			
Golf Courses. Ewa has seven public and private golf courses, and there are plans for five more. The City's courses include the West Loch and Ewa Villages golf courses. The Ewa Village course which will open in the spring of 1996 also provides flood protection and storm water detention for Ewa Villages.			X
Private golf courses include the Hawaii Prince, Puuloa, Kapolei, and Ko Olina golf courses. The U.S. military operates a golf course at Barbers Point Naval Air Station, (BPNAS) and will continue to do so after BPNAS is returned to civilian control. The Ewa-Gentry golf course is scheduled to begin construction 1997, and additional golf courses are planned for Ko Olina Resort, Makakilo, and Ewa Marina.			X
Golf courses can provide protection for open space, and help reduce flooding and non-point pollution by helping retain storm waters. Golf course development should be approved only after determination that the course meets social, growth, economic, and environmental guidelines and approval of a community integration program.			X
Recreation Complexes. Sports and recreation complexes designed to attract visitors from throughout the region and the rest of O'ahu have been proposed for a number of areas in Ewa. Proposals for a Kalaeloa Center on surplus lands at Barbers Point Naval Air Station call for creation of an "Olympic Village" type international training center, a baseball training facility, a rowing water course, a motorsports center, and a water theme park. Such complexes should be designed to be compatible with surrounding land uses and environmental features.			X
Discussion: While the Ewa DP's policies related to regional parks and recreation complexes are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives. The Petitioner is proposing to set aside land for a district park near Fort Weaver Road to serve surrounding area residents.			
3.3: COMMUNITY-BASED PARKS — General Policies			
Adequate parks to meet residents' recreational needs should be provided. Currently, Ewa has less community-based park acreage than the Department of Parks and Recreation island-wide standard indicates is needed for its existing population. The existing deficit relative to the standard is almost 40 acres.	X		
New residential development should strive to provide land for open space and recreation purposes at a minimum of two acres of park per 1,000 residents. Community-based parks (and associated service radius) include mini-parks (1/4 mile), neighborhood parks (1/2 mile), community parks (one mile), and district parks (two miles).	X		
Based on these standards, an additional 76 acres of community-based parks and recreation areas should be developed to meet the needs of the projected 2020 Ewa population.	X		
Access to recreational resources in the mountains, at the shoreline, and in the ocean should be protected and expanded. New development projects are an opportunity to provide public access to trail heads from the streets extending toward the lf mountain slopes or approaching the edges of the	X		

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gulches. In addition, the City should support other efforts to expand access to mountain and gulch trails in areas where urban development will not occur.			
Development master plans should provide accessible pathways from surrounding streets to facilitate pedestrian and bicycle access to all features in parks.			
Discussion: While many of the future residents of Ho'opili will come from other areas of O'ahu, it is acknowledged that the recreational needs of the residents of Ho'opili must be met. Based on the *Ewa Development Plan* "requirement" of two acres of park per 1,000 residents, Ho'opili's proposed 11,750 units is expected to generate approximately 35,250 residents (at an average household size of 3 residents per household), resulting in a "requirement" of 70.5 acres of park. The Ho'opili project proposes a district park with active playfields, proposed to be located near Fort Weaver Road to serve surrounding area residents. In addition, a Canyon Park, located at the southeastern portion of the Ho'opili project, will provide a unique wilderness-type park alternative for residents. A Civic Plaza is envisioned as a community gathering space for outdoor concerts, farmer's markets, and other community events. "Mini" (neighborhood) parks located throughout the project will be within walking distance of most residences. The siting of parks will consider the potential opportunities for co-location of parks with elementary and middle school sites. The proposed project will include pedestrian and/or bicycle paths connecting streets and parks.			
3.4: HISTORIC AND CULTURAL RESOURCES — General Policies			
Physical references to Ewa's history and cultural roots should be emphasized to help define Ewa's unique sense of place. Existing visual landmarks should be protected, and creation of new culturally appropriate landmarks should be supported.	**X**		
Significant historic features from the plantation era and earlier periods should be preserved.	**X**		
Whenever possible, significant vistas should be retained.	**X**		
Discussion: Five historic properties (SIHP Nos. 50-80-12-4344, 4345, 4346, 4347, and 4348) were documented during Cultural Surveys Hawai'i's archaeological inventory survey of the Petition Area. All five historic properties have been assessed as eligible for the State Register of Historic Places under Criteria C and D, except for Site 4344, which is only eligible under criterion D. The State Historic Preservation Division (SHPD) concurs with these "significance" assessments. The SHPD also concurs with the consulting archaeologist's (Cultural Surveys Hawai'i) mitigation recommendations, which include: (1) no further archaeological work at Site 4344, (2) preservation of Sites 4345, 4346, 4347, and 4348, and (3) archaeological monitoring in the vicinity of the four areas of historic habitation (Honouliuli taro lands, Kapalani Catholic Church, Pipeline Village, and Drivers/Stable Village). A preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for its review and approval. The major visual resources in the vicinity of the Petition Area are the ocean and the Wai<u>'</u>anae and Ko'olau mountain ranges. The most heavily traveled roads in the vicinity of the project site are Fort Weaver Road and the H-1 Freeway. A vast majority of the project site is not visible from Fort Weaver Road, because it is set back and 30 to 40 feet higher than Fort Weaver Road. Since the Petition Area is west of Fort Weaver Road, development of the Petition Area will not obstruct views of the Ko'olau Mountains from either Fort Weaver (or the H-1 Freeway.) Development of the Petition Area will also not likely obstruct views of the Wai'anae Mountain range. There are presently no views towards the ocean from the portion of Fort Weaver Road between the H-1 Freeway and the Child and Family Services Complex (near the southeast corner of the Petition Area). There are occasional views towards the ocean and Diamond Head in the far distance across the project site from the high-speed H-1 Freeway. Development of the Petition Area may alter these views, but it should be noted that views of 'Ewa, in its present state, is not just of agricultural fields but also of a major electrical substation site, as well as 138kV lines mounted on tall metal poles. Also, the City			

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and County of Honolulu is proposing an elevated rail transit system as part of the HHCTC project through the project site and along North-South Road.			
3.5: CITY OF KAPOLEI — General Policies			
The City of Kapolei should serve as the urban core, or the 'downtown' for the Secondary Urban Center. It should accommodate a major share of the new employment in the Secondary Urban Center.	X		
The City of Kapolei should have a balanced mix of business and residential areas, complemented by the recreational, social and cultural activities of a city. Mixed use should be permitted and encouraged throughout most of the City area, in order to achieve the diversity and intensity of uses that characterize a city.	X		
The City of Kapolei is envisioned to be a true city, encompassing a full range of urban land uses, and laid out in small blocks connected by a grid system of public streets.			X
Discussion: The Ho'opili project is supportive of the Ewa DP's vision that the City of Kapolei should serve as the urban core, or the "downtown" for the Secondary Urban Center, with the main State and County governmental services located in the City of Kapolei and UHWO located in 'Ewa.			
3.6: RESIDENTIAL DEVELOPMENT — General Policies			
3.6.1: EWA VILLAGES			
The City and County of Honolulu has acquired the 600 acres surrounding and including Tenney, Renton and Varona Villages. The Master Plan for the Ewa Villages helps ensure continued tenancy and ownership opportunities for current residents as well as provides a vehicle for preservation efforts within the existing villages.			X
The existing village structures in the Ewa Villages should continue to be rehabilitated or adapted for reuse; and related affordable and market housing should be developed to create a total of 1,900 units, including the existing housing.			X
A City golf course has been recently developed to provide storage for storm waters. In addition, a district park, additional neighborhood parks/open space, and a small shopping center should be developed; and infrastructure improvements should be made.			X
Ewa Villages should once again stand as a thriving and identifiable community, and should serve as a living example of Hawaii's plantation heritage.			X
Discussion: While the Ewa DP's policies related to residential development of the 'Ewa Villages are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives. The Petition Area abuts the 'Ewa Villages Golf Course.			
3.6.2: EWA MARINA			
Ewa Marina, when developed, should be the region's principal recreational marina destination for local residents and visitors. Developed on over 1,100 acres located between Ewa Beach and Kalaeloa (Barbers Point Naval Air Station), the community should be centered around a 120-acre marina which should serve as a major recreational resource and visual amenity for the community.			X
The marina should provide recreational boating opportunities, supported by 1,400 boat slips, marine haul-out and other repair facilities, and a public boat ramp.			X
The City supports timely development of the Ewa Marina as a key element needed to mitigate drainage impacts in the Kaloi Gulch watershed during major storms. The marina's role as a storm water storage and detention			X

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basin has been acknowledged and included in previously approved environmental impact statements and land use approvals for projects in the Kaloi gulch watershed.			
Ewa Marina should provide substantial public areas through shoreline and waterfront access, expansion of Oneula Beach Park, and creation of a District Park on Fort Weaver Road. The public waterfront promenade at Ewa Marina should have a hard edge and should focus on boating activity. Shoreline parks linked by pedestrian ways should be provided for public use along the entire waterway. A golf course should provide a major open space and visual amenity while also providing detention basins to receive run-off from light storms.			X
On the eastern end, the Ewa Marina community should consist of Low and Medium Density Residential neighborhoods extending westward from Ft. Weaver Road, encompassing the eastern "loop" of the marina and an island within the marina.			X
The existing community commercial center at Ewa Beach should be enlarged by development on land along Ft. Weaver Road at the eastern corner of the Ewa Marina community.			X
On the west, a mix of activities should be sited around the marina basin, including a Marina Mixed Use area with resort and commercial development, a High Density Residential area, and a Marine Industrial area. Ewa Marina is planned to have about 950 visitor units to support its marina-oriented activities.			X
Discussion: While the Ewa DP's policies related to the residential development of the 'Ewa Marina are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives. While a relatively small portion of the Petition Area lies within the Kalo'i Gulch drainage basin, Ho'opili will be designed to detain future runoff from the site to current flows, until such time as the outlet to the ocean at 'Ewa Marina is opened. <u>During the Draft EIS public review period, HASEKO (Ewa), Inc. wrote: "...the location of the proposed ocean outlet is at One'ula Beach Park, and not at 'Ewa Marina (now known as Hoakalei Marina)...Because of the potential environmental problems associated with intersecting the Kalo'i Gulch regional drainage system with the Honouliuli sewer outfall pipe, the outlet has been relocated from the marina, which is to the west of the sewer outfall pipe, to the beach park, which lies east of the outfall." HASEKO (Ewa), Inc. also wrote: "The ability to construct the ocean outlet is dependent upon issuance of a conservation district use permit (CDUP) by the State Board of Land and Natural Resources. Haseko has applied for the CDUP, which is now being processed through a contested case proceeding."</u>			
3.6.3.1: EXISTING AND PLANNED RESIDENTIAL COMMUNITIES – General Policies			
The following general policies may be applied to the expansion or renovation of existing residential communities, as well as to new communities.			
Overall Density. To achieve the desired compactness and character of development in planned residential communities, the housing density of the aggregate area zoned for residential use (including the streets) should be in the range of 10 to 15 units per acre. (This average does not include areas zoned for commercial or industrial use.)	X		
Higher Density Housing Along the Transit Corridor. To promote use of mass transit, higher density residential use should be developed along a major rapid transit corridor linking Kapolei with Waipahu and Primary Urban Center communities to the east High Density Residential and Commercial uses should be developed at six transit nodes, which would cover a one quarter mile radius around major transit stops. Areas along the rapid transit corridor should have housing densities of 25 units per acre, and greater	X		

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densities are expected within the transit nodes.			
Physical Definition of Neighborhoods. The boundaries of neighborhoods should be made evident through the use of street patterns, landscape or natural features, and building form and siting. The focus of neighborhood activity should be on the local street or a common pedestrian right-of-way or recreation area.	X		
Compatible Mix of Building Forms. There should be a variety of housing types and densities to avoid visual monotony and accommodate a variety of housing needs, but without sharp contrasts between the exterior appearances of adjacent housing areas.	X		
Transit-Oriented Streets. Street patterns and rights-of-way should be designed to accommodate mass transit service and make it convenient to access for as many households as possible.	X		
Pedestrian and Bicycle Travel. Pedestrian and bicycle travel should be encouraged, particularly to reach neighborhood destinations such as schools, parks and convenience stores.	X		
Integration of Linear Corridors. Physical and visual connections between communities should be encouraged through the creative design of transportation and utility corridors and drainage systems.	X		
Provision of Community Facilities. Land should be provided for community facilities including churches, community centers, and elderly and child care centers.	X		

Discussion: The Ho'opili project will construct up to 11,750 residential units of varying product types. The Project will consist of for-sale single-family units and multi-family units, with multi-family rental units also available. The proposed project is envisioned as a new kind of development, one that improves the quality of people's lives by allowing them to live, work, learn, shop and play in their own community. As such, a network of open space and walking/biking paths will encircle the Ho'opili project. In keeping with the City and County of Honolulu's plans to place a high-capacity transit corridor within Ho'opili, two types of higher density housing are being proposed along the transit corridor: Mixed-Use/Medium Density Residential and Mixed-Use/High Density Residential.

Mixed-Use/Medium Density Residential

Planned to be oriented along future high-capacity transit and major roadway alignments, these medium density mixed use districts would include live-work residential units or residential uses over ground floor commercial and office uses. Within these districts that comprise approximately 340 acres (all of which will not be developed for housing because the acreage includes secondary roads, off-street parking and mini-"neighborhood" parks), there are approximately 5,200 dwelling units planned at densities of 15 to 29 units per acre along with retail and office use.

Mixed-Use/High Density Residential

Planned to be located near major transportation junctions, these higher density mixed use districts would include commercial, office space, and higher density live-work residential units or residential uses above ground floor businesses. Within these districts that comprise approximately 50 gross acres (which includes secondary roads, off-street parking and mini-"neighborhood" parks) would be approximately 40 net developable acres that would accommodate approximately 1,450 dwelling units planned at densities of 30 to 50 units per acre along with retail and office use.

The project will be designed to have transit-oriented streets, including transit boulevards with street sections including a high-capacity transit corridor right-of-way, as well as streets designed to accommodate bus transit. To enhance the convenience of both high-capacity transit as well as bus transit, the project will be designed to have a network of slower speed streets with sidewalks to

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encourage bicycle and pedestrian modes of travel. The Ho'opili project will be designed to facilitate multi-modal (automobile, bicycle and pedestrian) connectivity between projects and to City and County of Honolulu streets and regional roadways (where permitted). Figure 2.8: Proposed Circulation Plan shows the approximate alignment of is being proposed by DHHL, UHWO and the Petitioner and how they may connect to bikeways proposed by others (such as HCDA), the bike path shown along North-South Road on the Ewa DP Public Facilities Map, the bikeways shown on the State Bicycle Plan 2003 and the City and County of Honolulu's Draft Ewa Connectivity Study, future schools and park sites proposed by HCDA, DHHL, UHWO and the Petitioner, and possible transit stops (locations being finalized as of this writing).			
3.6.3.2: EXISTING AND PLANNED RESIDENTIAL COMMUNITIES- Guidelines – Low Density Residential			
Low Density Residential Low Density Residential areas consist of one and two-story single-family attached and/or detached dwellings with individual entries. **Density** • Density should be 5 to 12 units per acre, typical of residential zoning districts and allowing the application of optional design standards for Clusters and Planned Unit Developments. **Building Height** • In general, buildings should not exceed two stories, although the height may vary according to required flood elevation, slope, and roof form. **Site Design** • The site design for small-lot developments should avoid monotonous rows of garages and driveways along neighborhood street frontages by employing features such as varied building setbacks and shared driveways. **Building Form** • Buildings should provide visual interest and individual identity by using varied roof forms, exterior colors and finishes, building orientation, floor plans and architectural details.	X		
Discussion: Since nearly all of the above guidelines for Low Density Residential appear to be consistent with new urbanism principles, at the present time, it would appear the Petitioner would have little difficulty implementing nearly all of the above guidelines.			
3.6.3.2: EXISTING AND PLANNED RESIDENTIAL COMMUNITIES- Guidelines – Medium Density Residential			
Medium Density Residential Medium Density Residential areas consist of two- and three-story townhouse or low-rise apartment buildings. Dwelling units may have common entries, but buildings are typically non-elevator structures. **Density** • Density should be 10 to 30 units per acre. **Height** • In general, buildings should not exceed three stories above grade. Maximum building heights should allow for pitched roof forms. **Building Form** • Building form, orientation, location of entries and landscape screening should be employed to maintain a sense of residential scale and provide greater privacy and individual identity for housing units. **Compatibility** • Building scale, roof form and the quality of materials should be compatible with those of adjacent low-density residential areas.	X		
Discussion: Since nearly all of the above guidelines for Medium Density Residential appear to be			

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consistent with new urbanism principles, at the present time, it would appear the Petitioner would have little difficulty implementing nearly all of the above guidelines. It should be noted that some flexibility should be permitted to allow Medium Density Residential to be located in mixed-use zones, with the ground floor or lower floors occupied by retail and service commercial uses.			
3.6.3.2: EXISTING AND PLANNED RESIDENTIAL COMMUNITIES- Guidelines – High Density Residential			
High Density Residential High Density Residential developments take the form of multi-story apartment buildings. They may be located in mixed-use zones, with the ground floor or lower floors occupied by retail and service commercial uses. **Location** • In general, high-density residential buildings would be located in large planned residential communities, adjacent to major collector streets, commercial or civic centers. • High Density Residential is intended to be the predominant form of housing in and near the City of Kapolei and around transit nodes on the planned rapid transit corridor between Waipahu and Kapolei. **Density** • Allowable building density should accommodate 25 to 90 units per acre. **Height** • Building heights should not exceed 150 feet in the City of Kapolei and the Ko Olina Resort and 90 feet elsewhere. Taller building heights are intended to allow higher densities, create variation in the city-scape, [and] give a visual sign of transit nodes, and identify the City of Kapolei's importance as a regional center. **Architectural Character** • The building scale, roof form and the quality of materials may reflect a more urban character. **Height Setbacks** • Building height setbacks and landscaping should be employed to reduce the direct visibility of taller buildings from lower density residential areas and from the streetfront. Lower building elements may directly abut the streetfront.	X		
Discussion: Since nearly all of the above guidelines for High Density Residential appear to be consistent with new urbanism principles, at the present time, it would appear the Petitioner would have little difficulty implementing nearly all of the above guidelines.			
3.6.3.2: EXISTING AND PLANNED RESIDENTIAL COMMUNITIES- Guidelines – Circulation System			
Master-planned projects should each have a circulation plan, or "circulation element" in their Project Master Plan. **Transit Routes and Facilities** • The circulation plan should define the hierarchy of streets within the project and its relationship to the surrounding transportation network. • The circulation plan should also indicate existing and proposed bus routes and specific measures to accommodate efficient transit service for as many households as possible. • The rights-of-way along transit routes should make provisions for bus shelters, bus pull-outs, and, if applicable, park-and-ride facilities and/or future transit stations.	X		
Pedestrian and Bicycle Routes and Facilities • The circulation plan should indicate any principal pedestrian and bicycle paths that are physically separated from roadways. • Street intersections along these separated paths should have a narrow curb	X		

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radius and include special signage and paving to encourage safe and convenient pedestrian and bicycle crossings. • Interior pedestrian/bicycle routes may be provided as an alternative to paved sidewalks along local streets. • Most residences should be within a five-minute (or one-quarter mile) walking distance of a proposed bus route, unless localized topographic conditions make such a requirement impractical.			
Discussion: Prior to rezoning, a circulation plan defining the hierarchy of streets within the project and its relationship to the surrounding transportation network will be developed. The circulation plan will also indicate: - existing and proposed bus routes and specific measures to accommodate efficient transit service for as many households as possible; - any principal pedestrian and bicycle paths that are physically separated from roadways (and that interior pedestrian/bicycle routes may be provided as an alternative to paved sidewalks along local streets); - that street intersections along these separated paths should have a narrow curb radius and include special signage and paving to encourage safe and convenient pedestrian and bicycle crossings; - a five-minute walking radius from proposed bus and transit routes (unless localized topographic conditions make such a requirement impractical).			
3.7: NON RESIDENTIAL DEVELOPMENT — General Policies			
This section provides general policies, non-residential development, including planned commercial retail centers, Ko Olina Resort, industrial centers, Kalaeloa (Barbers Point Naval Air Station), Pearl Harbor Naval Base (West Loch), and the University of Hawaii West Oahu.			
3.7.1.1: PLANNED COMMERCIAL RETAIL CENTERS – General Policies			
Planned commercial centers, outside of the City of Kapolei, should provide retail shopping and services for the Ewa residential communities in which they are located. These centers differ from commercial areas within towns such as Waipahu or the City of Kapolei because they are typically managed as a unit with shared parking and center management.	X		
Commercial centers outside of the City of Kapolei should concentrate commercial uses in central locations instead of in continuous commercial strips along arterial roads. Pedestrian and transit access to and within the centers should be emphasized. **Definitions.** Four types of commercial centers can be defined based on size and function: • **Neighborhood Commercial Center** (5-10 acres or less, typically located within or adjacent to residential area, up to 100,000 square feet [sq. ft.] of floor area); • **Community Commercial Center** (10-30 acres, typically located on an arterial highway or at the intersection of two major collector streets, up to 250,000 sq. ft. of floor area); • **Major Community Commercial Center** (up to 50 acres, located in communities which are not near an urban center, up to 500,000 sq. ft. of floor area); and • **Regional Commercial Center** (more than 50 acres, located with frontage on	X		

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a major arterial highway and access from freeway interchange, more than 500,000 sq. ft. of floor area). No Major Community Commercial Centers or Regional Commercial Centers are indicated for Ewa outside of the City of Kapolei since the City of Kapolei is intended to provide for regional shopping needs. **Neighborhood Commercial Center.** Neighborhood Commercial Centers can be located within any residential community, and should be reviewed and approved as part of development of master planned residential communities or redevelopment of existing communities. Neighborhood Commercial Centers have frontage on at least one collector street, and may have up to 100,000 sq. ft. of floor area, which is leased to tenants such as grocery stores, sundries stores and other services and shops catering to common household needs. Single commercial establishments, such as convenience stores or "Mom and Pop" stores, or groupings of stores smaller than five acres in size also fall within this category, provided that they are appropriately located and will not contribute to the evolution of a commercial strip. **Community Commercial Center.** This type of center principally serves the community in which it is located, providing for basic shopping and service needs on a larger scale than the neighborhood center. Community Commercial Centers may contain up to 250,000 sq.ft. of floor area, and major attractions typically include a large grocery store, a drug store, and/or a department store. The other, smaller tenants in the center are largely dependent on the effectiveness of the major tenants to draw customers. The Kapolei Shopping Center is an example of this type of commercial center. Locations for existing and planned Community Commercial Centers at Ewa Beach, Laulani, Kapolei East (near the intersection of Farrington Highway and the North-South Road), Villages of Kapolei, Makaiwa Hills and Ko Olina Marina are shown on the Urban Land Use Map in Appendix A. Office uses should not be a principal use in Ewa Community Commercial Centers. Offices which provide services to the local community may be included in the centers, but the emphasis should be on retail uses. In Ewa, developments primarily oriented to office uses should be located in the City of Kapolei.			
Discussion: The Ho'opili project plans to provide approximately 235 gross acres (which includes secondary roads and off-street parking) for business/commercial uses. As a predominately mixed-use development, the proposed retail commercial uses would be best fall in the Ewa DP-described as "Neighborhood Commercial Centers" or "Community Commercial Centers." It should be noted that some flexibility should be permitted to allow Community Commercial Centers to include office use as a principal use, especially around transit stations, including the half-mile transit-influence zones. In order to minimize work-related commuter traffic and the characterization of 'Ewa as a bedroom community of Honolulu, the Petitioner feels that allowing office use as a principal use in 'Ewa Community Commercial Centers will help Ho'opili in its goal to achieve a job-housing balance (and thus balance the work-related traffic from Ewa towards the Central Business District in the morning (and vice-versa in the afternoon). These areas could be significant employment generators for Ho'opili and the region. In addition, these commercial/business uses will be located conveniently near the major transportation corridors of the region, and will designed to promote bus, high-			

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capacity transit, and pedestrian and bicycle access.			
3.7.1.2: PLANNED COMMERCIAL RETAIL CENTERS – Planning Principles			
Planning principles for retail centers vary according to the size of the commercial center and the purpose it serves. The following planning principles apply to Neighborhood and Community Commercial Centers:			
• **Mix of Uses.** Planned commercial centers should be dedicated primarily to retail uses and to office uses that provide services to the surrounding community. Residential uses may also be incorporated in such commercial centers.	X		
• **Appropriate Scale.** The building mass of a commercial center should be in keeping with its urban and natural setting,	X		
• **Compatible Style.** The architectural character of commercial centers should respect the surrounding urban and natural features, particularly when located adjacent to a residential area or significant natural or historic feature. Neighborhood commercial centers should reflect a residential architectural character.	X		
• **Accessibility.** Commercial centers should incorporate site design and facilities to promote pedestrian, bicycle and transit access. Pedestrian and bicycle access is more important for smaller, neighborhood centers, while transit access is more significant for community centers. These planning principles should be applied to the expansion or renovation of existing commercial centers, as well as to new centers.	X		
Discussion: The Ho'opili project plans to include "Neighborhood Commercial Centers" and "Community Commercial Centers" as defined in the Ewa DP. As suggested in the Ewa DP's "Planning Principles" for "Planned Commercial Retail Centers," the planned commercial centers are planned to enhance a mixed use of development where residents can work and shop within walking distance of their homes. So for instance in areas where bus and high-capacity transit is easily accessible, there may be ground floor retail, office space on the second and third stories and residential use above that. However, it is possible that future office uses may provide services to a greater geographical area than the immediate surrounding community. An extreme example would be an internet-based company that provides website design for clients outside of 'Ewa. In less densely developed areas there would be accommodation for more parking and the massing may be more appropriate to low-rise residential development. However, in areas where there is elevated rail transit, there may be ground floor retail, retail at the transit station level, office space in between both levels of retail, as well as office space above (the transit station level) and residential use above that. The architectural character of a particular street block within the Ho'opili project would differ according to it location within the site, its surrounding uses and its proximity to both bus and transit stations. It is agreed that the overall architectural character of the commercial centers should be compatible with the surrounding neighborhoods, but there is a possibility that differing design characters may be established for each neighborhood. The entire Ho'opili project will be designed to promote pedestrian and bicycle access, as well as transit access, where available.			
3.7.1.3: PLANNED COMMERCIAL RETAIL CENTERS – Guidelines			
Neighborhood Commercial Centers **Architectural Character** • The architectural character should respect adjacent residential uses. • Gable and hip-form roofs are encouraged, using breaks in the roof line to	X		

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reduce the apparent scale of large roof plates. • Residential character may also be expressed by using exterior materials and colors that are typically found in neighborhood houses. **Building Siting** • Buildings should be oriented to the pedestrian. • Storefronts should face the street and, to the extent possible, be sited close to the sidewalk. • Parking and service areas should be placed behind the buildings or otherwise visually screened from streets and residential areas. **Building Height and Density** • Buildings should maintain a residential scale. • Building height limits should allow for gable and hip-form roof elements. • The total floor area for a lot or contiguous lots with common parking should not exceed 100,000 sq. ft. **Vehicular Access** • Access to the parking and loading areas should be from a collector street. • Access to a local residential street may be permitted if it is only for emergency or secondary access and would not encourage through traffic along the local street. **Pedestrian and Bicycle Facilities** • There should be at least one pedestrian access from the public sidewalk or other off-site pedestrian pathway to the entrances of establishments in the commercial center that does not require crossing a traffic lane or parking lot aisle or driveway. • Bicycle racks should be designed to provide security and be visible from the street entry. **Visual Screening, Lighting & Signage** • Parking and service areas should be screened from the street and adjacent residential lots by planting a landscape screen of trees and hedges along street frontages and property lines and planting shade trees throughout the parking lot. • Only low-level or indirect lighting, if any, should be used in parking lots. • All signage should be unilluminated or indirectly illuminated.			
Community Commercial Centers **Architectural Character** • The architectural character may be varied, depending on the context. • Commercial center buildings that are visible from adjacent residential areas should reflect a residential character; other facades may have a character more typical of a commercial building. • The design should avoid disruptive contrasts between facades that are visible simultaneously from public areas. **Building Bulk and Massing** • When the building is adjacent to a residential area or a building of historic value, there should be a transition in scale from larger building elements of the commercial center to finer elements near the adjacent use. • Portions of buildings visible from a street should avoid blank facades by using texture, articulation, color and fenestration to create visual interest. • Facades that are close to the public right-of-way should be composed of display windows and pedestrian entrances. **Building Height and Density** • Building heights should generally not exceed 45 feet.	X		

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• The total floor area should not exceed 250,000 sq. ft. for a standard Community Commercial Center. **Pedestrian, Bicycle and Transit Facilities** • Street frontage improvements for bus stops, including a bus shelter and a pull-out off a traffic lane, should be provided along all abutting streets which have bus routes. • There should be a pedestrian pathway from the bus stop to an entrance to the main building of the commercial center. The pathway should be clearly indicated with special paving or markings and covered to provide weather protection, if the commercial center building is not directly connected to the bus shelter. • Bicycle racks should be designed to provide security and be visible from the street entry to the commercial center. **Visual Screening** • The visibility of parking and service areas from the street and adjacent residential areas should be minimized through screening. • A landscape screen, consisting of trees and hedges, should be planted along the street fronting the parking lot or garage. • If there is a parking lot, shade trees should be planted throughout. • If there is a parking garage close to and readily visible from a street, landscape planters should be provided along the facade of each parking level fronting the street. • Service areas should be visually screened from public and residential areas. **Signage** • Signage visible from residential areas should be indirectly illuminated.			
Discussion: Since nearly all of the above guidelines for Neighborhood Commercial Centers appear to be consistent with new urbanism principles, at the present time, it would appear the Petitioner would have little difficulty implementing nearly all of the above guidelines (for Neighborhood Commercial Centers). It should be noted that some flexibility should be allowed for roof forms, in the event that adjacent residential or other uses utilize roof forms that are different, or in order to achieve greater energy efficiency. At the present time, it is not envisioned that there will be a Neighborhood Commercial Center with a total floor area for a lot or contiguous lot with common parking exceeding 100,000 square feet, but over the 25± years that this project may be built out, it is possible that a major employer may decide to locate in a predominately residential area, to allow its employees opportunities to live near their place of employment. Since nearly all of the above guidelines for Community Commercial Centers appear to be consistent with new urbanism principles, at the present time, it would appear the Petitioner would have little difficulty implementing nearly all of the above guidelines (for Community Commercial Centers). It should be noted that some definition of what are "disruptive contrasts between facades" should be given, as there are many older neighborhoods in Hawai'i, where say, a single building with Asian-style architecture stands out against other more consistent forms of architecture, but yet is reflective of one or more cultures that make up Hawai'i.			
3.7.2: KO OLINA RESORT			
Ko Olina Resort is designated in the General Plan as one of four "secondary" resort destinations which are part of an overall strategy to relieve growth pressure on Waikiki.			X
The resort, which is located on 640 acres between Kahe Point Beach Park and the Barbers Point Deep Draft Harbor, should be an integral part of the Secondary Urban Center.			X
When developed, Ko Olina Resort should be a water-oriented residential and			X

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resort community with about 4,000 visitor units in hotels and resort condominiums and 8,700 residential units in Phase I and II. Ko Olina is master-planned to incorporate recreational features in addition to visitor accommodations. Recreational facilities include two golf courses, a small boat marina, and four man-made swimming lagoons. Development for the first golf course and the swimming lagoons, and installation of roads and utilities are completed. Development of the second golf course will occur in Phase II. The first hotel opened in 1993 with almost 400 rooms.			
As it develops, Ko Olina should provide substantial waterfront areas for public use. The entire shoreline should be natural open space, softened by landscaping, and should focus on the beach and swimming lagoons			X
Discussion: The Ewa DP's policies related to the Ko 'Olina Resort are not directly applicable to the Ho'opili project.			
3.7.3: INDUSTRIAL CENTERS – GENERAL POLICIES			
Barbers Point Industrial Area			
Industrial centers in Ewa include the Barbers Point Industrial Area and Honouliuli Industrial Area. Industrial activity should also be permitted at other dispersed industrial areas, as noted below.			X
As an alternative to industrial uses, a commercial, cultural or recreational entertainment attraction may be permitted in the area fronting the OR&L Historic Railway, provided that the use is designed to enhance the viability of the operation of the railway for historic theme rides, strengthen the linkage between the Ko Olina Resort and the City of Kapolei and proceed with a strong community based planning process.			X
Barbers Point Industrial Area includes Campbell Industrial Park, Barbers Point Deep Draft Harbor, Kenai Industrial Park, and Kapolei Business Park. It should continue to grow as one of O'ahu and the State's most important industrial areas. It is the site of the States largest heavy industrial area (Campbell Industrial Park) and an important industrial harbor and fuel transfer point.			X
The future industrial and transportation uses of Barbers Point Naval Air Station (BPNAS) will be determined by the Barbers Point Redevelopment Commission. The northern parts of Kapolei Business Park and any BPNAS lands designated for industrial use should provide for light industrial uses as a transition between heavy industry at Campbell Industrial Park and the City of Kapolei.			X
An additional electrical power generating plant could be constructed at the Barbers Point Industrial Area, possibly taking advantage of cogeneration opportunities with other industrial activities. The 138 kilovolt transmission corridor running from the Barbers Point Industrial Area to Waiau could accommodate additional load on the existing poles.			X
Honouliuli Industrial Area			
Honouliuli should remain a smaller industrial area, used primarily for wastewater treatment. It includes 13 acres of land in the 'Ewa by Gentry project which is designated for light industrial use. A power generation facility may be included if it is dependent on wastewater treatment operations and can be designed so that it is generally not visible from nearby major public rights-of-way, residential areas, and commercial areas.			X
The Honouliuli Wastewater Treatment Plant should be expanded to accommodate additional growth in the region as well as to provide additional facilities for higher levels of wastewater treatment The City should acquire an additional 60 acres to accomplish this.	X		
Other Industrial Areas			

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Service-oriented industrial uses should be allowed throughout the region as noted below. Uses requiring larger lots should be located in Campbell Industrial Park Small lot uses including automobile repair shops contractor's yards, and businesses serving residential and commercial areas should be allowed to locate near the City of Kapolei in the Kapolei Business Park and on any industrial lands which may be designated within Barbers Point Naval Air Station.	X		
The **Hawaiian Electric Company generating plant** in Kahe Valley should remain the largest source of electrical power on Oahu The plant could be expanded which would take advantage of available land area, cooling system capacity and power transmission lines.			X
The **industrial area planned for the western edge of Ewa Marina** should accommodate marine haul-out facilities, repair shops, and related small boat industrial uses.			X
Discussion: The Ewa DP's policies related to the Barbers Point Industrial Area are not directly applicable to the Ho'opili project. The Ho'opili project will generate additional flow that must be treated at the Honouliuli WWTP. To mitigate the additional burden, the project will participate in the Wastewater System Facility Charge (WSFC) program and contribute funds (based on building permits) to expand the treatment plant. The Ho'opili project proposes to provide approximately 50 gross acres (which includes secondary roads and off-street parking) for larger light industrial and business mixed use. It is estimated that there would be a net development area of approximately 40 acres industrial mixed-use.			
3.7.3.2: INDUSTRIAL CENTERS – PLANNING PRINCIPLES			
The general policies for industrial centers are supported by the following planning principles: • **Appropriate Scale.** The visibility of large building volumes and tall building or machinery elements from resort areas, residential areas, commercial and civic districts, and parks should be minimized through site planning and landscaping. • **Environmental Compatibility.** Industries and utilities that discharge air or water pollutants, even when treated, should be located in areas where they would impose the least potential harm on the natural environment in case the treatment process fails to perform adequately. Uses that generate high noise levels should be located and operated in a way that will keep noise to an acceptable level in existing and planned residential areas. The building setback from the shoreline should be a minimum of 60 feet in the Ewa coastal area, as recommended in the Oahu Shoreline Study (1989), and 150 feet where possible.	X		
Discussion: Development within the proposed light industrial and business mixed use areas within the Petition Area will guided by design controls to ensure the scale of development is compatible with surrounding areas and visual impacts will be kept to a minimum. No noxious uses or uses that generate constant high noise levels would be considered compatible with this predominately mixed-use community. The Petition Area is well beyond 150 feet from the shoreline.			
3.7.4: KALAELOA (BARBERS POINT NAVAL AIR STATION)			
Development of a major new regional public park, and provision of continuous lateral public access along the shoreline are priority reuse options for the BPNAS Local Reuse Plan.			X
A continuous pedestrian route along the entire Ewa coast should be created. The entire shoreline of the BPNAS should be reserved for public access and recreation after military use of BPNAS ceases.			X
In addition, building setbacks from the shoreline should be required, a lateral public access easement along the Campbell Industrial Park shoreline should be			X

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acquired, and public shoreline pathways should be established at Ko Olina and Ewa Marina.			
The road network should be integrated with the regional circulation system.			X
There should be ample lands devoted to uses that will create long term jobs for Ewa's residents.			X
Discussion: While the Ewa DP's policies related to the development of Kalaeloa are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives.			
3.7.5: PEARL HARBOR NAVAL BASE (WEST LOCH)			
The West Loch Branch of Naval Magazine Lualualei will be the principal site where U.S. Department of Defense ordnance handling and storage for Oahu will be consolidated. The existing Explosives Safety Zone at West Loch will remain, but will not need to be enlarged.			X
The City should request expansion of limited public access to the shoreline waters of West Loch beyond the West Loch Shoreline Park and should support retaining and enhancing wetland areas along the Pearl Harbor shoreline.			X
Discussion: While the Ewa DP's policies related to the non residential development of the Pearl Harbor Naval Base are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives. While the Petitioner acknowledges the importance of the Pearl Harbor Naval Base to the nation's security, it is hopeful that the Navy will allow an easement over a small portion of its lands between the proposed project's makai-most drainage detention basin and West Loch of Pearl Harbor. With respect to the West Loch drainage basin, the project intends to collect all storm water and route it to the existing detention basin located on the east side of Fort Weaver Road and south of the OR&L railroad tracks. The routing would require the installation of a concrete channel from the southeastern end of Parcel C, under Fort Weaver Road (using the existing cane haul underpass) and connecting to the existing detention basin. The basin would be expanded to ensure that the water quality storage component of the City and County of Honolulu Standards was achieved. An overflow from the detention basin would discharge to the West Loch of Pearl Harbor (See Parcel D2 on Figure 1.5: Parcels Map). The portion of the project within the West Loch drainage basin is the bulk of Parcel C. The overflow from the detention basin would have to cross Navy property. Permission of the Navy would be required. Initial inquiries have been made to the Navy to see if the overflow can be negotiated. Issues with the Navy include security and access in a post- "9/11" environment, Navy plans for development in the overflow corridor, and the acquisition of a maintenance commitment by the City and County of Honolulu. The concept of the overflow across Navy property is not new and was approved in concept back in the early- to mid- 1990's. Lack of action and the issues cited above are points that need to be resolved for the overflow option to move forward. If permitted, the overflow option across Navy property will solve drainage problems occurring on Fort Weaver Road, within West Loch Estates and within portions of 'Ewa Villages by effectively collecting the storm water that currently is misdirected across these properties. The current Navy position with respect to use of the Navy's land for drainage purposes is that the land is not available for use and the project should pursue "other available options." The alternative available is to expand the project's on-site detention system to retain all increased run-off generated in the West Loch drainage basin.			
3.7.6: UNIVERSITY OF HAWAII WEST OAHU			
The campus should evoke a unique sense of place that distinguishes it as an important civic and cultural institution in Ewa. Project size is 2,800 students by			X

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the end of construction (which is to begin no later than the end of December 2011) and 7,600 students by 2020. The projected 2020 faculty and staff are 800.			
The campus should be oriented to support pedestrian access to and transit usage from a major transit node located on the North-South Road. The development of the University of Hawaii West Oahu campus should include plans to provide shuttle bus service to the transit node at the corner of Farrington Highway and the proposed North-South Road. The campus should be designed so that open space areas can be used for flood detention and retention as part of the Kaloi Gulch watershed master plan.			X
Discussion: While the Ewa DP's policies related to the UH West O'ahu campus are not directly applicable to the Ho'opili project, the Petitioner supports the development of UH West O'ahu. The UH West O'ahu will enable Ho'opili residents to obtain post-secondary degrees without commuting to the UH Mānoa campus or other higher education institutions in Honolulu.			
CHAPTER 4: PUBLIC FACILITIES AND INFRASTRUCTURE POLICIES AND PRINCIPLES			
4.1.6: TRANSPORTATION SYSTEMS — General Policies			
The following general transportation systems policies support the vision for development of Ewa.			
Adequate Access and Services. Before zoning approval is given for new residential and commercial development in Ewa, the Department of Transportation Services should either: (I) indicate that adequate transportation access and services can be provided with existing facilities and systems, or (2) recommend conditions that should be included as part of the zone change approval in order to assure adequacy,			X
Discussion: The above policy is directly addressed to the Department of Transportation Services, however, the Petitioner has been coordinating with DTS regarding the methodology for preparing the traffic impact assessment report, the long-planned widening of Farrington Highway and the HHCTC project, among other issues.			
Transportation System Functions. To support Ewa's role as the site for the Secondary Urban Center and a major growth area for new residential and employment development, its transportation system should:			
• Provide adequate access between residences and jobs, shopping, and recreation centers in Ewa as development occurs;	X		
• Provide improved access to and from adjacent areas, especially Central Oahu; and			X
• Provide adequate capacity for major peak-hour commuting to work in the Primary Urban Center. (Although the share of residents who will both live and work in Ewa is projected to increase from 17% to 44% by 2020, a majority of residents will still commute to jobs outside the region.)	X		
Discussion: Ho'opili is being designed to maximize connectivity within and to/from surrounding properties. Most of the site is relatively flat, which will enhance its accessibility by pedestrians and bicyclists. A fine grid of closely-spaced blocks is envisioned over most of the site and where topography allows. In addition, the project will be designed to ~~embrace~~ support both enhanced bus transit and high-capacity transit. Finally, it is proposed that a mix of land uses be distributed throughout the site, creating several "complete" neighborhoods, where residents can work, shop, play and study, all within walking distance of a park and/or transit stop. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting the Petition Area; the proposed East-West Connector Road through the Petition			

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Area; and the segment of the proposed HHCTC mass-transit project through the Petition Area. However, ultimately, the goal of the Secondary Urban Center is to achieve a job/housing balance within Ewa so that residents would not have to commute to jobs outside the region. 'Ewa's proposed land uses will more likely to allow the Secondary Urban Center to achieve such a job/housing balance than the newer communities in Central Oahu, which is primarily residential in nature.			
Improved Linkages. Additional routes, as noted in Section 4.1.3 of this Plan, should be created between the various parts of the region, including to and across BPNAS after it is returned to civilian control.	**X**		
Discussion: Besides long-planned roads such the widening of Farrington Highway, Kapolei Parkway and the North-South Road, recently proposed roads include: 1) the East-West Connector Road (connecting Farrington Highway, UHWO, North-South Road, DHHL East Kapolei Development Parcel 2, Ho'opili and Fort Weaver Road); 2) the extension of North-South Road in a makai direction through Kalaeloa (formerly "BPNAS") into Ocean Pointe and eventually Ewa Beach; and 3) widening Roosevelt Avenue. The Petitioner is supportive of the above additional routes and is planning to accommodate the portion of the East-West Connector Road through the project site.			
Reduction in Automobile Use. Reliance on the private passenger vehicle should be reduced by:			
• Provision of circulation systems with separated pedestrian and bicycle paths and convenient routes for public transit service,	**X**		
• Use of more traditional "grid" patterns for street systems in new development areas to facilitate bus routes and encourage pedestrian travel,	**X**		
• Provision of supporting facilities and amenities for pedestrian, bicycle, and public transit use. The use of bike trails, bicycle racks at commercial centers, bicycle storage facilities at employment centers as well as bus shelters at bus stops will be encouraged.	**X**		
• Acquisition of a dedicated rapid transit right-of-way prior to development, and support for high-density and high-traffic land uses along the rapid-transit corridor, especially within a quarter-mile of centers of the transit nodes, subject to City Council approval of any system.	**X**		
Discussion: Ho'opili is being designed to maximize connectivity within and to/from surrounding properties. Most of the site is relatively flat, which will enhance its accessibility by pedestrians and bicyclists. The Kapolei Area Bikeway Plan (KABP), published by James Campbell Company LLC in 1991, establishes a comprehensive bikeway network to serve the 'Ewa Plain. Bike paths within the project will be designed to encourage residents to bicycle between their homes and work, school, social, recreational and commercial areas. As currently planned, the project will be designed to include various types of bikeways, including: grade-separated bicycle/pedestrian paths; and lower-speed roads suitable for experienced bicyclists. The Petitioner has coordinated with both UHWO and DHHL to develop a regional network of bikeways that facilitates connectivity between projects and that as a network connects to the bikeway system proposed by the Kapolei Area Bikeway Plan (See Figure 2.8: Proposed Circulation Plan). A fine grid of closely-spaced blocks is envisioned over most of the site and where topography allows. In addition, the project will be designed to ~~embrace~~ support both enhanced bus transit and high-capacity transit. The Petitioner acknowledges that supporting facilities and amenities for pedestrian, bicycle, and public transit use will facilitate and encourage walking, biking and using transit, and reduce the need to accommodate personal automobiles, unnecessarily wide roads, parking, et cetera. The Petitioner will plan for bike trails, bicycle racks at commercial centers, bicycle storage facilities at employment centers as well as bus shelters at bus stops. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has			

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been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will probably be concentrated around the transit station(s). Also possible is a transit maintenance and storage facility.			
4.1.7: TRANSPORTATION SYSTEMS — Planning Principles			
Because of its generally even, gradually sloping terrain, Ewa offers decided advantages for transportation.			
• It provides an opportunity to create multiple linkages and routes between the various parts of the region. This advantage is enhanced by the planned closing of the Barbers Point Naval Air Station, which will return the area to civilian use and thereby allow for increased road linkages to and across former Naval Air Station lands.	X		
• The terrain allows for relatively less expensive development of a dedicated transit right-of-way. The flat terrain also increases the feasibility of constructing a rapid transit system on that right-of-way.	X		
• Both the terrain and the sunny, low rainfall climate enhance bicycling as an alternative form of transportation as well as for recreation. An improved environment for bicycling and walking also improves the potential for high transit ridership. (See the discussion of the Kapolei Area Bikeway Plan above in Sec. 4.1.5.)	X		
Discussion: Ho'opili is being designed to maximize connectivity within and to/from surrounding properties. Most of the site is relatively flat, which will enhance its accessibility by pedestrians and bicyclists. The Kapolei Area Bikeway Plan (KABP), published by James Campbell Company LLC in 1991, establishes a comprehensive bikeway network to serve the 'Ewa Plain. Bike paths within the project will be designed to encourage residents to bicycle between their homes and work, school, social, recreational and commercial areas. As currently planned, the project will be designed to include various types of bikeways, including: grade-separated bicycle/pedestrian paths; and lower-speed roads suitable for experienced bicyclists. The Petitioner has coordinated with both UHWO and DHHL to develop a regional network of bikeways that facilitates connectivity between projects and that as a network connects to the bikeway system proposed by the Kapolei Area Bikeway Plan (See Figure 2.8: Proposed Circulation Plan). Besides long-planned roads that would connect various parts of the region, such the widening of Farrington Highway, Kapolei Parkway and the North-South Road, recently proposed roads include: 1) the East-West Connector (connecting Farrington Highway, UHWO, North-South Road, DHHL East Kapolei Development Parcel 2, Ho'opili and Fort Weaver Road); 2) the extension of North-South Road in a makai direction through Kalaeloa (formerly "BPNAS") into Ocean Pointe and eventually Ewa Beach; and 3) widening Roosevelt Avenue. The Petitioner is supportive of the above additional routes and is planning to accommodate the portion of East West Connector through Ho'opili. For the most part, as the Petition Area is relatively flat (except at Honouliuli Gulch) and open (cultivated fields), it allows for relatively less expensive development of a high-capacity transit corridor. Since the area has a relatively dry climate and most of the Petition Area is relatively flat it makes Ho'opili conducive to bicycling for transportation to the adjoining UHWO and other nearby			

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destinations, as well as for recreation. It is acknowledged that enhancing the opportunities for bicycling and walking will help to extend the reach and influence of transit ridership.			
Planning principles and guidelines addressing residential and commercial land uses, set forth in Chapter 3, Sections 3. 6 and 3.7 above, provide substantial guidance toward enhancing pedestrian, bicycle and transit modes of transportation. The following principles should guide the development of a multi-modal transportation system for Ewa:			
• **Comprehensive Roadway Network.** The roadway system should be designed to provide multiple routes for traveling among the various residential communities and activity centers of Ewa, thereby lending variety to travel within the region and promoting communication among its communities. Network designs for communities should take on more of a grid pattern, increasing intersections between collector streets. The design should also increase connections between parallel major collectors and arterials - e.g., between North-South Road and Fort Weaver Road - rather than relying primarily upon loop roads to feed the major roadways. Planning for East Kapolei and for the reuse of Barbers Point Naval Air Station are important opportunities for creating such connections.	X		
• **Land Use Planning Anticipating Rapid Transit.** Key to the vision for Ewa is reservation of a rapid transit corridor prior to development and the planning of high-density and high-traffic land uses along the corridor. This strategy will contribute to the feasibility of developing a high-speed transit line and will result in a more mobile, less automobile-dependent community. Planning for all the communities along the proposed transit corridor on Farrington Highway, North-South Road, and Kapolei Parkway should reflect the desire to establish a rapid transit corridor with high density residential and commercial nodes located at regular intervals.	X		
• **Transit-Oriented Community Street Systems.** Circulation systems within residential communities and commercial centers should emphasize connections between north-south and east-west streets and accessibility from residential streets to bus routes, parks, schools and commercial centers. Circulation systems should be designed to facilitate bicycle and pedestrian travel, to increase transit use, and to reduce dependence on automobile travel. See Chapter 3, Sections 3.6 and 3.7, for more detailed planning principles and guidelines for circulation in residential communities and commercial centers.	X		
• **Community-Level Street Standards.** Standards for public streets within residential communities and commercial centers should be revised to support and improve pedestrian and bicycle travel and on-street parking. While average motor vehicle speed may be reduced, safety and enjoyability for pedestrians and bicyclists would be increased, and greater efficiency in land use, reduced constructions costs, and improved street function may occur.	X		
Discussion: A discussion regarding the multi-modal transportation system in Ho'opili is described below:			

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Comprehensive Roadway Network. Ho'opili is being designed to maximize connectivity within and to/from surrounding properties. To provide multiple routes for traveling through Ho'opili, a fine grid of closely-spaced blocks is envisioned over most of the site and where topography allows. Major planned and proposed regional connectors have been considered in the planning of the proposed project. These include: setting aside additional right-of-way for the City and County of Honolulu's widening of Farrington Highway; multiple connections to Farrington Highway; setting aside land for the proposed East-West Road; connection to the proposed North-South Road (under construction); and construction of a mauka-makai "North-South Bypass" road. **Land Use Planning Anticipating Rapid Transit.** Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will probably be concentrated around the transit station(s). **Transit-Oriented Community Street Systems.** The Ho'opili transportation gridded circulation system is envisioned to emphasize connections between north-south and east-west streets and accessibility from residential (and residential mixed-use) streets to bus (and high-capacity transit) routes, parks, schools and business/commercial centers. The circulation systems will be designed to facilitate bicycle and pedestrian travel, to enhance the desirability of transit use, and to reduce dependence on automobile travel. **Community-Level Street Standards.** Within the proposed fine network of gridded streets, it is envisioned that most streets will include on-street parking and sidewalks and/or grade-separated multi-modal bike/pedestrian paths. This will allow experienced bicyclists to travel on most roadways and inexperienced bicyclists to stay off roads, except at intersections.			
4.2.1: WATER ALLOCATION AND SYSTEM DEVELOPMENT — General Policies			
The following general policies should be followed in developing Ewa potable and nonpotable water systems to meet the projected demand.			
Adequacy of Water Supply. Before zoning approval is given for new residential or commercial development in Ewa, the Board of Water Supply should either indicate that adequate potable and nonpotable water is available or recommend conditions that should be included as part of the zone change approval in order to assure adequacy.	**X**		
Dual Transmission Lines. Where required, developments should have dual water lines to allow conservation of potable water and use of nonpotable water for irrigation and other appropriate uses. Such requirements shall be determined during review of project master plans for new developments and approval of zoning applications.	**X**		
Development and Allocation of Potable Water. The State Commission on Water Resource Management has final authority in all matters regarding administration of the State Water Code. Under that authority, the Board of Water Supply should coordinate development of potable water sources and allocation of all potable water intended for urban use on Oahu. State and private well development projects could then be integrated into and made consistent with City water			**X**

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source development plans.			
Use of Nonpotable Water. An adequate supply of nonpotable water should be developed for irrigation and other suitable uses on the Ewa Plain in order to conserve the supply of potable water and to take advantage of dual water systems constructed by Ewa developers. The Pearl Harbor aquifer is the most cost effective and accessible water resource of potable quality, and it is needed to support the existing and future domestic potable water uses described in the development plans. To minimize the risk of impacts to our precious potable water sources, the use of reclaimed water ('reclaimed wastewater effluent") and brackish waters as nonpotable irrigation sources in the coastal caprock area such as the Ewa Plain should be given high priority. Significant demand exists for nonpotable water for golf courses, landscape irrigation and industrial uses on the Ewa Plain. In addition to the compatibility of the source to the demand in the area, the infrastructure to distribute the reclaimed water in that area is being planned. Use of reclaimed water and brackish water should, therefore, focus on meeting demand in the Ewa Plain where there are no adverse consequences to the drinking water resources. Experiences with increasing chloride, nitrate and pesticide contamination of groundwater indicate that activities on the surface of the land can have a detrimental effect on the quality of drinking water. Nonpotable water used above Pearl Harbor aquifer should be low in total dissolved solids to protect the quality of drinking water withdrawn from wells located down-gradient of the application.	X		
Use of Waiahole Ditch Water. A sufficient amount of water is needed to meet the diversified agricultural needs for Ewa and Central Oahu along with high quality recharge of the Pearl Harbor aquifer. A number of potential sources are identified in Table 4.2, including: caprock, surface water, spring waters, Waiahole Ditch Water and wastewater effluent, The amount of water available and the potential use of each of these sources varies according to location. The State Commission on Water Resource Management should consider all sources of water in making allocations.			X
Water Reclamation. The City will reclaim and distribute wastewater effluent, provided that paying customers can be found for the nonpotable water. No additional costs will be borne by sewer users to subsidize private users of recycled effluent. Under the City's agreement through a Consent Decree with the U.S. Environmental Protection Agency and the State Department of Health, the City plans to reclaim and use up to 10 mgd of Oahu's wastewater by 2001. Construction of the secondary treatment unit at the Honouliuli Wastewater Treatment Plant has been completed. The facility is capable of providing 13 million gallons per day (mgd) of undisinfected secondary treated reclaimed water (R-3 quality). In Fiscal Year 1997-98, the City plans to build a pilot project at Honouliuli to study the potential for aquifer recharge with disinfected secondary treated reclaimed water (R-2 quality) and to evaluate the resulting water quality impacts within the lower Ewa plain region. The R-3 secondary treatment facility at	X		

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
Honouliuli will be upgraded to an R-2 facility when the pilot project is ready to begin. The pilot project will have a capacity of 5 106 mgd. If the pilot project indicates the water quality of the Ewa caprock aquifer can be improved with effluent recharge with no detrimental impacts to near shore waters, the pilot project will be expanded to provide 13 mgd of recharge, providing that customers can be found to pay for the capital costs of the distribution system and the cost of operating and maintaining the facility and distribution system.			
Integrated Resource Management. Management of all potable and nonpotable water sources, including ground water, stream water, storm water, and effluent reuse should be integrated through amendments to the Oahu Water Management Plan and future Integrated Resource Management plans which will require Council approval and adequate public review, following City development of plans and adoption of an appropriate management process.			**X**

Discussion:

Adequacy of Water Supply. As requested by the Board of Water Supply in their comments on the EISPN, a Conceptual Water Master Plan addressing potable and non-potable water facilities has been prepared and reproduced in its entirety and attached to this EIS as Appendix M ~~will be submitted to~~ for BWS ~~for its~~ review and approval.

Dual Transmission Lines. With respect to non-potable water requirements, the project will be maximizing non-drinking usage to minimize the demand on the safe drinking water system. If a suitable supply is made available, ~~S~~street right of ways of the Ho'opili project will have underground non-drinking distribution systems. The project will be maximizing the use of non-potable water for irrigation to minimize the impact on the source component of the BWS system. It is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies. A Conceptual Water Master Plan addressing safe drinking and non-potable water facilities has been prepared and reproduced in its entirety and attached to this EIS as Appendix M ~~will be submitted to~~ for BWS ~~for its~~ review and approval. In addition, construction drawings will be submitted to BWS for its review and approval. During the public review period of the Draft EIS, the DLNR Commission on Water Resource Management requested that "the reuse of storm water and installation of water efficient fixtures be considered" and recommended "the use of xeriscaping and the planting of drought tolerant and salt-tolerant plans to conserve water supplies."

Use of Nonpotable Water. It is proposed to upgrade the existing non-drinking source (EP 5 & 6 located within Parcel C) to a BWS dedicable standard to be used as the source for the non-drinking system. It is also proposed to ultimately allow for future dedication of the non-drinking system. It is estimated that the ultimate non-drinking demand for the project will be approximately 2.1 MGD.

Water Reclamation. Another source of non-potable water is reclaimed water. The Honolulu Board of Water Supply (BWS) entered into the water recycling business in 2000 by purchasing the Honouliuli Water Reclamation Facility. Water recycling of treated wastewater effluent is one element of a broader BWS strategy to protect O'ahu's aquifers and to conserve water resources through conservation and development of new water supplies. Treated effluent from the facility is now irrigating golf courses that were once using brackish water, including West Loch, 'Ewa Villages, Hawai'i Prince, and Coral Creek. The facility is also providing recycled water (at a different level of treatment) to industries at Campbell Industrial Park.

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
The project will be maximizing the use of non-potable water for irrigation to minimize the impact on the source component of the BWS system. It is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies. A Conceptual Water Master Plan addressing safe drinking and non-potable water facilities has been prepared and reproduced in its entirety and attached to this EIS as Appendix M ~~will be submitted to~~ for BWS ~~for its~~ review and approval. In addition, construction drawings will be submitted to BWS for its review and approval. During the public review period of the Draft EIS, the DLNR Commission on Water Resource Management requested that "the reuse of storm water and installation of water efficient fixtures be considered" and recommended "the use of xeriscaping and the planting of drought tolerant and salt-tolerant plans to conserve water supplies."			
4.3.1 WASTEWATER TREATMENT – General Policies			
All wastewater produced by new developments in Ewa should be connected to a regional or municipal sewer service system.	X		
Where feasible, effluent should be treated and used as a source of nonpotable water for irrigation and other uses below the Underground Injection Control line of the State Department of Health and the "No-Pass' Line of the Board of Water Supply. As noted above, the Department of Environmental Services has made a commitment to the U.S. Environmental Protection Agency and the State Department of Health to reclaim and use up to 10 million gallons a day (mgd) of wastewater islandwide by 2001.	X		
Wastewater treatment plants should generally be located in areas shown as planned for industrial use and away from residential areas shown on the Urban Land Use Map in Appendix A. Existing treatment plants are shown on the Urban Land Use Map and the Public Facilities Map in Appendix A. A City review and approval process, such as the Plan Review Use process, which provides adequate public notice and input, complete technical analysis of the project, and approval by the City Council, shall be required for any major new private wastewater treatment plant. Other system elements, such as pump stations and mains, should not require such comprehensive review and policy approval.			X
Discussion: Within the 'Ewa area, sewage is treated by the City and County of Honolulu's Honouliuli Wastewater Treatment Facility (WWTF). The treatment facility is located at the corner of North Hanson Road and Geiger Road, approximately 7,200 feet (1.4 miles) south of Parcel C. The Petition Area is upwind of the Honouliuli WWTF during predominant tradewind conditions. The nearest existing sewer collection system to the Petition Area is the Makakilo Interceptor/Kapolei Interceptor system located along the OR&L railroad tracks. The Department of Hawaiian Homelands (DHHL) is currently extending a collection system component from the Makakilo/Kapolei collection in a northerly direction up the North-South Road alignment to serve its land holdings in the area. The component (42-inch sewer) has been oversized to accommodate the Ho'opili project as well as the University of Hawai'i West O'ahu (UHWO) campus. Based on average daily flows, the facility has a primary treatment capacity of 38 million gallons per day (MGD), with future plans to expand to 51 MGD. The primary means of disposal is through a deep ocean outfall with a design capacity of 112 MGD. The facility was recently upgraded (with the Honouliuli Water Reclamation Facility) to produce 10 MGD of R-1 quality effluent, which is suitable for irrigation reuse. The Petitioner plans to install a dual transmission system with separate lines for drinking and non-potable water. While one potential source of non-potable water is brackish water wells, another possible source is R-1 quality effluent from the Honouliuli WRF.			
4.4.1 ELECTRICAL POWER DEVELOPMENT – General Policies			

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
Major system improvements -- such as development of a new power generating plant and/or major new transmission lines -. should be analyzed and approved based on islandwide studies and siting evaluations. Strong consideration should be given to placing any new transmission lines underground.			X
Electrical power plants should generally be located in areas shown as planned for Industrial use and away from Residential areas shown on the Urban Land Use Map in Appendix A. Existing power plants are shown on the Urban Land Use Map and Public Facilities Map in Appendix A. Any proposed major new electrical power plant or proposals for a new above-ground or underground transmission corridor carrying voltages of ~~I 38kV~~ 138kV or greater shall be considered through a City review and approval process, such as the Plan Review Use process, which provides public review, complete analysis, and approval from the Department of Land Utilization and the City Council.			X
Other system elements, such as sub-stations and transmission lines, are not shown on the Map and should be reviewed and approved administratively.	X		
Discussion: Electricity for the Petition Area is provided by Hawaiian Electric Company (HECO), which has an available generation capacity (peak demand) of approximately 1,687 megawatts (Gross MW). According to the HECO website, HECO "is looking for companies to supply enough biofuel -- either ethanol or biodiesel -- to fuel HECO's new Campbell Industrial Park Generating Station planned to be in service by mid-2009. HECO reached an agreement with the State Consumer Advocate, subject to approval by the State Public Utilities Commission, to fuel this new 110-megawatt* peaking plant with 100-percent, renewable biofuel." HECO's transmission lines in the area include 138 kV lines mounted on tall metal poles from across the H-1 Freeway, across a portion of Parcel B, along Farrington Highway and then in the makai direction along the proposed North-South Road corridor. Within Ho'opili, electrical transmission lines will be placed underground. Preliminary discussions with HECO indicate that up to three substations will need to be sited within the Petition Area.			
4.5.1 SOLID WASTE HANDLING AND DISPOSAL – General Policies			
The East Kapolei site identified in the SWIM Plan should not be developed as a landfill, It is in an area planned for residential use and is adjacent to the University of Hawaii West Oahu campus,			X
Siting and/or expansion of sanitary landfills should be analyzed and approved based on islandwide studies and siting evaluations,			X
Discussion: The above policy is outside of the purview of the Petitioner and probably intended for the Department of Environmental Services.			
4.6.1: DRAINAGE SYSTEMS — General Policies			
Drainage system design should emphasize control and minimization of non-point source pollution and the retention and/or detention of storm water on-site and in appropriate open space and wetland areas.	X		
Storm water should be viewed as a potential irregular source of water for recharge of the aquifer which should be retained for absorption rather than quickly moved to coastal waters.	X		
Natural and man-made vegetated drainageways and retention basins should be the preferred solution to drainage problems wherever they could promote water recharge, help control non-point source pollutants, and provide passive recreation benefits.	X		
Discussion: The project will increase impervious surfaces such as roadways, roofs, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Petition Area. However, detention basins and/or retention basins are being planned and sited to detain and/or retain storm water to ensure that areas downstream of the project are not impacted.			

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
Surface water quality can be impacted through development. The project will be providing detention basins to meet City and County of Honolulu Standards for water quality treatment.			
4.6.2: DRAINAGE SYSTEMS — Planning Principles			
Principles to guide the development of Ewa drainage systems include:			
• **Retention and Detention.** Public and private agencies should employ methods of retaining or detaining storm water for gradual release into the ground as the preferred strategy for management of storm water. Where feasible, any open space, including parking lots, landscaped areas, mini and community parks, and public and private golf courses should be used to detain or infiltrate storm water flows to reduce their volume and runoff rates and the amounts of sediments and pollutants transported.	X		
• **Relation to the Regional Open Space Network.** To the extent possible, the developers should integrate planned improvements to the drainage system into the regional open space network by emphasizing the use of retention basins, creation of passive recreational areas, and recreational access for pedestrians and bicycles. Natural gulches on the slopes of the Waianae Range foothills which are within the Urban Growth Boundary should be preserved as part of the open space network.	X		
Discussion: The project will increase impervious surfaces such as roadways, roofs, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Petition Area. However, detention basins and/or retention basins are being planned and sited to detain and/or retain storm water to ensure that areas downstream of the project are not impacted. Surface water quality can be impacted through development. The project will be providing detention basins to meet City and County of Honolulu Standards for water quality treatment. Honouliuli Gulch will be linked to the regional open space network and bicycle (and pedestrian) circulation system. While most of the Petition Area is on a plateau, part of the site next to Honouliuli Village is below a cliff of the plateau. Part of the cliff has eroded and formed a "canyon" (min-valley). As part of the master plan for the Petition Area, a Canyon Park is proposed, which would be located at the southeastern portion of the Ho'opili project. This park would provide a unique wilderness-type park alternative for residents, and would part of Ho'opili's open space network.			
The following principles apply specifically to development within the Kaloi Gulch drainage basin,			
• **Key Role of Ewa Marina.** The City supports timely development of the Ewa Marina as a key element needed to mitigate drainage impacts in the Kaloi Gulch watershed during major storms, The marina's role as a storm water storage and detention basin has been acknowledged and included in previously approved environmental impact statements and land use approvals for projects in the Kaloi Gulch watershed.	X		
• **Relation to the Ewa Village Master Plan and Other Previously Approved Developments in the Basin.** Solutions to handling drainage problems on lands above Ewa Villages must be compatible with the drainage design of the Ewa Villages Master Plan and other developments in the Kaloi Gulch drainage basin which have already been approved. The Ewa Villages drainage design assumes that runoff will not exceed existing levels received from sugar cane fields north of the golf course, will enter the Ewa Villages	X		

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
golf course water retention areas through a number of dispersed channels, and will not be at velocities which would scour out the golf course water retention areas.			
Discussion: While a relatively small portion of the Petition Area lies within the Kalo'i Gulch drainage basin, Ho'opili will be designed to detain future runoff from the site to current flows before entering Kalo'i Gulch, until such time as the outlet to the ocean at 'Ewa Marina is opened. During the Draft EIS public review period, HASEKO (Ewa), Inc. wrote: "...the location of the proposed ocean outlet is at One'ula Beach Park, and not at 'Ewa Marina (now known as Hoakalei Marina)...Because of the potential environmental problems associated with intersecting the Kalo'i Gulch regional drainage system with the Honouliuli sewer outfall pipe, the outlet has been relocated from the marina, which is to the west of the sewer outfall pipe, to the beach park, which lies east of the outfall." HASEKO (Ewa), Inc. also wrote: "The ability to construct the ocean outlet is dependent upon issuance of a conservation district use permit (CDUP) by the State Board of Land and Natural Resources. Haseko has applied for the CDUP, which is now being processed through a contested case proceeding."			
4.7.1: SCHOOL FACILITIES — General Policies			
The State Department of Education should review and recommend on the adequacy of school facilities, either at existing schools or at new school sites to be made available when the development is completed.	**X**		
Developers should pay their fair share of all costs needed to insure provision of adequate school facilities for the children living in their developments.	**X**		
Discussion: The Petitioner has been coordinating with the Department of Education (DOE) over a number of years to determine the number, type and location of schools to serve the future residents of Ho'opili. The proposed project could include as many as five public school sites. The project could provide approximately 90 acres for Department of Education (DOE) school sites. Currently, three elementary schools, one middle school, and one high school are sited on the Conceptual Land Use Plan. The Petitioner intends to pay its fair share contribution. In addition, the Petitioner has initiated discussions with existing private schools whether they would be interested in opening campuses within Ho'opili. The current conceptual land use plan includes one potential location for a private school site.			
4.7.2: SCHOOL FACILITIES — Planning Principles			
The following principles should be followed in planning and operating schools in Ewa:			
• **Schools as Community Centers.** Because of the difficult financial problems for all sectors, new communities are likely to have fewer churches, private social halls, and recreation facilities. As a result, schools may have to assume important functions as cultural and recreational centers and as meeting facilities. The State DOE should design school facilities to facilitate community use during non-school hours and weekends.			**X**
• **Co-location with Parks.** Elementary and intermediate schools should be co-located with neighborhood or community parks, and designs of facilities should be coordinated by the State DOE and the Department of Parks and Recreation when needless duplication of parking and of athletic, recreation, and meeting facilities can be avoided.	**X**		
• **Shared Facilities.** The Department of Parks and Recreation should coordinate the development and use of athletic facilities such as swimming pools and gymnasiums with the DOE where such facilities would maximize use and reduce duplication of function.			**X**
• **Fair Share Contribution.** The City will support the State Department of Education's request for fair share contributions from developers of residential projects to insure that adequate school facilities are in place at existing and new schools to meet the needs of residents.	**X**		

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
Discussion: The Petitioner agrees that future school cafetoriums can serve as community centers and can play in role in building neighborhoods. The Petitioner also concurs that elementary and middle schools should be co-located with parks. The Petitioner intends to pay its fair share contribution.			
4.8.1: PUBLIC SAFETY FACILITIES — General Policies			
Adequate staffing and facilities are needed to ensure public safety. New development should be approved only if staffing and facilities will be adequate to provide fire and police protection when development is completed.	X		
Discussion: The Honolulu Fire and Police Departments are being consulted early in the planning process (including during this EIS). To date, no major issues of concerns have been raised by either department. The project will comply with all Honolulu Fire Department requirements for access, water supply, and building construction. In addition, the Petitioner is proposing a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a fire station, EMS site and/or police substation.			
4.9 OTHER COMMUNITY FACILITIES			
Other existing and proposed community facilities shown on the Urban Land Use Map in Appendix A include hospitals, colleges, correctional facilities, and cemeteries. Key facilities include the planned University of Hawaii West Oahu campus and St. Francis West Hospital. Location of new community facilities should comply with the following principles:			
• Colleges and Hospitals. Colleges and hospitals should generally be located in urban areas near transit nodes, commercial centers, or high-density residential areas.			X
• Correctional Facilities. Correctional facilities should generally be located on industrial or agricultural lands. (However, a youth detention facility can be located within the City of Kapolei as part of a relocated Family Court.) If such a facility is proposed for lands not planned for industrial or agricultural use, a City review and approval process which provides public review, complete analysis, and policy approval should be used.			X
• Other Major Facilities. Major public, quasi-public or private facilities or utilities which provide essential community services but which could have a major adverse impact on surrounding land uses should be considered through a City review and approval process, such as the Plan Review Use process, which provides public notification, review by appropriate agencies, opportunities for public comment, and approval by the City Council.			X
Discussion: While the *Ewa Development Plan's* policies related to other community facilities are not directly applicable to the Ho'opili project, the Petitioner concurs that any major public, quasi-public or private facilities or utilities which provide essential community services but which could have a major adverse impact on surrounding land uses should be considered through a City review and approval process, such as the Plan Review Use process, which provides public notification, review by appropriate agencies, opportunities for public comment, and approval by the City Council.			
4.10 ADDED OR CHANGED PUBLIC FACILITIES			
Public facilities other than those listed in this plan shall be identified on the Public Infrastructure Map.	X		
Discussion: The Public Facilities Map shows a future intermediate school site and a future district park site in the vicinity of the Ho'opili project site. The proposed project could include as many as five public school sites, depending on further discussions with the State Department of Education. As presently planned, the project includes accommodations for public facilities on six sites on a total of 100 acres. These sites could accommodate three elementary schools, one middle school, one high school and an additional public facilities space. It is currently proposed that a site be set aside for a district park adjacent to a proposed middle school site near the intersection of Old Fort Weaver Road and Fort Weaver Road. The district park site could serve the residents of Ho'opili and the			

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Ewa Development Plan – Objectives and Policies	S	N/S	N/A
surrounding area. The number of public facilities proposed within the project site exceeds the requirements of the *Ewa Development Plan*.			
CHAPTER 5: IMPLEMENTATION			
5.4.2: PROJECT MASTER PLANS			
The Project Master Plan is intended solely as a guide to help describe in words and illustrations how a project promotes the vision, policies, principles and guidelines for Ewa. Projects associated with a significant zone change which involve 25 acres or more shall include a Project Master Plan to the Department of Planning & Permitting. The Project Master Plan shall cover all project phases. It shall be reviewed to determine whether the project supports the vision, policies, principles, and guidelines of the Ewa Development Plan. In the event a Final EIS has already been accepted by the City and County of Honolulu for a particular project, then a subsequent Project Master Plan will not be required. The Project Master Plan should be based on the best information available to the applicant at the time the Change of Zone Application is submitted to the City and County of Honolulu.	X		
Discussion: A Draft Project Master Plan is attached to this EIS as Appendix Q. As the alignment of the HHCTC project has not been finalized within the Petition Area, it is premature to identify the desired zoning for the proposed project. The Draft Project Master Plan is based on the best information available to date.			

CONSISTENCY WITH THE VISION FOR 'EWA

'Ewa will continue to experience tremendous growth, and has made significant progress toward providing a new, or secondary urban center for O'ahu. The population has nearly doubled since 1990 and is expected to double again by 2030. Job growth should be equally impressive with another 40,000 jobs expected to be created by 2025. O'ahu residents and visitors should be attracted to 'Ewa by a new university campus, new resort, new small boat marina and waterfront activities, the growth of Ko 'Olina, and the City of Kapolei bustling with retail and commercial establishments and private and government offices. 'Ewa will be built around a regional system of open space and greenways so that it has the feel of a network of communities "within a garden."

Ho'opili is highly consistent with the goals and objectives of two primary recognized long-range development plans for the area, the City and County of Honolulu's directed growth policy for the area, the *Ewa Development Plan* (Ewa DP) and the *Kapolei Area Long Range Master Plan* (See Figure 3.4: Kapolei Area Long Range Master Plan), which was adopted by the City and County of Honolulu as part of Resolution 91-34. The Ewa DP states that growth in the area will include community building, not just project development, with communities designed to enhance lives, reduce automobile dependency, and be connected via a network of greenways.

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Ho'opili fundamentally adheres to the best intentions of the area's long-range master plans and the possibilities for a better 'Ewa with its:

- concentrated mixed-use development pattern;
- ~~embrace~~ support of "Traditional Neighborhood Design" and "Transit-Oriented Development" principles so that the entire project is walkable, connected and transit-ready;
- commitment to contributing to a strong jobs-housing balance within the greater Kapolei area;
- earmarking of large areas for community gathering places, schools, parks and open space and a comprehensive bicycle/pedestrian network; and
- A density of approximately 11,750 homes that should provide many housing opportunities within the affordable and market-rate price ranges.

Ho'opili continues to be highly coordinated with major planning and development efforts by other regional developers, including the Department of Hawaiian Home Lands, the Hawaii Community Development Authority and University of Hawai'i at West O'ahu. Meetings among regional developers as well as County and State agencies have been held on a regular and frequent basis to discuss shared infrastructure improvements, timing and connectivity. As a result, joint development agreements have already been entered into between the area's developers and the City and County of Honolulu regarding regional sewer transmission line improvements, with more to follow.

Ho'opili can play a key role in actualizing the community's vision for 'Ewa and enhancing the desirability of living on the 'Ewa Plain. Ho'opili, or "coming together," is part of the bridge where Honolulu's existing central corridor that reaches to Waipahu meets the urban core of the 'Ewa Plain, the City of Kapolei. It is where neighboring towns from Waipahu to Ko 'Olina and from Makakilo to 'Ewa Beach will be welcome and can gather.

Residents should celebrate the benefits of this connected community for generations to come. Ho'opili is a community that is:

- Going to enhance living in 'Ewa: more time spent with families, fewer vehicle trips and cleaner air quality, and greater community gathering opportunities;
- Highly livable with a range of housing options – including affordable, workforce, and senior housing – plus parks, community facilities, schools, with a diversity of jobs and retail options;
- Sustainable, "green" requiring fewer car trips with its bicycle and pedestrian paths;
- Innovative, incorporating principles of "Traditional Neighborhood Design," and "transit-oriented development"; and
- Based on a healthy, live-work environment.

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5.3.3 Land Use Ordinance

The Petition Area is presently zoned AG-1 Restricted Agricultural District by the City and County of Honolulu Land Use Ordinance (LUO). As such, a Zone Change will be required for the 1,553.844 acre Petition Area.

5.3.4 Special Management Area

The Petition Area is located outside of the Special Management Area (SMA) as established by the City and County of Honolulu.

5.3.5 Ewa, Central Oahu and Primary Urban Center Public Infrastructure Maps

Based on comments received from the Department of Planning and Permitting (DPP) during the public review period, it should be noted that DPP is currently processing two separate but similar revisions to the Ewa, Central Oahu (CO) and Primary Urban Center (PUC) Public Infrastructure Maps (PIM) regarding the Honolulu High Capacity Transit Corridor Project.

In February 2008, the Department of Transportation Services (DTS) submitted a proposal to the DPP to revise the Ewa, CO and PUC PIMs by adding symbols for a "Rapid Transit Corridor," "Transit Stations," "Corporation Yard," and "Park and Ride" facilities. The proposed symbols represent the Locally Preferred Alternative (LPA) that was approved by the City Council via Ordinance 07-1. The DTS' proposal was circulated for public review and comment, and adoption of Resolution 08-97 occurred on May 7, 2007. Figure 2.8: Proposed Circulation Plan of the Final EIS has been revised to reflect the City's proposal in Resolution 08-97, CD1 for the Honolulu High Capacity Transit Corridor Project.

In March 2008, the City Council introduced Resolution 08-69 regarding a revision to the Ewa, CO and PUC PIM's be adding 40 "Transit Station" symbols along the length of the LPA. Resolution 08-69 does not include symbols for the "Rapid Transit Corridor," "Corporation Yard," and "Park and Ride" facilities. The DPP is currently preparing to circulate the proposal for public review and comment before forwarding a report and draft resolution to the City Council for action.

As of this writing, the City and County of Honolulu (City) has begun work on the Draft Environmental Impact Statement (EIS) for the Honolulu High-Capacity Transit Corridor (HHCTC) project, with a target publication date in the second or third quarter of 2008. By the time the HHCTC Draft EIS is published, the final alignment of the "Rapid Ttransit Corridor and the locations of: "Transit Stations," "Corporation Yard" (transit maintenance and storage), "Park and Ride" facilities in Ewa will be known. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or through the project site, with either one or two transit station locations. The Petitioner acknowledges that sites for a transit maintenance and storage facility and/or a portion of a park and ride facility may be required within the Petition Area.

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5.4 REQUIRED PERMITS AND APPROVALS

The following is a list of major approvals and permits required for the implementation of the proposed project. From the earliest stages of the planning process, the Petitioner has worked with all affected agencies to obtain their comments and necessary approval of plan and specifications.

Table 5.9. Required Permits/Approvals

PERMIT/APPROVAL	APPROVING AUTHORITY	STATUS	PROJECT SUBMITTAL DATE
State Land Use District Boundary Amendment (with EIS)	State of Hawai'i Land Use Commission	Petition has been filed; processing on hold until EIS process has been completed.	First Quarter 2007
Zone Change	City and County of Honolulu Department of Planning and Permitting/City Council	Application to be filed assuming successful processing of SLUDBA.	Third Quarter 2009
Large Lot Subdivision ~~Approval~~ Action	City and County of Honolulu Department of Planning and Permitting	Application to be submitted after change the Zone Change application is approved.	Third Quarter 2010
National Pollutant Discharge Elimination System (NPDES) Permit	State of Hawai'i Department of Health	Application to be submitted prior to Building/Grading Permits.	2011
Building/Grading Permits	City and County of Honolulu Department of Planning and Permitting	Application to be filed after the Zone Change application is approved.	2011
Water Use Permit	State of Hawai'i Department of Land and Natural Resources, Commission on Water Resource Management	Application to be submitted prior to Building/Grading Permits	2011

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6.0
Alternatives to the Proposed Action

6.0 ALTERNATIVES TO THE PROPOSED ACTION

In compliance with the provisions of Title 11, Department of Health (DOH), Chapter 200, Environmental Impact Statement Rules, Section 11-200-10(6), the alternatives considered are limited to those that would satisfy the objectives of the proposed mixed-use development, while minimizing the potential for adverse environmental impacts. The feasible alternatives must realistically address the project's economic characteristics while also responding to the surrounding land uses that will be impacted by the project. In conformance with applicable regulations, other possible alternatives have been investigated to identify alternative sites, the appropriate uses for the property, and how they would best be accomplished.

6.1 "NO-ACTION" ALTERNATIVE

The "no-action" alternative would not be consistent with stated governmental policies, which direct future growth to the 'Ewa region. The City and County of Honolulu *General Plan* states:

> *Encourage development within the secondary urban center at Kapolei and the Ewa and Central Oahu urban-fringe areas to relieve developmental pressures in the remaining urban-fringe and rural areas and to meet housing needs not readily provided in the primary urban center.*

Under this alternative, the site would remain as agricultural land, underutilized in terms of meeting the demand for residential homes (including affordable homes) and accompanying land uses. The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall. The demand for housing could result in the following scenarios or combinations thereof: there would be more pressure to develop in the other districts, including the rural areas and other areas currently used for cultivation; there could be a demand for higher density housing in undeveloped areas of 'Ewa at a density not experienced to date; there would be more "doubling up" (larger number of persons per household, with more than one family under roof); those that are not willing to put up with the previously described scenarios may decide to relocate to the U.S. mainland where housing prices have dropped.

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The "no-action" alternative was rejected because it is not consistent with government plans to develop Kapolei as the Second City.

6.2 ALTERNATIVE SITES

There are very few large parcels left on O'ahu that are designated for residential development. The largest amount of developable land that is undeveloped lies in Central O'ahu and on the North Shore. As shown on the *Ewa Development Plan*, the Petition Area is designated mostly Low and Medium Density Residential. As such, the City and County of Honolulu has long recognized that the Petition Area is best used for residential and other development. Directing growth to 'Ewa and in the "urban-fringe" portions of Central O'ahu reduces the pressure to develop outside of the Urban Growth Boundary of Central O'ahu, and the North Shore, Ko'olau Loa, Ko'olau Poko and Wai'anae districts. This alternative has been rejected because it would be clearly contrary to *General Plan* policy. The potential benefit of this alternative is that for those that object to further development on the 'Ewa Plain, it might be preferable for development to occur elsewhere on O'ahu, such as in the Primary Urban Center, East Honolulu, Central O'ahu, North Shore, Ko'olau Loa, Ko'olau Poko and Wai'anae districts.

The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall.

6.3 ALTERNATIVES RELATED TO DIFFERENT DESIGNS OR DETAILS OF THE PROPOSED ACTIONS WHICH WOULD PRESENT DIFFERENT ENVIRONMENTAL IMPACTS

Different designs could be applied to the project, and depending on the density and design capacity, would result in different environmental impacts. For example, a higher density project that kept the same residential unit count as proposed (11,750) would reduce the buildable area (a positive benefit) and possibly reduce the quantity of surface runoff (a positive benefit). ~~This~~ Another potential benefit of this alternative is that it would likely be easier to serve by bus and correspondingly increase ridership. However, the residential buildings would be larger and taller. This alternative would not allow as wide a range of residential products to market and was thus rejected. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural

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employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion).

Another alternative would be to set aside less open space and to spread out the community over a larger land area. Such an alternative is best portrayed by the current *Kapolei Long Range Master Plan* and *Ewa Development Plan* Land Use Map designations for the Petition Area. This alternative would reduce the density (to some, a positive benefit) but consume more land, increasing the quantity of surface runoff, and requiring a much larger investment in grading and infrastructure. This alternative would make it difficult for residents to be served by bus, and even more difficult by high-capacity transit. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). This alternative was also rejected.

The demand for safe drinking water and the quantities of wastewater, solid waste, and traffic generated would vary with different designs, depending on the number/quantity of residential units, schools, commercial square footage, and roads.

6.4 ACTIONS OF A SIGNIFICANTLY DIFFERENT NATURE WHICH WOULD PROVIDE SIMILAR BENEFITS WITH DIFFERENT ENVIRONMENTAL IMPACTS

One scenario that would be significantly different from the proposed action is that an elevated rail line and accompanying transit stops would not be built through Ho'opili. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts (assume greater traffic impacts than without the HHCTC project); and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). The impacts of this scenario will be better described in the upcoming HHCTC DEIS.

For the 'Ewa district drivers enduring the longest morning commutes to the Central Business District or UH Mānoa, the modes of transportation will continue to be limited to: private motorized vehicle (including zipper lane), TheBus, TheBoat, Vanpool, et cetera. While this is a scenario that could inevitably result in lengthening commute times, individual commuters will either: bear with the commute in return for the comfortable lifestyles offered by their homes in 'Ewa; move from their homes in 'Ewa and move closer

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to their workplaces or schools; or find schools and/or employment in the 'Ewa region. The opening of UHWO will reduce traffic from those undergraduate students in Leeward and Central O'ahu who commute to UH Mānoa, and indirectly reduce the demand for student housing on the UH Mānoa campus (reducing the demand for off-street parking demand on campus, reducing the demand for on-street parking in the surrounding neighborhoods, increasing the supply of student housing on campus, and reducing the demand for student housing off-campus). If the Petitioner is allowed to develop a mixed-use (residential/commercial/office/light industrial) project as proposed, then, more employment opportunities will be provided to existing residents of the region, reducing the need for some 'Ewa residents to commute outside of the District to work. To offset the non-implementation of the HHCTC project, the City and County of Honolulu may decide to increase The Bus and The Boat services. The positive benefits of this alternative is that the visual impact impacts of an elevated rail system would be avoided as well as long-term commitment of State and Federal funds for the HHCTC project. This alternative is not desirable, but feasible.

6.5 THE ALTERNATIVE OF POSTPONING ACTION PENDING FURTHER STUDY

Development of the 'Ewa region as O'ahu's Second City has been studied and planned for many years. Further study of any proposed development on the property would only be delaying what has long been proposed in the *Ewa Development Plan*. Therefore, this alternative was rejected, as it would not achieve the overall objectives for the project, which would create a mixed-use community that more employment opportunities will be provided to existing residents of the region, reducing the need for some 'Ewa residents to commute outside of the District to work. The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Occasionally, however, continued cultivation of the site would generate dust when portions of the site are harvested and plowed. Implementation of this alternative will temporarily avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall.

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7.0
Contextual Issues

7.0 CONTEXTUAL ISSUES

Key issues within the context of the Ho'opili project are presented in this section.

7.1 RELATIONSHIP BETWEEN THE SHORT-TERM USES OF THE ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

As discussed previously in this EIS, the Petition Area consists mainly of agriculturally cultivated cropland/or vacant land formerly under sugarcane cultivation. Due to the high demand for residential units and jobs throughout the State, particularly on the island of O'ahu, the Petitioner is proposing a mixed-use, transit-ready community including residential, business/commercial, light industrial/business, open space, parks, schools and other public facilities, in an area long-planned for urban development (*Ewa DP).*

Allowing the Petition Area to remain in its current state would be inconsistent with the property's *Ewa Development Plan* designation for Low and Medium Density Residential, High Density Residential, Agricultural and Preservation, Parks, Transit Node (High Density Residential and Commercial), and Future Intermediate School. While it is acknowledged that productivity of the Petition Area for cultivated crop production would be lost if the proposed project is developed, it is the City and County of Honolulu's land use policy to protect large tracts of land in Central O'ahu and the North Shore for agricultural uses, by establishing an Urban Growth Boundary.

Through careful planning during the planning and design phases, the property will complement the urban character of the emerging Secondary Urban Center, as planned by the City and County of Honolulu. At full build-out, the Ho'opili project has the greater potential for long-term productive use of the Petition Area. The development is large enough and will be designed to allow residents to live, work, learn, play, and shop in one area, thus generating significant social and economic benefits to the community through employment, educational, and home ownership opportunities, and the provision of infrastructure and other community services and facilities.

7.2 CUMULATIVE AND SECONDARY IMPACTS

This chapter identifies cumulative and secondary impacts that may result from the development of Ho'opili and the East Kapolei region. During the public review period, the State Department of Land and Natural Resources (DLNR), Engineering Division wrote: "DLNR currently owns approximately 183 acres of land near and/or adjacent to the Ho'opili project…The DLNR parcels have excellent development potential based on the location of these lands adjacent to or near major arteries (H-1 Freeway, Farrington Highway, North-South Road) and the City's proposed transit line as well as the substantial increase development projects in the area. Consequently, regional infrastructure should

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take into consideration the potential development of the DLNR parcels, and DLNR requests that it be included in the planning and design of any regional infrastructure in the area that would serve the DLNR parcels."

7.2.1 Impacts on the Physical Environment

Climate, Topography, and Soils. Planned developments in the East Kapolei region (the proposed Ho'opili project, University of Hawai'i at West O'ahu (UHWO), Department of Hawaiian Home Lands (DHHL) East Kapolei Development Parcels 1 and 2, Kroc Center, and the "DLNR parcels") are not expected to adversely impact regional climate, topography, and soils of existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. However, within their respective project sites, construction of the East Kapolei developments will impact mostly minor topographic features and soils, and new buildings may affect the respective micro-climate of each building site (by retaining and/or reflecting solar energy and heat, creating shade where none presently exists, or creating "wind tunnels"). Grading operations will comply with DOH regulations and are not expected to adversely impact air and water quality.

Drainage and Groundwater. Regional infrastructure will be developed to control drainage in the East Kapolei area, for those areas draining into Kalo'i Gulch. The planned developments will introduce impervious surfaces through the construction of buildings, roadways, parking areas, and walkways. Increased impervious surfaces (i.e., roofs, roadway surfaces, and sidewalks) will increase the potential for runoff, although existing and proposed detention basins throughout East Kapolei will effectively manage drainage towards Kalo'i Gulch or other drainage basins. Through implementation of the proposed drainage improvements, the planned developments in East Kapolei are not expected to adversely impact existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Ocean Pointe, Villages of Kapolei and Makakilo. Additionally, landscaping introduced by the East Kapolei developments will reduce the potential for soil erosion, compared to current conditions on vacant and actively cultivated lands. All drainage facilities will comply with the City and County of Honolulu's Storm Drainage Standards. A non-potable water system will be developed for 'Ewa to reduce the demand for safe drinking water from the BWS system.

Natural Hazards. It is unlikely that any of the proposed structures and uses associated with the planned developments in 'Ewa will affect the potential occurrence of earthquakes, hurricanes, or tsunami or adversely impact existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. By designing future structures to the then-approved building code, future buildings will likely be designed to mitigate the potential damage from natural hazards.

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Flora and Fauna. The cumulative impact of the planned developments in East Kapolei is the reduction of habitat. However, past and present agricultural activities in the Petition Area have altered natural habitats; as such, existing flora and fauna are primarily introduced species. During construction, faunal species are likely to vacate the site for suitable habitats nearby. After construction, these species may return, depending on their preference of habitat and the landscaping provided. The planned developments in East Kapolei are not expected to adversely impact the flora and fauna of existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

7.2.2 Impacts on the Human Environment

Archaeological/Historic and Cultural Resources. An archaeological inventory survey was conducted of the Petition Area. Five historic properties were documented on the Petition Area. All five historic properties have been assessed as eligible for the State Register of Historic Places under Criteria C and D, except for Site 4344, which is only eligible under criterion D. The State Historic Preservation Division (SHPD) concurs with these significance assessments. According to SHPD, the archaeological inventory survey report is now accepted. In addition, a preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for its review and approval. Recently completed archaeological inventory survey reports for both the proposed project and the neighboring 500-acre UHWO site provide more information about the 'Ewa area and consistently show that due to prior sugar cane cultivation, pre-historic features are nearly non-existent. A cultural impact assessment was also prepared for the Petition Area and it found that there are no contemporary or continuing cultural or traditional practices currently occurring within the proposed Project Area. Therefore, no impacts are expected and no mitigation measures are planned. The regional cumulative impacts on archaeological and cultural resources within 'Ewa appear to be minimal. The planned developments in East Kapolei are not expected to adversely impact the archaeological and historical resources of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Agriculture. Lands in the Petition Area and the remainder of 'Ewa were historically used for sugarcane cultivation and most recently for diversified agriculture. Much of East Kapolei (including the Petition Area) is actively cultivated through short-term agreements. With the proposed developments in East Kapolei (UHWO, DHHL East Kapolei Development Parcel 1, DHHL East Kapolei Development Parcel 2 and Ho'opili, land will be withdrawn from production, resulting in some loss in revenues, jobs, and payroll, unless replacement agricultural leases are established elsewhere. While ~~A~~ample agricultural land is available to accommodate the projected growth of diversified agriculture on O'ahu (such as Central O'ahu and the North Shore) and elsewhere in the State of Hawai'i, some reviewers of the Draft EIS have expressed concern about the potential loss of agricultural land. The planned developments in East Kapolei are not expected to adversely impact the agricultural resources of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch,

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Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. However, ultimate development of the Petition Area and the remainder of East Kapolei will reduce the exposure of soils to the erosional forces of wind and rainfall.

Noise. Over the long term, as 'Ewa develops and the 'Ewa population grows, noise levels will increase above current conditions. Residential, business/commercial, light industrial/business, parks, schools and other public facilities will generate noise. New roadways and improvements to existing roadways are proposed, and vehicles traveling to, from, through, and within the 'Ewa area will be a significant contributor of noise. The planned HHCTC will also generate noise. East Kapolei is generally not surrounded by noise sensitive uses (residential, educational and medical structures and facilities). Mauka of East Kapolei is H-1 and vacant land. To the west is the Kapolei Golf Course. To the south are Kapolei Parkway and the 'Ewa Villages Golf Course and to the east and grade-separated is Old Fort Weaver Road and Honouliuli Village. ~~However~~Moreover, noise-sensitive uses (residential, educational and medical) occurring in buildings are likely to be insulated and equipped with air conditioners, mitigating noise from traffic, wind, and aircraft.

Air Quality. Emissions from cars and equipment used to generate electricity can affect air quality. The planned developments in East Kapolei will attract traffic and use electricity, but are not expected to significantly affect regional air quality, as new technologies, increasingly stringent air pollution control regulations and improving automobile technology, and alternative forms of transportation (i.e., Honolulu High-Capacity Transit Corridor (HHCTC), buses and other public transportation, bicycling, walking) may offset potential increases in air pollution. Predominant tradewinds during the afternoon provide dispersal of emissions. The planned developments in East Kapolei are not expected to adversely impact the long-term air quality of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. Depending on the phase of construction, there will be occasions when dust may be generated despite mitigative measures (such as during gusts of particularly strong wind) and depending on the location of construction may affect Honouliuli (which is mostly upwind of the project site), 'Ewa Villages (separated by the 'Ewa Villages Golf Course) and the DHHL East Kapolei Development Parcel 2 project (abutting). The Petitioner and DHHL is coordinating on mitigating this potential impact.

Man-Made Hazards. No industrial facilities handling explosive or fire-prone materials (i.e., liquid propane, gasoline, or other storage tanks) exist in the Petition Area. However, there are two hazardous sites in and near the East Kapolei area – the former 'Ewa Sugar Mill, which is surrounded by the 'Ewa Villages residential and golf project and has a current status of No Further Remedial Action Planned, and the 'Ewa Sugar/O'ahu Sugar Company Pesticide Mixing and Loading Site, which is located to the east of North-South Road on Department of Hawaiian Home Lands (DHHL) property. The land uses proposed by the planned developments in 'Ewa (no heavy industrial land uses or zoning are

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proposed) are not likely to expose people or buildings to explosive or flammable fuels or chemical containers. The planned land uses in East Kapolei are not expected to expose residents of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo to noxious land uses.

Visual Resources. The planned developments in East Kapolei will change the open space character of the area and introduce urban structures and street trees including the UHWO campus, various types of residences (associated with DHHL, UHWO and the proposed project), commercial/industrial/business centers (associated with DHHL, UHWO and the proposed project), schools, public uses (the Kroc Center, churches) and transportation facilities (such as the North-South Road and in the most visually prominent scenario of high-capacity transit – elevated rail, associated transit stations, a park and ride facility and possibly a rail transit maintenance and storage facility). The East Kapolei developments will include landscaping to reduce the bulk of buildings and structures, and enhance the visual character of the sites. In the case of Ho'opili, open space buffers will reduce the impact of views from the H-1 Freeway, and relatively low-intensive land uses are proposed along Old Weaver Road near Honouliuli Village. Also within Ho'opili, mostly lower density housing is proposed along the 'Ewa Villages Golf Course and along DHHL East Kapolei Development Parcel 2, to maintain the character of these surrounding areas. The planned developments in East Kapolei will permanently replace the open space character of East Kapolei with a master-planned community as viewed from the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

7.2.3 Impacts on the Socio-Economic Environment

Population, Housing, Neighborhood Commercial Uses, and Character/Lifestyle of the Community. The planned developments (UHWO, DHHL East Kapolei Development Parcels 1 and 2, Kroc Center and Ho'opili) will help to further the growth of the Second City by adding to the critical mass of residential, business/commercial, light industrial/business, open space, parks, schools and other public facilities in 'Ewa, making it a more "complete" community. In the same fashion that many residents in East Honolulu or the Primary Urban Center have no need to leave to visit other districts for essential "goods and services," 'Ewa residents may someday have little need to leave their district. No homes or residents will be displaced by the East Kapolei projects, which will be developed on lands that are currently undeveloped, most of which is being cultivated. The planned developments in East Kapolei will provide a variety of live, work, play, study and shopping opportunities to the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo, which are not currently available on site.

Economic Impacts and Employment. As the planned developments in East Kapolei are gradually built out, agricultural lands will be withdrawn from agricultural production,

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resulting in some loss of revenues, jobs, and payroll. It is likely though, that cultivation is likely to gradually relocate to vacant agricultural land further north of East Kapolei and in Kunia, Central O'ahu, and the North Shore. Over time, the loss of economic productivity from agricultural activity will be more than offset by the construction of the planned developments, which will provide significantly greater revenues, more employment opportunities, and higher payrolls. Local businesses will profit from the developments in 'Ewa, and money spent by workers and businesses will flow through the West O'ahu regional economy particularly in the City of Kapolei. The County and State will benefit from the developments through the generation of real property, income and general excise tax revenues, more than off-setting government services. The planned developments in East Kapolei will provide a variety of live, work, play, study and shopping opportunities to the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo, which are not currently available on site.

7.2.4 Impacts on Infrastructure Facilities

Water. Many of the new residents in 'Ewa will have already been residing on O'ahu, thus the demand for water will shift from where they live now on O'ahu to 'Ewa. The 'Ewa projects are being designed assuming to assure that there are adequate sources, storage and transmission facilities to service 'Ewa, without having to reduce source from where future residents currently reside elsewhere on O'ahu and relocate the water allocation to 'Ewa. UHWO and Ho'opili will be designed to include dual water systems, allowing new parks, open space and roadway landscaping to be irrigated with recycled water from the Honouliuli Water Reclamation Facility (WRF). The planned developments in East Kapolei are not expected to adversely impact the supply of drinking water for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Wastewater. Many of the new residents in 'Ewa will have already been residing on O'ahu, thus the need for collection, treatment and disposal of wastewater will shift from where they live now on O'ahu to 'Ewa. The 'Ewa projects are being designed assuming to assure that there are adequate collection, treatment and disposal facilities to service 'Ewa. Where other wastewater treatment facilities on O'ahu do not have the capability to provide recycled water, Honouliuli does. Also, since UHWO and Ho'opili will be designed to include dual water systems, this will allow parks, open space and roadway landscaping to be irrigated with recycled water from the Honouliuli WRF. The planned developments in East Kapolei are not expected to adversely impact the capacity of the existing wastewater system to treat and dispose of wastewater currently being generated from the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

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Drainage. The Petition Area falls within three different drainage basins. One of these three drainage basins, Kalo'i Gulch, is shared by UHWO, DHHL, Ho'opili and the Kroc Center. The Kalo'i Gulch drainage basin stretches to the top of the eastern slopes of the Wai'anae mountain range and terminates near the ocean in the vicinity of Haseko's Ocean Pointe development. The drainage basin, mauka of the H-1 Freeway, is 3,000 acres and generates a peak flow of 5,000 cubic feet per second (CFS). The drainage basin size increases to 4,330 acres and carries a peak flow of 8,900 CFS at the entrance to 'Ewa Villages. Approximately only 100 acres of the Ho'opili project are within this watershed.

The proposed developments in East Kapolei will increase impervious surfaces such as roadways, roofs, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Kalo'i Gulch drainage basin. However, each of the East Kapolei projects (the proposed Ho'opili project, University of Hawai'i at West O'ahu (UHWO), Department of Hawaiian Home Lands (DHHL) East Kapolei Development Parcels 1 and 2, Kroc Center) will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. The East Kapolei projects will also be providing storage and detention to meet the Rules Relating to Storm Drainage Standards with respect to water quality standards. The basin size could be decreased at some time in the future when the terminus of Kalo'i Gulch basin is finalized. All projects discharging to the Kalo'i Gulch basin currently have discharge restrictions and these restrictions will continue until the Kalo'i Gulch outlet is opened. Through implementation of the proposed drainage improvements, the planned developments in East Kapolei are not expected to adversely impact existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Ocean Pointe, Villages of Kapolei and Makakilo.

Solid Waste. While many of the new residents in 'Ewa will have already been residing on O'ahu, there will be new residents attracted to and residing in Ho'opili who will be new to O'ahu. As O'ahu's population increases, the capacity of the Waimānalo Gulch Landfill will decrease. The issue of solid waste recycling and ultimate disposal will not only affect 'Ewa, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo, but every resident on O'ahu.

Roadways and Traffic. Ho'opili involves development of a mixed-use community on approximately 1,555 acres in East Kapolei. The Ho'opili Conceptual Land Use Plan ("Plan") reflects the desire for a community that is "complete" with: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents. Implementation of the Plan will allow residents the ability to live, work, learn, play, and shop within Ho'opili without needing to use personal motor vehicles on regional roadways.

Ho'opili will be connected to the surrounding 'Ewa District (and neighboring Department of Hawaiian Home Lands (DHHL), the University of Hawai'i at West O'ahu (UHWO),

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Kroc Center and the Hawaii Community Development Authority (HCDA) properties by a network of closely-spaced gridded streets and bicycle paths within Ho'opili which allows a variety of circulation options for residents and visitors through East Kapolei. Wider tree-lined boulevards will create a distinct axis running north-south and diagonally east-west across the site, but unlike a conventional subdivision of cul-de-sacs, there will many more streets, sized at a walking scale. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will be concentrated around the transit station(s). Also possible is a transit maintenance and storage facility.

There are several major transportation projects that have been long-planned for East Kapolei. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road/H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili (and UHWO); the proposed East-West Connector Road through the Petition Area (that would connect Farrington Highway with Fort Weaver Road, through UHWO, DHHL East Kapolei Development Parcel 2 and Ho'opili); and the segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area.

Assuming that mitigation measures are implemented, the result of the analysis indicates that the Ho'opili project would result in what the traffic engineering consultant identifies as significant impacts to only one intersection under Scenario A: With Transit Corridor Scenario; this would occur at Farrington Highway/Leokū Street. Under Scenario B: Without Transit Corridor Scenario, a total of three intersections are anticipated to result in what the traffic engineering consultant identifies as significant impacts as a result of the Ho'opili project: Farrington Highway/Leokū Street, Fort Weaver Road/Old Fort Weaver Road and Fort Weaver Road/Renton Road. Those residents surrounding the project site, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo who travel through the above identified intersections would be most impacted by the proposed project.

7.2.5 Impacts on Public Facilities and Services

Electrical and Communication Facilities. Steam units, diesel units, and gas turbines used to generate electricity also generate emissions and affect air quality. Any increase in demand for electricity not generated by renewable resources will have an indirect impact

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on air quality. Sustainability guidelines have been developed by UHWO. Sustainability options are being considered for the Ho'opili project.

Ho'opili project buildings, activities, and site grounds are planned to be designed with energy-saving considerations, and the project will strive to be consistent with the State's objective to promote cost-effective energy conservation through the adoption of energy-efficient practices and technologies. Due to the sunny climate, the Petition Area (and the rest of 'Ewa) will be suited for the use of renewable energy technologies including photovoltaics. In addition, based on the Department of Business, Economic Development & Tourism (DBEDT), Strategic Industries Division's recommendations, Ho'opili's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies. The planned developments in East Kapolei are not expected to adversely impact the availability of energy for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

The planned developments in East Kapolei will also increase the demand for communications services (i.e., cable television and telephone service), but are unlikely to have an adverse effect on existing communications systems for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Recreational Facilities. The 'Ewa region is the fastest growing region in O'ahu, and the proposed developments in 'Ewa will help to meet the demand for additional recreational facilities. Parks will be provided by Ho'opili to meet the Petition Area's requirements of the City and County of Honolulu's Park Dedication Ordinance. New recreational facilities (i.e., tennis courts, basketball/volleyball courts, and jogging paths) within the UHWO campus are also planned for use primarily by students, faculty, and staff. Additionally, the private developer of UHWO's lands will provide recreational facilities in accordance with the City and County of Honolulu's Park Dedication Ordinance. The DHHL residential subdivision adjacent to and southwest of the Ho'opili community proposes 4.5 acres for park use and 10.7 acres for a community center to be developed and operated by the Salvation Army. The proposed center could include a swimming pool, performing arts center, child care center, gymnasium, education center, game and recreation areas, and other multi-use spaces. The facilities would be available to the general public.

Existing regional park facilities in West O'ahu, Central O'ahu, and Waipi'o may be visited by new residents of the East Kapolei developments; however, other park facilities have long been planned in Kalaeloa. The planned developments in East Kapolei are not expected to adversely impact State and County parks used by residents of the existing

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surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Medical Facilities. Health care services in the 'Ewa region are provided by Hawai'i Medical Center West (the nearest hospital facility), Pali Momi Medical Center, Wahiawā General Hospital, Kaiser Permanente Waipi'o Clinic, and the recently opened Kapolei Medical Park (located across the Kapolei Shopping Center at the corner of Farrington Highway and Fort Barrette Road). Other routine medical services can be obtained at major hospital facilities in urban Honolulu, about a 30-minute drive from the subject property. The City and County of Honolulu has 18 emergency medical services Advanced Life Support Ambulance units and two Rapid Response Paramedic units on O'ahu. Two of the Advanced Life Support Ambulance units are located nearby, one at the Kapolei Fire Station, the other at the Waipahu Fire Station. One of the Rapid Response Paramedic units is located at the nearby Hawai'i Medical Center West. The proposed UH West O'ahu student center is programmed to include a student health clinic.

The East Kapolei projects will increase the population of Kapolei, and as such, there will be an occasional and unavoidable demand for emergency medical services. It is unlikely, however, that this demand will impact the level of service provided to other residents of O'ahu. Existing medical and healthcare facilities in the 'Ewa region and surrounding areas should be able to accommodate the anticipated increase in demand. The planned developments in East Kapolei are not expected to adversely impact the availability of medical facilities for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Educational Facilities. The UH West O'ahu adjacent to and west of the Ho'opili project will be a higher education institution in the 'Ewa region, enabling Leeward and Central O'ahu residents to obtain post-secondary degrees without commuting to the UH Mānoa campus or other higher education institutions in Honolulu.

The demand for educational facilities will increase as the population of 'Ewa grows. The Petitioner is setting aside land for three elementary schools, one middle school, and one high school with Ho'opili. UHWO has set aside land for an elementary school site near its southern boundary that might be shared by residents of the DHHL East Kapolei Development Parcel 1 project. The DHHL East Kapolei Development Parcel 2 project includes one elementary and one middle school sites. The State of Hawaii Department of Education (DOE) is also contemplating a high school on DHHL land immediately north of the UH West O'ahu site. Since the school-aged population is not constant, there is a possibility that not all of the above schools (a total of 2 high schools, two middle schools, and five elementary schools) will be needed after 20 to 25 years (the approximate time frame required for full build out of the combined East Kapolei projects. Through providing required public school sites (and the timely construction of schools by the State DOE), the planned developments in East Kapolei are not expected to adversely impact existing

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developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. During the public review period, the DOE noted that "…the number of schools required for this project may change if the developer decides to increase residential densities per potential transit-oriented development (TOD) zoning."

Police Protection. East Kapolei is located within Honolulu Police Department (HPD) District 8, which encompasses the leeward coast and the 'Ewa Plain. There are approximately 100 field officers assigned to this district, and response time for the entire district fluctuates between five and seven minutes. In order to meet the growing needs of the 'Ewa Plain communities, in 2000, the City and County of Honolulu opened the Regional Kapolei Police Station at 1100 Kamokila Boulevard.

The East Kapolei projects will increase the population of Kapolei and the demand for police service. According to the *Ewa Development Plan*, the 'Ewa Villages Substation is planned to service the East 'Ewa region, which includes East Kapolei. The service date for this substation has yet to be determined. The Petitioner is proposing a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a police substation, fire station and/or emergency medical service (EMS) site. The planned developments in East Kapolei are not expected to adversely impact the availability of police protection for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Fire Protection. Fire protection in the *Ewa Development Plan Area* is provided by the Honolulu Fire Department (HFD) 'Ewa Beach Fire Station (an engine company), Makakilo Fire Station (an engine company), and Kapolei Fire Station (an engine and ladder company, and the Battalion 4 Headquarters). The Kapolei Fire Station located in Kapolei Business Park was completed in 1995 to serve the expanding development on the 'Ewa Plain.

The East Kapolei projects will increase the population of Kapolei and the demand for fire service. According to the *Ewa Development Plan*, to meet the projected population and economic growth in 'Ewa by 2020, three fire stations at 'Ewa Villages, Ko 'Olina, and Makaiwa Hills are planned, however service dates have yet to been determined. A new fire station is being planned on the DHHL East Kapolei Development Parcel 1 site near the intersection of Kapolei Parkway and North-South Road. The Petitioner is proposing a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a fire station, EMS site and/or police substation. The planned developments in East Kapolei are not expected to adversely impact the availability of fire protection for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

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7.3 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

The proposed Ho'opili project would result in the irreversible and irretrievable commitment of certain natural and fiscal resources. Major resource commitments include the Petition Area and the money, construction materials, non-renewable resources, labor, and energy required for the project's completion.

The Petition Area was historically used for sugarcane cultivation; presently portions are under short-term agreements for diversified agriculture. The majority of the Petition Area is classified as Prime Agricultural Land by the ALISH system; however, a substantial commitment of water and land is required to realize the property's agronomic qualities. For instance, the price of water and land rent being enjoyed by the tenants on the Petition Area are well below market rates. In addition, there are agricultural lands that are more suitable for agricultural purposes (in relation to State and County plans to create a second city in 'Ewa) can be found elsewhere on O'ahu and throughout the State of Hawai'i.

The proposed Ho'opili project will require a substantial monetary investment to install both off-site and on-site infrastructure (i.e., roads, drainage, water, and wastewater facilities). The development will increase the use of existing public infrastructure and services, but in return will also generate revenues to the State and County in the form of excise, income and property taxes as well as provide needed residential, employment, recreational, educational and retail opportunities.

Labor and materials, which are mostly non-renewable and irretrievable resources, will be required during construction. After construction, operation of the project will require the continued use of water and electricity. Nevertheless, the proposed development will significantly lessen the amount of water used that was previously needed to serve lands used for agricultural purposes. In addition, non-potable water (brackish and/or reclaimed water) will be used for irrigation purposes where allowed under DOH regulations. Sustainability guidelines are being considered for the Ho'opili project, and the Petitioner will try to incorporate various measures to reduce conventional electrical consumption, or to use renewable energy sources.

The proposed Ho'opili project will require an irreversible and irretrievable commitment of resources, but will provide significant socio-economic benefits to the City and County of Honolulu and the State of Hawai'i. Development of the Petition Area will provide residential and employment. The proposed use of the Petition Area is consistent with the *Ewa Development Plan* and will enhance the growth of the Second City, enabling residents to live, work, learn, play, and shop without commuting to areas outside of the 'Ewa region for essential "goods and services."

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7.4 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS THAT CANNOT BE AVOIDED

The environmental impacts anticipated to result from development of the Ho'opili project are typical of any large-scale development and have been discussed throughout this EIS. Although uses of the Petition Area and adjacent properties, in the past and present, have significantly altered the natural landscape, under the current proposal (a mixed use community), the existing landscape will be transformed to urban development.

Construction-related Impacts. Potential environmental impacts (i.e., noise, soil erosion, fugitive dust and exhaust emissions, and temporary traffic disruption) will primarily occur during the construction period (to occur in various parts of the Petition Area through 2030). All construction activities will occur during daylight hours and will comply with DOH noise regulations to minimize increases in noise levels. During construction, the Petition Area may be subject to potential soil erosion and fugitive dust; as such, all construction activities will comply with State DOH regulations, and after construction, soil erosion will likely be reduced compared to current conditions (cultivation).

Infrastructure Impacts. Solid waste, wastewater and additional stormwater runoff will be generated on-site, and energy and water will be consumed for operation of the proposed Ho'opili project. Since many of the new residents of the Ho'opili project already reside on O'ahu, they are already generating solid waste, wastewater and stormwater runoff as well as consuming electricity and water. These impacts are typical of urban development and will be mitigated at Ho'opili through site design, the proper selection and installation of fixtures and appliances, and management practices. Major on-site and off-site infrastructure improvements proposed as part of the proposed project include the installation of new safe drinking and non-potable water systems (including storage and transmission), wastewater collection systems, major drainage improvements, on- and off-site transportation facility improvements (including roads and pedestrian/bicycle paths), electrical/communication infrastructure (including those that harness renewable sources), and designs and practices than facilitate recycling.

Visual Impacts. The appearance of and the views through the Petition Area will significantly change as agriculture-related structures and vegetation are replaced by urban structures and trees. However, the project site and area are relatively flat, providing no shoreline views. Views from future internal roadways will be given consideration to the extent possible, and extensive landscaping and appropriate architectural design will mitigate the visual appearance of the developed areas.

Faunal Impacts. The number of some introduced birds will likely increase, while the number of introduced birds that prefer open grasslands and agricultural fields will likely decrease. No native, threatened, or endangered species have been observed, and as such, none are expected to be impacted by the proposed project.

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Agricultural Impacts. Some of the public currently benefits from employment and income generated through short-term revocable agricultural leases on portions of the Petition Area. These cultivated lands will gradually be withdrawn from agricultural production for the development of the Ho'opili community; however, there is an ample supply of land suitable for diversified agriculture on O'ahu and the State of Hawai'i. The proposed project is located within the Urban Growth Boundary delineated in the *Ewa Development Plan* and planned for urban development, not agricultural production.

Traffic Impacts. The Petitioner acknowledges that the traveling time for residents in the 'Ewa (and Wai'anae and Central O'ahu) regions commuting to jobs and/or schools in the Primary Urban Center as one of the most serious issues facing O'ahu today. This has been recognized by various State and County agencies including the O'ahu Metropolitan Planning Organization (OMPO), the State Department of Transportation (DOT), the City and County of Honolulu Department of Transportation Services (DTS) and the City County of Honolulu Department of Planning and Permitting, Traffic Review Branch (DPP TRB), and is being addressed through the Statewide Transportation Improvement Program (STIP) process, State and County Capital Improvements Program (CIP), the Ewa Impact Fee, private developers and the City's Honolulu High-Capacity Transit Corridor (HHCTC) project.

The proposed Ho'opili project involves development of a mixed-use community on approximately 1,555 acres in 'Ewa. The Conceptual Land Use Plan reflects the desire for a community that is "complete" with: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents. Implementation of the Plan will allow residents the ability to live, work, learn, play, and shop within Ho'opili without needing to use personal motorized vehicles on regional roadways.

Ho'opili will be connected to the surrounding 'Ewa District (and neighboring Department of Hawaiian Home Lands (DHHL), the University of Hawai'i at West O'ahu (UHWO) and the Hawaii Community Development Authority (HCDA) properties by an internal network of closely-spaced gridded streets and bicycle paths which allow a variety of circulation options for residents and visitors. Wider tree-lined boulevards will create a distinct axis running north-south and diagonally east-west across the site, but unlike a conventional subdivision of cul-de-sacs, there will many more streets, sized at a walking scale. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher

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intensity development (and density) will be concentrated around the transit station(s). Also possible is a transit maintenance and storage facility.

There are several major transportation projects that have been long-planned for East Kapolei. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road/H-1 Freeway interchange; a portion of the North-South Road/Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the segment of the proposed Honolulu High-Capacity Transit Corridor (HHCTC) project through the Petition Area.

The proposed project has been designed to reduce future residents' reliance on private motorized vehicles through the following measures:

- Ho'opili is the first new project designed to ~~embrace~~ support high-capacity transit (elevated, fixed-guideway) corridor and station(s) (and a possible transit maintenance and storage facility);
- the Petition Area is large enough to be designed and offer a full range of mixed land uses, including a wide range of places of live, work, shop, recreate and learn and will aspire to achieve a job-housing balance;
- Ho'opili is designed to maximize connectivity (transit, pedestrian, bicycle and vehicular) with surrounding streets and communities (including DHHL and UHWO), while minimizing cul-de-sacs and dead-end streets;
- Ho'opili will be designed to take advantage of the relatively flatness of the site and proximity to UHWO by designing streets and grade-separated multi-modal pathways for walking and bicycling; and
- the Petitioner will seek to implement other transportation management and transportation demand management (TDM) strategies (such as requesting that the State/County consider extending or instituting contra-flow of major transportation corridors during a.m. and p.m. peak travel times).

The most important TDM strategy is that Ho'opili is designed to ~~embrace~~ support both rail and bus transit and the project is proposed to have mixed uses over most of the entire Petition Area.

7.5 RATIONALE FOR PROCEEDING WITH THE PROJECT NOTWITHSTANDING UNAVOIDABLE EFFECTS

As noted in Sections 2.1.6 and 5.3.2 of this EIS, the proposed Ho'opili project complies with the *Ewa Development Plan* and is the rationale for proceeding notwithstanding any unavoidable negative effects.

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7.6 UNRESOLVED ISSUES

Unresolved issues are regularly associated with projects in the planning and preliminary design phases. This chapter, in compliance with Section 11-200-17(n), HAR, describes the unresolved issues associated with development of the proposed project. Discussion of how such issues will be resolved and what overriding reasons exist for proceeding with the project are listed below.

Honolulu High-Capacity Transit Corridor (HHCTC) Alignment Through Ho'opili. As of this writing, the high-capacity transit corridor alignment through Ho'opili has not been finalized. As previously noted, Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will probably be concentrated around the transit station(s). Also unresolved at this time is the location of a possible transit maintenance and storage facility.

State of Hawaii Department of Education (State DOE) School Fair Share Requirements. The Petitioner is currently coordinating with the State DOE regarding the number of schools that will be required for the development of the Ho'opili project. This will be identified as an unresolved issue until the number of schools required is finalized during the EIS process.

Drainage. The Petition Area falls within three different drainage basins. For the portion of the Petition Area within the West Loch drainage basin, it is planned to collect all storm water and route it to an existing detention basin located on the east side of Fort Weaver Road and south of the OR&L railroad tracks. The basin would be expanded to ensure that the water quality storage component of the City and County of Honolulu Standards was achieved. An overflow from the detention basin would discharge to the West Loch of Pearl Harbor. The overflow from the proposed makai detention basin would have to cross Navy property. Permission of the Navy would be required. The concept of the overflow across Navy property is not new and was approved in concept back in the early- to mid-1990's. However, as of this date, the Navy has rejected any considerations to allow increased runoff to cross Navy land. Permission from the Navy needs to be resolved for the overflow option to move forward, otherwise the detention basin will need to be expanded to retain the runoff.

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8.0
Consultation

8.0 CONSULTATION

The EIS process and planning of Ho'opili involved communicating with Federal, State, and County agencies, and individuals, private companies, and community organizations, including those listed below.

Federal:

- Army Corps of Engineers
- Navy

State of Hawai'i:

- Governor
- Department of Education
- Department of Hawaiian Home Lands
- Department of Health
- Department of Land and Natural Resource
- Department of Transportation
- Hawaii Community Development Authority
- Land Use Commission
- Office of Planning
- University of Hawai'i – West O'ahu

City and County of Honolulu:

- Mayor
- Board of Water Supply
- Department of Emergency Services
- Department of Environmental Services, Wastewater Management Division
- Department of Planning and Permitting
- Department of Transportation Services

Other Agencies and Individuals:

- Maureen Andrade, Village Park Community Association
- Todd Apo, City Councilmember
- Gary Bautista, 'Ewa Neighborhood Board
- Dick Beamer, Retired Army/Honorary Mayor of 'Ewa Beach
- Scott Belford, HOSEFF Non-Profit
- Darrlyn Bunda, Committee for Balanced Transportation
- Rida Cabanilla, State Representative
- John Condello, Hawai'i Theological Institute
- Charles Djou, City Councilmember
- BJ Dorman, Salvation Army Hawai'i
- Everett Dowling, The Dowling Company

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- Will Espero, State Senator
- Kurt Fevella, 'Ewa Neighborhood Board
- John Field, Punahou School
- Mike Fitzgerald, Enterprise Honolulu
- Pearlyn Fukuba, HCDA/Kalaeloa
- Mike Gabbard, State Senator
- Nestor Garcia, City Councilmember
- Frank Genadio, Makakilo Resident, Committee for Balanced Transportation
- Kevin Gilbert, Hawai'i Theological Institute
- Carolyn Golojuch, Makakilo Resident
- Michael Golojuch, Palehua Community Association
- Scotty Gomes, Fellowship of Catholic Men
- Donna Goth, Aina Nui Corporation
- Sharon Har, State Representative
- Teri Ikehara, West Loch Estates President
- Dr. Val Iwashita, 'Iolani School
- Larry G. Jefts, Sugarland Farms
- Brian Kanno, Former State Legislator
- Guy Kidder, Fellowship of Catholic Men
- Walter Kirimitsu, Saint Louis School
- Coby Lynn, 'Ewa Beach Lion Club
- Eileen Lynn, 'Ewa Beach Resident
- Tesha Malama, 'Ewa Beach Resident
- Stephen Meder, UH Center for Smart Building and Community Design
- Dr. Mark Mitchell, Kahi Mohala
- Scott Mitchell, Fellowship of Catholic Men
- Mark Moses, Former State Legislator
- Richard Oshiro, Waipahu Neighborhood Board
- Kimberly Pine, State Representative
- Rodolfo Ramos, 'Ewa Task Force
- Peter Rappa, UH Sea Grant Extension Service
- Frances Rivero, 'Ewa Beach Boys and Girls Club
- Ross Rolirad, Rotary Club
- Lou Salza, ASSETS School
- Dr. James Scott, Punahou School
- Alec Sou, Aloun Farm, Inc.
- Chuck Sted, Hawaii Pacific Health
- Georgette Stevens, West O'ahu Economic Development Association
- Summer Thomson, 'Ewa Beach Boys and Girls Club
- Keith Timson, Makakilo Resident
- Maeda Timson, Kapolei Neighborhood Board
- David Arakawa, Land Use Research Foundation
- Karen Wenke, 'Ewa Resident, 'Ewa Lions, Small Business Person
- Chuck Wheatley, Guardian Angels/Waipahu

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- Daniel White, Island Pacific Academy
- Lance Widner, Royal Kunia Community Association
- Stephanie Widner, Royal Kunia Resident
- George Yakowenko, Waipahu Neighborhood Board
- Annette Yamaguchi, Waipahu Business Association
- Linda Young, Kapolei Neighborhood Board, Malanai Iki Association

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9.0
List of Preparers

9.0 LIST OF PREPARERS

This EIS was prepared by PBR HAWAII, 1001 Bishop Street, ASB Tower, Suite 650, Honolulu, Hawai'i 96813. Key technical consultants involved in the preparation of this project and their company affiliations and specialties are listed below:

Firm	Area of Expertise
Decision Analysts Hawaii, Inc.	Agricultural Impact Analysis
B.D. Neal & Associates	Air Quality Study
Cultural Surveys Hawai'i Inc.	Archaeological Inventory Survey
Cultural Surveys Hawai'i Inc.	Cultural Impact Assessment
Rana Productions, Ltd.	Faunal Survey
LeGrande Biological Surveys Inc.	Flora Survey
Mikiko Corporation	Fiscal Impact Study
Mikiko Corporation	Market Study
D.L. Adams Associates, Ltd.	Acoustical Study
Tom Nance Water Resource	Conceptual Water Master Plan Engineering
Bills Engineering Inc.	Preliminary Wastewater Collection System Master Plan
Bills Engineering Inc.	Drainage Master Plan
MK Engineers, Ltd.	Preliminary Electrical and Communications Master Plan
Belt Collins Hawaii Ltd.	Social Impact Assessment
Wilbur Smith Associates	Traffic Impact Analysis Report
Bryant Brothers	Traffic Impact Analysis Report
Pacific Analytics, L.L.C.	Arthropod Survey and Assessment

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10.0
Glossary

10.0 GLOSSARY

The following is a list of terms, abbreviations, and acronyms used in the EIS.

A

AAQS	Ambient Air Quality Standards
ADA	Americans with Disabilities Act
ALISH	Agricultural Lands of Importance to the State of Hawaii

B

BOE	State of Hawai'i Board of Education
BWS	City and County of Honolulu Board of Water Supply

C

CFS	Cubic Feet per Second
CIP	Capital Improvement Project
City	City and County of Honolulu
CSH	Cultural Surveys Hawaii, Inc.
CZM	State of Hawai'i Coastal Zone Management Program

D

dBA	A-weighted decibel
DBED&T	State of Hawai'i Department of Business, Economic Development & Tourism
DDC	City and County of Honolulu Department of Design and Construction
DES	City and County of Honolulu Department of Environmental Services
DHHL	State of Hawai'i Department of Hawaiian Home Lands
DOE	State of Hawai'i Department of Education
DOH	State of Hawai'i Department of Health
DOT	State of Hawai'i Department of Transportation
DP	Development Plan
DPA	Development Plan Area
DPR	City and County of Honolulu Department of Parks and Recreation
DPP	City and County of Honolulu Department of Planning and Permitting
DPP TRB	City and County of Honolulu Department of Planning and Permitting, Traffic Review Branch
DTS	City and County of Honolulu Department of Transportation Services

E

EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
EMF	Electro Magnetic Fields
EMS	Emergency Medical Services
Ewa DP	Ewa Development Plan

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Ewa DPA	Ewa Development Plan Area
F	
F	Fahrenheit
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FTE	Full-Time Equivalent
G	
GM	Gallons per Minute
H	
HAR	Hawaii Administrative Rules
HCDCH	State of Hawai'i Housing and Community Development Corporation of Hawaii
HCS	Highway Capacity Software
HECO	Hawaiian Electric Company, Inc.
HFD	City and County of Honolulu Fire Department
HHCTC	Honolulu High-Capacity Transit Corridor Project
HOV	High-Occupancy Vehicle
HPD	City and County of Honolulu Police Department
HRS	Hawaii Revised Statutes
H-1	H-1 Freeway
H-2	H-2 Freeway
J	
JDA	Joint Development Agreement
K	
KCDD	Kalaeloa Community Development District
kV	~~Kilo Volt~~ Kilovolt
L	
LCA	Land Court Award
Ldn	Day-night equivalent sound level measured in dBA
LOS	Level of Service
LOTMA	Leeward Oahu Transportation Management Association
LPA	Locally Preferred Alternative
LSB	Land Study Bureau
LUC	State of Hawai'i Land Use Commission
LUO	City and County of Honolulu Land Use Ordinance
M	
MG	Million Gallons
MGD	Million Gallons per Day
MOS	Minimum Operable Segment
MSL	Mean Sea Level
MSW	Municipal Solid Waste
MVA	Megavolt Amperes
MW	Gross Megawatts

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N

NAS	Naval Air Station
NPDES	National Pollutant Discharge Elimination System

O

OEQC	State of Hawai'i Office of Environmental Quality Control
OMPO	Oahu Metropolitan Planning Organization
OR&L	Oahu Railway & Land
ORTP	Oahu Regional Transportation Plan
OSCo	Oahu Sugar Company, Ltd.

P

PSI	Per Square Inch

R

ROW	Right-of-Way

S

SHPD	State of Hawai'i Department of Land and Natural Resources Historic Preservation Division
SMA	Special Management Area
SOBA	Southern O'ahu Basal Aquifer
State	State of Hawai'i
STIP	Statewide Transportation Improvement Program

T

TDM	Travel Demand Management
TIAR	Traffic Impact Analysis Report
TMK	Tax Map Key
TWSC	Two-Way Stop-Controlled

U

UHWO	University of Hawai'i – West O'ahu
UIC	Underground Injection Control
USDA	United States Department of Agriculture
USGBC	United States Green Building Council
UV	Ultraviolet Light

W

WIS	Wahiawā Irrigation System
WRF	Water Reclamation Facility
WSA	Wilbur Smith & Associates
WSFC	Wastewater System Facility Charge
WWTP	Wastewater Treatment Plant

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11.0
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12.0

Comments on the Environmental Impact Statement Preparation Notice & Responses

12.0 COMMENTS ON THE ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE AND RESPONSES

The Environmental Impact Statement Preparation Notice (EISPN) was published in the March 8, 2007 issue of the OEQC *The Environmental Notice* and was sent to the agencies, organizations, and individuals listed in the following table. The public comment period on the EISPN was from March 8, 2007 to April 9, 2007. Agencies, organizations, or individuals that submitted comments on the EISPN are listed in bold. Comment and response letters have been reproduced and follow Table 12.1 below.

Table 12.1. EISPN Comment Letters

	AGENCY	EISPN MAIL DATE	DATE OF COMMENTS
STATE			
1	Department of Agriculture	03-07-07	--
2	**Department of Accounting & General Services**	03-07-07	04-04-07
3	**Department of Business, Economic Development and Tourism**	03-07-07	04-09-07
4	Department of Business, Economic Development and Tourism – Energy, Resources & Technology Division	03-07-07	--
5	Department of Business, Economic Development and Tourism – Land Use Commission	03-07-07	--
6	Department of Business, Economic Development and Tourism – Office of Planning	03-07-07	--
7	Department of Defense	03-07-07	--
8	**Department of Education**	03-07-07	04-10-07
9	Department of Hawaiian Home Lands	03-07-07	--
10	**Department of Health – Environmental Planning Office**	03-07-07	04-03-07
11	**Department of Health – Office of Environmental Quality Control**	03-07-07	03-30-07
12	**Department of Land and Natural Resources**	03-07-07	04-09-07
13	**Department of Land and Natural Resources – Historic Preservation Division**	03-07-07	03-27-07
14	**Department of Transportation**	03-07-07	04-09-07
15	Hawaii Community Development Authority	03-07-07	--
16	**Office of Hawaiian Affairs**	03-07-07	06-20-07
17	**State Legislature – Representative Sharon Har**	03-07-07	04-10-07
18	State Legislature – Representative Alex Sonson	03-07-07	--
19	State Legislature – Senator Mike Gabbard	03-07-07	--
20	State Legislature – Senator Clarence Nishihara	03-07-07	--
21	University of Hawai'i – Environmental Center	03-07-07	--

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	AGENCY	EISPN MAIL DATE	DATE OF COMMENTS
22	University of Hawai'i – Center for Smart Building and Community Design	03-07-07	--
23	University of Hawai'i – Sea Grant	03-07-07	--
24	University of Hawai'i – West O'ahu	03-07-07	--
25	Hawai'i State Library	03-07-07	--
26	'Ewa Beach Public and School Library	03-07-07	--
27	Kapolei Public Library	03-07-07	--
28	Waipahu Public Library	03-07-07	--
29	Kaimukī Regional Library	03-07-07	--
30	Kāne'ohe Regional Library	03-07-07	--
31	Pearl City Regional Library	03-07-07	--
32	University of Hawai'i – Hamilton Library	03-07-07	--
33	Department of Business, Economic Development and Tourism Library	03-07-07	--
34	Legislative Reference Bureau	03-07-07	--
35	City and County of Honolulu Department of Customer Services Library (formerly the Municipal Reference and Records Center)	03-07-07	--
FEDERAL			
36	**Department of the Army – Army Engineer District**	03-07-07	05-07-07
37	Department of the Interior – Fish and Wildlife Service	03-07-07	--
38	Department of the Navy	03-07-07	--
CITY AND COUNTY OF HONOLULU			
39	**Board of Water Supply**	03-07-07	03-27-07
40	City Council – Councilmember Todd Apo	03-07-07	--
41	**Department of Community Services**	03-07-07	03-20-07
42	**Department of Design and Construction**	03-07-07	04-03-07
43	Department of Environmental Services	03-07-07	--
44	**Department of Facility Maintenance**	03-07-07	04-13-07
45	**Department of Parks and Recreation**	03-07-07	03-16-07
46	**Department of Planning and Permitting**	03-07-07	05-01-07
47	**Department of Transportation Services**	03-07-07	04-18-07
48	'Ewa Neighborhood Board, No. 23	03-07-07	--
49	**Fire Department**	03-07-07	03-28-07
50	Makakilo/Kapolei Neighborhood Board, No. 34	03-07-07	--
51	**Police Department**	03-07-07	03-27-07
52	Waipahu Neighborhood Board, No. 22	03-07-07	--
OTHER ORGANIZATIONS/INDIVIDUALS			
53	Aloun Farm, Inc.	03-07-07	--
54	**Committee for Balanced Transportation**	03-07-07	~~04/02/07~~ 03-31-07
55	Enterprise Honolulu	03-07-07	--

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	AGENCY	EISPN MAIL DATE	DATE OF COMMENTS
56	'Ewa Beach Boys and Girls Club	03-07-07	--
57	'Ewa Beach Lions Club	03-07-07	--
58	'Ewa Task Force	03-07-07	--
59	Guardian Angels	03-07-07	--
60	**HASEKO (Ewa), Inc.**	--	04-09-07
61	**Hawaiian Electric Company, Inc.**	03-07-07	10-05-07
62	**Hawaiian Telcom**	03-07-07	04-02-07
63	Malanai Iki Association	03-07-07	--
64	Mr. Frank Law	03-07-07	--
65	Palehua Community Association	03-07-07	--
66	Rotary Club	03-07-07	--
67	Royal Kunia Community Association	03-07-07	--
68	Salvation Army	03-07-07	--
69	Sugarland Farms	03-07-07	--
70	Village Park Community Association	03-07-07	--
71	West O'ahu Economic Development Association	03-07-07	--

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LINDA LINGLE
GOVERNOR

APR 05 2007

RUSS K. SAITO
COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810

(P)1073.7

APR - 4 2007

Mr. Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: EISPN to Reclassify Approximately 1,704.265 Acres from Agriculture to Urban, Hoopili, Oahu, TMK: 9-1-17:04 (portion), 59, and 72; 9-1-18:01 and 04; 9-1-10:02, 14 (portion), and 15 (portion) and 9-2-02:02, and 9-2-02:01 (portion), 04, 05, 06 and 07

Thank you for your letter dated March 7, 2007. This project does not directly affect the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you have any questions, please have your staff call Mr. Bruce Bennett of the Planning Branch at 586-0491.

Sincerely,

ERNEST Y. W. LAU
Public Works Administrator

BB:mo
c: Ms. Genevieve Salmonson, DOH-OEQC
Mr. Anthony Ching, DBEDT-Land Use Commission

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
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THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
Executive Vice-President

VINCENT SHIGEKUNI
Vice-President

GRANT E. MURAKAMI, AICP
Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KISH MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

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E-mail: sysadmin@pbrhawaii.com

HILO OFFICE
101 Aupuni Street
Hilo Lagoon Centre, Suite 310
Hilo, Hawai'i 96720-3262
Tel: (808) 961-3333
Fax: (808) 961-3883

WAILUKU OFFICE
1787 Wili Pa Loop, Suite 4
Wailuku, Hawai'i 96793-1271
Tel: (808) 242-2678

Mr. Ernest Y. W. Lau, Public Works Administrator
State of Hawai'i
Department of Accounting and General Services
P.O. Box 119
Honolulu, Hawai'i 96810

Attn: Bruce Bennett

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Lau:

Thank you for your letter dated April 4, 2007 (your reference number (P) 1073.7). We acknowledge your assessment that this project does not directly affect the Department of Accounting and General Services' projects or existing facilities, and therefore, the department has no comments to offer at this time.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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LINDA LINGLE
GOVERNOR
THEODORE E. LIU
DIRECTOR
MARK K. ANDERSON
DEPUTY DIRECTOR

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

STRATEGIC INDUSTRIES DIVISION
235 South Beretania Street, Leiopapa A Kamehameha Bldg., 5th Floor, Honolulu, Hawaii 96813
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

Telephone: (808) 587-3807
Fax: (808) 586-2536
Web site: www.hawaii.gov/dbedt

April 9, 2007

PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Attn: Vincent Shigekuni

Re: Environmental Impact Statement Preparation Notice (EISPN)
Ho'opili, Ewa, Oahu
Tax Map Key: 9-1-17:04 (portion, 59, and 72; 9-1-18:01 and 04; 9-1-10: 02, 14 (portion), and 15 (portion) and 9-2-02:02, and 9-2-02:01 (portion), 04, 05, 06 and 07

In response to your March 7, 2007, notice, thank you for the opportunity to provide comments on the EISPN for the Ho'opili development. The proposed project would have an area of 1,704 acres including a mixed-use, transit-ready community including: low-medium density residential/live-work, mixed-use medium density residential, mixed-use/high density residential, light industrial mixed-use/business, schools, parks, open space and roads.

We would like to call your attention to: (1) State energy conservation goals; and, (2) energy and resource efficiency and renewable energy and resource development.

1. State energy conservation goals. Project buildings, activities, and site grounds should be designed and/or retrofit with energy saving considerations. The mandate for such consideration is found in Chapter 344, HRS ("State Environmental Policy") and Chapter 226 ("Hawaii State Planning Act"). In particular, we would like to call to your attention HRS 226 18(c) (4) which includes a State objective of promoting all cost-effective energy conservation through adoption of energy-efficient practices and technologies.

   We recommend that you consult the City and County of Honolulu Energy Code early in your project. Hawaiian Electric Company, Inc. may also have suggestions and demand-side management programs that offer rebates for installation of energy efficient technologies.

2. Energy and resource efficiency and renewable energy and resource development. We do not note any proposed covenants to enhance the sustainability of the development, including green architecture, solar water heating and photovoltaic energy for appliances, shading of exterior lighting, and water conservation measures.

   We encourage the parties to this development to make a further commitment to energy and resource efficiency and include a requirement in the Conditions, Covenants, and Restrictions for a development that meets the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) Certification. Zero-Net Energy Green Homes should be considered.

Our website (http://www.hawaii.gov/dbedt/info/energy/efficiency/) provides detailed information on guidelines, directives and statutes, as well as studies and reports on aspects of energy efficiency. Please also do not hesitate to contact Carilyn Shon, Energy Efficiency Branch Manager, at telephone number 587-3810, for additional information on LEED, energy efficiency, and renewable energy resources.

Sincerely,

Maurice H. Kaya
Chief Technology Officer

c: OEQC
State Land Use Commission

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PBR HAWAII
& ASSOCIATES, INC.

February 9, 2008

W. FRANK BRANDT, FASLA
Chairman

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President

R. STAN DUNCAN, ASLA
Executive Vice President

RUSSELL Y. J. CHUNG, FASLA
Executive Vice President

VINCENT SHIGEKUNI
Vice President

GRANT T. MURAKAMI, AICP
Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
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KIMI MIKAMI SUEN, LEED® AP
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Fax: (808) 961-3089

WAILUKU OFFICE
1787 Wili Pa Loop, Suite 4
Wailuku, Hawaii 96793-2271
Tel: (808) 242-3678

Mr. Maurice H. Kaya, Chief Technology Officer
State of Hawai'i
Department of Business, Economic Development & Tourism
Strategic Industries Division
P.O. Box 2359
Honolulu, Hawai'i 96804

Attn: Ms. Carilyn Shon

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Kaya:

Thank you for your letter dated April 9, 2007. We offer the following responses to your comments:

1. The project will address the applicable provisions of Chapter 344, Hawaii Revised Statutes (HRS) ("State Environmental Policy") and Chapter 226, HRS ("Hawaii State Planning Act"). Where feasible, project buildings, activities, and site grounds will be designed with energy-saving considerations. Given the natural climate, the project will be suited for the use of renewable energy technologies including photovoltaics. In addition, based on DBEDT's recommendations, Ho'opili's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECo) on demand-side management programs that offer rebates for installation of energy-efficient technologies.

2. Please note that sustainability guidelines are being considered for the Ho'opili project. The developer has submitted an application for a Leadership in Energy and Environmental Design (LEED) Neighborhood Design (ND) designation by the U.S. Green Building Council (USGBC) and was placed on the list of LEED ND pilot projects. According to the USGBC website, "The LEED for Neighborhood Design Rating System integrates the principles of smart growth, urbanism, and green building into the first national standard for neighborhood design. LEED certification provides independent, third-party verification that a development's location and design meet accepted high standards for environmentally responsible, sustainable, development. LEED for Neighborhood Design is a collaboration between the U.S. Green Building Council, the Congress for the New Urbanism, and the Natural Resources Defense Council."

Thank you very much for calling our attention to your website which provides detailed information on guidelines, directives, and statutes, as well as studies and reports on aspects of energy efficiency (http://www.hawaii.gov/dbedt/info/energy/efficiency/state).

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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LINDA LINGLE
GOVERNOR

PATRICIA HAMAMOTO
SUPERINTENDENT

STATE OF HAWAI'I
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAII 96804

OFFICE OF THE SUPERINTENDENT

April 10, 2007

Mr. Vincent Shigekuni
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice for Ho'opili, East Kapolei, Ewa District

The Department of Education (DOE) has reviewed the Environmental Impact Statement Preparation Notice (EISPN) for the proposed Ho'opili project in East Kapolei. DOE has met on several occasions with the developer of the project and has had lengthy discussions on the school impacts of almost 12,000 additional residential units. The DOE concurs with the EISPN statement that the total number of public schools that need to be built within the project is not established, pending more definitive data about the proposed housing, but that a minimum of five schools will be required. We expect to continue to meet in the future as more information on the residential units becomes available.

The DOE is concerned with the school enrollment numbers in section 4.9.1 School. The table on page 47 and 48 does not include the middle school and high school serving the Campbell High School complex area. Also, the enrollment figures are not the official figures used by the Facilities Development Branch. In addition, since enrollment projections are updated every year, for every school, it is important to identify the year in which the projections were made. Please contact the Facilities Development Branch to update the enrollment figures for the Draft Environmental Impact Statement.

The DOE has no other comments at this time. We appreciate the opportunity to comment on the EISPN. If you have any questions, please call Heidi Meeker of the Facilities Development Branch at 733-4862.

Very truly yours,

Patricia Hamamoto
Superintendent

PH:jmb

c: Randolph Moore, Acting Assistant Superintendent, OBS
Duane Kashiwai, Public Works Administrator, FDB
Mamo Carreira, CAS, Campbell/Kapolei/Waianae Complex Areas
Genevieve Salmonson, OEQC
Anthony Ching, SLUC

AN AFFIRMATIVE ACTION AND EQUAL OPPORTUNITY EMPLOYER

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

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Chairman

THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
Executive Vice-President

VINCENT SHIGEKUNI
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RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
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KIMI MIKAMI YUEN, LEED® AP
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Fax: (808) 523-1402
E-mail: sys@pbrhawaii.com

HILO OFFICE
101 Aupuni Street
Hilo Lagoon Center, Suite 310
Hilo, Hawai'i 96720-3262
Tel: (808) 961-3333
Fax: (808) 961-1583

WAILUKU OFFICE
1787 Wili Pa Loop, Suite 4
Wailuku, Hawai'i 96793-1273
Tel: (808) 242-2878

Ms. Patricia Hamamoto, Superintendent
State of Hawai'i
Department of Education
P.O. Box 2360
Honolulu, Hawai'i 96804

Attn: Ms. Heidi Meeker

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Ms. Hamamoto:

Thank you for your letter dated April 10, 2007 (your reference number: PH:jmb). We offer the following responses to your comments:

1. We acknowledge your assessment that the EISPN statement that the total number of public schools that need to be built within the project is not established, pending more definitive data about the proposed housing, but that a minimum of five schools will be required.

2. We acknowledge your concern with the school enrollment numbers in the EISPN. As such, the Facilities Development Branch will be contacted to update the enrollment figures in the Draft Environmental Impact Statement (EIS).

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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PLANNING • LANDSCAPE ARCHITECTURE • ENVIRONMENTAL STUDIES • ENTITLEMENTS • PERMITTING • GRAPHIC DESIGN

AR00027346

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EPO-07-060

April 3, 2007

Mr. Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

SUBJECT: Environmental Impact Statement (EIS) Preparation Notice for Hoopili Project, Ewa, Oahu, Hawaii
TMK: (1) 9-1-017: 004 (portion), 059 and 072
(1) 9-1-018: 001 and 004
(1) 9-1-010: 002, 014 (portion) and 015 (portion)
(1) 9-2-002: 001 (portion), 002, 004, 005, 006 and 007

Thank you for allowing us to review and comment on the subject documents. The documents were routed to the various branches of the Department of Health (DOH) Environmental Health Administration. We have the following Clean Water Branch, Hazard Evaluation & Emergency Response Office and General comments.

Clean Water Branch (CWB)

The CWB has reviewed the limited information contained in the subject document and offers the following comments:

1. The Army Corps of Engineers should be contacted at (808) 438-9258 for this project. Pursuant to Federal Water Pollution Control Act (commonly known as the "Clean Water Act" (CWA) Paragraph 401(a)(1), a Section 401 Water Quality Certification (WQC) is required for "[a]ny applicant for Federal license or permit to conduct any activity including, but not limited to, the construction or operation of facilities, which may **result** in any discharge into the navigable waters..." (emphasis added). The term "discharge" is defined in CWA, Subsections 502(16), 502(12), and 502(6); Title 40, Code of Federal Regulations (CFR), Section 122.2; and Hawaii Administrative Rules (HAR), Chapter 11-54.

2. In accordance with HAR, Sections 11-55-04 and 11-55-34.05, the Director of Health may require the submittal a Notice of Intent (NOI) for general permit coverage authorized under the National Pollutant Discharge Elimination System (NPDES). An NOI to be covered by an

NPDES general permit is to be submitted at least 30 days before the commencement of the respective activity. A separate NOI is needed for coverage under each NPDES general permit. The NOI forms may be picked up at our office or downloaded from our website at: http://www.hawaii.gov/health/environmental/water/cleanwater/forms/forms/genl-index.html

a. Storm water associated with industrial activities, as defined in Title 40, CFR, Sections 122.26(b)(14)(i) through 122.26(b)(14)(ix) and 122.26(b)(14)(xi). [HAR, Chapter 11-55, Appendix B]

b. Storm water associated with construction activities, including clearing, grading, and excavation, that result in the disturbance of equal to or greater than one (1) acre of total land area. The total land area includes a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under a larger common plan of development or sale. **An NPDES permit is required before the commencement of the construction activities.** [HAR, Chapter 11-55, Appendix C]

c. Discharges of treated effluent from leaking underground tank remedial activities. [HAR, Chapter 11-55, Appendix D]

d. Discharges of once through cooling water less than one (1) million gallons per day. [HAR, Chapter 11-55, Appendix E]

e. Discharges of hydrotesting water. [HAR, Chapter 11-55, Appendix F]

f. Discharges of construction dewatering effluent. [HAR, Chapter 11-55, Appendix G]

g. Discharges of treated effluent from recycled water distribution systems. [HAR, Chapter 11-55, Appendix J]

h. Discharges of storm water from a small municipal separate storm sewer system. [HAR, Chapter 11-55, Appendix K]

3. In accordance with HAR, Section 11-55-38, the applicant for an NPDES permit is required to either submit a copy of the new NOI or NPDES permit application to the State Department of Land and Natural Resources, State Historic Preservation Division (SHPD), or demonstrate to the satisfaction of the DOH that the project, activity, or site covered by the NOI or application has been or is being reviewed by SHPD. If applicable, please submit a copy of the request for review by SHPD or SHPD's determination letter for the project.

4. Any discharges related to project construction or operation activities, with or without a Section 401 WQC or NPDES permit coverage, shall comply with the applicable State Water

AR00027347

Quality Standards as specified in HAR, Chapter 11-54.

The Hawaii Revised Statutes, Subsection 342D-50(a), requires that "[n]o person, including any public body, shall discharge any water pollutants into state waters, or cause or allow any water pollutant to enter state waters except in compliance with this chapter, rules adopted pursuant to this Chapter, or a permit or variance issued by the director."

If you have any questions, please contact the Engineering Section, CWB, at 586-4309.

Hazard Evaluation & Emergency Response Office (HEER)

As a common practice, lands formerly used for sugarcane production are now being developed into communities where residential home, schools and commercial businesses are being constructed. Chemicals associated with the sugarcane industry persist in soils today and may be a threat to public health and the environment. Elevated arsenic levels were discovered in soil at formerly sugarcane production areas on the islands. The HEER Office has identified former sugarcane production areas for assessment throughout the state and plans to work with property owners to conduct environmental assessment to identify and address elevated soil arsenic levels prior to finalizing development plans for the properties

The parcels listed in the EIS Preparation Notice for the Hoopili Project were used for sugarcane production and should be assessed for chemicals associated with the sugarcane industry. Environmental assessments conducted on adjacent parcels have identified chemicals of concern. The developers of the Hoopili Project and the DOH have met to discuss addressing potential risks at the site through environmental assessments. Section 1.9 of the EIS Preparation Notice should include an investigation of hazardous substances. If contaminants are found at elevated levels, then additional assessment is needed to determine potential risks and the need for remedial action. Removal or remedial plans must comply with Chapter 128D, Environmental Response Law, HRS, and Title 11, Chapter 451, HAR, State Contingency Plan.

If you have any questions, please contact HEER Office at 586-4250.

General

We strongly recommend that you review all of the Standard Comments on our website: www.state.hi.us/health/environmental/env-planning/landuse/landuse.html. Any comments specifically applicable to this project should be adhered to.

If there are any questions about these comments please contact Jiacai Liu with the Environmental Planning Office at 586-4346.

Sincerely,

KELVIN H. SUNADA, MANAGER
Environmental Planning Office

c: EPO
CWB
HEER
Anthony Ching, State Land Use Commission

AR00027348

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& ASSOCIATES, INC.

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Executive Vice President

VINCENT SHIGEKUNI
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Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI MIKAMI YUEN, LEED® AP
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SCOTT ALIKA ARIOGO
Associate

SCOTT MURAKAMI, ASLA
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WAILUKU OFFICE
1787 Wili Pa Loop, Suite 9
Wailuku, Hawai'i 96793-1871
Tel: (808) 242-2878

February 9, 2008

Mr. Kelvin H. Sunada, Manager
Environmental Planning Office
State of Hawai'i
Department of Health
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

Attn: Mr. Jiacai Liu

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Sunada:

Thank you for your letter dated April 3, 2007 (your reference number: EPO-07-060). We offer the following responses to your comments:

Clean Water Branch (CWB)

1. The Army Corps of Engineers was provided a copy of the EISPN but was unable to determine whether a Federal permit (including a Department of Army permit) is required for this project. An application for jurisdictional determination will be submitted to the Army Corps of Engineers.

2. As stated in the EISPN, a National Pollutant Discharge Elimination System (NPDES) Permit(s) will be required for the project.

Hazard Evaluation & Emergency Response Office (HEER)

As you may be aware, the developer has been coordinating with the Department of Health (DOH) to address potential risks at the project site. As we understand it, since May of 2007, HEER's interest is now in the presence (or absence) of dioxin, and may be concerned with arsenic if site conditions warrant.

General

4. As recommended, the Standard Comments on the Department of Health website (http://www.state.hi.us/health/environmental/env-planning/landuse/landuse.html) have been reviewed and will be adhered to as applicable.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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AR00027349

LINDA LINGLE
GOVERNOR OF HAWAI'I

GENEVIEVE SALMONSON
DIRECTOR

STATE OF HAWAI'I
DEPARTMENT OF HEALTH
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
235 SOUTH BERETANIA STREET
LEIOPAPA A KAMEHAMEHA, SUITE 702
HONOLULU, HAWAI'I 96813
Telephone (808) 586-4185
Facsimile (808) 586-4186
Electronic Mail: OEQC@doh.hawaii.gov

March 30, 2007

Mr. Robert Bruhl
D. R. Horton – Schuler Division
828 Fort Street Mall, 4th Floor
Honolulu, Hawai'i 96813

Mr. Vincent Shigekuni
PBR Hawai'i
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawai'i 96813

Mr. Anthony Ching
State Land Use Commission
P.O. Box 2359
Honolulu, Hawai'i 96804

Dear Messrs. Bruhl, Shigekuni and Ching:

The Office of Environmental Quality Control has reviewed the final environmental assessment for the Hoopili Project, Tax Map Key 9-1-17:04 (portion; 59, and 72; 9-1-18:01 and 04; 9-1-10: 02, 14 (portion), and 15 (portion) and 9-2-02:02, and 9-2-02:01 (portion), 04, 05, 06, and 07, in the judicial district of 'Ewa. The Office of Environmental Quality Control offers the following comments for your consideration and response.

1. ***Surface Water Quality Hydrologically Downgradient of the Project Site:*** The final environmental assessment discusses groundwater resources and hydrology in Section 3.5, but needs to discuss the quality of surface waters downgradient from the project and what kinds of direct, indirect or cumulative impacts the project will have on surface water quality. Please discuss this in the draft environmental impact statement.
2. ***Biological Survey:*** In an environmental impact statement in Ewa for former sugar cane lands, several colonies of endangered plants were found. Please include in the draft environmental impact statement a biological survey of the project site.
3. ***Native and Indigenous Vegetation for Post Construction Landscaping:*** Please consider planting the graded and disturbed areas of the project site with native and indigenous vegetation after construction has been completed. Please see http://www.state.hi.us/health/oeqc/guidance/sustainable.htm.

Thank you for the opportunity to comment. If there are any questions, please call Mr. Leslie Segundo, Environmental Health Specialist, at (808) 586-4185.

Sincerely,

Genevieve Salmonson

GENEVIEVE SALMONSON
Director of Environmental Quality Control

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THOMAS S. WITTEN, ASLA
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WAILUKU OFFICE
1787 Wili Pa Loop, Suite 4
Wailuku, Hawai'i 96793-1271
Tel: (808) 242-2678

February 8, 2008

Ms. Katherine P. Kealoha, Director
State of Hawai'i
Department of Health
Office of Environmental Quality Control
235 South Beretania Street
Leiopapa A Kamehameha, Suite 702
Honolulu, Hawai'i 96813

Attn: Mr. Leslie Segundo

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Ms. Kealoha:

Thank you for the letter dated March 30, 2007. We offer the following responses to your comments:

1. Please note that a discussion of the quality of surface waters downgradient from the project and what kinds of direct, indirect, or cumulative impacts the project will have on surface water quality will be included in the Draft Environmental Impact Statement (EIS).

2. As requested, a biological survey of the project site will be included and summarized in the Draft EIS.

3. Thank you for calling our attention to your website which establishes guidelines for sustainable building design in Hawai'i (http://www.state.hi.us/health/oeqc/guidance/sustainable.htm). Native and indigenous vegetation will be considered in the selection of plan materials.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

AR00027350

Ms. Katherine P. Keatoha
SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)
February 8, 2008
Page 2

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

ec: Office of Environmental Quality Control

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LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
Chairperson
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
First Deputy

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
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HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

April 9, 2007

PBR Hawaii
ASB Tower Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813
Attention: Vincent Shigekuni

Office of Environmental Quality Control
235 South Beretania Street Suite 702
Honolulu, Hawaii 96813

Gentlemen:

Subject: Ho'opili Environmental Impact Statement Preparation Notice, Kapolei, Oahu, Tax Map Key: (1) 9-1-17:59, 72; 9-1-18:1, 4; 9-1-10:2, 14, 15; 9-2-2:2, 9-2-2:1,4 to 7

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comment.

Other than the comments from Division of Water Resource Management, Land Division – Oahu District, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Should you have any questions, please feel free to call our office at 587-0433. Thank you.

Sincerely,

Russell Y. Tsuji
Administrator

AR00027351

LINDA LINGLE
GOVERNOR OF HAWAII

RECEIVED
LAND DIVISION
2007 MAR 27 P 3:47
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

4-2-07
Ed.

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
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KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

March 8, 2007

RECEIVED
07 MAR 9 P3:47
COMMISSION ON WATER RESOURCE MANAGEMENT

MEMORANDUM

TO: DLNR Agencies:
__Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
__Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
FR: x Div. of Water Resource Management
__Office of Conservation & Coastal Lands
x Land Division – Oahu District/Keith/Gavin/Barbara Lee

TO:
FROM: Russell Y. Tsuji
SUBJECT: Ho'opili Environmental Impact Statement Preparation Notice
LOCATION: Kapolei, Oahu
APPLICANT: PBR Hawaii & Associates, Inc. on behalf of D.R. Horton – Schuler, LLC

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 5, 2007.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: Edwin T. Sebok
Date: 3/23/07

LINDA LINGLE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
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HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

March 8, 2007

MEMORANDUM

TO: DLNR Agencies:
__Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
__Engineering Division
__Div. of Forestry & Wildlife
__Div. of State Parks
x Div. of Water Resource Management
__Office of Conservation & Coastal Lands
x Land Division – Oahu District/Keith/Gavin/Barbara Lee

FROM: Russell Y. Tsuji
SUBJECT: Ho'opili Environmental Impact Statement Preparation Notice
LOCATION: Kapolei, Oahu
APPLICANT: PBR Hawaii & Associates, Inc. on behalf of D.R. Horton – Schuler, LLC

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 5, 2007.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
(X) We have no comments.
( ) Comments are attached.

Signed: Cecil Santos
Date: 3/13/07

AR00027352

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
Chairman

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Associate

KIMI MIKAMI YUEN, LEED AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Russell Y. Tsuji, Administrator
State of Hawai'i
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, Hawai'i 96809

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Tsuji:

Thank you for your letter dated April 9, 2007. We understand that the EISPN was distributed to the following divisions:

1. Division of Water Resource Management (no comments); and
2. Land Division – Oahu District/Keith/Gavin/Barbara Lee (no comments).

We acknowledge that the Department of Land and Natural Resources has no other comments to offer on the subject matter.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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LINDA LINGLE
GOVERNOR OF HAWAII

APR 05 2007

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

PETER T. YOUNG
CHAIRPERSON
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COMMISSION ON WATER RESOURCE MANAGEMENT

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FIRST DEPUTY

DEAN NAKANO
ACTING DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
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KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

March 27, 2007

Mr. Vincent Shigekuni
PBR Hawaii & Associates, Inc.
1001 Bishop Street
ASB Tower, Suite 650
Honolulu, HI 96813

LOG NO: 2007.0909
DOC NO: 0703amj09
Archaeology

Dear Mr. Shigekuni:

SUBJECT: Chapter 6E-8 Historic Preservation Review –
Environmental Impact Statement Notice of Intent (EISPN), Ho'opili Project
Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu
TMK: (1) 9-1-various plats & parcels, 9-2-various plats & parcels

Thank you for submitting the aforementioned document, which we received on March 8, 2007. The proposed undertaking consists of the reclassification of approximately 1554 acres of land from the Agricultural District to the Urban District.

As stated in your document, "[a] preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for their review and approval." We look forward to reviewing these documents, and recommend that you include all relevant historic-preservation documents, including all final reports and SHPD acceptance letters, in the draft EIS.

We look forward to reviewing the Draft EIS.

Please contact Mr. Adam Johnson (O'ahu Assistant Archaeologist) at (808) 692-8015 if you have any questions or concerns regarding this letter.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

amj:

cc: Office of Environmental Quality Control
Land Use Commission

AR00027353

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
Chairman

THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice President

RUSSELL Y.J. CHUNG, FASLA
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Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Ms. Melanie Chinen, Administrator
State of Hawai'i
Department of Land and Natural Resources
State Historic Preservation Division
601 Kamokila Boulevard, Room 555
Kapolei, Hawai'i 96707

Attn: Adam Johnson

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Ms. Chinen:

Thank you for your letter dated March 27, 2007 (your reference number LOG NO: 2007.0909; DOC NO: 0703amj09; archaeology). As stated in the EISPN, a preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for its review and approval. As recommended, the Draft EIS will include all relevant historic-preservation documents, including all final reports and SHPD acceptance letters.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

BARRY FUKUNAGA
INTERIM DIRECTOR

Deputy Directors
FRANCIS PAUL KEENO
BRENNON T. MORIOKA
BRIAN H. SEKIGUCHI

IN REPLY REFER TO:

STP 8.2450

April 9, 2007

Mr. Vincent Shigekuni
PBR Hawaii & Associates, Inc.
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Ho'opili
D. R. Horton – Schuler, LLC
EIS Preparation Notice for LUC Petition No. A06-771 Filing
TMK: 9-1-17: 04 (portion), 59, and 72; 9-1-18: 01 and 04;
9-1-10: 02, 14 (portion), and 15 (portion) and 9-2-02: 02, and
(portion), 04, 05, 06 and 07

Thank you for providing the notification on the subject proposed land development project. We have the following initial comments as an interested party:

1. The site of the project is not directly under aircraft flight paths for Kalaeloa Airport or Honolulu International Airport. However, the developer and prospective residents/occupants should be advised and made aware that single-event noise may occur from potential overflights of aircraft or under certain weather/atmospheric conditions, particularly from aircraft approaching or departing Kalaeloa Airport.

2. The development of the project will have a significant traffic impact on our highway facilities in the Kapolei-Ewa region. The developer should prepare and submit a traffic impact analysis report (TIAR). The TIAR should cover both project traffic impacts and the cumulative traffic impacts to the community and region, which the project will be contributing to, including the existing and future road network in the area. Accesses and connections to any State highway also need to be identified. The TIAR should provide recommended and required transportation mitigation measures and roadway improvements to address the impacts, including the developer's participation in and contribution to provide the mitigation measures and improvements. We will need to review and approve the TIAR.

AR00027354

3. We should be included in agency reviews and approvals of the drainage plans for the subject project.

4. Any construction work by or for the subject project that can affect a State highway and/or can occur within or adjoin a State highway right-of-way will need our prior review and approval.

We will defer any other additional comments on the subject project until we receive and have the opportunity to review more information on the project. We would appreciate receiving at least five (5) copies of any report or document on the project for review by our operating divisions.

We appreciate the opportunity to provide our comments.

Very truly yours,

BARRY FUKUNAGA
Interim Director of Transportation

c: Genevieve Salmonson, Office of Environmental Quality Control
Laura Thielen, Office of Planning, DBEDT
Anthony Ching, Land Use Commission

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

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Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. KISHIKAWA, ASLA
Associate

KIMI MIKASA YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Brennon Morioka, Interim Director
State of Hawai'i
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813-5097

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Morioka:

Thank you for the letter dated April 9, 2007 (your reference number: STP 8.2450). We offer the following responses to your comments:

1. We acknowledge that single-event noise may occur from potential overflights of aircraft or under certain weather/atmospheric conditions, particularly from aircraft approaching or departing Kalaeloa Airport.

2. As suggested a traffic impact analysis report will be prepared and submitted to the Department of Transportation (DOT) for review and approval. The traffic consultant has met and/or spoken with various DOT staff to confirm the intersections to be analyzed and the general methodology to be used in estimating trip generation.

3. As requested, the DOT will be included in agency reviews and approvals of the drainage plans for the subject project.

4. We acknowledge that any construction work by or for the subject project that can affect a State highway and/or can occur within or adjoin a State highway right-of-way will need prior DOT review and approval.

5. We acknowledge that the DOT will defer any other additional comments on the subject project until additional information regarding the project is provided.

6. Please be assured that your agency will receive at least five (5) copies of the Draft EIS and at least five (5) copies of any additional reports and/or documents as soon as they are available for review.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

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AR00027355

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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PHONE (808) 594-1888

FAX (808) 594-1865

STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD07/2945

June 20, 2007

Vincent Shigekuni
Consultant
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, HI 96813

RE: Request for comment on an Environmental Impact Statement Preparation Notice for the proposed Ho'opili project located in East Kapolei; TMKs: 9-1-017:004, 059 and 072; 9-1-018:001 and 004; 9-1-010:002, 014 and 015; 9-2-002:002; and 9-2-002:001, 004, 005, 006 and 007

Dear Vincent Shigekuni,

The Office of Hawaiian Affairs (OHA) is in receipt of your request for comments on the above-referenced proposal, which would allow for the reclassification of approximately 1,554 acres of land from the Agricultural District to the Urban District. We apologize for the delayed response and offer no comments at this time.

Thank you, however, for the opportunity to comment initially. OHA looks forward to the opportunity to review the forthcoming Draft Environmental Impact Statement in greater detail. If you have further questions or concerns, please contact Heidi Guth at (808) 594-1962 or e-mail her at heidig@oha.org.

Sincerely,

Clyde W. Nāmu'o
Administrator

AR00027356

C: Office of Environmental Quality Control
235 South Beretania Street
Suite 702
Honolulu, HI 96813

Anthony Ching
State of Hawai'i
Land Use Commission
P.O. Box 2359
Honolulu, HI 96804

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
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Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Clyde W. Nāmu'o, Administrator
State of Hawai'i
Office of Hawaiian Affairs
711 Kapi'olani Boulevard, Suite 500
Honolulu, Hawai'i 96813

Attn: Ms. Heidi Guth

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Nāmu'o:

Thank you for your letter dated June 20, 2007 (your reference number: HRD07/2945). We acknowledge that the Office of Hawaiian Affairs has no comments to offer at this time. Please be assured that a copy of the Draft EIS will be transmitted to your office.

Thank you again for your participation in the Environmental Impact Statement process for this project.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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AR00027357

HOUSE OF REPRESENTATIVES

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

April 10, 2007

Mr. Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Thank you for the opportunity to provide comments on DR Horton's Ho'opili project. This project plans to add a significant number of homes in a region that has seen a great population increase in a short amount of time. However, infrastructure has not kept up with development.

I support the Ho'opili project only insofar as it includes plans to adequately address the issue of infrastructure including, but not limited to, roads, schools, and the water and sewer system.

While the project is in its early stages, it is imperative that the infrastructure be built concurrently and not after the construction of the housing. This project will have a great effect on the district I represent and I look forward to being able to provide further comments as the project proceeds through the various stages of development.

Once again, thank you for the opportunity to provide comments on this matter. If you have any questions, please do not hesitate to contact me.

Aloha,

Sharon E. Har
State Representative
40th House District
Kapolei, Makakilo, Royal Kunia, Kalaeloa

SEH:km

cc: Office of Environmental Quality Control
State of Hawaii Land Use Commission

2007040207

Representative Sharon E. Har
State Capitol, Room 313 • Honolulu, Hawaii 96813
Phone: (808) 586-8500 • Fax: (808) 586-8504 • E-mail: rephar@capitol.hawaii.gov

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Tel: (808) 242-2878

February 9, 2008

Representative Sharon E. Har
State Capitol, Room 313
Honolulu, Hawai'i 96813

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Representative Har:

Thank you for your letter dated April 10, 2007 (your reference number: SEH:km). Thank you for your support of the Ho'opili project. We acknowledge that the project will add a significant number of homes in the 'Ewa region. Please be assured that the project will be built out over 20 years, and as such, infrastructure including, but not limited to, roads, schools, and the water and sewer system, can be planned and installed concurrently with the construction of housing.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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AR00027358

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF

May 7, 2007

Regulatory Branch

File No. POH-2006-233-2

Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

This is in response to your letter dated March 7, 2007 for comments for an environmental impact statement (EIS) for the proposed Ho'opili development in East Kapolei, 'Ewa District, O'ahu Island, Hawaii, various TMKs. We have reviewed the information you submitted with respect to the Corps' authority to issue Department of the Army (DA) permits pursuant to Section 10 of the Rivers and Harbors Act (RHA) of 1899 (33 USC 403) and Section 404 of the Clean Water Act (CWA) (33 USC 1344).

Based on the information provided in the EIS preparation notice (EISPN) prepared on behalf of the applicant, D.R. Horton – Schuler, LCC, we are unable to provide a determination whether a DA permit would be required. A DA permit will be required for any work in navigable waters of the U.S. or activities that involve the placement or discharge of dredged or fill material into waters of the U.S. Please send us a copy of the draft EIS, project plans, or for review. The draft EIS should identify any water resources, including wetlands, which may be affected by the proposed project.

If you have any questions regarding this information request, please contact Ms. Joy Anamizu by phone at 808-468-7023 or by electronic mail at joy.n.anamizu@usace.army.mil and reference the file number above in future correspondence.

Sincerely,

George P. Young, P.E.
Chief, Regulatory Branch

PBR HAWAII
& ASSOCIATES, INC.

February 9, 2008

W. FRANK BRANDT, FASLA
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Senior Associate

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Associate

KIMI AIHKAMI YUEN, LELO'AP
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Associate

SCOTT MURAKAMI, ASLA
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Mr. George P. Young, P.E.,
Chief, Regulatory Branch
U.S. Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawai'i 96858-5440

Attn: Ms. Joy Anamizu, Regulatory Branch

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Young:

Thank you for your letter dated May 7, 2007 (your reference number: POH-2006-233-2). We acknowledge that the U.S. Army Engineer District is unable to provide a determination whether a Department of the Army permit pursuant to Section 10 of the Rivers and Harbors Act of 1889 and Section 404 of the Clean Water Act would be required for the proposed project. An application for jurisdictional determination will be submitted to the Army Corps of Engineers. As requested, a copy of the Draft EIS, identifying any water resources, including wetlands, which may be affected by the proposed project, will be sent to the U.S. Army Engineer District for review.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521 5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

ce Office of Environmental Quality Control

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BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843

March 27, 2007

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Manager and Chief Engineer

DEAN A. NAKANO
Deputy Manager and Chief Engineer

Mr. Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Your Letter Dated March 7, 2007 Regarding the Environmental Impact Statement Preparation Notice for Ho'opili

Thank you for the opportunity to comment on the proposed project.

We have the following comments to offer:

1. A potable and non-potable water master plan of the entire parcel should be submitted for our review and approval. The master plan should include the water requirements and proposed infrastructure facilities. The master plan should show that the facilities are able to provide water service and fire protection in accordance with our Water System Standards.

2. The developer will be required to install the necessary water system improvements to serve the proposed development. The construction drawings should also be submitted for our review and approval.

When water is made available, the applicant will be required to pay our Water System Facility Charges for resource development and transmission.

If you have any questions, please contact Robert Chun at 748-5440.

Very truly yours,

KEITH S. SHIDA
Principal Executive
Customer Care Division

cc: Office of Environmental Quality Control (OEQC)

Water for Life . . . Ka Wai Ola

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

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Associate

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SCOTT MURAKAMI, ASLA
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Mr. Keith S. Shida, Principal Executive
Customer Care Division
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawai'i 96843

Attn: Mr. Robert Chun

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Shida:

Thank you for your letter dated March 27, 2007. We have reviewed your letter and offer the following responses to your comments:

1. A Conceptual Water Master Plan addressing potable and non-potable water facilities will be submitted to BWS for its review and approval.

2. We acknowledge that D.R. Horton or its successors will be required to install the necessary water system improvements to serve the proposed development.

3. Construction drawings will be submitted to BWS for its review and approval.

4. We acknowledge that D.R. Horton or its successors will be required to pay the BWS Water System Facilities Charges for resource development and transmission.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

AR00027360

Mr. Keith S. Shida
SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)
February 8, 2008
Page 2

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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DEPARTMENT OF COMMUNITY SERVICES
CITY AND COUNTY OF HONOLULU
715 SOUTH KING STREET, SUITE 311 • HONOLULU, HAWAII 96813 • AREA CODE 808 • PHONE: 527-5311 • FAX: 527-5488

MUFI HANNEMANN
MAYOR

DEBORAH KIM MORIKAWA
DIRECTOR

MARK K. OTO
SENIOR ADVISOR

March 20, 2007

Mr. Vincent Shigekuni
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice
Ho'opili

Thank you for providing us with the opportunity to review and comment on the Ho'opili Environmental Impact Statement (EIS) Preparation Notice.

The draft EIS should provide more detailed information on the types of affordable housing that will be developed in terms of unit size, types and pricing. Our customary recommendation is to require that no less than 30 percent of the total number of dwelling units in the project must be affordable to households with incomes not exceeding 120 percent of the median income for Honolulu, and no less than 10 percent of the total number of dwelling units being affordable to household's with incomes not exceeding 80 percent of the median income. Given the severe shortage of affordable rental housing our community currently faces, it is our preference that the unit mix include an affordable rental housing component that could be developed by a nonprofit developer or nonprofit/for profit partnership using existing affordable housing programs such as the low income housing tax credit program. We would also ask that consideration be given to set aside a few house lots for the development of group homes for persons with special needs. As a matter of policy, the City & County of Honolulu promotes the dispersal of housing for persons with special needs throughout the community.

We appreciate your consideration of these comments, and we look forward to reviewing the draft EIS when it becomes available. Questions regarding this matter may be directed to Mr. Randy Wong at 768-7747.

Sincerely,

Deborah Kim Morikawa
Director

DKM:rg
cc: Office of Environmental Quality Control
State of Hawai'i, Land Use Commission

AR00027361

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
Chairman

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Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Ms. Deborah Kim Morikawa, Director
City & County of Honolulu
Department of Community Services
715 South King Street, Suite 311
Honolulu, Hawai'i 96813

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Ms. Morikawa:

Thank you for your letter dated March 20, 2007. We have reviewed your letter and offer the following responses to your comments.

As noted in the EISPN, "The Project may provide up to 11,750 residential units in a variety of housing types. D.R. Horton is aware of the current City and County of Honolulu affordable housing requirements (30 percent of the total number of units) and is prepared to price up to 30 percent of the total number of units developed on-site as affordable. In addition to home ownership opportunities, the project will provide commercial, educational, and recreational opportunities for residents."

While it is very early in the development process, with the first homes not envisioned for sale until 2012, pricing will be based on then-prevailing County rules and market conditions.

As previously noted, the project is in the planning process so there may be an opportunity to identify a few house lots throughout the proposed project for the development of group homes for persons with special needs. Thank you again for your participation in the Environmental Impact Statement process. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc Office of Environmental Quality Control

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DEPARTMENT OF DESIGN AND CONSTRUCTION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 11TH FLOOR
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MAYOR

EUGENE C. LEE, P.E.
DIRECTOR

CRAIG I. NISHIMURA, P.E.
DEPUTY DIRECTOR

APR 05 2007

April 3, 2007

Mr. Vincent Shigekuni
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice
Hoopili, Oahu, Ewa

Thank you for giving us the opportunity to comment on the above project.

The Department of Design and Construction (DDC) has the following comments:

- DDC recommends that the developer meet with City officials from the Department of Planning and Permitting, Department of Design and Construction, and Department of Parks and Recreation at an early stage in the development's planning process to develop a conceptual plan for overall park development which is acceptable and appropriate.

- On page 23 of the Environmental Impact Statement Preparation Notice (EISPN), the authors state that their proposed neighborhood parks would be one to two acres in size. Public dedicated parks of such a small size are not likely to be acceptable to the City. Although we support the goal of locating parks within walking distance of their users (up to 1/2 mile), the City's standard for public neighborhood parks is four to six acres to accommodate such land-intensive uses as ballfields, play courts, play equipment, etc. Privately built and maintained neighborhood parks of the proposed size might be acceptable for receiving credit for park dedication purposes, provided the parks are developed in an appropriate way useful to the community. The developer should also consider possibly co-locating parks adjacent to public schools.

- The proposed development borders Farrington Highway which is a transportation facility on the Oahu Regional Transportation Plan (ORTP).

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This facility has been determined to be an integral transportation facility in the Ewa Plains, and is planned for future widening between Fort Weaver Road and the proposed North-South Road; in addition, it is also identified in the MOS alignment for the Transit project. The Farrington Highway widening is an integral part of the Oahu Regional Transportation Plan and is needed to provide improved regional circulation. The Hoopili development should provide improvements to the existing Farrington Highway to accommodate the future traffic volume expected to be generated from the development.

- DDC would appreciate receiving copies of the draft and final EIS documents when published.

Should you have any questions, please contact Craig Nishimura, Deputy Director, at 768-8481.

Very truly yours,

Eugene C. Lee, P.E.
Director

ECL:lt (198758)

c: Lester Chang, Department of Parks and Recreation
Robert Sumitomo, Department of Planning and Permitting
DDC Facilities Division
DDC Civil Division
Office of Environmental Quality Control
State Land Use Commission

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

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Mr. Eugene C. Lee, P.E., Director
Department of Design and Construction
City and County of Honolulu
650 South King Street, 11th Floor
Honolulu, Hawai'i 96813

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Lee:

Thank you for your letter dated April 3, 2007. We offer the following responses to your comments:

1. The developer will meet with City officials from the Department of Planning and Permitting, Department of Design and Construction, and Department of Parks and Recreation (DPR) at an early stage in the development's planning process to develop a conceptual plan for overall park development which is acceptable and appropriate.

2. Thank you for the information on neighborhood parks. We realize that using DPR's terminology, the one to two acre parks should be described as "mini-parks" and not "neighborhood parks." We would greatly appreciate the opportunity to more fully describe our preliminary concepts for these mini-parks with you in the near future

3. We acknowledge that the proposed development borders Farrington Hwy which is a transportation facility on the Oahu Regional Transportation Plan (ORTP), and therefore, concur that the widening of Farrington Highway is an integral part of the ORTP and is needed to provide improved regional circulation. The developer will coordinate with DDC regarding the expansion of the right-of-way for the City's planned widening of Farrington Highway, as well as improvements to the highway (such as turning lanes) which are needed to mitigate traffic that can be directly attributed to the proposed development.

4. Please be assured that DDC will be sent a copy of the Draft EIS.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

AR00027363

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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DEPARTMENT OF FACILITY MAINTENANCE
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MUFI HANNEMANN
MAYOR

LAVERNE HIGA, P.E.
DIRECTOR AND CHIEF ENGINEER

GEORGE "KEOKI" MIYAMOTO
DEPUTY DIRECTOR

IN REPLY REFER TO:
DRM 07-312

April 13, 2007

Mr. Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: **Environmental Impact Statement Preparation Notice (EISPN), Hoopili**

Thank you for the opportunity to review and comment on the subject EISPN dated January 2007.

The EISPN proposes to reclassify 1,553.844 acres of land from Agricultural District to Urban District. Future development will include a network of streets and bikeways with the required storm drainage improvements. The City and County maintenance resources will need to be expanded for the additional infrastructure. The Ewa region is experiencing tremendous growth putting a strain on resources that maintain the accompanied improvements.

Accordingly, we request any future Draft Environmental Impact Statement (DEIS) include a maintenance analysis which anticipates the labor, equipment and materials needed to maintain the proposed infrastructure to a recognized standard.

Also, maintenance jurisdiction of the proposed bikeways should be addressed in the DEIS. Bikeway facilities not located with dedicable roadways should be privately-owned and maintained by the community association.

Should you have any questions, please call Charles Pignataro of the Division of Road Maintenance, at 484-7697.

Sincerely,

Laverne Higa, P.E.
Director and Chief Engineer

c: Office of Environmental Quality Control
State of Hawaii, Land Use Commission

AR00027364

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

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Mr. Craig Nishimura, P.E., Acting Director and Chief Engineer
City & County of Honolulu
Department of Facility Maintenance
1000 Uluohia Street, Suite 215
Kapolei, Hawai'i 96707

Attn: Mr. Charles Pignataro

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Nishimura:

Thank you for the letter dated April 13, 2007 (your reference number: DRM 07-312). We have reviewed your letter and offer the following responses to your comments.

1. As you kindly offered, we spoke with staff at your department regarding the request for a maintenance analysis. The Draft EIS will include an economic and fiscal impact analysis that should describe the impact of the project on County resources and how anticipated revenues may or may not offset maintenance costs.

2. As recommended, maintenance jurisdiction of the proposed bikeways will be addressed in the Draft EIS. Bikeway facilities not located within dedicable roadways will be privately-owned and maintained by a community association(s).

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521 5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc Office of Environmental Quality Control

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DEPARTMENT OF PARKS AND RECREATION
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MUFI HANNEMANN
MAYOR

LESTER K.C. CHANG
DIRECTOR

DANA TAKAHARA-DIAS
DEPUTY DIRECTOR

March 16, 2007

Mr. Vincent Shigekuni
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice Ho'opili

Thank you for the opportunity to review and comment on the Environmental Impact Statement Preparation Notice for D. R. Horton's proposed Ho'opili project.

The Department of Parks and Recreation has no comment at this time.

Should you have any questions, please contact Mr. John Reid, Planner, at 692-5454.

Sincerely,

LESTER K. C. CHANG
Director

LKCC:mk
(198817)

cc: Office of Environmental Quality Control
State of Hawaii, Land Use Commission

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PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

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SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Lester K. C. Chang, Director
Department of Parks and Recreation
City and County of Honolulu
Kapolei Hale
1000 Uluohia Street, Suite 309
Kapolei, Hawai'i 96707

Attn: Mr. John Reid

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Chang:

Thank you for your letter dated March 16, 2007. We acknowledge that the Department of Parks and Recreation has no comments to offer at this time.

Thank you again for your participation in the Environmental Impact Statement process for this project.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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MUFI HANNEMANN
MAYOR

HENRY ENG, FAICP
DIRECTOR

DAVID K. TANOUE
DEPUTY DIRECTOR

2007/ELOG-658
2007/GEN-8 (TH)

May 1, 2007

Mr. Vincent Shigekuni, Vice President
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice for the Proposed Ho'opili Project, Tax Map Key: 9-1-017:004 (por.), 059 and 072; 9-1-018:001 and 004; 9-1-010:002, 014 (por.), and 015 (por.); 9-2-002:001, 9-2-002:002, 004, 005 and 007

We have reviewed the subject project and offer the following comments:

1. Section 1.0 Introduction

   On Page 1 of the Introduction, one (1) of the Tax Map Key parcels listed is 9-2-02:01 (portion). However, TMK: 9-2-02:01 (portion) is not listed on Page 2, nor identified in Figures 1, 2, 2.1, 2.2, and 3. Additionally, this same parcel is not reflected in Table 1 on Page 3. If TMK: 9-2-02:01 (portion) is part of the proposed project site or Petition area, it needs to be included where appropriate in the Draft Environmental Impact Statement (DEIS). Also, please indicate the proposed uses and zoning in Table 1.

   On Page 2 of the Introduction, the "Existing Zoning Designation" states that the current zoning is "AG-1 (Agricultural)." Our records indicate that certain parcels (TMK: 9-1-10:14 (portion) and 15 (portion)) within the "non-petition area" are identified as having both AG-1 Restricted Agricultural District and F-1 Military and Federal District zoning. We recommend that the DEIS reflect the following:

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- Revise the term "AG-1 (Agricultural)" to "AG-1 Restricted Agricultural District."

- Provide a zoning map(s) and table to identify the zoning for all parcels (within and outside the petition area) of land. If none of the parcels are zoned F-1 Military and Federal District, then it would be helpful for the new zoning map(s) to show how the proposed parcels are not included in the F-1 areas.

- To supplement Table 1, it would be helpful to revise Section 1.4 by modifying the existing TMK maps or inserting a new map to graphically show the landowners involved.

- Land Use Ordinance (LUO). The discussion of the LUO should also indicate how much of the 1,704.265-acre project area is proposed to be rezoned.

2. Compliance with the State of Hawaii and City and County of Honolulu Environmental Laws

The DEIS should discuss how the proposed action supports the City's General Plan.

With respect to the Ewa Development Plan, we recommend that the DEIS provide graphic and narrative information on how the proposed action fulfills the policy of a network of open space and greenways (Section 2.2.3). Specifically, the DEIS should focus on how the proposal:

- Utilizes a system of linear greenbelts to connect to existing communities.
- Utilizes landscaped buffers and other forms of open space to create a separate identity for the Ho'opili community.
- Meets or exceeds the Ewa DP's minimum requirement of two (2) acres of park space per 1,000 residents
- Considers potential opportunities for co-location of parks with elementary schools; and
- Creates accessible pathways from surrounding streets to facilitate pedestrian and bicycle access to all features in parks (Section 3.3).

The DEIS should discuss how Ho'opili will implement the Ewa DP policies, principles, and guidelines pertaining to planned residential communities (Section 3.6.3); and industrial centers (Section 3.7.3).

The DEIS should provide graphic and narrative information on how the proposed action supports the Ewa DP's general policies pertaining to higher density housing along the transit corridor, transit-oriented streets and pedestrian and bicycle travel, with particular emphasis on accessibility to reach neighborhood

destinations via non-automotive modes of travel (Section 3.6.3.1). The DEIS should also address how the project conforms to the guidelines for a circulation system planned for Ho'opili and how it will be integrated with existing and future developments such as West Loch Estates, Ewa Villages, University of Hawaii (UH) West Oahu, and DLNR and DHHL projects (Section 3.6.3.2). The discussion on circulation should be a component of the project master plan that the applicant will have to prepare as a requirement for "significant zone changes" (Section 5.4.2).

The Conceptual Land Use Map (Figure 6) shows several areas throughout the petition area proposed for business/commercial use. The DEIS should focus on how the proposed business/commercial use is consistent with the Ewa DP's general policies, planning principles, and guidelines pertaining to planned commercial centers (Section 3.7.1). This discussion should also focus on pedestrian and bicycle accessibility (Section 3.7.1.2).

The DEIS should explain how Ho'opili implements the Ewa DP's policies, principles, and guidelines for transportation systems (Section 4.1). The DEIS should focus on how the proposed action supports the development of a comprehensive roadway network and a transit-oriented community street system.

The DEIS should also provide graphic and narrative information on the planned high-capacity transit corridor, including the location of the stations planned on the North-South Road adjacent to the future UH West Oahu campus and on Farrington Highway. A park and ride facility should also be considered at one (1) of the transit stations to increase convenience, accessibility, and encourage ridership. The DEIS should explain that the City has identified Parcel B as a possible site for a maintenance facility to serve the planned high-capacity transit corridor.

The DEIS should also explain how the proposed action supports the Ewa DP's policies, principles, and guidelines pertaining to water allocation system development (Section 4.2); drainage systems (4.6); and school facilities (Section 4.7).

The Ewa DP's Open Space Map shows panoramic makai views from the H-1 Freeway across Parcel B, and views across Parcel B from Fort Weaver Road. The DEIS should discuss how the proposed action impacts these panoramic views.

The Ewa DP's Public Facilities Map shows a proposed bike path along the North-South Road. This proposed bike path should be considered in the refinement of the Conceptual Land Use Plan since it provides an important link between the proposed project and UH West Oahu, and neighboring communities.

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3. Section 2.0 Description of the Project

   The list of current tenants and existing land uses listed in Table 2, Section 2.1.2 of the EISPN should be supplemented by a map in the DEIS showing where these tenants are currently leasing land in the project area.

4. Section 3.0 Assessment of the Existing Natural Environment, Potential Impacts, and Mitigation Measures

   Section 3.4, states that land leases will be withdrawn in phased and "as needed basis." We recommend that the DEIS and agricultural impact assessment report explain what will happen to these tenants after their leases are withdrawn.

   Page 31, paragraph 3 states that a very small portion of parcel C is in Zone AE and X. We recommend that the applicant verify if a portion of parcel C is in Zone XS and AEF as our records indicate.

5. Section 4.0 Assessment of the Existing Human Environment, Potential Impacts and Mitigation Measures

   The term "Public Transit Authority" mentioned in the last paragraph on Page 40 should be revised to "Oahu Transit Service." The Oahu Transit Service is a private company hired by the City and County of Honolulu to operate TheBus that provides public transit for Oahu, including the routes mentioned on Page 40.

   The DEIS should indicate the existing flows being treated at the Honouliuli Wastewater Treatment Plant (WWTP) and any improvements to the WWTP needed to accommodate future wastewater demand. The preliminary Wastewater Collection Master Plan should also include figures for wet-weather flows.

   Section 4.8.4 of the EISPN mentions that the project area is within the Kaloi, Honouliuli Stream, and West Loch drainage basins. It would be very helpful if a map showing these drainage basins in relation to the project area can be included in the DEIS.

   Section 4.9.3 of the EISPN discusses health care and hospital facilities. We recommend that the DEIS expand this section by discussing emergency medical service resources that will be needed to serve Ho'opili. We recommend that the Department of Emergency Services be added to the list consulted parties in Section 6.0.

Should you have any questions, please contact Tim Hata of our staff at 768-8043.

Very truly yours,

Henry Eng, FAICP, Director
Department of Planning and Permitting

HE:js

cc: OEQC
Land Use Commission

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AR00027368

PBR HAWAII
& ASSOCIATES, INC.

February 9, 2008

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RUSSELL Y. J. CHUNG, FASLA
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Mr. Henry Eng, FAICP, Director
City & County of Honolulu
Department of Planning and Permitting
650 South King Street, 7th Floor
Honolulu, Hawai'i 96813

Attn: Mr. Tim Hata

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Eng:

Thank you for your letter dated May 1, 2007 [your reference number: 2007/ELOG-658; 2007/GEN-8 (TH)]. We have reviewed your letter and offer the following responses to your comments.

1. Section 1.0 Introduction.

   a. Please note that TMK:9-2-02:01 (portion) is not part of the proposed project site or Petition Area, and as such, revisions will be made in the Draft EIS.

   b. AG-1 (Agricultural) will be revised to AG-1 Restricted Agricultural District in the Draft EIS.

   c. A zoning map and table identifying the zoning for all parcels (within and outside the petition area) of land will be included in the Draft EIS.

   d. A map identifying current land ownership in relation to the proposed project, will be included in the Draft EIS.

   e. The Draft EIS will note that 1,555.145 acres will need to be rezoned.

2. Compliance with the State of Hawai'i and City and County of Honolulu Environmental Laws.

   a. A discussion of how the proposed project supports the City's General Plan will be included in *Section 5.3.1, General Plan* of the Draft EIS.

   b. As recommended, the Draft EIS will provide graphic and narrative information on how the proposed action fulfills the policy of a network of open space and greenways (Section 2.2.3 of the Ewa DP).

   c. The Draft EIS will discuss how the project will implement the Ewa DP policies, principles, and guidelines pertaining to planned residential communities and industrial centers (Sections 3.6.3 and 3.7.3 of the Ewa DP).

   d. The Draft EIS will provide graphic and narrative information on how the proposed action supports the Ewa DP's general policies pertaining to higher density housing along the transit corridor, transit-oriented streets, and pedestrian and bicycle travel, with particular emphasis on accessibility to reach neighborhood destinations via non-automotive modes of travel (Section 3.6.3.1 of the Ewa DP). In addition, the Draft EIS will address how the project conforms to the guidelines for a circulation system planned for Ho'opili and how it will be integrated with existing and future developments (Section 5.4.2 of the Ewa DP). A project master plan which will include a transportation master plan will be prepared and included in the Zone Change permit application.

   e. The Draft EIS will include discussion on how the proposed business/commercial use is consistent with Ewa DP's general policies, planning principles, guidelines pertaining to planned commercial centers (Section 3.7.1 of the Ewa DP), and pedestrian and bicycle accessibility (Section 3.7.1.2 of the Ewa DP).

   f. The Draft EIS will include discussion of how the project will implement the Ewa DP's policies, principles, and guidelines for transportation systems (Section 4.1 of the Ewa DP).

   g. The Draft EIS will include a map and narrative information on the planned high-capacity transit corridor, including the location of the transit stations planned on the North-South Road and Farrington Highway. D.R. Horton has been in coordination with area developers and it is our understanding that a park and ride facility is being considered at one of the transit stations closest to UHWO, the Kroc Center and Kapolei Parkway to increase convenience, accessibility, and encourage ridership. It is acknowledged that Parcel B is one of two sites along the transit corridor being considered for a potential rail maintenance and storage facility.

   h. The Draft EIS will explain how the proposed action supports the Ewa DP's policies, principles and guidelines pertaining to water allocation system development (Section 4.2 of the Ewa DP), drainage systems (Section 4.6 of the Ewa DP) and school facilities (Section 4.7 of the Ewa DP).

   i. The Draft EIS will include a discussion of how the proposed action impacts these panoramic views.

   j. The Draft EIS will include a Conceptual Regional Public Facilities and Bikeway Master Plan for East Kapolei that was developed with UHWO and DHHL. The proposed bike path and North-South Road is shown as being integral to providing bicycle and pedestrian connectivity to planned bike and multi-modal paths within the proposed project, UHWO and DHHL.

3. Section 2.0 Description of the Project.

   a. A map depicting where current tenants are currently leasing land in the project area, to serve as a supplement to Table 2, will be included in the Draft EIS.

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4. Section 3.0 Assessment of the Existing Natural Environment.

   a. The fact that current agricultural operations will eventually have to be phased out to other locations off-site will be addressed in the agricultural impact analysis report and Draft EIS.

   b. As recommended, we have reviewed the November 20, 2000 Flood Insurance Rate Map (Number 15003C0220) and was not able to find any references to Zone AEF and XS on the entire map or the adjoining map to the south (Number 15003C0220). So unless directed otherwise, we will limit our references to flood zones A, AE, X and D.

5. Section 4.0 Assessment of the Existing Human Environment.

   a. The term "Public Transit Authority" will be revised to "Oahu Transit Services" in the Draft EIS.

   b. Based on average daily flows, the Honouliuli Wastewater Treatment Plant (WWTP) has a primary treatment capacity of 38 million gallons per day (MGD), with future plans to expand to 51 MGD. The facility has an existing flow of 27 MGD. The Ho'opili project will generate additional flow that must be treated at the Honouliuli WWTP. To mitigate the additional burden, the project will participate in the Wastewater System Facility Charge (WSFC) program and contribute funds (based on building permits) to expand the treatment plant. Preliminary contact with the City and County of Honolulu, Department of Environmental Services has indicated that the sewer system has the capacity to accommodate the Project with a build-out beginning in four to six years and ending 15 to 20 years after. The Wastewater Collection Master Plan includes figures for wet-weather flows

   c. A map depicting the Kalo'i Gulch, Honouliuli Stream, and West Loch drainage basins in relation to the project area is shown in Figure 4 of the Drainage Master Plan included as an appendix in the Draft EIS.

   d. The Draft EIS will include a discussion of emergency medical service resources that will be needed to serve the Ho'opili project. As recommended, the Department of Emergency Services will be added to the list of consulted parties.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521 5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc Office of Environmental Quality Control

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DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 3RD FLOOR
HONOLULU, HAWAII 96813
Phone: (808) 768-8305 • Fax: (808) 523-4730 • Internet: www.honolulu.gov

NUFI FANNEMANN
MAYOR

MELVIN N. KAKU
DIRECTOR

RICHARD F. TORRES
DEPUTY DIRECTOR

TP3/07-198732R

April 18, 2007

Mr. Vincent Shigekuni
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Ho'opili

Thank you for your letter of March 7, 2007, requesting our review of and comments on the Environmental Impact Statement (EIS) Preparation Notice for the subject project.

We have the following comments for your consideration as you prepare the draft EIS:

1. The disposition of the roadways within the project should be noted in the document.

2. We look forward to continuing the close coordination that has occurred between the subject project and our Honolulu High-Capacity Transit Corridor Project.

3. The last paragraph on Page 40 of the EIS Preparation Notice describes the existing City bus system in the project area. The second sentence should be revised to delete the reference to the Public Transit Authority. Also, the third sentence incorrectly states that Routes C, 93 and 93A pass the property on Farrington Highway. These routes run on Interstate H-1 in the vicinity of the property. Routes 40 and 40A pass the property on Farrington Highway.

Should you have any questions regarding these comments, please contact Ms. Faith Miyamoto of the Transportation Planning Division at 768-8350.

Sincerely,

MELVIN N. KAKU
Director

cc: Ms. Genevieve Salmonson
Office of Environmental Quality Control

Mr. Anthony Ching
State of Hawaii Land Use Commission

AR00027371

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
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1287 Wili Pa Loop, Suite 1
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Tel: (808) 242-2676

Mr. Wayne Yoshioka, Director
Department of Transportation Services
City & County of Honolulu
650 South King Street, 3rd Floor
Honolulu, Hawai'i 96813

Attn: Ms. Faith Miyamoto

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Yoshioka:

Thank you for the letter dated April 18, 2007 (your reference number: TP3/07-198732R). We have reviewed your letter and offer the following responses to your comments.

1. It is anticipated that most of the roadways within the project area will be dedicated to the City and County of Honolulu; this will be noted in the Draft EIS.

2. Please be assured that we will continue to coordinate with the Department of Transportation Services (DTS) in regards to its Honolulu High-Capacity Transit Corridor Project; specifically the alignment of the transit corridor through and the location of a transit station within the project site.

3. We appreciate your suggested revisions to page 40 of the EISPN. These revisions will be made in the Draft EIS.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521 5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc Office of Environmental Quality Control

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HONOLULU FIRE DEPARTMENT
CITY AND COUNTY OF HONOLULU

636 South Street
Honolulu, Hawaii 96813-5007
Phone: 808-723-7139 Fax: 808-723-7111 Internet: www.honolulu.gov/hfd

MUFI HANNEMANN
MAYOR

KENNETH G. SILVA
FIRE CHIEF

ALVIN K. TOMITA
DEPUTY FIRE CHIEF

March 28, 2007

Mr. Vincent Shigekuni
Vice President
PBR Hawaii & Associates, Inc.
Suite 650, American Savings Bank Tower
1001 Bishop Street
Honolulu, Hawaii 96813-3484

Dear Mr. Shigekuni:

Subject: Environmental Impact Statement Preparation Notice
Ho'opili
Ewa, Oahu
Tax Map Keys: 9-1-017: 004 (portion), 059, and 072; 9-1-018: 001 and 004;
9-1-010: 002, 014 (portion), and 015 (portion); 9-2-002: 002;
9-2-002: 001 (portion), 004, 005, 006, and 007

In response to your letter dated March 7, 2007, regarding the above-mentioned subject, the Honolulu Fire Department (HFD) reviewed the material provided and requires that the following be complied with:

1. Provide a fire apparatus access road for every facility, building, or portion of a building hereafter constructed or moved into or within the jurisdiction when any portion of the facility or any portion of an exterior wall of the first story of the building is located more than 150 feet (45 720 mm) from a fire apparatus access road as measured by an approved route around the exterior of the building or facility. (1997 Uniform Fire Code, Section 902.2.1.)

2. Provide a water supply, approved by the county, capable of supplying required fire flow for fire protection to all premises upon which facilities or buildings, or portions thereof, are hereafter constructed or moved into or within the county.

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On-site fire hydrants and mains capable of supplying the required fire flow shall be provided when any portion of the facility or building is in excess of the 150 feet (45 720 mm) from a water supply on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building. (1997 Uniform Fire Code, Section 903.2, as amended.)

3. Submit civil drawings to the HFD for review and approval.

Should you have any questions, please call Battalion Chief Lloyd Rogers of our Fire Prevention Bureau at 723-7151.

Sincerely,

KENNETH G. SILVA
Fire Chief

KGS/SK:jl

cc: Office of Environmental Quality Control
Anthony Ching, State of Hawaii, Land Use Commission

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
Chairman

THOMAS S. WITTEN, ASLA
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R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
Executive Vice-President

VINCENT SHIGEKUNI
Vice-President

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Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI AIKAMI YUEN, LEED® AP
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SCOTT MURAKAMI, ASLA
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Fax: (808) 961-4989

WAILUKU OFFICE
1787 Wili Pa Loop, Suite 4
Wailuku, Hawaii 96793-1271
Tel: (808) 242-2878

Fire Chief Kenneth G. Silva
Honolulu Fire Department
City and County of Honolulu
636 South Street
Honolulu, Hawai'i 96813-5007

Attn: Battalion Chief Lloyd Rogers

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Fire Chief Silva:

Thank you for your letter dated March 28, 2007 (your reference number: KGS/SK:jl). We offer the following responses to your comments:

1. Fire apparatus access roads shall be designed and constructed in accordance with the Uniform Fire Code, Section 902.2.1, as amended.

2. Water infrastructure shall be designed and installed in accordance with the Uniform Fire Code, Section 903.2, as amended.

3. Civil drawings will be submitted to your department for your review and approval.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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AR00027373

POLICE DEPARTMENT

CITY AND COUNTY OF HONOLULU

801 SOUTH BERETANIA STREET · HONOLULU, HAWAII 96813
TELEPHONE (808) 529-3111 · INTERNET: www.honolulupd.org

MUFI HANNEMANN
MAYOR

BOISSE P. CORREA
CHIEF

GLEN R. KAJIYAMA
PAUL D. PUTZULU
DEPUTY CHIEFS

OUR REFERENCE BS-DK

March 27, 2007

Mr. Vincent Shigekuni
PBR Hawaii & Associates, Inc.
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

This is in response to your agency's letter of March 7, requesting comments on an Environmental Impact Statement Preparation Notice for the Ho`opili project in Ewa.

This project should have no unanticipated impact on the facilities or operations of the Honolulu Police Department.

If there are any questions, please call Major Michael Moses of District 8 at 692-4253 or Mr. Brandon Stone of the Executive Office at 529-3644.

Sincerely,

BOISSE P. CORREA
Chief of Police

By
JOHN P. KERR
Assistant Chief of Police
Support Services Bureau

cc: OEQC
Mr. Anthony Ching, Land Use Commission

Serving and Protecting With Aloha

PBR HAWAII
& ASSOCIATES, INC.

W. FRANK BRANDT, FASLA
Chairman

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1787 Wili Pa Loop, Suite 4
Wailuku, Hawai'i 96793-1271
Tel: (808) 242-2878

February 8, 2008

Mr. Boisse P. Correa, Chief of Police
Police Department
City and County of Honolulu
801 South Beretania Street
Honolulu, Hawai'i 96813

Attn: Mr. Michael Moses/Mr. Brandon Stone

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Correa:

Thank you for your letter dated March 27, 2007 (your reference number BS-DK). We acknowledge your assessment that the project should have no unanticipated impact on the facilities or operations of the Honolulu Police Department.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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COMMENTS ON HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE OF JANUARY 2007

NOTE: The following comments are based on an assumption that much of the text in the subject document will be included in the EIS.

Frank Genadio
Committee for Balanced Transportation

In two places concerning open space, on pages 7 and 8, reference is made to "As much as 210 acres of parks and open space could be provided" for the project. Suggest changing of the word "could" to "will" in the Draft EIS to ensure preservation of that open space. While the use of "could" in relation to schools is understood due to uncertainties on the potential number of students, the developer's firm commitment to open space will aid efforts for rezoning of the other acreage.

References to "rail," on pages 9, 10, and 20, are premature. Bill 79, passed by the City Council for transit, refers to a "fixed guideway." Suggest change to "mass transit"—unless a (pre-EIS publication) Council decision agrees with the city that some form of rail will be used on the fixed guideway.

Concerning electrical power development (page 10), no reference is made to solar power. Photovoltaic panels on any new construction—including affordable homes—will not only ease the burden on HECO's capacity but lead to lower prices for occupants' electricity. This form of energy will surely be even more efficient by the time the first homes and facilities in Ho'opili are under development.

Figure 6 shows DLNR land and business/commercial acreage (Parcel A) on both makai sides of the H-1 North-South Interchange. The interchange is shown in a "diamond" configuration, as currently planned by the State DOT. Suggest that both DLNR and Ho'opili developers agree to leave enough open space on the mauka side of those parcels to ensure room for a future full cloverleaf interchange, a much more efficient means of freeway access that will not require the (two) traffic signals needed for the diamond configuration. Text to that effect should be included in the Major Roads description on page 23.

The title for Section 2.2.3 states "...and Preliminary Costs." Suggest removal of this portion since no costs are given—unless they are added in the Draft EIS.

The last sentence of the first paragraph on page 52 should be changed to read something like "As the first phase of the project, the City Council selected a minimum operable segment (MOS) that will be from near the southwest corner of Ho'opili up the North-South Road to Farrington Highway, through Waipahu, Pearl City, and Aiea, and via Salt Lake Boulevard through downtown Honolulu to Ala Moana Center."

This study also should acknowledge the possibility of a rail maintenance and storage yard in the development area. Two sites are under consideration for the MOS, one near Leeward Community College and the other in Parcel B. Suggest adding a sentence to the (one sentence) second paragraph on page 52, to read "If required for the transit project, space will be allocated in Parcel B for a potential rail maintenance and storage facility." (NOTE: Personal testimony given to the City Council was for extension of the western end of the MOS by about 4,000 feet makai and placement of the facility in Kalaeloa or [possibly] as an expanded facility shared with the existing Hawaiian Railway yard.)

Editing Comments (provided in case this document is used for EIS preparation):

Page	Para	Line	Comment
12	1	6	Change "have been already been" to "have already been"
20	2	8	Change "compliment St. Francis" to "complement Hawai'i Medical Center West"
21	1	1	Change "connect" to "connects"
21	3	3	Change "is proposed" to "its proposed"
35	2	1	Change "no aircrafts" to "no aircraft"
43	6	1	Change "located the" to "located at the"
45	2	2	Change "of 6,600" to "6,600"
46	4	2	Change "Navy see" to "Navy to see"
47	4	3	The sentence starting with "However...five..." should be changed to read "The project will include as many as five..."
51	2	2	Change "23-mile" to "28-mile"
52	4	3	Change "Council has select" to "Council has selected"
52	5	5	Change "in residents" to "in which residents"
52	5	9	Change "Kapolei develops" to "Kapolei develop"

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PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
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Mr. Frank Genadio
Committee for Balanced Transportation
92-1370 Kikaha Street
Kapolei, Hawai'i 96707

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Genadio:

Thank you for your letter received March 31, 2007. We offer the following responses to your comments:

1. We appreciate your suggested revisions to pages 7 and 8 of the EISPN, but planning for this project is in its infancy and between now and zoning there may be requests for more land set asides for the roadway improvements (such as the proposed East-West Connector) or additional school sites which were not originally envisioned. These public land set asides would have to come out of the land area currently set aside for parks and open space.

2. We appreciate your suggested revisions to pages 9, 10, and 20 of the EISPN. References to "rail" will be replaced with "mass transit" in the Draft EIS.

3. Current plans for the development of Ho'opili include both energy efficient design and the use of electricity to be developed and sold by Hawaiian Electric Company (which itself is exploring non-oil dependent sources of energy), and as such, the project will be suited for the use of renewable energy technologies including photovoltaics.

4. We acknowledge your concern regarding the configuration of the H-1 North-South Interchange, please be assured that the developer will continue to coordinate with the State Department of Transportation to ensure that the interchange will be properly planned. As we recently learned from a presentation by the State DOT Highways Division, a full, cloverleaf interchange was studied, and it was determined that there was not enough land area between H-1 and Farrington Highway.

5. As required by Chapter 343, *Hawaii Revised Statutes*, the Draft EIS is required to include a description of the "Phasing and timing of action." An expanded discussion regarding "Project Developed Timetable and Preliminary Costs" associated with the project will be included in the Draft EIS.

6. The Draft EIS will include the following:

   For the first phase of the transit project, the City Council selected a minimum operable segment (MOS) that will start near the southwest corner of the Ho'opili project and proceed up along the North-South Road to Farrington Highway, navigating toward the direction of Waipahu, Pearl City, and Aiea, and traversing to Salt Lake Boulevard en route for downtown Honolulu to Ala Moana Center. As of this writing, we understand that the portion of the alignment between the Kroc Center and Waipahu may be subject to change.

7. The Draft EIS will include the following:

   If required for the transit project, the developer will coordinate with DTS regarding the possibility of allocating a portion of the project lands for a potential mass transit maintenance and storage facility.

8. Thank you for pointing out the minor editing errors in the EISPN. These revisions will be made in the Draft EIS.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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AR00027376

HASEKO

HASEKO (Ewa), Inc.

April 9, 2007

Mr. Robert Bruhl
D.R. Horton – Schuler Division
828 Fort Street Mall, 4th floor
Honolulu, Hawaii 96813

Re: Ho'opili Environmental Impact Statement Preparation Notice ("EISPN")

Dear Mr. Bruhl:

Thank you for this opportunity to submit comments during the EIS scoping period for your exciting and vibrant Ho'opili project. According to the EISPN, approximately 100 acres of the Ho'opili project will be within the Kalo'i Gulch Watershed instead of the 300 acres that was originally anticipated. Because Ocean Pointe and Oneula Beach Park lies at the seaward terminus of the Kalo'i Gulch Watershed, we are particularly interested in the potential drainage impacts of this and other projects within the watershed.

We concur with the EISPN that, for project lands within the Kalo'i Gulch Drainage Basin, on-site detention basins will be constructed to collect stormwater runoff and discharge the flow at a rate that will not exceed pre-development conditions. We appreciate the EISPN's inclusion of the current discharge restrictions for landowners and developers in the Kalo'i Gulch Drainage Basin and the acknowledgment that these existing physical restrictions will remain in place until the flow capacity of the drainage channel is increased by construction of a permanent ocean outlet.

In order for the region's flood control plans to be effective, all developers in the watershed need to cooperate, participate and contribute to efforts to address issues such as on-site detention and retention of stormwater flows to control runoff volume.

We look forward to continuing participation by you and the other developers in the watershed as we collectively move forward on resolving this major regional issue.

Thank you for this opportunity to comment on your EISPN.

Very truly yours,

Nancy Maeda
Executive Vice President

91-1001 Kaimalie Street, Suite 205 • Ewa Beach, Hawaii 96706-5005
Telephone (808) 689-7772 • Fax (808) 689-5757

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

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Chairman

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SCOTT ALIKA ABRIGO
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Associate

Ms. Nancy Maeda, Executive Vice President
HASEKO (Ewa), Inc.
91-1001 Kaimalie Street, Suite 205
'Ewa Beach, Hawai'i 96706-5005

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Ms. Maeda:

Thank you for your letter dated April 9, 2007. We acknowledge your interest in the potential drainage impact of the Ho'opili project and other projects within the Kalo'i Gulch Watershed. With respect to this portion of the project, on-site drainage basins will be constructed to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. Please note that we will continue to coordinate with the City and County of Honolulu and the State Department of Transportation to discuss issues within the Kalo'i Gulch Watershed. A Drainage Master Plan will be prepared and included in the Draft Environmental Impact Statement (EIS) for the project.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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Wailuku, Hawai'i 96793-1271
Tel: (808) 242-2878

AR00027377

Hawaiian Electric Company, Inc. - PO Box 2750 - Honolulu, HI 96840-0001

EIS

October 5, 2007

Mr. Vincent Shigekuni
PBR Hawaii & Associates, Inc.
ASB Tower - Suite 650
1001 Bishop Street
Honolulu, HI 96813-3484

Dear Mr. Shigekuni:

Re: Ho'opili
East Kapolei, Ewa, Oahu

Thank you for the opportunity to comment on the above-referenced project. We apologize for this late response.

HECO has no objections at this time. The following comments were received from various divisions of our Engineering Department:

(1) HECO has the following existing facilities within the project area that will require continued access for maintenance purposes:

(a) Transmission & Distribution - Overhead sub-transmission and distribution lines supplying Parcel F1; overhead transmission and distribution facilities within Parcel B; overhead facilities surrounding Parcels A, B, C and D; and

(b) Transmission Substation - Substation facilities, mainly within Parcel B;.

(c) Telecommunications - Overhead fiber optic cable facilities, mainly within Parcels B and C;

We appreciate your efforts to keep us apprised of the planning process and reserve the opportunity to further comment on the protection of existing power facilities and lines, as well as easements, that may be affected by the project. As the project progresses, please continue to keep us informed. We will be better able to evaluate any effects on our system facilities further along in the project's development. We request that development plans show all affected HECO facilities, and address any conflicts between the proposed plans and HECO's existing facilities. Please forward the pre-final development plans to HECO for review.

(2) Our Distribution Planning Division/Project Management has determined that to serve the ultimate load for the proposed development, three distribution substations, including power lines to and from them, will be needed. Installation of the substations and power lines will require Public Utilities Commission approval, as well other applicable state and city as approvals and permits. We request that these substations be included as part of the draft EIS.

(3) Should it become necessary to relocate HECO's facilities, please immediately submit a request in writing and we will work with you so that construction of the project may proceed as smoothly as possible. Please note that there may be costs associated with any relocation work, and that such costs may be borne by the requestor. Because any redesign or relocation of HECO's facilities may cause lengthy delays, upon determination that HECO facilities will need to be relocated, HECO should be notified immediately in order to minimize any delays in or impacts on the project schedule.

(4) Electrical Power Development, page 10. Please revise the available generation capacity (peak demand) from 1,669 MW to "1,687 megawatts (Gross MW)."

I suggest dealing directly with the following Engineering division contacts to coordinate HECO's continuing input in this project:

Transmission & Distribution - Michael Lum (543-7030)
Transmission Substation - Hope Hamada (543-7216)
Telecommunications - Terrine Uehira (543-7084)
Distribution Planning/Project Mgt - Kerstan Wong (543-7059)

Sincerely,

Kirk S. Tomita
Senior Environmental Scientist

cc: OEQC
Anthony Ching/LUC
M. Lum
H. Hamada
T. Uehira
K. Wong

AR00027378

PBR HAWAII
& ASSOCIATES, INC.

Feburary 8, 2008

W. FRANK BRANDT, FASLA
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Vice President

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Principal

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Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

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1787 Wili Pa Loop, Suite 1
Wailuku, Hawai'i 96793-1871
Tel: (808) 242-2878

Mr. Kirk S. Tomita, Senior Environmental Scientist
Hawaiian Electric Company, Inc.
P.O. Box 2750
Honolulu, Hawai'i 96840-0001

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Mr. Tomita:

Thank you for your letter dated October 5, 2007. We acknowledge that the Hawaiian Electric Company, Inc (HECO) has no objections to the project at this time. We have reviewed your letter and offer the following responses to your comments.

1. The Draft EIS will note that existing HECO facilities are located within the project area. Should HECO have to tend to existing facilities within the project area, the Petitioner will allow continued access to HECO for maintenance purposes. Pre-final development plans will be forwarded to HECO for review.

2. We acknowledge your assessment that three distribution substations will be needed to serve the ultimate load for the project, including power lines extending out from the substations. In addition, the installation of power lines and substations will require approval by the State Public Utilities Commission, as well as other applicable State and City approvals and permits. The approximate location of these substations will be included in the Draft EIS.

3. Should the project's development require the relocation of HECO's facilities, the Petitioner will notify HECO immediately in order to minimize any delays in or impacts on the project schedule.

4. Please note that the available generation capacity (peak demand) of approximately "1,669 megawatts (MW)," will be revised to "1,687 megawatts (Gross MW)" in the Draft EIS.

We appreciate your suggestion to deal directly with HECO's engineering divisions to coordinate continuing input in the project. Thank you again for your participation in the Environmeutal Impact Statement process for this project.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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APR 09 2007

Hawaiian Telcom
April 2, 2007

PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Attention: Mr. Vincent Shigekuni

Dear Mr. Shigekuni:

Subject: **Environmental Impact Statement Preparation Notice (EISPN) for Ho'opili, Ewa, Oahu, TMK: 9-1-17:04 (portion), 59, and 72; 9-1-18:01 and 04; 9-1-10: 02, 14 (portion), and 15 (portion) and 9-2-02:02, and 9-2-02:01 (portion), 04, 05, 06, and 07.**

Thank you for the opportunity to review and comment on the Environmental Impact Statement Preparation Notice (EISPN) in accordance to Hawaii Revised Statues, Chapter 343 and Administrative Rules, Title 11, Chapter 200 for Ho'opili with transmittal dated March 7, 2007.

We have the following comments to make:

- As far as Hawaiian Telcom is concerned, providing telephone service should not negatively impact the environment within the project area.
- Hawaiian Telcom has aerial and underground facilities along Farrington Hwy that will be affected by the road widening of Farrington Hwy. Further review is required by Hawaiian Telcom during the design stages of the project to determine the scope of work and the associated relocation costs.
- All electrical work shall conform to all electrical codes.
- Hawaiian Telcom requires electrical drawings of the project to be submitted for our review and approval before construction starts.

If you have any questions, please contact Cliff Anguay at 840-2989.

Sincerely,

Jill Z. Lee
Section Manager
OSP Engineering, Oahu

1177 Bishop Street • Honolulu • Hi 96813

PBR HAWAII
& ASSOCIATES, INC.

February 8, 2008

W. FRANK BRANDT, FASLA
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Executive Vice-President

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Vice-President

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Principal

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Wailuku, Hawai'i 96793-1871
Tel: (808) 242-2678

Ms. Jill Z. Lee, Section Manager
OSP Engineering, Oahu
Hawaiian Telcom
P.O. Box 2200
Honolulu, Hawai'i 96841

Attn: Mr. Cliff Anguay

SUBJECT: HO'OPILI ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Dear Ms. Lee:

Thank you for your letter received April 2, 2007. We offer the following responses to your comments:

1. We acknowledge your assessment that providing telephone service should not negatively impact the environment within the project area.

2. We acknowledge that the road widening of Farrington Highway will affect Hawaiian Telcom facilities along Farrington Highway, and therefore, will require further review during the design stages of the project to determine the scope of work and the associated relocation costs.

3. All electrical work shall conform to all electrical codes.

4. Electrical drawings of the project will be submitted to Hawaiian Telcom for review and approval before the start of construction.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comments will be included in the Draft EIS.

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If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Office of Environmental Quality Control

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13.0
Comments on the Draft Environmental Impact Statement & Responses

13.0 COMMENTS ON THE DRAFT ENVIRONMENTAL IMPACT STATEMENT AND RESPONSES

The Ho'opili Draft Environmental Impact Statement was sent to the following agencies, organizations and individuals. The public comment period on the Draft EIS was from February 23, 2008 to April 8, 2008. Agencies, organizations, or individuals that submitted comments on the Draft EIS are listed in bold.

Table 13.1. DEIS Comment Letters

	AGENCY	DEIS MAIL DATE	DATE OF COMMENTS
STATE			
1	**Department of Agriculture**	02-20-08	04-08-08
2	**Department of Accounting & General Services**	02-20-08	03-06-08
3	**Department of Business, Economic Development and Tourism**	02-20-08	04-08-08
4	Department of Business, Economic Development and Tourism – Energy, Resources & Technology Division	02-20-08	--
5	**Department of Business, Economic Development and Tourism – Land Use Commission**	02-20-08	03-27-08
6	**Department of Business, Economic Development and Tourism – Office of Planning**	02-20-08	04-08-08
7	**Department of Defense**	02-20-08	03-31-08
8	**Department of Education**	02-20-08	04-03-08
9	**Department of Hawaiian Home Lands**	02-20-08	04-15-08
10	**Department of Health – Environmental Planning Office**	02-20-08	04-02-08
11	**Department of Health – Environmental Planning Office (Memo from the Hazard Evaluation & Emergency Response Office)**	--	03-13-08
12	Department of Health – Office of Environmental Quality Control	02-20-08	--
13	**Department of Land and Natural Resources**	02-20-08	04-03-08, 04-11-08
14	Department of Land and Natural Resources – Historic Preservation Division	02-20-08	--
15	**Department of Transportation**	02-20-08	04-07-08
16	Hawaii Housing Finance & Development Corporation	03-03-08	--

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	AGENCY	DEIS MAIL DATE	DATE OF COMMENTS
17	**Hawaii Community Development Authority**	02-20-08	04-07-08
18	**Office of Hawaiian Affairs**	02-20-08	04-17-08
19	State Legislature – Representative Sharon Har	02-20-08	--
20	**State Legislature – Representative Maile Shimabukuro**	--	04-08-08
21	**State Legislature – Representative Rida Cabanilla**	--	03-12-08
22	State Legislature – Senator Will Espero	02-20-08	--
23	State Legislature – Senator Mike Gabbard	02-20-08	--
24	State Legislature – Senator Clarence Nishihara	02-20-08	--
25	**University of Hawai'i – Environmental Center**	02-20-08	04-08-08
26	University of Hawai'i – Water Resources Research Center	02-20-08	--
27	University of Hawai'i – Center for Smart Building and Community Design	02-20-08	--
28	University of Hawai'i – Sea Grant	02-20-08	--
29	**University of Hawai'i – West O'ahu**	02-20-08	04-08-08
30	Hawai'i State Library	02-20-08	--
31	'Ewa Beach Public and School Library	02-20-08	--
32	Kapolei Public Library	02-20-08	--
33	Waipahu Public Library	02-20-08	--
34	Kaimukī Regional Library	02-20-08	--
35	Kāne'ohe Regional Library	02-20-08	--
36	Pearl City Regional Library	02-20-08	--
37	Līhu'e Regional Library	02-25-08	--
38	Hilo Regional Library	02-25-08	--
39	Kahului Regional Library	02-25-08	--
40	University of Hawai'i – Hamilton Library	02-20-08	--
41	Department of Business, Economic Development and Tourism Library	02-20-08	--
42	Legislative Reference Bureau	02-20-08	--
43	City and County of Honolulu Department of Customer Services Library (formerly the Municipal Reference and Records Center)	02-20-08	--
FEDERAL			
44	Department of the Army – Army Engineer District	02-20-08	--
45	**Department of the Interior – Fish and Wildlife Service**	02-20-08	04-08-08
46	Department of the Navy	02-20-08	--
CITY AND COUNTY OF HONOLULU			
47	**Board of Water Supply**	02-20-08	03-06-08
48	City Council – Councilmember Todd Apo	02-20-08	--
49	City Council – Councilmember Nestor Garcia	02-20-08	--

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	AGENCY	DEIS MAIL DATE	DATE OF COMMENTS
50	**Department of Community Services**	02-20-08	03-06-08
51	Department of Design and Construction	02-20-08	--
52	Department of Environmental Services	02-20-08	--
53	**Department of Facility Maintenance**	02-20-08	04-07-08
54	**Department of Parks and Recreation**	02-20-08	03-07-08
55	**Department of Planning and Permitting**	02-20-08	04-07-08
56	Department of Transportation Services	02-20-08	--
57	'Ewa Neighborhood Board, No. 23	02-20-08	--
58	**Fire Department**	02-20-08	03-12-08
59	Makakilo/Kapolei Neighborhood Board, No. 34	02-20-08	--
60	**Police Department**	02-20-08	03-05-08
61	Waipahu Neighborhood Board, No. 22	02-20-08	--
OTHER ORGANIZATIONS/INDIVIDUALS			
62	Honolulu Advertiser	02-20-08	--
63	Honolulu Star Bulletin	02-20-08	--
64	Pacific Business News	02-20-08	--
65	Salvation Army	02-20-08	--
66	**Hawaiian Electric Company, Inc.**	02-20-08	04-28-08
67	Hawaiian Telcom	02-20-08	--
68	Enterprise Honolulu	02-20-08	--
69	**Steve Kelly (City of Kapolei/Kapolei Property Development LLC.)**	02-20-08	04-08-08
70	**HASEKO (Ewa), Inc.**	--	04-14-08
71	**Leeward – Central Community Roundtable (aka Leeward – Central Community Forum)**	--	04-07-08
72	**Tom Berg**	--	03-27-08
73	**Tesha Malama**	--	04-08-08
74	**Agnes Patopan**	--	04-09-08
75	**Al Chock**	--	04-03-08
76	**Johnnie-Mae Perry**	--	04-08-08
Agricultural Tenants			
77	Frank Law (Fat Law's Farm Inc.)	02-20-08	--
78	**Aloun Farm, Inc.**	02-20-08	04-01-08
79	Sugarland Farms, Inc.	02-20-08	--
80	Rocker G Livestock	02-20-08	--
81	Syngenta Seeds, Inc.	02-20-08	--
82	Yoshikawa Farms	02-20-08	--
Ho'opili Task Force Members			
83	Maureen Andrade	02-20-08	--
84	Gary Bautista	02-20-08	--
85	Dick Beamer	02-20-08	--
86	Scott Belford	02-20-08	--

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	AGENCY	DEIS MAIL DATE	DATE OF COMMENTS
87	Kurt Fevella	02-20-08	--
88	Pearlyn Fukuba	02-20-08	--
89	Frank Genadio	02-20-08	--
90	Michael Golojuch	02-20-08	--
91	Richard Hargrave	02-20-08	--
92	Coby Lynn	02-20-08	--
93	Richard Oshiro	02-20-08	--
94	Rodolpho Ramos	02-20-08	--
95	Frances Rivero	02-20-08	--
96	Ross Rolirad	02-20-08	--
97	Georgette Stevens	02-20-08	--
98	Summer Thomson	02-20-08	--
99	Maeda Timson	02-20-08	--
100	Karen Wenke	02-20-08	--
101	Chuck Wheatly	02-20-08	--
102	Lance Widner	02-20-08	--
103	George Yakowenko	02-20-08	--
104	Linda Young	02-20-08	--

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LINDA LINGLE
Governor

SANDRA LEE KUNIMOTO
Chairperson, Board of Agriculture

DUANE K. OKAMOTO
Deputy to the Chairperson

State of Hawaii
DEPARTMENT OF AGRICULTURE
1428 South King Street
Honolulu, Hawaii 96814-2512
Phone: (808) 973-9600 Fax: (808) 973-9613

April 8, 2008

FACSIMILE TRANSMITTAL (3 pages) 523-1402

Mr. Vincent Shigekuni
Vice President
PBR Hawaii
ABS Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Draft Environmental Impact Statement (DEIS)
Hoopili (D.R. Horton – Schuler Homes)
TMK: 9-1-17: por. 4, 59, 72
9-1-18: 1, 4
Area: 1,553.884 acres

The Department of Agriculture has reviewed the subject document and offers the following comments and recommendations.

The proposed development will require the reclassification of the entire project area from the Agricultural to the Urban District. The City's Ewa Development Plan designates the area primarily for residential uses. Full development of the project will span from 2009 to 2030.

The project site has many of the attributes that would likely qualify it as candidate Important Agricultural Lands, pursuant to Chapter 205, Hawaii Revised Statutes. The Department of Agriculture acknowledges, however, that for many years the City has designated the project site and the balance of the Ewa plain for urban growth. Nevertheless, the loss of these highly productive agricultural lands and the relocation of the farming operations northward make it imperative that the agricultural lands, north of the H-1 Freeway and along Kunia Road, designated as "Agricultural Land Preservation"

Mr. Vincent Shigekuni
April 8, 2008
Page -2-

in the Ewa Development Plan and Central Oahu Sustainable Communities Plan remain in agriculture.

There are four farming operations that are leased or licensed to occupy nearly the entire project site – Aloun Farms (1,000 acres of which 301 are planted), Fat Law's Farm (100 acres of which 80 are planted), Sugarland Farms (197 acres of which 64 are planted), and Syngenta Seeds (200 acres of which 59 are planted).

We find the Agricultural Impact Analysis (AIA) to be very comprehensive and detailed in its description and analysis, but underplays the impact on agriculture by comparing to statewide rather than Oahu parameters. We recommend the full impact of the loss of productive agricultural use of the project site found throughout Volume I of the DEIS be discussed from an Oahu rather than statewide perspective as the primary market for most of the agricultural production is on Oahu. For instance, the 1,497 acres of leased agricultural land in the project site is 13.7% of the 10,900 acres of farm land said to be available on Oahu (3,150 acres in Kunia and 7,750 acres in the North Shore - Appendix A, page ES-5, section 9-b). The $6 million in farmgate revenues is about 4.4% of Oahu revenue from sales of all crops (2005 Statistics of Hawaii Agriculture, page 12), or 15.4% of the farmgate value of vegetables and melons produced on Oahu (ibid., page 11). The farm worker employment of 77 people represents about 3.7% of all the farm workers on Oahu (ibid., page 87).

Timely relocation of farms and related assets to new production areas is important to minimize the impact of the project on agriculture in general and maintain the availability of a significant supply of fresh food for Oahu. We note that the "...(p)etitioner continues to work on the eventual relocation of the largest tenant, Aloun Farm, Inc., to other farm areas in Central Oahu and the North Shore..." (DEIS Volume 1, page 30). We recommend that the EIS disclose and the Land Use Commission consider requiring meaningful relocation assistance be given to all affected farming operations. Furthermore, the importance of phased development and allowing cultivation of these lands up until the last possible moment is important and should be made a condition of approval by the Land Use Commission, given the 21-year build-out period and the importance of the production in the area to supplying Oahu's demand for fresh fruits and vegetables. Aloun Farms has vacuum cooling and packing facilities, these assets and those of the other farming operations should be described in the EIS and considered as part of the cost of relocation, particularly if they are fixed (immobile) assets. The lower-than-market land rents (ranging from $194 to $630 per acre/year) and irrigation water (pumped groundwater) will be difficult to match elsewhere, and as noted in the report, the primary source of irrigation water for the North Shore agricultural lands is contaminated with sub-standard treated effluent and until R-1 effluent standard can be achieved, cannot be used on directly edible crops (AIA, pages 29-30). In summary, farm relocation is likely to be expensive and time-consuming, even with the business-tested skills of the affected farmers.

AR00027387

Thank you for the opportunity to comment on this DEIS. Should you have any questions, please contact Earl Yamamoto at 973-9466 or email at earl.j.yamamoto@hawaii.gov.

Sincerely,

Sandra Lee Kunimoto
Chairperson, Board of Agriculture

c: Rodney Maile, Acting Director
State Land Use Commission
P. O. Box 2359
Honolulu, Hawaii 96804

Office of Planning

HoopiliEIS2.e08

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
Chairman

THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
Executive Vice-President

VINCENT SHIGEKUNI
Vice-President

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Wailuku, Hawai'i 96793-1271
Tel: (808) 242-2878

Ms. Sandra Lee Kunimoto, Chairperson
State of Hawaii
Board of Agriculture
1428 South King Street
Honolulu, Hawai'i 96814-2512

Attn: Mr. Earl Yamamoto

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Ms. Kunimoto:

Thank you for your letter dated April 8, 2008. We have reviewed your letter and offer the following responses:

Department of Agriculture Comment: "The project site has many of the attributes that would likely qualify it as candidate Important Agricultural Lands, pursuant to Chapter 205, Hawaii Revised Statutes. The Department of Agriculture acknowledges, however, that for many years the City has designated the project site and the balance of the Ewa plain for urban growth. Nevertheless, the loss of these highly productive agricultural lands and the relocation of the farming operations northward make it imperative that the agricultural lands, north of the H-1 Freeway and along Kunia Road, designated as "Agricultural Land Preservation" in the Ewa Development Plan and Central Oahu Sustainable Communities Plan remain in agriculture."

Response: We concur some that the property has some of the criteria that would qualify it as Important Agricultural Lands (IAL), the most important criteria being that it is currently in an economically viable agricultural production. It should be noted that the viability of existing agricultural operations is facilitated by extremely favorable land lease and water rates, which are kept at or below market rates). We also concur that since the City has designated the project site and the balance of the 'Ewa plain for urban growth, which the State has strongly supported. This is evidenced by the fact that the State played and continues to play a significant role in planning and funding for the growth of the Second City in Kapolei on formerly highly productive agricultural lands. Major investments in infrastructure (traffic) and other State-funded facilities and projects (the Villages of Kapolei, State office building, the planned new judiciary complex, various DHHL housing developments and the new UH West O'ahu Campus) have contributed and will contribute to the growth of the Second City.

AR00027388

Department of Agriculture Comment: "There are four farming operations that are leased or licensed to occupy nearly the entire project site — Aloun Farms (1,000 acres of which 301 are planted), Fat Law's Farm (100 acres of which 80 are planted), Sugarland Farms (197 acres of which 64 are planted), and Syngenta Seeds (200 acres of which 59 are planted)."

Response: We note the findings of the Agricultural Impact Analysis prepared for the DEIS differ slightly with the information provided above. Table 2 of the Agricultural Impact Analysis ("Hoopili Impact on Agriculture," Decision Analysts, Inc., February 2008) calculates the following: Aloun Farms (1,000 acres of which 301 are planted), Fat Law's Farm (100 acres of which 60 are planted), Sugarland Farms (197 acres of which 74 are planted), and Syngenta Seeds (200 acres of which 52 are planted).

Department of Agriculture Comment: "We find the Agricultural Impact Analysis (AIA) to be very comprehensive and detailed in its description and analysis, but underplays the impact on agrieulture by comparing to statewide rather than Oahu parameters. We recommend the full impact of the loss of productive agricultural use of the project site found throughout Volume I of the DEIS be discussed from an Oahu rather than statewide perspective as the primary market for most of the agricultural production is on Oahu. For instance, the 1,497 acres of leased agricultural land in the project site is 13.7% of the 10,900 acres of farm land said to be available on Oahu (3,150 acres in Kunia and 7,750 acres in the North Shore -Appendix A, page ES-5, section 9-b). The $6 million in farmgate revenues is about 4.4% of Oahu revenue from sales of all crops (2005 Statistics of Hawaii Agriculture, page 12), or 15.4% of the farmgate value of vegetables and melons produced on Oahu (ibid., page 11). The farm worker employment of 77 people represents about 3.7% of all the farm workers on Oahu (ibid, page 87)."

Response: Based on the information your Department provided, the third and twelfth paragraphs of Section 3.4 *Agricultural Impact, Anticipated Impacts and Mitigation Measures* of the Final EIS will be revised as follows:

> *The creation of the Ho'opili project will require that the approximately 1,553.844 acre Petition Area be withdrawn from agricultural use. The project will result in a direct loss of approximately 1,497 acres of agricultural land being leased for various agricultural operations. This amounts to less than one percent of the approximately 160,000 acres of agricultural land that remain available throughout the State of Hawai'i. On the island of O'ahu, approximately 10,900 acres of agricultural land would remain available in Kunia and the North Shore. <u>During the Draft EIS public review period, the State Department of Agriculture commented that the 1,497 acres of leased agricultural land in the project site is 13.7% of the 10,900 acres of farm land reported to be available on Oahu (3,150 acres in Kunia and 7,750 acres in the North Shore)...</u>*
>
> *Upon full build-out of the Ho'opili project, approximately $6 million per year in revenues, an average of about 80 jobs and $1.7 million per payroll will be displaced from the Petition Area. <u>According to comments received from the State Department of Agriculture during the Draft EIS public review period, "the $6 million in farmgate revenues is about 4.4% of Oahu revenue from sales of all crops (2005 Statistics of Hawaii Agriculture, page 12), or 15.4% of the farmgate value of vegetables and melons produced on Oahu (ibid., page 11). The farm worker employment of 77 people represents about 3.7% of all the farm workers on Oahu (ibid, page 87)."</u> Affected lessees are anticipated to be able to secure replacement lands, therefore, enabling them to maintain prior levels of production, sales revenues, employment and payroll. Should sufficient replacement land not be available on the island of O'ahu, then other options include the relocation of agricultural businesses to Neighbor Islands with available agricultural land.*

Department of Agriculture Comment: "Timely relocation of farms and related assets to new production areas is important to minimize the impact of the project on agriculture in general and maintain the availability of a significant supply of fresh food for Oahu. We note that the "...(p)etitioner continues to work on the eventual relocation of the largest tenant, Aloun Farm, Inc., to other farm areas in Central Oahu and the North Shore..." (DEIS Volume 1, page 30). We recommend that the EIS disclose and the Land Use Commission consider requiring meaningful relocation assistance be given to all affected farming operations. Furthermore, the importance of phased development and allowing cultivation of these lands up until the last possible moment is important and should be made a condition of approval by the Land Use Commission, given the 21-year build-out period and the importance of the production in the area to supplying Oahu's demand for fresh fruits and vegetables. Aloun Farms has vacuum cooling and packing facilities, these assets and those of the other farming operations should be described in the EIS and considered as part of the cost of relocation, particularly if they are fixed (immobile) assets. The lower- than-market land rents (ranging from $194 to $630 per acre/year) and irrigation water (pumped groundwater) will be difficult to match elsewhere, and as noted in the report, the primary source of irrigation water for the North Shore agricultural lands is contaminated with sub-standard treated effluent and until R-1 effluent standard can be achieved, cannot be used on directly edible crops (AIA, pages 29-30). In summary, farm relocation is likely to be expensive and time-consuming, even with the business-tested skills of the affected farmers."

Response: As indicated in the Draft EIS, the Petitioner has been working to assist the tenants in finding a suitable site or sites for relocation. However, to date, no site has been secured for that purpose. Given the planned growth in the region, the leases issued to the existing tenants reflected the fact that the area would be subject to urbanization in the future. The tenants all signed the leases with full knowledge of the circumstances. In the meantime and in light of the pending development of the region, land and water were kept at or below market rates.

We note your Department's comments that suggest that the Land Use Commission require meaningful relocation assistance be given to all affected farming operations. As indicated in the prior response, the Petitioner has been working to assist tenants to find sites for relocation and has been subsidizing their rents through below market rates for land and water. Indeed, provisions were also made for multi-year abatement of rent payments as a material enhancement to enter into a lease for an area that was openly acknowledged by all parties as slated for urban development.

With respect to your comment that Aloun Farms' assets such as their vacuum cooling and packing facilities and those of the other farming operations should be described in the EIS and considered as part of the cost of relocation, particularly if they are fixed (immobile) assets. We

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have fully informed all tenants, including Aloun Farms, of the impending urbanization of the area and have cautioned against additional improvements being located in the Petition Area. In addition, the Petitioner's consideration of their tenants' future requests for improvements will take into consideration the impending development in the area.

It should also be noted that this area has been designated as an urban growth area and the State is also actively developing in the region on adjacent agricultural lands into the Villages of Kapolei, UH West O'ahu (UHWO) Campus, North-South Road and the Department of Hawaiian Home Lands East Kapolei development. As you are aware, Aloun Farms is also a tenant on State lands and will have to relocate from the UHWO and DHHL sites. The State played and continues to play a significant role in planning and funding for the growth of the Second City in Kapolei. Major investments in infrastructure and other publicly funded facilities have contributed to the growth of the Second City. In addition, the City and County of Honolulu is planning on embarking on what may be the largest Capital Improvement Project in the State's history in its Honolulu High Capacity Transit project, which is planned to start in East Kapolei and run through the Petition Area. Finally, during the public review period, the State Department of Land and Natural Resources (DLNR), Engineering Division wrote: "DLNR currently owns approximately 183 acres of land near and/or adjacent to the Ho'opili project...The DLNR parcels have excellent development potential based on the location of these lands adjacent to or near major arteries (H-1 Freeway, Farrington Highway, North-South Road) and the City's proposed transit line as well as the substantial increase development projects in the area." The DLNR parcels are being leased by some of the same tenants within the Petition Area.

In light of these impending State and County projects, the Petitioner has been working with its agricultural tenants to continue their operations on the Petitioner's land at Petitioner subsidized rates with the full understanding that the Petitioner will develop within the area in the next ten years. We have been and will continue to coordinate with our tenants on our development plans so that relocation will go as smoothly as possible; however, we respectfully disagree with the Department's suggestion that the Petitioner is singled out by being responsible for its tenants' relocation costs when it has attempted to accommodate displaced tenants from other urbanized areas, including State lands.

Thank you again for your Department's participation in the Environmental Impact Statement process for this project. Your Department's comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

AR00027390

LINDA LINGLE
GOVERNOR

RUSS K. SAITO
COMPTROLLER

BARBARA A. ANNIS
DEPUTY COMPTROLLER

STATE OF HAWAII
DEPARTMENT OF ACCOUNTING AND GENERAL SERVICES
P.O. BOX 119, HONOLULU, HAWAII 96810

(P)1070.8

MAR - 6 2008

Mr. Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Hoopili, Oahu, Draft Environmental Impact Statement (DEIS) to Reclassify Approximately 1,553.844 Acres from Agriculture to Urban. Petition area: TMK 9-1-17:04 (portion), 59, and 72; 9-1-18:01 and 04; Remainder of the Project Area: 9-1-10:02, 14 (portion), and 15 (portion) and 9-1-17:04 (portion), and 9-2-01: 04, 05, 06 and 07; and 9-2-02:02

Thank you for your letter dated February 20, 2008. This project does not directly affect the Department of Accounting and General Services' projects or existing facilities, and we have no comments to offer at this time.

If you have any questions, please have your staff call Mr. Bruce Bennett of the Planning Branch at 586-0491.

Sincerely,

ERNEST Y. W. LAU
Public Works Administrator

BB:mo
c: Ms. Katherine P. Kealoha, DOH-OEQC
Mr. Rodney Maile, State Land Use Commission

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Mr. Ernest Y. W. Lau, Public Works Administrator
State of Hawai'i
Department of Accounting and General Services
P.O. Box 119
Honolulu, Hawai'i 96810

Attn: Mr. Bruce Bennett

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Lau:

Thank you for your letter dated March 6, 2008 (your reference number: (P)1070.8). We acknowledge your assessment that the proposed project does not directly affect the Department of Accounting and General Services' projects or existing facilities, and therefore, the department has no comments to offer at this time.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

STRATEGIC INDUSTRIES DIVISION
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April 8, 2008

PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Attn: Vincent Shigekuni

Re: Draft Environmental Impact Statement (DEIS)
Ho'opili, Ewa, Oahu
Tax Map Key: 9-1-17:04 (portion, 59, and 72; 9-1-18:01 and 04; 9-1-10: 02, 14 (portion), and 15 (portion) and 9-2-02:02, and 9-2-02:01 (portion), 04, 05, 06 and 07

In response to your February 20, 2008, notice, thank you for the opportunity to provide comments on the DEIS for the Ho'opili development. We have no additional comments to those in our April 9, 2007, letter to you.

Sincerely,

Elizabeth Corbin

Elizabeth Corbin
Acting Energy Program Administrator

c: OEQC
State Land Use Commission

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
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Associate

Ms. Elizabeth Corbin
Acting Energy Program Administrator
State of Hawai'i
Department of Business Economic Development & Tourism
Strategic Industries Division
P.O. Box 2359
Honolulu, Hawai'i 96804

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Ms. Corbin:

Thank you for your letter dated April 8, 2008. We acknowledge that your department has no additional comments to those provided in your Department's letter dated April 9, 2007.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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Department of Business, Economic Development & Tourism
State of Hawai'i

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Interim Executive Officer

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Chief Clerk

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Senior Planner

FRED A. TALON
Drafting Technician

March 27, 2008

Mr. Vincent Shigekuni, Vice President
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Docket No. A06-771
Draft Environmental Impact Statement (DEIS)
Ho`opili
Ewa, Oahu, Hawaii
Tax Map Keys: 9-1-17: por. 4, 59, and 72; and 9-1-18: 1 and 4

We have reviewed the subject DEIS for the proposed development and have the following comments:

1) In accordance with section 11-200-17(e)(5), HAR, the phasing and timing of the proposed action should be described. The DEIS points out that the project timeline extends from 2009 to 2030. Pursuant to the Land Use Commission's (LUC) rules (§15-15-50(c)(19), HAR), in the event full urban development cannot substantially be completed before ten years following LUC approval, a schedule for development of the total project together with a map identifying the location of each increment shall be provided. Accordingly, we request that the current development timetable in the DEIS be expanded to more specifically identify the phases of each component of the development and their respective timeline for completion and also be accompanied by a map illustrating their location.

2) In accordance with section 11-200-17(f), HAR, alternatives to the proposed action should be described in a separate and distinct section. We note that the alternatives that are presented are primarily discussed in a negative context relative to the proposed development. Please also include a discussion on the potential benefits of the alternatives, including the extent to which the alternatives could avoid some or all of the short and long-term adverse environmental effects.

235 SOUTH BERETANIA STREET ● SUITE 405 ● HONOLULU, HAWAI'I 96813 ● TEL (808) 587-3822 ● FAX (808) 587-3827 ● EMAIL: luc@dbedt.hawaii.gov
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804

3) In accordance with section 11-200-17(h), HAR, the status of each identified approval should be described. Therefore, we request that to the extent possible the *projected* submittal dates (i.e., by month/year) of the applications and plans for approval to the various agencies be provided.

4) In accordance with section 11-200-17(i), HAR, the probable impact of the proposed action on the environment shall be included. Review of the DEIS indicates that no inventory and assessment of arthropods on the subject property was conducted. In the interest of full environmental disclosure, we request that such a study be conducted.

In addition, we request that the discussion on solid waste disposal (section 4.8.6) reference the LUC's recent action that extended the deadline to close the Waimanalo Gulch Sanitary Landfill to November 1, 2008, and the current plans of the City and County of Honolulu Department of Environmental Services to expand the landfill by another approximately 92.5 acres.

A discussion on the existing civil defense conditions and potential impacts and proposed mitigation measures should also be included.

Section 11-200-17(i), HAR, also requires that the interrelationships and cumulative impacts of related projects be discussed, including the potential secondary effects. We note that section 7.2, *Cumulative and Secondary Impacts*, confines the discussion to proposed developments in the East Kapolei region to include the University of Hawaii at West Oahu campus, the Department of Hawaiian Home Lands East Kapolei Development Parcels 1 and 2, and the Kroc Center. We note that there is no mention of *existing* developments in the Ewa District in which the project is situated. Accordingly, we request that existing developments, including, but not limited to, the communities of Waipahu, West Loch, and Ewa Villages also be considered in the assessment of cumulative and secondary effects.

5) We note that the subject property was cultivated in sugarcane or pineapple and is currently used for, among other things, diversified agriculture. As such, there may be chemicals associated with these activities that are present in the soils. To the extent that such chemicals could be a threat to public health and the environment, we request that this matter be assessed to determine the potential risks and any remedial action that needs to be taken.

6) We request that information on the cost of the project be expanded to include a breakdown of costs by component (onsite and offsite) and by development phase.

7) For your information, Schuler Homes, Inc., a Delaware corporation, filed a Petition for Land Use District Boundary Amendment (Petition) on May 16, 1996, to reclassify a portion of the Petition Area, consisting of approximately 753.573 acres of land, from the Agricultural District to the Urban District for single and multi-family residential, commercial, school, and park uses. The Petition was voluntarily withdrawn pursuant to

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the Commission's Order Granting Motion to Withdraw Petition for Land Use District Boundary Amendment dated September 18, 1996. We request that the DEIS be revised to include this previous filing in the background description of the Petition Area.

We have no further comments to offer at this time. Thank you for the opportunity to comment on the subject DEIS.

Should you have any questions, please feel free to call me or Bert Saruwatari of our office at 587-3822.

Sincerely,

RODNEY A. MAILE
Interim Executive Officer

c: Office of Environmental Quality Control

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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SCOTT ALIKA AHRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Dan Davidson, Executive Officer
Land Use Commission
Department of Business, Economic Development & Tourism
State of Hawai'i
P.O. Box 2359
Honolulu, Hawai'i 96804

Attn: Mr. Bert Saruwatari

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Davidson:

Thank you for the letter dated March 27, 2008. We have reviewed the LUC's letter and offer the following response to your comments.

1. As requested the preliminary phasing and timing of the proposed project will be provided in the Final EIS. Section 2.7 *Development Timetable and Preliminary Costs* of the Final EIS will be revised as follows:

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Tel: (808) 242-2878

AR00027394

The Petitioner estimates that the development of the Ho'opili project (major off-site and on-site infrastructure improvements including grading, drainage, sewer, safe-drinking water, non-potable water, roadways, landscaping and improvements to Farrington Highway and North-South Road for access) will cost approximately $4.6 billion (in Year 2007 dollars), spent over the project timeline of 2009 – 2030. During the public review period, both the Land Use Commission and the State Office of Planning made reference to subsection 15-15-50, Hawaii Administrative Rules (HAR). Subsection 15-15-50, HAR identifies the form and contents of a petition to the State Land Use Commission to amend the State Land Use District Boundaries, including representing "...that development of the subject property in accordance with the demonstrated need therefore will be accomplished before ten years after the date of commission approval. In the event full urban development cannot substantially be completed within such period, the petitioner shall also submit a schedule for development of the total of such project in increments together with a map identifying the location of each increment, each such increment to be completed within no more than a ten-year period." The construction of Ho'opili's development will be a challenging process that will require ongoing coordination between many fundamental parts. Infrastructure and road access, neighboring property development, demands of the commercial and housing markets, careful continued agriculture and general property management, and economic viability will all be considered throughout the construction planning process. Furthermore, the City & County of Honolulu's (City) transit project, the largest public works endeavor in Hawai'i's history, will within Ho'opili have its longest traverse through privately owned property and further expand development challenges undoubtedly in unprecedented ways. Many of these parts may involve developing different areas of the project site within the same construction timetable as discussed further below:

Several major development priorities include in no particular order:

- *Water Service from the North. Both of Ho'opili's main potable water storage and transmission systems will reside mauka of H-1. Considerable investment will be required in the construction of tanks and transmission lines that will ultimately service two water zones within Ho'opili that roughly divide the site between northern and southern halves. (Necessary offsite utility easements have already been secured at a price.) Nonpotable water will be sourced from the reclamation operations at the Honouliuli Wastewater Treatment Plant (WWTP), meaning it will be delivered to Ho'opili from the opposite end from where its potable source will come. Preliminary budgetary construction cost estimates range from between $35 million to $40 million with another $20 million possible from BWS for service connections.*

- *Sewer Service from the South. Unlike Ho'opili's main water system, sewer service will come from the southern end of the property. The first of what is expected to be several Joint Development Agreements (JDA) to secure and construct wastewater transmission is in place with DHHL, UHWO, DLNR and the City and funded. Indeed, the DOT has already constructed this line as part of the North-South Road Phase 1A contract. Discussions are expected to commence later this year in earnest on separate JDAs for two additional segments. Nearly $2 million has already been invested to date, preliminary budgetary costs estimates for these two JDAs range from $10 million to $15 million to stub service at the property's southwestern border, $5 million to $10 million to route through to the mauka area and as much as another $60 million for the City's Department of Environmental Services uses connection charges.*

- *Balancing Spread out Access, Initial Infrastructure Needs and Cash Flows. Today, Ho'opili's lands along the Farrington Highway corridor, its northernmost boundary, present Ho'opili's easiest access for construction purposes and future occupants. Once DHHL completes its section of the East-West Connector Road and the State DOT completes the North-South Road (both now under construction), Ho'opili will have construction and occupant access open at its southern and westernmost locations. This is significant because while available for development today, the Farrington Highway corridor is expected to present some of Ho'opili's greatest development challenges, predominantly the distance sewer lines will have to run through undeveloped land for service, as well as timing development to the City's planned improvements to Farrington Highway itself. Thus, the Petitioner will look to mobilize on these other areas as early as practicable. Nonetheless, there are several key commercial parcels in this Farrington Highway corridor that will need to be among the earliest to be marketed in order to generate cash flow to support needed upfront utility (such as water and sewer as detailed above) and road infrastructure throughout Ho'opili. As a result, development should be started in more than one area from the onset. Over the build-out of the project, it is expected that as much as $50 million to $60 million could be spent on drainage systems and hundreds of millions will be invested in roadway systems servicing the project.*

- *Balancing Job Generation, Appropriate Initial Housing Deliveries and Transit. The majority of the employment areas within Ho'opili are within the Farrington Highway corridor to the north of the property, while the residential development areas that could be most sensible to develop first – the single-family areas – are to the south. Starting housing construction there could generally preserve higher density development in the areas in and around the transit corridor to the north to be better staged with transit's completion and more appropriately address the various demands it will create.*

- *Managing Agricultural Operations. As lands are moved into development over time, consideration will have to be given to the significant challenges of maintaining a working agricultural water system and providing ongoing and unencumbered vehicular access to crop areas. This will be no small task, as it will be the objective of the Petitioner to keep active farms onsite as long as practicable.*

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As previously stated the development is expected to occur over approximately 20 years. This area of 'Ewa has long been planned for development (Kapolei Area Long Range Master Plan and Ewa Development Plan).

There are several major transportation projects that have been planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the first segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area. As major off-site infrastructure (water, sewer, drainage, electrical and communications) would likely occur in most of the above major road right-of-ways, and the exact timing of the completion of these transportation improvements undetermined, it is difficult for the Petitioner to provide a map identifying the phasing of the proposed action in 10 year increments with any degree of certainty. While the phasing of development may be more relevant where there is little or no development, 'Ewa has rapidly developed in recent years and proposed transportation improvements are indicative of State and County assumptions that this portion of 'Ewa would be eventually developed.

2. Alternatives to the proposed action were already described in separate and distinct sections of the Draft EIS (Section 6.0). Section 6.0 *Alternatives to the Proposed Action* of the Final EIS will be revised as follows:

In compliance with the provisions of Title 11, Department of Health (DOH), Chapter 200, Environmental Impact Statement Rules, Section 11-200-10(6), the alternatives considered are limited to those that would satisfy the objectives of the proposed mixed-use development, while minimizing the potential for adverse environmental impacts. The feasible alternatives must realistically address the project's economic characteristics while also responding to the surrounding land uses that will be impacted by the project. In conformance with applicable regulations, other possible alternatives have been investigated to identify alternative sites, the appropriate uses for the property, and how they would best be accomplished.

6.1 "No-Action" Alternative

The "no-action" alternative would not be consistent with stated governmental policies, which direct future growth to the 'Ewa region. The City and County of Honolulu General Plan states:

> *Encourage development within the secondary urban center at Kapolei and the Ewa and Central Oahu urban-fringe areas to relieve developmental pressures in the remaining urban-fringe and rural areas and to meet housing needs not readily provided in the primary urban center.*

Under this alternative, the site would remain as agricultural land, underutilized in terms of meeting the demand for residential homes (including affordable homes) and accompanying land uses. The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall. The demand for housing could result in the following scenarios or combinations thereof: there would be more pressure to develop in the other districts, including the rural areas and other areas currently used for cultivation; there could be a demand for higher density housing in undeveloped areas of 'Ewa at a density not experienced to date; there would be more "doubling up" (larger number of persons per household, with more than one family under roof); those that are not willing to put up with the previously described scenarios may decide to relocate to the U.S. mainland where housing prices have dropped.

The "no-action" alternative was rejected because it is not consistent with government plans to develop Kapolei as the Second City.

6.2 Alternative Sites

There are very few large parcels left on O'ahu that are designated for residential development. The largest amount of developable land that is undeveloped lies in Central O'ahu and on the North Shore. As shown on the Ewa Development Plan, the Petition Area is designated mostly Low and Medium Density Residential. As such, the City and County of Honolulu has long recognized that the Petition Area is best used for residential and other development. Directing growth to 'Ewa and in the "urban-fringe" portions of Central O'ahu reduces the pressure to develop outside of the Urban Growth Boundary of Central O'ahu, and the North Shore, Ko'olau Loa, Ko'olau Poko and Wai'anae districts. This alternative has been rejected because it would be clearly contrary to General Plan policy. The potential benefit of this alternative is that for those that object to further development on the 'Ewa Plain, it might be preferable for development to occur elsewhere on O'ahu, such as in the Primary Urban Center, East Honolulu, Central O'ahu, North Shore, Ko'olau Loa, Ko'olau Poko and Wai'anae districts.

The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff

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generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall.

6.3 Alternatives Related to Different Designs or Details of the Proposed Actions Which Would Present Different Environmental Impacts

Different designs could be applied to the project, and depending on the density and design capacity, would result in different environmental impacts. For example, a higher density project that kept the same residential unit count as proposed (11,750) would reduce the buildable area (a positive benefit) and possibly reduce the quantity of surface runoff (a positive benefit). ~~This~~ Another potential benefit of this alternative is that it would likely be easier to serve by bus and correspondingly increase ridership. However, the residential buildings would be larger and taller. This alternative would not allow as wide a range of residential products to market and was thus rejected. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion).

Another alternative would be to set aside less open space and to spread out the community over a larger land area. Such an alternative is best portrayed by the current Kapolei Long Range Master Plan and Ewa Development Plan Land Use Map designations for the Petition Area. This alternative would reduce the density (to some, a positive benefit) but consume more land, increasing the quantity of surface runoff, and requiring a much larger investment in grading and infrastructure. This alternative would make it difficult for residents to be served by bus, and even more difficult by high-capacity transit. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). This alternative was also rejected.

The demand for safe drinking water and the quantities of wastewater, solid waste, and traffic generated would vary with different designs, depending on the number/quantity of residential units, schools, commercial square footage, and roads.

6.4 Actions of a Significantly Different Nature Which Would Provide Similar Benefits With Different Environmental Impacts

One scenario that would be significantly different from the proposed action is that an elevated rail line and accompanying transit stops would not be built through Ho'opili. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts (assume greater traffic impacts than without the HHCTC project); and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). The impacts of this scenario will be more fully described in the upcoming HHCTC DEIS.

For the 'Ewa district drivers enduring the longest morning commutes to the Central Business District or UH Mānoa, the modes of transportation will continue to be limited to: private motorized vehicle (including zipper lane), TheBus, TheBoat, Vanpool, et cetera. While this is a scenario that could inevitably result in lengthening commute times, individual commuters will either: bear with the commute in return for the comfortable lifestyles offered by their homes in 'Ewa; move from their homes in 'Ewa and move closer to their workplaces or schools; or find schools and/or employment in the 'Ewa region. The opening of UHWO will reduce traffic from those undergraduate students in Leeward and Central O'ahu who commute to UH Mānoa, and indirectly reduce the demand for student housing on the UH Mānoa campus (reducing the demand for off-street parking demand on campus, reducing the demand for on-street parking in the surrounding neighborhoods, increasing the supply of student housing on campus, and reducing the demand for student housing off-campus). If the Petitioner is allowed to develop a mixed-use (residential/commercial/office/light industrial) project as proposed, then, more employment opportunities will be provided to existing residents of the region, reducing the need for some 'Ewa residents to commute outside of the District to work. To offset the non-implementation of the HHCTC project, the City and County of Honolulu may decide to increase The Bus and The Boat services. The positive benefits of this alternative is that the visual impact impacts of an elevated rail system would be avoided as well as long-term commitment of State and Federal funds for the HHCTC project. This alternative is not desirable, but feasible.

6.5 The Alternative of Postponing Action Pending Further Study

Development of the 'Ewa region as O'ahu's Second City has been studied and planned for many years. Further study of any proposed development on the property would only be delaying what has long been proposed in the Ewa Development Plan. Therefore, this alternative was rejected, as it would not achieve the overall objectives for the project, which would create a mixed-use community that more employment opportunities will be provided to existing residents of the region, reducing the need for some 'Ewa residents to commute outside of the District to work. The potential

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benefit of this alternative is that while remaining under cultivation, the site would provide open space. Occasionally, however, continued cultivation of the site would generate dust when portions of the site are harvested and plowed. Implementation of this alternative will temporarily avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall.

3. As requested, Table 2.3 *Required Permits/Approvals* of the EIS will be revised to include the projected submittal dates (as follows).

Table 2.3. Required Permits/Approvals

PERMIT/APPROVAL	APPROVING AUTHORITY	STATUS	PROJECTED SUBMITTAL DATE
State Land Use District Boundary Amendment (with EIS)	State of Hawai'i Land Use Commission	Petition has been filed; processing on hold until EIS process has been completed.	First Quarter 2007
Zone Change	City and County of Honolulu Department of Planning and Permitting/City Council	Application to be filed assuming successful processing of SLUDBA.	Third Quarter 2009
Large Lot Subdivision ~~Approval~~ Action	City and County of Honolulu Department of Planning and Permitting	Application to be submitted after change the Zone Change application is approved.	Third Quarter 2010
National Pollutant Discharge Elimination System (NPDES) Permit	State of Hawai'i Department of Health	Application to be submitted prior to Building/Grading Permits.	2011
Building/Grading Permits	City and County of Honolulu Department of Planning and Permitting	Application to be filed after the Zone Change application is approved.	2011
Water Use Permit	State of Hawai'i Department of Land and Natural Resources, Commission on Water Resource Management	Application to be submitted prior to Building/Grading Permits	2011

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4. As requested, an assessment of arthropods on the subject property was conducted and is enclosed to this letter. A new paragraph will be added before the last paragraph of Section, 3.8 Fauna, Existing Conditions of the Draft EIS:

> *During the public review period, the Land Use Commission requested an assessment of arthropods on the Petition Area. A survey of arthropods on the Petition Area was conducted on May 9, 2008 by Dr. Gregory Brenner of Pacific Analytics, L.L.C. The primary objectives of the survey were to: provide a general description of the arthropod fauna of the Petition Area; evaluate the habitats (if any); and search and assess the potential for threatened or endangered arthropod species as well as species of concern. According to Dr. Brenner, the arthropod species that were collected during the study would be considered typical of what would be found in lowland sites with little or no native vegetation and disturbed by agricultural operations. No species were found that are locally unique to the site. A copy of the assessment is attached to this EIS as Appendix R.*

In addition a new paragraph will be added after the last paragraph of Section 3.8 *Fauna, Anticipated Impacts and Mitigation Measures:*

> *The results of the arthropod survey at the Petition Area (See Appendix R) indicate that there are no special concerns or legal constraints related to invertebrate resources in the Petition Area. No invertebrate species listed as endangered, threatened or that are currently proposed for listing under either federal or State of Hawai'i endangered species statutes are known to exist on the project site.*

As requested, the second paragraph of Section 4.8.5 *Solid Waste Disposal Facilities* of the EIS will be revised as follows:

> *Waimānalo Gulch Landfill, which opened in 1989, is located northwest of the proposed Ho'opili project. While the land is owned by the City and County of Honolulu, the landfill is operated by Waste Management, Inc. The site accepts ash and residue from the H-POWER facility, industrial wastes, and non-combustible construction and demolition debris. Commercial haulers pay $72.75 per ton to dispose solid waste at the facility. During the public review period, the State Land Use Commission reported that it took action to extend the deadline to close the Waimanalo Gulch Sanitary Landfill to November 1, 2008, and the City and County of Honolulu Department of Environmental Services has plans to expand the landfill by another approximately 92.5 acres.*

As requested, a discussion on the existing civil defense conditions and potential impacts and proposed mitigation measures will also be included. During the public review period, the State Civil Defense's (SCD) requested that the developer install at least three outdoor warning sirens. A new paragraph will be added at the end of Section 3.6 *Natural Hazards, Anticipated Impacts and Mitigation Measures* of the EIS to read as follows.

> *During the public review period of the Draft EIS, the State Civil Defense (SCD) commented that "the developer install at least three outdoor warning sirens... At the present time SCD personnel recommends that the minimum-size siren have a sound rating of 121-decibels @ 100 feet, omni-directional and solar powered." SCD also noted that "As the development plans are finalized, State Civil Defense (SCD) will be better able to define the placement and size of the sirens." The Petitioner will continue to coordinate with the SCD as development plans are finalized to be better able to define the placement and size of the sirens.*

As requested, Section 7.2 *Cumulative and Secondary Impacts* of the EIS will be revised to include a discussion of existing developments.

> *This chapter identifies cumulative and secondary impacts that may result from the development of Ho'opili and the East Kapolei region. During the public review period, the State Department of Land and Natural Resources (DLNR), Engineering Division wrote: "DLNR currently owns approximately 183 acres of land near and/or adjacent to the Ho'opili project...The DLNR parcels have excellent development potential based on the location of these lands adjacent to or near major arteries (H-1 Freeway, Farrington Highway, North-South Road) and the City's proposed transit line as well as the substantial increase development projects in the area. Consequently, regional infrastructure should take into consideration the potential development of the DLNR parcels, and DLNR requests that it be included in the planning and design of any regional infrastructure in the area that would serve the DLNR parcels."*
>
> ***7.2.1 Impacts on the Physical Environment***
>
> *Climate, Topography, and Soils. Planned developments in the East Kapolei region (the proposed Ho'opili project, University of Hawai'i at West O'ahu (UHWO), Department of Hawaiian Home Lands (DHHL) East Kapolei Development Parcels 1 and 2, Kroc Center, and the "DLNR parcels") are not expected to adversely impact regional climate, topography, and soils of existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa Villages of Kapolei and Makakilo. However, within their respective project sites, construction of the East Kapolei developments will impact mostly minor topographic features and soils, and new buildings may affect the respective micro-climate of each building site (by retaining and/or reflecting solar energy and heat, creating shade where none presently exists, or creating "wind tunnels"). Grading operations will comply with DOH regulations and are not expected to adversely impact air and water quality.*
>
> *Drainage and Groundwater. Regional infrastructure will be developed to control drainage in the East Kapolei area, for those areas draining into Kalo'i Gulch. The planned developments will introduce impervious surfaces through the construction of buildings, roadways, parking areas, and walkways. Increased impervious surfaces*

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(i.e., roofs, roadway surfaces, and sidewalks) will increase the potential for runoff, although existing and proposed detention basins throughout East Kapolei will effectively manage drainage towards Kalo'i Gulch or other drainage basins. Through implementation of the proposed drainage improvements, the planned developments in East Kapolei are not expected to adversely impact existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Ocean Pointe, Villages of Kapolei and Makakilo. Additionally, landscaping introduced by the East Kapolei developments will reduce the potential for soil erosion, compared to current conditions on vacant and actively cultivated lands. All drainage facilities will comply with the City and County of Honolulu's Storm Drainage Standards. A non-potable water system will be developed for 'Ewa to reduce the demand for safe drinking water from the BWS system.

Natural Hazards. *It is unlikely that any of the proposed structures and uses associated with the planned developments in 'Ewa will affect the potential occurrence of earthquakes, hurricanes, or tsunami or adversely impact existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. By designing future structures to the then-approved building code, future buildings will likely be designed to mitigate the potential damage from natural hazards.*

Flora and Fauna. *The cumulative impact of the planned developments in East Kapolei is the reduction of habitat. However, past and present agricultural activities in the Petition Area have altered natural habitats; as such, existing flora and fauna are primarily introduced species. During construction, faunal species are likely to vacate the site for suitable habitats nearby. After construction, these species may return, depending on their preference of habitat and the landscaping provided. The planned developments in East Kapolei are not expected to adversely impact the flora and fauna of existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.*

7.2.2 Impacts on the Human Environment

Archaeological/Historic and Cultural Resources. *An archaeological inventory survey was conducted of the Petition Area. Five historic properties were documented on the Petition Area. All five historic properties have been assessed as eligible for the State Register of Historic Places under Criteria C and D, except for Site 4344, which is only eligible under criterion D. The State Historic Preservation Division (SHPD) concurs with these significance assessments. According to SHPD, the archaeological inventory survey report is now accepted. In addition, a preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for its review and approval. Recently completed archaeological inventory survey reports for both the proposed project and the neighboring 500-acre UHWO site provide more information about the 'Ewa area and consistently show that due to prior sugar cane cultivation, pre-historic features are nearly non-existent. A cultural*

impact assessment was also prepared for the Petition Area and it found that there are no contemporary or continuing cultural or traditional practices currently occurring within the proposed Project Area. Therefore, no impacts are expected and no mitigation measures are planned. The regional cumulative impacts on archaeological and cultural resources within 'Ewa appear to be minimal. The planned developments in East Kapolei are not expected to adversely impact the archaeological and historical resources of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Agriculture. *Lands in the Petition Area and the remainder of 'Ewa were historically used for sugarcane cultivation and most recently for diversified agriculture. Much of East Kapolei (including the Petition Area) is actively cultivated through short-term agreements. With the proposed developments in East Kapolei (UHWO, DHHL East Kapolei Development Parcel 1, DHHL East Kapolei Development Parcel 2 and Ho'opili, land will be withdrawn from production, resulting in some loss in revenues, jobs, and payroll, unless replacement agricultural leases are established elsewhere. While ~~A~~ample agricultural land is available to accommodate the projected growth of diversified agriculture on O'ahu (such as Central O'ahu and the North Shore) and elsewhere in the State of Hawai'i, some reviewers of the Draft EIS have expressed concern about the potential loss of agricultural land. The planned developments in East Kapolei are not expected to adversely impact the agricultural resources of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. However, ultimate development of the Petition Area and the remainder of East Kapolei will reduce the exposure of soils to the erosional forces of wind and rainfall.*

Noise. *Over the long term, as 'Ewa develops and the 'Ewa population grows, noise levels will increase above current conditions. Residential, business/commercial, light industrial/business, parks, schools and other public facilities will generate noise. New roadways and improvements to existing roadways are proposed, and vehicles traveling to, from, through, and within the 'Ewa area will be a significant contributar of noise. The planned HHCTC will also generate noise. East Kapolei is generally not surrounded by noise sensitive uses (residential, educational and medical structures and facilities). Mauka of East Kapolei is H-1 and vacant land. To the west is the Kapolei Golf Course. To the south are Kapolei Parkway and the 'Ewa Villages Golf Course and to the east and grade-separated is Old Fort Weaver Road and Honouliuli Village. ~~However~~Moreover, noise-sensitive uses (residential, educational and medical) occurring in buildings are likely to be insulated and equipped with air conditioners, mitigating noise from traffic, wind, and aircraft.*

Air Quality. *Emissions from cars and equipment used to generate electricity can affect air quality. The planned developments in East Kapolei will attract traffic and use electricity, but are not expected to significantly affect regional air quality, as new technologies, increasingly stringent air pollution control regulations and improving*

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automobile technology, and alternative forms of transportation (i.e., Honolulu High-Capacity Transit Corridor (HHCTC), buses and other public transportation, bicycling, walking) may offset potential increases in air pollution. Predominant tradewinds during the afternoon provide dispersal of emissions. The planned developments in East Kapolei are not expected to adversely impact the long-term air quality of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. Depending on the phase of construction, there will be occasions when dust may be generated despite mitigative measures (such as during gusts of particularly strong wind) and depending on the location of construction may affect Honouliuli (which is mostly upwind of the project site), 'Ewa Villages (separated by the 'Ewa Villages Golf Course) and the DHHL East Kapolei Development Parcel 2 project (abutting). The Petitioner and DHHL is coordinating on mitigating this potential impact.

Man-Made Hazards. No industrial facilities handling explosive or fire-prone materials (i.e., liquid propane, gasoline, or other storage tanks) exist in the Petition Area. However, there are two hazardous sites in and near the East Kapolei area – the former 'Ewa Sugar Mill, which is surrounded by the 'Ewa Villages residential and golf project and has a current status of No Further Remedial Action Planned, and the 'Ewa Sugar/O'ahu Sugar Company Pesticide Mixing and Loading Site, which is located to the east of North-South Road on Department of Hawaiian Home Lands (DHHL) property. The land uses proposed by the planned developments in 'Ewa (no heavy industrial land uses or zoning are proposed) are not likely to expose people or buildings to explosive or flammable fuels or chemical containers. The planned land uses in East Kapolei are not expected to expose residents of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo to noxious land uses.

Visual Resources. The planned developments in East Kapolei will change the open space character of the area and introduce urban structures and street trees including the UHWO campus, various types of residences (associated with DHHL, UHWO and the proposed project), commercial/industrial/business centers (associated with DHHL, UHWO and the proposed project), schools, public uses (the Kroc Center, churches) and transportation facilities (such as the North-South Road and in the most visually prominent scenario of high-capacity transit – elevated rail, associated transit stations, a park and ride facility and possibly a rail transit maintenance and storage facility). The East Kapolei developments will include landscaping to reduce the bulk of buildings and structures, and enhance the visual character of the sites. In the case of Ho'opili, open space buffers will reduce the impact of views from the H-1 Freeway, and relatively low-intensive land uses are proposed along Old Weaver Road near Honouliuli Village. Also within Ho'opili, mostly lower density housing is proposed along the 'Ewa Villages Golf Course and along DHHL East Kapolei Development Parcel 2, to maintain the character of these surrounding areas. The planned developments in East Kapolei will permanently replace the open space character of

East Kapolei with a master-planned community as viewed from the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

7.2.3. Impacts on the Socio-Economic Environment

Population, Housing, Neighborhood Commercial Uses, and Character/Lifestyle of the Community. *The planned developments (UHWO, DHHL East Kapolei Development Parcels 1 and 2, Kroc Center and Ho'opili) will help to further the growth of the Second City by adding to the critical mass of residential, business/commercial, light industrial/business, open space, parks, schools and other public facilities in 'Ewa, making it a more "complete" community. In the same fashion that many residents in East Honolulu or the Primary Urban Center have no need to leave to visit other districts for essential "goods and services," 'Ewa residents may someday have little need to leave their district. No homes or residents will be displaced by the East Kapolei projects, which will be developed on lands that are currently undeveloped, most of which is being cultivated. The planned developments in East Kapolei will provide a variety of live, work, play, study and shopping opportunities to the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo, which are not currently available on site.*

Economic Impacts and Employment. *As the planned developments in East Kapolei are gradually built out, agricultural lands will be withdrawn from agricultural production, resulting in some loss of revenues, jobs, and payroll. It is likely though, that cultivation is likely to gradually relocate to vacant agricultural land further north of East Kapolei and in Kunia, Central O'ahu, and the North Shore. Over time, the loss of economic productivity from agricultural activity will be more than offset by the construction of the planned developments, which will provide significantly greater revenues, more employment opportunities, and higher payrolls. Local businesses will profit from the developments in 'Ewa, and money spent by workers and businesses will flow through the West O'ahu regional economy particularly in the City of Kapolei. The County and State will benefit from the developments through the generation of real property, income and general excise tax revenues, more than off-setting government services. The planned developments in East Kapolei will provide a variety of live, work, play, study and shopping opportunities to the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo, which are not currently available on site.*

7.2.4. Impacts on Infrastructure Facilities

Water. *Many of the new residents in 'Ewa will have already been residing on O'ahu, thus the demand for water will shift from where they live now on O'ahu to 'Ewa. The 'Ewa projects are being designed assuming to assure that there are adequate sources, storage and transmission facilities to service 'Ewa, without having to reduce source from where future residents currently reside elsewhere on O'ahu and relocate*

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the water allocation to 'Ewa. UHWO and Ho'opili will be designed to include dual water systems, allowing new parks, open space and roadway landscaping to be irrigated with recycled water from the Honouliuli Water Reclamation Facility (WRF). The planned developments in East Kapolei are not expected to adversely impact the supply of drinking water for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Wastewater. Many of the new residents in 'Ewa will have already been residing on O'ahu, thus the need for collection, treatment and disposal of wastewater will shift from where they live now on O'ahu to 'Ewa. The 'Ewa projects are being designed assuming to assure that there are adequate collection, treatment and disposal facilities to service 'Ewa. Where other wastewater treatment facilities on O'ahu do not have the capability to provide recycled water, Honouliuli does. Also, since UHWO and Ho'opili will be designed to include dual water systems, this will allow parks, open space and roadway landscaping to be irrigated with recycled water from the Honouliuli WRF. The planned developments in East Kapolei are not expected to adversely impact the capacity of the existing wastewater system to treat and dispose of wastewater currently being generated from the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Drainage. The Petition Area falls within three different drainage basins. One of these three drainage basins, Kalo'i Gulch, is shared by UHWO, DHHL, Ho'opili and the Kroc Center. The Kalo'i Gulch drainage basin stretches to the top of the eastern slopes of the Wai'anae mountain range and terminates near the ocean in the vicinity of Haseko's Ocean Pointe development. The drainage basin, mauka of the H-1 Freeway, is 3,000 acres and generates a peak flow of 5,000 cubic feet per second (CFS). The drainage basin size increases to 4,330 acres and carries a peak flow of 8,900 CFS at the entrance to 'Ewa Villages. Approximately only 100 acres of the Ho'opili project are within this watershed.

The proposed developments in East Kapolei will increase impervious surfaces such as roadways, roofs, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Kalo'i Gulch drainage basin. However, each of the East Kapolei projects (the proposed Ho'opili project, University of Hawai'i at West O'ahu (UHWO), Department of Hawaiian Home Lands (DHHL) East Kapolei Development Parcels 1 and 2, Kroc Center) will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. The East Kapolei projects will also be providing storage and detention to meet the Rules Relating to Storm Drainage Standards with respect to water quality standards. The basin size could be decreased at some time in the future when the terminus of Kalo'i Gulch basin is finalized. All projects discharging to the Kalo'i Gulch basin currently have discharge restrictions and these restrictions will continue until the Kalo'i Gulch outlet is opened. Through implementation of the proposed drainage improvements, the planned developments in

East Kapolei are not expected to adversely impact existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Ocean Pointe, Villages of Kapolei and Makakilo.

Solid Waste. While many of the new residents in 'Ewa will have already been residing on O'ahu, there will be new residents attracted to and residing in Ho'opili who will be new to O'ahu. As O'ahu's population increases, the capacity of the Waimānalo Gulch Landfill will decrease. The issue of solid waste recycling and ultimate disposal will not only affect 'Ewa, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo, but every resident on O'ahu.

Roadways and Traffic. Ho'opili involves development of a mixed-use community on approximately 1,555 acres in East Kapolei. The Ho'opili Conceptual Land Use Plan ("Plan") reflects the desire for a community that is "complete" with: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents. Implementation of the Plan will allow residents the ability to live, work, learn, play, and shop within Ho'opili without needing to use personal motor vehicles on regional roadways.

Ho'opili will be connected to the surrounding 'Ewa District (and neighboring Department of Hawaiian Home Lands (DHHL), the University of Hawai'i at West O'ahu (UHWO), Kroc Center and the Hawaii Community Development Authority (HCDA) properties by a network of closely-spaced gridded streets and bicycle paths within Ho'opili which allows a variety of circulation options for residents and visitors through East Kapolei. Wider tree-lined boulevards will create a distinct axis running north-south and diagonally east-west across the site, but unlike a conventional subdivision of cul-de-sacs, there will many more streets, sized at a walking scale. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will be concentrated around the transit station(s). Also possible is a transit maintenance and storage facility.

There are several major transportation projects that have been long-planned for East Kapolei. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road/H-1 Freeway interchange; a portion of the intersection of North-South Road

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and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili (and UHWO); the proposed East-West Connector Road through the Petition Area (that would connect Farrington Highway with Fort Weaver Road, through UHWO, DHHL East Kapolei Development Parcel 2 and Ho'opili); and the segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area.

Assuming that mitigation measures are implemented, the result of the analysis indicates that the Ho'opili project would result in what the traffic engineering consultant identifies as significant impacts to only one intersection under Scenario A: With Transit Corridor Scenario; this would occur at Farrington Highway/Leokū Street. Under Scenario B: Without Transit Corridor Scenario, a total of three intersections are anticipated to result in what the traffic engineering consultant identifies as significant impacts as a result of the Ho'opili project: Farrington Highway/Leokū Street, Fort Weaver Road/Old Fort Weaver Road and Fort Weaver Road/Renton Road. Those residents surrounding the project site, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo who travel through the above identified intersections would be most impacted by the proposed project.

7.2.5. Impacts on Public Facilities and Services

Electrical and Communication Facilities. Steam units, diesel units, and gas turbines used to generate electricity also generate emissions and affect air quality. Any increase in demand for electricity not generated by renewable resources will have an indirect impact on air quality. Sustainability guidelines have been developed by UHWO. Sustainability options are being considered for the Ho'opili project.

Ho'opili project buildings, activities, and site grounds are planned to be designed with energy-saving considerations, and the project will strive to be consistent with the State's objective to promote cost-effective energy conservation through the adoption of energy-efficient practices and technologies. Due to the sunny climate, the Petition Area (and the rest of 'Ewa) will be suited for the use of renewable energy technologies including photovoltaics. In addition, based on the Department of Business, Economic Development & Tourism (DBEDT), Strategic Industries Division's recommendations, Ho'opili's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies. The planned developments in East Kapolei are not expected to adversely impact the availability of energy for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

The planned developments in East Kapolei will also increase the demand for communications services (i.e., cable television and telephone service), but are unlikely to have an adverse effect on existing communications systems for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Recreational Facilities. The 'Ewa region is the fastest growing region in O'ahu, and the proposed developments in 'Ewa will help to meet the demand for additional recreational facilities. Parks will be provided by Ho'opili to meet the Petition Area's requirements of the City and County of Honolulu's Park Dedication Ordinance. New recreational facilities (i.e., tennis courts, basketball/volleyball courts, and jogging paths) within the UHWO campus are also planned for use primarily by students, faculty, and staff. Additionally, the private developer of UHWO's lands will provide recreational facilities in accordance with the City and County of Honolulu's Park Dedication Ordinance. The DHHL residential subdivision adjacent to and southwest of the Ho'opili community proposes 4.5 acres for park use and 10.7 acres for a community center to be developed and operated by the Salvation Army. The proposed center could include a swimming pool, performing arts center, child care center, gymnasium, education center, game and recreation areas, and other multi-use spaces. The facilities would be available to the general public.

Existing regional park facilities in West O'ahu, Central O'ahu, and Waipi'o may be visited by new residents of the East Kapolei developments; however, other park facilities have long been planned in Kalaeloa. The planned developments in East Kapolei are not expected to adversely impact State and County parks used by residents of the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Medical Facilities. Health care services in the 'Ewa region are provided by Hawai'i Medical Center West (the nearest hospital facility), Pali Momi Medical Center, Wahiawā General Hospital, Kaiser Permanente Waipi'o Clinic, and the recently opened Kapolei Medical Park (located across the Kapolei Shopping Center at the corner of Farrington Highway and Fort Barrette Road). Other routine medical services can be obtained at major hospital facilities in urban Honolulu, about a 30-minute drive from the subject property. The City and County of Honolulu has 18 emergency medical services Advanced Life Support Ambulance units and two Rapid Response Paramedic units on O'ahu. Two of the Advanced Life Support Ambulance units are located nearby, one at the Kapolei Fire Station, the other at the Waipahu Fire Station. One of the Rapid Response Paramedic units is located at the nearby Hawai'i Medical Center West. The proposed UH West O'ahu student center is programmed to include a student health clinic.

The East Kapolei projects will increase the population of Kapolei, and as such, there will be an occasional and unavoidable demand for emergency medical services. It is unlikely, however, that this demand will impact the level of service provided to other residents of O'ahu. Existing medical and healthcare facilities in the 'Ewa region and surrounding areas should be able to accommodate the anticipated increase in

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demand. The planned developments in East Kapolei are not expected to adversely impact the availability of medical facilities for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Educational Facilities. The UH West O'ahu adjacent to and west of the Ho'opili project will be a higher education institution in the 'Ewa region, enabling Leeward and Central O'ahu residents to obtain post-secondary degrees without commuting to the UH Mānoa campus or other higher education institutions in Honolulu.

The demand for educational facilities will increase as the population of 'Ewa grows. The Petitioner is setting aside land for three elementary schools, one middle school, and one high school with Ho'opili. UHWO has set aside land for an elementary school site near its southern boundary that might be shared by residents of the DHHL East Kapolei Development Parcel 1 project. The DHHL East Kapolei Development Parcel 2 project includes one elementary and one middle school sites. The State of Hawaii Department of Education (DOE) is also contemplating a high school on DHHL land immediately north of the UH West O'ahu site. Since the school-aged population is not constant, there is a possibility that not all of the above schools (a total of 2 high schools, two middle schools, and five elementary schools) will be needed after 20 to 25 years (the approximate time frame required for full build out of the combined East Kapolei projects. Through providing required public school sites (and the timely construction of schools by the State DOE), the planned developments in East Kapolei are not expected to adversely impact existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. During the public review period, the DOE noted that "...the number of schools required for this project may change if the developer decides to increase residential densities per potential transit-oriented development (TOD) zoning."

Police Protection. East Kapolei is located within Honolulu Police Department (HPD) District 8, which encompasses the leeward coast and the 'Ewa Plain. There are approximately 100 field officers assigned to this district, and response time for the entire district fluctuates between five and seven minutes. In order to meet the growing needs of the 'Ewa Plain communities, in 2000, the City and County of Honolulu opened the Regional Kapolei Police Station at 1100 Kamokila Boulevard.

The East Kapolei projects will increase the population of Kapolei and the demand for police service. According to the Ewa Development Plan, the 'Ewa Villages Substation is planned to service the East 'Ewa region, which includes East Kapolei. The service date for this substation has yet to be determined. The Petitioner is proposing a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a police substation, fire station and/or emergency medical service (EMS) site. The planned developments in East Kapolei are not expected to adversely impact the availability of police protection for the existing surrounding communities, including, but not limited to, the communities of

Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

Fire Protection. Fire protection in the Ewa Development Plan Area is provided by the Honolulu Fire Department (HFD) 'Ewa Beach Fire Station (an engine company), Makakilo Fire Station (an engine company), and Kapolei Fire Station (an engine and ladder company, and the Battalion 4 Headquarters). The Kapolei Fire Station located in Kapolei Business Park was completed in 1995 to serve the expanding development on the 'Ewa Plain.

The East Kapolei projects will increase the population of Kapolei and the demand for fire service. According to the Ewa Development Plan, to meet the projected population and economic growth in 'Ewa by 2020, three fire stations at 'Ewa Villages, Ko 'Olina, and Makaiwa Hills are planned, however service dates have yet to been determined. A new fire station is being planned on the DHHL East Kapolei Development Parcel 1 site near the intersection of Kapolei Parkway and North-South Road. The Petitioner is proposing a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a fire station, EMS site and/or police substation. The planned developments in East Kapolei are not expected to adversely impact the availability of fire protection for the existing surrounding communities, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo.

5. The Petitioner has been coordinating with the State Department of Health (DOH) Hazard Evaluation & Emergency Response Office (HEER). Based on recent correspondence from HEER, the last two paragraphs of Section 4.5 *Man-Made Hazards* of the EIS will be revised to read as follows:

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On March 13, 2008, in an interdepartmental memorandum from the DOH Hazard Evaluation & Emergency Response Office (HEER) to the DOH Environmental Planning Office, HEER wrote: "The land under consideration for development of the Ho'opili Project mixed residential/commercial community was formerly used to grow sugar cane. The Draft EIS acknowledges the presence of potential contamination, and investigative work is being coordinated with the HEER Office." The Petitioner is working with DOH on a sampling methodology to determine the presence and levels of certain pesticides. Subsequent actions will be based on the results of the sampling.

Based on sampling done on the adjacent DHHL property, no impacts from pesticide use on the former sugar cane cultivation of the Petition Area are anticipated. Since the Ewa Plain was once mostly under sugar cultivation and large areas have subsequently been developed for residential use without any apparent ill effects, it is anticipated that future residents in the Petition Area will not be exposed to unacceptable levels of pesticides from past or present agricultural activities. During the public review period, the HEER recommended that soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The scope of the investigative work is currently being coordinated with the HEER Office to ensure that the study will be carried out in the most efficient and effective manner possible.

6. As requested, information on the cost of the project will be expanded to include a breakdown of costs by component (onsite and offsite) and by development phase. Section 2.7 *Development Timetable and Preliminary Costs* of the Draft EIS will be revised to read as follows:

The Petitioner estimates that the development of the Ho'opili project (major off-site and on-site infrastructure improvements including grading, drainage, sewer, safe-drinking water, non-potable water, roadways, landscaping and improvements to Farrington Highway and North-South Road for access) will cost approximately $4.6 billion (in Year 2007 dollars), spent over the project timeline of 2009 – 2030. During the public review period, both the Land Use Commission and the State Office of Planning made reference to subsection 15-15-50, Hawaii Administrative Rules (HAR). Subsection 15-15-50, HAR identifies the form and contents of a petition to the State Land Use Commission to amend the State Land Use District Boundaries, including representing "...that development of the subject property in accordance with the demonstrated need therefore will be accomplished before ten years after the date of commission approval. In the event full urban development cannot substantially be completed within such period, the petitioner shall also submit a schedule for development of the total of such project in increments together with a map identifying the location of each increment, each such increment to be completed within no more than a ten-year period." The construction of Ho'opili's development will be a challenging process that will require ongoing coordination between many fundamental parts. Infrastructure and road access, neighboring property development, demands of the commercial and housing markets, careful continued agriculture and general property management, and economic viability will all be

considered throughout the construction planning process. Furthermore, the City & County of Honolulu's (City) transit project, the largest public works endeavor in Hawai'i's history, will within Ho'opili have its longest traverse through privately owned property and further expand development challenges undoubtedly in unprecedented ways. Many of these parts may involve developing different areas of the project site within the same construction timetable as discussed further below:

Several major development priorities include in no particular order:

- *Water Service from the North. Both of Ho'opili's main potable water storage and transmission systems will reside mauka of H-1. Considerable investment will be required in the construction of tanks and transmission lines that will ultimately service two water zones within Ho'opili that roughly divide the site between northern and southern halves. (Necessary offsite utility easements have already been secured at a price.) Nonpotable water will be sourced from the reclamation operations at the Honouliuli Wastewater Treatment Plant (WWTP), meaning it will be delivered to Ho'opili from the opposite end from where its potable source will come. Preliminary budgetary construction cost estimates range from between $35 million to $40 million with another $20 million possible from BWS for service connections.*

- *Sewer Service from the South. Unlike Ho'opili's main water system, sewer service will come from the southern end of the property. The first of what is expected to be several Joint Development Agreements (JDA) to secure and construct wastewater transmission is in place with DHHL, UHWO, DLNR and the City and funded. Indeed, the DOT has already constructed this line as part of the North-South Road Phase 1A contract. Discussions are expected to commence later this year in earnest on separate JDAs for two additional segments. Nearly $2 million has already been invested to date, preliminary budgetary costs estimates for these two JDAs range from $10 million to $15 million to stub service at the property's southwestern border, $5 million to $10 million to route through to the mauka area and as much as another $60 million for the City's Department of Environmental Services uses connection charges.*

- *Balancing Spread out Access, Initial Infrastructure Needs and Cash Flows. Today, Ho'opili's lands along the Farrington Highway corridor, its northernmost boundary, present Ho'opili's easiest access for construction purposes and future occupants. Once DHHL completes its section of the East-West Connector Road and the State DOT completes the North-South Road (both now under construction), Ho'opili will have construction and occupant access open at its southern and westernmost locations. This is significant because while available for development today, the Farrington Highway corridor is expected to present some of Ho'opili's greatest development challenges, predominantly the distance sewer lines will have to run through undeveloped land for service, as well as timing development to*

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the City's planned improvements to Farrington Highway itself. Thus, the Petitioner will look to mobilize on these other areas as early as practicable. Nonetheless, there are several key commercial parcels in this Farrington Highway corridor that will need to be among the earliest to be marketed in order to generate cash flow to support needed upfront utility (such as water and sewer as detailed above) and road infrastructure throughout Ho'opili. As a result, development should be started in more than one area from the onset. Over the build-out of the project, it is expected that as much as $50 million to $60 million could be spent on drainage systems and hundreds of millions will be invested in roadway systems servicing the project.

- ***Balancing Job Generation, Appropriate Initial Housing Deliveries and Transit.*** *The majority of the employment areas within Ho'opili are within the Farrington Highway corridor to the north of the property, while the residential development areas that could be most sensible to develop first – the single-family areas – are to the south. Starting housing construction there could generally preserve higher density development in the areas in and around the transit corridor to the north to be better staged with transit's completion and more appropriately address the various demands it will create.*

- ***Managing Agricultural Operations.*** *As lands are moved into development over time, consideration will have to be given to the significant challenges of maintaining a working agricultural water system and providing ongoing and unencumbered vehicular access to crop areas. This will be no small task, as it will be the objective of the Petitioner to keep active farms onsite as long as practicable.*

As previously stated the development is expected to occur over approximately 20 years. This area of 'Ewa has long been planned for development (Kapolei Area Long Range Master Plan and Ewa Development Plan).

There are several major transportation projects that have been planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the first segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area. As major off-site infrastructure (water, sewer, drainage, electrical and communications) would likely occur in most of the above major road right-of-ways, and the exact timing of the completion of these transportation improvements undetermined, it is difficult for the Petitioner to provide a map identifying the phasing of the proposed action in 10 year increments with any degree of certainty. While the phasing of development may be more relevant where there is little or no development, 'Ewa has

rapidly developed in recent years and proposed transportation improvements are indicative of State and County assumptions that this portion of 'Ewa would be eventually developed.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control

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Ref. No. P-12106

April 8, 2008

Mr. Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Ho`opili
D.R. Horton-Schuler Homes, LLC
Draft Environmental Impact Statement (DEIS)
`Ewa, Island of O`ahu
TMK(s): 9-1-17: 04 (por.), 059 and 072; and, 35; and
9-1-18: 001 and 004
State Land Use Commission Docket No. A06-771

Thank you for the opportunity to submit comments on the DEIS for the proposed Ho`opili development planned as a mixed use, transit-ready community to include residential, business and commercial areas, transit stops, schools, parks, and open space. The proposed development encompasses approximately 1,553 acres; all of which are proposed to be reclassified from the State Agricultural District to the State Urban District.

The following comments are offered to ensure that the final EIS provides a clear account for the user and decision-maker of site conditions, impacts of the proposed development as identified through studies and comments received in response to the preparation notice, development alternatives, and mitigation measures available. The comments include general observations as well as specific comments related to topic areas of interest to the State.

1. **Inclusion of information from comment letters and studies in the body of the final EIS; increased specificity of mitigation measures.**

The DEIS needs to be reviewed to determine where information provided in the appended comment letters and reference materials should be incorporated within the body of the final EIS. This will enable the reader to view the document and have a more thorough assessment of the potential impacts, alternatives, and mitigation measures

required, without having to cross-reference and extract information contained in the appended materials. The sections, Assessment of the Human Environment, Potential Impacts and Mitigation Measures, and Contextual Issues in the final EIS should include the identification of key measures and techniques that can be used to mitigate impacts.

2. **Development Timetable.**

Table 2.3, Required Permits/Approvals, should be updated to provide estimated timeframes for the necessary permits and approvals. Further, on page 22, the project timeline is identified as 2009-2030. The State Land Use Commission (LUC) requires that projects seeking reclassification be substantially completed within ten years or seek incremental approvals. The final EIS should reference LUC rules (§15-15-50, Hawaii Administrative Rules), a schedule of development for each phase of the total project, and a map showing the location of each increment and the timing of each component.

3. **Alternatives to the Proposed Action.**

The analysis of alternatives in the DEIS, including the "no action" alternative, needs to be more detailed and better developed. The proposed Ho`opili project represents a substantial change to present conditions and therefore the baseline "no action" alternative deserves a more rigorous discussion as do other reasonable alternatives.

4. **Energy.**

Section 4.8.6, Electrical Facilities, provides an overview of existing and projected transmission infrastructure and generating facilities. The assumption being that Hawaiian Electric Company will be the primary provider of power for the development. Mitigation measures that might result in energy efficiency and demand reductions are given very cursory exploration and should be expanded to include discussion of U.S. Green Building Council's (GBC) Leadership in Energy and Environmental Design (LEED) certification, Hawai'i Green Built, and Zero-Net Energy Green Homes.

The DEIS does not discuss the U.S. GBC's LEED for Neighborhood Development (ND) pilot program to which the Ho`opili Project is a participant. The LEED-ND recognizes projects that successfully protect and enhance the overall health, natural environment, and quality of life of communities. The rating system which is used in the program encourages smart growth, promotes efficient energy and water use, and the location and design of neighborhoods to reduce transportation impacts. We understand that a separate consultant, Van Meter Williams Pollack, has been retained to shepherd the Ho`opili project through the LEED-ND certification process. The final EIS should include a preliminary overview of the LEED-ND features to be incorporated into the project using

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the current U.S. GBC checklist for the program. Ho`opili is to be commended for pursuing LEED-ND certification during the pilot program period as an early adopter. Providing information on the measures to be incorporated in the project will aid government agencies, decision-makers, and the public in reviewing the project's development applications.

5. **Education.**

The State Department of Education (DOE) is responsible for determining the number of schools required to service a proposed development based on a formula contained in Chapter 302A, Hawaii Revised Statutes. The DEIS identifies the school fair-share requirements as an unresolved issue. The final EIS should provide specific information on the requirements as negotiated between the applicant and DOE.

Currently, the DEIS indicates the project's Conceptual Land Use Plan provides for up to five school sites. DOE has indicated some concerns with the potential traffic impacts of the proposed high school location along Farrington Highway, and the configurations of the lands set aside for school sites. These issues should be addressed in the final EIS.

6. **Agricultural lands.**

The project area is currently in the State Agricultural District and is zoned AG-1 Restricted Agricultural District by the County. The long-range plan for the area is for urban development as part of developing Kapolei as the Second City.

The project area contains approximately 1,500 acres in active agricultural uses on short-term leases. The majority of the project area is ALISH-designated as Prime, and rated A or B by the Land Study Bureau Land Classification system. The proposed development would appear to have a significant impact on the availability of important agricultural lands. Based on the figures provided in Section 3.4, Agricultural Impact, the loss of these high quality agricultural lands is roughly 10% of that available on Oahu. The final EIS should include some discussion about the displacement of the lessees and the location of alternative areas on the Island with comparable costs and access to resources.

7. **Housing.**

The supply of affordable housing to meet the needs of Hawaii's working families is critical to both the State and County. The final EIS should consider and discuss alternative configurations that might increase the affordable housing component and strategies for insuring the continued affordability of housing units developed.

8. **Public Health.**

The DEIS indicates the historic cultivation of sugarcane on the project's lands, as well as the current use for diversified agriculture. These activities have been linked to persistent, long-term chemicals used in cultivation that could pose a threat to public health and the environment. The final EIS should include a determination of the potential risks associated with past agricultural practices on the subject area and any remedial action that needs to be taken.

9. **Solid Waste.**

In the DEIS, Section 4.8.5, Solid Waste Disposal Facilities, does not provide any discussion on plans by the City and County of Honolulu to expand the Waimanalo Gulch Sanitary Landfill or the recent LUC decision to extend the deadline for closing that facility until November 2009. The final EIS should include a discussion of these factors and address the project's solid waste management options.

10. **Drainage.**

The final EIS should include a discussion of low impact development techniques that can be incorporated into the building and site design to improve stormwater management. The Hawaii Coastal Zone Management Program's publication, *Low Impact Development: A Practioner's Guide* (2006), provides examples of design techniques that offer alternatives to conventional drainage plans.

The DEIS identifies that the project is situated within three distinct drainage basins. One of which is Kalo`i drainage basin that has been the subject of considerable attention and currently has agreements in place with other landowners whose runoff may create impacts. The final EIS should reference the specific maximum discharge values that would be allowed into the Kalo`i drainage system, the structural features that will be employed to meet those restrictions, and whether the applicant has or will enter into agreements to abide by those limits.

Drainage from the subject property into the West Loch drainage basin is expected to be addressed through an agreement with the Navy to allow detention and flow on and across their lands. However, to date, the Navy has rejected this idea. The final EIS should provide a definitive answer from the Navy regarding this issue, or the alternative solution to construct sufficient on-site retention basins should be discussed in detail as the anticipated mitigation measure.

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11. **Transportation.**

Transportation challenges within the 'Ewa region are significant. The proposed Ho'opili project would be one of the last large-scale developments in the Second City of Kapolei. The State Department of Transportation has expressed ongoing concern regarding the regional traffic congestion along H-2, H-1, Kamehameha Highway, Farrington Highway, Kunia/Fort Weaver Road, and the interchanges.

The DEIS provides some general discussion and the Traffic Impact Analysis Report included in the DEIS as Appendix L provides a more detailed analysis of anticipated impacts to public roadways. The final EIS should include an illustrative figure that identifies the specific roadways, intersections, and freeways that the Ho'opili project will impact, and for which Ho'opili will fund and/or construct mitigation measures.

The Office recommends using the final EIS process as a means to incorporate and use sustainable design and development practices in the proposed project. The Office of Environmental Quality Control's, *Guidelines for Sustainable Building Design in Hawai'i*, and the U.S. GBC's LEED-ND pilot program offer guidelines and checklists for this purpose. The adoption of sustainable building and development practices has long-term economic, social, and environmental benefits to project developers, and Hawaii's residents and communities.

Thank you for the opportunity to review the DEIS and offer comments. The Office of Planning looks forward to receiving the Petitioner's final EIS. If you have any questions, please contact Scott Derrickson, AICP, of the Land Use Division at 587-2805.

Sincerely,

Abbey Seth Mayer
Director

c: Rodney Maile, LUC
Bryan Yee, AG
Katherine Puana Kealoha, OEQC

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Attn: Mr. Scott Derrickson, AICP

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Mayer:

Thank you for your letter dated April 8, 2008. We have reviewed the State Office of Planning's letter and offer the following response to its comments.

1. **Inclusion of information from comment letters and studies in the body of the final EIS; increased specificity of mitigation measures.** As requested the DEIS will be reviewed to determine where information provided in the appended comment letters and reference materials should be incorporated within the body of the Final EIS. We respectfully disagree with the State Office of Planning's implication that the sections of the DEIS titled: "Assessment of the Human Environment, Potential Impacts and Mitigation Measures" and "Contextual Issues" do not include identification of key measures and techniques that can be used to mitigate impacts as even a cursory review would indicate otherwise.

2. **Development Timetable.** As requested, Table 2.3 *Required Permits/Approvals* of the EIS will be revised to include the estimated timeframes for the necessary permits and approvals (as follows).

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AR00027409

Table 2.3. Required Permits/Approvals

PERMIT/APPROVAL	APPROVING AUTHORITY	STATUS	PROJECTED SUBMITTAL DATE
State Land Use District Boundary Amendment (with EIS)	State of Hawai'i Land Use Commission	Petition has been filed; processing on hold until EIS process has been completed.	First Quarter 2007
Zone Change	City and County of Honolulu Department of Planning and Permitting/City Council	Application to be filed assuming successful processing of SLUDBA.	Third Quarter 2009
Large Lot Subdivision ~~Approval~~ Action	City and County of Honolulu Department of Planning and Permitting	Application to be submitted after change the Zone Change application is approved.	Third Quarter 2010
National Pollutant Discharge Elimination System (NPDES) Permit	State of Hawai'i Department of Health	Application to be submitted prior to Building/Grading Permits.	2011
Building/Grading Permits	City and County of Honolulu Department of Planning and Permitting	Application to be filed after the Zone Change application is approved.	2011
Water Use Permit	State of Hawai'i Department of Land and Natural Resources, Commission on Water Resource Management	Application to be submitted prior to Building/Grading Permits	2011

Based on the State of Office of Planning's comments, the last paragraph of Section 2.7 *Development Timetable and Preliminary Costs* of the Draft EIS will be revised to read as follows:

The Petitioner estimates that the development of the Ho'opili project (major off-site and on-site infrastructure improvements including grading, drainage, sewer, safe-drinking water, non-potable water, roadways, landscaping and improvements to Farrington Highway and North-South Road for access) will cost approximately $4.6 billion (in Year 2007 dollars), spent over the project timeline of 2009 – 2030. During the public review

period, both the Land Use Commission and the State Office of Planning made reference to subsection 15-15-50, Hawaii Administrative Rules (HAR). Subsection 15-15-50, HAR identifies the form and contents of a petition to the State Land Use Commission to amend the State Land Use District Boundaries, including representing "...that development of the subject property in accordance with the demonstrated need therefore will be accomplished before ten years after the date of commission approval. In the event full urban development cannot substantially be completed within such period, the petitioner shall also submit a schedule for development of the total of such project in increments together with a map identifying the location of each increment, each such increment to be completed within no more than a ten-year period." The construction of Ho'opili's development will be a challenging process that will require ongoing coordination between many fundamental parts. Infrastructure and road access, neighboring property development, demands of the commercial and housing markets, careful continued agriculture and general property management, and economic viability will all be considered throughout the construction planning process. Furthermore, the City and County of Honolulu's (City) transit project, the largest public works endeavor in Hawai'i's history, will within Ho'opili have its longest traverse through privately owned property and further expand development challenges undoubtedly in unprecedented ways. Many of these parts may involve developing different areas of the project site within the same construction timetable as discussed further below:

Several major development priorities include in no particular order:

- *Water Service from the North. Both of Ho'opili's main potable water storage and transmission systems will reside mauka of H-1. Considerable investment will be required in the construction of tanks and transmission lines that will ultimately service two water zones within Ho'opili that roughly divide the site between northern and southern halves. (Necessary offsite utility easements have already been secured at a price.) Nonpotable water will be sourced from the reclamation operations at the Honouliuli Wastewater Treatment Plant (WWTP), meaning it will be delivered to Ho'opili from the opposite end from where its potable source will come. Preliminary budgetary construction cost estimates range from between $35 million to $40 million with another $20 million possible from BWS for service connections.*

- *Sewer Service from the South. Unlike Ho'opili's main water system, sewer service will come from the southern end of the property. The first of what is expected to be several Joint Development Agreements (JDA) to secure and construct wastewater transmission is in place with DHHL, UHWO, DLNR and the City and funded. Indeed, the DOT has already constructed this line as part of the North-South Road Phase IA contract. Discussions are expected to commence later this year in earnest on separate JDAs for two additional segments. Nearly $2 million has already been invested to date, preliminary budgetary costs estimates for these two JDAs range from $10 million to $15 million to stub service at the property's southwestern border, $5 million to $10 million to route through to the mauka area and as much as another $60*

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million for the City's Department of Environmental Services uses connection charges.

- *Balancing Spread out Access, Initial Infrastructure Needs and Cash Flows. Today, Ho'opili's lands along the Farrington Highway corridor, its northernmost boundary, present Ho'opili's easiest access for construction purposes and future occupants. Once DHHL completes its section of the East-West Connector Road and the State DOT completes the North-South Road (both now under construction), Ho'opili will have construction and occupant access open at its southern and westernmost locations. This is significant because while available for development today, the Farrington Highway corridor is expected to present some of Ho'opili's greatest development challenges, predominantly the distance sewer lines will have to run through undeveloped land for service, as well as timing development to the City's planned improvements to Farrington Highway itself. Thus, the Petitioner will look to mobilize on these other areas as early as practicable. Nonetheless, there are several key commercial parcels in this Farrington Highway corridor that will need to be among the earliest to be marketed in order to generate cash flow to support needed upfront utility (such as water and sewer as detailed above) and road infrastructure throughout Ho'opili. As a result, development should be started in more than one area from the onset. Over the build-out of the project, it is expected that as much as $50 million to $60 million could be spent on drainage systems and hundreds of millions will be invested in roadway systems servicing the project.*

- *Balancing Job Generation, Appropriate Initial Housing Deliveries and Transit. The majority of the employment areas within Ho'opili are within the Farrington Highway corridor to the north of the property, while the residential development areas that could be most sensible to develop first – the single-family areas – are to the south. Starting housing construction there could generally preserve higher density development in the areas in and around the transit corridor to the north to be better staged with transit's completion and more appropriately address the various demands it will create.*

- *Managing Agricultural Operations. As lands are moved into development over time, consideration will have to be given to the significant challenges of maintaining a working agricultural water system and providing ongoing and unencumbered vehicular access to crop areas. This will be no small task, as it will be the objective of the Petitioner to keep active farms onsite as long as practicable.*

As previously stated the development is expected to occur over approximately 20 years. This area of 'Ewa has long been planned for development (Kapolei Area Long Range Master Plan and Ewa Development Plan).

There are several major transportation projects that have been planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the first segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area. As major off-site infrastructure (water, sewer, drainage, electrical and communications) would likely occur in most of the above major road right-of-ways, and the exact timing of the completion of these transportation improvements undetermined, it is difficult for the Petitioner to provide a map identifying the phasing of the proposed action in 10 year increments with any degree of certainty. While the phasing of development may be more relevant where there is little or no development, 'Ewa has rapidly developed in recent years and proposed transportation improvements are indicative of State and County assumptions that this portion of 'Ewa would be eventually developed.

3. **Alternatives to the Proposed Action.** As requested, the "No Action" of Section 6.1 *"No-Action" Alternative* of the Draft EIS will be revised to read as follows:

6.1 "NO-ACTION" ALTERNATIVE

The "na-action" alternative would not be consistent with stated governmental policies, which direct future growth to the 'Ewa region. The City and County of Honolulu General Plan states:

> *Encourage development within the secondary urban center at Kapolei and the Ewa and Central Oahu urban-fringe areas to relieve developmental pressures in the remaining urban-fringe and rural areas and to meet housing needs not readily provided in the primary urban center.*

Under this alternative, the site would remain as agricultural land, underutilized in terms of meeting the demand for residential homes (including affordable homes) and accompanying land uses. The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall. The demand for housing could result in the following scenarios or combinations thereof: there would be more pressure to develop in the other districts, including the rural areas and other areas currently used for cultivation;

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there could be a demand for higher density housing in undeveloped areas of 'Ewa at a density not experienced to date; there would be more "doubling up" (larger number of persons per household, with more than one family under roof); those that are not willing to put up with the previously described scenarios may decide to relocate to the U.S. mainland where housing prices have dropped.

The "no-action" alternative was rejected because it is not consistent with government plans to develop Kapolei as the Second City.

4. **Energy.** Based on the State Office of Planning's comments, the eighth paragraph of Section 4.8.6 *Electrical Facilities, Anticipated Impacts and Mitigation Measures* of the Draft EIS will be revised to read as follows:

Based on DBEDT Strategic Industries Division's recommendations, the Petitioner's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies (including solar power and energy-efficient appliances). During the public review period the State Office of Planning requested discussion of the following: the U.S. Green Building Council's (GBC) Leadership in Energy and Environmental Design (LEED) certification; Hawaii's Green Built, and Zero-Net Energy Green Homes.

U.S. Green Building Council's (GBC) Leadership in Energy and Environmental Design (LEED) Certification – According to the GBC website: "The Leadership in Energy and Environmental Design (LEED) Green Building Rating System™ encourages and accelerates global adoption of sustainable green building and development practices through the creation and implementation of universally understood and accepted tools and performance criteria. LEED is a third party certification program and the nationally accepted benchmark for the design, construction and operation of high performance green buildings. LEED gives building owners and operators the tools they need to have an immediate and measurable impact on their buildings' performance. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection and indoor environmental quality." Even though State agencies are directed to implement LEED Silver to the extent possible (under Chapter 196 of the Hawaii Revised Statutes), to date, there have only been a couple of projects built by the State of Hawai'i (Imiloa Astronomy Center, Waipahu Middle School Cafeteria, Hawai'i Gateway Energy Center) so certified.

According to the GBC website: "The LEED for Neighborhood Development Rating System integrates the principles of smart growth, urbanism and green building into the first national system for neighborhood design. LEED certification provides independent, third-party verification that a development's location and design meet

accepted high levels of environmentally responsible, sustainable development. Currently in its pilot period, LEED for Neighborhood Development is a collaboration among USGBC, the Congress for the New Urbanism and the Natural Resources Defense Council. The pilot program is no longer accepting projects. The post-pilot version of the rating system, which will be available to the public, is expected to launch in 2009." Ho'opili is part of the LEED-ND pilot program, and it is in the early stages of working with the U.S. Green Building Council (USGBC) to obtain information required to implement LEED-ND to the extent that it is feasible and practicable.

A preliminary overview of LEED-ND features to be incorporated into the development project site include:

In order to reduce the impacts of urban sprawl, or unplanned, uncontrolled spreading of urban development into areas outside of the metropolitan region, and create more livable communities, LEED for Neighborhood Development communities include:

- *locations that are closer to existing town and city centers,*
- *areas with good transit access, and*
- *sites adjacent to existing development.*

LEED for Neighborhood Development emphasizes the creation of compact, walkable, vibrant, mixed-use neighborhoods with good connections to nearby communities (such as UHWO and DHHL East Kapolei Development 2). Research has shown that living in a mixed-use environment within walking distance of shops and services results in increased walking and biking, which improve human cardiovascular and respiratory health and reduce the risk of hypertension and obesity.

LEED for Neighborhood Development also encourages increased transportation choice and decreased automobile dependence. These two things go hand-in-hand; convenient transportation choices such as buses, trains, car pools, bicycle lanes and sidewalks, for example, are typically more available near neighborhood centers and town centers, which are also the locations that produce shorter automobile trips. All of these concepts are being incorporated into the planning of the Ho'opili project.

Hawaii Builtgreen™ Home Program – According to the DBEDT website: "The 'Hawaii BuiltGreen™ Program' is a statewide program to make it easier for builders and homeowners to design and build energy- and resource-efficient homes in Hawaii. It includes hands-on, right-here-in-Hawaii examples of what to do and how to do it, such as a real home, exhibits, seminars, and workshops." According to the Building Industry Association website, there are no Hawaii BuiltGreen™ Award-winning housing projects built by the State of Hawai'i.

Zero-Net Energy Green Homes – According to Wikipedia: "A zero energy building (ZEB) or net zero energy building is a general term applied to a building with a net

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energy consumption of zero over a typical year. Zero energy buildings are gaining considerable interest as a means to cut greenhouse gas emissions and conserve energy... There are many overlapping similarities between the goals of ZEB and GB [Green Buildings]. However, the subtle differences are significant, but diminishing, as scarce knowledge becomes more widespread."

The goal of ZEB design is the reduction, and eventual elimination of, energy bills and greenhouse gas emissions using potentially complex thermal physics necessary for zero energy design.

It is unlikely that there are any net zero energy housing projects built by the State of Hawai'i.

5. **Education.** Unfortunately, we will be unable to provide specific information in the Final EIS on the requirements as negotiated between the Petitioner and the State Department of Education (DOE). During the public review period, DOE wrote: "Please revise the narrative to reflect that the DOE will determine the actual number of schools required for the Ho'opili development after the developer provides more definitive data on respective market prices, size, and number of bedrooms for each type of unit planned." Such information requested by DOE will not be available until after County zoning is approved.

   We are in receipt of the public review comments from DOE on the Draft EIS and they did not indicate in writing any "...concerns with the potential traffic impacts of the proposed high school location along Farrington Highway, and the configurations of the lands set aside for school sites." DOE did however provide information on the desirable configuration for the various campus sites. Revisions to the master plan to accommodate such requests will be incorporated prior to a request for a change in County zoning. The third to the last paragraph of Section 2.5.1 *Ho'opili Conceptual Land Use Plan* of the Draft EIS will be revised to read as follows:

   The proposed project could include as many as five public school sites. The Conceptual Land Use Plan shows the possible locations for five State Department of Education (DOE) school sites planned to be as accessible to the neighborhoods of Ho'opili as the community is developed; one high school, one middle school and three elementary schools. The plan can also accommodate private schools as the need is determined. In addition, area is set aside along the western end of Farrington Highway fronting the Petition Area for either a fire station or a police substation. In total, approximately 100 acres are allocated to meet public facility needs. The master plan will likely be adjusted prior to zoning to achieve DOE-desired public school campus site configurations.

6. **Agricultural lands.** Recently, the Petitioner has been working to assist the tenants in finding a suitable site or sites for relocation (as indicated on page 30 of the Draft EIS). However, to date, no site has been secured for that purpose. Given the planned growth in the region, the leases issued to the existing tenants reflected the fact that the area would be subject to urbanization in the future. The tenants all signed the leases with full knowledge

of the circumstances. In order to assist them in the short term consideration for the land and water were kept at or below market rates.

Hoopili: Impact on Agriculture (Appendix A of the Draft EIS Volume 2) identifies a total of 10,900 acres of former plantation land remaining on O'ahu which are available for other crops, including 3,150 acres of former pineapple land in Kunia and 7,750 acres on the North Shore. It is acknowledged that some of the higher elevation fields in Kunia and on the North Shore have less solar radiation than 'Ewa and lands in higher elevations incur higher pumping costs. Nevertheless, some limitations can be overcome with investment in improvements such as to existing water delivery systems.

7. **Housing.** Alternative configurations that might increase the affordable housing components were noted on pages 57 and 58 of the Draft EIS:

   The majority of Ho'opili's 11,750 residentinl units would consist of for-sale multi-family homes. The Project will also include for-sale single-family units and multi-family rental units. Ho'opili's single-family units would be developed at approximately 5- to 8-units per net acre. Multi-family units will range from low-rise townhome units at approximately 10- to 14-units per acre, to mid-rise development at 30- to 50-units per acre.

   The proposed housing will be in neighborhoods that integrate low- and medium-density or medium- and high-density residential areas. As a result, Ho'opili will cater to a range of income levels. In accordance with the City and County of Honolulu's affordable housing guidelines, up to 30 percent of the total number of units are expected to be developed as affordable housing units.

   Affordable housing unit pricing will need to be coordinated with City and County of Honolulu departments, as pricing will be based on then-prevailing County rules and market conditions. The project is in the planning process so there may be an opportunity to identify a few house lots throughout the proposed project for the development of group homes for persons with special needs.

   ... In addition to home ownership opportunities, the project will provide commercial, educational, and recreational opportunities which will enable residents the opportunity to live, work, learn, play, and shop within the community.

   Furthermore, the requirements for affordable housing on this island are set forth by the City and County of Honolulu and imposed by the City Council in unilateral agreements during the zoning process. In terms of addressing strategies for insuring the continued affordability of housing units to be developed, it is the Petitioner's intent is to comply with all legal requirements concerning affordable housing, including mandatory restrictions on transfer, sale/buyback and use.

8. **Public Health.** We acknowledge that residual pesticides in former agricultural lands could pose potential risks to human health and the environment in a residential setting. HEER

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recommends that as part of the pre-development process, the soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The last two paragraphs of Section 4.5, *Man-Made Hazards, Anticipated Impacts and Mitigation Measures* of the Draft EIS will be revised to read as follows:

On March 13, 2008, in an interdepartmental memorandum from the DOH Hazard Evaluation & Emergency Response Office (HEER) to the DOH Environmental Planning Office, HEER wrote: "The land under consideration for development of the Ho'opili Project mixed residential/commercial community was formerly used to grow sugar cane. The Draft EIS acknowledges the presence of potential contamination, and investigative work is being coordinated with the HEER Office." The Petitioner is working with DOH on a sampling methodology to determine the presence and levels of certain pesticides. Subsequent actions will be based on the results of the sampling.

Based on sampling done on the adjacent DHHL property, no impacts from pesticide use on the former sugar cane cultivation of the Petition Area are anticipated. Since the Ewa Plain was once mostly under sugar cultivation and large areas have subsequently been developed for residential use without any apparent ill effects, it is anticipated that future residents in the Petition Area will not be exposed to unacceptable levels of pesticides from past or present agricultural activities. During the public review period, the HEER recommended that soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The scope of the investigative work is currently being coordinated with the HEER Office to ensure that the study will be carried out in the most efficient and effective manner possible.

9. **Solid Waste.** We appreciate the information provided, four new paragraphs will be added to the beginning of Section 4.8.5 *Solid Waste Disposal Facilities, Anticipated Impacts and Mitigation Measures* of the Draft EIS to read as follows:

On March 7, 2008, the State Land Use Commission agreed to allow the City and County of Honolulu's Waimanalo Gulch Sanitary Landfill to remain open for at least 18 more months. The City had sought a 24-month extension, through May 1, 2010.

Waste Management of Hawaii has operated the Waimanalo Gulch Sanitary Landfill as an integral part of the City's solid waste management infrastructure for approximately 20 years. The facility is heavily regulated, monitored and controlled by local, state and federal government agencies.

Before Mayor Hannemann took office, the City Council chose to keep the landfill in its current location, after evaluating a wide range of potential options.

Mayor Hannemann has noted that the recent emergency disposal of 28 tons of recalled beef at the landfill demonstrated that O'ahu will always need such a facility. However, the City and County of Honolulu is striving to decrease the amount of waste that's sent to the landfill, including: expanding the City's curbside residential recycling program; shipping at least 100,000 tons of waste to a mainland facility, and expanding the H-Power garbage-to-energy plant.

10. **Drainage.** Based on the State Office of Planning's comments regarding Low Impact Development, the second to the last paragraph of Section 4.8.4 *Drainage Facilities, Anticipated Impacts and Mitigation Measures* of the Draft EIS will be revised to read as follows:

The project will increase impervious surfaces such as roadways, roofs, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Petition Area. However, detention basins and/or retention basins are being planned and sited to detain and/or retain storm water to ensure that areas downstream of the project are not impacted. Based on comments received from the City and County of Honolulu Department of Facilities Management during the public review period, storm drainage detention and retention basins within the project site shall be privately-owned and maintained, unless particular parcels of land are dedicated to or acquired by the government. During the public review period, the State Office of Planning requested a discussion of low impact development techniques that can be incorporated into the building and site design to improve stormwater management. Table 1.1 of Low Impact Development: A Practitioner's Guide (2006) lists specific Low Impact Development (LID) best management practices (BMP's) and techniques.

- *Preservation of Undisturbed Areas: As recommended, most of the existing undisturbed areas (or uncultivated) areas will be preserved, because the gulches and steeper sloped areas are unsuitable for development. Most of the project area is highly developable, but has been highly disturbed from past and present agricultural cultivation.*
- *Preservation of Buffers: Naturally vegetated buffers will be defined, delineated and preserved along Honouliuli Gulch.*
- *Reduction of Clearing and Grading: Clearing and grading of the site will be limited to the minimum amount for the development function, road access and infrastructure.*
- *Locating Sites in Less Sensitive Areas: Most of the Petition Area is highly developed and does not include sensitive resource areas such floodplains, steep slopes, wetlands, mature forests or critical habitats.*
- *Open Space Design: While the project will be more densely developed than most of the projects in the Villages of Kapolei or the rest of 'Ewa, this project acknowledges that there are very limited areas on O'ahu left to develop and this will allow other areas in Central O'ahu, North Shore, Ko'olauloa, Ko'olaupoko and Wai'anae to remain undeveloped.*
- *Roadway Reduction: The proposed traditional neighborhood design and pedestrian-friendly development concept proposes more but narrower roads than a conventional development, to: 1) ensure lower vehicle speeds; 2) enhance pedestrian safety in crossing the streets; and 3) facilitate safer bicycle travel.*
- *Sidewalk Reduction: The proposed pedestrian-friendly and traditional*

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neighborhood design development concept proposes meeting minimum standards for sidewalks to: 1) enhance greater pedestrian use, and 2) facilitate safer bicycle travel for children and inexperienced adult bicyclists. Impervious surfaces could be reduced by consolidating separate pedestrian and bicycle paths into multi-modal paths.

- *Driveway Reduction: The proposed development will strive to minimize driveway lengths and widths to reduce overall imperviousness.*
- *Cul-de-sac Reduction: The proposed pedestrian-friendly, traditional neighborhood design development concept seeks to avoid cul-de-sacs to increase connectivity within the project and to surrounding communities.*
- *Building Footprint Reduction: The proposed transit-oriented development concept is not adverse to taller buildings to reduce the impervious footprint of buildings while recognizing the visual appearance of Kapolei.*
- *Parking Reduction: The proposed mixed-use, pedestrian-friendly and transit-oriented development concept is supportive of reducing the current off-street parking requirements and reducing the overall imperviousness associated with parking lots.*
- *Vegetated Buffer/Filter Strips: Where feasible, runoff will be directed to open space buffers to treat and control stormwater runoff from developed areas.*
- *Open Vegetated Channels: Where feasible, properly designed and constructed vegetated channels will be provided to convey runoff, but it is unlikely that will occur along streets dedicated to the City and County of Honolulu.*
- *Bioretention and Rain Gardens: Where feasible, bioretention and rain gardens will be provided.*
- *Infiltration: Where feasible, infiltration trenches, basins or leaching chambers will be provided.*
- *Rooftop Runoff Reduction Mitigation: Where feasible, runoff will be directed from rooftops to pervious areas.*
- *Stream Daylighting for Redevelopment Projects: Not applicable because there are no previously-culverted/piped streams to "daylight" to restore natural habitats.*
- *Tree Planting: The proposed project will include street trees, park landscaping and project landscaping to reduce stormwater runoff and provide shade.*

In regards to Kalo'i Gulch, as noted on page 90 of the Draft EIS:

> *With respect to the portion of the project within the Kalo'i drainage basin, the project will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. The project will also be providing storage and detention to meet the Rules Relating to Storm Drainage Standards with respect to water quality standards. The basin size could be decreased at some time in the future when the terminus of Kalo'i basin is finalized. All developed projects discharging to the Kalo'i basin currently have discharge restrictions and these restrictions will continue until the Kalo'i basin terminus is finalized. The portions of the project within the Kalo'i drainage basin are Parcels A and the western most part of Parcel C adjacent to the North-South Roadway alignment (See Figure 4.2: Drainage Basins). The Petitioner will continue to coordinate with County and State agencies to discuss issues within the Kalo'i Gulch Watershed.*

Negotiations between the Petitioner and the Navy regarding the referenced Makai Detention parcels are ongoing. However, please note that the proposed project does not "hinge" upon outlet for the makai detention basin through Navy lands. As noted on page 91 of the Draft EIS, if the outlet is not permitted by the Navy:

> *The alternative drainage solution if the overflow across Navy property cannot be resolved is to construct retention basins on site holding back the total volume of a 100 year- 24 hour storm. These basins would be located on the southern portion of Parcel C.*

11. Transportation. The Petitioner acknowledges that the project is also obligated to provide for and/or implement the traffic mitigation measures and road/highway improvements determined necessary by the DOT Highways Division. We note, however, that the Highways Division is still in the process of concluding its review of the development plan and TIAR for the subject project. As such, the Petitioner will continue to coordinate with the DOT Highways Division on identifying the specific roadways, intersections and portions of freeways that the proposed project may impact, and for which the Petitioner will fund in part and/or construct mitigation measures.

In addition, the Petitioner acknowledges that the project is obligated under the applicable City & County of Honolulu ordinance to participate in and contribute to the Ewa Impact Fee for transportation improvements. This was noted in the third to the last paragraph of Section 4.8.1 *Transportation, Anticipated Impacts and Mitigation Measures* of the Draft EIS.

We concur that OEQC's *Guidelines for Sustainable Building Design in Hawaii* and the USGBC's LEED – ND pilot program provide guidelines for sustainable design and development practices, but the EIS process is intended disclose the impacts of a project. We believe such details are best addressed prior to detailed site planning.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

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If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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GOVERNOR

MAJOR GENERAL ROBERT G. F. LEE
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March 31, 2008

Mr. Vincent Shigekuni, Vice President
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Draft Environmental Impact Statement
Ho'opili, Ewa, Oahu, Hawaii

Thank you for the opportunity to comment on this development. After careful review of the documents for this development, we request that the developer install at least three outdoor warning sirens. As the development plans are finalized, State Civil Defense (SCD) will be better able to define the placement and size of the sirens. At the present time SCD personnel recommends that the minimum-size siren have a sound rating of 121-decibels @ 100 feet, omni-directional and solar powered. Enclosed Figure 2-9, Conceptual Land Use Plan map for the approximate location of the siren coverage area, is marked in red to denote the developer installed sirens in the subdivision, while the black circles denote the existing sirens. (Note: The circles are approximate coverage areas only.)

If you have any questions, please call Mr. Norman Ogasawara, Assistant Telecommunications Officer, at 733-4300, ext. 531.

Sincerely,

EDWARD T. TEIXEIRA
Vice Director of Civil Defense

Enc.

c: Mr Rodney Maile, State of Hawaii Land Use Commission
Department of Emergency Management, City and County of Honolulu
State Civil Defense Radio Shop

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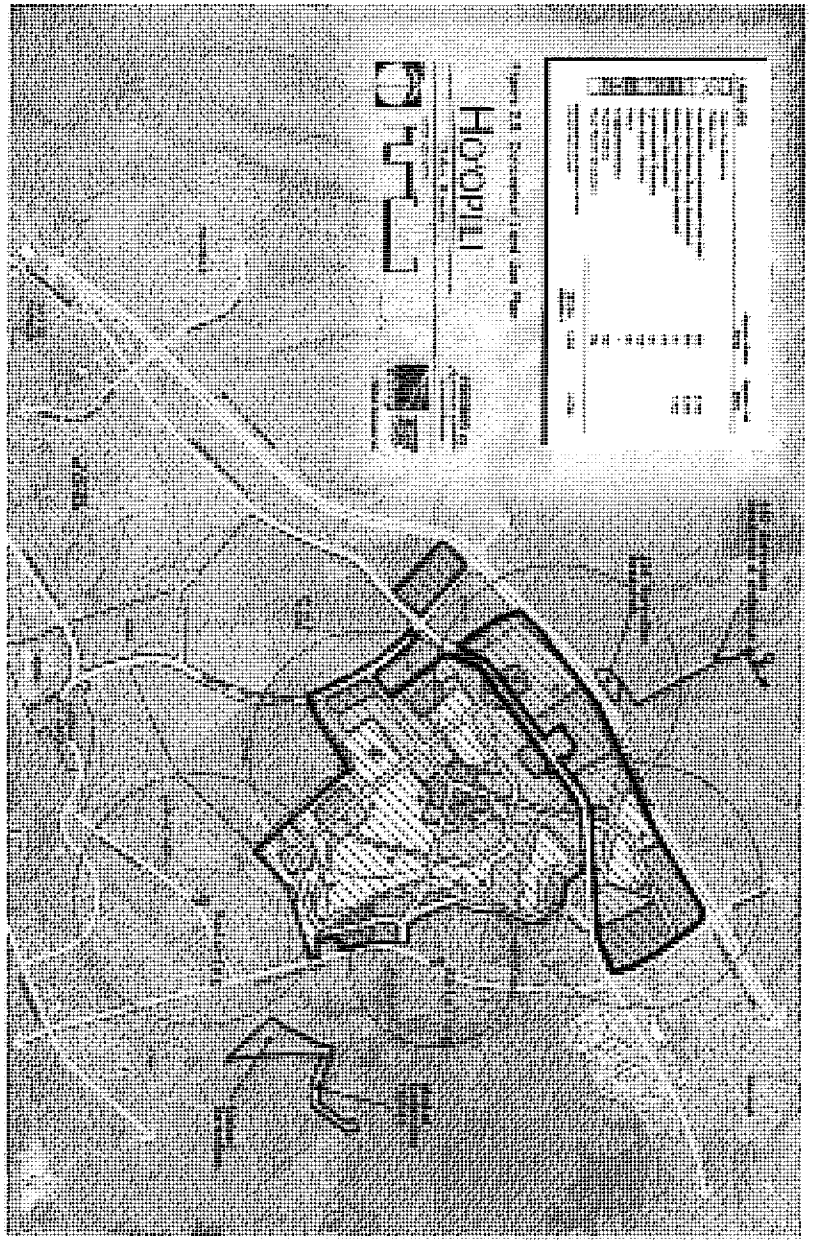

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Attn: Mr. Norman Ogasawara

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Teixeira:

Thank you for your letter dated March 31, 2008. We have reviewed your letter and offer the following response to your comments.

1. We acknowledge the State Civil Defense's (SCD) request that the developer install at least three outdoor warning sirens, with a minimum-size siren sound rating of 121-decibels @ 100 feet, omni-directional and solar powered. The applicant will continue to coordinate with the SCD as development plans are finalized to be better able to define the placement and size of the sirens.

   A new paragraph will be added to the end of Section 3.6 of the EIS to read as follows.

   During the public review period of the Draft EIS, the State Civil Defense (SCD) commented that "the developer install at least three outdoor warning sirens... At the present time SCD personnel recommends that the minimum-size siren have a sound rating of 121-decibels @ 100 feet, omni-directional and solar powered." SCD also noted that "As the development plans are finalized, State Civil Defense (SCD) will be better able to define the placement and size of the sirens." The Petitioner will continue to coordinate with the SCD as development plans are finalized to be better able to define the placement and size of the sirens.

2. Thank you for providing your revised Conceptual Land Use Plan map illustrating the approximate locations for the placement of the sirens.

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AR00027417

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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LINDA LINGLE
GOVERNOR

PATRICIA HAMAMOTO
SUPERINTENDENT

STATE OF HAWAI'I
DEPARTMENT OF EDUCATION
P.O. BOX 2360
HONOLULU, HAWAI'I 96804

OFFICE OF THE SUPERINTENDENT

RECEIVED
APR 04 2008
PBR HAWAII

April 3, 2008

Mr. Vincent Shigekuni, Vice President
PBR Hawaii
ASB Tower
1001 Bishop Street, Suite 650
Honolulu, Hawai'i 96813

Dear Mr. Shigekuni:

SUBJECT: Draft Environmental Impact Statement (DEIS) for Ho'opili, Ewa District, Oahu

The Department of Education (DOE) has reviewed the Draft Environmental Impact Statement (DEIS) for Ho'opili. We have the following comments:

Page xii, Executive Summary, Unresolved Issues, State of Hawaii Department of Education School Fair-Share Requirements: Please revise the narrative to reflect that the DOE will determine the actual number of schools required for the Ho'opili development after the developer provides more definitive data on respective market prices, size, and number of bedrooms for each type of unit planned.

Page 48, Section 4.3, Noise, Anticipated Impacts and Mitigation Measures, Operational Noise: Schools should not be located at sites where noise levels exceed 65 dBA.

Page 73, Section 4.8.1 Transportation, Anticipated Impacts: Please address the traffic impacts of locating a high school site along Farrington Highway. The DOE wonders why the traffic analysis did not refer to school traffic impacts in identified locations.

Pages 98-99, Section 4.9.1, Educational Facilities, Existing Conditions: The DOE does not understand why there is a discussion about the average size of some, but not all, schools constructed between 1997 and 2007. Different schools are designed for different enrollment sizes, and once schools open, enrollments change over time. Campus sizes also vary. Historical averages do not determine school design standards.

Page 99, Anticipated Impacts and Mitigation Measures: The DOE questions the appropriateness of stating that a high school in Ho'opili would "attract" residents from areas outside the project.

AR00027418

If the DEIS is referring to high school students, as opposed to home buyers, the DOE determines the attendance area for new schools and has a policy for the granting of geographic exceptions.

Page 226, Section 7, Contextual Issues, Section 7.2.5 Impacts on Public Facilities and Services, Educational Facilities: Please add a sentence in this section that the number of schools required for this project may change if the developer decides to increase residential densities per potential transit-oriented development (TOD) zoning.

The DOE's Educational Specifications state that the length to width ratio of school campuses should not exceed 2.5 to 1. We are concerned that the present ratio of the high school campus is 3.15 to 1. A long, narrow campus would constrain plans for the layout of the future high school. The DOE specifically requests a reevaluation of the shape of the high school campus.

The three elementary school campuses come close to, but do not exceed, the 2.5 to 1 ratio. If it is possible to make the elementary site more square in configuration, we believe there would be more options in planning the facilities on these sites. The configuration of the middle school site is sufficient.

Finally, it is noted that a meeting was held on March 12, 2008, with D.R. Horton – Schuler Division representatives. Preliminary estimates of the educational impacts of the development were discussed.

Should you have any questions, please call Heidi Meeker of the Facilities Development Branch at 377-8307.

Very truly yours,

Patricia Hamamoto
Superintendent

PH:jmb

cc: Randolph Moore, Assistant Superintendent, OSFSS
Duane Kashiwai, Public Works Administrator, FDB
Maino Carreira, CAS, Campbell/Kapolei/Waianae Complex Areas
Rodney Maile, Acting Director, Land Use Commission
Katherine P. Kealoha, Director, Office of Environmental Quality Control

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y.J. CHUNG, FASLA
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Associate

SCOTT A.I.K.A. BRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Ms. Patricia Hamamoto, Superintendent
State of Hawai'i
Department of Education
P.O. Box 2360
Honolulu, Hawai'i 96804

Attn: Ms. Heidi Meeker

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Ms. Hamamoto:

Thank you for your letter dated April 3, 2008. We have reviewed your letter and provide the following responses:

Page xii, Executive Summary, Unresolved Issues State of Hawaii Department of Education (State DOE) School Fair Share Requirements. As requested, the narrative of the EIS will be revised to read as follows:

The Petitioner is currently coordinating with the State DOE regarding the number of schools that will be required for the development of the Ho'opili project. During the Draft EIS public review period, the DOE commented that it will determine the actual number of schools required for the Ho'opili development after the developer provides more definitive data on respective market prices, size, and number of bedrooms for each type of unit planned. This will be identified as an unresolved issue until the number of schools required is finalized.

Page 48, Section 4.3, Noise, Anticipated Impacts and Mitigation Measures, Operational Noise. The last paragraph in this section of the EIS will be revised to read as follows:

The Exterior noise levels at two school sites (H-1 Freeway/Kunia Road and Farrington Highway) will exceed the Hawaii State Board of Education (BOE) Policy 6700 noise limit of L10 = 65 dBA (before mitigation). During the Draft EIS public review period, the DOE commented that schools should not be located at sites where noise levels exceed 65 dBA. Policy 6700 requires that air conditioning be provided to schools that are exposed to exterior noise levels in excess of the noise limit. The layout and construction of the school should be carefully designed such that exterior noise will not disturb learning activities and interfere with speech intelligibility. To reduce ambient noise levels at the school site, traffic noise mitigation measures may also be necessary, such as an earthen berm or noise barrier wall, or siting the buildings along high noise-generating roadways to essentially serve as noise barriers.

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AR00027419

Page 73, Section 4.8.1 Transportation, Anticipated Impacts. Please refer to the last paragraph of page 4-3 of the Traffic Impact Analysis Report (TIAR) which is in Appendix L of the DEIS. When the vehicle trips from the proposed project were estimated, the traffic engineering consultant included the estimated number of trips anticipated to be generated by the proposed schools. The estimated numbers of trips generated by school uses are shown on Tables 4-1 and 4-2 of the TIAR. No revisions to the text of the EIS are proposed.

Pages 98-99, Section 4.9.1, Educational Facilities, Existing Conditions. The information provided on these pages of the Draft EIS was an attempt to provide a historical context to show how many acres may be "exacted" from the Petitioner to address impacts to public schools. We concur that historical averages should not determine school design standards, especially as: 1) land values have skyrocketed, 2) residents have become more used to higher density and vertical development; and 3) new developments in professional planning practice have changed from the mindset of protecting residential uses from commercial uses to finding mixed residential and commercial uses as more desirable. The narrative of the EIS will be revised to read as follows:

~~*For planning purposes, the DOE assumes an enrollment of 550 students per elementary school, 600 students per middle school, and 1,000 students per high school. However, in 2007, the Hawaii State Legislature passed Act 245 regarding impact fees for schools. Act 245 defines "Recent School Construction Averages" as the department's historical average acres required and enrollment capacity for elementary (K-5), middle (6-8), and high (9-12). Based on existing school construction data, the historical average design standards are as follows:*~~

~~*Table 4.14, Existing School Construction Data*~~

~~SCHOOL TYPE~~	~~ACRES/SCHOOL~~	~~ENROLLMENT/SCHOOL~~	~~ACRES/STUDENT~~
~~Elementary School~~	~~12.5~~	~~800 students~~	~~.0156 acre~~
~~Middle School~~	~~16.5~~	~~1,500 students~~	~~.0110 acre~~
~~High School~~	~~49.0~~	~~1,600 students~~	~~.0306 acre~~

During the Draft EIS public review period, the DOE commented that "Different schools are designed for different enrollment sizes, and once schools open, enrollments change over time. Campus sizes also vary. Historical averages do not determine school design standards." The Petitioner concurs and proposes to provide a total of 90 acres throughout out the project site that can be planned by DOE for public schools. The Petitioner is working with the DOE so that the larger land area campuses are sited away from mixed-use developments. Schools fitting within a single-block can be sited in higher density areas.

Page 99, Anticipated Impacts and Mitigation Measures. Thank you for pointing out the possible misinterpretation of the noted sentence. The sentence in question will be revised to read as follows:

...A high school will be attractive to certainly ~~attract residents~~ homebuyers from areas outside of Ho'opili. This does not include the possibility that one or two private schools may be included in Ho'opili. If a planned private school(s) is built within the project, this will increase educational choices for local families. UHWO will offer higher education opportunities for regional residents.

Page 226, Section 7, Contextual Issues, Section 7.2.5 Impacts on Public Facilities and Services, Educational Facilities. As requested, the narrative of the EIS will be revised to read as follows:

The demand for educational facilities will increase as the population of 'Ewa grows. The Petitioner is setting aside land for three elementary schools, one middle school, and one high school with Ho'opili. UHWO has set aside land for an elementary school site near its southern boundary that might be shared by residents of the DHHL East Kapolei Development Parcel 1 project. The DHHL East Kapolei Development Parcel 2 project includes one elementary and one middle school sites. The State of Hawaii Department of Education (DOE) is also contemplating a high school on DHHL land immediately north of the UH West O'ahu site. Since the school-aged population is not constant, there is a possibility that not all of the above schools (a total of 2 high schools, two middle schools, and five elementary schools) will be needed after 20 to 25 years (the approximate time frame required for full build out of the combined East Kapolei projects. Through providing required public school sites (and the timely construction of schools by the State DOE), the planned developments in East Kapolei are not expected to adversely impact existing developments, including, but not limited to, the communities of Waipahu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa, Villages of Kapolei and Makakilo. During the public review period, the DOE noted that "...the number of schools required for this project may change if the developer decides to increase residential densities per potential transit-oriented development (TOD) zoning."

We appreciate the information provided on the desirable configuration for the various campus sites. Revisions to the master plan to accommodate such requests will be incorporated prior to a request for a change in County zoning. The third to the last paragraph of Section 2.5.1. *Ho'opili Conceptual Land Use Plan* of the EIS will be revised to read as follows:

The proposed project could include as many as five public school sites. The Conceptual Land Use Plan shows the possible locations for five State Department of Education (DOE) school sites planned to be as accessible to the neighborhoods of Ho'opili as the community is developed; one high school, one middle school and three elementary schools. The plan can also accommodate private schools as the need is determined. In addition, area is set aside along the western end of Farrington Highway fronting the Petition Area for either a fire station or a police substation. In total, approximately 100 acres are allocated to meet public facility needs. The master plan will likely be adjusted prior to zoning to achieve DOE-desired public school campus site configurations.

AR00027420

We acknowledge that the Petitioner has met with DOE on several occasions (the latest meeting on March 12, 2008) to discuss preliminary estimates of the educational impacts of the project as well as the location of proposed school sites.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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LINDA LINGLE
GOVERNOR
STATE OF HAWAII

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MICAH A. KANE
CHAIRMAN
HAWAIIAN HOMES COMMISSION

KAULANA H. PARK
DEPUTY TO THE CHAIRMAN

ROBERT J. HALL
EXECUTIVE ASSISTANT

STATE OF HAWAI'I
DEPARTMENT OF HAWAIIAN HOME LANDS
P.O. BOX 1879
HONOLULU, HAWAI'I 96805

April 15, 2008

Mr. Vincent Shigekuni, Vice President
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, HI 96813

Dear Mr. Shigekuni:

Subject: Ho'opili, Oahu
Draft Environmental Impact Statement

Thank you for allowing us to review and comment on the subject Draft Environmental Impact Statement (DEIS). We apologize for submitting our comments after the posted deadline.

The Department of Hawaiian Home Lands (DHHL) offers its support of the proposed project. Construction activities and the retail and industrial components of the Ho'opili master-planned community will give our homestead lessees in Kapolei and the Leeward Coast the opportunity to work close to home.

The DHHL shall continue to cooperate with the D.R. Horton - Schuler Division (Horton) in the development of off-site wastewater collection infrastructure and roadway inter-connectivity between our developments.

Our primary concern with the proposed plan is the potential need for additional access to the North-South Road at the boundary of the subject project site and DHHL's East Kapolei II. There is an existing sixty-foot easement along that boundary, which DHHL intends to develop into a roadway of approximately the same width. We encourage Horton to reserve a similar amount of land on their property for future widening of the roadway.

AR00027421

It would be very helpful to have a map to accompany the internal street descriptions in section 4.8.1 (page 71).

Please call Mr. Darrell Ing in our Land Development Division at 587-6451 if you have any questions.

Aloha and mahalo,

Micah A. Kane, Chairman
Hawaiian Homes Commission

c: Office of Environmental Quality Control

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
Chairman

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Associate

Mr. Micah A. Kane, Chairman
Hawaiian Homes Commission
State of Hawai'i
P.O. Box 1879
Honolulu, Hawai'i 96805

Attn: Mr. Darrell Ing

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Chairman Kane:

Thank you for your letter dated April 15, 2008 and for your stated support for the proposed project. The Petitioner is extremely grateful for the cooperative effort in developing off-site wastewater collection infrastructure and planning for roadway interconnectivity between the DHHL and Ho'opili projects.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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AR00027422

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GOVERNOR OF HAWAII

CHIYOME L. FUKINO, M.D.
DIRECTOR OF HEALTH

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P.O. Box 3378
HONOLULU, HAWAII 96801-3378

In reply, please refer to:
EPO-08-028

April 2, 2008

Mr. Vincent Shigekuni, Vice President
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

SUBJECT: Draft Environmental Impact Statement (DEIS) for the Ho'opili Project
Ewa, Oahu, Hawaii
TMK: (1) 9-1-017: 004 and others; 1,553.844 acres

Thank you for allowing us to review and comment on the subject application. The document was routed to the various branches of the Department of Health (DOH) Environmental Health Administration. We have the following Clean Water Branch, Waste Water Branch, Clean Air Branch, Indoor and Radiological Health Branch, and General comments.

Clean Water Branch

The Department of Health, Clean Water Branch (CWB), has reviewed the subject document and offers these comments on your project. Please note that our review is based solely on the information provided in the subject document and its compliance with Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55. You may be responsible for fulfilling additional requirements related to our program. We recommend that you also read our standard comments on our website at http://www.hawaii.gov/health/environmental/env-planning/landuse/CWB-standardcomment.pdf.

1. Any project and its potential impacts to State waters must meet the following criteria:

   a. Antidegradation policy (HAR, Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.

   b. Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.

   c. Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

2. You are required to obtain a National Pollutant Discharge Elimination System (NPDES) permit for discharges of wastewater, including storm water runoff, into State surface waters (HAR, Chapter 11-55). For the following types of discharges into Class A or Class 2 State waters, you may apply for NPDES general permit coverage by submitting a Notice of Intent (NOI) form:

   a. Storm water associated with construction activities, including clearing, grading, and excavation, that result in the disturbance of equal to or greater than one (1) acre of total land area. The total land area includes a contiguous area where multiple separate and distinct construction activities may be taking place at different times on different schedules under a larger common plan of development or sale. An NPDES permit is required before the start of the construction activities.

   b. Treated effluent from leaking underground storage tank remedial activities.

   c. Once through cooling water less than one (1) million gallons per day.

   d. Hydrotesting water.

   e. Construction activity dewatering.

   f. Occasional or unintentional discharges from recycled water systems.

   g. Storm water from a small municipal separate storm sewer system.

   You must submit a separate NOI form for each type of discharge at least 30 calendar days prior to the start of the discharge activity, except when applying for coverage for discharges of storm water associated with construction activity. For this type of discharge, the NOI must be submitted 30 calendar days before to the start of construction activities. The NOI forms may be picked up at our office or downloaded from our website at http://www.hawaii.gov/health/environmental/water/cleanwater/forms/genl-index.html.

3. For types of wastewater discharges not listed in Item 2 above or wastewater discharging into Class 1 or Class AA waters, you may need to obtain an NPDES individual permit. Class 1 waters include, but is not limited to, all State waters in natural reserves, preserves, sanctuaries, and refuges established by the Department of Land and Natural Resources (DLNR) under Hawaii Revised Statutes (HRS), Chapter 195, or similar reserves for the protection of aquatic life established under HRS, Chapter 195.

AR00027423

An application for an NPDES individual permit must be submitted at least 180 calendar days before the commencement of the discharge. The NPDES application forms may be picked up at our office or downloaded from our website at http://www.hawaii.gov/health/environmental/water/cleanwater/forms/indiv-index.html.

4. You must also submit a copy of the NOI or NPDES permit application to the State DLN R, State Historic Preservation Division (SHPD), or demonstrate to the satisfaction of the CWB that SHPD has or is in the process of evaluating your project. Please submit a copy of your request for review by SHPD or SHPD's determination letter for the project along with your NOI or NPDES permit application, as applicable.

5. Page ix of the Executive Summary states: "A grading permit is required to modify the topography, and additionally, a National Pollutant Discharge Elimination System (NPDES) permit will be required prior to construction to address **nnn-point source** discharges." The NPDES permit is for **point source** discharges of pollutants to State waters.

6. Appropriate Best Management Practices (BMPs) must be implemented when disturbing and/or remediating areas contaminated with dioxin, arsenic, or other pollutants. These BMPs must isolate and confine contaminated work areas and ensure compliance with the State's Water Quality Standards (WQS).

7. State waters (including Kaloi Gulch) require the best degree of treatment upland and prior to discharge. State waters shall not be used as treatment. Constructing storage structures and detention basins in State waters is prohibited.

8. Please note that all discharges related to the project construction or operation activities, whether or not NPDES permit coverage and/or Section 401 Water Quality Certification are required, must comply with the WQS. Noncompliance with water quality requirements contained in HAR, Chapter 11-54, and/or permitting requirements, specified in HAR, Chapter 11-55, may be subject to penalties of $25,000 per day per violation.

If you have any questions, please visit our website at http://www.hawaii.gov/health/environmental/water/cleanwater/index.html, or contact the Engineering Section, CWB, at 586-4309.

Waste Water Branch

The document proposes the development of a mixed use community in Ewa – complete with employment centers, quality schools, shopping, gathering and recreational places and parks and open space for residents.

The project is located in the Critical Wastewater Disposal Area (CWDA) where no new cesspools will be allowed. It is also located in the Pass Zone.

We have no objections to the proposal and offer our recommendation for approval as the domestic wastewater needs of the project will be handled by connection to the Honouliuli Wastewater Treatment Plant (WWTP) (as stated that the Petitioner has contributed towards increasing the capacity of the Makakilo/Kapolei Interceptor sewers to the Honouliuli WWTP).

We further encourage the developer to work with the County to utilize recycled wastewater for irrigation and other non-potable water purposes in open space and landscaping areas.

All wastewater plans must meet Department's Rules, HAR Chapter 11-62, "Wastewater Systems." We do reserve the right to review the detailed wastewater plans for conformance to applicable rules. If you have any questions, please contact the Planning & Design Section of the Wastewater Branch at 586-4294.

Clean Air Branch

Fugitive dust emissions occur during all phases of construction and operations. Activities close to existing residences, businesses, public areas or thoroughfares can cause dust problems. For cases involving mixed land use, we strongly recommend that buffer zones be established, wherever possible, in order to alleviate potential nuisance problems. We recommend that the contractors operate under a dust control management plan. The plan does not require the Department of Health approval, however it will help with identifying and minimizing the dust problems from the proposed project.

Examples of measures that can be included in the dust control plan are:

a) Planning the different phases of construction, focusing on minimizing the amount of dust-generating materials and activities, centralizing on-site vehicular traffic routes, and locating potential dust-generating equipment in areas of the least impact;
b) Providing an adequate water resource at the site prior to start-up of construction activities;
c) Landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;
d) Minimizing dust from shoulders and access roads;
e) Providing adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and
f) Controlling dust from debris being hauled away from the project site.

All activities must comply with the provisions of Hawaii Administrative Rules, §11-60.1-33 on Fugitive Dust. If you have any questions, please contact the Clean Air Branch at 586-4200.

AR00027424

Indoor and Radiological Health Branch

Project activities shall comply with the Administrative Rules of the Department of Health, Chapter 11-46, Community Noise Control. Should there be any questions, please contact Russell S. Takatu, Environmental Health Program Manager, Indoor and Radiological Health Branch, at 586-4701

General

We strongly recommend that you review all of the Standard Comments on our website: www.state.hi.us/health/environmental/env-planning/landuse/landuse.html. Any comments specifically applicable to this project should be adhered to.

If there are any questions about these comments please contact Jiacai Liu with the Environmental Planning Office at 586-4346.

Sincerely,

KELVIN H. SUNADA, MANAGER
Environmental Planning Office

c: EPO
CWB
WWB
CAB
IRH

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
Chairman

THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
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Mr. Kelvin H. Sunada, Manager
Environmental Planning Office
State of Hawai'i
Department of Health
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

Attn: Mr. Jiacai Liu

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Sunada:

Thank you for your letter dated April 2, 2008 (your reference: EPO-08-028). We have reviewed your letter and offer the following responses to your comments:

Clean Water Branch

1. The proposed project will comply with Hawaii Administrative Rules (HAR), Chapters 11-54 and 11-55.

2. A National Pollutant Discharge Elimination System (NPDES) permit is required. The need for this permit is stated in the Final EIS on page xiv (Listing of Permits and Approvals Required) and Table 5.9 (Required Permits/Approvals).

   At the appropriate time during the NPDES permit preparation process, the Clean Water Branch will be contacted, and a Notice of Intent will be submitted at least 30 days before the commencement of activities requiring the NPDES permit.

3. If it is determined to be required, an individual NPDES permit will be obtained. We understand that an application for an individual NPDES permit must be submitted at least 180 days before commencement of construction activities.

4. A copy of the NPDES permit application will be submitted to the State Department of Land and Natural Resources, State Historic Preservation Division (SHPD) for review.

5. Page xi of the Executive Summary (previously page ix in the Draft EIS) will be revised as follows:

   A grading permit is required to modify the topography, and additionally, a National Pollutant Discharge Elimination System (NPDES) permit will be required prior to construction to address ~~non-~~point source discharges.

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6. Best Management Practices will be implemented to isolate and confined contaminated work areas and be in compliance with the State of Hawai'i's Water Quality Standards (WQS).

7. The proposed project is being planned to include detention basins and/or retention basins to detain and/or retain storm water to ensure that areas downstream of the project are not impacted.

8. We acknowledge that all discharges related to the project construction or operation activities must comply with the WQS.

Waste Water Branch

We acknowledge that the wastewater generated from the project will be disposed of through the connection to the City & County Sewer Service System. As recommended, the Petitioner will work with the City and utilize recycled water for irrigation and other non-potable water purposes in the open spaces and for landscaping areas to the extent practicable. All wastewater plans will conform to applicable provisions of Chapter 11-62, HAR "Wastewater Systems," and the DOH Wastewater Branch reserves the right to review the detailed wastewater plans for conformance to applicable rules.

The following text will be added after the last paragraph of Section 4.8.3 *Wastewater Facilities, Anticipated Impact and Mitigative Measures* of the EIS:

> *All wastewater plans will conform to applicable provisions of Chapter 11-62, HAR, "Wastewater Systems," and the DOH Wastewater Branch reserves the right to review the detailed wastewater plans for conformance to applicable rules. In addition, the Petitioner will work with the Board of Water Supply and utilize recycled water for irrigation and other non-potable water purposes in the open spaces and for landscaping areas to the extent practicable.*

Clean Air Branch

We concur that there is a significant potential for fugitive dust emissions during construction and greatly appreciate the information provided. We have revised the first paragraph of Section 3.3 *Soils, Anticipated Impacts and Mitigation Measures* of the EIS to read as follows:

> *During project construction, there is a potential for soil loss through the generation of dust and water-borne soil erosion as areas are graded. All grading operations will be conducted in accordance with dust and erosion control and other requirements of the City and County of Honolulu Grading Ordinance and all applicable provisions regulating Fugitive Dust set forth under Section 11-60.1-33, HAR regarding. A NPDES permit will also be required prior to construction to address construction-related runoff. Additionally, a watering program will be implemented during construction to minimize soil loss through fugitive dust emission. During the public review period, the Department of Health (DOH) Clean Air Branch (CAB) recommended that a dust control management be prepared. The DOH CAB also provided additional examples of measures that can be implemented during construction:*

> • *where possible, for areas involving mixed land uses, buffer zones be established to alleviate potential dust nuisance problems;*
> • *planning the different phases of construction, focusing on minimizing the amount of dust-generating materials and activities, centralizing on-site vehicular traffic routes, and locating potential dust-generating equipment in areas of the least impact;*
> • *providing an adequate water resource and watering program at the site prior to start-up of construction activities;*
> • *landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;*
> • *minimizing dust from shoulders and access roads;*
> • *providing adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and*
> • *controlling dust from debris being hauled away from the project site.*

In addition, during the public review period, the Office of Hawaiian Affairs wrote: OHA recommends cleaning job-site construction equipment and establishing groundcover as quickly as possible after grading with native or endemic drought tolerant species. In addition to landscaping and watering programs, other mitigation measures suggested include:

> • *Early construction of drainage control features;*
> • *Construction of temporary sediment basins to trap silt, where needed;*
> • *Use of temporary berms and cut-off ditches where needed; and*
> • *Use of temporary silt fences (coir works well) or straw bales to trap silt.*

Indoor and Radiological Health Branch

Project activities will comply with Chapter 11-46, HAR (Community Noise Control). We have revised the first paragraph of Section 4.3 *Noise, Anticipated Impacts and Mitigation Measures, Construction Noise* of the EIS to read as follows:

> *Noise will be generated by construction and earth-moving equipment during the project's development. However, over the life of the project, depending where development will occur, construction noise will be relatively short-term, occur only during daytime hours, and comply with ~~DOH noise regulations~~ Chapter 11-46, HAR (Community Noise Control). Noise impacts will only be heard on margins of the Petition Area that border sensitive land uses, such as existing residential uses on the eastern boundary (minimal development is currently contemplated along Old Fort Weaver Road) and the southern boundary (buffered by the 'Ewa Villages Golf Course) of the Petition Area. In general, the Petition Area is surrounded by roads or open space; thus there are relatively few current residents that would be impacted by construction noise. There are no adjacent schools or hospitals to the Petition Area.*

The third paragraph of Section 4.3 *Noise, Anticipated Impacts and Mitigation Measures, Operational Noise* of the EIS has been revised to read as follows:

> *The project is designed to have higher densities than the existing Villages of Kapolei, and as such, will present similar ambient noise conditions as might be expected where a mix of*

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multi-family residential and commercial uses occur. Noise mitigation measures will be incorporated into the project design to prevent such impacts, such as installing landscaping, and installing mufflers and/or erecting barriers around noisy mechanical equipment (such as air conditioning). Consideration will be given to the layout of the commercial areas to meet State Department of Health noise regulations and reduce the noise impact. It is expected that the Petitioner will likely include restrictions on hours of operations on commercial uses in order to minimize the impact of potential noise producing uses such as bars and nightclubs or indoor recreational land uses. Project activities will comply with Chapter 11-46, HAR (Community Noise Control).

General

The following responses are offered to the Standard Comments on your website: http://www.state.hi.us/health/environmental/env-planning/landuse/landuse.html for the Environmental Planning Office:

- Waterbody type and class: The proposed project is located within three distinct drainage basins: Kalo'i Stream, Hunehune Stream and West Loch. The proposed project does not contain any other wetlands, streams, or known waterbodies onsite.

- National Pollutant Discharge Elimination System (NPDES): A NPDES permit is required for this project. The need for this permit is stated in Table 5.9 of the EIS. The Drainage Master Plan is attached as an Appendix O of the EIS.

- Water quality management: A Drainage Master Plan has been prepared and is attached as Appendix O of the EIS. The proposed drainage system calls for detention basins to help mitigate and filter runoff generated onsite. The drainage system is summarized in Section 4.8.4 *Drainage Facilities* of the EIS.

- Impaired waters of Hawai'i: No water bodies on the current 2004 List of Impaired Waters in Hawaii Prepared under Clean Water Act Section 303 (d) are expected to be impacted by the proposed project.

- We acknowledge your suggestion that we identify and analyze potential project impacts at a watershed scale. Section 4.8.4 *Drainage Facilities, Anticipated Impacts and Mitigation Measures* of the EIS and the Drainage Master Plan describe the proposed drainage system which include detention basins that are consistent with your recommendation to implement alternative and green engineering solutions to mitigate runoff and improve water quality and the project's potential impact on aquatic and riparian ecosystems.

The following responses are offered to the Standard Comments for the Hazard Evaluation and Emergency Response Office:

- We are in receipt of a memorandum dated March 13, 2008 from Mr. Harold Lao from the State of Hawai'i Department of Health Hazard Evaluation & Emergency Response Office (HEER), recommending that as part of the pre-development process,

the soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The the first and second paragraphs of Section 4.5, *Man-Made Hazards, Anticipated Impacts and Mitigation Measures of the EIS* will be revised as follows:

On March 13, 2008, in an interdepartmental memorandum from DOH Hazard Evaluation & Emergency Response Office (HEER) to the DOH Environmental Planning Office, HEER wrote: "The land under consideration for development of the Ho'opili Project mixed residential/commercial community was formerly used to grow sugar cane. The Draft EIS acknowledges the presence of potential contamination, and investigative work is being coordinated with the HEER Office." The Petitioner is working with DOH on a sampling methodology to determine the presence and levels of certain pesticides. Subsequent actions will be based on the results of the sampling.

Based on sampling done on the adjacent DHHL property, no impacts from pesticide use on the former sugar cane cultivation of the Petition Area are anticipated. Since the Ewa Plain was once mostly under sugar cultivation and large areas have subsequently been developed for residential use without any apparent ill effects, it is anticipated that future residents in the Petition Area will not be exposed to unacceptable levels of pesticides from past or present agricultural activities. During the public review period, the HEER recommended that soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The scope of the investigative work is currently being coordinated with the HEER Office to ensure that the study will be carried out in the most efficient and effective manner possible.

We offer the following responses to the Standard Comments for the Clean Air Branch:

- Construction/Demolition Involving Asbestos: Since the majority of the site is currently undeveloped, cultivated for many years for sugarcane, and most recently for diversified agriculture, it is not expected that there may be asbestos on site. However, if asbestos is found, the applicant or subsequent developers will contact the Asbestos Abatement Office in the Noise, Radiation and Indoor Air Quality Branch prior to construction/demolition.

- Control of Fugitive Dust: Discussion of this issue and proposed mitigation measures are provided in Section 3.3 *Soils, Anticipated Impacts and Mitigation Measures* of the EIS.

We offer the following responses to the Standard Comments for the Clean Water Branch:

- In their review of the Environmental Impact Statement Preparation Notice, the Army Corps of Engineers wrote it was unable to provide a determination whether a Department of Army permit would be required for the proposed project. An application for jurisdictional determination will be submitted to the Army Corps of Engineers.

AR00027427

- A National Pollutant Discharge Elimination System (NPDES) permit is required. The need for this permit is stated in the Final EIS on page xiv (Listing of Permits and Approvals Required) and Table 5.9 (Required Permits/Approvals).

  At the appropriate time during the NPDES permit preparation process, the Clean Water Branch will be contacted, and a Notice of Intent will be submitted at least 30 days before the commencement of activities requiring the NPDES permit.

  If it is determined to be required, an individual NPDES permit will be obtained. We understand that an application for an individual NPDES permit must be submitted at least 180 days before commencement of construction activities.

- A copy of the NPDES permit application will be submitted to the State Department of Land and Natural Resources, State Historic Preservation Division (SHPD) for review.

- In response to your comments, the last paragraph of Section 4.8.4 *Drainage Facilities, Anticipated Impacts and Mitigative Measures* has been revised as follows:

  Surface water quality can be impacted through development. Per comments received by the State Department of Health Clean Water Branch, any discharges related to project construction or operation activities shall comply with the applicable State Water Quality Standards as specified in Chapter 11-54, HAR. Further, the DOH Clean Water Branch wrote that the Hawaii Revised Statutes, Section 342D-50(a) requires that "[n]o person, including any public body, shall discharge any water pollutants into state waters, or cause or allow any water pollutant to enter state waters except in compliance with this chapter, rules adopted pursuant to this Chapter, or a permit or variance issued by the director." The project will need to obtain NPDES permits and Grading Permits (as previously identified in the DEIS). Both required permits have substantial effort identified in their applications specifically addressing BMP issues. The substantive parts of the permitting processes focus on BMP tools and monitoring. Features will include: stabilized gravel entrances, siltation berms, diversion of storm water around work areas, use of detention basins, diversion swales, filter traps at catch basins, calculation of soils losses meeting acceptable levels and monitoring plans. BMP's are an important part of current construction practice. The project will be providing detention basins to meet City and County of Honolulu Standards for water quality treatment. Structural methods may also be used to meet water quality requirements of the Rules Relating to Storm Drainage Standards. Structural methods include the use of Stormceptor® type storm drain manholes.

We offer the following responses to the Standard Comments for the Safe Drinking Water Branch:

- Public Water Systems: Discussion of this issue and proposed mitigation measures are provided in Section 4.8.2 *Water Supply Facilities* of the EIS.

- Underground Injection Control: No underground injection wells are proposed for this project.

- Groundwater Protection Program: No 9- or 18-hole golf courses are proposed for this project.

We offer the following responses to the Standard Comments for the Solid and Hazardous Waste Branch:

- Detailed discussion on solid waste management for the project is provided in Section 4.8.5 *Solid Waste Disposal Facilities* of the EIS.

The Standard Comments for the Wastewater Branch listed on your website are the same as the comments included in your letter and are answered above.

For Noise, Radiation, and Indoor Air Quality Branch Standard Comments, the proposed project will comply with the Administrative Rules of the Department of Health.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

AR00027428

LINDA LINGLE
GOVERNOR OF HAWAII

CHIYOME LEINAALA FUKINO,
M.D. DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:
08-064 RP

March 13, 2008

TO: Kelvin Sunada, Manager
Environmental Planning Office

FROM: Harold Lao
Hazard Evaluation & Emergency Response Office (HEER)

SUBJECT: Comments from HEER for the Draft EIS for the proposed Ho'opili Project, Ewa, Oahu, Hawaii

The land under consideration for development of the Ho'opili Project mixed residential/commercial community was formerly used to grow sugar cane. The Draft EIS acknowledges the presence of potential contamination, and investigative work is being coordinated with the HEER Office.

Residual pesticides in former agricultural lands could pose potential risks to human health and the environment in a residential setting. As part of the pre-development process, HDOH recommends that soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated.

Detailed guidance for the investigation of former agricultural lands is currently under preparation. Interim guidance is presented in the HEER office documents referenced below. The HEER office recommends that the developer initiate an environmental investigation of the former agricultural lands as early in the process as possible. Preparation of investigation work plans should continue to be coordinated with the HEER office to ensure that the study is carried out in the most efficient and effective manner possible.

References:

HDOH, 2005, *Screening For Environmental Concerns at Sites With Contaminated Soil and Groundwater* (May 2005): Hawai'i Department of Health, Office of Hazard Evaluation and Emergency Response, http://www.hawaii.gov/health/environmental/hazard/eal2005.html

HDOH, 2006, *Soil Action Levels and Categories for Bioaccessible Arsenic* (August 2006): Hawai'i Department of Health, Office of Hazard Evaluation and Emergency Response, http://www.hawaii.gov/health/environmental/hazard/eal2005.html

HDOH, 2006, *Proposed dioxin action levels for East Kapolei Brownfield Site* (March 2006): Hawai'i Department of Health, Office of Hazard Evaluation and Emergency Response, http://www.hawaii.gov/health/environmental/hazard/eal2005.html

HDOH, 2007, *Use of laboratory batch tests to evaluate potential leaching of contaminants from soil* (April 2007): Hawai'i Department of Health, Office of Hazard Evaluation and Emergency Response, http://www.hawaii.gov/health/environmental/hazard/eal2005.html

HDOH, 2007, *Pesticides in former agricultural lands and related areas - Updates on investigation and assessment* (August 2007): Hawai'i Department of Health, Office of Hazard Evaluation and Emergency Response, http://www.hawaii.gov/health/environmental/hazard/eal2005.html

AR00027429

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
Chairman

THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
Executive Vice-President

VINCENT SHIGEKUNI
Vice-President

GRANT T. MURAKAMI, AICP
Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HEGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Kelvin H. Sunada, Manager
Environmental Planning Office
State of Hawai'i
Department of Health
P.O. Box 3378
Honolulu, Hawai'i 96801-3378

Attn: Mr. Harold Lao

SUBJECT: **HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT**

Dear Mr. Sunada:

We are in receipt of a memorandum dated March 13, 2008 (your reference: 08-064 RP) from Mr. Harold Lao from the State Department of Health Hazard Evaluation & Emergency Response Office (HEER). We have reviewed the memorandum and offer the following responses to HEER's comments:

We acknowledge that residual pesticides in former agricultural lands could pose potential risks to human health and the environment in a residential setting. HEER recommends that as part of the pre-development process, the soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The second paragraph of Section 4.5, *Man-Made Hazards, Anticipated Impacts and Mitigation Measures* of the Final EIS will be revised to read as follows:

> *Based on sampling done on the adjacent DHHL property, no impacts from pesticide use on the former sugar cane cultivation of the Petition Area are anticipated. Since the Ewa Plain was once mostly under sugar cultivation and large areas have subsequently been developed for residential use without any apparent ill effects, it is anticipated that future residents in the Petition Area will not be exposed to unacceptable levels of pesticides from past or present agricultural activities. <u>During the public review period the HEER recommended that soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The scope of the investigative work is currently being coordinated with the HEER Office to ensure that the study will be carried out in the most efficient and effective manner possible.</u>*

HONOLULU OFFICE
1001 Bishop Street
ASB Tower, Suite 650
Honolulu, Hawai'i 96813-3401
Tel: (808) 521-5631
Fax: (808) 523-1402
E-mail: sysadmin@pbrhawaii.com

HILO OFFICE
101 Aupuni Street
Hilo Lagoon Center, Suite 310
Hilo, Hawai'i 96720-4262
Tel: (808) 961-3333
Fax: (808) 961-4989

WAILUKU OFFICE
1787 Wili Pa Loop, Suite 4
Wailuku, Hawai'i 96793-1271
Tel: (808) 242-2878

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

April 3, 2008

PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Attention: Mr. Vincent Shigekuni

Gentlemen:

Subject: Draft Environmental Impact Statement for Ho'opili

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR) Land Division distributed or made available a copy of your report pertaining to the subject matter to DLNR Divisions for their review and comment.

Other than the comments from Engineering Division, Division of Forestry & Wildlife, Land Division, the Department of Land and Natural Resources has no other comments to offer on the subject matter. Should you have any questions, please feel free to call our office at 587-0433. Thank you.

Sincerely,

Charlene E. Unoki

Morris M. Atta
Administrator

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

February 22, 2008

MEMORANDUM

TO: DLNR Agencies:
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
__Div. of State Parks
x Commission on Water Resource Management
__Office of Conservation & Coastal Lands
x Land Division – Oahu District/Keith Chun

'08 FEB 25 P12:34 ENGINEERING

FROM: Morris M. Atta
SUBJECT: Draft Environmental Impact Statement for Ho'opili
LOCATION: Ewa, Oahu, TMK: (1) 9-1-17:por 4, 59, 72; 9-1-18:1, 4; 9-1-10:2, por 14, 15: 9-1-17:por 4; 9-2-1:4, 5, 6, 7; 9-2-2:2
APPLICANT: PBR Hawaii

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 1, 2008.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed:
Date: 3/23/08

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LAND DIVISION
2008 MAR 25 P 3:41

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DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/MorrisAtta
Ref.: DEAHonpiliPBR
Maui.398

COMMENTS

(X) We confirm that the project site, according to the Flood Insurance Rate Map (FIRM), is located in Zones X, A and AE. The National Flood Insurance Program does not have any regulations for developments within Zone X, however, it does regulate developments within Zones A and AE as indicated in bold letters below.

( ) Please take note that the project site, according to the Flood Insurance Rate Map (FIRM), is also located in Zone ____.

( ) Please note that the correct Flood Zone Designation for the project site according to the Flood Insurance Rate Map (FIRM) is ___.

(X) Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken. If there are any questions, please contact the State NFIP Coordinator, Ms. Carol Tyau-Beam, of the Department of Land and Natural Resources, Engineering Division at (808) 587-0267.

Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:

(X) Mr. Robert Sumitomo at (808) 768-8097 or Mr. Maria Siu Li at (808) 768-8098 of the City and County of Honolulu, Department of Planning and Permitting.

( ) Mr. Kelly Gomes at (808) 961-8327 (Hilo) or Mr. Kiran Emler at (808) 327-3530 (Kona) of the County of Hawaii, Department of Public Works.

( ) Mr. Francis Cerizo at (808) 270-7771 of the County of Maui, Department of Planning.

( ) Mr. Mario Antonio at (808) 241-6620 of the County of Kauai, Department of Public Works.

( ) The applicant should include water demands and infrastructure required to meet project needs. Please note that projects within State lands requiring water service from the Honolulu Board of Water Supply system will be required to pay a resource development charge, in addition to Water Facilities Charges for transmission and daily storage.

( ) The applicant should provide the water demands and calculations to the Engineering Division so it can be included in the State Water Projects Plan Update.

( ) Additional Comments: _____

( ) Other: _____

Should you have any questions, please call Ms. Suzie S. Agraan of the Planning Branch at 587-0258.

Signed: _____
ERIC T. HIRANO, CHIEF ENGINEER

Date: 3/23/08

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

February 22, 2008

RECEIVED
LAND DIVISION
2008 MAR 24 A 11:24
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

MEMORANDUM

TO: DLNR Agencies:
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
__Div. of State Parks
x Commission on Water Resource Management
__Office of Conservation & Coastal Lands
x Land Division – Oahu District (Keith Chun)

FROM: Morris M. Atta
SUBJECT: Draft Environmental Impact Statement for Ho'opili
LOCATION: Ewa, Oahu, TMK: (1) 9-1-17:por 4, 59, 72; 9-1-18:1, 4; 9-1-10:2, por 14, 15: 9-1-17:por 4; 9-2-1:4, 5, 6, 7; 9-2-2:2
APPLICANT: PBR Hawaii

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 1, 2008.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
(✓) Comments are attached.

Signed: _____
Date: 3/24/08

AR00027432

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

MEMORANDUM

TO: Morris M. Atta
Acting Administrator

FROM: Keith Chun

DATE: March 20, 2008

SUBJECT: Request for comments on Draft EIS for Ho'opili
Ewa, Oahu, Hawaii; TMK (1) 9-1-17: por 4, 59, 72; 9-1-18: 1, 4; 9-1-10:2; por 14; 15; 9-1-17: por 4; 9-2-1: 4, 5, 6, 7; 9-2-2:2

Thank your for the opportunity to review and provide comments on the above mentioned draft EIS. Our comments regarding this application are provided below:

1. DLNR currently owns approximately 183 acres of land near and/or adjacent to the Ho'opili project. These DLNR lands (identified by TMK: (1) 9-1-16:08; (1) 9-1-17:86; and (1) 9-1-18:03 & 05) are all within the State Land Use Urban District boundary and designated as High Density Residential, Community Commercial Center and Transit Node (High Density Residential and Commercial) in the City & County of Honolulu Planning Department's Ewa Development Plan dated August 1997.

   The DLNR parcels have excellent development potential based on the location of these lands adjacent to or near major arteries (H-1 Freeway, Farrington Highway, North-South Road) and the City's proposed transit line as well as the substantial increase in development projects in the area. Consequently, regional infrastructure should take into consideration the potential development of the DLNR parcels, and DLNR requests that it be included in the planning and design of any regional infrastructure in the area that would serve the DLNR parcels. .

If you have any questions, please call Gavin Chun at 587-0385. Thank you.

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

February 22, 2008

MEMORANDUM

From: ~~TO:~~

DLNR Agencies:
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
__Div. of State Parks
x Commission on Water Resource Management
__Office of Conservation & Coastal Lands
x Land Division – Oahu District/Keith Chun

To: ~~FROM:~~ Morris M. Atta Marlene
SUBJECT: Draft Environmental Impact Statement for Ho'opili
LOCATION: Ewa, Oahu, TMK: (1) 9-1-17:por 4, 59, 72; 9-1-18:1, 4; 9-1-10:2, por 14, 15: 9-1-17:por 4; 9-2-1:4, 5, 6, 7; 9-2-2:2
APPLICANT: PBR Hawaii

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 1, 2008.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
(X) We have no comments.
( ) Comments are attached.

Signed:
Date: 2.26.08

AR00027433

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

February 22, 2008

RECEIVED
LAND DIVISION
2008 FEB 27 P 3:29
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

MEMORANDUM

TO: DLNR Agencies:
- x Div. of Aquatic Resources
- __Div. of Boating & Ocean Recreation
- x Engineering Division
- x Div. of Forestry & Wildlife
- __Div. of State Parks
- x Commission on Water Resource Management
- __Office of Conservation & Coastal Lands
- x Land Division – Oahu District/Keith Chun

FROM: Morris M. Atta
SUBJECT: Draft Environmental Impact Statement for Ho'opili
LOCATION: Ewa, Oahu, TMK: (1) 9-1-17:por 4, 59, 72; 9-1-18:1, 4; 9-1-10:2, por 14, 15: 9-1-17:por 4; 9-2-1:4, 5, 6, 7; 9-2-2:2
APPLICANT: PBR Hawaii

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 1, 2008.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

(X) We have no objections.
( ) We have no comments.
( ) Comments are attached.

Signed:
Date:

PAUL J. CONRY, ADMINISTRATOR
DIVISION OF FORESTRY AND WILDLIFE

FEB 26 2008

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
Executive Vice-President

VINCENT SHIGEKUNI
Vice-President

GRANT T. MURAKAMI, AICP
Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
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Wailuku, Hawai'i 96793-1271
Tel: (808) 242-2875

Mr. Morris M. Atta, Administrator
State of Hawai'i
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, Hawai'i 96809

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Atta:

Thank you for your letter dated April 3, 2008. We have reviewed your letter and it is our understanding that the Draft EIS was distributed to the following divisions:

1. Division of Aquatic Resources (no comments provided);
2. Engineering Division (comments provided);
3. Division of Forestry and Wildlife (comments provided);
4. Commission on Water Resource Management (no comments provided);
5. Land Division – Oahu District (comments provided); and
6. Land Division – Keith Chun (comments provided).

After careful review of your letter, we offer the following responses to comments provided by the respective divisions of your department.

Engineering Division

1. We acknowledge that portions of the project site, according to the Flood Insurance Rate Map (FIRM), are located in Zones X, A and AE; and that while the National Flood Insurance Program does not have any regulations for developments within Zone X, it does regulate developments within Zone A and AE. Based on the DLNR Engineering Division's comments, the following paragraph will be added after Table 3.2 in the Final EIS:

AR00027434

During the public review period, the State Department of Land and Natural Resources Engineering Division confirmed the flood zone designations affecting the Petition Area and wrote that: "The National Flood Insurance Program does not have any regulations for developments within Zone X, however, it does regulate developments within Zone A and AE...Please note that the project must comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken...Please be advised that 44CFR indicates the minimum standards set forth by the NFIP. Your Community's local flood ordinance may prove to be more restrictive and thus take precedence over the minimum NFIP standards. If there are questions regarding the local flood ordinances, please contact the applicable County NFIP Coordinators below:...Mr. Robert Sumitomo at (808) 768-8096 or Mr. Mario Siu Li at (808) 768-8098 of the City and County of Honolulu, Department of Planning and Permitting..." While it is highly unlikely that any development will be proposed on lands designated Zone A or AE, the Petitioner will continue to coordinate with the Department of Planning and Permitting to discuss project-related issues, including the City's local flood ordinance."

2. As noted above, the project will comply with the rules and regulations of the National Flood Insurance Program (NFIP) presented in Title 44 of the Code of Federal Regulations (44CFR), whenever development within a Special Flood Hazard Area is undertaken. In addition, the Petitioner will continue to coordinate with the Department of Planning and Permitting to discuss project-related issues, including the City's local flood ordinance.

Division of Forestry and Wildlife

1. We acknowledge that the Division of Forestry and Wildlife has no objections to the proposed project. The fourth to the last paragraph in Section 3.7 *Flora, Anticipated Impacts and Mitigative Measures* of the Final EIS will be revised to read as follows:

   None of the plant species which occurred on the Petition Area are considered to be a threatened ~~and~~ or endangered species or a species of concern. During the public review period, the State Department of Land and Natural Resources, Division of Forestry and Wildlife wrote that it had no objections to the proposed project.

2. In addition, the fifth to the last paragraph in Section 3.8, *Fauna, Anticipated Impacts and Mitigative Measures* of the Final EIS will be revised to read as follows:

   The majority of the sites surveyed within the Project Area are lands formerly cultivated in sugarcane or pineapple, having led to high degrees of disturbance or destruction of native habitat. Current habitats are deemed "depauperate" (severely diminished) by the biological consultant. Some of the sites are currently under partial cultivation, but those habitats likewise have been severely degraded. During the public review period, the State Department of Land and Natural Resources,

Division of Forestry and Wildlife wrote that it had no objections to the proposed project.

Land Division – Oahu District

1. We acknowledge that the Land Division – Oahu District has no comments to offer at this time.

Land Division – Keith Chun

1. The Petitioner acknowledges the development potential of the State-owned parcels adjacent to the Ho'opili project. The Petitioner also acknowledges the regional infrastructure request and supports DLNR's being included in the planning and design of any regional infrastructure in the area that would serve the DLNR parcels. Based on DLNR Land Division's comments, the first and second paragraphs of Section 7.2, *Cumulative and Secondary Impacts* of Final EIS will be revised to read as follows:

   This chapter identifies cumulative and secondary impacts that may result from the development of Ho'opili and the East Kapolei region. During the public review period, the State Department of Land and Natural Resources (DLNR), Engineering Division wrote: "DLNR currently owns approximately 183 acres of land near and/or adjacent to the Ho'opili project...The DLNR parcels have excellent development potential based on the location of these lands adjacent to or near major arteries (H-1 Freeway, Farrington Highway, North-South Road) and the City's proposed transit line as well as the substantial increase development projects in the area. Consequently, regional infrastructure should take into consideration the potential development of the DLNR parcels, and DLNR requests that it be included in the planning and design of any regional infrastructure in the area that would serve the DLNR parcels."

   7.2.1 ***Impacts on the Physical Environment***

   Climate, Topography, and Soils. *Planned developments in the East Kapolei region (the proposed Ho'opili project, University of Hawai'i at West O'ahu (UHWO), Department of Hawaiian Home Lands (DHHL) East Kapolei Development Parcels 1 and 2, Kroc Center, and the "DLNR parcels") are not expected to adversely impact regional climate, topography, and soils of existing developments, including, but not limited to, the communities of Waipalu, West Loch, Honouliuli, 'Ewa Villages, 'Ewa Villages of Kapolei and Makakilo. However, within their respective project sites, construction of the East Kapolei developments will impact mostly minor topographic features and soils, and new buildings may affect the respective micro-climate of each building site (by retaining and/or reflecting solar energy and heat, creating shade where none presently exists, or creating "wind tunnels"). Grading operations will comply with DOH regulations and are not expected to adversely impact air and water quality.*

AR00027435

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

O:\Job25\2503.01 DR Horton-E Kapolei\EIS\Final EIS\Final EIS Response Letters\BL-12 DLNR Response.doc

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

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APR 15 2008
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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

April 11, 2008

PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Attention: Mr. Vincent Shigekuni

Gentlemen:

Subject: Draft Environmental Impact Statement for Ho'opili

Thank you for the opportunity to review and comment on the subject matter. The Department of Land and Natural Resources' (DLNR), Land Division distributed or made available a copy of your report pertaining to the subject matter to the Commission on Water Resource Management for their review and comment.

The Department of Land and Natural Resources has no other comments to offer on the subject matter. Should you have any questions, please feel free to call our office at 587-0433. Thank you.

Sincerely,

for Morris M. Atta
Administrator

AR00027436

LINDA LINGLE
GOVERNOR OF HAWAII

LAURA H. THIELEN
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

February 22, 2008

MEMORANDUM

TO: **DLNR Agencies:**
x Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
x Engineering Division
x Div. of Forestry & Wildlife
__Div. of State Parks
x Commission on Water Resource Management
__Office of Conservation & Coastal Lands
x Land Division – Oahu District/Keith Chun

FROM: Morris M. Atta
SUBJECT: Draft Environmental Impact Statement for Ho'opili
LOCATION: Ewa, Oahu, TMK: (1) 9-1-17:por 4, 59, 72; 9-1-18:1, 4; 9-1-10:2, por 14, 15; 9-1-17:por 4; 9-2-1:4, 5, 6, 7; 9-2-2:2
APPLICANT: PBR Hawaii

Transmitted for your review and comment on the above referenced document. We would appreciate your comments on this document. Please submit any comments by April 1, 2008.

If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact my office at 587-0433. Thank you.

Attachments

( ) We have no objections.
( ) We have no comments.
( ) Comments are attached.

Signed: _____
Date: _____

LINDA LINGLE
GOVERNOR OF HAWAII

RECEIVED
LAND DIVISION
2008 APR -8 A 10:32
DEPT. OF LAND & NATURAL RESOURCES
STATE OF HAWAII

LAURA H. THIELEN
CHAIRPERSON

MEMBERS
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LAWRENCE H. MIIKE, M.D., J.D.

KEN C. KAWAHARA, P.E.
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P.O. BOX 621
HONOLULU, HAWAII 96809

April 3, 2008

REF: HoopiliDEIS.doc

TO: Morris Atta, Acting Administrator
Land Division

FROM: Ken C. Kawahara, P.E., Deputy Director
Commission on Water Resource Management

SUBJECT: Draft Environmental Impact Statement for Ho'opili

FILE NO.: N/A

Thank you for the opportunity to review the subject document. The Commission on Water Resource Management (CWRM) is the agency responsible for administering the State Water Code (Code). Under the Code, all waters of the State are held in trust for the benefit of the citizens of the State, therefore, all water use is subject to legally protected water rights. CWRM strongly promotes the efficient use of Hawaii's water resources through conservation measures and appropriate resource management. For more information, please refer to the State Water Code, Chapter 174C, Hawaii Revised Statutes, and Hawaii Administrative Rules, Chapters 13-167 to 13-171. These documents are available via the Internet at *http://www.hawaii.gov/dlnr/cwrm*.

Our comments related to water resources are checked off below.

☒ 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.

☐ 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.

☒ 3. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.

Permits required by CWRM: Additional information and forms are available at *www.hawaii.gov/dlnr/cwrm/forms.htm*.

☒ 4. The proposed water supply source for the project is located in a designated ground-water management area, and a Water Use Permit is required prior to use of ground water.

☐ 5. A Well Construction Permit(s) is (are) required before the commencement of any well construction work.

☐ 6. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.

DRF-IA 03/02/2006

AR00027437

☒ 7. There is (are) well(s) located on or adjacent to this project. If wells are not planned to be used and will be affected by any new construction, they must be properly abandoned and sealed. A permit for well abandonment must be obtained.

☐ 8. Ground-water withdrawals from this project may affect streamflows, which may require an instream flow standard amendment.

☐ 9. A Stream Channel Alteration Permit(s) is (are) required before any alteration can be made to the bed and/or banks of a stream channel.

☐ 10. A Stream Diversion Works Permit(s) is (are) required before any stream diversion works is constructed or altered.

☐ 11. A Petition to Amend the Interim Instream Flow Standard is required for any new or expanded diversion(s) of surface water.

☐ 12. The planned source of water for this project has not been identified in this report. Therefore, we cannot determine what permits or petitions are required from our office, or whether there are potential impacts to water resources.

☒ 13. We recommend that the report identify feasible alternative non-potable water resources, including reclaimed wastewater.

☒ OTHER:

The Commission on Water Resource Management (CWRM) would also like to ask that the reuse of storm water and the installation of water efficient fixtures be considered as a means to augment the development's proposed water usage. CWRM also recommends the use of xeriscaping and the planting of drought and salt-tolerant plants to conserve water supplies.

If there are any questions, please contact Jeremy Kimura at 587-0269.

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
Chairman

THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y.J. CHUNG, FASLA
Executive Vice-President

VINCENT SHIGEKUNI
Vice-President

GRANT T. MURAKAMI, AICP
Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. KISHIKAWA, ASLA
Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABREGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Morris M. Atta, Administrator
State of Hawai'i
Department of Land and Natural Resources
Land Division
P.O. Box 621
Honolulu, Hawai'i 96809

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Atta:

Thank you for your letter dated April 11, 2008. We have reviewed your letter and offer the following responses to comments provided by the Commission on Water Resource Management:

1. As recommended, the Petitioner's civil engineering consultant, Bills Engineering, Inc., has been, and will continue to coordinate with the City and County of Honolulu Board of Water Supply (BWS) to integrate the project into BWS' water use and development plans. A water master plan was prepared for this purpose and was reproduced in its entirety in the Hoopili DEIS Volume II as Appendix M.

2. The State Department of Health (DOH) will be involved in reviewing the project with respect to water quality from the EIS process to actual construction plans. The project will comply with any resulting requirements related to water quality. Per your comments, we have consulted with Tom Nance Water Resource Engineering and we will revise the first paragraph of Section 3.5 *Groundwater Resources/Hydrology, Anticipated Impacts and Mitigation Measures* of Final EIS as follows:

> *The total average daily source requirement for ultimate build-out is estimated at 3.9 MGD. The present agricultural use of the Petition Area provides recharge to the alluvial portion of the caprock from excess applied irrigation water. This irrigation return eventually moves into the aquifer in the upper limestone layer of the caprock, becoming a portion of its recharge, albeit a relatively small portion. According to Tom Nance Water Resource Engineering, development of the Ho'opili project will diminish this small component of the recharge to some extent, but will have an immeasurable impact on water level in the upper limestone layer.*

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Wailuku, Hawaii 96793-1871
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AR00027438

The project is not expected to impact groundwater resources, as the caprock acts as a barrier to the drinking water in the Petition Area. The caprock in 'Ewa, around Pearl Harbor, and in Honolulu, does function to retard seawater intrusion into the drinking water aquifer in the volcanics. According to Tom Nance Water Resource Engineering, it is an incredibly important contribution to the availability of drinking water which comes about due to the mostly impermeable contact surface between the volcanics and the overlying caprock. It is not due to the water level in the caprock.

Both the drinking water aquifer in the volcanics and the brackish to saline aquifer in the caprock's upper limestone layer are in hydraulic contact with seawater nearshore and offshore. Sea level changes, whether weeks or months long due to large scale whether phenomena in the Pacific or a longer term sea level rise, does cause both aquifers to rise or fall accordingly. According to Tom Nance Water Resource Engineering, the Ho'opili project will have no impact on sea level changes.

Although the Petition Area is situated mauka of the UIC line, no injection wells or cesspools will be installed (since the project's wastewater collection system will eventually connect to the Honouliuli Wastewater Treatment Facility), and any runoff or wastewater disposal required for the project will be managed in full compliance with State Department of Health (DOH) regulations. Irrigation for landscaping will utilize brackish water from the 'Ewa caprock and/or treated effluent (R-1 quality) from the City and County of Honolulu's Honouliuli Wastewater Treatment Facility (if available) to facilitate the recharge of caprock water and to reduce the demand for safe drinking water from the BWS system.

3. As noted on page xiv and Table 5.9 Required Permits/Approvals of the Draft EIS, a Water Use Permit is required for the project. An application will be submitted to CRWM prior to Building/Grading Permits. The only known source of ground water use will be associated with the development of a non-potable water system as generally described in the conceptual Water Master Plan (Appendix M of Hoopili DEIS Volume II).

4. We acknowledge that any wells that are not planned to be used and that will be affected by new construction will be properly abandoned and sealed. A permit for well abandonment will be applied for and processed.

5. As noted in Section 4.8.2 *Water Supply Facilities, Anticipated Impacts and Mitigation Measures* of the Final EIS:

   With respect to non-potable water requirements, the project will be maximizing non-drinking usage to minimize the demand on the safe drinking water system. If a suitable supply is made available, Sstreet right of ways of the Ho'opili project will have underground non-drinking distribution systems. It is proposed to upgrade the existing non-drinking source (EP 5 & 6 located within Parcel C) to a BWS dedicable standard to be used as the source for the non-drinking system. It is also proposed to ultimately allow for future dedication of the non-drinking system. It is estimated that the ultimate non-drinking demand for the project will be approximately 2.1 MGD.

The Petitioner will consider the use of drought tolerant/low water use plants and the implementation of xeriscaping principles for landscaping within the Ho'opili project to the extent practicable. The installation of an efficient irrigation system, possibly using drip irrigation, will be considered in the design of the project where feasible. Moisture sensors to avoid the operation of the system in the rain and if the ground has adequate moisture would be incorporated into the irrigation system, where feasible.

Another source of non-potable water is reclaimed water. The Honolulu Board of Water Supply (BWS) entered into the water recycling business in 2000 by purchasing the Honouliuli Water Reclamation Facility. Water recycling of treated wastewater effluent is one element of a broader BWS strategy to protect O'ahu's aquifers and to conserve water resources through conservation and development of new water supplies. Treated effluent from the facility is now irrigating golf courses that were once using brackish water, including West Loch, 'Ewa Villages, Hawai'i Prince, and Coral Creek. The facility is also providing recycled water (at a different level of treatment) to industries at Campbell Industrial Park.

6. The Petitioner will consider the reuse of storm water and the installation of water efficient fixtures; and is considering the use of xeriscaping and the planting of drought tolerant and salt-tolerant plants to conserve water supplies, where applicable.

   The last paragraph of Section 4.8.2 *Water Supply Facilities, Anticipated Impacts and Mitigation Measures* of the Final EIS will be revised as follow:

   The project will be maximizing the use of non-potable water for irrigation to minimize the impact on the source component of the BWS system. It is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies. A Conceptual Water Master Plan addressing safe drinking and non-potable water facilities has been prepared and reproduced in its entirety and attached to this EIS as Appendix M ~~will be submitted to~~ for BWS ~~for its~~ review and approval. In addition, construction drawings will be submitted to BWS for its review and approval. During the public review period of the Draft EIS, the DLNR Commission on Water Resource Management requested that "the reuse of storm water and installation of water efficient fixtures be considered" and recommended "the use of xeriscaping and the planting of drought tolerant and salt-tolerant plans to conserve water supplies."

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

AR00027439

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

O:\Job25\2503.01 DR Horton-E Kapolei\EIS\Final EIS\Final EIS Response Letters\BL-27 DLNR CWRM Response.doc

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

BRENNON T. MORIOKA
DIRECTOR

Deputy Directors
MICHAEL D. FORMBY
FRANCIS PAUL KEENO
BRIAN H. SEKIGUCHI

IN REPLY REFER TO:

STP 8.2831

April 7, 2008

Mr. Vincent Shigekuni
Vice President
PBR Hawaii & Associates, Inc.
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Ho'opili
D.R. Horton – Schuler Homes, LLC
Draft Environmental Impact Statement (Draft EIS)
Petition Area: TMK: 9-1-17: 04 (portion), 59, and 72; 9-1-18: 01 and 04.
Remainder of the Project Area: TMK: 9-1-10: 02, 14 (portion), and 15 (portion); 9-1-17: 04 (portion); 9-2-01: 04, 05, 06 and 07; and 9-2-02: 02

The Department of Transportation (DOT) submits the following comments on the subject project as presented in the Draft EIS:

1. The DOT's prior comments related to the project's EIS Preparation Notice in letter STP 8.2450 dated April 9, 2007 and your response in letter February 8, 2008 (copies attached) on the project's transportation impacts are still valid and applicable to the subject Draft EIS. To summarize:

   a. Occasional aircraft overflights and aircraft single-event noise may occur. Prospective occupants should be made aware of the potential for such occurrences.

   b. The project's location next to the State highways, proposed direct accesses and connections to a State highway, and contribution of additional traffic in the area and onto the highways require project and regional traffic mitigation measures and road/highway improvements.

   c. Drainage systems, other project construction plans and work affecting the highway right-of-ways require prior DOT review and approval.

AR00027440

2. The subject project is one of several major land developments scheduled to occur in the Kapolei-Ewa region, including projects in Makakilo and Kunia, around the same 2010-2030 time period. The subject project itself will create significant transportation impacts and further contribute to collective regional impacts, which will produce even greater cumulative impacts. Both these impacts, as well as the influence of the Honolulu High-Capacity Transit project, must be addressed.

   The project is obligated under the applicable City & County of Honolulu ordinance to participate in and contribute to the Ewa Impact Fee for transportation improvements.

   The project is also obligated to provide for and/or implement the traffic mitigation measures and road/highway improvements determined necessary by the DOT Highways Division. The Highways Division is in the process of concluding its review of the development plan and TIAR for the subject project. When the analysis is completed, the Highways Division will contact your firm.

Due to the significant impacts associated with the subject project, the DOT feels that further analysis and evaluation of the transportation factors is necessary. Thank you for the time and opportunity afforded to review the project plans and TIAR. Your continued cooperation is appreciated.

Very truly yours,

BRENNON T. MORIOKA, PH.D., P.E.
Director of Transportation

Attach.

c: Rodney Maile, Land Use Commission
   Mary Lou Kobayashi, Office of Planning, DBEDT

LINDA LINGLE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

BARRY FUKUNAGA
INTERIM DIRECTOR

Deputy Directors
FRANCIS PAUL KEENO
BRENNON T. MORIOKA
BRIAN H. SEKIGUCHI

IN REPLY REFER TO:

STP 8.2450

April 9, 2007

Mr. Vincent Shigekuni
PBR Hawaii & Associates, Inc.
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Ho'opili
D. R. Horton – Schuler, LLC
EIS Preparation Notice for LUC Petition No. A06-771 Filing
TMK: 9-1-17: 04 (portion), 59, and 72; 9-1-18: 01 and 04;
9-1-10: 02, 14 (portion), and 15 (portion) and 9-2-02: 02, and
(portion), 04, 05, 06 and 07

Thank you for providing the notification on the subject proposed land development project. We have the following initial comments as an interested party:

1. The site of the project is not directly under aircraft flight paths for Kalaeloa Airport or Honolulu International Airport. However, the developer and prospective residents/occupants should be advised and made aware that single-event noise may occur from potential overflights of aircraft or under certain weather/atmospheric conditions, particularly from aircraft approaching or departing Kalaeloa Airport.

2. The development of the project will have a significant traffic impact on our highway facilities in the Kapolei-Ewa region. The developer should prepare and submit a traffic impact analysis report (TIAR). The TIAR should cover both project traffic impacts and the cumulative traffic impacts to the community and region, which the project will be contributing to, including the existing and future road network in the area. Accesses and connections to any State highway also need to be identified. The TIAR should provide recommended and required transportation mitigation measures and roadway improvements to address the impacts, including the developer's participation in and contribution to provide the mitigation measures and improvements. We will need to review and approve the TIAR.

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3. We should be included in agency reviews and approvals of the drainage plans for the subject project.

4. Any construction work by or for the subject project that can affect a State highway and/or can occur within or adjoin a State highway right-of-way will need our prior review and approval.

We will defer any other additional comments on the subject project until we receive and have the opportunity to review more information on the project. We would appreciate receiving at least five (5) copies of any report or document on the project for review by our operating divisions.

We appreciate the opportunity to provide our comments.

Very truly yours,

BARRY FUKUNAGA
Interim Director of Transportation

DS:km

c: Genevieve Salmonson, Office of Environmental Quality Control
Laura Thielen, Office of Planning, DBEDT
Anthony Ching, Land Use Commission

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Mr. Brennon Morioka, Director
State of Hawai'i
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813-5097

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Morioka:

Thank you for your letter dated April 7, 2008 (your reference: STP 8.2831). We have reviewed your letter and offer the following responses to your comments:

1. We acknowledge that the Department of Transportation's prior comments related to the project's EIS Preparation Notice in letter STP 8.2450 dated April 9, 2007 and our response in a letter dated February 8, 2008 on the project's transportation impacts are still valid and applicable to the DEIS. Specifically:

   a. We acknowledge that single-event noise may occur from potential overflights of aircraft or under certain weather/atmospheric conditions, particularly from aircraft approaching or departing Kalaeloa Airport. Prospective occupants will be made aware of the potential for such occurrences. The third to the last paragraph of Section 4.3 *Noise, Anticipated Impacts and Mitigation Measures* of the EIS will be revised as follows:

      Aircraft noise due to operations at nearby Kalaeloa Airport and the Honolulu International Airport may be audible at the project site. However, flights directly above the site are infrequent and the project site is outside of the Ldn 55 noise contour for both airports. Therefore, a significant noise impact due to aircraft noise is not expected. <u>However, per the comments made by the State Department of Transportation during the Draft EIS public review period, prospective occupants will be made aware of the potential for such occurrences.</u>

   b. Proposed traffic mitigation measures were identified on pages 79 through 84 of the DEIS.

   c. We acknowledge that drainage systems, other project construction plans and work affecting the highway right-of-ways require prior DOT review and approval. The second paragraph in Section 2.6 *Infrastructure Improvements* of the EIS will be revised as follows:

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> *Major on-site infrastructure improvements required for the project include: facilities for water transmission and distribution; wastewater collection; traffic circulation; drainage; and electrical and communication systems. It is possible that one or more micro-utility companies may be providing a portion or all of the electrical and/or communication systems for the project. For instance, there are companies that can install solar photovoltaic panels on buildings for free in return for charging lower electrical rates than HECO. While the specific nature of each improvement is not known at this time, the EIS is intended to address all current and future instances involving the use of State and/or County lands and funds relating to the Ho'opili project, including micro-utility companies that may require the use over State and/or County lands to operate and maintain any utility lines or facilities. Per comments made by the State Department of Transportation during the Draft EIS public review period, drainage systems, other project construction plans and work affecting the highway right-of-ways require prior DOT review and approval.*

2. We acknowledge your concern that the project will create significant transportation impacts and further contribute to collective regional impacts, which will produce even greater cumulative impacts. The cumulative impacts of the project and other projects in the area were addressed in the Traffic Impact Analysis Report prepared by Wilbur Smith & Associates (February 2008), which was reproduced in its entirety in the DEIS as Appendix L and summarized in Section 4.8.1 *Transportation* of the DEIS.

   We acknowledge that the project is obligated under the applicable City & County of Honolulu ordinance to participate in and contribute to the Ewa Impact Fee for transportation improvements. This was noted in the third to the last paragraph of Section 4.8.1 *Transportation, Anticipated Impacts and Mitigation Measures* of the DEIS.

   Furthermore, we acknowledge that the project is also obligated to provide for and/or implement the traffic mitigation measures and road/highway improvements determined necessary by the DOT Highways Division. We acknowledge that the Highways Division is in the process of concluding its review of the development plan and TIAR for the subject project. As such, the Petitioner will continue to coordinate with the DOT Highways Division during the design of the project.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

HAWAII COMMUNITY DEVELOPMENT AUTHORITY
KAKAAKO KALAELOA

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Ref. No.: PL Kalaeloa 17.1.1

April 7, 2008

Mr. Vincent Shigekuni
PBR Hawaii & Associates Inc.
1001 Bishop Street
ASB Tower 650
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

SUBJECT: Draft Environmental Impact Statement for the Ho'opili Project Ewa, O'ahu, Hawaii

Thank you for the opportunity to review and comment on the Ho'opili Project Draft Environmental Impact Statement (DEIS). In 2002, the State Legislature transferred the responsibility for the planning and redevelopment of the Kalaeloa Community Development District (KCDD) to the Hawaii Community Development Authority (HCDA). Given the scope and impact of the Ho'opili project upon the Kapolei Ewa region it is my hope that the live, work and play objectives of the Kalaeloa Master Plan will be coordinated with your project.

The HCDA supports the development of an internal network of closely-spaced gridded streets and bike paths linking the project to the surrounding communities of University of Hawaii West Oahu (UHWO), Department of Hawaiian Homes Land (DHHL), Ewa Villages, and the KCDD. This objective is consistent with the HCDA Kalaeloa Master Plan. Improving connectivity throughout the region was one of the most important issues identified during the strategic planning meetings for the region as well as the KCDD. The extension of the Kapolei Area Bikeway Plan to include UHWO, DHHL, and the KCDD in the DEIS is also noteworthy and consistent with our Master Plan.

Thank you for the opportunity to comment on the DEIS. Should you require clarification, please contact Tesha Malama via email at tesha@hcdaweb.org or at 520-2686.

Sincerely,

Anthony J. H. Ching
Executive Director

AJHC/TM:js
c: State of Hawaii Land Use Commission

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PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Mr. Anthony J.H. Ching, Executive Director
State of Hawai'i
Hawai'i Community Development Authority
677 Ala Moana Boulevard, Suite 1001
Honolulu, Hawai'i 96813

Attn: Ms. Tesha Malama

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Ching:

Thank you for your letter dated April 7, 2008 (your reference number: PL Kalaeloa 17.1.1). We greatly appreciate your letter and your agency's participation in our meetings with the University of Hawai'i at West Oahu, the Department of Hawaiian Home Lands, the Kroc Center and others. The fourth paragraph of the Executive Summary of the EIS will be revised to read as follows:

> *Ho'opili is planned to be connected to the surrounding 'Ewa District (and neighboring DHHL, UHWO and HCDA properties) by a network of streets and bicycle paths which should allow a variety of circulation options for residents and visitors. During the public review period, the Hawai'i Community Development Authority (HCDA) wrote that: "The HCDA supports the development of an internal network of closely-spaced gridded streets and bike paths linking the project to the surrounding communities of University of Hawaii West Oahu (UHWO), Department of Hawaiian Home Lands (DHHL), Ewa Villages, and the KCDD. This objective is consistent with the HCDA Kalaeloa Master Plan. Improving connectivity throughout the region was one of the most important issues identified during the strategic planning meetings for the region as well as the KCDD. The extension of the Kapolei Area Bikeway Plan to include UHWO, DHHL, and the KCDD in the DEIS is also noteworthy and consistent with our Master Plan."*

> *Wider tree-lined boulevards are intended to create a distinct axis running north-south and east-west across the site. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. Also possible is a transit maintenance and storage facility. While the proposed residential unit count should not materially change, it will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as ridership generation, "capture" of transit-oriented development potential and the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will concentrate higher intensity development (and density) around the transit station(s). A site for a transit maintenance and storage facility is also possible. (As of this writing, the City and County of Honolulu (City) has begun work on the Draft Environmental Impact Statement (EIS) for the Honolulu High-Capacity Transit Corridor (HHCTC) project, with a target publication date in the second quarter of 2008. By the time the HHCTC Draft EIS is published, the final alignment of the high-capacity transit corridor, the location of transit stations, and the location of the transit maintenance and storage facility will be known).*

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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STATE OF HAWAI'I
OFFICE OF HAWAIIAN AFFAIRS
711 KAPI'OLANI BOULEVARD, SUITE 500
HONOLULU, HAWAI'I 96813

HRD08/2945B

April 17, 2008

Vincent Shigekuni, Vice President
PBR Hawaii & Associates, Inc.
1001 Bishop Street,
ABS Tower, Suite 650
Honolulu, Hawai'i 96813-3484

RE: Ho'opili Draft Environmental Impact Statement (DEIS) and Reclassification of Land from Agricultural to Urban, 'Ewa District, O'ahu, TMKs: 9-1-17: 04, 59, and 72; 9-1-18:01 and 04; 9-1-10: 02, 14 and 15; 9-1-17:04; 9-2-01:04, 05, 06 and 07; and 9-2-02:02.

Dear Mr. Shigekuni,

The Office of Hawaiian Affairs (OHA) is in receipt of the above referenced request for comments concerning a DEIS for the proposed Ho'opili development and reclassification of 1,553.844 acres of land from agricultural to urban in the 'Ewa District on O'ahu. We offer the following comments:

OHA understands, and as the applicant has pointed out, that the City and County of Honolulu is in a housing crisis and our collective population is expected to grow in the foreseeable future.[1] We also understand that the amount of available land for our homes is scarce. Naturally, this puts us all in a bind. However, OHA fundamentally cannot support a project that proposes to remove the best and most highly-protected agricultural lands on this island from current and active production. OHA notes that these lands have been described as the "'golden triangle" on O'ahu, and that they have historically been some of the most productive and consistent agricultural lands in our State.[2]

[1] See page 12 of the DEIS.

[2] See, http://www.honoluluadvertiser.com/apps/pbcs.dll/article?AID=/20080331/NEWS01/803310303/0/NEWS01, posted on March 31, 2008.

OHA stresses that this land is zoned Agriculture A-1 which requires that the greatest possible protection be given to these lands. (see Hawaii Revised Statutes Section 205) OHA is deeply concerned that this area be used for agricultural uses only. Our concerns are echoed by the myriad of laws and legislation supporting a strong agricultural economic base and retention of those lands primarily in agricultural pursuits in the specific project area. (see Hawaii Revised Statutes, Section 205, O'ahu General Plan and Sustainable Communities Plan; Section 1-115 of the City Subdivision Rules and Regulations; the State Coastal Zone Management Act; and even the city's 'Ewa Development Plan, last updated in 2000, which emphasizes that high-value farmland be preserved for agriculture for 3,000 acres in the general project area.) OHA stresses that only accessory agribusiness activities which meet the above intent are to be permitted in this area.

Hawaii Revised Statutes section 205-2 states that, "In the establishment of agricultural districts the greatest possible protection shall be given to those lands with a high capacity for intensive cultivation". That is exactly the kind of land that this project proposes to use and as such, OHA cannot reasonably see how the removal of 1,553.844 acres of prime agricultural lands currently in use does not run afoul of state and county land use plans, controls and policies.

Further, Hawaii Revised Statutes section 205-41 states;

> It is declared that the people of Hawaii have a substantial interest in the health and sustainability of agriculture as an industry in the State. There is a compelling state interest in conserving the State's agricultural land resource base and assuring the long-term availability of agricultural lands for agricultural use to achieve the purposes of:
>
> (1) Conserving and protecting agricultural lands;
>
> (2) Promoting diversified agriculture;
>
> (3) Increasing agricultural self-sufficiency; and
>
> (4) Assuring the availability of agriculturally suitable lands pursuant to article XI, section 3, of the Hawaii state constitution.

In 1961, the Committee on Lands and Natural Resources remarked that its goal in creating the State Land Use Commission was primarily to "protect productive

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agricultural lands…through state zoning."[3] The high value assigned to agriculture lands was emphasized again by the 1976 legislature when they assigned Class A and B agricultural lands "additional protection…[against county approval of] agricultural subdivisions."[4]

Further, and as mentioned in Hawaii Revised Statutes section 205-41, even our state constitution emphasizes that:

> The State shall conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands. The legislature shall provide standards and criteria to accomplish the foregoing.
>
> Lands identified by the State as important agricultural lands needed to fulfill the purposes above shall not be reclassified by the State or rezoned by its political subdivisions without meeting the standards and criteria established by the legislature and approved by a two-thirds vote of the body responsible for the reclassification or rezoning action.

Additionally, and as the applicant knows, most of the soils in the project area are rated A or B. This is significant because A and B soil classified agriculture lands have additional layers of protection given to them in Hawaii Revised Statutes section 205-4.5 (16)(b) which does not allow a county to approve a subdivision of these lands unless subdivision is made subject to restrictions that keep them in agricultural use.

OHA realizes that housing is an important issue for our beneficiaries and a difficult one for this State. This is why we seek to improve upon environmental review documents such as these so that public input can be considered; impacts mitigated and proposed projects become the best that they can be. This is also why we urge the applicant to provide us with additional alternatives analysis. The heart of an environmental review document is its discussion of alternatives. OHA seeks to find a rigorous and objective analysis of all reasonable alternatives to the proposed action, including a discussion of the "no action" alternative as a base-point to which the proposed action can be compared. This was not done in this case. The Alternatives Analysis section of the Executive Summary is nine lines long and the Alternatives to the Proposed Action section (6.0) of

[3] S. Stand. Comm. Rep. 850, 1st Leg., Gen. Sess. (1961), reprinted in 1961 Haw. Sen. J. 883, 883. From Avoiding the Next Hokuli'a, Adrienne Suarez, 27 UH L. Rev. 441.

[4] S. Conf. Comm. Rep. 2-76, 8th Leg., Reg. Sess. (1976), reprinted in 1976 Haw. Sen. J. 836, 836. From Avoiding the Next Hokuli'a, Adrienne Suarez, 27 UH L. Rev. 441.

the DEIS is but four pages long. A proposed action of this magnitude dealing with an issue of this importance requires more attention than:

> Further study or delay of any proposed development on the property would not be consistent with the *Ewa Development Plan* or the County's objective of directing growth to 'Ewa. Therefore, various alternatives for the site were rejected…."

OHA notes that being in a hurry or citing previous studies is not reason to skirt an alternatives analysis. Neither is an arrangement of consistent goals, as there are just as many land use policies and goals (if not more) that the applicant proposes to violate. OHA understands that this issue is a difficult one; however, as this is the applicant's proposed project we ask them to provide valid alternatives analysis for review and public comment in order to make this a better project and avoid further unnecessary costs.

In terms of housing, OHA additionally notes that according to the Center on Budget and Policy Priorities webpage, (http://www.cbpp.org/4-17-06sfp.htm); as of April 2006, the poverty level for a two-parent family of four in Hawaii is $19,961. As such, we ask how many of the applicant's proposed homes will be made to be affordable and to what standard is affordable defined.

Regarding drainage, OHA notes that Kalo'i Gulch is proposed to be shared by all of the current users and the University of Hawai'i at West O'ahu, the Department of Hawaiian Homelands, the Kroc Center, Haseko's Ocean Pointe development as well as the applicant. Therefore, we will hold the applicant to their statement made on page 223 of the DEIS that discharge flow rates will not exceed pre-development conditions and that the rules relating to water quality standards will be adhered to. However, we do seek clarification on this point because page x of the DEIS states, "Over time the project will result in an increase in wastewater being generated that currently being generated on-site (by agricultural activities)."[5] OHA is also confused as to whether discharge rates will not exceed pre-development conditions because of the statement on page xi: "The project will increase impervious surfaces such as roadways, roof, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Petition Area."[6]

[5] Page 91 of the DEIS also makes a similar statement.

[6] Page 223 of the DEIS also makes a similar claim. OHA does note page 118 of the DEIS states that the Kalo'i basin will not exceed pre-developmetn conditions while the Honoululi basin willdischarge at rates not exceeding the 10-year occurrence flow rate (for which OHA would request analysis for impacts to the nearshore environment) and that the West Loch basin has no drainage rate.

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OHA wishes to point out that there are a host of State water quality standards that must be met by this project.[7] For example, all Hawai'i state waters are classified as Class A or Class AA. Class A waters have strict pollution discharge regulations to protect them for recreational and aesthetic enjoyment. This includes the Clean Water Branch requirements that any project and its potential impacts to State waters meet the following criteria:

> -Anti-degradation policy (Hawai'i Administrative Rules (HAR), Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.
>
> -Designated uses (HAR, Section 11-54-3), as determined by the classification of the receiving State waters.
>
> -Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

OHA further notes that the Kalo'i Gulch drainage way (as do the Honouliuli and West Loch drainage basins which are potentially to be used for this project) eventually discharges into the ocean. As such, OHA inquires as to the monitoring plan proposed by the applicant to ensure that the Rules Relating to Storm Drainage Standards and discharges into State waters are being complied with.

OHA also sees that the DEIS on page 33 states, "Proposed drainage improvements within the Petition Area include on-site detention and retention basins, which will promote on-site infiltration of surface water and facilitate groundwater recharge." OHA points out that this is in contradiction to the statement made on the previous page of the DEIS (page 32) which indicates that surface water is not tied to groundwater: "Within the Petition Area, surface water in the channel (Honouliuli) does not appear to be connected to the groundwater."

OHA urges the applicant to be aware of the potential for water in the detention and retention ponds to seep into the groundwater system. As such, we ask if an overfill pipe will be included in these ponds and what are the impacts from the expected overflow. Further, we ask that the applicant provide analysis as to the effects of the increased discharges from their proposed use of the Petition Area drainage basins on the nearshore environment. In particular we are concerned about the effects from this project on fishing grounds, limu and fishponds, all of which are found in the area and all of which

[7] This is because the proposed project is seen as exempt due to its not being significantly different from the original fill design. See 33 Code of Federal Regulations 323.4(a)(2).

are being currently used by our beneficiaries for their constitutionally protected cultural practices. We note that the Cultural Impact Assessment states on page 98 that there are such practices in the Project Area but that:

> The Project Area is approximately 600m (2,000 feet) back from the coast therefore marine resources will not be affected.

OHA disagrees with this statement and seeks clarification as to what the basis was for this particular determination. Analysis for this type of conclusion in an environmental review document should be accompanied by such things as instream flow rates, biological assessments and brackish water content for the area. This is particularly important because we see that our beneficiaries' interests will be negatively impacted by this action in this regard.

Also, regarding the makai detention basin, OHA notes that permission of the Navy would be required for this basin to be built and not only has the Navy not given its permission, they have refused and, despite what may have been in the past, there is no indication that OHA is aware of that they may acquiesce to the applicants request. Naturally, this raises a host of concerns for all involved, no doubt mostly to the applicant.[8] However, OHA does wish to see analysis provided in an environmental review for all aspects of a proposed project that are truly feasible at the time of writing the document. Future possibilities and conditionals cannot provide the basis for substantive review and meaningful public input.

To help mitigate the adverse impacts of a proposed project and make it the best it can be OHA urges that the applicant provide information and analysis for parts of the project that are likely to come to fruition.[9] We point this out because we also see that this project hinges upon not only Navy permission that is not forthcoming, but also a proposed building out of a wastewater treatment plant and associated improvements[10], the "assumption"[11] for a proposed transportation system servicing the area, and recycling programs that do not exist yet.

Regarding stormwater in general, OHA wishes to see stormwater as a resource to be captured and conserved rather than a nuisance to be channeled and drained away. As stormwater travels down a drainage system, it accumulates industrial waste, pesticides,

[8] OHA notes that if Navy land is used, a Section 106 of the National Historic Preservation Act consultation and other federal assessments may be triggered.
[9] DEIS, page 91.
[10] DEIS, page 31.
[11] "The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed...." DEIS, page ix.

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oils, and chemicals. These pollutants quickly settle into the nearshore sediments and are re-suspended into the water column when disturbed.

Persistent organic pollutants (POPs) are organic compounds that linger in the environment, travel through the food web, and pose risks to human health and the environment. Organic hydrocarbons, including petroleum products, are examples of POPs. POPs are most commonly introduced to marine systems via discharged sewage and stormwater effluent, terrestrial runoff, and oil spills. POPs can also bioaccumulate in the nearshore species that inhabit these areas.

Therefore, OHA recommends the use of a stormwater management system that would filter these and other pollutants out and slow the amount of sediments entering our waters. The following four water management methods and erosion control structures are used by the Food and Agriculture Organization of the United Nations[12]:

- runoff harvesting (catching runoff for supplementary irrigation);
- total absorption or infiltration;
- runoff diversion (redirecting excess water);
- runoff spreading (distribution of runoff energy).

OHA is pleased to see that the applicant is proposing to use retention and detention ponds where possible. OHA does remark that if ponds are used, they should be shallow with slow sloping bottoms. The slow sloping sides are needed for safety if people happen to fall in. A surrounding area around the pond should be provided for water storage when heavy rains are present. OHA does ask if retention and detention ponds will be installed near each other in a row so that the water will get held up in the detention pond and slowly drain into the retention pond. The detention pond will help eliminate flooding and the retention will hold the remaining water. The use of permeable paving materials can also retain some of the rain that falls and catch basins can capture and help to slow the runoff thereby reducing turbidity and sediment runoff.

Retention and detention ponds also serve to remove pollutants, such as POPs and trash. Since retention and detention ponds are the drainage basin for an area, pollutants, trash and debris are washed into these areas often after heavy rains or wind rather than entering the nearshore environment. Retention and detention ponds can help to capture many types of pollutants. Also, OHA recommends allowing native and drought resistant "thick" vegetation or "buffer strips" to grow where possible to filter and slow runoff and

[12] See http://www.fao.org/docrep/T1765E/t1765e0n.htm.

soak up pollutants. Trees, shrubs, and groundcover absorb up to fourteen times more rainwater than a grass lawn and they don't require fertilizer.[13]

OHA also suggests that any drainage channels be altered from their smooth bottoms with the addition of berms, blocks, or recessed 'checkerboards' to further reduce the introduction of sediments and turbidity into the nearshore environment.

OHA appreciates the applicant's intent to reduce inflow and infiltration via manholes, which should result in increased capacity in the existing system and hopefully reduce peak flows, thereby mitigating the need for wet-weather storage facilities.

As you know, inflow of storm runoff through manhole covers, particularly in areas that are inundated due to poor drainage, can be significant. In addition to the applicant's already mentioned procedures for manholes, OHA also suggests that the applicant consider that substantial inflow could potentially enter manholes below the frame due to misalignment, damaged mortar or cone, or other problems. In some cases, rain induced infiltration may also enter through the manhole cone if the surrounding material is highly permeable and the cone exhibits porous brick mortar joints.

Section 1-4.2 (4) (a)(3) of the *Rules Relating to Storm Drainage Standards* states that the bottoms of manholes shall be shaped to channelize flow and sloped with the slope of the pipe.[14] OHA asks if the Stormceptor type storm drain manholes will accomplish these goals.

OHA was surprised that this DEIS did not contain information regarding Best Management Practices (BMPs). The cost of improperly maintained BMPs can be devastating to a business and community. Improperly maintained BMPs not only decrease in efficiency of removing pollutants, they also create environmental hazards (such as flooding and contamination), placing an owner or property manager at risk for liability.

Structural best management practices seem to be most effective when they can be combined in a treatment train. "Treatment train" refers to the application of a series of physical stormwater best management practices to achieve improved drainage water quality. However, BMPs will fail if improperly located within the treatment train or not properly maintained.

[13] See Maryland's Stormwater Management Program at:
http://www.mde.state.md.us/Programs/WaterPrograms/SedimentandStormwater/index.asp
[14] See http://www.cleanwaterhonolulu.com/storm/notices/swmp/app-e1.pdf.

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Once implemented, however, BMPs require monitoring to ensure that they are achieving the objectives for which they were selected. BMP monitoring also involves scheduling of inspections to ensure that the outcomes of BMPs meet expectations. At the heart of BMP effectiveness monitoring is a listing of each BMP, its expected performance and an assessment of whether the controlled value (noise, dust, water quality, etc.) is within targeted limits.

OHA, therefore, inquires as to the applicant's BMP plan (including monitoring and effectiveness) which should be prepared and implemented to minimize the impacts on water quality. Long term operational impacts such as increased pollutant loads in storm discharges should similarly be included in the plan and treated to the best degree possible prior to discharge in order to conform with Hawai'i Administrative Rules §11-54-03(c)(2)(A)(i) and (iii).

Regarding soil erosion, the erosion control standards and guidelines state that large projects like this one (Categories 4 and 5) must utilize the Universal Soil Loss Equation to evaluate and compare existing conditions with relative soil loss rates caused by construction and post-construction activities not exceeding the maximum allowable soil loss rates for Oahu. (see www.cleanwaterhonolulu.com/storm/notices/swmp/app-c2.pdf and also Rules Relating to Storm Drainage Standards at www.cleanwaterhonolulu.com/storm/notices/swmp/app-c1.pdf) OHA inquires as to the nature of the soil erosion rates and subsequent discharge that the applicant calculates will occur as a result of this proposed project.

To mitigate these negative effects, OHA recommends cleaning job-site construction equipment and establishing groundcover as quickly as possible after grading with native or endemic drought tolerant species. In addition to landscaping and watering programs, other mitigation measures suggested include:

- Early construction of drainage control features;
- Construction of temporary sediment basins to trap silt, where needed;
- Use of temporary berms and cut-off ditches where needed; and
- Use of temporary silt fences (coir works well) or straw bales to trap silt.

Use of sediment pouches placed at drainage catch basins to capture silt and sediment before the surface flow enters the drainage system or coir erosion and sediment control products is recommended. Water from dewatering should be treated in a settling tank and disposed of in the wastewater collection system and under no circumstances should it be allowed to enter the subsurface drainage system or nearby waterways.

OHA was also pleased to read on page xi of the DIES that the applicant intends to reduce, reuse and recycle materials and promote the "optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling." However, other than tying into the city's proposed recycling plan and possibly using photovoltaics, we did not read much detail regarding these types of plans and OHA would be very interested in learning more about them and how specifically these goals will be accomplished.[15]

OHA would also like to point out that the applicant should consider that by 2020, 20% of Hawai'i's electricity is to be from renewable sources.[16] Further, the Energy Advisory Committee's first of three major concerns for Hawai'i listed in their 2005 Functional Plan is the State's over dependency on oil and fossil fuels. The committee also lists these two objectives:

> A) To moderate the growth in energy demand through conservation and energy efficiency.
>
> B) Displace oil and fossil fuels through alternate and renewable energy resources.

As such, OHA recommends the use of not only photovoltaic cells but also small wind harvesting electrical generation for peripheral uses such as parking lot lighting. Solar energy should also be incorporated into the building plans. During construction, OHA urges the use of recyclable materials: steel studs and structural members, and wood products from certified sustainable sources.

OHA also recommends using the Leadership in Energy and Environmental Design (LEED) Green Building Rating System. This is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. Surface runoff generated by the facility should be stored or re-used for on site needs as part of a design concept attempting to reduce or eliminate any demands on the municipal storm drainage system. These are the types of things that OHA would like to see of a

[15] Pages 14 and 22 of the DEIS had provided no details regarding the proposed sustainable 'green' community either.

[16] See Act 95, Session Laws of Hawai'i which, in 2004 set that new original renewable portfolio standard goal.

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project that seeks to "incorporate green building practices to be an environmentally-sound, healthy and resource-efficient community."[17]

OHA would like to suggest that the project area be landscaped with the type of groundcover that is comprised of drought tolerant native or indigenous species. Any invasive or aggressive non-native species should also be removed. Doing so would not only serve as practical water-saving landscaping practices and pollution filters, but also serve to further the traditional Hawaiian concept of mālama 'āina and create a more Hawaiian sense of place.

Further, OHA also notes that the biological assessment regarding flora as presented in the DEIS on page 36 is not complete:

> Due to access issues that prevented the botanical consultants from surveying the detention parcel that terminates in Pearl Harbor (Parcel D2), the property was observed from a nearby footpath and appears to be dominated by kiawe. (emphasis added)

OHA recognizes that this is the applicant's proposal and, therefore, the applicant's responsibility to fulfill the requirements of an environmental assessment. If access to the property is an issue, (which clearly it is- the Navy has not given permission for the applicant to use this parcel) then the applicant should present an alternative along with the appropriate analysis for that alternative. Under no circumstances should a lack of access or information be used (much less presented in a DEIS) by an applicant as an excuse in an environmental review document. This frustrates the very purpose of the environmental review process which is to provide the public with information regarding all aspects of a proposed undertaking so that informed comments can be given and harmful effects mitigated. In short, OHA cannot perform our constitutional mandate to assess a proposed project for its potential impacts to our beneficiaries nor are we able to make this the best project it can be due to a lack of information.

OHA is relieved by the assurances given in the DEIS that should iwi kūpuna or Native Hawaiian cultural or traditional deposits be found during ground disturbance, work will cease, and the appropriate agencies will be contacted pursuant to applicable law. However, we are concerned about the details of the preservation plan and archaeological monitoring plan that is being prepared for such a large area with the potential for cultural deposits to be unearthed.

[17] DEIS, page vii.

OHA apologizes for the timing of this review and we understand that your acceptance of these comments is discretionary. We do thank you for your understanding and time. If you have any further questions or concerns, please contact Grant Arnold at (808) 594-0263 or grantn@oha.org.

Sincerely,

Clyde W. Nāmu'o
Administrator

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August 11, 2008

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Attn: Mr. Grant Arnold

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Nāmu'o:

Thank you for your letter dated April 17, 2008 (OHA's reference number HRD08/2945B) which was dated nine days after the end of the public review period set pursuant to section 11-200-22, Hawaii Administrative Rules ("HAR"). We offer this response to your comments although state law does not require your comments be considered or responded to. By our response, we do not intend to waive or relinquish any rights that we have or may have under law, including the right to object to any potential standing that you may claim to have or allegations that you may raise pursuant to Chapter 343, Hawaii Revised Statutes ("HRS") and Title 11, Chapter 200, HAR. We have reviewed your letter and offer the following responses to OHA's comments.

Agriculture

Office of Hawaiian Affairs Comment: "OHA understands, and as the applicant has pointed out, that the City and County of Honolulu is in a housing crisis and our collective population is expected to grow in the foreseeable future. We also understand that the amount of available land for our homes is scarce. Naturally, this puts us all in a bind. However, OHA fundamentally cannot support a project that proposes to remove the best and most highly-protected agricultural lands on this island from current and active production. OHA notes that these lands have been described as the "golden triangle" on O'ahu, and that they have historically been some of the most productive and consistent agricultural lands in our State.

OHA stresses that this land is zoned Agriculture A-1 which requires that the greatest possible protection be given to these lands. (see Hawaii Revised Statutes Section 205) OHA is deeply concerned that this area be used for agricultural uses only. Our concerns are echoed by the myriad of laws and legislation supporting a strong agricultural economic base and retention of those lands primarily in agricultural pursuits in the specific project area. (see Hawaii Revised Statutes, Section 205, O'ahu General Plan and Sustainable Communities Plan; Section 1-115 of the City Subdivision Rules and Regulations; the State Coastal Zone Management Act; and even the city's 'Ewa Development Plan, last updated in 2000, which emphasizes that high-value farmland be preserved for agriculture for 3,000 acres in the general project area.) OHA stresses that only accessory agribusiness activities which meet the above intent are to be permitted in this area.

Hawaii Revised Statutes section 205-2 states that, "In the establishment of agricultural districts the greatest possible protection shall be given to those lands with a high capacity for intensive cultivation". That is exactly the kind of land that this project proposes to use and as such, OHA cannot reasonably see how the removal of 1,553.844 acres of prime agricultural lands currently in use does not run afoul of state and county land use plans, controls and policies.

Further, Hawaii Revised Statutes section 205-41 states;

> *It is declared that the people of Hawaii have a substantial interest in the health and sustainability of agriculture as an industry in the State. There is a compelling state interest in conserving the State's agricultural land resource base and assuring the long-term availability of agricultural lands for agricultural use to achieve the purposes of:*
> *(1) Conserving and protecting agricultural lands;*
> *(2) Promoting diversified agriculture; -*
> *(3) Increasing agricultural self-sufficiency; and*
> *(4) Assuring the availability of agriculturally suitable lands pursuant to article XI, section 3, of the Hawaii state constitution.*

In 1961, the Committee on Lands and Natural Resources remarked that its goal in creating the State Land Use Commission was primarily to "protect productive agricultural lands... through state zoning." The high value assigned to agriculture lands was emphasized again by the 1976 legislature when they assigned Class A and B agricultural lands "additional protection... [against county approval of] agricultural subdivisions."

Further, and as mentioned in Hawaii Revised Statutes section 205-41, even our state constitution emphasizes that:

> *The State shall conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of*

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agriculturally suitable lands. The legislature shall provide standards and criteria to accomplish the foregoing.

Lands identified by the State as important agricultural lands needed to fulfill the purposes above shall not be reclassified by the State or rezoned by its political subdivisions without meeting the standards and criteria established by the legislature and approved by a two-thirds vote of the body responsible for the reclassification or rezoning action.

Additionally, and as the applicant knows, most of the soils in the project area are rated A or B. This is significant because A and B soil classified agriculture lands have additional layers of protection given to them in Hawaii Revised Statutes section 205-4.5 (16)(b) which does not allow a county to approve a subdivision of these lands unless subdivision is made subject to restrictions that keep them in agricultural use."

Response: We acknowledge OHA's comments regarding: Hawai'i Revised Statutes, Section 205; O'ahu General Plan and Sustainable Communities Plan; Section 1-115 of the City Subdivision Rules and Regulations; the State Coastal Zone Management Act; the Land Study Bureau's Detailed Land Classification System; and the 'Ewa Development Plan.

We also acknowledge OHA's comments regarding the government's constitutional duty to protect agricultural lands through state zoning. Although we understand OHA's concern that Class A and B lands are proposed for residential development, the cited classifications, laws and regulations do not prohibit rezoning and reclassification of agricultural lands.

The laws pertaining to reclassification and enumerated in Chapter 205, HRS do not preclude the applicant from requesting reclassification simply because lands can be used for the cultivation of crops. Furthermore, the section of the Constitution cited on Page 3 of OHA's comment letter has not been fully implemented by statute.

Pursuant to Act 183, 2005 Session Laws of Hawai'i, the counties are currently undertaking a process to identify "Important Agricultural Lands" (IALs) within their respective jurisdictions. Once these lands are identified by the counties, Land Use Commission is required before they are officially designated IALs. IALs across the State still have yet to be identified. However, past planning actions by the City and County of Honolulu give indication that they would be hesitant to designate lands within their defined urban growth boundary as IALs.

Ho'opili's proposed action is consistent with the growth policy for 'Ewa. 'Ewa is a key component of the City and County of Honolulu's directed growth policies. In 1974, Donald Wolbrink of Harland Bartholomew developed a visionary plan for Kapolei. After much public discussion, the decision to direct urban growth to the 'Ewa area became the official policy of the City and County of Honolulu. In 1977, the Honolulu City Council approved a new General Plan that designated 'Ewa as the location for a Secondary Urban

Center for O'ahu. The Secondary Urban Center was to be the focus of major economic activity, housing development, and a center for government services, while preserving areas such as Wai'anae and the North Shore for rural uses.

Ho'opili's proposed action follows in the footsteps of various state, City, and private planned and developed projects in the area. DHHL, HHFDC, and UHWO have all developed former agricultural lands immediately adjacent to the proposed Ho'opili project into the Villages of Kapolei, University of Hawai'i – West O'ahu Campus, and the Department of Hawaiian Home Lands East Kapolei development. All these developments also fall within the City-established urban growth boundary. Most of these developments have occurred where the Land Use Commission has approved State Land Use District Boundary amendments from Agriculture to Urban. Also, as OHA is aware, DHHL's position is that it is exempt from State land use laws, County zoning and governmental land use policies, and their decisions have also urbanized hundreds of acres on the 'Ewa Plain.

The State appears to maintain its commitment toward growing the Second City in Kapolei by its construction of State office building, and a planned new judiciary complex on former agricultural lands. It has been reported that OHA itself is seeking 110 acres of land in Kalaeloa that while most recently used for military use, was previously used for sugar cane cultivation.

Alternative Analysis

Office of Hawaiian Affairs Comment: "OHA realizes that housing is an important issue for our beneficiaries and a difficult one for this State. This is why we seek to improve upon environmental review documents such as these so that public input can be considered; impacts mitigated and proposed projects become the best that they can be. This is also why we urge the applicant to provide us with additional alternatives analysis. The heart of an environmental review document is its discussion of alternatives. OHA seeks to find a rigorous and objective analysis of all reasonable alternatives to the proposed action, including a discussion of the "no action" alternative as a base-point to which the proposed action can be compared. This was not done in this case. The Alternatives Analysis section of the Executive Summary is nine lines long and the Alternatives to the Proposed Action section (6.0) of the DEIS is but four pages long. A proposed action of this magnitude dealing with an issue of this importance requires more attention than:

Further study or delay of any proposed development on the property would not be consistent with the Ewa Development Plan or the County's objective of directing growth to 'Ewa. Therefore, various alternatives for the site were rejected

OHA notes that being in a hurry or citing previous studies is not reason to skirt an alternatives analysis. Neither is an arrangement of consistent goals, as there are just as many land use policies and goals (if not more) that the applicant proposes to violate. OHA understands that this issue is a difficult one; however, as this is the applicant's

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proposed project we ask them to provide valid alternatives analysis for review and public comment in order to make this a better project and avoid further unnecessary costs."

Response: Based on OHA's comments, Section 6.0 *Alternatives To The Proposed Action* of the EIS will be revised as follows:

In compliance with the provisions of Title 11, Department of Health (DOH), Chapter 200, Environmental Impact Statement Rules, Section 11-200-10(6), the alternatives considered are limited to those that would satisfy the objectives of the proposed mixed-use development, while minimizing the potential for adverse environmental impacts. The feasible alternatives must realistically address the project's economic characteristics while also responding to the surrounding land uses that will be impacted by the project. In conformance with applicable regulations, other possible alternatives have been investigated to identify alternative sites, the appropriate uses for the property, and how they would best be accomplished.

6.1 *"No-Action" Alternative*

The "no-action" alternative would not be consistent with stated governmental policies, which direct future growth to the 'Ewa region. The City and County of Honolulu General Plan states:

> *Encourage development within the secondary urban center at Kapolei and the Ewa and Central Oahu urban-fringe areas to relieve developmental pressures in the remaining urban-fringe and rural areas and to meet housing needs not readily provided in the primary urban center.*

Under this alternative, the site would remain as agricultural land, underutilized in terms of meeting the demand for residential homes (including affordable homes) and accompanying land uses. The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall. The demand for housing could result in the following scenarios or combinations thereof: there would be more pressure to develop in the other districts, including the rural areas and other areas currently used for cultivation; there could be a demand for higher density housing in undeveloped areas of 'Ewa at a density not experienced to date; there would be more "doubling up" (larger number of persons per household, with more than one family under roof); those that are not willing to put up with the previously described scenarios may decide to relocate to the U.S. mainland where housing prices have dropped.

The "no-action" alternative was rejected because it is not consistent with government plans to develop Kapolei as the Second City.

6.2 *Alternative Sites*

There are very few large parcels left on O'ahu that are designated for residential development. The largest amount of developable land that is undeveloped lies in Central O'ahu and on the North Shore. As shown on the Ewa Development Plan, the Petition Area is designated mostly Low and Medium Density Residential. As such, the City and County of Honolulu has long recognized that the Petition Area is best used for residential and other development. Directing growth to 'Ewa and in the "urban-fringe" portions of Central O'ahu reduces the pressure to develop outside of the Urban Growth Boundary of Central O'ahu, and the North Shore, Ko'olau Loa, Ko'olau Poko and Wai'anae districts. This alternative has been rejected because it would be clearly contrary to General Plan policy. The potential benefit of this alternative is that for those that object to further development on the 'Ewa Plain, it might be preferable for development to occur elsewhere on O'ahu, such as in the Primary Urban Center, East Honolulu, Central O'ahu, North Shore, Ko'olau Loa, Ko'olau Poko and Wai'anae districts.

The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall.

6.3 *Alternatives Related to Different Designs or Details of the Proposed Actions Which Would Present Different Environmental Impacts*

Different designs could be applied to the project, and depending on the density and design capacity, would result in different environmental impacts. For example, a higher density project that kept the same residential unit count as proposed (11,750) would reduce the buildable area (a positive benefit) and possibly reduce the quantity of surface runoff (a positive benefit). ~~This~~ Another potential benefit of this alternative is that it would likely be easier to serve by bus and correspondingly increase ridership. However, the residential buildings

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would be larger and taller. This alternative would not allow as wide a range of residential products to market and was thus rejected. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion).

Another alternative would be to set aside less open space and to spread out the community over a larger land area. Such an alternative is best portrayed by the current Kapolei Long Range Master Plan and Ewa Development Plan Land Use Map designations for the Petition Area. This alternative would reduce the density (to some, a positive benefit) but consume more land, increasing the quantity of surface runoff, and requiring a much larger investment in grading and infrastructure. This alternative would make it difficult for residents to be served by bus, and even more difficult by high-capacity transit. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). This alternative was also rejected.

The demand for safe drinking water and the quantities of wastewater, solid waste, and traffic generated would vary with different designs, depending on the number/quantity of residential units, schools, commercial square footage, and roads.

6.4 ACTIONS OF A SIGNIFICANTLY DIFFERENT NATURE WHICH WOULD PROVIDE SIMILAR BENEFITS WITH DIFFERENT ENVIRONMENTAL IMPACTS

One scenario that would be significantly different from the proposed action is that an elevated rail line and accompanying transit stops would not be built through Ho'opili. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts (assume greater traffic impacts than without the HHCTC project); and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). The impacts of this scenario will be better described in the upcoming HHCTC DEIS.

For the 'Ewa district drivers enduring the longest morning commutes to the Central Business District or UH Mānoa, the modes of transportation will continue to be limited to: private motorized vehicle (including zipper lane), TheBus, TheBoat, Vanpool, et cetera. While this is a scenario that could inevitably result in lengthening commute times, individual commuters will either: bear with the commute in return for the comfortable lifestyles offered by their homes in 'Ewa; move from their homes in 'Ewa and move closer to their workplaces or schools; or find schools and/or employment in the 'Ewa region. The opening of UHWO will reduce traffic from those undergraduate students in Leeward and Central O'ahu who commute to UH Mānoa, and indirectly reduce the demand for student housing on the UH Mānoa campus (reducing the demand for off-street parking demand on campus, reducing the demand for on-street parking in the surrounding neighborhoods, increasing the supply of student housing on campus, and reducing the demand for student housing off-campus). If the Petitioner is allowed to develop a mixed-use (residential/commercial/office/light industrial) project as proposed, then, more employment opportunities will be provided to existing residents of the region, reducing the need for some 'Ewa residents to commute outside of the District to work. To offset the non-implementation of the HHCTC project, the City and County of Honolulu may decide to increase The Bus and The Boat services. The positive benefits of this alternative is that the visual impact impacts of an elevated rail system would be avoided as well as long-term commitment of State and Federal funds for the HHCTC project. This alternative is not desirable, but feasible.

6.5 THE ALTERNATIVE OF POSTPONING ACTION PENDING FURTHER STUDY

Development of the 'Ewa region as O'ahu's Second City has been studied and planned for many years. Further study of any proposed development on the property would only be delaying what has long been proposed in the Ewa Development Plan. Therefore, this alternative was rejected, as it would not achieve the overall objectives for the project, which would create a mixed-use community that more employment opportunities will be provided to existing residents of the region, reducing the need for some 'Ewa residents to commute outside of the District to work. The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Occasionally, however, continued cultivation of the site would generate dust when portions of the site are harvested and plowed. Implementation of this alternative will temporarily avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion).

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Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall.

Affordable Housing

Office of Hawaiian Affairs Comment: "In terms of housing, OHA additionally notes that according to the Center on Budget and Policy Priorities webpage, (http://www.cbpp.org/4- 17-06sfp.htm); as of April 2006, the poverty level for a two-parent family of four in Hawaii is $19,961. As such, we ask how many of the applicant's proposed homes will be made to be affordable and to what standard is affordable defined."

Response: The Center on Budget and Policy Priorities, a Washington, D.C. think-tank, does not set affordable housing policy for the State or City. Affordable housing requirements are typically set and approved by the counties, in this case, by the Honolulu City Council as may be specified in conditions set forth in as zoning conditions requiring the developer to develop affordable housing units. The Petitioner's intent is to comply with all legal requirements concerning affordable housing, including mandatory restrictions on transfer, sale/buyback and use.

Drainage

Office of Hawaiian Affairs Comment: "Regarding drainage, OHA notes that Kalo'i Gulch is proposed to be shared by all of the current users and the University of Hawai'i at West O'ahu, the Department of Hawaiian Homelands, the Kroc Center, Haseko's Ocean Pointe development as well as the applicant. Therefore, we will hold the applicant to their statement made on page 223 of the DEIS that discharge flow rates will not exceed pre-development conditions and that the rules relating to water quality standards will be adhered to."

Response: As noted on page 90 of the Draft EIS:

Approximately 100 acres of the Ho'opili project are within this watershed... With respect to the portion of the project within the Kalo'i drainage basin, the project will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. The project will also be providing storage and detention to meet the Rules Relating to Storm Drainage Standards with respect to water quality standards. The basin size could be decreased at some time in the future when the terminus of Kalo'i basin is finalized. All developed projects discharging to the Kalo'i basin currently have discharge restrictions and these restrictions will continue until the Kalo'i basin terminus is finalized.

Please note that the portion of the project within the Kalo'i drainage basin represents only approximately 6% of the entire petition area.

Office of Hawaiian Affairs Comment: "However, we do seek clarification on this point because page x of the DEIS states, "Over time the project will result in an increase in wastewater being generated that currently being generated on-site (by agricultural activities)."

Response: "Waste water" is a term usually referred to when the contents of human waste is flushed into toilets and liquid wastes are disposed into their sinks. As there are only a limited number of humans currently employed on the Petition Area by existing lessees, the amount of waste water generated is relatively low. As Ho'opili is developed and occupied, the daytime (and nighttime) population will significantly increase, and most residents and visitors (such as those that live elsewhere but work, play, shop or study in Ho'opili) will either turn on faucets that will cause water to drain into sinks and/or generate human waste that will be flushed into toilets. All of this used water and waste material will be collected and treated at the Honouliuli Wastewater Treatment Facility, and some of it will be treated it for reuse (industrial use or irrigation of landscaping).

Office of Hawaiian Affairs Comment: "OHA is also confused as to whether discharge rates will not exceed pre-development conditions because of the statement on page xi: "The project will increase impervious surfaces such as roadways, roof, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Petition Area."

Response: The statements OHA refers to on pages x and xi refer to different processes: one involving wastewater (human waste), and the other drainage (what happens to rain water when it falls on either underdeveloped or developed lands). To put it very simply, the concern with drainage on property "A" is what damage the rain water (usually more appropriately referred to as "storm water") could present to neighboring property "B" (or properties) which is located at an elevation lower than property "A." Again, simply put, current laws allow no more runoff from property "A" to enter property "B" than occurs before new development. Assuming that development of property "A" increases the amount of rain water to collect, then calculations are made to estimate how much more storm water is going to collect on site than under previous conditions. (Please note that not in all situations will new development necessarily result in surface conditions to collect more storm water). We acknowledge that compared to existing conditions, development of the Petition Area will increase the amount of storm water that will collect on site, but the Petitioner is aware that with the increased storm water, it will not be permitted to allow the increased storm water to leave the site in greater quantities, or more specifically, velocities, than it does now.

Office of Hawaiian Affairs Comment: "OHA wishes to point out that there are a host of State water quality standards that must be met by this project. For example, all Hawai'i state waters are classified as Class A or Class AA. Class A waters have strict pollution discharge regulations to protect them for recreational and aesthetic enjoyment. This

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includes the Clean Water Branch requirements that any project and its potential impacts to State waters meet the following criteria:

- Anti-degradation policy (Hawai'i Administrative Rules (HAR), Section 11-54-1.1), which requires that the existing uses and the level of water quality necessary to protect the existing uses of the receiving State water be maintained and protected.

- Designated uses HAR, Section 11-54-3), as determined by the classification of the receiving State waters.

- Water quality criteria (HAR, Sections 11-54-4 through 11-54-8).

OHA further notes that the Kalo'i Gulch drainage way (as do the Honouliuli and West Loch drainage basins which are potentially to be used for this projeet) eventually discharges into the ocean. As such, OHA inquires as to the monitoring plan proposed by the applieant to ensure that the Rules Relating to Storm Drainage Standards and discharges into State waters are being complied with."

Response: The project will comply with all regulations set forth by 33 CFR 323.4. The project's detention/retention facilities have two purposes: to reduce the project's peak flow to predevelopment conditions and to provide water quality detention. As noted on page 92 of the Draft EIS:

> *The project will be providing detention basins to meet City and County of Honolulu Standards for water quality treatment. Structural methods may also be used to meet water quality requirements of the Rules Relating to Storm Drainage Standards. Structural methods include the use of Stormceptor® type storm drain manholes.*

Also, monitoring and compliance verification will occur on two fronts:

1. It is primarily the project's (and its Contractors) responsibility to comply with all BMP (Best Management Practices) conditions to ensure that Rules Related to Storms Water Standards as well as all NPDES (Construction Activities) conditions are met. BMP tools used to ensure compliance are silt fences, stabilized gravel entrances, cut-off swales, detention basins, sediment traps and filter berms to name a few. Contractor standard monitoring requirements typically include photo documentation (pre-construction, post-construction and at every time there is rainfall event that that exceeds 0.5 inches in any 24 hour period results in a discharge) and routine checks of all the utilized BMP features.
2. The City has assigned inspectors that provide regular visits to project job sites to verify the Contract and project are in compliance. The State Department of Health also has enforcement personnel who visit job sites.

Office of Hawaiian Affairs Comment: "OHA also sees that the DEIS on page 33 states, "Proposed drainage improvements within the Petition Area include on-site detention and retention basins, which will promote on- site infiltration of surface water and facilitate groundwater recharge." OHA points out that this is in contradiction to the statement made on the previous page of the DEIS (page 32) which indicates that surface water is not tied to groundwater: "Within the Petition Area, surface water in the channel (Honouliuli) does not appear to be connected to the groundwater."

Response: Please refer to Figure 4.2. The project site encompasses three distinct drainage basins: Kalo'i, West Loch and Honouliuli. Please note that the Makai Detention area and outlet services the drainage from the West Loch Drainage Basin. The statements you mention above are not contradictory because the statement on page 33 discusses the potential for groundwater recharge from on-site detention and retention basins for the West Loch Drainage Basin, and the statement on page 32 refers to the source of water flowing in Honouliuli Stream through the Honouliuli Basin.

Within the same paragraph that OHA cites, it is also stated that: "Honouliuli Stream channel acts as the primary channel for runoff from part of the Petition Area and drainage of the watershed upstream." The portion of the Petition Area within the Honouliuli Stream drainage basin is approximately 635 acres or approximately 10% of the Honouliuli Stream drainage basin mauka of Farrington Highway. Stormwater that collects in Honouliuli Stream drainage basin mauka of the Petition Area, collects and flows into Honouliuli Stream.

Office of Hawaiian Affairs Comment: "OHA urges the applicant to be aware of the potential for water in the detention and retention ponds to seep into the groundwater system. As such, we ask if an overfill pipe will be included in these ponds and what are the impacts from the expected overflow."

Response: The location the project's proposed retention and detention systems are not over the primary drinking water aquifer. It is anticipated that their grass bottoms and ability to enhance percolation will be beneficial to the storm water principles cited in your comments regarding storm water quality and management.

Office of Hawaiian Affairs Comment: "Further, we ask that the applicant provide analysis as to the effects of the increased discharges from their proposed use of the Petition Area drainage basins on the nearshore environment."

Response: The information provided in the Drainage Master Plan (reproduced in its entirety as Appendix O of the Ho'opili Draft EIS Volume II) was intended to act as the analysis related to discharges into the near shore environment. The goal of the Storm Water Quality Section of the City Drainage Standards is to address the long term impact on water quality by establishing controls on timing and rate of discharge. Specific emphasis is placed on controlling timing of release from smaller frequent storms. This the analysis provided in the Drainage Master Plan (Appendix O of the Ho'opili Draft EIS

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Volume II). By meeting the timed release requirements of the City Drainage Standards it is correlated that the water quality has been treated to best practicable levels.

Office of Hawaiian Affairs Comment: "In particular we are concerned about the effects from this project on fishing grounds, limu and fishponds, all of which are found in the area and all of which are being currently used by our beneficiaries for their constitutionally protected cultural practices. We note that the Cultural Impact Assessment states on page 98 that there are such practices in the Project Area but that:

> *The Project Area is approximately 600m (2,000 feet) back from the coast therefore marine resources will not be affected.*

OHA disagrees with this statement and seeks clarification as to what the basis was for this particular determination. Analysis for this type of conclusion in an environmental review document should be accompanied by such things as instream flow rates, biological assessments and brackish water content for the area. This is particularly important because we see that our beneficiaries' interests will be negatively impacted by this action in this regard."

Response: We appreciate OHA's concern regarding the above statement. Usually, much of the issue surrounding cultural practice pertains to public access, and therefore the statement should have read:

> *The Project Area is approximately 600m (approximately 2,000 feet) back from the coast. Therefore, access to marine resources will not be affected.*

The above sentence will be added at the end of the third to the last paragraph of Section 4.2 *Cultural Resources* of the Final EIS.

Office of Hawaiian Affairs Comment: "Regarding the makai detention basin, OHA notes that permission of the Navy would be required for this basin to be built and not only has the Navy not given its permission, they have refused and, despite what may have been in the past, there is no indication that OHA is aware of that they may acquiesce to the applicants request. Naturally, this raises a host of concerns for all involved, no doubt mostly to the applicant. However, OHA does wish to see analysis provided in an environmental review for all aspects of a proposed project that are truly feasible at the time of writing the document. Future possibilities and conditionals cannot provide the basis for substantive review and meaningful public input.

To help mitigate the adverse impacts of a proposed project and make it the best it can be OHA urges that the applicant provide information and analysis for parts of the project that are likely to come to fruition. We point this out because we also see that this project hinges upon not only Navy permission that is not forthcoming, but also a proposed building out of a wastewater treatment plant and associated improvements, the "assumption" for a proposed transportation system servicing the area, and recycling programs that do not exist yet."

Response: Negotiations between the Applicant and the Navy regarding the referenced Makai Detention parcels are ongoing. If applicable, the Applicant will comply with all relevant Federal Codes, Regulations and Rules including a Section 106 review. However, please note that the proposed project does not "hinge" upon outlet for the makai detention basin through Navy lands. As noted on page 91 of the Draft EIS, if the outlet is not permitted by the Navy:

> *The alternative drainage solution if the overflow across Navy property cannot be resolved is to construct retention basins on site holding back the total volume of a 100 year- 24 hour storm. These basins would be located on the southern portion of Parcel C.*

Office of Hawaiian Affairs Comment: "Regarding storm water in general, OHA wishes to see storm water as a resource to be captured and conserved rather than a nuisance to be channeled and drained away. As storm water travels down a drainage system, it accumulates industrial waste, pesticides, oils, and chemicals. These pollutants quickly settle into the nearshore sediments and are re-suspended into the water column when disturbed.

Persistent organic pollutants (POPs) are organic compounds that linger in the environment, travel through the food web, and pose risks to human health and the environment. Organic hydrocarbons, including petroleum products, are examples of POPs. POPs are most commonly introduced to marine systems via discharged sewage and stormwater effluent, terrestrial runoff, and oil spills. POPs can also bioaccumulate in the nearshore species that inhabit these areas.

Therefore, OHA recommends the use of a stormwater management system that would filter these and other pollutants out and slow the amount of sediments entering our waters. The following four water management methods and erosion control structures are used by the Food and Agriculture Organization of the United Nations:

- runoff harvesting (catching runoff for supplementary irrigation);
- total absorption or infiltration;
- runoff diversion (redirecting excess water); and
- runoff spreading (distribution of runoff energy)."

Response: The OHA comments on storm water primarily relate to management and use as a resource. The Drainage Master Plan (Appendix O of the Ho'opili Draft EIS Volume II) focuses on the management aspects related to minimizing deterioration of near shore water quality. The management aspects focus on controlled timing as required by current standards. Timed release is especially effective at addressing sediment loads, but also indirectly addresses persistent organic pollutants (POPs) by capture due to attachment to the sediment load.

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With respect to use of storm water as a resource, the drainage consultant supports the management methods cited by OHA (from the Food and Drug Organization of the United Nations), and adds that the Drainage Master Plan (Appendix O of the Ho'opili Draft EIS Volume II) partially implements some of the general concepts.

Office of Hawaiian Affairs Comment: "OHA is pleased to see that the applicant is proposing to use retention and detention ponds where possible. OHA does remark that if ponds are used, they should be shallow with slow sloping bottoms. The slow sloping sides are needed for safety if people happen to fall in. A surrounding area around the pond should be provided for water storage when heavy rains are present. OHA does ask if retention and detention ponds will be installed near each other in a row so that the water will get held up in the detention pond and slowly drain into the retention pond. The detention pond will help eliminate flooding and the retention will hold the remaining water. The use of permeable paving materials can also retain some of the rain that falls and catch basins can capture and help to slow the runoff thereby reducing turbidity and sediment runoff.

Retention and detention ponds also serve to remove pollutants, such as POPs and trash. Since retention and detention ponds are the drainage basin for an area, pollutants, trash and debris are washed into these areas often after heavy rains or wind rather than entering the nearshore environment. Retention and detention ponds can help to capture many types of pollutants. Also, OHA recommends allowing native and drought resistant 'thick" vegetation or "buffer strips' to grow where possible to filter and slow runoff and soak up pollutants. Trees, shrubs, and groundcover absorb up to fourteen times more rainwater than a grass lawn and they don't require fertilizer."

Response: The retention/detention basins by definition accomplish partial absorption and spreading. Runoff harvesting is not anticipated to be practicable. This is primarily due to O'ahu's short runoff time of concentration (peak flows occur for very short periods) and sustainability of the runoff source (retention/detention basins are anticipated to be essentially dry for a majority of the year). We will also take into consideration OHA's suggestions regarding vegetation types, and slope angle.

Office of Hawaiian Affairs Comments: "OHA also suggests that any drainage channels be altered from their smooth bottoms with the addition of berms, blocks, or recessed 'checkerboards' to further reduce the introduction of sediments and turbidity into the nearshore environment.

OHA appreciates the applicant's intent to reduce inflow and infiltration via manholes, which should result in increased capacity in the existing system and hopefully reduce peak flows, thereby mitigating the need for wet-weather storage facilities.

As you know, inflow of storm runoff through manhole covers, particularly in areas that are inundated due to poor drainage, can be significant. In addition to the applicant's already mentioned procedures for manholes, OHA also suggests that the applicant

consider that substantial inflow could potentially enter manholes below the frame due to misalignment, damaged mortar or cone, or other problems. In some cases, rain induced infiltration may also enter through the manhole cone if the surrounding material is highly permeable and the cone exhibits porous brick mortar joints.

Section 1-4.2 (4) (a)3) of the Rules Relating to Storm Drainage Standards states that the bottoms of manholes shall be shaped to channelize flow and sloped with the slope of the pipe. OHA asks if the Stormceptor type storm drain manholes will accomplish these goals."

Response: OHA has commented on construction techniques for channel bottoms and manholes. New construction will be guided by County Standards. Where possible and County Standards allow, rough concrete channel bottoms will be used. New construction following proper design should not create poor drainage allowing for inundation through manholes. With respect to *Stormceptor*® manholes, construction is almost identical to a City and County manhole, with a feature added to collect "first flush" oils and sediment from more frequent storm events.

Office of Hawaiian Affairs Comment: "OHA was surprised that this DEIS did not contain information regarding Best Management Practices (BMPs). The cost of improperly maintained BMPs can be devastating to a business and community. Improperly maintained BMPs not only decrease in efficiency of removing pollutants, they also create environmental hazards (such as flooding and contamination), placing an owner or property manager at risk for liability.

Structural best management practices seem to be most effective when they can be combined in a treatment train. "Treatment train" refers to the application of a series of physical stormwater best management practices to achieve improved drainage water quality. However, BMPs will fail if improperly located within the treatment train or not properly maintained.

Once implemented, however, BMPs require monitoring to ensure that they al-e achieving the objectives for which they were selected. B monitoring also involves scheduling of inspections to ensure that the outcomes of BMPs meet expectations. At the heart of BMP effectiveness monitoring is a listing of each B, its expected performance and an assessment of whether the controlled value (noise, dust, water quality, etc.) is within targeted limits.

OHA, therefore, inquires as to the applicant's BMP plan (including monitoring and effectiveness) which should be prepared and implemented to minimize the impacts on water quality. Long term operational impacts such as increased pollutant loads in storm discharges should similarly be included in the plan and treated to the best degree possible prior to discharge in order to conform with Hawai'i Administrative Rules §1 1-54-O3c)(2)(A)(i) and (iii).

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Regarding soil erosion, the erosion control standards and guidelines State that large projects like this one (Categories 4 arid 5) must utilize the Universal Soil Loss Equation to evaluate and compare existing conditions with relative soil loss rates caused by construction and post-construction activities not exceeding the maximum allowable soil loss rates for Oahu. (see www.cleanwaterhololulu.comlstoimlnotices/swmp/app-c2.pdf and also Rules Relating to Storm Drainage Standards at www.cleanwaterhonolulu.com/stormlnoticeslswmpfapp-cl.pdf) OHA inquires as to the nature of the soil erosion rates and subsequent discharge that the applicant calculates will occur as a result of this proposed project."

Response: The last paragraph of Section 4.8.4, *Drainage Facilities, Anticipated Impacts and Mitigative Measures* of the Draft EIS will be revised to read as follows:

> *Surface water quality can be impacted through development. Per comments received by the State Department of Health Clean Water Branch, any discharges related to project construction or operation activities shall comply with the applicable State Water Quality Standards as specified in Chapter 11-54, HAR. Further, the DOH Clean Water Branch wrote that the Hawaii Revised Statues, Subsection 342D-50(a), requires that "[n]o person, including any public body, shall discharge any water pollutants into state waters, or cause or allow any water pollutant to enter state waters except in compliance with this chapter, rules adopted pursuant to this Chapter, or a permit or variance issued by the director." The project will need to obtain NPDES permits and Grading Permits (as previously identified in the DEIS). Both required permits have substantial effort identified in their applications specifically addressing BMP issues. The substantive parts of the permitting processes focus on BMP tools and monitoring. Features will include: stabilized gravel entrances, siltation berms, diversion of storm water around work areas, use of detention basins, diversion swales, filter traps at catch basins, calculation of soils losses meeting acceptable levels and monitoring plans. BMP's are an important part of current construction practice. The project will be providing detention basins to meet City and County of Honolulu Standards for water quality treatment. Structural methods may also be used to meet water quality requirements of the Rules Relating to Storm Drainage Standards. Structural methods include the use of Stormceptor® type storm drain manholes.*

Office of Hawaiian Affairs Comment: "To mitigate these negative effects, OHA recommends cleaning job-site construction equipment and establishing groundcover as quickly as possible after grading with native or endemic drought tolerant species. In addition to landscaping and watering programs, other mitigation measures suggested include:

- Early construction of drainage control features;
- Construction of temporary sediment basins to trap silt, where needed;
- Use of temporary berms and cut-off ditches where needed; and
- Use of temporary silt fences (coir works well) or straw bales to trap silt."

Response: We appreciate the information provided. Please note that the first paragraph of Section 3.3, *Soils, Anticipated Impacts and Mitigative Measures* of the Draft EIS will be revised to read as follows:

> *During project construction, there is a potential for soil loss through the generation of dust and water-borne soil erosion as areas are graded. All grading operations will be conducted in accordance with dust and erosion control and other requirements of the City and County of Honolulu Grading Ordinance and all applicable provisions regulating Fugitive Dust set forth under Section 11-60.1-33, HAR regarding. A NPDES permit will also be required prior to construction to address construction-related runoff. Additionally, a watering program will be implemented during construction to minimize soil loss through fugitive dust emission. During the public review period, the Department of Health (DOH) Clean Air Branch (CAB) recommended that a dust control management be prepared. The DOH CAB also provided additional examples of measures that can be implemented during construction:*
>
> - *where possible, for areas involving mixed land uses, buffer zones be established to alleviate potential dust nuisance problems;*
> - *planning the different phases of construction, focusing on minimizing the amount of dust-generating materials and activities, centralizing on-site vehicular traffic routes, and locating potential dust-generating equipment in areas of the least impact;*
> - *providing an adequate water resource and watering program at the site prior to start-up of construction activities;*
> - *landscaping and providing rapid covering of bare areas, including slopes, starting from the initial grading phase;*
> - *minimizing dust from shoulders and access roads;*
> - *providing adequate dust control measures during weekends, after hours, and prior to daily start-up of construction activities; and*
> - *controlling dust from debris being hauled away from the project site.*
>
> *In addition, during the public review period, the Office of Hawaiian Affairs wrote: OHA recommends cleaning job-site construction equipment and establishing groundcover as quickly as possible after grading with native or endemic drought tolerant species. In addition to landscaping and watering programs, other mitigation measures suggested include:*
>
> - *Early construction of drainage control features;*
> - *Construction of temporary sediment basins to trap silt, where needed;*
> - *Use of temporary berms and cut-off ditches where needed; and*
> - *Use of temporary silt fences (coir works well) or straw bales to trap silt.*

Office of Hawaiian Affairs Comment: "Use of sediment pouches placed at drainage catch basins to capture silt and sediment before the surface flow enters the drainage

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system or coir erosion and sediment control products is recommended. Water from dewatering should be treated in a settling tank and disposed of in the wastewater collection system and under no circumstances should it be allowed to enter the subsurface drainage system or nearby waterways."

Response: Sediment filters at catch basins were identified as one of the BMP tools included in our earlier response to your BMP comments. Dewatering will be treated in accordance with the allowed criteria in the NPDES Form G permit process. The need for dewatering for the project should be minimal or non-existent.

Recycling

Office of Hawaiian Affairs Comment: "OHA was also pleased to read on page xi of the DEIS that the applicant intends to reduce, reuse and recycle materials and promote the "optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling." However, other than tying into the city's proposed recycling plan and possibly using photovoltaics, we did not read much detail regarding these types of plans and OHA would be very interested in learning more about them and how specifically these goals will be accomplished."

Response: In response to your comments, the last five paragraphs of Section 4.8.5 *Solid Waste Disposal Facilities, Anticipated Impacts and Mitigation Measures* will be revised to read as follows:

According to the U.S. Environmental Protection Agency, in 2006, individuals recycled 1.5 pounds of our individual waste generation rate of 4.6 pounds per day, for a net waste generation amount of 3.1 pounds per day. Assuming an average household size of 3.0 persons, at full build-out, the solid waste generated by the project is estimated to average approximately 109,275 pounds per day. According to the City and County of Honolulu, approximately 15 percent of residential solid waste is recyclable newspaper, aluminum, glass, and plastic; and 25 to 30 percent is compostable yard trimming. In the future, the H-POWER plant will need to be expanded or an increased emphasis will need to be placed on recycling to dispose of the solid waste.

Recycling will be encouraged within the project including the reuse and recycling of green waste generated during construction clearing and grubbing activities, the use of recycled construction and demolition wastes and the use of materials made from recycled products, the use of locally produced compost as available for landscaping, and the provision of space for recycling bins in the detailed design of the community. As such, a construction waste recycling plan will be prepared before the start of construction.

The City and County of Honolulu is restarting its curbside pick up recycling program. In November, 2007, two pilot curbside recycling programs began in Mililani and Hawai'i Kai. During the six to twelve month evaluation period, the

City and County of Honolulu Department of Environmental Services staff will be coordinating plans for islandwide expansion.

On June 27, 2008, the Associated Press reported that Mililani and Hawai'i Kai residents have recycled 54 percent of their cans, bottles, newspapers and green waste during the city's six-month curbside recycling pilot project. City Officials with the City and County of Honolulu Department of Environmental Services (DES) are reportedly satisfied with the results and are moving forward with plans to provide some 160,000 O'ahu homes the curbside recycling service by May 2010. In the new plan, the city will collect garbage and recyclables each once a week. The DES will no longer have garbage pickup twice-weekly. A study released by DES predicts the program will divert an estimated 53,800 tons of mixed recyclables and green waste from O'ahu landfills. They plan to begin expanding the program to more communities in November 2008.

The goal for waste management is to appropriately reduce, reuse and recycle materials, to minimize generation of solid waste and achieve diversion from landfills. As such, in conformance with Chapter 344-4(2), HRS, the project will promote the optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling.

Resources

Office of Hawaiian Affairs Comment: "OHA would also like to point out that the applicant should consider that by 2020, 20% of Hawai'i's electricity is to be from renewable sources. Further, the Energy Advisory Committee's first of three major concerns for Hawai'i listed in their 2005 Functional Plan is the State's over dependency on oil and fossil fuels. The committee also lists these two objectives:

A) To moderate the growth in energy demand through conservation and energy efficiency.
B) Displace oil and fossil fuels through alternate and renewable energy resources.

As such, OHA recommends the use of not only photovoltaic cells but also small wind harvesting electrical generation for peripheral uses such as parking lot lighting."

Response: The Applicant will make efforts to support the State's mandate enumerated in Act 95, 2004 Session Laws of Hawai'i for electricity-generating public utilities to produce 20% of their energy through renewable uses by the year 2020.

We also thank OHA for the recommendation regarding small wind harvesting electrical generation. Section 2.8, *Sustainable Building Design* of the EIS will be revised to read as follows:

Sustainability options are being considered for the Ho'opili project. Where feasible, project buildings, activities, and site grounds are intended to be designed

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with energy-saving considerations. Given the natural climate, the project may be suited for the use of renewable energy technologies including photovoltaics. During the public review period, the Office of Hawaiian Affairs wrote: "...OHA recommends the use of not only photovoltaic cells but also small wind harvesting electrical generation for peripheral uses such as parking lot lighting."

According to the American Wind Energy Association, small wind energy systems typically range from $3,000 to $5,000 for every kW (kilowatt) of generating capacity, or about $40,000 for a 10 kW system (installed). According to the Hawaiian Electric Company (HECO), wind generation energy resources typically cost approximately $.08 to $.11/kW per hour, however these rates apply to larger wind systems (wind farms) as opposed to individual wind systems whose rates are not readily available by HECO.

Photovoltaic (PV) systems range in price from $8,250 for a one-kW system to more than $40,000 for a five-kW system. According to HECO, internal estimates for photovoltaic (PV) energy resources typically cost approximately $.30 to $.40/kW per hour.

The average energy consumption by a single-family residence in Hawai'i is approximately 600 kW per hour. According to HECO, "Non-firm sources, such as wind and solar, are called "as-available" resources and must be backed up by firm generation to ensure electricity is available when customers need it -- 24 hours a day, regardless of whether the wind is blowing or the sun is shining."

"In addition to not being available 24-hours-a-day, the variability of wind, typical of the trade winds in Hawaii, can cause power problems. It can affect the quality of power produced. Today, a lot of sensitive electronic equipment can be damaged or disrupted by the variability of power produced from sources like the wind. These fluctuations can also place a big strain on the utility's fossil fuel generators if they have to kick in and meet the demand for electricity when the wind power is suddenly not available."

Even when "as-available" resources are available, HECO still needs to cut back on "as-available" renewable energy sources during off-peak periods of electricity use. This is due to scenarios where customer demand for power drops too low, generation must be turned off to cut back on power production. Otherwise, the electric system could potentially overload and become unstable. Furthermore, fossil-fuel generation can only be reduced so much. This on-and-off cycling could lead to damage and accelerated deterioration of fossil-fuel generators. It also causes the generators to burn more fuel than necessary which leads to an increased cost of electricity.

In June 2008, Governor Lingle signed SB 644 which requires that solar water heaters be required before issuance of a building permit on or after January 2010 for single-family residences.

In addition, based on the Department of Business, Economic Development & Tourism (DBEDT), Strategic Industries Division's recommendations, Ho'opili's mechanical and electrical consultants, in consultation with its sustainability consultant, will be directed to review the City and County of Honolulu's Energy Code early in the project and to consult with Hawaiian Electric Company, Inc. (HECO) on demand-side management programs that offer rebates for installation of energy-efficient technologies.

Office of Hawaiian Affairs Comment: "Solar energy should also be incorporated into the building plans."

Response: In regards to incorporating solar energy into building plans, please note that on page 95 of the Draft EIS it was stated:

The Petitioner is also considering the potential use of photovoltaic cells on future project buildings, where practicable. As an example, large national retailers are entering agreements with micro utility companies who arrange for solar power systems financing and sells such systems to the micro utility company's financing partner. In addition, these micro utilities design, install and maintain these photovoltaic systems per each customer's requirements. The customer pays the financing partner for the solar electricity generated over a long-term power purchase agreement. At the end of the term specified under the agreement, the customer typically has the option to renew the agreement, transfer the equipment to a new site, or purchase the system outright from the financing partner.

Senate Bill 644, SD3, HD3, CD1 was recently passed by the Legislature this session, and proposes to require all new homes built after January 1, 2010 to have solar water heating systems. Should this bill become law, the petitioner intends to comply.

Office of Hawaiian Affairs Comment: "During construction, OHA urges the use of recyclable materials: steel studs and structural members, and wood products from certified sustainable sources."

Response: We thank OHA for its suggestions. Please note that pages 92 and 93 of the DEIS stated:

Recycling shall be encouraged within the project including the reuse and recycling of green waste generated during construction clearing and grubbing activities, the use of recycled construction and demolition wastes and the use of materials mode from recycled products, the use of locally produced compost as available for landscaping, and the provision of space for recycling bins in the detailed design of the community. As such, a construction waste recycling plan will be prepared before the start of construction.

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LEED

Office of Hawaiian Affairs Comment: "OHA also recommends using the Leadership in Energy and Environmental Design (LEED) Green Building Rating System. This is the nationally accepted benchmark for the design, construction, and operation of high performance green buildings. LEED promotes a whole-building approach to sustainability by recognizing performance in five key areas of human and environmental health: sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality. Surface runoff generated by the facility should be stored or re-used for on site needs as part of a design concept attempting to reduce or eliminate any demands on the municipal storm drainage system. These are the types of things that OHA would like to see of a project that seeks to "incorporate green building practices to be an environmentally- sound, healthy and resource-efficient community."

Response: Thank you very much for the information on LEED. Ho'opili is part of the LEED-ND pilot program, and it is in the early stages of working with the U.S. Green Building Council (USGBC) to obtain information required to implement LEED-ND to the extent that it is feasible and practicable.

Landscaping

Office of Hawaiian Affairs Comment: "OHA would like to suggest that the project area be landscaped with the type of groundcover that is comprised of drought tolerant native or indigenous species. Any invasive or aggressive non-native species should also be removed. Doing so would not only serve as practical water-saving landscaping practices and pollution filters, but also serve to further the traditional Hawaiian concept of mālama 'āina and create a more Hawaiian sense of place."

Response: We thank OHA for the suggestion. As noted on page 37 of the Draft EIS:

> *Native and indigenous vegetation will be considered in the selection of plant materials when a landscaping master plan is prepared.*

Flora

Office of Hawaiian Affairs Comment: "Further, OHA also notes that the biological assessment regarding flora as presented in the DEIS on page 36 is not complete:

> *Due to access issues that prevented the botanical consultants from surveying the detention parcel that terminates in Pearl Harbor (Parcel D2), the property was observed from a nearby footpath and appears to be dominated by kiawe. (emphasis added)*

OHA recognizes that this is the applicant's proposal and, therefore, the applicant's responsibility to fulfill the requirements of an environmental assessment. If access to the property is an issue, (which clearly it is - the Navy has not given permission for the applicant to use this parcel) then the applicant should present an alternative along with the appropriate analysis for that alternative. Under no circumstances should a lack of access or information be used (much less presented in a DEIS) by an applicant as an excuse in an environmental review document. This frustrates the very purpose of the environmental review process which is to provide the public with information regarding all aspects of a proposed undertaking so that informed comments can be given and harmful effects mitigated. In short, OHA cannot perform our constitutional mandate to assess a proposed project for its potential impacts to our beneficiaries nor are we able to make this the best project it can be due to a lack of information."

Response: As noted on page 91 of the Draft EIS, if the outlet is not permitted by the Navy:

> *The alternative drainage solution if the overflow across Navy property cannot be resolved is to construct retention basins on site holding back the total volume of a 100 year- 24 hour storm. These basins would be located on the southern portion of Parcel C.*

Since the alternative involves an area that could be surveyed, the existing biological (flora and fauna) conditions and impacts were described on pages 36-37 and 39-40 of the Draft EIS.

Archaeological

Office of Hawaiian Affairs Comment: "OHA is relieved by the assurances given in the DEIS that should iwi kupuna or Native Hawaiian cultural or traditional deposits be found during ground disturbance, work will cease, and the appropriate agencies will be contacted pursuant to applicable law. However, we are concerned about the details of the preservation plan and archaeological monitoring plan that is being prepared for such a large area with the potential for cultural deposits to be unearthed."

Response: Please be assured that the preservation plan and archaeological monitoring plan are being prepared and will be submitted to the State Historic Preservation Division for their review and comment. Please note that construction is not expected to begin until the necessary governmental approvals are granted.

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Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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HOUSE OF REPRESENTATIVES

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

LAND USE COMMISSION
STATE OF HAWAII
2008 APR -8 P 1:40

April 8, 2008

State of Hawaii Land Use Commission
Attn: Rodney Maile
P.O.Box 2359
Honolulu, Hawai'i 96804-2359.

Also sent via E-Mail to: rmaile@dbedt.hawaii.gov

RE: Testimony in OPPOSITION to Schuler Homes' Ho`opili Project

The Ho`opili project will displace Aloun Farms and several other farmers who have been successfully farming for several years on prime A and B agriculture land previously owned by Campbell Estate. While Schuler has told the media that the farmers will be relocated, when pressed, it does not appear that Schuler has any guarantee of that. Schuler is simply "inquiring" with other land owners about whether Aloun and the other farmers can be relocated. Sadly, Aloun and the other farmers are bound by "gag clauses" in their leases that prevent them from speaking out against this displacement.

Under our current law, the public can voice its opposition before the Land Use Commission (LUC) and the Planning Commission. The Kapolei Neighborhood Board, Life of the Land, and many others have taken a strong stand against Schuler Homes, calling it a "crime" to evict these farmers from prime agricultural land at a time when Hawaii lawmakers have decried the fact that our state imports over 90% of our food.

Further, while 30% of these homes are required to be affordable, the buy back provision is only temporary. So in 10 years, we will be faced with the loss of precious farms on prime agricultural land, which will likely be replaced by high priced or luxury homes owned by the wealthy.

I urge the LUC to exercise its mission to serve as a check and balance to the County. It was unacceptable for the County to include this land in its urban growth boundary. Given the speculative real estate pressures on Hawaii's limited lands, there is no reason to expedite the

Representative Maile S.L. Shimabukuro, District 45
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AR00027463

HOUSE OF REPRESENTATIVES

STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

conversion of farmland to market priced and luxury housing, particularly in light of Hawaii's food security and homeless crises.

Please note that I am testifying as an individual, and my views do not necessarily represent those of the Hawaii State Legislature or all of the constituents I represent. My testimony is also supported by Wai'anae Coast residents Karen Young and Rodlyn Brown, as listed below my signature line.

Sincerely,

REP. MAILE SHIMABUKURO, Chair of Human Services and Housing Committee
KAREN YOUNG, Wai'anae Coast resident
RODLYN BROWN, Wai'anae Coast resident

Representative Maile S.L. Shimabukuro, District 45
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August 11, 2008

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The Honorable Maile Shimabukuro
House of Representatives, 45th District
Hawai'i State Capitol, Room 406
415 South Beretania Street
Honolulu, HI 96813

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Representative Shimabukuro:

Thank you for your email dated April 8, 2008. We acknowledge your concern that the proposed project would upon full build-out, displace Aloun Farms and several other farmers.

We appreciate your concerns and the concerns of some of your constituents and office staff. However, the 'Ewa Plain has long been identified by State and City and County of Honolulu ("City") planning agencies as accommodating projected long-term population growth on O'ahu. The growth of the "Second City" is the stated policy of the City government with a goal of reducing development pressures in Wai'anae, Central O'ahu, North Shore, Ko'olau Loa and Ko'olau Poko. We offer the following responses to your specific comments:

Representative Shimabukuro's Comment: The Ho'opili project will displace Aloun Farms and several other farmers who have been successfully farming for several years on prime A and B agriculture land previously owned by Campbell Estate. While Schuler has told the media that the farmers will be relocated, when pressed, it does not appear that Schuler has any guarantee of that. Schuler is simply "inquiring" with other land owners about whether Aloun and the other farmers can be relocated. Sadly, Aloun and the other farmers are bound by "gag clauses" in their leases that prevent them from speaking out against this displacement.

Response: The Petitioner remains committed to working on the relocation of its largest tenant, Aloun Farm, Inc., consistent with its statement on Page 30 of the Draft EIS. However, to date, no site has been secured for that purpose.

All tenants signed leases with full written notice that the area would be subject to future urbanization given anticipated growth in the region, and relocation was imminent at some point in the future. In consideration for the tenants' eventual need to relocate, the Petitioner has made efforts to assist them in the short-term by keeping lease costs for the land and water at or below market rates. This consideration is also mentioned on Page 30 of the Draft EIS.

AR00027464

Representative Shimabukuro's Comment: Under our current law, the public can voice its opposition before the Land Use Commission (LUC) and the Planning Commission. The Kapolei Neighborhood Board, Life of the Land, and many others have taken a strong stand against Schuler Homes, calling it a "crime" to evict these farmers from prime agricultural land at a time when Hawaii lawmakers have decried the fact that our state imports over 90% of our food.

Response: We concur with the first sentence in the paragraph immediately above. There will be ample opportunities for the public to voice their opposition or support for the project before the Land Use Commission, Planning Commission and City Council. We are not aware that either the Kapolei Neighborhood Board nor Life of the Land have submitted written comments during the DEIS public review period "...against Schuler Homes, calling it a "crime" to evict these farmers from prime agricultural land at a time when Hawaii lawmakers have decried the fact that our state imports over 90% of our food." We would like to take this opportunity to note that there are a couple of errors in fact:

1) No farmers are being evicted. As noted above, all leases issued and agreed to the existing tenants reflected that the area would be subject to future urbanization, and they would have to relocate. In consideration for the tenants' eventual need to relocate, for the petitioner kept land and water costs at or below market rates.
2) We take issue with your characterization of the situation as being an eviction and a crime. First, we are not evicting the tenants from their agricultural lands but abiding by the term limits set forth in the leases. These are term limits that were negotiated between the farmers and the landowner and agreed to. However, should legal issues arise if the terms of a lease are not being met or are being violated, we have taken appropriate actions to make sure the violations do not continue.
3) Although "...Hawai'i lawmakers have decried the fact that our state imports over 90% of our food[,]" there are various factors that limit the growth of diversified crops in Hawai'i. As the agricultural impact analysis report (Appendix A of the Draft EIS) stated:

> *"A great many crops can be grown in Hawai'i's year-round subtropical climate, and a number of them can be grown profitably in volumes that require a few hundred acres. However, the modest growth in land requirements for diversified crops reflects the fact that few crops can be grown profitably on a large scale. The primary factors that have limited the growth of diversified agriculture in Hawai'i are given below:*
>
> — *Hawai'i's subtropical climate is not well-suited to the commercial production of major crops that grow better in the temperate mainland climates.*
>
> — *For certain crops, special hybrids adapted to Hawai'i's subtropical climate are yet to be developed.*
>
> — *Crop pests are more prevalent and more expensive to control in Hawai'i than they are on the mainland where the cold winters kill many pests.*

> — *Fruit-fly infestations prevent exports of many crops, or require expensive treatment.*
>
> — *Most soils in Hawai'i have low nutrient levels and therefore require high expenditures for fertilizer.*
>
> — *Hawai'i suffers from high farm-labor costs, largely because the agriculture industry must compete against the visitor industry and related industries for its labor.*
>
> — *Compared to many other farm areas that supply U.S. markets, the cost of shipping agricultural supplies and equipment to Hawai'i is high, as is the cost of exporting produce from Hawai'i to mainland markets. High shipping costs are a result of Hawai'i's remote location and to Federal regulations that require use of American-built ships and U.S. crews between U.S. ports.*
>
> — *For a number of crops, consumption volumes in Hawai'i are too small to support large, efficient farms (i.e., the volumes are too small to realize economies of scale).*
>
> — *On-going trends towards food suppliers purchasing produce that is certified as safe and towards buying from a single supplier of many food items favor large farms.*
>
> — *Hawai'i farmers must compete against highly efficient mainland and foreign farms which, in a number of cases, can deliver produce to Hawai'i more cheaply than it can be produced locally. This is due to economies of scale and, in comparison to Hawai'i, low costs for land, labor, supplies, fertilizer, pest control, equipment, etc."*

Representative Shimabukuro's Comment: Further, while 30% of these homes are required to be affordable, the buy back provision is only temporary. So in 10 years, we will be faced with the loss of precious farms on prime agricultural land, which will likely be replaced by high priced or luxury homes owned by the wealthy.

Response: Your statement reflects the requirements set forth by the City and County of Honolulu in its Rules for the Terms of Unilateral Agreements Requiring Affordable Housing. The Petitioner's intent is to comply with all legal requirements concerning affordable housing, including mandatory restrictions on transfer, sale/buyback and use.

It is quite plausible that the market value of the affordable homes offered in Ho'opili could exceed the original purchase price once the mandatory buyback period has expired. However, this potential problem concerns issues related to public policy. Lawmakers at the State or County are better suited to address these concerns rather than the developer.

AR00027465

Representative Shimabukuro's Comment: I urge the LUC to exercise its mission to serve as a check and balance to the County. It was unacceptable for the County to include this land in its urban growth boundary. Given the speculative real estate pressures on Hawaii's limited lands, there is no reason to expedite the conversion of farmland to market priced and luxury housing, particularly in light of Hawaii's food security and homeless crises.

Response: We acknowledge your comments regarding City's plans (Ewa Development Plan). As an elected State official and an individual, you certainly have the right to convey your wishes to concerning departments and agencies of the State that the City's Ewa Development Plan be completely reversed.

Over the years, a number of communities developed in the 'Ewa region, including the 'Ewa Plantation Villages, the 'Ewa Beach community, and Barbers Point Naval Air Station (now known as Kalaeloa). In the 1960's Makakilo City and the James Campbell Industrial Park were started based on an overall master plan for the area prepared by the Estate of James Campbell in the mid-1950's.

'Ewa is a key component of the City and County of Honolulu's directed growth policies. In 1974, Donald Wolbrink of Harland Bartholomew developed a visionary plan for Kapolei. After much public discussion, the decision to direct urban growth to the 'Ewa area became the official policy of the City and County of Honolulu. In 1977, the Honolulu City Council approved a new General Plan that designated 'Ewa as the location for a Secondary Urban Center for O'ahu. The Secondary Urban Center was to be the focus of major economic activity, housing development, and a center for government services, while preserving areas such as Wai'anae and the North Shore for rural uses.

In August 1977, the State Land Use Commission (SLUC) approved the first State Land Use District Boundary Amendment (SLUDBA) in 'Ewa. This SLUDBA permitted the development of West Beach (now referred to as Ko 'Olina). Subsequent to the Ko 'Olina approval, both the State and the City and County of Honolulu filed at least four petitions with the SLUC to amend the State Land Use Districts in 'Ewa from Agricultural to Urban. In all of the petitions, the General Plan designation of 'Ewa as the Secondary Urban Center was cited as proof that "urbanization" of 'Ewa was consistent with the City and County of Honolulu's planning policy. Similarly, when the Honolulu City Council adopted the *Ewa Development Plan* (DP) in 1997, petitioners cited both the General Plan and the Ewa DP for their respective project's consistency with the City and County of Honolulu's directed growth policy.

In nearly all of the State and City and County of Honolulu SLUDBA's, soils were rated at or near the top of agricultural productivity rating systems: "A" or "B" by the Land Study Bureau (LSB), and "Prime" under the agricultural lands of importance to the State of Hawaii (ALISH) system. For example, the largest SLUDBA involved 1,300 acres of land adjoining Ho'opili in SLUC Docket No. A99-728, also referred to as the Housing and Community Development Corporation of Hawaii (HCDCH) East Kapolei. Ninety-seven percent of the soils in HCDCH East Kapolei were rated "A" or "B" by the LSB, and nearly all of the 1,300 acres were rated "Prime" under ALISH. HCDCH East Kapolei is now under or proposed for development by the University of Hawai'i West O'ahu, the Department of Hawaiian Home Lands, the State

Department of Transportation (North-South Road), the proposed Salvation Army Kroc Center, and the State Department of Land and Natural Resources.

Based on the prior actions undertaken by the state government, we believe that your opposition is contrary to recent developments by State entities in and around the 'Ewa plain. HHFDC, UHWO, DHHL and DOT have all developed former agricultural lands immediately adjacent to the proposed Ho'opili project into the Villages of Kapolei, University of Hawai'i - West O'ahu Campus, the Department of Hawaiian Home Lands East Kapolei development and North-South Road. All of these developments also fall within the urban growth boundary.

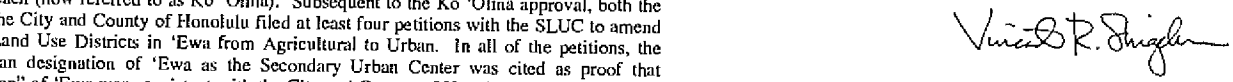
The State appears to maintain its commitment toward growing the Second City in Kapolei by its construction of State office building, and a planned new judiciary complex on former agricultural lands. Finally, during the public review period, the State Department of Land and Natural Resources (DLNR), Engineering Division wrote: "DLNR currently owns approximately 183 acres of land near and/or adjacent to the Ho'opili project...The DLNR parcels have excellent development potential based on the location of these lands adjacent to or near major arteries (H-1 Freeway, Farrington Highway, North-South Road) and the City's proposed transit line as well as the substantial increase development projects in the area."

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII



Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

AR00027466

HOUSE OF REPRESENTATIVES
STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

March 12, 2008

DR Horton- Schuler Division
828 Fort Street Mall, 4th Floor
Honolulu, Hawaii 96813

Contact: Dean Uchida

Dear Applicant,

HOOPILI MASTER PLANNED MIXED USE COMMUNITY

COMMENT ON DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

As a reminder, I provided testimony on April 9, 2007 regarding the pre-conditions of the Hoopili Project as a development scheme that would upon full build-out, exacerbate the traffic congestion conditions plaguing the Ewa Region and the loss of prime agricultural productive lands.

Many constituents have contacted me regarding the Hoopili Project and want to ensure that in the approval process to reclassify approximately 1,553 acres from an Agricultural District to an Urban District, that such reclassification include the following requisites and placed upon the *Applicant*:

- THE LEVEL OF SERVICE ON THE H-1 FREEWAY IS ELEVATED FROM ITS CURRENT LEVEL OF SERVICE "F" TO A LEVEL OF SERVICE "A" OR A NEW EXPRESSWAY LINKING WEST OAHU WITH DOWNTOWN HONOLULU IS AVAILABLE

- THE EAST WEST CONNECTOR ROAD COMPLETED AND OPEN FOR PUBLIC USE PRIOR TO PERMITTING THE ADDITION OF HOUSING DEVELOPMENT TO OCCUR

Respectfully,

Rida Cabanilla

Cc: State Land Use Commission/Anthony Ching
PBR Hawaii/Vincent Shigekuni
Office of Environmental Quality Control

State Representative Rida Cabanilla
State Capitol, Room 442 • Honolulu, Hawaii 96813
Telephone: (808) 586-6080 • Fax: (808) 586-6081 • Email: repcabanilla@capitol.hawaii.gov

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August 11, 2008

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The Honorable Representative Rida Cabanilla
State Capitol, Room 442
Honolulu, Hawai'i 96813

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Representative Cabanilla:

Thank you for your letter dated March 12, 2008, wherein you recommend the following conditions from Ho'opili:

- The level of service on the H-1 Freeway is elevated from its current Level of Service "F" to a Level of Service "A" or a new expressway linking West Oahu with Downtown Honolulu is available.

- The East West Connector Road completed and open for public use prior to permitting the addition of housing development to occur.

We investigated your recommendations. Based on the Traffic Impact Analysis Report (TIAR), Ho'opili, Oahu, Hawaii, prepared by Wilbur Smith Associates, dated February 2008 (Appendix L of the Draft Environmental Impact Statement), the above conditions do not appear to be reasonably related to the need created by Ho'opili nor are the degree of the conditions roughly proportional to the impact on traffic caused by Ho'opili. For this reason, the above conditions go too far and rise to the level of unconstitutional takings under the 5th Amendment Takings Clause of the U.S. Constitution. *See, Nollan v. California Coastal Commission*, 485 U.S. 825 (1987) and *Dolan v. City of Tigard*, 512 U.S. 374 (1994).

The Petitioner's TIAR analyzes the anticipated impacts of Ho'opili and proposes measures to mitigate the impacts directly caused by Ho'opili under various scenarios. As required by law, the Petitioner will contribute its proportional share of improvements to state and county transportation facilities that are reasonably related to the need created by Ho'opili, as documented by the TIAR.

AR00027467

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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FAX TRANSMITTAL SHEET

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University of Hawaii
2500 Dole Street, Krauss Annex 19, Honolulu, HI 96822
Telephone: (808) 956-7361 Fax: (808) 956-3980

DATE: 4/8/2008

FROM: Peter Rappa
Environmental Review Coordinator

TO: Dean Uchida, D.R. Horton (521-6698)

Vincent Shigekuni, PBR Hawaii (523-1402)

Rodney Maile, State of Hawaii, Land Use Commission (587-3827)

OEQC (586-4186)

SUBJECT: **REVIEW OF DRAFT EIS**
HO'OPILI PROJECT
'EWA, OAHU

No. of Pages: including cover sheet: _____

AR00027468

Water Resources Research Center
Environmental Center

UNIVERSITY of HAWAI'I MĀNOA

April 8, 2008
EIS: 777

Mr. Dean Uchida
D.R Horton – Schuler Division
828 Fort Street Mall
Honolulu, HI 96813

Dear Mr. Uchida:

Draft Environmental Impact Statement
Ho'opili Project
'Ewa, Oahu

D.R. Horton – Schuler Division, proposes the development of Ho'opili, a mixed-use, transit-ready community in the 'Ewa district of Oahu. The petition area is located to the south of H-1 Freeway, north of Mango Tree Road, east of the proposed UH-West Oahu, and west of Old Fort Weaver Road. Ho'opili is envisioned as consisting of residential units of varying densities (approx. 11,750 units), commercial/business areas, industrial areas, schools, public facilities, transit stops, parks, and large amounts of open space. The proposed development requires the reclassification of approximately 1,553 acres from the Agricultural District to the Urban District. Infrastructure improvements to be improved, expanded, or installed in association with this project include drainage systems, access and circulation roads, water and wastewater collection lines, and electrical/communication systems.

This review was conducted with the assistance of Mark Merlin, Botany; Sharon Ching Williams, Center for Smart Growth and Community Design; and Ryan Riddle, Environmental Center.

General Comments

Ho'opili is obviously a well-designed and innovative community - one that offers mitigation measures for many current and projected transportation and housing dilemmas. We are concerned however, about the implications of permanently removing this land from agricultural production. Ho'opili is planned for one of the last remaining arable properties on the island of Oahu – a parcel once described as "the golden triangle" by Oahu Sugar Plantation employees. 1,375 acres or about 88% of the petition area is designated as prime agricultural land with good soil, easy access to clean irrigation water, transportation to the market, and ideal solar

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radiation. Given rising fuel costs, transportation costs, and current economic conditions, it is easy to envision a future in which the State of Hawai'i may find this land essential for crop cultivation.

The DEIS concluded that development of this parcel would result in a negligible impact on the growth of diversified agriculture to the state as a whole. The report cited that "the limiting factor to the growth of diversified crops will *not* be the land *supply*. Instead, growth will be limited by the *size of the market* for crops that can be grown *profitably* in Hawaii" (Appendix pp. ES-14 – ES-15). We contend that very soon, this may not be the case. The *size of the market* for crops that can be grown *profitably* in Hawaii will likely grow in proportion to the rapidly increasing costs of importing them.

While Ho'opili is planned for a parcel already outlined for development in the 'Ewa Development Plan (EDP), current events appear to necessitate a new assessment of the EDP. We feel that it is prudent to consider the long-term needs of Oahu, and the state as a whole, by protecting Oahu's prime agricultural lands for seen and unforeseen future agricultural use.

Additionally, we would like elaboration on measures that may be implemented to aid the displaced farmers. Some of the farms in the project area have other lands to which they can be moved, but some do not. What will happen to those farms that will lose their land and do not have other places to which they can relocate? Will D.R. Horton attempt to find them other land on which to farm or otherwise compensate them for the loss of land?

In addition to our general comments, we also have several specific comments.

Archaeological and Historical Resources (pp. 41-43)

On page 41 and 42, five historic properties are listed as being within the petition area, however, no map is included. The addition of a map would enable the reader to more clearly envision the distribution of the sites within the petition area.

Operational Noise (pp. 47-48)

The statement on page 47 of the DEIS, "Over the long-term operation of the project, several new noise generating activities (new land uses, additional traffic) which are not currently present; and introduced new residents to ongoing noise generating activities (aircraft noise, future traffic without the project on surrounding roads, transit" is overly long and confusing. This statement should be rewritten to improve readability and comprehension.

AR00027469

April 8, 2008
Page 3

Man-Made Hazards (p. 53)

In the discussion on pesticides, the DEIS states that large areas adjacent to the petition area have been developed for residential use without any apparent ill effects. We wonder, were there no traces of pesticides found, or were pesticides found in adjacent areas simply within acceptable levels?

Thank you for the opportunity to review this Draft EIS.

Sincerely,

Ryan Riddle on behalf of John Cusick

John Cusick
Associate Specialist

cc: OEQC
Rodney Maile, State of Hawaii, Land Use Commission
Vincent Shigekuni, PBR Hawaii
James Moncur, WRRC

AR00027470

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August 11, 2008

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Mr. John Cusick, Associate Specialist
Environmental Center
University of Hawaii
2500 Dole Street, Krauss Annex 19
Honolulu, Hawai'i 96822

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Cusick:

Thank you for your letter dated April 8, 2008 (your reference number EIS: 777). We thank you for your comments that "Hoopili is obviously a well-designed and innovative community – one that offers mitigation measures for many current and projected transportation and housing dilemmas." We have reviewed your comments and offer the following responses:

General Comments

Environmental Center Comment: "We are concerned however, about the implications of permanently removing this land from agricultural production. Ho'opili is planned for one of the last remaining arable properties on the island of Oahu – a parcel once described as "the golden triangle" by Oahu Sugar Plantation employees. 1,375 acres or about 88% of the petition area is designated as prime agricultural land with good soil, easy access to clean irrigation water, transportation to the market, and ideal solar radiation. Given rising fuel costs, transportation costs, and current economic conditions, it is easy to envision a future in which the State of Hawaii may find this land essential for crop cultivation."

Response: According to the agricultural impact analysis report prepared for the Draft EIS ("Hoopili Impact on Agriculture," Decision Analysts, Inc., February 2008) "...the acreage released from plantation agriculture has far outpaced the demand for land for diversified crops...an estimated 160,000+ acres remain available for diversified crops. Because of the increased availability of agricultural land, a number of landowners report lower per-acre agricultural land rents on Oahu and the Neighbor Islands compared to rents charged before the major contraction in plantation acreage." While we would concur that rising fuel and transportation costs are of concern, it is interesting to note that Mauna Kea Banana Company recently announced it was ending its banana production citing rising fertilizer and energy costs. So the opposite result from what the Environmental Center is anticipating may actually be occurring.

Environmental Center Comment: "The DEIS concluded that development of this parcel would result in a negligible impact on the growth of diversified agriculture to the state as a whole. The report cited that "the limiting factor to the growth of diversified crops will *not* be the land *supply*. Instead, growth will be limited by the *size of the market* for crops that can be grown *profitably* in Hawaii" (Appendix pp. ES-14-ES-15). We contend that very soon, this may not be the case. The *size of the market* for crops can be grown *profitably* in Hawaii will likely grow in proportion to the rapidly increasing costs of importing them."

Response: While we would concur that the demand for diversified agricultural crops will increase over time, there are various factors that limit the growth of diversified crops in Hawaii. As the agricultural impact analysis report (Appendix A of the Draft EIS) stated:

> *"A great many crops can be grown in Hawai'i's year-round subtropical climate, and a number of them can be grown profitably in volumes that require a few hundred acres. However, the modest growth in land requirements for diversified crops reflects the fact that few crops can be grown profitably on a large scale. The primary factors that have limited the growth of diversified agriculture in Hawai'i are given below:*
>
> — *Hawai'i's subtropical climate is not well-suited to the commercial production of major crops that grow better in the temperate mainland climates.*
>
> — *For certain crops, special hybrids adapted to Hawai'i's subtropical climate are yet to be developed.*
>
> — *Crop pests are more prevalent and more expensive to control in Hawai'i than they are on the mainland where the cold winters kill many pests.*
>
> — *Fruit-fly infestations prevent exports of many crops, or require expensive treatment.*
>
> — *Most soils in Hawai'i have low nutrient levels and therefore require high expenditures for fertilizer.*
>
> — *Hawai'i suffers from high farm-labor costs, largely because the agriculture industry must compete against the visitor industry and related industries for its labor.*
>
> — *Compared to many other farm areas that supply U.S. markets, the cost of shipping agricultural supplies and equipment to Hawai'i is high, as is the cost of exporting produce from Hawai'i to mainland markets. High shipping costs are a result of Hawai'i's remote location and to Federal regulations that require use of American-built ships and U.S. crews between U.S. ports.*
>
> — *For a number of crops, consumption volumes in Hawai'i are too small to support large, efficient farms (i.e., the volumes are too small to realize economies of scale).*
>
> — *On-going trends towards food suppliers purchasing produce that is certified as safe and towards buying from a single supplier of many food items favor large farms.*
>
> — *Hawai'i farmers must compete against highly efficient mainland and foreign farms which, in a number of cases, can deliver produce to Hawai'i more cheaply than it can be produced locally. This is due to economies of scale and, in comparison to Hawai'i, low costs for land, labor, supplies, fertilizer, pest control, equipment, etc."*

Environmental Center Comment: "While Ho'opili is planned for a parcel already outlined for development in the 'Ewa Development Plan (EDP), current events appear to necessitate a new assessment of the EDP. We feel that it is prudent to consider the long-term needs of Oahu, and the state as a whole, by protecting Oahu's prime agricultural lands for seen and unforeseen future agricultural use."

Response: The University of Hawai'i Environmental Center's position is contrary to long established land use policies that were meant to focus development away from country and rural areas such as the North Shore, Waianae, et cetera. Further, such a reversal of public policy is contrary to development efforts undertaken by State agencies such as HHFDC, UHWO, and DHHL developed the adjacent prime agricultural lands into the Villages of Kapolei, University of Hawai'i-West O'ahu Campus, and the Department of Hawaiian Home Lands East Kapolei development. The State played and continues to play a significant role in planning and funding for the growth of the Second City in Kapolei (including the State office building and a planned new judiciary complex) on former prime agricultural lands. Major investments in infrastructure and other publicly-funded facilities have contributed to the growth of the Second City. In addition, the City and County of Honolulu is planning on embarking on what may be the largest Capital Improvement Project in the State's history in its Honolulu High-Capacity Transit project which is planned to start in East Kapolei and run through the petition area. As the Environmental Center knows, the transit corridor alignment was selected to serve the greatest number of Honolulu residents and commuters. Finally, during the public review period, the State Department of Land and Natural Resources (DLNR), Engineering Division wrote: "DLNR currently owns approximately 183 acres of land near and/or adjacent to the Ho'opili project... The DLNR parcels have excellent development potential based on the location of these lands adjacent to or near major arteries (H-1 Freeway, Farrington Highway, North-South Road) and

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the City's proposed transit line as well as the substantial increase development projects in the area."

Environmental Center Comment: "Additionally, we would like elaboration on measures that may be implemented to aid the displaced farmers. Some of the farms in the project area have other lands to which they can be moved, but some do not. What will happen to those farms that will lose their land and do not have other places to which they can relocate? Will D.R. Horton attempt to find them other land on which to farm or otherwise compensate them for the loss of land?"

Response: As indicated in the Draft EIS, the Petitioner has been working to assist the tenants in finding a suitable site or sites for relocation. However, to date, no site has been secured for that purpose. Given the planned growth in the region, the leases issued to the existing tenants reflected the fact that the area would be subject to urbanization in the future. The tenants all signed the leases with full knowledge of the circumstances. In order to assist them in the short term consideration for the land and water were kept at or below market rates.

Archaeological and Historical Resources

As requested, the EIS will be revised to include a new Figure 4.1 showing the locations of the five historic sites mentioned.

Operational Noise

Thank you very much for noting the missing text. This paragraph (the sixth paragraph of Section 4.3 *Noise*) will be revised in the Final EIS to read as follows:

> *Over the long-term operation of the project, several new noise generating activities (such as new land uses, additional traffic) will be introduced, which are not currently present; and introduced new residents to ongoing noise generating activities (such as aircraft noise, future traffic without the project on surrounding roads, transit).*

Man-Made Hazards

The Petitioner has been coordinating with the State Department of Health (DOH) Hazard Evaluation & Emergency Response Office (HEER). Based on recent correspondence from HEER, the last two paragraphs in Section 4.5 *Man-Made Hazards, Anticipated Impacts and Mitigation Measures* of the EIS will be revised to read as follows:

> *On March 13, 2008, in an interdepartmental memorandum from the DOH Hazard Evaluation & Emergency Response Office (HEER) to the DOH Environmental Planning Office, HEER wrote: "The land under consideration for development of the Ho'opili Project mixed residential/commercial community was formerly used to grow sugar cane. The Draft EIS acknowledges the presence of potential contamination, and investigative work is being coordinated with the HEER Office." The Petitioner is working with DOH on a sampling methodology to determine the presence and levels of certain pesticides. Subsequent actions will be based on the results of the sampling.*
>
> *Based on sampling done on the adjacent DHHL property, no impacts from pesticide use on the former sugar cane cultivation of the Petition Area are anticipated. Since the Ewa Plain was once mostly under sugar cultivation and large areas have subsequently been developed for residential use without any apparent ill effects, it is anticipated that future residents in the Petition Area will not be exposed to unacceptable levels of pesticides from past or present agricultural activities. During the public review period, the HEER recommended that soils be tested for residual pesticide contamination and that the presence of potential hazards be evaluated. The scope of the investigative work is currently being coordinated with the HEER Office to ensure that the study will be carried out in the most efficient and effective manner possible.*

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

encl: Figure 4.1: Archaeological Sites

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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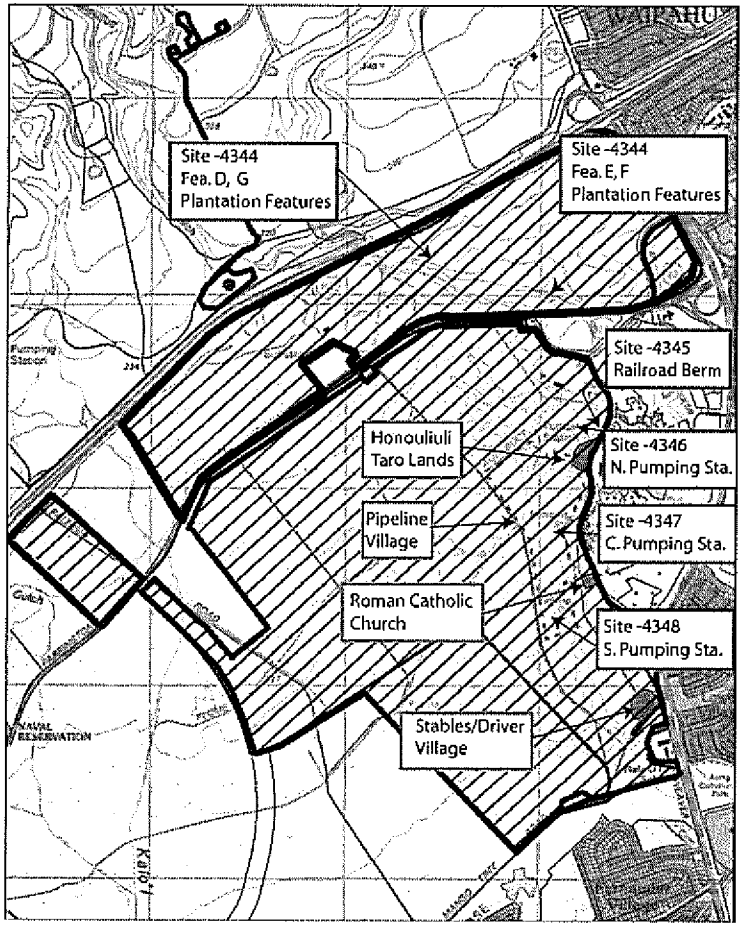

LEGEND

Petition Area

Figure 4.1: Historical Sites

HO'OPILI

O'ahu, Hawai'i

NORTH

Not to Scale

PBR HAWAII & ASSOCIATES, INC.

Source: Cultural Surveys Hawai'i
Disclaimer: This graphic has been prepared for general planning purposes only.

UNIVERSITY of HAWAI'I® WEST O'AHU

Office of the Chancellor

April 8, 2008

Vincent Shigekuni, Vice President
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, HI 96813

Dear Mr. Shigekuni:

SUBJECT: Draft Environmental Impact Statement – Ho'opili
'Ewa, O'ahu, Hawai'i, Tax Map Key 9-1-17: 04 (por), 59, and 72; 9-1-18: 01 and 04.

Thank you for your letter dated February 20, 2008 requesting the University to review and comment on the Draft Environmental Impact Statement (DEIS) to reclassify approximately 1,553.844 acres of land in 'Ewa for the proposed Ho'opili development.

As the land owner of the 500 acre site located west of the proposed development, the University supports approval of D.R. Horton's Ho'opili DEIS. UH West O'ahu has long been a supporter of Kapolei as O'ahu's planned second city. Allowing 'Ewa Plain residents the opportunity to live, work, play and study within Kapolei will allow the vision of a second city to become reality.

As the Chancellor of UH West O'ahu, I was invited to be a member of D.R. Horton's community task force that provided recommendations in the planning phase of the Ho'opili development. In addition, UH West O'ahu and D.R. Horton participate in ongoing meetings with the "East Kapolei Developers Group" to coordinate roadways, traffic concerns, infrastructure and to keep everyone abreast of the progress in the area. Through this group, things such as creation of a coordinated master bike plan and road way circulation plan was created.

Ongoing discussion and coordination is needed with regional landowners to address issues such as infrastructure, transit, roadways, etc., and we expect D.R. Horton will continue to work collaboratively with us to ensure success for the region.

Again, we support D.R. Horton's DEIS and look forward to working together with them for many years to come. Should you have any questions, please feel free to contact Mr. Allan Ah San, Project Manager, at 692-0918.

Regards,

Gene I. Awakuni
Chancellor

C: Rodney Maile, SLUC Acting Director
Sam Callejo, Vice President, UH System

96-129 Ala 'Ike
Pearl City, Hawai'i 96782
Telephone: (808) 454-4750
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August 11, 2008

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Mr. Gene I. Awakuni, Chancellor
University of Hawai'i – West O'ahu
96-129 Ala 'Ike
Pearl City, Hawai'i 96782

Attn: Mr. Allan Ah San

SUBJECT: **HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT**

Dear Chancellor Awakuni:

Thank you for your letter dated April 8, 2008. We have reviewed your letter and offer the following responses to your comments.

1. Thank you for your support of the Ho'opili project.

2. The Petitioner acknowledges that ongoing discussion and coordination is needed with regional landowners to address issues such as infrastructure, transit, roadways, etc., and will continue to work collaboratively with the University of Hawai'i – West O'ahu to ensure success for the 'Ewa region.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawaii 96850

In Reply Refer To:
2008-TA-0127

APR 0 8 2008

Mr. Vincent Shigekuni
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Subject: Draft Environmental Impact Statement for Proposed Hoopili Development Ewa, Oahu, Hawaii

Dear Mr. Shigekuni:

The U.S. Fish and Wildlife Service has reviewed the draft Environmental Impact Statement (DEIS) for the Hoopili proposed mixed-use community development (proposed project) located in Ewa on the island of Oahu. These comments are provided in accordance with the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.; 87 Stat. 884), as amended (ESA); and other authorities mandating Federal oversight of natural resources including the Migratory Bird Treaty Act (16 U.S.C. 703 et seq.)(MBTA).

The proposed project will rezone 1,554 acres of land from agriculture district to urban district. The overall goal of the proposed project is to develop 1,600 acres into a mixed-use development with residential, business, and associated infrastructure. The proposal includes development of a Makai settling basin [(D1) TMK 9-1-010:002] with an outlet [(D2) 9-1-010:014 and 015 (por.)], that will drain through U.S. Navy land adjacent to the U.S. Fish and Wildlife Service National Wildlife Refuge [(NWR) (Pearl Harbor NWR – Honouliuli unit)]. The Honouliuli unit was established for the recovery of the federally endangered Hawaiian stilt (*Himantopus mexicanus knudseni*) and it also supports the federally endangered Hawaiian moorhen (*Gallinula chloropus sandvicensis*), Hawaiian coot (*Fulica alai*), and Hawaiian duck (*Anos wyvilliana*) as well as populations of migratory waterfowl and shorebirds protected under the MBTA.

We are concerned the DEIS does not adequately address potential adverse effects to federally protected bird species. The proposed project could act as a nuisance attractant for listed waterbirds specifically as it relates to the settling basin areas D1 and D2. Uncovered, open water attracts migratory and listed waterbirds to areas they would normally avoid. This type of attraction may result in increased predation pressure from non-native predators such as mongoose, rats, feral dogs and cats. There are feral cats and documented cat feeding stations near the Honouliuli unit and the proposed Makai settling basin and outlet. Attraction to the

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settling basin could lead to increased waterbird predation resulting in failed nesting attempts and adult bird mortality.

Therefore, we recommend coordination with our office to develop avoidance and minimization measures for the federally listed species that may be attracted to the open water settling basin in the proposed project. The project as currently proposed, with the use of the Makai settling basin and outlet, may require consultation pursuant to section 7 of the ESA. Section 7 requires Federal agencies to insure that any action authorized, funded or carried out by them is not likely to jeopardize the continued existence of listed species or adversely modify or destroy their critical habitat. The Federal nexus may be the U.S. Navy since their land may be involved in the proposed project.

If there is no Federal nexus, then private landowners, corporations, state or local governments, or other non-Federal landowners who wish to conduct activities on their land that might incidentally harm (or "take") wildlife federally listed as endangered or threatened must first obtain an incidental take permit from the U.S. Fish and Wildlife Service. An incidental take permit allows a property owner to conduct otherwise lawful activities in the presence of listed species. A non-Federal entity develops a Habitat Conservation Plan (HCP) in order to apply for an incidental take permit under section 10(a)(1)(B) of the ESA. The HCP integrates the applicant's proposed project or activity with the needs of the species. It describes, among other things, the anticipated effect of a proposed taking on the affected species and how that take will be minimized and mitigated. Such information must be submitted with any incidental take permit application.

We are available to assist you in developing appropriate minimization and avoidance measures for listed waterbirds. If you have questions regarding these comments, please contact Aaron Nadig of my staff (phone: 808-792-9400, fax: 808-792-9581).

Sincerely,

Patrick Leonard
for Field Supervisor

cc:
Rodney Maile, State of Hawaii Land Use Commission
Sylvia Pelizza, Oahu National Wildlife Refuge Complex

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Mr. Patrick Leonard, Field Supervisor
United States Department of the Interior
Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122, Box 50088
Honolulu, Hawai'i 96850

Attn: Mr. Aaron Nadig

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Leonard:

Thank you for your letter dated April 8, 2008 (your reference number 2008-TA-0127). We greatly appreciate the information provided in your letter. Please be assured that the potential outlet to Pearl Harbor is still considered an unresolved issue as the Navy has yet to reply to our proposal.

In response to the Service's comments regarding the potential that the proposed action may result in impacts to listed waterbird species, the last two paragraphs of Section 3.8 *Fauna, Anticipated Impacts and Mitigation Measures* of the EIS will be revised to read as follows:

> *The notable exceptions to the above are the four endangered waterbird species which currently inhabit the National Wildlife Refuge located north of Parcels D1 and D2. These birds may utilize the proposed detention basin if sufficient water collects to allow ponding. There may be periodic disturbance to the waterbird species if temporary construction occurs within the proposed detention basin (to enlarge it) or if an outlet is allowed. As previously noted, the waterbirds breed in the Honouliuli Unit of the National Wildlife Refuge, less than a sixth of a mile (250 meters) north of Parcels D1 and D2. While the proposed detention basin is located near the Refuge, there is no suitable habitat for these waterbirds in Parcels D1 and D2. According to Bills Engineering, the project civil engineer, the proposed makai drainage will rarely contain standing water.*

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At the present time there is no federal nexus associated with this project, because it does not appear that the U.S. Navy will permit access or grant an easement for an outlet from the proposed makai drainage retention basin. If and when this component of the proposed development moves forward, the Petitioner will consult with both the U.S. Fish and Wildlife Service and the State of Hawai'i Division of Forestry and Wildlife to ensure that the construction and operation of the detention basin does not result in deleterious impacts to any species currently listed as endangered, threatened or proposed for listing under either federal or State of Hawai'i endangered species statutes.

Otherwise, impacts to the other existing alien mammalian and avian species and their habitats are expected to be minimal. Disturbance and displacement of individual alien species is likely to occur as construction and development infill takes place. The disturbance will be of a temporary nature.

The results of the arthropod survey at the Petition Area (See Appendix R) indicate that there are no special concerns or legal constraints related to invertebrate resources in the Petition Area. No invertebrate species listed as endangered, threatened or that are currently proposed for listing under either federal or State of Hawai'i endangered species statutes are known to exist on the project site.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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BOARD OF WATER SUPPLY

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March 6, 2008

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Deputy Manager and Chief Engineer

Mr. Vincent Shigekuni, Vice President
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Your Letter of February 20, 2008 on the Draft Environmental Impact Statement (DEIS) for Ho'opili, TMK: 9-1-17:4,59,72; 9-1-18:1,4; 9-1-10:2,14,15; 9-1-17:4; 9-2-1:4, 5, 6, 7; 9-2-2:2

Thank you for the opportunity to comment on the proposed project.

We have the following comments to offer:

1. A potable and non-potable water master plan of the entire development should be submitted for our review and approval. The master plan should include the water requirements and proposed infrastructure facilities. The master plan should show that the facilities are able to provide water service and fire protection in accordance with our Water System Standards.

2. The developer will be required to install the necessary water system improvements to serve the proposed development. The construction drawings should also be submitted for our review and approval.

3. Board of Water Supply (BWS) Rules and Regulations require the use of non-potable water for the irrigation of large landscaped areas if a suitable supply is available. The developer should look into the feasibility of serving the large landscaped areas within the development with non-potable water. If the use of non-potable water is not feasible or not available, a report of the findings should be submitted before we allow the use of potable water for irrigation of large landscaped areas. The developer should contact our Water Resources Division at 748-5900 for the availability of recycled water and other non-potable water supplies.

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4. We recommend the use of drought tolerant/low water use plants and possible xeriscaping principles for all landscaping. We also recommend the installation of an efficient irrigation system, possibly using drip irrigation. The irrigation system should incorporate moisture sensors to avoid the operation of the system in the rain and if the ground has adequate moisture.

5. The developer should also consider rain barrel catchments, water-efficient front-load washer appliances and ultra low-flow toilets.

If you have any questions, please contact Robert Chun at 748-5443.

Very truly yours,

KEITH S. SHIDA
Program Administrator
Customer Care Division

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
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Mr. Keith S. Shida, Program Administrator
Customer Care Division
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawai'i 96843

Attn: Mr. Robert Chun

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Shida:

Thank you for your letter dated March 6, 2008. We have reviewed your letter and offer the following response to your comments.

1. A conceptual water master plan was prepared and reproduced in its entirety in the Draft EIS Volume II as Appendix M. The water master plan included the Project's water requirements and proposed infrastructure facilities. The water master plan indicated that with the construction of the necessary improvements, the facilities are able to provide water service and fire protection in accordance with the Board of Water Supply's (BWS) Water System Standards.

2. We acknowledge that the Petitioner will be required to install the necessary water system improvements to serve the proposed development. As noted on page 86 of the Draft EIS: *"New water system demands will require that the Petitioner provide system upgrades to the transmission and storage components to ensure that the system operates effectively and meets BWS standards."*

   Also, as noted on page 87 of the Draft EIS, construction drawings will be submitted to BWS for its review and approval.

3. We acknowledge that BWS Rules and Regulations require the use of non-potable water for the irrigation of large landscaped areas if a suitable supply is available. A conceptual water master plan that was prepared and reproduced in its entirety in the Draft EIS Volume II as Appendix M assumed dual potable and non-potable water demand and system. As noted on page 87 of the Draft EIS, it is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. Per the BWS comments, the last paragraph in Section 4.8.2, *Water Supply Facilities, Anticipated Impacts and Mitigative Measures* of the Final EIS will be revised to read as follows:

AR00027477

The project will be maximizing the use of non-potable water for irrigation to minimize the impact on the source component of the BWS system. It is proposed that the project's greenbelts, parks and roadway medians use non-potable water for irrigation, if a suitable supply will be available. The BWS Water Resources Division will be contacted regarding the availability of recycled water and other non-potable water supplies. A Conceptual Water Master Plan addressing safe drinking and non-potable water facilities has been prepared and reproduced in its entirety and attached to this EIS as Appendix M ~~will be submitted to~~ for BWS ~~for its~~ review and approval. In addition, construction drawings will be submitted to BWS for its review and approval. During the public review period of the Draft EIS, the DLNR Commission on Water Resource Management requested that "the reuse of storm water and installation of water efficient fixtures be considered" and recommended "the use of xeriscaping and the planting of drought tolerant and salt-tolerant plans to conserve water supplies."

4. Per the BWS comments, the third to the last paragraph in Section 4.8.2, *Water Supply Facilities, Anticipated Impacts and Mitigative Measures* of the Final EIS will be revised to read as follows:

With respect to non-potable water requirements, the project will be maximizing non-drinking usage to minimize the demand on the safe drinking water system. If a suitable supply is made available, Sstreet right of ways of the Ho'opili project will have underground non-drinking distribution systems. It is proposed to upgrade the existing non-drinking source (EP 5 & 6 located within Parcel C) to a BWS dedicable standard to be used as the source for the non-drinking system. It is also proposed to ultimately allow for future dedication of the non-drinking system. It is estimated that the ultimate non-drinking demand for the project will be approximately 2.1 MGD. The Petitioner will consider the use of drought tolerant/low water use plants and the implementation of xeriscaping principles for landscaping within the Ho'opili project to the extent practicable. The installation of an efficient irrigation system, possibly using drip irrigation, will be considered in the design of the project where feasible. Motion sensors to avoid the operation of the system in the rain and if the ground has adequate moisture would be incorporated into the irrigation system, where feasible.

5. Thank you for your comments regarding smart water consumption. The Petitioner will consider the implementation of rain barrel catchments, water-efficient frontload washer appliances and ultra low-flow toilets, as appropriate. Per the BWS comments, the first paragraph in Section 4.8.2, *Water Supply Facilities, Anticipated Impacts and Mitigative Measures* of the Final EIS will be revised to read as follows:

The total average daily source requirement for ultimate build-out is estimated at 3.9 MGD. The future water demand from the proposed project is based on standard civil engineering methodology; it is possible that with the implementation of feasible water conservation appliances, future water demand from the project may be lessened. During the public review period, the BWS wrote: "The developer should also consider rain barrel catchments, water-efficient front- load washer appliances and ultra low-flow toilets." It is intended that source (well supply) would be provided by BWS from existing sources. Although BWS cannot reserve water for future projects, it has indicated that there is water available to meet the estimated water demand for the project (3.9 MGD). Water Facility Charges paid by the Petitioner will be used by the Board to assist in the source replenishment caused by the project's water demands.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

AR00027478

DEPARTMENT OF COMMUNITY SERVICES
CITY AND COUNTY OF HONOLULU
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ERNEST Y. MARTIN
DEPUTY DIRECTOR

March 6, 2008

Mr. Vincent Shigekuni, Vice President
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Response to Draft Environmental Impact Statement
Ho'opili Project

Thank you for providing us with the opportunity to review and comment on the Ho'opili Draft Environmental Impact Statement (DEIS). Prior to development, we understand that you will coordinate details of the affordable housing program in the Ho'opili project that pertain to regulations and programs of the City and County of Honolulu.

The Department of Community Services appreciates your consideration of these comments, and looks forward to reviewing the final EIS when it becomes available. Questions regarding this matter may be directed to Mr. Randy Wong at 768-7747.

Sincerely,

Deborah Kim Morikawa
Director

DKM:rg

cc: Rodney Maile, Acting Director,
State of Hawai'i, Land Use Commission

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
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Ms. Deborah Kim Morikawa, Director
Department of Community Services
City and County of Honolulu
715 South King Street, Suite 311
Honolulu, Hawai'i 96813

Attn: Mr. Randy Wong

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Ms. Morikawa:

Thank you for your letter dated March 6, 2008. We have reviewed your letter and offer the following response to your comments.

We concur that the details of the affordable housing program in the Ho'opili project that pertain to the regulations and programs of the City and County of Honolulu (County) will be coordinated with the County prior to development.

The fourth paragraph of Section 4.7.3 *Housing, Anticipated Impacts and Mitigative Measures* of the EIS will be revised as follows.

> *The proposed housing will be in neighborhoods that integrate low- and medium-density or medium- and high-density residential areas. As a result, Ho'opili will cater to a range of income levels. In accordance with the City and County of Honolulu's affordable housing guidelines, up to 30 percent of the total number of units are expected to be developed as affordable housing units. Details of the affordable housing program in the Ho'opili project that pertain to the regulations and programs of the City and County of Honolulu will be coordinated with the County prior to development.*

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

AR00027479

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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DEPARTMENT OF FACILITY MAINTENANCE

CITY AND COUNTY OF HONOLULU

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MUFI HANNEMANN
MAYOR

CRAIG I. NISHIMURA, P.E.
DIRECTOR AND CHIEF ENGINEER

GEORGE "KEOKI" MIYAMOTO
DEPUTY DIRECTOR

IN REPLY REFER TO:
DRM 08-282

April 7, 2008

Mr. Vincent Shigekuni
PBR Hawaii
1001 Bishop Street
ASB Tower, Suite 650
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Draft Environmental Impact Statement (DEIS), Hoopili

Thank you for the opportunity to review and comment on the DEIS dated February 2008, for the proposed Hoopili development.

Although not identified in the DEIS, it is our understanding that the project bikeways and walkways not located within roadways to be dedicated to the City will be privately-owned and maintained.

Furthermore, the DEIS does not indicate maintenance jurisdiction of the storm drainage detention and retention basins. These basins shall not be maintained by the City and shall be privately-owned and maintained.

Should you have any questions, please call Charles Pignataro of the Division of Road Maintenance, at 768-3697.

Sincerely,

Craig I. Nishimura, P.E.
Director and Chief Engineer

c: State of Hawaii-Land Use Commission

AR00027480

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Mr. Craig I. Nishimura, Director and Chief Engineer
Department of Facility Maintenance
City and County of Honolulu
1000 Uluohia Street
Kapolei Hale, Suite 215
Kapolei, Hawai'i 96707

Attn: Mr. Charles Pignataro

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Nishimura:

Thank you for your letter dated April 7, 2008. We concur that project bikeways and walkways not located within road rights-of-ways dedicated to the government will be privately-owned and maintained. Based on your comments, the third to the last paragraph of Section 4.9.5, *Recreational Facilities* of the EIS will be revised to read:

> *Open space buffers are proposed to be located along the H-1 Freeway and Old Fort Weaver Road. In addition, linear parks and open space will encircle the Ho'opili project with walking/biking paths. "Mini" parks located throughout the project will be within walking distance of most residences. A regional bikeway plan has been developed in cooperation with UHWO, DHHL and HCDA. Figure 4.3: East Kapolei Regional Bikeway Plan shows the approximate alignment of bikeways being proposed by DHHL, UHWO and the Petitioner and how they may connect to bikeways proposed by others (such as HCDA), the bike path shown on the Ewa DP Public Facilities Map, the bikeways shown on the State Bicycle Plan 2003, and park sites proposed by HCDA, DHHL, UHWO and the Petitioner, and possible transit stops (locations being finalized as of this writing). Based on comments received from the City and County of Honolulu Department of Facilities Management during the public review period, project bikeways and walkways not located within road rights-of-ways dedicated to the government will be privately-owned and maintained.*

We also concur that storm drainage detention and retention basins within the project site shall be privately-owned and maintained, unless particular parcels of land are dedicated to or acquired by the government. Based on your comments, the second to the last paragraph of Section 4.8.4, *Drainage Facilities* of the Draft EIS will be revised to read:

> *The project will increase impervious surfaces such as roadways, roofs, paved parking areas, and sidewalks. These surfaces will cause an increase in storm water discharge within the Petition Area. However, detention basins and/or retention basins are being planned and sited to detain and/or retain storm water to ensure that areas downstream of the project are not impacted. Based on comments received from the City and County of Honolulu Department of Facilities Management during the public review period, storm drainage detention and retention basins within the project site shall be privately-owned and maintained, unless particular parcels of land are dedicated to or acquired by the government. During the public review period, the State Office of Planning requested a discussion of low impact development techniques that can be incorporated into the building and site design to improve stormwater management. Table 1.1 of Low Impact Development: A Practitioner's Guide (2006) lists specific Low Impact Development (LID) best management practices (BMP's) and techniques.*

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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AR00027481

DEPARTMENT OF PARKS AND RECREATION

CITY AND COUNTY OF HONOLULU

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MUFI HANNEMANN
MAYOR

LESTER K. C. CHANG
DIRECTOR

GAIL Y. HARAGUCHI
DEPUTY DIRECTOR

March 7, 2008

Mr. Vincent Shigekuni, Vice President
PBR HAWAII
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Draft Environmental Impact Statement-Hoopili Project

Thank you for the opportunity to review and comment on the Draft Environmental Assessment for D. R. Horton's proposed Hoopili project.

The Department of Parks and Recreation has no comment. As proposed in the draft EIS we look forward to meeting with the developer at an early stage in the development's planning process to develop a conceptual plan for overall park development which is acceptable and appropriate.

Should you have any questions, please contact Mr. John Reid, Planner, at 768-3017.

LESTER K. C. CHANG
Director

LKCC:jr
(249865)

cc: Rodney Maile, Acting Director, State of Hawaii Land Use Commission

w/PBR1

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& ASSOCIATES, INC.

August 11, 2008

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Mr. Lester K. C. Chang, Director
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City and County of Honolulu
Kapolei Hale
1000 Uluohia Street, Suite 309
Kapolei, Hawai'i 96707

Attn: Mr. John Reid

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Chang:

Thank you for your letter dated March 7, 2008. We acknowledge that the Department of Parks and Recreation has no comments to offer at this time. We thank you for meeting with us on April 22, 2008. We greatly appreciated you sharing your vision for how the region's recreational needs would be met and how the proposed project will play its role in this vision. The Petitioner assures you that it will continue to coordinate with your Department to develop a conceptual plan for overall park development which is acceptable and appropriate.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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AR00027482

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
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HENRY ENG, FAICP
DIRECTOR

DAVID K. TANOUE
DEPUTY DIRECTOR

2007/GEN-8 (TH)

April 7, 2008

Mr. Vincent Shigekuni, Vice President
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Subject: Draft Environmental Impact Statement for Ho'opili, Ewa, Oahu,
Tax Map Keys: 9-1-017:004 (portion), 059, and 072; 9-1-018:001 and 004;
9-1-010:002, 014 (portion), and 015 (portion); and 9-2-002:002; and
9-2-001: 004, 005, 006, and 007

We have reviewed the subject Draft Environmental Impact Statement (DEIS) and offer the following comments.

1. Any anticipated increases in surface runoff should be mitigated through the use of retention basins for the three (3) major drainage basins until the Kaloi drainage system is completed, and a drainage easement across Navy land is approved.

2. Table 2.1 of the DEIS indicates that Roberts Hawaii School Bus, Inc. is a current tenant on the project site. This company stores up to 30 school buses and 60 handi-van vehicles. The applicant should include a map, or revise Figure 2.3 to show where this activity is located. A preliminary check of our records indicates that there is no land use approval for this use. Unless documentation is available granting the outdoor storage use, we will assume the use has not been permitted.

3. On Page 74, regarding transportation impacts, a transit reduction factor was applied under Scenario A, but there is no description of the factor or any statements as to how the factor is being applied or how it was determined. There should be a disclosure of the assumptions being used to calculate the transit factor and any other assumptions used throughout the traffic analysis section of the DEIS. At the very least, there should be citations of references to the traffic report appendix.

   The traffic impact analysis does not adequately describe current conditions on the H-1 Freeway and the interchanges at Kunia and Makakilo in which project traffic would feed into. During the AM peak period, motorists on the H-1 Freeway frequently experience accidents and stalled vehicles along the segment of H-1 from Kunia to Aiea. The accident/stalled vehicle events cause traffic to back up to Kapolei, which affect all

eastbound on-ramps to the H-1 and surface streets leading to the H-1 on-ramps during these events. These events have been increasing and occur about 1-2 times per week, sometimes not always backed up to Kapolei, but usually about halfway between Kunia and Kapolei. Since the H-1 between Kunia and Aiea lack shoulder lanes to allow vehicles to pull off the travel lanes, even minor accidents and stalled vehicles create very long delays to motorists. The DEIS does not adequately address these recurring events and the contribution of the project traffic would probably increase the frequency of these events. The Traffic Impact Analysis Report (TIAR) should include measures to address these situations and not just the improvements planned for local roads leading up to the H-1.

The TIAR should better describe current PM peak conditions at the Fort Barrette/ Farrington Highway intersection where traffic conditions cause long queues that affect the Makakilo/Kapolei westbound off-ramp queues, which affects through traffic on the H-1 just east of the Makakilo Interchange. As the Fort Barrette Road/Farrington Highway intersection increases in v/c, the TIAR should describe projected PM peak conditions on the west-bound off ramp and the effect on H-1 through lanes.

Lastly, the FEIS should discuss the timing of major transportation improvements against the project's timeline.

4. The Department of Planning and Permitting (DPP) is currently processing two (2) separate but similar revisions to the Ewa, Central Oahu (CO), and Primary Urban Center (PUC) Public Infrastructure Maps (PIM) regarding the Honolulu High Capacity Transit Corridor Project.

   In February 2008, the Department of Transportation Services (DTS) submitted a proposal to the DPP to revise the Ewa, CO, and PUC PIM by adding symbols for a "Rapid Transit Corridor," "Transit Stations," "Corporation Yard," and "Park and Ride" facilities. The proposed symbols represent the Locally Preferred Alternative (LPA) that was approved by the City Council via Ordinance 07-1. The DTS' proposal was circulated for public review and comment, and is now before the City Council for action as Resolution 08-97, CD1.

   In March 2008, the City Council introduced Resolution 08-69 regarding a revision to the Ewa, CO, and PUC PIM by adding 40 "Transit Station" symbols along the length of the LPA. Resolution 08-69 does not include symbols for the rapid transit corridor, corporation yards, or park and ride facilities. The DPP is currently preparing to circulate the proposal for public review and comment before forwarding a report and draft resolution to the City Council for action.

   In view of these recent developments, we recommend adding a new subsection to Section 5.3 of the FEIS that briefly discusses the role of the PIM process, and how these resolutions may affect the proposed project.

AR00027483

The Proposed Circulation Plan (Figure 2.8) should be amended to reflect the City's proposal in Resolution 08-87, CD1 for the Honolulu High Capacity Transit Corridor Project. Resolution 08-97, CD1 shows PIM symbols for the proposed alignment, transit stations, and corporation yard. Adoption of Resolution 08-97, CD1 is expected on May 7, 2008.

These comments do not constitute our final comments on this project. As it proceeds through the entitlement process, we expect to ask for more information pursuant to zone change and permitting requirements. Should you have any questions, please contact Tim Hata of our staff at 768-8043.

Very truly yours,

Henry Eng, FAICP, Director
Department of Planning and Permitting

HE:js

cc: OEQC
Land Use Commission

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PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Mr. Henry Eng, FAICP, Director
Department of Planning and Permitting
City and County of Honolulu
650 South King Street, 7th Floor
Honolulu, Hawai'i 96813

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Eng:

Thank you for your letter dated April 7, 2008. We have reviewed your letter and offer the following responses to your comments:

1. Retention basins are proposed to mitigate increased flow into Kalo'i Gulch until the drainage system is completed. The Honouliuli drainage basin will utilize retention basins to match the design capacity of the drainage system. The West Loch drainage basin will treat all discharge for water quality prior to discharge. We concur that a drainage easement will be required for the West Loch system across Navy land or an alternate drainage solution will have to be utilized. The Draft EIS identifies an 100-year 24-hour retention. All drainage basins will need to provide retention/detention for water quality.

2. The Roberts Hawaii School Bus, Inc. is currently on a month-to-month lease that was inherited when the Petitioner purchased the property. The Petitioner has been paying industrial property taxes for the approximately one acre site. Figure 2.3: Current Lessees of the Final EIS will be revised to show the location of the Roberts Hawaii School Bus, Inc.'s bus storage site. Thank you for bringing this matter to our attention. The Petitioner will investigate this matter and take the appropriate action.

3. Responses to Comments are below:

   a. A detailed description of the transit reduction factor along with other reduction factors applied to Scenario A is provided in Chapter 4 Traffic Estimate (page 4-4) of the Ho'opili TIAR.

AR00027484

b. We acknowledge your comment that current traffic during the morning peak period result in on H-1 from Kunia to Aiea result in extensive queuing and backup. When accidents occur, stalled vehicles in traffic lanes do worsen queuing and backup due to the absence of shoulder lanes. However, as this event is an occasional event rather than a daily event, these were not discussed in the TIAR. The State DOT does have plans to take corrective action to alleviate current traffic operations. Currently, there is ongoing discussion to implement contraflow lanes for the PM peak hour between the Waiawa interchange to the Waikele interchange which would help alleviate the traffic congestion as well. Currently, the timeline for the contraflow lane implementation is not known.

c. As part of the Oahu Regional Transportation Plan for 2030, a new interchange is being planned at Kapolei between the Palailai and the Makakilo Interchange. In addition, new eastbound and westbound ramps will be constructed for the Makakilo interchange. The PM peak hour traffic conditions at the Fort Barrette/Farrington Highway intersection should be alleviated by these new planned improvements.

d. As recommended, the timing of major transportation improvements and their reported schedule for implementation will be shown on a map that will be included in the Final EIS as Figure 4.2 ('Ewa Regional Transportation Plan).

4. As recommended, a new subsection to the Final EIS will be created to discuss the role of the Ewa, Central Oahu, and Primary Urban Center (PUC) Public Infrastructure Maps (PIM) process and its affect on the Ho'opili project. A new Section 5.3.5 *Ewa, Central Oahu and Primary Urban Center Public Infrastructure Maps* of the EIS will be added to read as follows:

Based on comments received from the Department of Planning and Permitting (DPP) during the public review period, it should be noted that DPP is currently processing two separate but similar revisions to the Ewa, Central Oahu (CO) and Primary Urban Center (PUC) Public Infrastructure Maps (PIM) regarding the Honolulu High Capacity Transit Corridor Project.

In February 2008, the Department of Transportation Services (DTS) submitted a proposal to the DPP to revise the Ewa, CO and PUC PIMs by adding symbols for a "Rapid Transit Corridor," "Transit Stations," "Corporation Yard," and "Park and Ride" facilities. The proposed symbols represent the Locally Preferred Alternative (LPA) that was approved by the City Council via Ordinance 07-1. The DTS' proposal was circulated for public review and comment, and adoption of Resolution 08-97 occurred on May 7, 2007. Figure 2.8: Proposed Circulation Plan of the Final EIS has been revised to reflect the City's proposal in Resolution 08-97, CD1 for the Honolulu High Capacity Transit Corridor Project.

In March 2008, the City Council introduced Resolution 08-69 regarding a revision to the Ewa, CO and PUC PIM's be adding 40 "Transit Station" symbols along the length of the LPA. Resolution 08-69 does not include symbols for the "Rapid Transit Corridor," "Corporation Yard," and "Park and Ride" facilities. The DPP is currently preparing to circulate the proposal for public review and comment before forwarding a report and draft resolution to the City Council for action.

As of this writing, the City and County of Honolulu (City) has begun work on the Draft Environmental Impact Statement (EIS) for the Honolulu High-Capacity Transit Corridor (HHCTC) project, with a target publication date in the second or third quarter of 2008. By the time the HHCTC Draft EIS is published, the final alignment of the "Rapid Ttransit Corridor and the locations of: "Transit Stations," "Corporation Yard" (transit maintenance and storage), "Park and Ride" facilities in Ewa will be known. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or through the project site, with either one or two transit station locations. The Petitioner acknowledges that sites for a transit maintenance and storage facility and/or a portion of a park and ride facility may be required within the Petition Area.

5. The Petitioner looks forward to continue coordinating with your department as it proceeds through the entitlement process.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

encl: Figure 2.3: Current Lessees
Figure 2.8: Proposed Circulation Plan
Figure 4.2: 'Ewa Regional Transportation Plan

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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LEGEND

- Project Site Boundary
- Petition Area
- Aloun Processing Plant Lease (3 A.C.)
- Aloun Farm Lease
- Sugarland Lease
- Gard Seed Lease
- Hawaii Agricultural Research Center Lease
- U.S. Filter Operating Lease (Non-Major #3)
- Sublessee Areas
- Approximate Location of Roberts Hawaii School Bus, Inc.

Source: D.R. Horton-Schular Division
Disclaimer: This graphic has been prepared for general planning purposes only.

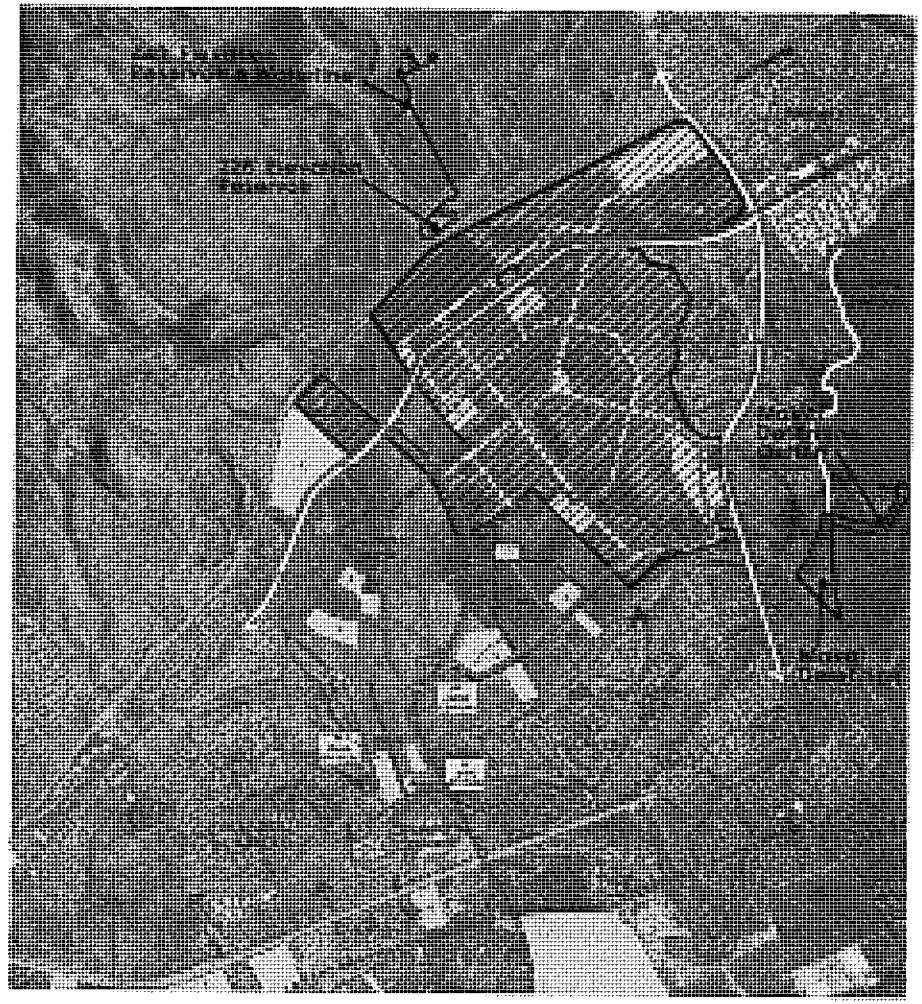
Figure 2.3: Current Lessees

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.



- Project Site Boundary
- Petition Area
- Proposed UH West O'ahu Bikeway
- Proposed Ho'opili Bikeway
- Proposed DHHL Bikeway
- Proposed Bikeway by Others
- Existing State Bike Plan
- Pearl Harbor Historic Trail and Leeward Bikeway
- Express and Local Bus Routes
- Proposed HHCTC Corridor
- TS Proposed Transit Stop
- Circulator Shuttle
- Proposed Parks
- S Proposed Schools
- PF Proposed Public Facility
- Right-in / Right-out
- Right-in / Right-out

Source: State of Hawaii Department of Transportation Bicycle Plan 2000; Draft Ewa Connectivity Study 2007.
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2.8: Proposed Circulation Plan

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

AR00027486

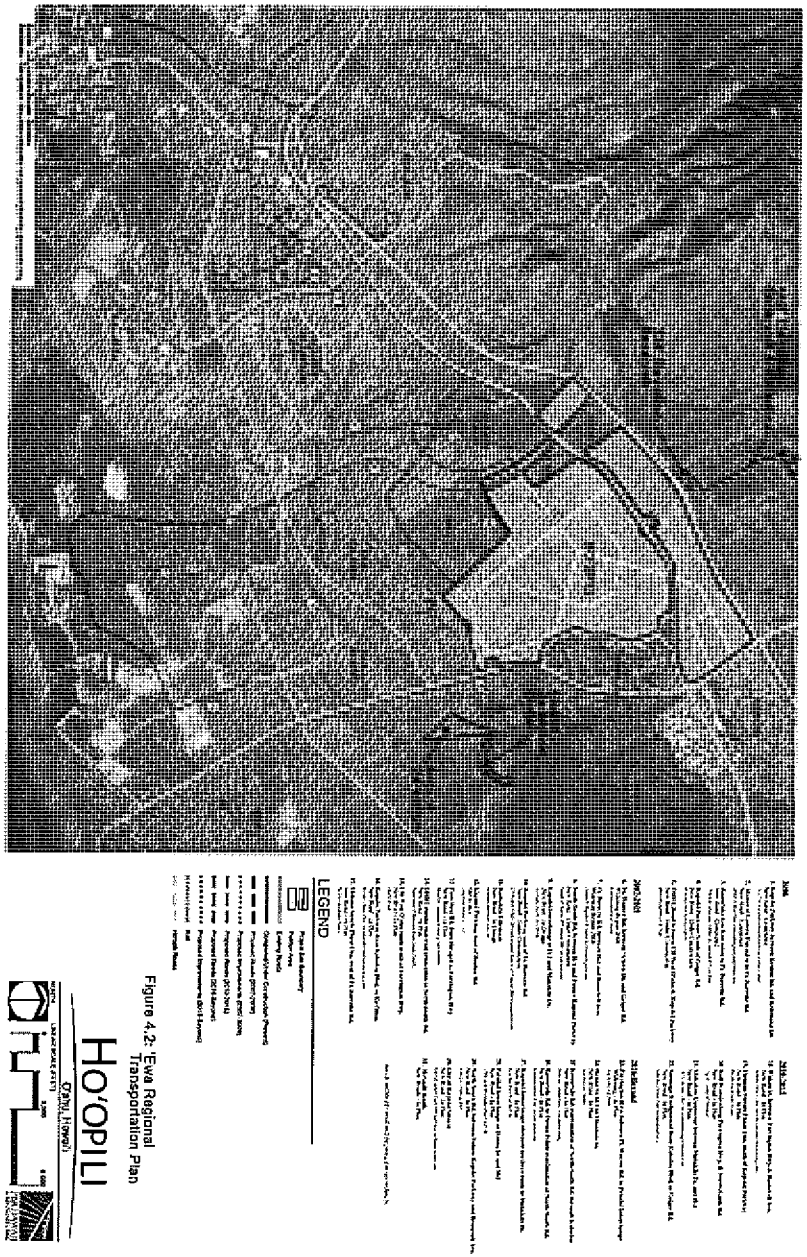


Figure 4.2: 'Ewa Regional Transportation Plan

HONOLULU FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

636 South Street
Honolulu, Hawaii 96813-5007
Phone: 808-723-7139 Fax: 808-723-7111 Internet: www.honolulu.gov/hfd

MUFI HANNEMANN
MAYOR

KENNETH G. SILVA
FIRE CHIEF

ALVIN K. TOMITA
DEPUTY FIRE CHIEF

March 12, 2008

Mr. Vincent Shigekuni, Vice President
PBR Hawaii & Associates, Inc.
American Savings Bank Tower
1001 Bishop Street, Suite 650
Honolulu, Hawaii 96813-3484

Dear Mr. Shigekuni:

Subject: Draft Environmental Impact Statement
Ho'opili
Ewa, Oahu
Tax Map Keys: 9-1-017: 004 (portion), 059, and 072; 9-1-018: 001 and 004;
9-1-010: 002, 014 (portion), and 015 (portion);
9-2-001: 004, 005, 006, and 007; 9-2-002: 002

In response to your letter dated February 20, 2008, regarding the above-mentioned subject, the Honolulu Fire Department (HFD) reviewed the material provided and has no additional comments. Please refer to our comments of March 28, 2007, which were included in the Environmental Impact Statement Preparation Notice.

Should you have any questions, please call Battalion Chief Socrates Bratakos of our Fire Prevention Bureau at 723-7151.

Sincerely,

KENNETH G. SILVA
Fire Chief

KGS/SK:bh

cc: Rodney Maile, Acting Director
State of Hawaii, Land Use Commission

AR00027487

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
Chairman

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President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHING, FASLA
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Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Kenneth G. Silva, Fire Chief
Honolulu Fire Department
City and County of Honolulu
636 South Street
Honolulu, Hawai'i 96813-5007

Attn: Battalion Chief Socrates Bratakos

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Chief Silva:

Thank you for your letter dated March 12, 2008. We acknowledge that the Honolulu Fire Department (HFD) has no additional comments, other than those provided in a letter dated March 28, 2007 on the Environmental Impact Statement Preparation Notice.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU
801 SOUTH BERETANIA STREET · HONOLULU, HAWAII 96813
TELEPHONE: (808) 529-3111 · INTERNET: www.honolulupd.org

MUFI HANNEMANN
MAYOR

OUR REFERENCE BS-KP

BOISSE P. CORREA
CHIEF

PAUL D. PUTZULU
MICHAEL D. TUCKER
DEPUTY CHIEFS

March 5, 2008

Mr. Vincent Shigekuni, Vice President
PBR Hawaii & Associates, Inc.
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

This is in response to your letter of February 20, 2008, requesting comments on a Draft Environmental Impact Statement for the Ho`opili project in Ewa.

The Honolulu Police Department (HPD) will need to expand its patrol services as Ho`opili is developed, given that beat 879 (which now has only a few homes) will eventually have another 11,750 units and at least 35,000 new residents. The HPD looks forward to making the best use of the public facility site proposed by the developer as planning progresses.

If there are any questions, please call Major Michael Moses of District 8 at 692-4253 or Mr. Brandon Stone of the Executive Office at 529-3644.

Sincerely,

BOISSE P. CORREA
Chief of Police

By
DEBORA A. TANDAL
Assistant Chief of Police
Support Services Bureau

cc: Mr. Rodney Maile
Land Use Commission

Serving and Protecting With Aloha

AR00027488

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
Chairman

THOMAS S. WITTEN, ASLA
President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
Executive Vice-President

VINCENT SHIGEKUNI
Vice-President

GRANT T. MURAKAMI, AICP
Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

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2787 Wili Pa Loop, Suite 4
Wailuku, Hawai'i 96793-1271
Tel: (808) 242-2876

Mr. Boisse P. Correa, Chief of Police
Police Department
City and County of Honolulu
801 South Beretania Street
Honolulu, Hawai'i 96813

Attn: Major Michael Moses/Mr. Brandon Stone

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Chief Correa:

Thank you for your letter dated March 5, 2008 (your reference number: BS-KP). We acknowledge that the Honolulu Police Department (HPD) will need to expand its patrol services as the project is developed. As such, we look forward to coordinating with the HPD to make the best use of the proposed public facility site as planning progresses.

The first paragraph of Section 4.9.2 *Police Protection, Anticipated Impacts and Mitigation Measures* of the EIS will be revised as follows:

> *The project will increase the population of Kapolei and the demand for police service. According to the Ewa Development Plan, the 'Ewa Villages Substation is planned to service the East 'Ewa region, which includes the Ho'opili project. The service date for this substation has yet to be determined. The Petitioner is proposing a public facility site immediately mauka of Farrington Highway near the western portion of Parcel B for a use such as a police substation, fire station and/or emergency medical service (EMS) site. During the public review period for the EISPN, the HPD wrote that "the project should have no unanticipated impact on the facilities or operations of the Honolulu Police Department." During the public review period for the Draft EIS, the HPD wrote that "the Honolulu Police Department (HPD) will need to expand its patrol services as Ho'opili is developed... the HPD looks forward to making the best use of the public facility site proposed by the developer as planning progresses."*

Thank yon again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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AR00027489

Hawaiian Electric Company, Inc. • PO Box 2750 • Honolulu, HI 96840-0001

RECEIVED
APR 3 0 2008
PBR HAWAII

EIS

April 28, 2008

Mr. Vincent Shigekuni, Vice President
PBR Hawaii & Associates, Inc.
ASB Tower - Suite 650
1001 Bishop Street
Honolulu, HI 96813-3484

Dear Mr. Shigekuni:

Re: Ho'opili

Thank you for the opportunity to comment on the above-referenced project. Hawaiian Electric Company, Inc. (HECO) has no objections at this time. The following comments were received from our Engineering and Construction & Maintenance Departments:

(1) Engineering/Transmission & Distribution (Sherman Uyehara, 543-7536). HECO has existing overhead and underground facilities within the subject property and will require continued access for maintenance purposes.

The existing overhead electrical facilities along Farrington Highway contain 46kV subtransmission lines, and the area behind the Ewa Nui Substation contain 138kV transmission lines. The relocation of a 46kV line may require a determination by the Public Utilities Commission (PUC) that the line should be constructed overhead (versus underground), pursuant to HRS 269-27.6, and may require a PUC public hearing for overhead construction through a residential area, pursuant to HRS 269-27.5. The PUC approval process for overhead relocation could take from nine months to a year, but may take longer depending on the timing, schedule and complexity of the project. HECO will not be able to order materials or start construction until the requisite PUC approvals are received.

Should it become necessary to relocate HECO's facilities, please immediately submit a request in writing and we will work with you so that construction of the project may proceed as smoothly as possible. Please note that there may be costs associated with any relocation work, and that such costs may be borne by the requestor. Because any redesign or relocation of HECO's facilities may cause lengthy delays, upon determination that HECO facilities will need to be relocated, HECO should be notified immediately in order to minimize any delays in or impacts on the project schedule.

During the planning and design phase of the project, please keep in mind that State Law [OSHA 1910.269(k)(2B)] requires that a worker and the longest object he/she may contact cannot come closer than a minimum radial clearance of ten feet when working close to or under any overhead lines rated 50kV and below. For each additional 10kV above 50kV, an additional four inches shall be added to the ten-foot clearance requirement. In addition, a minimum clearance of ten feet must be maintained during excavation around utility poles and/or their anchor systems to prevent weakening or pole support failure. Clearances shall be maintained between HECO's ductlines and all adjacent structures, according to HECO's Standards.

We appreciate your efforts to keep us apprised of the planning process. As the project progresses, please continue to keep us informed. We will be better able to evaluate any effects on our system facilities further along in the project's development. We request that development plans show all affected HECO facilities, and address any conflicts between the proposed plans and HECO's existing facilities. Please forward the pre-final development plans to HECO for review.

(2) Engineering/Telecommunications Section (Dixson Lau, 543-7543). HECO has existing overhead telecommunications facilities along with our electrical facilities within Parcels A, B and C of the proposed project. Please keep us informed in the same manner as requested above by our Transmission & Distribution Division.

(3) Engineering/Transmission Substation Section (Hope Hameda, 543-7216) Currently, there are existing substation facilities within the project area, mainly within Parcel B (TMK 9-2-28: 01). Please also keep us informed as requested by our Transmission & Distribution Division.

(4) Construction & Maintenance (Paul Nakagawa, 543-7062). We will need continued access to our facilities for maintenance purposes, as covered by our existing easement(s). Should relocation of or additional facilities be required, a formal request should be submitted and coordinated through appropriate HECO department(s).

To ensure HECO's continuing input in this project, I suggest dealing directly with the points of contact noted above. Thank you again for the opportunity to comment.

Sincerely,

Kirk S. Tomita
Senior Environmental Scientist

cc: Mr. Rodney Maile (LUC)
S. Uyehara/M. Lum
H. Hamada/D. Lau/R. Shiroma/D.M. Arakaki
P. Nakagewa

AR00027490

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

W. FRANK BRANDT, FASLA
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Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI AHKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
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Tel: (808) 242-2878

Mr. Kirk S. Tomita, Senior Environmental Scientist
Hawaiian Electric Company, Inc.
P.O. Box 2750
Honolulu, Hawai'i 96840-0001

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Tomita:

Thank you for your letter dated April 28, 2008. We acknowledge that the Hawaiian Electric Company, Inc. (HECO) has no objections at this time. We have reviewed your letter and offer the following responses to your comments:

Engineering/Transmission & Distribution

1. We acknowledge that HECO has existing overhead and underground facilities within the subject property and will require continued access for maintenance purposes.

2. According to Bills Engineering, the project civil engineer, all overhead lines may have to be relocated with the exception of the 138kV (kilovolt) lines. The 12kV and 46kV lines that may become subject to relocation would most likely be placed underground. We acknowledge that the potential relocation of 46kV subtransmission lines along Farrington Highway may require a determination by the State of Hawai'i Public Utilities Commission (PUC) that the line be constructed overhead versus underground and may require a PUC public hearing for overhead construction through a residential area pursuant to HRS 269-27.5. Your company is probably aware that the City and County of Honolulu has long had plans to widen and improve Farrington Highway (between the Kapolei Golf Course to Fort Weaver Road), so please be assured that the Petitioner is unlikely to develop residential uses along Farrington Highway until the City and County of Honolulu has finalized their plans for improving Farrington Highway.

3. We acknowledge that the PUC approval process for overhead relocation could take from nine months to a year, but may take longer depending on the timing, schedule and complexity of the project and that HECO will not be able to order materials or start construction until the requisite PUC approvals are received. Should the project's development require the relocation of HECO's facilities, the Petitioner will notify HECO immediately in order to minimize any delays in or impacts on the project schedule. As previously noted, this is likely to occur after the City and County of Honolulu has finalized their plans for improving Farrington Highway.

4. The Petitioner intends to comply with State Law [OSHA 1910.269(k)(2B)] during the planning and design phase of the project. It is also acknowledged that a minimum of clearance of ten feet must be maintained during excavation around utility poles and/or their anchor systems to prevent weakening or pole support failure. Additionally, it is acknowledged that clearances shall be maintained between HECO's ductlines and all adjacent structures, according to HECO's Standards.

5. The Petitioner's civil and electrical engineering consultants will continue to coordinate with HECO's Transmission & Distribution Section as plans progress. As requested, development plans will show all affected HECO facilities, and address any conflicts between the proposed plans and HECO's existing facilities. Pre-final development plans will be forwarded to HECO for review.

Engineering/Telecommunications Section

1. We acknowledge that HECO has existing overhead telecommunication facilities along HECO's electrical facilities within Parcels A, B and C of the proposed project. The Petitioner's civil and electrical engineering consultants will continue to coordinate with HECO's Telecommunications Section as plans progress.

Engineering/Transmission Substation Section

1. We believe that the TMK that HECO cites as being within the Petition Area is incorrect. The parcel identified as TMK: 9-2-28: 01 appears to be located near the intersection of Makakilo Drive and Palahia Drive. We believe the Ewa Nui Substation is identified as TMK: 9-1-18: 06 and is not part of (but surrounded by) a portion of the project site identified as TMK: 9-1-18: 06. The Petitioner's civil and electrical engineering consultants will continue to coordinate with HECO's Transmission Substation Section as plans progress.

Construction & Maintenance

1. As noted earlier in this letter, the Petitioner acknowledges that HECO will need continued access for maintenance purposes. Should the relocation of or additional facilities be required, a formal request will be submitted and coordinated through the appropriate HECO department(s).

AR00027491

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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The City of Kapolei

April 8, 2008

Mr. Vincent Shigekuni
Vice President
PBR Hawaii & Associates, Inc.
ASB Tower
1001 Bishop Street, Suite 650
Honolulu, HI 96813

Dear Mr. Shigekuni:

Comments on Ho'opili Draft
Environmental Impact Statement Dated February 2008

Thank you for the opportunity to comment on the Ho'opili Draft Environmental Impact Statement. We appreciate the opportunity to continue to be consulted as the planning for the project evolves.

Sincerely,

Steve Kelly
Manager, Development

ga:01036300\K10044

cc: Rodney Maile, Interim Executive Officer
Land Use Commission, State of Hawaii

Aina Nui Corporation | Kapolei Property Development LLC | *Affiliates of the James Campbell Company LLC*
1001 Kamokila Boulevard, Campbell Building, Suite 250 | Kapolei, Hawaii 96707 | Main: 808.674.3541 | Fax: 808.674.3111 | www.kapolei.com

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PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
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Principal

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RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
Associate

KIMI MIKAMI YUEN, LEED® AP
Associate

SCOTT ALIKA ABRIGO
Associate

SCOTT MURAKAMI, ASLA
Associate

Mr. Steve Kelly
Manager, Development
Aina Nui Corporation
Kapolei Property Development LLC
1001 Kamokila Boulevard
Campbell Building, Suite 250
Kapolei, Hawai'i 96707

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Kelly:

Thank you for your letter dated April 8, 2008 and for your participation in the Environmental Impact Statement process for this project. Please be assured that you will continue to be consulted as the planning for this project progresses. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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HASEKO
HASEKO (Ewa), Inc.

RECEIVED
APR 16 2008
PBR HAWAII

April 14, 2008

Mr. Vincent R. Shigekuni
Vice President
PBR Hawaii
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Haseko (Ewa), Inc. (Haseko) offers the following comments on the Ho'opili Draft Environmental Impact Statement (DEIS).

Haseko is the owner and developer of the Ocean Pointe and Hoakalei developments, located at the makai end of the Kalo'i Gulch drainage basin. We are thankful that Ho'opili shares our concern for the well-being of our neighbors within the Kalo'i watershed, and appreciate the discussion included in the DEIS on drainage issues and the acknowledgement of special storm water discharge restrictions on developments within the Kalo'i Gulch drainage basin on until such time as an ocean outlet is constructed. Essentially, developments within the Kalo'i Gulch drainage basin are not allowed to increase overall flows or channelized storm water flows until there is an ocean outlet for storm water discharge.

The ability to construct the ocean outlet is dependent upon issuance of a conservation district use permit (CDUP) by the State Board of Land and Natural Resources. Haseko has applied for the CDUP, which is now being processed through a contested case proceeding. Although Haseko, as the applicant, and Gentry, as an intervenor, are the only two parties in the contested case in support of the CDUP application, all developments within the Kalo'i Gulch drainage basin will be affected by the decision in this case.

Please note that the location of the proposed ocean outlet is at One'ula Beach Park, and not at 'Ewa Marina (now known as Hoakalei Marina) as stated on page 208 of the DEIS. Because of the potential environmental problems associated with intersecting the Kalo'i Gulch regional drainage system with the Honouliuli sewer outfall pipe, the outlet has been relocated from the marina, which is to the west of the sewer outfall pipe, to the beach park, which lies east of the outfall. In June, 2007, the Honolulu City Council approved this relocation by issuing a special management area use permit for that purpose (Resolution No. 07-118, CD1).

91-1001 Kaimalie Street, Suite 205 • Ewa Beach, Hawaii 96706-5005
Telephone (808) 689-7772 • Fax (808) 689-5757

AR00027493

We look forward to the successful realization of Ho'opili and the traffic improvements and other community benefits this master-planned development will help bring to the 'Ewa Plain.

Thank you for the opportunity to review and comment on the DEIS.

Very truly yours,

NANCY MAEDA
Executive Vice President

NM:al

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Ms. Nancy Maeda, Executive Vice President
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91-1001 Kaimalie Street, Suite 205
'Ewa Beach, Hawai'i 96706-5005

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Ms. Maeda:

Thank you for your letter dated April 14, 2008. We have reviewed your letter and offer the following responses to your comments.

1. We acknowledge that developments within the Kalo'i Gulch drainage basin are not allowed to increase overall flows or channelized storm water flows until there is an ocean outlet for storm water discharge. As mentioned in the Draft EIS, with respect to the portion of the project within the Kalo'i drainage basin, the project will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions.

2. We concur that the location of the proposed ocean outlet is at One'ula Beach Park, and not at the Hoakalei Marina (referred to as 'Ewa Marina in the Draft EIS). Table 5.8. Ewa Development Plan – Objectives and Policies (*Section 3.6.2: 'Ewa Marina, Discussion*) of the Final EIS will be revised as follows:

> *Discussion: While the Ewa DP's policies related to the residential development of the 'Ewa Marina are not directly applicable to the Ho'opili project, the Petitioner supports the plan's objectives. While a relatively small portion of the Petition Area lies within the Kalo'i Gulch drainage basin, Ho'opili will be designed to detain future runoff from the site to current flows, until such time as the outlet to the ocean at 'Ewa Marina is opened. During the Draft EIS public review period, HASEKO (Ewa), Inc. wrote: "...the location of the proposed ocean outlet is at One'ula Beach Park, and not at 'Ewa Marina (now known as Hoakalei Marina)...Because of the potential environmental problems associated with intersecting the Kalo'i Gulch regional drainage system with the Honouliuli sewer outfall pipe, the outlet has been relocated from the marina, which is to the west of the sewer outfall pipe, to the beach park, which lies east of the outfall." HASEKO (Ewa), Inc. also wrote: "The ability to construct the ocean outlet is dependent upon issuance of a conservation district use permit (CDUP) by the State Board of Land and Natural Resources. Haseko has applied for the CDUP, which is now being processed through a contested case proceeding."*

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Table 5.8. Ewa Development Plan – Objectives and Policies (*Section 4.6.2: Drainage Systems - Planning Principles, Discussion*) of the Final EIS will be revised as follows:

> ***Discussion:*** *While a relatively small portion of the Petition Area lies within the Kalo'i Gulch drainage basin, Ho'opili will be designed to detain future runoff from the site to current flows before entering Kalo'i Gulch, until such time as the outlet to the ocean at 'Ewa Marina is opened. During the Draft EIS public review period, HASEKO (Ewa), Inc. wrote: "...the location of the proposed ocean outlet is at One'ula Beach Park, and not at 'Ewa Marina (now known as Hoakalei Marina)...Because of the potential environmental problems associated with intersecting the Kalo'i Gulch regional drainage system with the Honouliuli sewer outfall pipe, the outlet has been relocated from the marina, which is to the west of the sewer outfall pipe, to the beach park, which lies east of the outfall." HASEKO (Ewa), Inc. also wrote: "The ability to construct the ocean outlet is dependent upon issuance of a conservation district use permit (CDUP) by the State Board of Land and Natural Resources. Haseko has applied for the CDUP, which is now being processed through a contested case proceeding."*

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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Leeward – Central Community Roundtable

April 7, 2008

Dr. Kioni Dudley
Chairman

Ben Acohido

Lorrain Burgess

Ann Freed

Richard Poirier

Vincent Shigekuni, Vice President
PBR Hawaii
1001 Bishop Street
Honolulu, Hawai'i 96813

Re: Comments on Draft EIS for Ho'opili project

Dear Mr. Shigekuni:

In August of 2007, the Hawaii State Supreme Court, in reversing the circuit court decision of Sierra Club vs. the State Department of Transportation, mandated, as a matter of law, the state DOT to conduct an environmental assessment of the Super Ferry which would include an analysis of the secondary and cumulative impacts as well as the primary impacts generated by the operation of the Super Ferry. The Leeward-Central Community Roundtable requests that the final EIS for the Ho'opili development include an analysis of the primary, secondary, and cumulative impacts of the project in the various areas below, which would include the identification of needs and deficiencies, and appropriate mitigation measures.

Traffic:

All references in this section will be to pages within the section, "Appendix L, Traffic Impact Analysis Report" of Volume 2 of the Ho'opili draft EIS.

Below is a combination of Table 2.7 and Table 5.3 of which provides the LOS for Peak-hour Freeway Segment operations. It includes existing conditions, and conditions for the year 2030 with rail but without the Ho'opili project, and conditions for the year 2030 with rail and with the Ho'opili project.

Morning Peak:

#	Freeway	Segment	Existing LOS	2030 without Ho'opili (Includes rail)	2030 with Ho'opili (Includes rail)
1	H-1 EB	S/O Makakilo Dr.	A	E	E
2	H-1 EB	W/O Kunia Rd.	C	F	F
3	H-1 EB	W/O Pa'iwa St.	E	E	F
4	H-1 EB	E/O Kamehameha	D	E	F
5	H-2 SB	At Ka 'Uka Blvd.	D	D	D
6	H-1 WB	S/O Makakilo Dr.	A	C	C
7	H-1 WB	W/O Kunia Rd.	C	C	C
8	H-1 WB	W/O Pa'iwa St.	C	B	C
9	H-1 WB	E/O Kamehameha	C	C	C
10	H-2 NB	At Ka 'Uka Blvd.	B	C	C

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Afternoon Peak:

#	Freeway	Segment	Existing LOS	2030 without Ho'opili (Includes rail)	2030 with Ho'opili (Includes rail)
1	H-1 EB	S/O Makakilo Dr.	B	D	E
2	H-1 EB	W/O Kunia Rd.	D	D	D
3	H-1 EB	W/O Pa'iwa St.	C	D	E
4	H-1 EB	E/O Kamehameha Hwy.	B	D	E
5	H-2 SB	At Ka 'Uka Blvd.	B	C	C
6	H-1 WB	S/O Makakilo Dr.	B	F	F
7	H-1 WB	W/O Kunia Rd.	C	E	F
8	H-1 WB	W/O Pa'iwa St.	E	C	D
9	H-1 WB	E/O Kamehameha Hwy.	E	E	F
10	H-2 NB	At Ka 'Uka Blvd.	C	F	F

1. Your report states on page 7 states that "traffic impact" will be indicated when an LOS deteriorates to E or worse. As the table shows, four of the five Honolulu-bound Morning segments and seven of the ten segments both ways in the Afternoon show such loss when comparing the existing conditions to 2030 conditions with Ho'opili. However, table 5.3 shows "traffic impact" for only two of the morning segments and five of the afternoon segments. You arrive at this favorable "no-impact" designation by comparing "2030 with Ho'opili" only with "2030 without Ho'opili." Ho'opili is likely to begin construction before a number of other projects in the area, yet your action treats all other projects as if they come first. We request that the final EIS compare "existing conditions" with "2030 with Ho'opili" in determining traffic impact. Traffic impact status for four morning segments and seven afternoon segments seems warranted.

2. The "Chapter 7 Conclusion" on page.7-1 of your "Traffic Analysis Report" mentions intersections, concluding that, with mitigation, only one intersection will have "traffic impact." The Conclusion however, is seriously flawed in that it does not mention freeway segments at all, and ignores the "traffic impact" in the four morning segments and seven afternoon segments.

3. The Conclusion is further flawed in that it also does not mention unacceptable conditions for Ramp-Freeway Junction Operation, even though page 3-22 states that three in the morning and three in the afternoon are unacceptable, and Table 3.4 shows six of twenty Ramp Junctions for 2030 at LOS E or F. Mitigation for only one ramp is discussed at Impact 6.1.2F. The Conclusion for the final EIS should show "traffic impact" for six of the twenty Ramp Junctions.

4. The Conclusion seems further flawed in its assessment of impact on traffic intersections, both in that it presumes its lane-change mitigation measures will work, and in that it includes in mitigation efforts changes in habit by the population which have never been achieved before: such as carsharing, rent subsidies, and transit subsidies by employers. Given the concerted efforts of the DOT to ease traffic congestion through creative re-striping and other changes over the last several years, it is questionable why the solutions proposed have not been adopted by the DOT if they so assuredly will work. We request that all mitigation proposals be discussed with the DOT and DTS and that their answers be recorded in the conclusion. Please comment on the feasibility of the state or city acting on each, and the cost. We request that the Conclusion restate the number of intersections which will have traffic impact in light of those conversations.

5. The Tables showing existing conditions, and Scenario A, year 2030 conditions without and with the project list volume, density and LOS, but the do not show time spent in traffic. What are the times spent in traffic for the various sites? Please show current and 2030 Scenario A figures without and with the project.

6. The draft EIS only studies freeway segments as far east as the H-1/H-2 merge. Heavy traffic continues on into the city of Honolulu. This project will surely affect traffic all the way into town. We request that the final EIS contain studies of segments for the rest of the freeway.

7. The draft EIS discusses intersections and on/off ramps. In doing so, it combines all of the lanes of an intersection or ramp. While one lane may be an LOS F, it can be balanced off with a lane that is an A to make the intersection or ramp a C. Please make an additional, separate listing of all LOS E and F lanes so that they can easily be identified, and note the time backed up in each.

8. Moving to points not mentioned in the draft EIS: Ho'opili will occupy what can be pictured as a triangle, bordered on two sides by the two busiest roadways in West O'ahu. The tip of the triangle, where the two roadways converge, will continue to be the choke point for two roads. Both sides of one roadway, H-1, are open space for miles before the merge. There is a small number of homes (a few hundred) in West Loch, on one side of the other road, Ft. Weaver Rd. The many thousands of cars that feed into the H-1/Ft. Weaver merge at the tip of the triangle now pass this open space. When the 12,000 homes of Ho'opili fill the triangle, all of the homes of Ho'opili will be closer to the merge than any of the homes from which the thousands of cars now traveling the roads come. The 7069 cars from Ho'opili will empty onto Ft. Weaver and H-1 *in front of* the thousands of current travelers during peak hours each morning. The 12,077 cars returning to Ho'opili in the afternoon will slow the cars returning to farther distances. What effort is being made or will be made to inform those thousands of drivers, already enduring great traffic problems, that traffic from 12,000 homes will feed into the merge ahead of them? What efforts are being made or will be made to collect their input?

9. The draft EIS does not address the secondary and cumulative costs to drivers in physical health, mental health, loss of family time, and early death. What are these? What are the affects for latch-door kids? How much will the delay in traffic cause the people affected in child care? How much in gasoline? Please calculate these things for the entire trip to and from the city of Honolulu.

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Agriculture:

"Appendix A, Agricultural Impact Analysis" discusses loss of agricultural lands, but does not discuss the nature of those lands. It also does not discuss the climate of the area which is an important factor in what plants can be grown.

The book, *Detailed Land Classification – Island of Oahu* Bulletin No. 11, December 1972 by the Land Study Bureau – University of Hawaii, classifies all lands on Oahu on a scale of A to E. Those classified as A and B are "prime agricultural lands." All of the flat land in the Ho'opili project is classified as "prime agricultural lands." Much of it is classified as A. These lands are extremely rich. Climate is another factor. There are other "prime agricultural lands" which have not been covered with housing, but few exist in such a sunny area, with mild winds. These lands were called the golden triangle in sugar plantation days. We request that the final EIS study what other places on the island could be found which mimic the desirable conditions of the Ho'opili lands. This would include a study of the best land and climate characteristics for growing the various crops that are being grown and have been grown on the property since sugar times.

Because of the high price of gasoline, two airlines that service Hawaii and one mainland airline declared bankruptcy and stopped flying this week. Experts tell us that the price of gasoline will never return to prices we have known in the past. Rather, with the emergence of automobiles in China and India, we can only expect higher and higher gasoline prices. Other airlines will eventually be forced into bankruptcy. And it may be necessary for Oahu to produce all the crops that feed our people. We request that the final EIS study this situation – specifically how much land at what land classifications (A to E) and under what climatic conditions (sun and wind) does Oahu need to sustain the anticipated 2030 number of people on the island. Further, please report in the EIS on the connection of gasoline price to and cost of shipping, and at what price the cost of gasoline will make it unfeasible to bring in food by air.

Water:

The several appendices on Water discuss a number of aspects—available potable and non-potable water, and drainage. There is no discussion on the aquifer itself and the effect housing, as opposed to current farmland, will have on water draining down to replenish the waters below. Although water seeps down only to the caprock in this area, rather than seeping down to refill the aquifer, the fresh water above the caprock is necessary to keep the salt water from flowing into the aquifer. We request that the final EIS present a study of this replenishment of fresh water to hold back the saltwater.

Rising seas also will bring seawater towards the aquifer. Lower brackish water above the caprock will allow the flooding of the clear water in the aquifer. We ask that the study of the water needed to hold back the seawater and the ways the water above the caprock can be replenished if the housing is build be included in the EIS.

Finally, this island has already reached its carrying capacity in regard to water. Thus the fear about the loss of brackish water from seepage in the Ho'opili area. Charges for desalinated water will be higher than water from the aquifer. We request a study of water on O'ahu in general to establish that this project will not in any way move the island toward need for desalinated or otherwise reclaimed water..

Culture:

Appendix F of Volume 2 "Cultural Impact Assessment" spends roughly one hundred pages discussing ancient Hawaiian culture and concludes that "no contemporary or continuing cultural practices currently occur within the proposed Project Area.

Appendix F does not mention local culture, local lifestyle, or pidgin. The west side of the island over the last near-century has been the local people's side of the island. There has been a local culture practiced here for decades. Newcomers and new ways are a great threat to that culture.

On page 18 of Appendix K, under "In-Migrant Population," it is stated that 660 FTE part-time/second home buyers or off-island retirees will reside in Ho'opili. That is roughly 5% of the 12,000 anticipated homes in Ho'opili. This does not begin to match the reality in other new developments on the island.

We request that this study come up with realistic numbers for newcomers. And we request that an assessment the impact of these in-migrants on local culture be conducted.

Tourism:

The EIS does not have a study of the effect of Ho'opili on tourism. Surely, toursists come to Hawaii to see a lush tropical paradise. They do not expect to see urban sprawl covering the island. The green space between Waipahu and Kapolei (the area that will be covered by Ho'opili) is a necessary break from urbanization and needs to be preserved. Without the break, tourists will find solid city from Hawaii Kai to Makaha.

The 'Ihilani, the Vacationclub timeshares, and the new Disney hotel at Ko 'Olina are basing publicity on "the other Hawaii." Tourists need the experience of seeing some country, some of the tropical green of paradise, as they drive to Ko 'Olina. Otherwise, it is no different from Waikiki, only further away.

We request that the final EIS have a study of the affect of the urbanization of this area on tourism, and that this study include interviews with prominent figures in tourism on Oahu.

Sincerely,

Dr. Kioni Dudley

Dr. Kioni Dudley, Chairman

AR00027497

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Dr. Kioni Dudley, Chairman
Leeward – Central Community Roundtable aka Leeward – Central Community Forum
92-1365 Hauone Street
Kapolei, Hawai'i 96707

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Dr. Dudley:

Thank you for your letter dated April 7, 2008. We have reviewed your letter and offer the following responses to your comments:

Traffic

Leeward – Central Community Roundtable Comment: Your report states on page 7 states that "traffic impact" will be indicated when an LOS deteriorates to B or worse. As the table shows, four of the five Honolulu-bound Morning segments and seven of the ten segments both ways in the Afternoon show such loss when comparing the existing conditions to 2030 conditions with Ho'opili. However, table 5.3 shows "traffic impact" for only two of the morning segments and five of the afternoon segments. You arrive at this favorable "no-impact" designation by comparing "2030 with Ho'opili" only with "2030 without Ho'opili." Ho'opili is likely to begin construction before a number of other projects in the area, yet your action treats all other projects as if they come first. We request that the final EIS compare "existing conditions" with "2030 with Ho'opili" in determining traffic impact. Traffic impact status for four morning segments and seven afternoon segments seems warranted.

Response: As requested, a new Table 4.13 (Comparison of Existing Traffic and Year 2030 Traffic With and Without the Project) will be added to the Final EIS.

Table 4.13. Comparison of Existing Traffic and Year 2030 Traffic With and Without the Project

MORNING PEAK				INCLUDES RAIL:	INCLUDES RAIL:
#	Freeway	Segment	Existing LOS	2030 without Ho'opili	2030 with Ho'opili
1	H-1 EB	S/O Makakilo Dr.	A	E	E
2	H-1 EB	W/O Kunia Rd.	C	E	E
3	H-1 EB	W/O Pa'iwa St.	E	E	E
4	H-1 EB	E/O Kamehameha	D	E	E
5	H-2 SB	At Ka 'Uka Blvd.	D	D	D
6	H-1 WB	S/O Makakilo Dr.	A	C	C
7	H-1 WB	W/O Kunia Rd.	C	C	C
8	H-1 WB	W/O Pa'iwa St.	C	B	C
9	H-1 WB	E/O Kamehameha	C	C	C
10	H-2 NB	At Ka 'Uka Blvd.	B	C	C

AFTERNOON PEAK				INCLUDES RAIL:	INCLUDES RAIL:
#	Freeway	Segment	Existing LOS	2030 without Ho'opili	2030 with Ho'opili
1	H-1 EB	S/O Makakilo Dr.	B	D	E
2	H-1 EB	W/O Kunia Rd.	D	D	D
3	H-1 EB	W/O Pa'iwa St.	C	D	B
4	H-1 EB	E/O Kamehameha Hwy.	B	D	B
5	H-2 SB	At Ka 'Uka Blvd.	B	C	C
6	H-1 WB	S/O Makakilo Dr.	B	F	F
7	H-1 WB	W/O Kunia Rd.	C	E	E
8	H-1 WB	W/O Pa'iwa St.	E	C	D
9	H-1 WB	E/O Kamehameha Hwy.	E	E	F
10	H-2 NB	At Ka' Uka Blvd.	C	F	F

Source: Wilbur Smith Associates, Traffic Impact Analysis Report for Ho'opili (2007)

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Leeward – Central Community Roundtable Comment: The "Chapter 7 Conclusion" on page.7-1 of your "Traffic Analysis Report" mentions intersections, concluding that with mitigation, only one intersection will have "traffic impact." The Conclusion however, is seriously flawed in that it does not mention freeway segments at all, and ignores the "traffic impact" in the four morning segments and seven afternoon segments.

Response: A paragraph that describes the effects on freeway segments will be added to the Executive Summary as well as Chapter 7 (Conclusion) of a revised TIAR, which will be updated as part of the permitting process.

Leeward – Central Community Roundtable Comment: The Conclusion is further flawed in that it also does not mention unacceptable conditions for Ramp-Freeway Junction Operation, even though page 3-22 states that three in the morning and three in the afternoon are unacceptable, and Table 3.4 shows six of twenty Ramp Junctions for 2030 at LOS E or F. Mitigation for only one ramp is discussed at Impact 6.1.2F. The Conclusion for the final EIS should show "traffic impact" for six of the twenty Ramp Junctions.

Response: As suggested, a paragraph will be added to include a discussion on ramp-freeway junction operations to the Executive Summary as well as Chapter 7 (Conclusion) of a revised TIAR, which will be updated as part of the permitting process.

Leeward – Central Community Roundtable Comment: The Conclusion seems further flawed in its assessment of impact on traffic intersections, both in that it presumes its lane-change mitigation measures will work, and in that it includes in mitigation efforts changes in habit by the population which have never been achieved before: such as car sharing, rent subsidies, and transit subsidies by employers. Given the concerted efforts of the DOT to ease traffic congestion through creative re-striping and other changes over the last several years, it is questionable why the solutions proposed have not been adopted by the DOT if they so assuredly will work. We request that all mitigation proposals be discussed with the DOT and DTS and that their answers be recorded in the conclusion. Please comment on the feasibility of the state or city acting on each, and the cost. We request that the Conclusion restate the number of intersections which will have traffic impact in light of those conversations.

Response: As we understand your comments, it consists of two parts – 1) addressing the traffic impacts through additional or revised lanes at problem intersections, and 2) the feasibility of contra-flow lanes and other Transportation Demand Management (TDM) measures.

The traffic consultant believes that the proposed changes to the lane configurations at these intersections would mitigate the traffic impacts from the Ho'opili development at these anticipated "bottleneck" locations in the area roadway network. The additional lanes would increase capacity for critical traffic movements at each intersection and thereby increase overall intersection capacity and reduce much or all of the forecast additional delays that could otherwise result from the Ho'opili traffic.

The consultant identified the cited potential additional TDM measures and use of contra-flow lanes as additional actions for consideration beyond those that have been proposed for implementation and included in the analyses. The additional TDM actions do include some that have not previously been tried on Oahu and thus were suggested "for consideration" without including any substantial change in the Ho'opili traffic forecasts. The Petitioner will continue to work with the State DOT and City and County of Honolulu Department of Transportation Services (DTS) regarding the feasibility of implementing the various lane changes and TDM actions. The mitigations proposed in the TIAR will be discussed with the DOT and DTS and their answers will be recorded as requested.

Leeward – Central Community Roundtable Comment: The Tables showing existing conditions, and Scenario A, year 2030 conditions without and with the project list volume, density and LOS, but the do not show time spent in traffic. What are the times spent in traffic for the various sites? Please show current and 2030 Scenario A figures without and with the project.

Response: The existing and future traffic conditions were analyzed using traffic models that assess conditions at individual key at-grade intersections and at freeway ramps in the Project vicinity. These particular models were used since the focus was to identify those locations that would be most affected by the increased traffic and to test potential roadway modifications to mitigate the significant adverse impacts of the Project. These models do provide an indication of the change in travel speeds/times through the individual analyzed intersections and freeway ramps, but do not provide an overall change in travel time through the corridor. The travel time information provided includes:

- Key Intersections – The Synchro model used in the study provides the estimated total vehicle delay on each roadway approach and for each traffic movement at the studied intersections. This vehicle delay represents the increased travel time in approaching and slowing for the intersection traffic control as well as the time spent in traffic queue waiting to pass through the intersection. The estimated delay by roadway approach can be found on the intersection worksheets for the existing, 2030 Baseline (without Project), and 2030 with Project scenarios in the Appendices of the Ho'opili TIAR prepared by Wilbur Smith Associates. Comparison of the delays at the intersection approaches along a roadway between the Without Project and With Project scenarios would provide a general approximation of the change in travel time along a route.

- Freeway Ramps – The Highway Capacity Software (HCS) used to analyze the ramp junctions with the Freeway mainline lanes provides the estimated change in traffic speeds for the through freeway traffic and for the ramp traffic along the merging or diverging areas for the key on- and off-ramps providing the Project traffic access to/from the H-Freeway. However, the analysis output does not provide information to directly estimate changes in travel time along a route between scenarios since these speeds apply only to freeway section in the vicinity of the ramp junction.

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As the Ho'opili Project progresses through additional studies for the City and County of Honolulu zoning review process, consideration will be given to the use of additional or revised models that could provide travel time estimates.

Leeward – Central Community Roundtable Comment: The draft EIS only studies freeway segments as far east as the H-1/H-2 merge. Heavy traffic continues on into the city of Honolulu. This project will surely affect traffic all the way into town. We request that the final EIS contain studies of segments for the rest of the freeway.

Response: The Oahu Metropolitan Planning Organization (OMPO) regional model used to develop the traffic forecasts takes into account the H-1/H-2 merge. The TIAR is compatible with the regional land use assumptions as part of the master land use plan. These assumptions are reflected in the traffic forecasts developed for this study. We believe the methodology used to prepare the TIAR is consistent with sound traffic engineering practice.

Leeward – Central Community Roundtable Comment: The draft EIS discusses intersections and on/off ramps. In doing so, it combines all of the lanes of an intersection or ramp. While one lane may be an LOS F, it can be balanced off with a lane that is an A to make the intersection or ramp a C. Please make an additional, separate listing of all LOS B and F lanes so that they can easily be identified, and note the time backed up in each.

Response: This information is presented in worksheets in Appendix A. Signal timings for the intersections analyzed under Year 2030 conditions have been optimized based on the traffic volumes in the forecast. The Synchro output worksheets show the level of service (LOS) outputs for the entire intersection as well as for each lane group as requested.

Leeward – Central Community Roundtable Comment: Moving to points not mentioned in the draft EIS: Ho'opili will occupy what can be pictured as a triangle, bordered on two sides by the two busiest roadways in West O'ahu. The tip of the triangle, where the two roadways converge, will continue to be the choke point for two roads. Both sides of one roadway, H-1, are open space for miles before the merge. There is a small number of homes (a few hundred) in West Loch, on one side of the other road, Ft. Weaver Rd. The many thousands of cars that feed into the H-1/Ft. Weaver merge at the tip of the triangle now pass this open space. When the 12,000 homes of Ho'opili fill the triangle, all of the homes of Ho'opili will be closer to the merge than any of the homes from which the thousands of cars now traveling the roads come. The 7069 cars from Ho'opili will empty onto Ft. Weaver and H-1 in front of the thousands of current travelers during peak hours each morning. The 12,077 cars returning to Ho'opili in the afternoon will slow the cars returning to farther distances. What effort is being made or will be made to inform those thousands of drivers, already enduring great traffic problems, that traffic from 12,000 homes will feed into the merge ahead of them? What efforts are being made or will be made to collect their input?

Response: For the morning peak hour, this comment can be addressed by modifying the apportionment of green time at these critical intersections such that the flow of traffic from Ho'opili onto the H-1 freeway is metered. Modification of signal timings or lanes will depend

on the policies and operations that the City and County of Honolulu and the State DOT adopt for signals along Fort Weaver Road.

For the afternoon peak hour, it will be harder to ascertain whether the traffic composition is mostly people commuting to Ho'opili or not. Hence, any penalties directed towards people commuting to Ho'opili might adversely affect other commuters as well.

Leeward – Central Community Roundtable Comment: The draft EIS does not address the secondary and cumulative costs to drivers in physical health, mental health, loss of family time, and early death. What are these? What are the affects for latch-door kids? How much will the delay in traffic cause the people affected in child care? How much in gasoline? Please calculate these things for the entire trip to and from the city of Honolulu.

Response: As noted in the Draft EIS Volume 2, a discussion of the secondary and cumulative impacts of the project on residents can be found in *Chapter Four: Impacts and Mitigations* of the Social Impact Assessment prepared by Belt Collins Hawaii Ltd. (November 2007). This report was appended to the Draft EIS as Appendix I. A letter clarifying the existing text is included in Appendix I and is underlined below. Among the conclusions reached in this report are:

> *Ho'opili has been planned with the reduction of traffic impacts in mind. First, it includes transit-oriented development. Bus lines have been identified to encourage residents throughout the project to use rapid transit or to use buses or bicycles within the project area. Street sizes and connectivity will encourage pedestrian and bicycle movement. To the extent that automobile use declines (or Ho'opili attracts new residents who are less committed to automobile use than others), residents can expect to have more exercise, and be healthier than people in other subdivisions of Leeward Oahu...*
>
> *Ho'opili will contribute to the growth of the urban community life in Ewa by providing new job locations, recreational areas, and schools as well as housing. <u>It is designed as a community in which many residents will not need to drive to Honolulu often.</u> Its transportation planning will work to address the region's serious traffic congestion problems. It will help to link existing and new communities, serving its neighbors as well as its residents.*

The above paragraphs will be added to page xi in the Executive Summary of the Final EIS. In sum, your concern with the impacts of traffic congestion is understandable. We share it. Ho'opili has been planned to minimize or avoid adverse traffic impacts and consequent social impacts.

<u>Agriculture</u>

Leeward – Central Community Roundtable Comment: "Appendix A, Agricultural Impact Analysis" discusses loss of agricultural lands, but does not discuss the nature of those lands. It also does not discuss the climate of the area which is an important factor in what plants can be grown.

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Response: The "nature of those lands" were described in *Hoopili: Impact on Agriculture* (Appendix A of the Draft EIS Volume 2) on pages 2 through 16, including: soil types; various Federal and State soil ratings; soil characteristics; summary of arable land; elevations; terrain; climatic conditions (solar radiation, rainfall, temperature, winds and storms); irrigation water; road access; potential crops; locational advantages and disadvantages for crop production; surrounding land uses; historic agricultural uses; and existing agricultural operations.

Leeward – Central Community Roundtable Comment: The book, Detailed Land Classification — island of Oahu Bulletin No. 11, December 1972 by the Land Study Bureau — University of Hawaii, classifies all lands on Oahu on a scale of A to E. Those classified as A and B are "prime agricultural lands." All of the flat land in the Ho'opili project is classified as "prime agricultural lands." Much of it is classified as A. These lands are extremely rich. Climate is another factor. There are other "prime agricultural lands" which have not been covered with housing, but few exist in such a sunny area, with mild winds. These lands were called the golden triangle in sugar plantation days. We request that the final EIS study what other places on the island could be found which mimic the desirable conditions of the Ho'opili lands. This would include a study of the best land and climate characteristics for growing the varions crops that are being grown and have been grown on the property since sugar times.

Response: If the question being posed is: "are there any lands which are exactly like the Petition Area?" then the answer would be that there are no other lands on Oahu with similar soils and climatic conditions other than the soils underlying the proposed UHWO and DHHL East Kapolei projects. As described in *Hoopili: Impact on Agriculture* (Appendix A of the Draft EIS Volume 2), the soils underlying the Petition Area are suited for low-elevation crops. While portions of the Petition Area may have been referred to as the "Golden Triangle" because of higher sugar yields than other lands cultivated for sugar cane, one cannot construe that all crops grown in the Golden Triangle would necessarily gross the highest yields.

Hoopili: Impact on Agriculture (Appendix A of the Draft EIS Volume 2) identifies a total of 10,900 acres of former plantation land remaining on Oahu which are available for other crops, including 3,150 acres of former pineapple land in Kunia and 7,750 acres on the North Shore. It is acknowledged that some of the higher elevation fields in Kunia and on the North Shore have less solar radiation than Ewa and lands in higher elevations incur higher pumping costs. Nevertheless, some limitations can be overcome with investment in improvements such as to existing water delivery systems.

Leeward – Central Community Roundtable Comment: Because of the high price of gasoline, two airlines that service Hawaii and one mainland airline declared bankruptcy and stopped flying this week. Experts tell us that the price of gasoline will never return to prices we have known in the past. Rather, with the emergence of automobiles in China and India, we can only expect higher and higher gasoline prices. Other airlines will eventually be forced into bankruptcy. And it may be necessary for Oahu to produce all the crops that feed our people. We request that the final EIS study this situation — specifically how much land at what land classifications (A to B) and under what climatic conditions (sun and wind) does Oahu need to sustain the anticipated 2030 number of people on the island. Further, please report in the EIS on the connection of

gasoline price to and cost of shipping, and at what price the cost of gasoline will make it unfeasible to bring in food by air.

Response: While we would concur that rising fuel and transportation costs are of concern, it is interesting to note that Mauna Kea Banana Company recently announced it was ending its banana production citing rising fertilizer and energy costs. So the opposite result from what you are anticipating may actually be occurring.

Water

Leeward - Central Community Roundtable Comment: The several appendices on Water discuss a number of aspects—available potable and non-potable water, and drainage. There is no discussion on the aquifer itself and the effect housing, as opposed to current farmland, will have on water draining down to replenish the waters below. Although water seeps down only to the caprock in this area, rather than seeping down to refill the aquifer, the fresh water above the caprock is necessary to keep the salt water from flowing into the aquifer. We request that the final EIS present a study of this replenishment of fresh water to hold back the saltwater.

Rising seas also will bring seawater towards the aquifer. Lower brackish water above the caprock will allow the flooding of the clear water in the aquifer. We ask that the study of the water needed to hold back the seawater and the ways the water above the caprock can be replenished if the housing is build be included in the EIS.

Finally, this island has already reached its carrying capacity in regard to water. Thus the fear about the loss of brackish water from seepage in the Ho'opili area. Charges for desalinated water will be higher than water from the aquifer. We request a study of water on O'ahu in general to establish that this project will not in any way move the island toward need for desalinated or otherwise reclaimed water.

Response: Per your comments, we have consulted with Tom Nance Water Resource Engineering and we will revise the first paragraph of Section 3.5 *Groundwater Resources/Hydrology, Existing Conditions* of the Final EIS as follows:

> *The 'Ewa region of O'ahu overlies the Southern O'ahu Basin Aquifer (SOBA), a designated Sole Source Aquifer. Drinking water supply is drawn from this aquifer in the volcanic formation at depth. According to Tom Nance Water Resource Engineering, the piezometric head of this aquifer, which is inland and directly beneath the Ho'opili site, is about 18 feet above sea level.*
>
> *The gently sloping topography of the 'Ewa Plain is comprised of terrestrial alluvium, which is made up of clay and mud eroded from volcanic rock. The terrestrial alluvium is inter-layered with coral limestone deposited during periods when the area was covered by the ocean. This geologic feature is commonly referred to as "caprock." The caprock overlies these volcanics to the near vicinity of Farrington Highway. In cross section, the caprock is wedge-shaped. It is about 1,000 feet thick at the shoreline and tapers to just a few tens of feet thick in the vicinity of Farrington Highway. It is comprised primarily of*

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limestone and marl on its seaward half (makai of OR&L Railroad right-of-way) and primarily terrestrial alluvium inland of the OR&L Railroad right-of-way. ~~The caprock is located makai of the H-1 Freeway and is approximately 1,000 feet thick near the shoreline.~~

Brackish to saline basal groundwater exists in the upper limestone layer of the caprock. According to Tom Nance Water Resource Engineering, its water level is 1.0 to 1.5 feet above sea level. It is referred to as the caprock aquifer, but it is not present through the entire caprock formation. It is limited to the upper limestone layer. All water in the caprock formation below the thin lens in the upper limestone layer is saltwater. Water in the caprock is too saline to be used for safe drinking water.

Leakage upward from the higher head, volcanic aquifer into the caprock formation does occur, but according to Tom Nance Water Resource Engineering, it is limited to the inland margin of the caprock. This rate of upward leakage is a function of geology and the piezometric head in the volcanics. It is not influenced by the much lower water level in the upper limestone layer of the caprock.

The current irrigation allocation for the Petition Area is 8.0 million gallons per day (MGD). The average irrigation use is approximately 2.0 to 3.0 million gallons per day (MGD), depending on the time of the year.

We will also revise the first paragraph of Section 3.5 *Groundwater Resources/Hydrology, Anticipated Impacts and Mitigation Measures* of the Final EIS as follows:

The total average daily source requirement for ultimate build-out is estimated at 3.9 MGD. The present agricultural use of the Petition Area provides recharge to the alluvial portion of the caprock from excess applied irrigation water. This irrigation return eventually moves into the aquifer in the upper limestone layer of the caprock, becoming a portion of its recharge, albeit a relatively small portion. According to Tom Nance Water Resource Engineering, development of the Ho'opili project will diminish this small component of the recharge to some extent, but will have an immeasurable impact on water level in the upper limestone layer.

The project is not expected to impact groundwater resources, as the caprock acts as a barrier to the drinking water in the Petition Area. The caprock in 'Ewa, around Pearl Harbor, and in Honolulu, does function to retard seawater intrusion into the drinking water aquifer in the volcanics. According to Tom Nance Water Resource Engineering, it is an incredibly important contribution to the availability of drinking water which comes about due to the mostly impermeable contact surface between the volcanics and the overlying caprock. It is not due to the water level in the caprock.

Both the drinking water aquifer in the volcanics and the brackish to saline aquifer in the caprock's upper limestone layer are in hydraulic contact with seawater nearshore and offshore. Sea level changes, whether weeks or months long due to large scale whether phenomena in the Pacific or a longer term sea level rise, does cause both aquifers to rise

or fall accordingly. According to Tom Nance Water Resource Engineering, the Ho'opili project will have no impact on sea level changes.

Although the Petition Area is situated mauka of the UIC line, no injection wells or cesspools will be installed (since the project's wastewater collection system will eventually connect to the Honouliuli Wastewater Treatment Facility), and any runoff or wastewater disposal required for the project will be managed in full compliance with State Department of Health (DOH) regulations. Irrigation for landscaping will utilize brackish water from the 'Ewa caprock and/or treated effluent (R-1 quality) from the City and County of Honolulu's Honouliuli Wastewater Treatment Facility (if available) to facilitate the recharge of caprock water and to reduce the demand for safe drinking water from the BWS system.

Probably like any other region where a directed growth policy is in place. O'ahu has a finite supply of potable quality groundwater, meaning development using additional groundwater will eventually result in the need for desalination. The proposed project is not unique in this regard. BWS has long range plans to develop a desalination plant at the makai end of Campbell Industrial Park to ultimately meet the island's needs.

Culture

Leeward - Central Community Roundtable Comment: Appendix F of Volume 2 "Cultural Impact Assessment" spends roughly one hundred pages discussing ancient Hawaiian culture and concludes that "no contemporary or continuing cultural practices currently occur within the proposed Project Area.

Appendix F does not mention local culture, local lifestyle, or pidgin. The west side of the island over the last near-century has been the local people's side of the island. There has been a local culture practiced here for decades. Newcomers and new ways are a great threat to that culture.

Response: We acknowledge your concern that the Cultural Impact Assessment does not mention local culture, local lifestyle, or pidgin. However, the guidelines set forth in the Cultural Impact Assessment were designed to fulfill the mandate to the Land Use Commission from the Hawai'i State Supreme Court in its ruling, *Ka Pa'akai O Ka 'Aina v. Land Use Commission, State of Hawai'i*. 94 Haw. 31 (2000). The specific section of the ruling that served to guide the development of the report is as follows:

In order for the rights of native Hawaiians to be enforceable, an appropriate analytical framework for enforcement is needed. Such an analytical framework must endeavor to accommodate the competing interests of protecting native Hawaiian culture and rights on the one hand, and economic development and security, on the other.

As such, the Cultural Impact Assessment is founded on the native Hawaiian traditions, customs and practices, rather than the local culture, lifestyle and language in general.

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Leeward - Central Community Roundtable Comment: On page 18 of Appendix K, under "In-Migrant Population," it is stated that 660 FTE part-time/second home buyers or off-island retirees will reside in Ho'opili. That is roughly 5% of the 12,000 anticipated homes in Ho'opili. This does not begin to match the reality in other new developments on the island.

We request that this study come up with realistic numbers for newcomers. And we request that an assessment the impact of these in-migrants on local culture be conducted.

Response: The 660 in-migrants reflect Mikiko Corporation's projection of part-time resident or retiree households that might settle in Ho'opili, who have previously lived off-Island. In addition, the Mikiko Corporation study estimates that approximately 2,170 persons could settle on O'ahu, at Ho'opili or elsewhere, due to employment opportunities generated by the development and operations of Ho'opili. Thus, the project's total population impact for O'ahu is estimated at 2,830 persons. This was addressed on pages 19 – 20 and 39 of the *Economic and Fiscal Impact Assessment for Ho'opili* (Appendix K of DEIS Volume II).

The City and County of Honolulu's affordable housing guidelines require that some 30% of the units at Ho'opili be occupied by primary residents. The projected 660 in-migrants to O'ahu is a full-time equivalent (FTE) population estimate based on 7% of the other 70% of units at the Project that would be sold as market-priced units. Thus, some 7% of sold market units at the Project are estimated to be used as part-time or retirement residences for persons who previously lived off-Island. The population projection also assumes an average 50% occupancy on such units (6 months of any given year), and an estimated 2.3 persons per occupied unit. These usage factors are considered potentially generous, given established patterns of part-time occupancy elsewhere in the State, and the location and nature of Ho'opili.

Ho'opili is not planned to offer the infrastructure that tends to attract part-time residents or retirees from off-Island. It will have no golf course and no resort amenities; neither does the site does offer ocean access or views. Rather, Ho'opili is planned as a primary residential mixed-use community that will offer significant jobs within and near to the Project itself.

<u>Tourism</u>

Leeward - Central Community Roundtable Comment: The EIS does not have a study of the effect of Ho'opili on tourism. Surely, tourists come to Hawaii to see a lush tropical paradise. They do not expect to see urban sprawl covering the island. The green space between Waipahu and Kapolei (the area that will be covered by Ho'opili) is a necessary break from urbanization and needs to be preserved. Without the break, tourists will find solid city from Hawaii Kai to Makaha.

The 'Ihilani, the Vacationclub timeshares, and the new Disney hotel at Ko 'Olina are basing publicity on "the other Hawaii." Tourists need the experience of seeing some country, some of the tropical green of paradise, as they drive to Ko 'Olina. Otherwise, it is no different from Waikiki, only further away.

We request that the final BIS [EIS] have a study of the affect of the urbanization of this area on tourism, and that this study include interviews with prominent figures in tourism on Oahu.

Response: You raise an interesting issue. Currently, views from Ko 'Olina towards Diamond Head yield views of Campbell Industrial Park; views towards Wai'anae, yield views of Kahe Power Plant; and views towards mauka, yield views of Honokai Hale. All of the surrounding urban developments were in place before Ko 'Olina was proposed. Development in East Kapolei (encompassing Ho'opili) and Ko 'Olina has long been a part of the "Campbell Estate Ewa Master Plan." We acknowledge your concern regarding the effect urbanization may have on tourism, however this area has been slated for future development and is within the Urban Growth Boundary in the Ewa Development Plan. As such, we believe that a study regarding the effect of Ho'opili on tourism is not warranted.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

AR00027503

March 27, 2008

DR Horton- Schuler Division
828 Fort Street Mall, 4th Floor
Honolulu, Hawaii 96813

Contact: Dean Uchida

Dear Applicant,

RE: HOOPILI MASTER PLANNED MIXED USE COMMUNITY

COMMENT ON DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

THE EAST WEST CONNECTOR ROAD SHOULD BE MANDATED AS A REQUISITE TO BE COMPLETED AND OPEN FOR PUBLIC USE PRIOR TO PERMITTING THE ADDITION OF HOUSING DEVELOPMENT TO OCCUR ON THE PROJECT.

I AM FOR THE DEVELOPMENT OF THE PROPERTY AND SUPPORT THE RENDERINGS SO FAR PROVIDED BY THE APPLICANT TO ADORN THE LANDSCAPE.

HOWEVER, TO APPROVE OF THE DEVELOPMENT SCHEME WITHOUT A TIMELINE, WITHOUT A DEADLINE, WITHOUT A PLAN TO CONSTRUCT THE EAST WEST ROAD SOONER THAN LATER, WOULD BE AN ERRANT ACT.

FURTHERMORE, SINCE THE EAST WEST ROAD WILL BE COMPLETED BY THE YEAR 2015 IN ALL OTHER JURISDICTIONS WHERE THE ROAD PASSES THROUGH, SUCH THOROUGHFARE WILL NOT BE AVAILABLE TO SERVE THE EWA BEACH RESIDENTS UNLESS THE APPLICANT COMPLETES THEIR PORTION ASSIGNED TO THEM.

PLEASE PLACE CONDITIONS UPON THE APPLICANT TO BUILD THE EAST WEST CONNECTOR ROAD PRIOR TO AUTHORIZING OR ADVANCING ANY OTHER TYPE OF DEVELOPMENT THAT IS NOT RELATED TO THE ROAD'S CONSTRUCTION.

Respectfully,

Tom Berg

Tom Berg
91-203 Hanapouli Circle
Ewa Beach, Hawaii 96706

Cc: State Land Use Commission/Anthony Ching
PBR Hawaii/Vincent Shigekuni
Office of Environmental Quality Control

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Mr. Tom Berg
91-203 Hanapouli Circle
'Ewa Beach, Hawai'i 96706

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Berg:

Thank you for your letter dated March 27, 2008. We have reviewed your letter and offer the following response to your comments.

There are several major transportation projects that have been long-planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road (EWCR) through the Petition Area; and the first segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area.

We are appreciative of your support for the development of the subject property and acknowledge your concern regarding the timing of the construction of the proposed East-West Connector Road. Please note that: 1) Ho'opili has been designed to accommodate an alignment for the EWCR; and 2) DHHL and UHWO will be starting development well before Ho'opili. Please note that the Petitioner, along with DHHL and UHWO, has submitted a letter to the City and County of Honolulu, Department of Planning and Permitting requesting that the EWCR be included in an updated list of projects to be funded under the Ewa Highway Master Plan (Section 33A-1.6(h) of the Revised Ordinances of Honolulu)..

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

AR00027504

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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PBR Hawaii & Associates Inc.
1001 Bishop Street
ASB Tower 650
Honolulu, Hawaii 96813
Fax: 523-1402
Attention: Vincent Shigekuni

Dear Mr. Shigekuni:

SUBJECT: Draft Environmental Impact Statement for the Ho'opili Project
Ewa, O'ahu, Hawaii

Thank you for the opportunity to review and provide comment. I wanted to compliment D.R. Horton's team for a comprehensive draft environmental impact statement. Their commitment of engaging the community in the planning process is highly regarded. Connectivity, infrastructure, transit-oriented-development, and job creation are all important issues to the Ewa region. The draft identifies and covers all these issues sufficiently. I believe the Ho'opili project encompasses all the elements necessary for a vibrant work, live, learn, and play community.

My concerns are not about the plan, but the execution of the plan. As the past developments have demonstrated along the Ewa plain, the developers have very little influence over the government agencies responsible for building the roads, schools, parks, infrastructure, etc. Gentry and Haseko have built beautiful communities and where they were responsible for the infrastructure and roads the projects are sufficient. But, the city and state road projects sat idle all the while the populations exploded and now the community faces 2 hour commute times to get into town and back. I believe our community has learned from the past and we are calling for the Ho'opili project to be a leader in development.

Ho'opili has an opportunity to incorporate all the learning and wisdom of past developments. Unconventionally, they can ensure that infrastructure, roads, and job creation centers be built before residential units. Focus on constructing connectivity projects, infrastructure, parks, and schools prior to homes. This type of construction execution will provide relief for existing communities. As a sample, Haseko and Gentry completed their portions of Kapolei Parkway which improved circulation within the communities. Though we are still waiting for city's portion of Kapolei Parkway and the state's North-South Road the completion of the developer's portions of Kapolei Parkway has relieved congestion on Ft. Weaver Road.

I realize the financial investment is costly, but our community has suffered long enough. We are counting on the State Land Use Commission to uphold this community expectation.

Sincerely,

Tesha H. Malama
91-816 Lawalu Pl.
Ewa Beach, HI 96706
Tesha96706@yahoo.com or 689-0908.

cc: State of Hawaii Land Use Commission

AR00027505

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August 11, 2008

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SCOTT MURAKAMI, ASLA
Associate

Ms. Tesha H. Malama
91-818 Lawalu Pl.
'Ewa Beach, Hawai'i 96706

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Ms. Malama:

Thank you for your letter regarding the Ho'opili Draft EIS. We greatly appreciate the comments on the comprehensiveness of the DEIS, the public engagement process and the project master plan. We have reviewed your letter and offer the following response to your comments.

We acknowledge your concerns regarding the execution of the plan regarding the construction of roads, schools, parks, infrastructure, etc. The Petitioner will continue to coordinate with State and City agencies to ensure that the necessary infrastructure is constructed in a timely manner.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement.

If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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Vincent Shigekuni

Dear Mr. Shigekuni,

The purpose of this letter is to express my comments on the Ho'opili Draft Environmental Impact Statement that was published in February 2008. As an introduction, I am generally dismayed by the lack of thorough environmental review in this document and I feel that it is not consistent with the intent or spirit of Hawaii's environmental laws. The size of this project requires a full analysis that looks at real alternatives and a wide range of impacts. This document does neither.

My first issue relates to the expected period of development for the project. The estimated completion of 2030 would seem to be at odds with the Land Use Commission's rules related to incremental districting that require substantial completion of the full development of the project within ten years. I did not come across an incremental development plan for the project in the EIS as the rules seem to require. Given this inadequacy and the likely inability to build all of those homes within ten years, it seems at most only a portion of the project should be redistricted out of agriculture to urban at this time and that the most productive agricultural land should not become urban.

My second issue relates to the project's consistency with the rest of Oahu's regional planning. Section 5 of the EIS makes no mention of why such intense urban development is planned in the "urban fringe" areas of Ewa as described in the Oahu General Plan. In fact, this project is outside of the "Secondary Urban Center" as shown in the General Plan where intense urban growth should be directed to minimize sprawl. The Ewa Development Plan describes the project area as residential and within an urban growth boundary, however it makes no mention of the amount of commercial and industrial development described in the project's EIS. As such, General Plan and Ewa Development amendments should be sought for this project so that the island has the chance to debate the level of growth appropriate for these types of undeveloped lands. This is especially necessary since the City is pushing to designate transit stops within the project area which seems like an effort to undermine the authority of the Land Use Commission and permit the project prior to it going through the necessary reviews.

The EIS also uses a desired jobs to housing balance presumably to downplay the substantial traffic impacts of over 160,000 new vehicles on the road per day. Looking at traffic impacts with a "with transit" condition is misleading as it doesn't speak to the likely potential that the train from Waipahu to the project will be expanded during the time it takes to build the project's homes. Also, I just can't see how the creation of only 680 net new jobs in any way justifies the 11, 750 homes planned for the project.

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In conclusion, I feel there is much more study needed for this EIS document to be deemed complete. Detailed soils and past agricultural production studies are needed to determine what land should be ruled out of this redistricting as I hope the project area will downsize. In addition, more detailed studies on traffic impacts along the H-1 Freeway are needed to understand whether the island has the capacity to absorb those 160,000 cars. Additional study is also needed to assess the regional capacities that will likely be strained by this project. I am particularly concerned about current water sources which will have long dried up by 2030.

The alternatives to the project discussed in Section 6 are woefully inadequate. How can alternatives honestly be evaluated with less than one page of available material each and without any comparable studies to back up the assertions made?

I hope there are many more government reviews to evaluate this project if it remains in its current form. In addition to the added City processed I mention in this letter, I feel an intervention with the Land Use Commission is necessary to downsize this project and to make sure that someone identifies that the County is currently setting the stage for development by identifying transit stops before the Commission has had a chance to deliberate.

Sincerely,

Agnes Patopan, Esq.
98 Koauka Loop
Aiea, HI 96701

Copies to Rodney Maile, Acting Director
State of Hawaii Land Use Commission

Henry Eng, Director
City and County of Honolulu Department of Planning and Permitting

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Ms. Agnes Patopan
98 Koauka Loop
Aiea, Hawai'i 96701

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Ms. Patopan:

Thank you for your letter. We have reviewed your letter and offer the following responses:

Ms. Patopan's Comment: The purpose of this letter is to express my comments on the Ho'opili Draft Environmental Impact Statement that was published in February 2008. As an introduction, I am generally dismayed by the lack of thorough environmental review in this document and I feel that it is *not* consistent with the intent or spirit of Hawaii's environmental laws. The size of this project requires a full analysis that looks at real alternatives and a wide range of impacts. This document does neither.

Response: We acknowledge your concerns about the document and will be revising the EIS, where necessary. We hope our responses and revisions will address the concerns you specify in the rest of your letter.

Ms. Patopan's Comment: My first issue relates to the expected period of development for the project. The estimated completion of 2030 would seem to be at odds with the Land Use Commission's rules related to incremental districting that require substantial completion of the fill development of the project within ten years. I did not come across an incremental development plan for the project in the EIS as the rules seem to require. Given this inadequacy and the likely inability to build all of those homes within ten years, it seems at most only a portion of the project should be redistricted out of agriculture to urban at this time and that the most productive agricultural land should not become urban.

Response: As requested, the preliminary phasing and timing of the proposed project will be provided in the Final EIS. Section 2.7 *Development Timetable and Preliminary Costs* of the Final EIS will be revised as follows:

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The Petitioner estimates that the development of the Ho'opili project (major off-site and on-site infrastructure improvements including grading, drainage, sewer, safe-drinking water, non-potable water, roadways, landscaping and improvements to Farrington Highway and North-South Road for access) will cost approximately $4.6 billion (in Year 2007 dollars), spent over the project timeline of 2009 – 2030. During the public review period, both the Land Use Commission and the State Office of Planning made reference to subsection 15-15-50, Hawaii Administrative Rules (HAR). Subsection 15-15-50, HAR identifies the form and contents of a petition to the State Land Use Commission to amend the State Land Use District Boundaries, including representing "...that development of the subject property in accordance with the demonstrated need therefore will be accomplished before ten years after the date of commission approval. In the event full urban development cannot substantially be completed within such period, the petitioner shall also submit a schedule for development of the total of such project in increments together with a map identifying the location of each increment, each such increment to be completed within no more than a ten-year period." The construction of Ho'opili's development will be a challenging process that will require ongoing coordination between many fundamental parts. Infrastructure and road access, neighboring property development, demands of the commercial and housing markets, careful continued agriculture and general property management, and economic viability will all be considered throughout the construction planning process. Furthermore, the City & County of Honolulu's (City) transit project, the largest public works endeavor in Hawaii's history, will within Ho'opili have its longest traverse through privately owned property and further expand development challenges undoubtedly in unprecedented ways. Many of these parts may involve developing different areas of the project site within the same construction timetable as discussed further below.

Several major development priorities include in no particular order:

- ***Water Service from the North.*** *Both of Ho'opili's main potable water storage and transmission systems will reside mauka of H-1. Considerable investment will be required in the construction of tanks and transmission lines that will ultimately service two water zones within Ho'opili that roughly divide the site between northern and southern halves. (Necessary offsite utility easements have already been secured at a price.) Nonpotable water will be sourced from the reclamation operations at the Honouliuli Wastewater Treatment Plant (WWTP), meaning it will be delivered to Ho'opili from the opposite end from where its potable source will come. Preliminary budgetary construction cost estimates range from between $35 million to $40 million with another $20 million possible from BWS for service connections.*

- ***Sewer Service from the South.*** *Unlike Ho'opili's main water system, sewer service will come from the southern end of the property. The first of what is expected to be several Joint Development Agreements (JDA) to secure and construct wastewater transmission is in place with DHHL, UHWO, DLNR and the City and funded. Indeed, the DOT has already constructed this line as part of the North-South Road Phase 1A contract. Discussions are expected to commence later this year in earnest on separate JDAs for two additional segments. Nearly $2 million has already been invested to date,*

preliminary budgetary costs estimates for these two JDAs range from $10 million to $15 million to stub service at the property's southwestern border, $5 million to $10 million to route through to the mauka area and as much as another $60 million for the City's Department of Environmental Services uses connection charges.

- ***Balancing Spread out Access, Initial Infrastructure Needs and Cash Flows.*** *Today, Ho'opili's lands along the Farrington Highway corridor, its northernmost boundary, present Ho'opili's easiest access for construction purposes and future occupants. Once DHHL completes its section of the East-West Connector Road and the State DOT completes the North-South Road (both now under construction), Ho'opili will have construction and occupant access open at its southern and westernmost locations. This is significant because while available for development today, the Farrington Highway corridor is expected to present some of Ho'opili's greatest development challenges, predominantly the distance sewer lines will have to run through undeveloped land for service, as well as timing development to the City's planned improvements to Farrington Highway itself. Thus, the Petitioner will look to mobilize on these other areas as early as practicable. Nonetheless, there are several key commercial parcels in this Farrington Highway corridor that will need to be among the earliest to be marketed in order to generate cash flow to support needed upfront utility (such as water and sewer as detailed above) and road infrastructure throughout Ho'opili. As a result, development should be started in more than one area from the onset. Over the build-out of the project, it is expected that as much as $50 million to $60 million could be spent on drainage systems and hundreds of millions will be invested in roadway systems servicing the project.*

- ***Balancing Job Generation, Appropriate Initial Housing Deliveries and Transit.*** *The majority of the employment areas within Ho'opili are within the Farrington Highway corridor to the north of the property, while the residential development areas that could be most sensible to develop first – the single-family areas – are to the south. Starting housing construction there could generally preserve higher density development in the areas in and around the transit corridor to the north to be better staged with transit's completion and more appropriately address the various demands it will create.*

- ***Managing Agricultural Operations.*** *As lands are moved into development over time, consideration will have to be given to the significant challenges of maintaining a working agricultural water system and providing ongoing and unencumbered vehicular access to crop areas. The objective of the Petitioner is to keep active farms onsite as long as practicable.*

As previously stated the development is expected to occur over approximately 20 years. This area of 'Ewa has long been planned for development (Kapolei Area Long Range Master Plan and Ewa Development Plan).

There are several major transportation projects that have been planned for 'Ewa. The Ho'opili project has been planned assuming that certain planned transportation projects will be constructed including a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1

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Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the first segment of the proposed Honolulu High-Capacity Transit Corridor project through the Petition Area. As major off-site infrastructure (water, sewer, drainage, electrical and communications) would likely occur in most of the above major road right-of-ways, and the exact timing of the completion of these transportation improvements undetermined, it is difficult for the Petitioner to provide a map identifying the phasing of the proposed action in 10 year increments with any degree of certainty. While the phasing of development may be more relevant where there is little or no development, Ewa has rapidly developed in recent years and proposed transportation improvements are indicative of State and County assumptions that this portion of 'Ewa would be eventually developed.

Ms. Patopan's Comment: My second issue relates to the project's consistency with the rest of Oahu's regional planning. Section 5 of the EIS makes no mention of why such intense urban development is planned in the "urban fringe" areas of Ewa as described in the Oahu General Plan. In fact, this project is outside of the "Secondary Urban Center" as shown in the General Plan where intense urban growth should be directed to minimize sprawl. The Ewa Development Plan describes the project area as residential and within an urban growth boundary, however it makes no mention of the amount of commercial and industrial development described in the project's EIS. As such, General Plan and Ewa Development amendments should be sought for this project so that the island has the chance to debate the level of growth appropriate for these types of undeveloped lands. This is especially necessary since the City is pushing to designate transit stops within the project area which seems like an effort to undermine the authority of the Land Use Commission and permit the project prior to it going through the necessary reviews.

Response: Objective D of the General Plan's Physical Development and Urban Design objectives and policies were discussed on page 173 of the DEIS. Currently the Ewa Development Plan allows for approximately 16,000+ units within the Petition Area, and the Petitioner is proposing significantly less units (11,750). The Petitioner has been coordinating with the Department of Planning and Permitting from even before the Ewa DP Update process was initiated, and we have been advised that this project would be included in the Ewa DP Update process. We will defer your comment on the authority of the Land Use Commission to others.

Ms. Patopan's Comment: The EIS also uses a desired jobs to housing balance presumably to downplay the substantial traffic impacts of over 160,000 new vehicles on the road per day. Looking at traffic impacts with a "with transit" condition is misleading as it doesn't speak to the likely potential that the train from Waipahu to the project will be expanded during the time it takes to build the project's homes. Also, I just can't see how the creation of only 680 net new jobs in any way justifies the 11,750 homes planned for the project.

Response: By "160,000" new vehicles you must be referring to the 158,669 new vehicle trips that are estimated under the "no transit" scenario. Vehicle trips include all estimated travel segments for each vehicle during the day, including such trips to/from: the babysitter, day care

and/or school; work; university; after-school activities; shopping/dining; etc. Please note the traffic impact analysis report addressed the impact of traffic at full development (year 2030). Construction of the Honolulu High-Capacity Transit Corridor project is expected to start in 2009 and the minimum operating segment (from East Kapolei to Ala Moana) will hopefully be completed well before 2030.

We made an error in the DEIS and incorrectly summarized the Economic and Fiscal Impact Assessment attached to the DEIS as Appendix K ("Economic and Fiscal Impact Assessment for Hoopili," Mikiko Corporation, August 2007. The last two paragraphs of Section 4.7.5 *Employment, Anticipated Impacts and Mitigation Measures* of the Final EIS will be revised to read as follows:

The project is expected to generate approximately 66,600 full-time equivalent (FTE) person-years of development related jobs during the construction phase of the project. The project will generate direct jobs via on-site retail and office facilities at Ho'opili's business park. Excluding those jobs that may relocate to Ho'opili from elsewhere in the State, approximately ~~680~~ 1,550 net new jobs are expected to be created (by 2030) through direct employment associated with the project. In addition, the project will generate indirect jobs via the supply of goods and services. Applying State employment multipliers to the project, approximately 870 jobs will be created through indirect employment associated with the project.

At full build out, employment associated with the Petition Area ~~employment~~ is expected to account for approximately 7,000 ~~1,550 net~~ new jobs. Consistent with the Ewa DP and the Kapolei Area Long Range Master Plan, the new jobs will generate employment in 'Ewa to reduce the need for residents traveling to downtown Honolulu for work-related purposes.

Ms. Patopan's Comment: In conclusion, I feel there is much more study needed for this EIS document to be deemed complete. Detailed soils and past agricultural production studies are needed to determine what land should be ruled out of this redistricting as I hope the project area will downsize. In addition, more detailed studies on traffic impacts along the H-1 Freeway are needed to understand whether the island has the capacity to absorb those 160,000 cars. Additional study is also needed to assess the regional capacities that will likely be strained by this project. I am particularly concerned about current water sources which will have long dried up by 2030.

Response: Decision Analysts, Inc. prepared an agricultural impact assessment report which was appended to the DEIS as Appendix A. The report addresses soils in details and past and current agricultural production in the area, on Oahu and statewide. In summary, the report found that there is more than adequate area statewide for diversified agriculture.

In regards to your comments about "160,000 cars" as we noted earlier, the impact of 158,669 new vehicle trips that are estimated under the "no transit" scenario was evaluated in the Traffic Impact Analysis Report and included in the DEIS in its entirety as Appendix L ("Traffic Impact Analysis Report (TIAR), Hoopili, Oahu, Hawaii, Wilbur Smith & Associates, February 2008).

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Regarding your comments on water, please note that a Conceptual Water Master Plan addressing safe drinking and non-potable water facilities was prepared and reproduced in its entirety and attached to the Draft EIS as Appendix M for BWS review and approval.

Ms. Patopan's Comment: The alternatives to the project discussed in Section 6 are woefully inadequate. How can alternatives honestly be evaluated with less than one page of available material ach and without any comparable studies to back up the assertions made?

Response: Based on your comments, Section 6.0 *Alternatives To The Proposed Action* of the EIS will be revised as follows:

In compliance with the provisions of Title 11, Department of Health (DOH), Chapter 200, Environmental Impact Statement Rules, Section 11-200-10(6), the alternatives considered are limited to those that would satisfy the objectives of the proposed mixed-use development, while minimizing the potential for adverse environmental impacts. The feasible alternatives must realistically address the project's economic characteristics while also responding to the surrounding land uses that will be impacted by the project. In conformance with applicable regulations, other possible alternatives have been investigated to identify alternative sites, the appropriate uses for the property, and how they would best be accomplished.

6.1 "NO-ACTION" ALTERNATIVE

The "no-action" alternative would not be consistent with stated governmental policies, which direct future growth to the 'Ewa region. The City and County of Honolulu General Plan states:

> *Encourage development within the secondary urban center at Kapolei and the 'Ewa and Central Oahu urban-fringe areas to relieve developmental pressures in the remaining urban-fringe and rural areas and to meet housing needs not readily provided in the primary urban center.*

Under this alternative, the site would remain as agricultural land, underutilized in terms of meeting the demand for residential homes (including affordable homes) and accompanying land uses. The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall. The demand for housing could result in the following scenarios or combinations thereof: there would be more pressure to develop in the other districts, including the rural areas and other areas currently used for cultivation; there could be a demand for higher

density housing in undeveloped areas of 'Ewa at a density not experienced to date; there would be more "doubling up" (larger number of persons per household, with more than one family under roof); those that are not willing to put up with the previously described scenarios may decide to relocate to the U.S. mainland where housing prices have dropped.

The "no-action" alternative was rejected because it is not consistent with government plans to develop Kapolei as the Second City.

6.2 ALTERNATIVE SITES

There are very few large parcels left on O'ahu that are designated for residential development. The largest amount of developable land that is undeveloped lies in Central O'ahu and on the North Shore. As shown on the Ewa Development Plan, the Petition Area is designated mostly Low and Medium Density Residential. As such, the City and County of Honolulu has long recognized that the Petition Area is best used for residential and other development. Directing growth to 'Ewa and in the "urban-fringe" portions of Central O'ahu reduces the pressure to develop outside of the Urban Growth Boundary of Central O'ahu, and the North Shore, Ko'olau Loa, Ko'olau Poko and Wai'anae districts. This alternative has been rejected because it would be clearly contrary to General Plan policy. The potential benefit of this alternative is that for those that object to further development on the 'Ewa Plain, it might be preferable for development to occur elsewhere on O'ahu, such as in the Primary Urban Center, East Honolulu, Central O'ahu, North Shore, Ko'olau Loa, Ko'olau Poko and Wai'anae districts.

The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Implementation of this alternative will avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall.

6.3 ALTERNATIVES RELATED TO DIFFERENT DESIGNS OR DETAILS OF THE PROPOSED ACTIONS WHICH WOULD PRESENT DIFFERENT ENVIRONMENTAL IMPACTS

Different designs could be applied to the project, and depending on the density and design capacity, would result in different environmental impacts. For example, a higher density project that kept the same residential unit count as proposed (11,750) would reduce the buildable area (a positive benefit) and possibly reduce the quantity of surface runoff (a positive benefit). ~~This~~ Another potential benefit of this alternative is that it would likely be easier to serve by bus and correspondingly increase ridership. However,

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the residential buildings would be larger and taller. This alternative would not allow as wide a range of residential products to market and was thus rejected. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion).

Another alternative would be to set aside less open space and to spread out the community over a larger land area. Such an alternative is best portrayed by the current Kapolei Long Range Master Plan and Ewa Development Plan Land Use Map designations for the Petition Area. This alternative would reduce the density (to some, a positive benefit) but consume more land, increasing the quantity of surface runoff, and requiring a much larger investment in grading and infrastructure. This alternative would make it difficult for residents to be served by bus, and even more difficult by high-capacity transit. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). This alternative was also rejected.

The demand for safe drinking water and the quantities of wastewater, solid waste, and traffic generated would vary with different designs, depending on the number/quantity of residential units, schools, commercial square footage, and roads.

6.4 ACTIONS OF A SIGNIFICANTLY DIFFERENT NATURE WHICH WOULD PROVIDE SIMILAR BENEFITS WITH DIFFERENT ENVIRONMENTAL IMPACTS

One scenario that would be significantly different from the proposed action is that an elevated rail line and accompanying transit stops would not be built through Ho'opili. Implementation of this alternative will not avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts (assume greater traffic impacts than without the HHCTC project); and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). The impacts of this scenario will be better described in the upcoming HHCTC DEIS.

For the 'Ewa district drivers enduring the longest morning commutes to the Central Business District or UH Mānoa, the modes of transportation will continue to be limited to: private motorized vehicle (including zipper lane), TheBus, TheBoat, Vanpool, et cetera. While this is a scenario that could inevitably result in lengthening commute

times, individual commuters will either: bear with the commute in return for the comfortable lifestyles offered by their homes in 'Ewa; move from their homes in 'Ewa and move closer to their workplaces or schools; or find schools and/or employment in the 'Ewa region. The opening of UHWO will reduce traffic from those undergraduate students in Leeward and Central O'ahu who commute to UH Mānoa, and indirectly reduce the demand for student housing on the UH Mānoa campus (reducing the demand for off-street parking demand on campus, reducing the demand for on-street parking in the surrounding neighborhoods, increasing the supply of student housing on campus, and reducing the demand for student housing off-campus). If the Petitioner is allowed to develop a mixed-use (residential/commercial/office/light industrial) project as proposed, then, more employment opportunities will be provided to existing residents of the region, reducing the need for some 'Ewa residents to commute outside of the District to work. To offset the non-implementation of the HHCTC project, the City and County of Honolulu may decide to increase The Bus and The Boat services. The positive benefits of this alternative is that the visual impact impacts of an elevated rail system would be avoided as well as long-term commitment of State and Federal funds for the HHCTC project. This alternative is not desirable, but feasible.

6.5 THE ALTERNATIVE OF POSTPONING ACTION PENDING FURTHER STUDY

Development of the 'Ewa region as O'ahu's Second City has been studied and planned for many years. Further study of any proposed development on the property would only be delaying what has long been proposed in the Ewa Development Plan. Therefore, this alternative was rejected, as it would not achieve the overall objectives for the project, which would create a mixed-use community that more employment opportunities will be provided to existing residents of the region, reducing the need for some 'Ewa residents to commute outside of the District to work. The potential benefit of this alternative is that while remaining under cultivation, the site would provide open space. Occasionally, however, continued cultivation of the site would generate dust when portions of the site are harvested and plowed. Implementation of this alternative will temporarily avoid: infrastructure impacts (solid waste, wastewater and additional stormwater runoff generated on site); visual impacts (appearance of the site changing from agricultural fields to a master-planned urban development); the loss of agricultural employment; traffic impacts; and construction-related impacts (such as construction noise, construction equipment exhaust emissions, temporary traffic disruption, fugitive dust and soil erosion). Occasionally, however, continued cultivation, harvesting and plowing of the site will expose soils to the erosional forces of wind and rainfall.

Ms. Patopan's Comment: I hope there are many more government reviews to evaluate this project if it remains in its current form. In addition to the added City processed I mention in this letter, I feel an intervention with the Land Use Commission is necessary to downsize this project and to make sure that someone identifies that the County is currently setting the stage for development by identifying transit stops before the Commission has had a chance to deliberate.

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Response: We acknowledge your concerns. Please be assured that there will be many more governmental reviews including the State Land Use District Boundary Amendment process and rezoning. You will have many opportunities to voice your concerns before the Land Use Commission, Planning Commission and City Council.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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LAND USE COMMISSION

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"alchock@att.net" <alchock@att.net>
04/03/2008 09:03 PM

To luc@dbedt.hawaii.gov
cc
bcc
Subject A06-771 - Ho'opili

Reference: A06-771, D. R. Horton - Schuler Homes, LLC, a Delaware limited liability company, d.b.a. D. R. Horton - Schuler Division.

I want to protest the granting of the Petition for Land Use District Boundary Amendment (from agricultural land use district to urban land use district) by Horton-Schuler Division.

The reason for this objection is that the transportation infrastructure is inadequate, and the additional traffic generated by the Ho'opili subdivision will clog up the current highway system (which already is operating at more than full capacity during the rush hours). The implementation of the *Honolulu High-Capacity Travel Corridor Project* is still in the developmental stage, with the City Council still generating a lot of waha nui about it. Even if the City Council should make a decision soon, the first segment, "the train to nowhere" (Kapolei to Pearl City), is not expected to be completed until 2012. Given the normal extended time for construction here, it would probably not take place until 2013 or 2014. The full project, to downtown Honolulu and the University of Hawai'i at Manoa (UHM), would, at the earliest, be completed in 2019, and more likely than not, be delayed at least a couple of years.

A developer normally develops all of the infrastructure (i.e., streets, sewage, utilities; land for schools and parks, and sometimes, even partial funding for them) within the subdivision, as demonstrated by the major developers (Gentry and Haseko) in the 'Ewa plain. However, the infrastructure outside the projects is the responsibility of the City & County and the State, and these governmental entities have not demonstrated their ability to provide them in a timely manner

.

A prime example of this is the North-South Road, from 'Ewa Beach to H-1. When we returned home in 1992 after an absence of a quarter century (we did come home every couple of years, however, since I taught at the UHM summer session), the State was still working on Kalaniana'ole Highway to East Honolulu (but that is an example on the other side of Honolulu proper). When we purchased our townhouse in 'Ewa by Gentry, there was a lot of wala'au about the North-South Road, and expectations

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that it would be completed immediately. Eighteen years later, this is till a myth. I got somewhat involved in community activities, with a three year term on the Board of the 'Ewa by Gentry Community Association (Vice President, 1993-95; President, 1995-96), as well as on the Board of our condominium, and co-spokesperson on the first 'Ewa-Makakilo Vision Team. While the two developers completed their portions of the North-South Road, the State has still not fulfilled its bargain! It also took the S tate & City almost ten years to change the traffic light synchronization on Fort Weaver Road from stopping at each intersection, to being able to move without stopping at each light. Now there is so much traffic that the cars move at a snail pace and stop at every light anyhow.

Need I say more? Do you really want to clog up H-1? Should we be reactive or proactive?

I can speak now, detached, because we have moved from the 'Ewa plain to Kane'ohe, where there are three highways to the leeward side of the Ko'olau, and where the commuting time has been reduced by more than 50%.

We need agricultural land close to the market. The current area is very productive, and the availability of similar land is not available with the urbanization of the island of O' ahu. The argument that because the parcels are surrounded by Urban Districts, we should abandon agriculture and have more subdivisions? Especially with the slowdown of the real estate market, the petitioner's proposals do not make any sense. The designation of different use districts was designed to prevent problems from occurring. Changing them at this time would not be wise.

I would respectfully request the Land Use Commission to deny the proposed Ho'opili petition.

Aloha,
Al Keali'i Chock
45-090 Namoku St. #1315-16
Kane'ohe 96744-5315

AR00027513

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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President

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Executive Vice-President

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GRANT T. MURAKAMI, AICP
Principal

TOM SCHNELL, AICP
Senior Associate

RAYMOND T. HIGA, ASLA
Senior Associate

KEVIN K. NISHIKAWA, ASLA
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Mr. Al Keali'i Chock
45-090 Namoku Street, #1315-16
Kane'ohe, Hawai'i 96744-5315

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Chock:

We are in receipt of your email dated April 3, 2008 to Mr. Rodney Maile of the Land Use Commission. We have reviewed your email and provide the following responses:

Transportation

Mr. Chock's Comment: "I want to protest the granting of the Petition for Land Use District Boundary Amendment (from agricultural land use district to urban land use district) by Horton-Schuler Division. The reason for this objection is that the transportation infrastructure is inadequate, and the additional traffic generated by the Ho'opili subdivision will clog up the current highway system (which already is operating at more than full capacity during the rush hours). The implementation of the *Honolulu High-Capacity Travel Corridor Project* is still in the developmental stage, with the City Council still generating a lot of waha nui about it. Even if the City Council should make a decision soon, the first segment, "the train to nowhere" (Kapolei to Pearl City), is not expected to be completed until 2012. Given the normal extended time for construction here, it would probably not take place until 2013 or 2014. The full project, to downtown Honolulu and the University of Hawai'i at Manoa (UHM), would, at the earliest, be completed in 2019, and more likely than not, be delayed at least a couple of years."

Response: We acknowledge that the construction of the project will generate additional traffic in the 'Ewa region. However, full development of the project is expected to occur around 2030, which provides for an adequate amount of time for the Honolulu High-Capacity Transit Corridor to be constructed. The development of the HHCTC within the Ho'opili project site would reduce the number of vehicle-trips generated by the project. The project in itself is designed to offer daily live, work, play, learning and shopping opportunities, reducing the need for residents to use H-1 Freeway and Fort Weaver Road. Coupled with that, the Second City of Kapolei is rapidly maturing and providing its own work and shopping opportunities. With UHWO being developed next door, Ho'opili residents who would have normally commuted to UH Manoa for their undergraduate degree will no longer have to do so.

Infrastructure

Mr. Chock's Comment: "A developer normally develops all of the infrastructure (i.e., streets, sewage, utilities; land for schools and parks, and sometimes, even partial funding for them) within the subdivision, as demonstrated by the major developers (Gentry and Haseko) in the 'Ewa plain. However, the infrastructure outside the projects is the responsibility of the City & County and the State, and these governmental entities have not demonstrated their ability to provide them in a timely manner.

A prime example of this is the North-South Road, from 'Ewa Beach to H-1. When we returned home in 1992 after an absence of a quarter century (we did come home every couple of years, however, since I taught at the UHM summer session), the State was still working on Kalaniana'ole Highway to East Honolulu (but that is an example oh the other side of Honolulu proper). When we purchased our townhouse in 'Ewa by Gentry, there was a lot of wala'au about the North-South Road, and expectations that it would be completed immediately. Eighteen years later, this is till a myth. I got somewhat involved in community activities, with a three year term on the Board of the 'Ewa by Gentry Community Association (Vice President, 1993-95; President, 1995-96), as well as on the Board of our condominium, and co-spokesperson on the first 'Ewa-Makakilo Vision Team. While the two developers completed their portions of the North-South Road, the State has still not fulfilled its bargain! It also took the State & City almost ten years to change the traffic light synchronization on Fort Weaver Road from stopping at each intersection, to being able to move without stopping at each light. Now there is so much traffic that the cars move at a snail pace and stop at every light anyhow.

Need I say more? Do you really want to clog up H-1? Should we be reactive or proactive?

I can speak now, detached, because we have moved from the 'Ewa plain to Kane'ohe, where there are three highways to the leeward side of the Ko'olau, and where the commuting time has been reduced by more than 50%."

Response: We acknowledge your concern that the infrastructure outside of the Ho'opili project is the responsibility of the City & County of Honolulu and the State of Hawai'i, and your assessment that these governmental entities have not demonstrated their ability to provide them in a timely manner. Please note that the Petitioner is coordinating with various City and State agencies and surrounding developers (such as DHHL and UHWO) so that on-site and off-site infrastructure facility improvements can be better timed with Ho'opili's development. In addition, Ho'opili will contribute to the Ewa Highway Transportation Master Plan Impact Fee program, supporting development of local roadways and easing impacts on the existing arterials.

Agriculture

Mr. Chock's Comment: "We need agricultural land close to the market. The current area is very productive, and the availability of similar land is not available with the urbanization of the island of O'ahu. The argument that because the parcels are surrounded by Urban Districts, we should abandon agriculture and have more subdivisions? Especially with the slowdown of the

real estate market, the petitioner's proposals do not make any sense. The designation of different use districts was designed to prevent problems from occurring. Changing them at this time would not be wise."

Response: We acknowledge your comments regarding agricultural lands on the island of O'ahu. However, the reality is that of the 43,400 acres that are were rated A and B on the State Geographical Information System layer in 1995, 41,750 acres or 96% are still available for agricultural use. The project site has been long planned by the Ewa Development Plan and Kapolei Long Range Master Plan as an area for new development. In addition, the Hawaii Housing Finance Development Corporation, University of Hawai'i - West O'ahu (UHWO), the State Department of Transportation, and the Department of Hawaiian Home Lands have all developed former agricultural lands immediately adjacent to the proposed Ho'opili project into the Villages of Kapolei, UHWO Campus, the North-South Road and the Department of Hawaiian Home Lands East Kapolei developments. All of these developments fall within the urban growth boundary.

Over the years, a number of communities developed in the 'Ewa region, including the 'Ewa Plantation Villages, the 'Ewa Beach community, and Barbers Point Naval Air Station (now known as Kalaeloa). In the 1960's, Makakilo City and the James Campbell Industrial Park were started based on an overall master plan for the area prepared by the Estate of James Campbell in the mid-1950's.

'Ewa is a key component of the City and County of Honolulu's directed growth policies. In 1974, Donald Wolbrink of Harland Bartholomew developed a visionary plan for Kapolei. After much public discussion, the decision to direct urban growth to the 'Ewa area became the official policy of the City and County of Honolulu. In 1977, the Honolulu City Council approved a new General Plan that designated 'Ewa as the location for a Secondary Urban Center for O'ahu. The Secondary Urban Center was to be the focus of major economic activity, housing development, and a center for government services, while preserving areas such as Wai'anae and the North Shore for rural uses.

In August 1977, the State Land Use Commission (SLUC) approved the first State Land Use District Boundary Amendment (SLUDBA) in 'Ewa. This SLUDBA permitted the development of West Beach (now referred to as Ko 'Olina). Subsequent to the Ko 'Olina approval, both the State and the City and County of Honolulu filed at least four petitions with the SLUC to amend the State Land Use Districts in 'Ewa from Agricultural to Urban. In all of the petitions, the General Plan designation of 'Ewa as the Secondary Urban Center was cited as proof that "urbanization" of 'Ewa was consistent with the City and County of Honolulu's planning policy. Similarly, when the Honolulu City Council adopted the Ewa Development Plan (DP) in 1997, petitioners cited both the General Plan and the Ewa DP for their respective project's consistency with the City and County of Honolulu's directed growth policy.

In nearly all of the State and City and County of Honolulu SLUDBA's, soils were rated at or near the top of agricultural productivity rating systems: "A" or "B" by the Land Study Bureau (LSB), and "Prime" under the agricultural lands of importance to the State of Hawaii (ALISH) system. For example, the largest SLUDBA involved 1,300 acres of land adjoining Ho'opili in SLUC Docket No. A99-728, also referred to as the Housing and Community Development

AR00027514

Corporation of Hawaii (HCDCH) East Kapolei. Ninety-seven percent of the soils in HCDCH East Kapolei were rated "A" or "B" by the LSB, and nearly all of the 1,300 acres were rated "Prime" under ALISH. HCDCH East Kapolei is now under or proposed for development by the University of Hawai'i West O'ahu, the Department of Hawaiian Home Lands, the State Department of Transportation (North-South Road), the proposed Salvation Army Kroc Center, and the State Department of Land and Natural Resources.

Additionally, the State appears to maintain its commitment toward growing the Second City in Kapolei by its construction of State office building, and a planned new judiciary complex on former agricultural lands. Finally, during the public review period, the State Department of Land and Natural Resources (DLNR), Engineering Division wrote: "DLNR currently owns approximately 183 acres of land near and/or adjacent to the Ho'opili project...The DLNR parcels have excellent development potential based on the location of these lands adjacent to or near major arteries (H-1 Freeway, Farrington Highway, North-South Road) and the City's proposed transit line as well as the substantial increase development projects in the area." In summary, while we understand your concerns regarding agricultural lands, the project remains consistent with long-standing planning policies that have taken into consideration the potential loss of agricultural land to the state.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

Rodney Maile/DBEDT
04/09/2008 04:12 PM

To Sandra M Matsushima/DBEDT@DBEDT, Bert Saruwatari/DBEDT@DBEDT
cc
bcc
Subject Fw: Testimony - Ho'opili Project

---- Forwarded by Rodney Maile/DBEDT on 04/09/2008 04:12 PM ----

"Johnnie-Mae L. Perry" <notpono@yahoo.com>
04/08/2008 06:15 PM

To rmaile@dbedt.hawaii.gov
cc
Subject Fwd: Testimony - Ho'opili Project

Hi Rodney,

Did you get my testimony (below) in time? I just found the correct email address.

Thanks,

Johnnie-Mae L. Perry

"Johnnie-Mae L. Perry" <notpono@yahoo.com> wrote:
Date: Sat, 5 Apr 2008 15:35:07 -0700 (PDT)
From: "Johnnie-Mae L. Perry" <notpono@yahoo.com>
Subject: Testimony - Ho'opili Project
To: rmaile@hawaii.gov/luc.state.hi.us

Please forward immediately to:

Mr. Rodney Maile (808 587-3822)
Accepting Authority: State of Hawaii Land Use Commission
P.O.Box 2359
Honolulu, Hawai'i 96804-2359.

RE: Ho'opili Project (HRS 343 DEIS)
District: 'EwaTMK: Petition Area: 9-1-17: 04 (portion), 59, and 72;9-1-18: 01 and 04.
Remainder of the ProjectArea: 9-1-10: 02, 14 (portion), and 15 (portion);9-1-17: 04 (portion); 9-2-01: 04, 05, 06 and07; and 9-2-02: 02.

PUBLIC COMMENT 04-08-08 -- HO'OPILI PROJECT

I, Johnnie-Mae L. Perry of 85-1214 Kaneilio St., Wai'anae, HI 96792 OPPOSE the Ho'opili Project because of the displacement of Aloun Farms, no plans of waste to energy technologies and no plans of working with Habitat for Humanity - Leeward to build 3,600 self-help homes.

AR00027515

Dean Uchida came to the Wai'anae Coast Neighborhood Board #24 on April 1 and did an informational presentation.

Yours truly,

Ms. Johnnie-Mae L. Perry
Concern Citizen

You rock. That's why Blockbuster's offering you one month of Blockbuster Total Access, No Cost.

You rock. That's why Blockbuster's offering you one month of Blockbuster Total Access, No Cost.

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& ASSOCIATES, INC.

August 11, 2008

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President

R. STAN DUNCAN, ASLA
Executive Vice-President

RUSSELL Y. J. CHUNG, FASLA
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Tel: (808) 242-2678

Ms. Johnnie-Mae L. Perry
85-1214 Kaneilio Street
Wai'anae, Hawai'i 96792

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Ms. Perry:

We are in receipt of your email dated April 5, 2008 to Mr. Rodney Maile of the Land Use Commission. We have reviewed your email and provide the following responses:

1. All tenants are aware of and have been kept informed about the urbanization plans for the property. At the time leases with the tenants were executed, these disclosures were made. In consideration for the tenants' eventual need to relocate, the Petitioner has made efforts to assist them in the short-term by keeping lease costs for the land and water at or below market rates. This consideration is also mentioned on Page 30 of the Draft EIS.

   The Petitioner remains committed to working on the relocation of its larger tenant, including Aloun Farm, Inc., consistent with its statement on Page 30 of the Draft EIS. However, to date, no site has been secured for that purpose.

2. While there are no plans to develop waste to energy technologies on the project site, recycling shall be encouraged within the project including the reuse and recycling of green waste generated during construction clearing and grubbing activities, the use of recycled construction and demolition wastes and the use of materials made from recycled products, the use of locally produced compost as available for landscaping, and the provision of space for recycling bins in the detailed design of the community. These mitigation measures were described on pages 92 and 93 of the Draft EIS. As noted on page 95 of the Draft EIS, the City and County of Honolulu has plans to expand the H-POWER refuse-to-energy plant by adding a third boiler at the facility.

3. The Petitioner lauds Habitat for Humanity – Leeward in its attempt to construct 3,600 self-help homes, however, there are no plans to incorporate these homes as part of the project. Please note that up to 30 percent of the total number of units for the Ho'opili project is expected to be developed as affordable housing units to comply with the City and County of Honolulu's affordable housing guidelines.

AR00027516

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

O:\job25\2503.01 DR Horton-E Kapolei\EIS\Final EIS\Final EIS Response Letters\BL-34 Perry Response.doc

From: ALEC5 [mailto:asou@alounfarms.com]
Sent: Tuesday, April 01, 2008 1:46 PM
To: Dean Y Uchida
Cc: 'Alan Gottlieb'
Subject: HOOPILI EIS
Importance: High

Dean,

In my review of the Ho'opili E.I.S., there is some conflicting information that I want to point out. Whether this will lead to a formal comment, I would like your response and discussion on would be appropriate.

The portion that reference to the economic impact of the farm business is incorrect (top of page #31). The numbers are significant far off that I believe it is appropriate to point out.

The figure of $6m is probably half as our entity exceed that and not to account for Fat Law/Jeff's winter tomato crop/and all the corn seed that contract grow on the plains. The job impact of 80 full time is also grossly under stated. While is would be alright to under gross the $$ generated, but the number of people under stated will surely come up as you take this through the Land Use Commission. AF alone, have always exceeded 130 full time. We have floated between 130 and 165 position. We've been on the low side in 2006 and '07 due to losing staff to housing/landscaping/and now Monsanto pull. We've made it up in lots of over time and part-timers. Outlook for 2008 is that we'll increase back up close to the optimal of 165 full time company. Again, there is still the corn seed/Sugarland/and Fat Law entity that employs.

I am on a short notice leave this week; here in Japan to introduce our Ewa Sweet Onion. I'll be checking emails and do have an emergency number, cel 81-80-67609027. Will be at this number the next 24 hrs.

Thanks.
Alec Sou
Aloun Farm, Inc.

AR00027517

PBR HAWAII
& ASSOCIATES, INC.

August 11, 2008

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Tel: (808) 242-2878

Mr. Alec Sou
Aloun Farm, Inc.
91-1440 Farrington Highway
Kapolei, Hawai'i 96707

SUBJECT: HO'OPILI DRAFT ENVIRONMENTAL IMPACT STATEMENT

Dear Mr. Sou:

Thank you for your email dated April 1, 2008. We have reviewed your email and offer the following response to your comments.

> *The portion that reference to the economic impact of the farm business is incorrect (top of page #31). The numbers are significnnt far off that I believe it is appropriate to point out.*
>
> *The figure of $6m is probably half as our entity exceed that and not to account for Fat Law/Jeff's winter tomato crop/and all the corn seed that contract grow on the plains. The job impact of 80 full time is also grossly under stated. While is would be alright to under gross the $$ generated, but the number of people under stated will surely come up as you take this through the Land Use Commission. AF alone, have always exceeded 130 full time. We have floated between 130 and 165 position. We've been on the low side in 2006 and '07 due to losing staff to housing/landscaping/and now Monsanto pull. We've made it up in lots of over time and part-timers. Outlook for 2008 is that we'll increase back up close to the optimal of 165 full time company. Again, there is still the corn seed/Sugarland/and Fat Law entity that employs.*

We greatly appreciate the information provided. According to our consultant, Bruce Plasch of Decision Analysts, Inc., his agricultural impact assessment is based in part, on interviews with existing tenants, many of who are farming in areas outside of the Petition Area as well. According to Mr. Plasch, he interviewed you on two separate occasions.

Regarding the specific number of jobs and revenue generated, Mr. Plasch's numbers were based only on the portion of Aloun Farms within the Petition Area. Please see Table 2, *Economic Activity Generated by Agricultural Operations in the Petition Area: 2007*, and Table 4, *Projected Economic Activity Generated by Agricultural Operations in the Petition Area: 2010*, as show in Appendix A, *Agricultural Impact Analysis*, of the Draft EIS.

Thank you again for your participation in the Environmental Impact Statement process for this project. Your comment letter and this response will be included in the Final Environmental Impact Statement. If you have any questions regarding this project, please do not hesitate to contact me at 521-5631.

Sincerely,

PBR HAWAII

Vincent R. Shigekuni
Vice President

cc: Ms. Katherine P. Kealoha, Office of Environmental Quality Control
Mr. Dan Davidson, State Land Use Commission

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HO'OPILI

O'AHU

FINAL
ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 OF 2
APPENDICES

JULY 2008

Prepared by:

PBR HAWAII
& ASSOCIATES, INC.

Prepared for:

D·R·HORTON America's Builder
SCHULER DIVISION

AR00027519

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Agricultural Impact Analysis

HO'OPILI:
IMPACT ON AGRICULTURE

DECISION ANALYSTS HAWAI'I, INC.

HO'OPILI:
IMPACT ON AGRICULTURE

PREPARED FOR:

D.R. Horton – Schuler Homes, LLC
dba D.R. Horton – Schuler Division

PREPARED BY:

Decision Analysts Hawai'i, Inc.

February 2008

AR00027522

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AR00027524

EXECUTIVE SUMMARY

1. PROPOSED DEVELOPMENT

D.R. Horton—Schuler Homes, LLC (dba D.R. Horton—Schuler Division) proposes to develop Ho'opili ("the Project"), a planned community to be located on 1,555.145 acres in the 'Ewa District, O'ahu. This area includes 1,553.844 acres that is referred to as the "Petition Area," plus another 1.301 acres in the State Urban District. Off-site drinking-water reservoirs and storm-water detention areas will add 45.120 acres, resulting in a total Project Area of 1,600.265 acres. The Project will include about 11,750 single- and multi-family homes; business and commercial space; light-industrial space; parks and open space; public facilities; and associated infrastructure.

The Petition Area—which is surrounded by a combination of existing and planned urban development on three sides and the H-1 Freeway on the fourth side—is designated for residential and related development in the County's 'Ewa Development Plan and is within the Urban Growth Boundary. The Project will require a State Land Use District Boundary Amendment to Urban, and a change in County zoning.

2. AGRICULTURAL CONDITIONS

Existing agricultural leases indicate that about 1,375 acres (88%) of the Petition Area are arable land. Soil ratings indicate that about 1,340 ± 65 acres of the Petition Area have favorable agronomic conditions for crop production. This area has high-quality soils, flat or gently sloping terrain, high solar radiation, low pumping costs for irrigation water, and good access. Because of the sunny conditions, the fields are well-suited for growing crops during the Winter months.

3. LOCATIONAL ADVANTAGES AND DISADVANTAGES FOR CROP PRODUCTION

The Petition Area is well-located for serving the Honolulu consumer market and export markets. This is due to the short trucking distance to the Honolulu markets, the Honolulu International Airport, and Honolulu Harbor.

4. LOCATION AND SURROUNDING LAND USES

The Project is *makai* of the H-1 Freeway, *mauka* of 'Ewa Villages, west of Fort Weaver Road and Old Fort Weaver Road, and east of other planned projects in East Kapolei (Figures 1 and 6). These planned projects include: the University of Hawai'i West O'ahu (UHWO) campus and related residential and commercial development, Department of Hawaiian Home Lands (DHHL) East Kapolei residential projects, DHHL commercial center, and the Kroc Community Center on DHHL land.

Urban development has occurred or will occur to the east, south and west of the Petition Area. To the north on the *mauka* side of the H-1 Freeway are agricultural fields in Kunia and grazing lands in the Kunia foothills.

5. EXISTING AGRICULTURAL OPERATIONS

Currently, four agricultural operations lease or sublease about 1,497 acres (96%) of the Petition Area:

- Aloun Farms, Inc.: about 1,100 acres, of which about 100 acres are subleased to Fat Law's Farm

  In total, Aloun Farms and its affiliate lease about 2,440 acres in 'Ewa, Kunia, and Central O'ahu. Three acres within the Petition Area are used for Aloun's primary operating facilities.

- Fat Law's Farm: about 100 acres subleased from Aloun Farms

  This is the entire acreage for this operation, but the company also markets produce grown elsewhere by other farmers.

- Sugarland Farms, Inc. ("Jefts Farm"): about 197 acres

  In total, the consultant estimates that Jefts Farms owns or leases over 5,000 acres in 'Ewa, Kunia, the North Shore of O'ahu, and Moloka'i.

- Syngenta Seeds, Inc.: about 200 acres

  In total, Syngenta leases and subleases about 740 acres in 'Ewa and Kunia, and about 3,000 acres on Kaua'i.

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6. DIRECT ON-SITE AGRICULTURAL IMPACTS

Ho'opili will result in the gradual loss of about 1,497 acres currently being leased for various agricultural operations. In isolation, and allowing for the replacement of Syngenta by another agricultural operation (see Section 8), this gradual loss of agricultural land will result in a related gradual loss of the following: approximately $6 million per year in revenues, average employment of about 80 jobs, and about $1.7 million per year in payroll.

In practice, however, most or all of the agricultural operations on the Ho'opili land are expected to relocate to other lands. In view of these anticipated relocations, mitigating measures are discussed at the end of the Section 10 which addresses cumulative impacts.

7. CUMULATIVE LOSS OF LAND FOR THE AFFECTED AGRICULTURAL OPERATIONS

In addition to the leased and subleased lands that gradually will be lost as the Project is developed over a 20-year period, three of the four agricultural operations in the Petition Area will eventually lose agricultural lands to (1) other private and State urban projects in 'Ewa and Central O'ahu that are within the County's Urban Growth Boundary, and (2) other agricultural operations in Kunia. For the affected agricultural operations, the approximate cumulative reductions in agricultural land will total about 3,600 acres (see Table ES-1). Syngenta's and Jefts Farms' losses of acreage to Monsanto (another agricultural operation) may occur within a few years. The agricultural land lost to urban projects is likely to begin in a few years and continue until as late as 2030.

By 2030, the acreage losses shown in Table ES-1 will leave Aloun Farms with about 160 acres of their current leased land, Fat Law's Farm with none of their current subleased land, and Syngenta with none of their leased acreage on O'ahu although some of their subleased acreage will remain available. Although reduced in size, Jefts Farms will retain over 4,000 acres of their current agricultural land.

8. CHANGES TO AGRICULTURAL OPERATIONS BEFORE HO'OPILI IS DEVELOPED

Monsanto's 2007 land purchase in lower Kunia includes the core of Syngenta's operations on O'ahu. Because of this purchase, the consultant anticipates that Syngenta will relocate from Kunia to some other area within the next few years—with or without Ho'opili, and before Ho'opili construction even begins.

Table ES-1. Cumulative Loss of Land for the Affected Agricultural Operations
(approximate acreage estimates by DAHI)

	Aloun Farms	Fat Law's Farm	Jefts Farms	Syngenta	TOTAL
Urban Projects					
Ho'opili, 'Ewa	1,000	100	197	200	1,497
State Projects, 'Ewa[1]	850	-	95	-	945
Koa Ridge, Central O'ahu	430	-	-	-	430
Agricultural Uses					
State Ag Park, Kunia	-	-	150	-	150
Monsanto Co., Kunia	-	-	220	360	580
Total	2,280	100	662	560	3,602

1. UHWO, DHHL and other State projects.

Source: Decision Analysts Hawai'i, Inc.

Syngenta could relocate to Kaua'i where they already lease about 3,000 acres, although the North Shore of O'ahu is a possibility. If the company relocates to Kaua'i, the economic activity for Syngenta's O'ahu operation would be transferred to Kaua'i. This would include about a dozen full-time workers, 15 to 20 part-time workers, and about 60 to 90 temporary workers during the peak Winter season.

After Syngenta vacates the 200 acres it now leases in the Petition Area, it is expected that the land will be leased short-term to another agricultural operation until construction of this site is ready to begin.

9. AVAILABILITY OF REPLACEMENT LAND

The impact of the cumulative loss of land on the affected agricultural operations will depend on the amount and quality of available replacement land Statewide and on O'ahu.

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a. Statewide

Statewide, a vast amount of land has been released from plantation agriculture: about 251,800 acres between 1968 and 2005, resulting in an average release of over 6,800 acres per year over a 37-year period (see Figure ES-1). The 2006 Del Monte closure in Kunia increased this figure by another 4,400 acres, resulting in a total release of at least 256,200 acres from plantation agriculture between 1968 and 2007. Over the 1968-to-2005 period, the demand for land for diversified crops increased by about 26,300 acres (about 10% of the land released from plantation agriculture).

The acreage released from plantation agriculture has far outpaced the demand for land for diversified crops. The net decrease in diversified crop land amounts to about 229,900 acres. While some of this land has been converted or is scheduled to be converted to urban uses and tree plantations, an estimated 160,000+ acres remain available for diversified crops.

If the Hawai'i Superferry is successful, cultivating crops on the Neighbor Islands for the Honolulu market, and vice versa, may become more economically feasible.

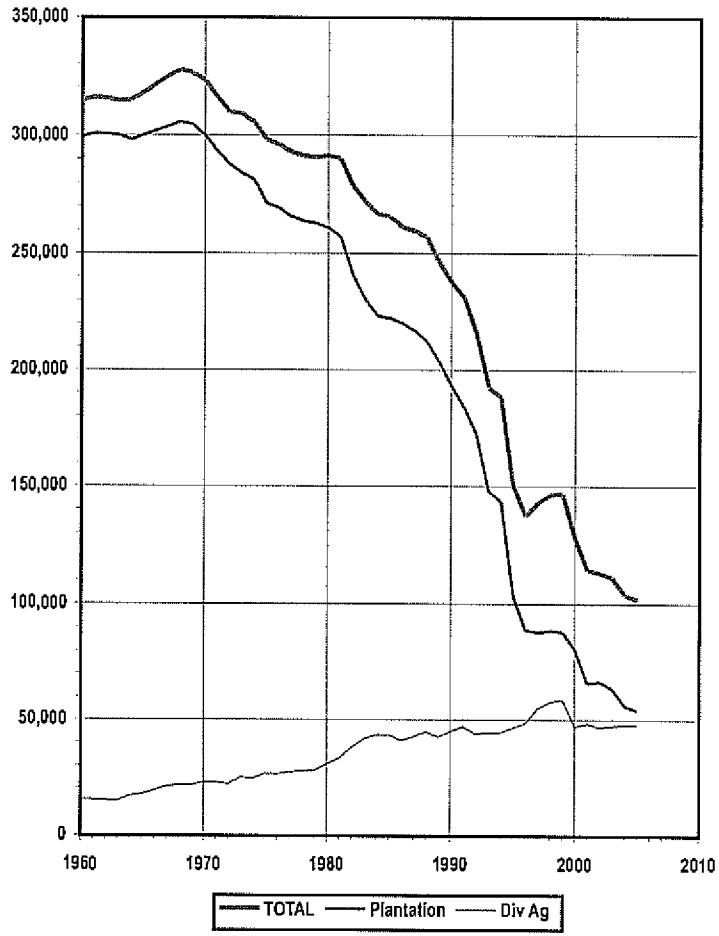
The above information indicates that considerable land is available in Hawai'i to accommodate the relocation of agricultural operations as well as the growth of diversified crop farming.

b. O'ahu

On O'ahu, a similar release of plantation land occurred. In total, about 10,900 acres of former plantation land remain available for other crops, including about 3,150 acres of former pineapple land in Kunia plus about 7,750 acres of former sugarcane and pineapple lands on the North Shore.

However, much of the available 10,900 acres have limitations for growing certain crops. Some limitations reflect permanent agronomic conditions. For example, the higher elevation fields in Kunia and on the North Shore have less solar radiation compared to 'Ewa. Nevertheless, some limitations can be overcome with investment in improvements. For example, on the North Shore, portions of the water delivery systems need major repairs, and the types of crops on fields irrigated with water from Wahiawa Reservoir (Lake Wilson) will be restricted as long as partially-treated wastewater continues to be discharged into the lake.

Figure ES-1 - Statewide Acreage in Crop: 1960 to 2005



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10. CUMULATIVE AGRICULTURAL IMPACTS

a. Loss of Land for the Affected Agricultural Operations

As summarized in Table ES-1, the Project will result in a direct loss of about 1,497 acres currently being leased for various agricultural operations. In combination with land lost to other State and private urban projects and to other agricultural uses, the four agricultural operations in the Petition Area will incur a cumulative loss of about 3,600 acres of their leased land. As noted above, it is expected that Syngenta will relocate for reasons unrelated to and before the Ho'opili construction begins.

b. Required Replacement Land

If Syngenta remains on O'ahu, then about 3,600 acres of replacement land will be needed on O'ahu by the four the affected agricultural operations. But, if Syngenta relocates its O'ahu activities to Kaua'i where most of its operations are located, then the O'ahu demand will be reduced to less than 2,900 acres of replacement land.

As summarized in the previous section, sufficient land is available on O'ahu and the Neighbor Islands. Nevertheless, major water-related improvements are required before all available agricultural lands on the North Shore of O'ahu will be suitable for growing diversified crops. Also, the available lands possess different agronomic conditions than those found in 'Ewa and lower Kunia.

c. Anticipated Changes in Agricultural Operations

Until 2030, the agricultural operations located in the Petition Area are likely to adjust to gradual acreage losses by implementing a combination of (1) leasing replacement lands, (2) possibly cultivating remaining lands more intensively, and/or (3) reducing their operations. By 2030, however, Aloun Farms will lose nearly all and Fat Law's Farm will lose all their leased lands, thereby necessitating relocation to Kunia and/or the North Shore.

Assuming that the affected lessees secure replacement lands, and assuming the necessary water improvements are made, then the affected agricultural operations could maintain about the same level of production, sales revenues, employment and payroll. However, major adjustments in their operations will be required since the replacement lands will have different agronomic conditions. Also, the lessees will incur additional expenses to prepare the soils and irrigation systems for their particular crops, and to move their offices, and cooling and packing facilities.

If sufficient replacement land is not available on O'ahu (due to the unlikely possibility that it will be used to grow an energy crop), then one or more of the agricultural operations could turn to a Neighbor Island. Potential feasibility is illustrated by the fact that two of the lessees already have agricultural operations on Neighbor Islands, while many Neighbor Islands growers supply O'ahu markets. However, the affected companies which may move to the Neighbor Islands will incur higher transportation costs, and delivery times will be longer. The costs and delays will be similar to those that Neighbor Island farmers now incur to supply the Honolulu market. In the future, these costs and delays may be somewhat lower because of the Superferry and the planned improvements to interisland barge service. The disadvantages of a Neighbor Island location could be partially offset by lower rents. However, for some perishable crops, the ferry service may not be sufficiently frequent or travel may take too long.

d. Flexibility of Affected Agricultural Operations to Resize

Since the affected diversified crop operations can be flexible with regard to their sizes, it is anticipated that they will survive regardless of the amount of replacement land they lease in the future. More to the point, changes in available agricultural land due to the Project are not likely to threaten the survival of Aloun Farms, Fat Law's Farm, or Jefts Farms.

e. Statewide Impacts

From a Statewide perspective, the cumulative agricultural impact of the Project will be modest regardless of how the affected agricultural operations adjust to losing all, or portions of, their leased acreage. Their lost agricultural production from the Petition Area and from other areas they now lease will be offset largely by (1) maintaining their current levels of operation and production by leasing replacement lands in Kunia and/or the North Shore, and possibly cultivating their remaining lands more intensively; (2) one or more of them relocating all or portions of their operations to a Neighbor Island; (3) other farmers on O'ahu and the Neighbor Islands increasing their production; or (4) some combination of the three.

Thus, it is likely that there will be little or no loss in Statewide agricultural production, revenues, employment or payroll.

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f. **Urbanization of Agricultural Lands**

Reconfigurations of farms such a those described above are common and appropriate when agricultural operations lease land in the path of planned urban expansion. For the affected operations, much of the land they lease is located in areas that the County and, for much of the 'Ewa Plain, the State have designated for eventual expansion of Kapolei. Also, all current tenants entered into lease agreements with this knowledge and, except for Fat Law's Farm, have benefited from rents that are now below market.

For diversified crop farmers who supply nearby markets, locations on the edge of town can be ideal for them because of the lower trucking costs. And until these lands are urbanized, the best "temporary" use of them may be agriculture—a use that may last decades. For example, the affected operations have cultivated their acreage on the 'Ewa Plain for 10 years or more, and some of this land will probably remain available to them for agriculture until as late as 2030.

But when urbanization does occur, the operations will incur the expense and disruption of relocating all their operations or major portions of them to other lands. Since lessees only have temporary rights to the land, the costs of relocating falls on the farmers and are not an obligation of the landowners. If the costs were an obligation of the landowners, they would avoid leasing their land to crop farmers and put their land in a lower value agricultural use such as cattle grazing which has similar land-management and property-tax benefits.

g. **Mitigating Measures**

The mitigation measures recommended below will contribute to the successful relocation of the four agricultural operations that will be displaced by Ho'opili in combination with other land-use changes in 'Ewa, lower Kunia and Central O'ahu. They are designed to (1) address water issues that limit crop production on the North Shore where most available farm lands on O'ahu are located, and (2) provide sufficient time to make the necessary improvements and arrangements for relocating. Some of the recommendations will also benefit other growers who may relocate to or expand on the North Shore.

The recommended mitigation measures are categorized by those which may be best implemented by government, and those which are within the purview of D.R. Horton:

— Government

- Upgrade the Wahiawa Wastewater Treatment Plant (WWTP) to treat wastewater to the State's R-1 standard, or eliminate discharging wastewater into the Wahiawa Reservoir.

This recommendation to the County is consistent with a 1998 Consent Decree with the U.S. Environmental Projection Agency (EPA). Its purpose is to allow farmers to use water from the Wahiawa Reservoir to irrigate any type of crop using any type of irrigation system.

Until the quality of the reservoir water is improved, most of the available agricultural land on the North Shore cannot be used to grow the types of vegetable crops the farmers grow in 'Ewa and lower Kunia. In turn, one or more agricultural operations that will be displaced by Ho'opili and by other projects may not be able to fully relocate to the North Shore until the improvements are made (assuming that relocating to the North Shore is their best option).

- Repair the Wahiawa Irrigation System (WIS)

Repairs to portions of the WIS are needed to address major and minor leaks and to prevent future leaks. Because of the leaks, a number of mid-level and high-level fields on the North Shore can no longer be irrigated in the summer months with water from Wahiawa Reservoir. Until these repairs are made and more fields can be irrigated reliably, one or more agricultural operations being displaced by Ho'opili and by other projects may not be able to fully relocate to the North Shore (assuming that relocating to the North Shore is their best option).

Because of the high cost of the repairs, State and Federal funds may be required.

— D.R. Horton

- To the extent possible, coordinate the development of Ho'opili with the affect agricultural operators and with developers of adjacent lands so as to maintain farming in 'Ewa for as long as possible.

The development of Ho'opili and of projects on adjacent State lands could continue until 2030. Until then, farming can continue in 'Ewa, provided that Ho'opili works with the agricultural operators and developers of adjacent land to: (1) maintain access to fields and irrigation water, and (2) phase development to minimize the potential for nuisance issues (discussed in the next section). This will allow more time for others to make the necessary improvements to the WWTP and the WIS.

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• Continue to lease agricultural land at below-market rents.

The affected agricultural operators will have to make frequent adjustments to their operations as development proceeds. These adjustments may include contracting their 'Ewa operations, rearranging water systems, building berms to reduce nuisance problems, etc.

Continued below-market rents will allow the affected agricultural operators to retain more funds to help finance the required adjustments.

11. NUISANCE ISSUES

a. Potential for Nuisance Issues

Nuisances arising from agricultural operations can become an issue for both residents and farmers. Residents who live close to and downwind from agricultural operations may complain about occasional noise, dust, chemical spraying, etc. In turn, the farmers may have to change their operations in order to address these complaints.

Regarding the existing homes that are located downwind of the agricultural operations in the Petition Area, they are buffered from nuisance problems by (1) farming activities on State land, (2) fallow fields on State land, and (3) the Kapolei Golf Course.

However, nuisance issues could arise during the 20 or so years while agricultural operations continue in portions of the Petition Area and homes are built and occupied nearby as part of Ho'opili or other projects on adjacent State lands.

Once Ho'opili and adjacent lands are fully developed, nuisance issues arising from agricultural activities will not occur since the lands will no longer be cultivated.

b. Mitigating Measures

To mitigate potential nuisance issues related to agricultural activities near newly built homes, the following mitigation measures are recommended:

— To the extent possible—and subject to transit alignment, water and other infrastructure improvements—phase the development of homes and coordinate agricultural leases to provide wide separations between homes and upwind agricultural activities.

— For each phase of development of Ho'opili and nearby projects, require farmers to provide a buffer of fallow fields and berms upwind of the homes before the homes are occupied.

— As necessary, limit agricultural activities (restricted hours of operation, restricted plowing and use of chemicals on windy days, etc.) so as to avoid or minimize nuisance problems.

— As long as agricultural operations continue in the Petition Area and on adjacent lands, inform home buyers in the area that they will be living near agricultural activities.

12. GROWTH OF DIVERSIFIED CROPS

The Project will commit about 1,554 acres of agricultural land to a non-agricultural use, of which about 1,375 acres are arable. The impact of this commitment on the growth of diversified crops is addressed below.

a. Potential Acreage Requirements for Diversified Crops

Crops to Replace Imports of Fruits and Vegetables

For low-elevation fruits and vegetables that have a history of profitable production in Hawai'i, potential land requirements in 2010 for 100% import substitution for the Hawai'i and O'ahu markets are estimated at 12,700 acres and 8,600 acres, respectively, plus additional acreage for fallowing land between crop plantings. When allowing for competition from imports, these estimates drop to about half.

Since Hawai'i farmers already supply a portion of the Hawai'i market, land requirements for increased import substitution are a fraction of the above estimates.

Export Crops

The many entrepreneurial agricultural efforts being undertaken on former plantation lands may lead to one or more major new export crops over the next 20+ years. However, the history of agricultural efforts in Hawai'i reveals that developing major new export crops that are successful in overseas markets is difficult and infrequent. For example, over the past 50 years in Hawai'i, farmers have explored numerous possibilities for export crops, but they have developed overseas markets for just one diversified crop that requires more than 10,000 acres (macadamia nuts at 18,300 acres in 2005); one additional crop that requires more than 5,000 acres (coffee at 8,000 acres); and only five additional crops or crop categories that require more than 1,000 acres each.

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At 4,220 acres in 2005 and growing at an average rate of 264 additional acres per year, the seed industry is expected to soon become only the third diversified crop that requires more than 5,000 acres. The fourth crop could be nursery and flower products: 3,895 acres and increasing at 235 acres per year.

Feed Crops

If feed crops could be grown in Hawai'i and priced competitively against mainland imports, they could replace some of the grains and hay that are now being imported to the State. Unfortunately, a number of commercial attempts in Hawai'i to grow grains and alfalfa have been unsuccessful.

Biofuel Crops

Crops can be grown to produce biomass to fuel a boiler, or as feedstock to produce fuels. In Hawai'i, the common practice has been to produce biomass as a by-product of some principal crop. However, a company plans to build an ethanol plant at Campbell Industrial Park using conventional technology but, at least initially, using imported molasses as the feedstock. For the longer term, this company is exploring the economics of growing sweet sorghum to supply feedstock to its ethanol plant. Acreage requirements for a new sorghum biofuel plantation on O'ahu would range from about 6,000 acres for viability to 15,000 acres if juice from sorghum were to replace all imported molasses. Also, two companies plan to build biodiesel refineries in Hawai'i: one on O'ahu and one on Maui. Both will use imported palm oil from Malaysia and other countries as their feed stock, but would refine locally produced vegetable oil if available.

However, a number of substantial difficulties must be overcome to develop one or more biofuel plantations. For example, it will be difficult to lease the large amount of land required for economic viability. Most major landowners will be reluctant to lease their land at comparatively low rents for the approximately 30-year period required to capitalize the investment. Also, per-acre returns from biofuel crops are comparatively low. In the long-term, emerging technology that is in the early stages of commercialization holds promise for a cheaper source of feedstock for ethanol. Instead of producing ethanol using sugars from conventional sources, the sugar would come from "cellulosic" sources. This would include green waste for which there would be no land rent and no growing costs, but there could be a disposal fee paid to the processor. In the long term, this less expensive source of feedstock could result in an unprofitable biofuel plantation.

These and other difficulties and risks suggest that the probability of successfully developing and sustaining a biofuel plantation in Hawai'i is low. The more likely scenario is that ethanol will be produced as a by-product of sugar and, over the long-term, it will be produced from green waste.

Recent Crop-Acreage Trends

For all diversified crops (i.e., all crops other than sugarcane and pineapple, including crops to replace imports and crops for export) Statewide land requirements grew as shown in Figure ES-1. As illustrated, growth in acreage has slowed over time, with an average growth of about 160 acres per year from 2000 to 2005. During this period, major export crops grew by an average of about 350 acres per year, while crops grown for the Hawai'i market declined by an average of about 190 acres per year.

b. Adjusted Supply of Land Available for the Growth of Diversified Crops

As discussed above, about 10,900 acres of farm land are available on O'ahu, and over 160,000 acres are available Statewide. Over time, a portion of this available land supply will be leased to the four agricultural operations that will have to relocated as a result of Ho'opili in combination with other land-use changes in 'Ewa, lower Kunia, and Central O'ahu. On O'ahu, this relocation will require about 2,900 to 3,600 acres, depending on whether Syngenta's O'ahu operation remains on O'ahu or relocates to Kaua'i. The adjusted supply of farm land that will remain available for diversified farming will total about 7,300 to 8,000 acres on O'ahu and over 156,000 acres Statewide.

This adjusted supply of available farm land far exceeds the amount of land that will be needed to accommodate the growth of diversified crops, whether demand is based on potential or recent trends. This indicates that the limiting factor to the growth of diversified crops will *not* be the *land supply*. Instead, growth will be limited by the *size of the market* for crops that can be grown *profitably* in Hawai'i.

c. Impact on the Growth of Diversified Crop Farming

The development of Ho'opili—in combination with other development projects in 'Ewa, Central O'ahu and elsewhere—involves the loss of too little good agricultural land to significantly affect the growth of diversified crop farming in Hawai'i. This conclusion is based on the above finding that ample land will remain available for diversified crops, with the available supply far exceeding the likely or potential demand.

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However, as discussed previously, water-related improvements are needed to allow full use of some of the available farm lands on the North Shore. These improvements are the responsibility of the landowners and government agencies.

d. Mitigating Measures

In view of the negligible impact of the Project on the growth of diversified agriculture, mitigation measures for the loss of good agricultural land are not recommended beyond the measures addressed in Section 9.h above.

13. OFFSETTING BENEFITS

As previously mentioned, Ho'opili will commit about 1,554 acres of agricultural land to a non-agricultural use, of which about 1,375 acres are arable. In turn, Ho'opili—in combination with other private and State urban projects and changes in agriculture land use in Kunia—will require the the affected agricultural operations to relocate.

These adverse impacts to agriculture will be offset by the following benefits of the Project:

- About 11,750 homes for Hawai'i residents, along with business and commercial space, light-industrial space, parks and open space, and public facilities.
- For 'Ewa, relatively high housing densities which, in turn, will contribute to slower urbanization of agricultural land than would be the case with lower densities.
- Construction jobs provided by the development activity.
- At full development of the Project, on-site jobs provided by business, commercial, industrial, and home-service activities.
- Tax revenues (excise taxes, personal income taxes, corporate income taxes, property taxes, etc.) generated by the development activity.
- Tax revenues generated by the families and businesses that occupy the Project.
- Improved land and partial funding for schools, parks and other public facilities.

14. CONSISTENCY WITH STATE AND COUNTY POLICIES

a. Availability of Lands for Agriculture

The *Hawaii State Constitution*, the *Hawaii State Plan*, the *State Agriculture Functional Plan*, and the *General Plan of the City and County of Honolulu* call directly or implicitly for preserving the economic viability of plantation agriculture and promoting the growth of diversified crops. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured.

With regard to plantation agriculture, the Petition Area is no longer part of a sugar plantation since O'ahu Sugar Co. closed in 1995 for reasons unrelated to the Project.

With regard to diversified crops, development of the Petition Area will result in a loss of good farm land, and the farms on this land will have to relocate. However, this loss of agricultural land will not limit the growth of diversified crops since ample agricultural land is available on O'ahu and on other islands. This is due to the enormous supply of farm land that is now available following the contraction of plantation agriculture (Figure ES-1). However, improvements to the WWTP and the WIS will be needed to allow full use of the available farm lands on the North Shore.

b. Conservation of Agricultural Lands

In addition to the above, State policies call for conserving and protecting prime agricultural lands, including protecting agricultural lands from urban development.

However, these policies—which were written before the major contraction of plantation agriculture in the 1990s—assume implicitly that profitable agricultural activities eventually will be available to use all available agricultural lands. This has proven to be a questionable assumption in view of the enormity of the contraction of plantation agriculture, the abundant supply of land that came available for diversified agriculture, and the slow growth in the amount of land being used for diversified crops (see Figure ES-1).

Furthermore, discussions in the Agriculture portion of the *State Functional Plan* recognize that redesignation of lands from Agricultural to Urban should be allowed "... upon a demonstrated change in economic or social conditions, and where the requested redesignation will provide greater benefits to the general public than its retention in ...agriculture;" that is, when an "overriding public interest exists." In this regard, major changes in economic and social conditions have occurred as a result of:

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— The on-going development of the City of Kapolei and the surrounding 'Ewa region as the second largest urban center in Hawai'i (see the policy discussion in the following subsection).

— Inadequate expansion in the supply of workforce housing which has contributed to high housing prices on O'ahu.

— The enormous contraction in plantation agriculture which has resulted in the supply of agricultural land far exceeding demand.

Moreover, development in the Petition Area will provide community benefits (about 11,750 homes and many on-site jobs) that far exceed those provided by agriculture (about 80 jobs after Syngenta is replaced by a new farm). In practice, however, development of the Petition Area is likely to have little or no impact on Statewide agricultural employment.

c. County 'Ewa Development Plan

The Petition Area is within the County's designated Urban Growth Boundary of the 'Ewa Development Plan in an area designated for residential development. Thus, the Project is consistent with the 'Ewa Development Plan in terms of future land use.

This Plan is part of a broader long-established County policy, with support from the State, to direct urban growth to 'Ewa, to portions of Central O'ahu, and to the primary urban center. In turn, the policy reduces development pressures on the outlying Districts of Ko'olau Loa, Ko'olau Poko, North Shore, and Wai'anae. The policy was designed to provide needed housing, jobs, and commercial and industrial space in compact areas; preserve agricultural lands and open space in Kunia, the North Shore, and outlying areas; preserve the "country" lifestyle of rural communities; and reduce the cost of providing government infrastructure and services.

Portions of the Project could be inconsistent with the phasing component of the currently approved 'Ewa Development Plan which indicates that urban expansion of the northern and eastern portions of the Petition Area is to occur after 2015. Such phasing in the current 'Ewa Development Plan would create nuisance issues by placing farm areas immediately upwind of the new Ho'opili homes. However, the 'Ewa Development Plan is in the process of being updated which, based on discussions with the County, is expected to reflect the removal of phasing from the Plan.

HO'OPILI:
IMPACT ON AGRICULTURE

1. INTRODUCTION[1,2]

D.R. Horton—Schuler Homes, LLC (dba D.R. Horton—Schuler Division) proposes to develop Ho'opili ("the Project"), a planned community to be located on 1,555.145 acres in the 'Ewa District, O'ahu. This area includes 1,553.844 acres that is referred to as the "Petition Area," plus another 1.301 acres in the State Urban District. Off-site drinking-water reservoirs and storm-water detention areas will add 45.120 acres, resulting in a total Project Area of 1,600.265 acres. The location of the Project, Tax Map Keys (TMKs), and the parcels and their acreages are shown in Figures 1, 2 and 3, respectively.

The Petition Area is designated for residential and related development in the City and County of Honolulu (County) 'Ewa Development Plan (see Figure 4), and is currently zoned "Agricultural." At the State level, the Petition Area is in the State Agricultural District (Figure 5). Thus, the Project will require a State Land Use District Boundary Amendment to Urban, and a change in County zoning. The conceptual land-use plan for the Project is shown in Figure 6.

This report addresses the impacts on agriculture of developing the Project. The material below gives the following information on the Project and its agricultural impacts: its location; a brief Project description; the agricultural conditions of the Petition Area, along with supporting Figures 7, 8 and 9; potential crops; locational advantages and disadvantages for crop production; surrounding land uses; historical agricultural uses; existing farm operations along with supporting Figure 10; for the affected farms, anticipated losses of farm land due to urban development and to other agricultural uses; anticipated changes in farming activity before the development of Ho'opili begins; availability of replacement farm land, along with supporting Figure 11; direct and cumulative impacts of the Project on affected farms; nuisance issues; the impact of the Project on the growth of diversified crop farming; benefits of the Project that will offset adverse agricultural impacts; and consistency of the Project with State and County agricultural policies.

Following the eleven figures at the end of the report, an Appendix provides a summary of State and County goals, objectives, policies and guidelines related to agricultural lands.

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2. LOCATION OF THE PROJECT [2]

The Project is *makai* of the H-1 Freeway, *mauka* of 'Ewa Villages, west of Fort Weaver Road and Old Fort Weaver Road, and east of the planned University of Hawai'i West O'ahu (UHWO) campus and planned development by the Department of Hawaiian Home Lands (DHHL) (Figures 1 to 6). As shown in Figures 2 and 3, the Petition Area is identified by the following TMKs:

TMK	Parcel	Acres
9-1-18:04	A	52.289
9-1-18:01	B	447.592
9-1-17:04 (por), 59 & 72	C	1,053.963

3. PROJECT DESCRIPTION[2]

Ho'opili will include about 11,750 single- and multi-family homes; business and commercial space; light-industrial space; parks and open space; public facilities (e.g., schools); and associated infrastructure (e.g., roadways, an electrical system, a telephone system, a cable-TV system, Internet systems, a drinking water system, a non-drinking water system for irrigating landscaped areas, sewers, and drainage).

4. AGRICULTURAL CONDITIONS

a. Soil Types[3]

As shown in Figure 7, the Petition Area consists of 19 soil types plus former reservoir sites. The complete names of the soil types and their slopes are:

- — EaB Ewa silty clay loam, 3 to 6 percent slopes
- — FL Fill land, mixed
- — HLMG Helemano silty clay, 30 to 90 percent slopes
- — HxA Honouliuli clay, 0 to 2 percent slopes
- — HxB Honouliuli clay, 2 to 6 percent slopes
- — Kfb Kaloko clay, noncalcerous variant
- — KlaB Kawaihapai stony clay loam, 2 to 6 percent slopes
- — KlA Kawaihapai clay loam, 0 to 2 percent slopes
- — KlbC Kawaihapai very stony clay loam, 0 to 15 percent slopes

- — KmaB Keaau stony clay, 2 to 6 percent slopes
- — KyA Kunia silty clay, 0 to 3 percent slopes
- — KyB Kunia silty clay, 3 to 8 percent slopes
- — KyC Kunia silty clay, 8 to 15 percent slopes
- — MuB Molokai silty clay loam, 3 to 7 percent slopes
- — MuC Molokai silty clay loam, 7 to 15 percent slopes
- — WkA Waialua silty clay, 0 to 3 percent slopes
- — W Water (former reservoir)
- — WzA Waipahu silty clay, 0 to 2 percent slopes
- — WzB Waipahu silty clay, 2 to 6 percent slopes
- — WzC Waipahu silty clay, 6 to 12 percent slopes

Table 1 shows the estimated acreage of each soil type according to its quality as rated by the Natural Resources Conservation Service (NRCS), formerly known as the Soil Conservation Service.

As indicated, HxA, KyA and WzA are the predominant soil types, comprising about 63.5% of the Petition Area.

b. Soil Ratings

Three classification systems are commonly used to rate Hawai'i soils: (1) Land Capability Grouping, (2) Agricultural Lands of Importance to the State of Hawai'i, and (3) Overall Productivity Rating.

Land Capability Grouping (NRCS Rating)[3]

The 1972 Land Capability Grouping by the U.S. Department of Agriculture, NRCS rates soils according to eight levels, ranging from the highest classification level I to the lowest VIII.

Table 1 shows that about 1,045.6 acres (67.3%) of the Petition Area have soils that are rated I. Class I soils have few limitations that restrict their use.

About 226.9 acres (14.6%) have soils that are rated IIe. Class II soils have moderate limitations that reduce the choice of plants or require moderate conservation practices. The subclassification "e" indicates that the soils are subject to erosion.

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Table 1. Ho'opili Petition Area: Soil Types and NRCS Ratings

Soil Types	Acres	%	NRCS Ratings[1]
Higher-quality			
HxA	243.9	15.7%	I
KlA	10.9	0.7%	I
KyA	411.6	26.5%	I
WkA	48.2	3.1%	I
WzA	331.0	21.3%	I
EaB	48.2	3.1%	IIe
HxB	14.0	0.9%	IIe
KlaB	4.7	0.3%	IIe
KyB	3.1	0.2%	IIe
MuB	76.1	4.9%	IIe
WzB	80.8	5.2%	IIe
Moderate-quality			
KyC	4.7	0.3%	IIIe
MuC	46.6	3.0%	IIIe
WzC	115.0	7.4%	IIIe
Kfb	15.5	1.0%	IIIw
KmaB	3.1	0.2%	IIIw
Lower-quality			
KfbC	4.7	0.3%	VIs
HLMG	68.4	4.4%	VIIe
FL	7.8	0.5%	n.r.
W (former reservoirs)	15.5	1.0%	n.r.
Total	1,553.8	100.0%	

1. Assuming all soils are irrigated.

Source: U.S. Department of Agriculture, Soil Conservation Service, *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*, August 1972.

About 166.3 acres (10.7%) have soils rated IIIe. Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.

About 18.6 acres (1.2%) have soils rated IIIw. The subclassification "w" indicates that the soils have excess water (i.e., they are poorly drained).

About 4.7 acres (0.3%) have soils rated VIs. Class VI soils have severe limitations that make them generally unsuitable for cultivation and restrict their use largely to pasture. The subclassification "s" indicates that the soils are rocky or stony.

About 68.4 acres (4.4%) have soils rated VIIe. Class VII soils have very severe limitations that make them unsuitable for cultivation and restrict their use largely to pasture.

About 23.3 acres (1.5%) have soils that are not rated because it is fill land or land associated with former reservoirs.

Agricultural Lands of Importance in the State of Hawai'i (ALISH)[4]

ALISH ratings were developed in 1977 by the NRCS, the UH College of Tropical Agriculture and Human Resources, and the State of Hawai'i, Department of Agriculture. This system classifies land into three broad categories: (a) Prime agricultural land which is land that is best suited for the production of crops because of its ability to sustain high yields with relatively little input and with the least damage to the environment; (b) Unique agricultural land which is non-Prime agricultural land used for the production of specific high-value crops; and (c) Other agricultural land which is non-Prime and non-Unique agricultural land that is important to the production of crops.

About 1,317.1 acres (84.8%) of the Petition Area have soils that are rated Prime; about 155.4 acres (10%) are rated Other; and about 80.8 acres (5.2%) are unclassified (Figure 8).

Overall Productivity Rating (LSB Rating)[5]

In 1972, the University of Hawai'i Land Study Bureau (LSB) developed the Overall Productivity Rating, which classifies soils according to five levels, with A representing the class of highest productivity and E the lowest.

About 517.4 acres (33.3%) of the Petition Area have soils rated A, about 890.3 acres (57.3%) are rated B, about 7.8 acres (0.5%) are rated C, about 17.1

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acres (1.1%) are rated D, about 87.0 acres (5.6%) are rated E, and about 34.2 acres (2.2%) are unrated (Figure 9).

Summary Evaluation of Soil Quality

These soil-rating systems suggest that about 1,340 ± 65 acres (86 ± 4%) of the Petition Area are comprised of higher-quality soils (I and II for the NRCS ratings, Prime for ALISH, and A and B for the LSB).

c. **Soil Characteristics**[3,5]

The better soils in the Petition Area exhibit a number of favorable characteristics: the soils are deep (over 30 inches); they have good machine tillability; they are well-drained; the erosion hazard is none to slight; and the slopes are gentle (see below). However, some of the soils (e.g., HxA) are very sticky and very plastic clay, and others (e.g., KyA) are medium to extremely acidic.

d. **Arable Land**[1]

Consistent with the above ratings, existing agricultural leases indicate that about 1,375 acres (88%) of the Petition Area are arable land. This assessment is based on the fact that the land classified as arable was once cultivated in sugarcane.

e. **Elevations**[6]

Elevations range from about 50 feet near the southeast corner of the property to about 220 feet near the 228' Elevation Reservoir (Figure 1).

f. **Terrain**[2,3]

Most of the Petition Area has flat or gently sloping land, with slopes ranging from 0% to 6%. The exception is Honouliuli Gulch which runs through the northeast corner of the Petition Area and separates Syngenta Seeds from Aloun Farms (Figure10).

g. **Climatic Conditions**

Like other areas in Hawai'i, the 'Ewa Plain has a mild *semi*tropical climate which is due primarily to three factors: (1) Hawai'i's mid-Pacific location near

the Tropic of Cancer, (2) the surrounding warm ocean waters that vary little in temperature between the Winter and Summer seasons, and (3) the prevailing northeasterly tradewinds that bring air having temperatures that are close to those of the surrounding waters.

Solar Radiation[7]

The 'Ewa Plain is one of the sunniest areas on O'ahu. It is semi-arid, with a relatively warm and dry climate and an average daily insolation ranging from about 470 to 500 calories per square centimeter.

Rainfall[8]

Rainfall in the Petition Area is low: averaging about 25 inches per year. Most of this rain occurs during the Winter rainy season (October through February), while the Summer months (May through September) are hot and dry. Monthly average rainfall is lowest at about 0.5 inch in August and highest at about 3 inches in January.

Temperatures[8]

Average low temperatures range from about 60° Fahrenheit in the Winter to about 69° in the Summer. Average high temperatures range from about 78° in the Winter to 87° in the Summer.

Winds and Storms[8,9]

Wind speeds average about 9.4 miles per hour (mph) in the Winter and about 13.1 mph in the Summer. Tradewinds blow from a northeasterly direction, but they tend to break down during the Fall, giving way to lighter, more variable wind conditions through the Winter and into early Spring. Storms are infrequent, occurring mostly from the south in the Winter months.

h. **Irrigation Water**[1]

The fields are irrigated with groundwater pumped from wells in the area. The lift is short, so pumping costs are relatively low. None of the fields are irrigated with water from Waiahole Ditch.

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i. Road Access[6]

Access to the fields is provided by plantation roads that connect to Farrington Highway, Fort Weaver Road, and Palehua Road.

Palehua Road provides a route for farmers to drive their trucks under the H-1 Freeway between the Petition Area and their operations in Kunia without having to use public roads. Portions of this road, including the segment between the H-1 Freeway and Farrington Highway, will become the North-South Road that will cross the 'Ewa Plain and provide additional access to the H-1 Freeway (Figure 6).

j. Summary

Of the approximately 1,553.8 acres in the Petition Area, soil ratings indicate that about 1,340 ± 65 acres have favorable agronomic conditions for crop production. This area has high-quality soils, flat or gently sloping terrain, high solar radiation, low pumping costs for irrigation water, and good access. Because of the sunny conditions, the fields are well-suited for growing crops during the Winter months. This is consistent with existing agricultural leases which indicate that about 1,375 acres (88%) are arable land.

5. POTENTIAL CROPS[10-14]

Based on the above agronomic conditions, most of the Petition Area is well-suited for low-elevation crops, including but not limited to the following crops which are commercially grown in 'Ewa: apple banana, basil, bell peppers, broccoli, cabbages, canteloupes, chives, choy sum, cucumbers, daikon, green beans, green onions, honeydew, kai choy, leaf lettuces, long beans, pak choy, romaine, seed corn, string beans, sweet corn, sweet potatoes, sweet onion, taro leaves, tomatoes, watermelons, and zucchini.

6. LOCATIONAL ADVANTAGES AND DISADVANTAGES FOR CROP PRODUCTION

The Petition Area is well-located for serving the Honolulu consumer market and export markets. This is due to the short trucking distance to the Honolulu markets, the Honolulu International Airport, and Honolulu Harbor.

In the U.S. mainland market, farmers in Hawai'i must compete against farmers on the mainland and in Mexico, Central and South America, the Caribbean, Australia, New Zealand, Southeast Asia, etc. Most of the competing farm areas have lower production and delivery costs than Hawai'i does. Competing against Mexico is particularly difficult given the North America Free Trade Agreement (NAFTA) and Mexico's proximity to major U.S. markets.

7. SURROUNDING LAND USES[2]

Existing and planned land uses surrounding the Petition Area are shown in Figure 6. By direction, these uses are as follows:

- To the north (*mauka*) are the H-1 Freeway, agricultural fields in Kunia and grazing lands in the Kunia foothills. All of these Kunia lands were once owned by James Campbell Company LLC (JCC). But over the past few years, JCC sold some of them and is in the process of selling the remainder. These lands are expected to remain in agriculture with the exception of land near Schofield Barracks which was purchased by the U.S. Army.
- To the east are Fort Weaver Road, Old Fort Weaver Road, the West Loch Golf Course, and the residential communities of Waipahu, Honouliuli, and West Loch Estates
- To the south (*makai*) are the 'Ewa Villages and other residential communities.
- To the west are agricultural fields on land owned by the State. These lands are in the Urban District and are scheduled to be developed as part of UHWO campus and related residential and commercial development, DHHL East Kapolei residential projects, DHHL commercial center, and the Kroc Community Center on DHHL land (Figure 6).

As indicated, urban development has occurred or will occur to the east, south and west of the Petition Area. Homes to the west will be downwind of the Project.

8. HISTORIC AGRICULTURAL USES[1,15-18]

Following the Mahele of 1848, the Petition Area was part of a 43,250-acre grant which, from 1871 to 1877, was leased for cattle grazing. In 1877, James Campbell purchased most of the property (including the Petition Area) for cattle ranching.

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In 1889, Campbell leased most of the 'Ewa Plain to Benjamin Dillingham who, in turn, subleased the land to the 'Ewa Plantation Company to cultivate sugarcane. The 'Ewa Plantation Company grew quickly and continued operating until 1970 when the O'ahu Sugar Company, Ltd. (OSCo) took over operations. Sugarcane cultivation continued on about 1,375 acres of the Petition Area until 1995 when OSCo closed.

Since the mid-1990s, the Petition area has been leased for diversified crop farming (that is, crops other than sugarcane or pineapple).

9. EXISTING AGRICULTURAL OPERATIONS

a. Agricultural Leases[1]

Currently, about 1,497 acres (96%) of the Petition Area are leased to three companies to grow diversified crops. As shown in Figure 10, these companies are:

- Aloun Farms, Inc. (about 1,100 acres)
- Sugarland Farms, Inc. (about 197 acres)
- Syngenta Seeds, Inc. (about 200 acres)

In addition, Fat Law's Farm subleases about 100 acres from Aloun Farms. These four farms are described below.

b. Aloun Farms, Inc.[1,13]

Since 1997, Aloun Farms has leased about 1,097 acres of the Petition Area, of which about 1,003 acres are considered arable. The original lease was with The Estate of James Campbell, now James Campbell Company, LLC (Campbell). The lease expires in 2013, but is subject to withdrawal rights by the landowner. In April 2007, lease rents were about $194 per acre per year for arable land, which is below current market rents for good agricultural land on O'ahu.

Aloun Farms leases an additional 3 acres of arable land for its major facilities, discussed below. The lease expires in 2017 and the landowner does not have withdrawal rights. In April 2007, lease rents were $150 per acre per year.

In addition to the lands in the Petition Area, Aloun Farms and a company affiliated with it (A.M. Enterprises, LLC) lease about 1,440 acres in 'Ewa, Kunia and Central O'ahu. Thus, Aloun Farms (with its affiliate) leases a total of about 2,540 acres. However, about 100 acres of its Ho'opili lands are subleased, resulting in a net of about 2,440 acres available to Aloun Farms. Nearly all of this land is arable, and most of the fields are of high quality. Having fields in 'Ewa, Kunia and Central O'ahu allows Aloun Farms to maintain year-round production of certain crops by taking advantage of the climatic and seasonal differences between the planting areas.

Averaged over time, about 910 acres (37%) are in crop. They farm their 'Ewa fields less intensively than the average (about 33% of the land in crop), while the Kunia and Central O'ahu fields are farmed more intensively (about 50% of the land in crop).

The 3-acre parcel mentioned above has two buildings on it having a combined footprint of about 22,600 square feet. The buildings are used by Aloun Farms for its cooling plant, packing facilities, and some of its warehouse space. To the east side of this parcel and within the Petition Area, nine buildings having a combined footprint of about 26,900 square feet provide additional operating and storage space.

Aloun Farms with its affiliate is the second largest diversified fruit and vegetable operation in Hawai'i. It is managed by skilled entrepreneurs who have special expertise in Asian vegetables and melons and in Asian markets. In 2006, Aloun Farms provided about 140 full-time-equivalent (FTE) jobs, including about 20 jobs involved with managing the operations. Salaries average about $22,000 per year.

Crops grown by Aloun Farms for the Hawai'i and overseas markets include:[11]

- Vegetables: bean shoot, broccoli, camote leaf (potato leaf), choy sum, daikon (Chinese and Korean), green onion, Japanese cucumber, kabocha squash, kai choy, long beans, long eggplant, pak choy, paria leaf (bitter melon leaf, peppers, radish, romaine and leaf lettuces, saluyot, string beans, sweet corn, sweet onion, won bok (Chinese cabbage), and zucchini.
- Fruits and melons: apple banana, cantaloupe, honeydew, Korean melon, Thai watermelon (small variety seedless red, yellow, seedless yellow), and watermelon.
- Herbs and spices: basil, chives, lemongrass, mint, and parsley (American and Chinese).
- Seed crops: corn and potatoes.

About 30% of the crops are grown in specific locations that take advantage of the distinctive climatic and agronomic conditions found in 'Ewa, but could be grown in areas having similar conditions. For certain crops, a few seasons are

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required to determine the best location for the crop, the best variety for the location, the best time to plant, etc.

Table 2 summarizes the consultant's estimates of the 2007 economic activity generated by agricultural operations in the Petition Area, along with the assumed multipliers used in the calculations. As shown for Aloun Farms, the estimates are approximately $3 million per year in revenues, an average employment of 45 jobs, and about $1 million per year in payroll.

c. **Fat Law's Farm, Inc.**[1,11,12]

Fat Law's Farm subleases about 100 acres from Aloun Farms. Their fields are located in the southeast corner of the Aloun lands (see Figure 10), extending south along the lower half of Old Fort Weaver Road and continuing along Fort Weaver Road. The operators began farming at this location on a little over 61 acres in 1996. The lease is month-to-month, and lease rents in April 2007 were about $630 per acre per year for arable land. At any given time, about 60 acres (60%), on average, are in crop and about 40 acres are between crops.

The company farms no other land in Hawai'i. However, they market produce that is farmed by relatives and friends on about 120 to 150 acres. Also, they have leased 150 acres in Hainan, China were they plan to grow tropical fruits (e.g., papaya) and vegetables to be marketed in Hong Kong, mainland China and Japan.

Fat Law's Farm has two on-site structures (about 12,800 square feet under roof) which house their offices, cooling plant, and warehouse space.

Fat Law's Farm is one of Hawai'i's main producers of fresh herbs and vegetables. Its primary crops are basil (Thai, hot and sweet), cucumbers, long beans, malongai leaves, and taro (leaves and stem). Other crops (which the Farm grows itself or markets for other farmers) include betai leaf, bitter melon, chives, curry leaf, la lop, long squash, ngo gai, peppermint, and Thai ginger.

Hawai'i customers include farmers' markets, supermarkets, produce stores, restaurants and wholesalers. The operation also exports Thai basil, sweet basil, taro leaves, chives, curry leaves, and malongai leaves to at least 14 major cities across the United States. They are nicknamed the "King of Basils," due to the fact that they provide more than 60% of the basil exports from Hawaii to the mainland.

In 2006, the U.S. Small Business Administration honored them as Exporter of the Year for Hawai'i and the Western United States. Also, Fat Law's Farm has received many awards for their outreach efforts to help immigrant small-scale farmers. They have provided encouragement, advice on farming practices, marketing help, and other assistance.

Table 2. Economic Activity Generated by Agricultural Operations in the Petition Area: 2007
(approximate estimates by DAHI)

	Aloun Farms	Fat Law's Farm	Jefts Farms	Syngenta	TOTAL
Agricultural acreage					
Total	1,000[1]	100	197	200	1,497
Arable land	903[2]	100	192	177	1,372
Average land in crop					
Percentage in crop	33.3%	60%	33.3%	25%	
Acres in crop	301	60	64	44	469
Adjustments	___	___	10[3]	8[4]	18
Adjusted acres in crop	301	60	74	52	487
Revenues (average annual)					
Revenue per acre in crop (thousands)	$10	$30	$10	$17	
Total revenues (millions)	$3.0	$1.8	$0.7	$0.9	$6.4
Employment (average)					
Jobs per 100 acres in crop	15	33	10	25	
Total Jobs	45	20	7	13	85
Payroll (average annual)					
Salary per job (thousands)	$22	$22	$25	$25	
Total payroll (millions)	$1.0	$0.4	$0.2	$0.3	$1.9

1. Excludes 100 acres leased to Fat Law's Farm.
2. Excludes 3 acres used for facilities.
3. 30 acres of Syngenta land used by Jefts Farms, with an average of 33% in crop, and assuming no reduction in acreage farmed by Jefts Farms.
4. 30 acres of Jefts Farms land used by Syngenta, with an average of 25% in crop, and assuming no reduction in acreage farmed by Syngenta.

Source: Decision Analysts Hawai'i, Inc.

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Fat Law's Farm sells about $3 million of fresh herbs and vegetables annually. Approximately 60% of the sales are derived from its own production, while the remainder comes from selling produce from other farms.

Employment averages about 20 FTE jobs, including six management positions. Workers earn about $6.75 to $7.25 per hour.

For the immediate future, about 5 acres will be converted to organic crops, followed by additional conversions if production proves profitable and demand is sufficient. Growing organic crops will increase revenues since they command higher prices, while the cost of chemicals will be reduced. However, the crops will have to be grown in plastic greenhouses to protect them from insects and wind.

Table 2 summarizes the consultant's estimates of the 2007 economic activity for Fat Law's Farm that takes place in the Petition Area. As shown, the estimates are approximately $1.8 million per year in revenues, an average employment of 20 jobs, and about $400,000 per year in payroll.

d. Sugarland Farms, Inc. ("Jefts Farms")[1,13,14]

Since late 1994, Sugarland Farms has leased about 197 acres in the Petition Area, of which about 192 acres are arable (see Figure 10). The original lease was with Campbell. The lease is year-to-year, and lease rents in April 2007 were about $231 per acre per year for arable land, which is slightly below current market rents for good agricultural land on O'ahu. In addition, Sugarland Farms and Syngenta have an arrangement that allows them to exchange between the two of them 30 acres at no charge. This enables Sugarland Farms to cultivate 30 additional acres in the Petition Area (see Figure 10). Thus, Sugarland Farms cultivates a total of about 227 acres in the Petition Area. The advantage to Syngenta is that it can more easily isolate seed plantings away from its other varieties to avoid cross-pollination.

Sugarland Farms is part of a larger group of family agricultural operations that collectively is referred to in this report as the "Jefts Farms." They include, but are not limited to: Larry Jefts Farms, LLC; Sugarland Farms, Inc.; Sugarland Distribution, Inc.; Waikele Farms, Inc.; and Akea Farms, Inc.

Jefts Farms comprises the largest diversified fruit and vegetable agricultural operation in Hawai'i, with agricultural lands estimated by the consultant at over 5,000 acres. Their fields are located in, but are not limited to, the following areas:

- 'Ewa fields in the Petition Area as noted above.
- Other 'Ewa fields that are sandwiched between the H-1 Freeway and Farrington Highway, and between and to the west of the Sugarland fields shown in Figure 10. These lands are leased from the State.
- Other 'Ewa fields east of Fort Weaver Road and within the Navy's Blast Zone for the West Loch Naval Magazine. Jefts Farms leases these lands from the U.S. Navy.
- Fields in Kunia north of the H-1 Freeway and west of Kunia Road. Jefts Farms leases some of this land from the State and, until recently, the remainder was leased from Campbell. However, most of the Campbell land in lower Kunia was sold to Pioneer Hi-Bred International and the Monsanto Company (Monsanto) for expanded seed-corn operations.
- Fields in Kunia to the north of the H-1 Freeway and east of Kunia Road. Jefts Farms leases most of these lands from Robinson Estate and the remainder from the State.
- Lands at Mokule'ia, O'ahu that are leased from Dole Food Company Hawai'i.
- Lands on Moloka'i.

The heart of Jefts Farms is the Kunia land that it leases from Robinson Estate. Jefts Farms main offices, cooling plant, packing facilities, warehouses, etc., are located in Kunia near the Hawai'i Country Club. These Robinson lands are outside the County's Urban Growth Boundary and, as such, will remain in agriculture for the foreseeable future.

Most of the Jefts Farms fields in Kunia and Central 'Ewa are of high quality. Averaged over time, about one-third of these lands is in crop. By having fields in both Kunia and 'Ewa, Jefts Farms is able to take advantage of the climatic and seasonal differences between the two planting areas to maintain year-round production of certain crops. For example, tomatoes and peppers are planted in Kunia during the Summer months, and in 'Ewa during the Winter months.

Principal crops grown by Jefts Farms include: bell peppers, cabbages, canteloupes, cucumbers, green beans, onions, sweet potatoes, tomatoes, and watermelons. Most of the produce is grown for the Hawai'i market, but some is exported. In addition to its own crops, about 150 acres are subleased each season to Syngenta for its seed-corn operation (see below)—this is in addition to the 30 acres discussed above that Jefts Farms exchanges with Syngenta.

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Employment by Jefts Farms is estimated by the consultant to exceed 150 farmhands. Annual salaries range from about $16,600 ($8 per hour) to over $60,000 for about a dozen key managers and technical experts.

Table 2 summarizes the consultant's estimates of the 2007 economic activity generated by farming activity in the Petition Area. As shown, the estimates for Jefts Farms are approximately $700,000 per year in revenues, an average employment of 7 jobs, and about $200,000 per year in payroll. This estimate takes into account the 30 acres of Syngenta land farmed by Jefts Farms.

e. Syngenta Seed, Inc.[II.34]

Syngenta is a global agribusiness headquartered in Switzerland with roots going back to 1758. In 2005, company sales amounted to about $8.1 billion which was derived from selling seeds (corn, soybean, other field crops, vegetables, and flowers) and crop-protection products (herbicides, fungicides and insecticides).

In Hawai'i, Syngenta is one of five major seed companies that use conventional breeding practices and genetic engineering to create improved or new parent seed corn—that is, corn seeds that will provide high yields of quality corn from plants that tolerate droughts and resist diseases. Most of the world's commercially grown corn can be traced back to Hawai'i. Syngenta and other companies also conduct research on soybeans, and other seed companies conduct research on sunflowers, soy, wheat and cotton. These seed companies are expanding steadily in Hawai'i: from the 2000/01 to the 2005/06 crop year, the amount of land in seed crops increased from 3,100 acres to 4,220 acres, and the value of the crop increased from about $37.5 million to about $70.4 million. The primary advantage of operating in Hawai'i is the year-round growing conditions which allow faster development of new hybrids and varieties: three crops per year are possible in Hawai'i versus one crop per year on the mainland. Hawai'i also provides a stable political and economic environment relative to other regions having similar agronomic conditions.

Since 1995, Syngenta has leased about 200 acres in the Petition Area, of which about 177 acres are arable (see Figure 10). The original lease was between Campbell and Garst Seed Company. Syngenta took over the lease when it purchased Garst in 2004. The lease expires in 2008, but is subject to withdrawal rights by the landowner. In April 2006, lease rents were about $215 per acre per year for arable land, which is slightly below current market rents for good agricultural land on O'ahu.

On average, about 45 acres of Syngenta's land in the Petition Area are used for parent seed operations (i.e., operations that increase the supply of selected seed varieties). The corn is normally planted in patches with considerable separation from other corn varieties in order to control pollination of the plants. In addition to its own plantings, Syngenta has an arrangement that allows Jefts Farms to use about 30 acres of Syngenta land in the Petition Area for vegetable crops. In exchange, Syngenta has use of a similar amount of land from Jefts Farms.

In total, Syngenta leases or subleases about 740 acres on O'ahu for its seed operations, including:

- The approximately 200 acres mentioned above.
- About 360 acres in Kunia that are under a long-term lease, subject to cancellation clauses. These lands front the west side of Kunia Road below Waiahole Ditch. The fields are used to research corn varieties and, to a lesser extent, soybeans. Also, Syngenta's processing facilities, warehouse, and offices are located there.
- About 30 acres that are made available as part of a land exchange with Jefts Farms. Plantings can occur in 'Ewa or Kunia.
- About 150 acres that are subleased seasonally from Jefts Farms. Plantings occur in 'Ewa and Kunia.

Most of Syngenta's fields in Kunia and 'Ewa are of high quality. In addition to its O'ahu operations, Syngenta has about 3,000 acres on Kaua'i for its seed operations.

On O'ahu, Syngenta provides employment for about a dozen full-time workers, 15 to 20 part-time workers, and about 60 to 90 temporary workers during the peak Winter season. Corresponding figures for the parent-seed portion of their operation—which includes farming the 'Ewa fields—are about two full-time workers, four part-time workers, and 10 to 15 workers in surges. Wages range from $8.75 to $17 per hour.

Table 2 summarizes the consultant's estimates of the 2007 economic activity generated by agricultural operations in the Petition Area. As shown, the estimates for Syngenta are approximately $900,000 per year in revenues, an average employment of 13 jobs, and about $300,000 per year in payroll. This estimate takes into account the 30 acres of Jefts Farms land that is farmed by Syngenta.

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f. Summary of Economic Activity of Agricultural Operations in the Petition Area; 2007

For all four agricultural operations, the consultant's estimates of the 2007 economic activity they generate in the Petition Area totals approximately $6.4 million per year in revenues (about $4,665 per acre on average), an average employment of about 85 jobs (about 6.2 jobs per 100 acres), and about $1.9 million per year in payroll (see Table 2).

10. CUMULATIVE LOSS OF LAND FOR THE AFFECTED AGRICULTURAL OPERATIONS

In addition to the leased and subleased lands that gradually will be lost as the Project is developed over a 20-year period, three of the four agricultural operations in the Petition Area will eventually lose agricultural lands to (1) other private and State urban projects in 'Ewa and Central O'ahu that are within the County's Urban Growth Boundary, and (2) other agricultural operations in Kunia. The cumulative loss of land for the affected agricultural operations is addressed in this section. The related cumulative impact on them is addressed in Section 13.

a. Overview[1,18,19-23]

For the affected agricultural operations, the approximate cumulative reductions in acreages are summarized in Table 3, and include the following:

— Urban Projects within the County's Urban Growth Boundary

- Ho'opili, Ewa: about 1,497 acres of farm land currently leased or subleased to the four farms in the Petition Area. Some of the land will used by the State Department of Transportation for the North-South Road.
- State projects, 'Ewa: about 945 acres currently farmed by Aloun Farms and Jefts Farms. State projects include (1) the UH West O'ahu campus and related residential and commercial development, and (2) a DHHL residential and commercial development (see Figure 6).
- Koa Ridge, Central Oahu: about 430 acres currently farmed by Aloun Farms. This is a proposed residential community by Castle & Cooke Homes Hawai'i.

— Changes in Agricultural Uses

- State Ag Park, Kunia: about 150 acres currently farmed by Jefts Farms.

Table 3. Cumulative Loss of Land for the Affected Agricultural Operations
(approximate acreage estimates by DAI-II)

	Aloun Farms	Fat Law's Farm	Jefts Farms	Syngenta	TOTAL
Urban Projects					
Ho'opili, 'Ewa	1,000	100	197	200	1,497
State Projects, 'Ewa[1]	850	-	95	-	945
Koa Ridge, Central O'ahu	430	-	-	-	430
Agricultural Uses					
State Ag Park, Kunia	-	-	150	-	150
Monsanto Co., Kunia	-	-	220	360	580
Total	2,280	100	662	560	3,602

1. UHWO, DHHL and other State projects.

Source: Decision Analysts Hawai'i, Inc.

- Monsanto, Kunia: about 580 acres currently farmed by Jefts Farms and Syngenta. Monsanto is a major seed company that purchased land in 2007 in lower Kunia west of Kunia Road.

Altogether, the four agricultural operations in the Petition area are projected to lose about 3,600 acres of their leased land: about 2,870 acres to private and State urban projects located within the County's Urban Growth Boundary, and about 730 acres which will remain in agriculture but will be farmed by other operators. Syngenta's and Jefts Farms' losses of acreage to Monsanto (another agricultural operation) may occur within a few years. The agricultural land lost to urban projects is likely to begin in a few years and continue until as late as 2030.

b. Aloun Farms

Aloun Farms is expected to gradually lose about 2,380 acres to urban projects (see Table 3). This will leave Aloun Farms with just 160 acres of its current Kunia farm, assuming that the lease to this land is renewed. This is the only land leased by Aloun Farms that is outside the County's Urban Growth Boundary.

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c. **Fat Law's Farm**

As shown in Table 3, Fat Law's Farm eventually will lose all of its 100-acre farm to Ho'opili.

d. **Jefts Farms**

Table 3 shows that Jefts Farms is projected to lose about 660 acres of good farm land: approximately 197 acres to Ho'opili, 95 acres to State urban projects, 150 acres for the State Ag Park in Kunia, and 220 acres to Monsanto's seed operation. Also, Jefts Farms will eventually lose access to Syngenta's 30 acres in 'Ewa since this is within the Petition Area. In addition, Jefts Farms lost about 230 acres of cultivated land in lower Kunia that Campbell sold to Pioneer Hi-Bred International (a seed company) in 2006.

Even with these acreage reductions, Jefts Farms will retain an estimated 4,000+ acres of farm land, and will remain the largest diversified fruit and vegetable farm operation in Hawai'i. On O'ahu, all of Jefts Farms remaining land is located outside the County's Urban Growth Boundary.

e. **Syngenta**

Syngenta is expected to lose about 560 of its 740 acres on O'ahu—this includes 360 acres purchased recently by Monsanto for its seed operations, and 200 acres in the Petition Area (see Table 3).

In addition to the direct acreage losses, Syngenta will no longer have use of the 30 acres on Jefts Farms leased land since Syngenta will no longer have land in 'Ewa to provide to Jefts Farms in exchange (see Section 9.d). Furthermore, inasmuch as Jefts Farm will have less land to sublease, Syngenta could lose access to some of the 150 acres that they sublease from Jefts Farms.

11. CHANGES TO AGRICULTURAL OPERATIONS BEFORE HO'OPILI IS DEVELOPED

a. **Relocation of Syngenta**

Monsanto's 2007 land purchase in lower Kunia includes all of the 360 acres in Kunia that comprise the core of Syngenta's operations on O'ahu. Because of this purchase, the consultant anticipates that Syngenta will relocate from Kunia to some other area. And because of termination clauses in the existing lease, it is likely that this relocation will occur within the next few years—with or without Ho'opili, and before Ho'opili construction even begins.

If Syngenta is to retain its same size after relocating, then they will require about 740 acres of replacement land—the approximate acreage that they now lease and sublease in Kunia and 'Ewa. Syngenta could relocate to Kaua'i where they already lease about 3,000 acres, although the North Shore of O'ahu is also a possibility.

If the company relocates to Kaua'i, then the demand for good farm land on O'ahu will decrease by about 740 acres while the demand on Kaua'i will increase by a similar amount (the acreage could be somewhat less than 740 acres if Syngenta farms their existing lands on Kaua'i more intensively). In this scenario, the economic activity for Syngenta's O'ahu operation would be transferred to Kaua'i. This would include about a dozen full-time workers, 15 to 20 part-time workers, and about 60 to 90 temporary workers during the peak Winter season.

b. **Interim Agriculture on Land Vacated by Syngenta**

After Syngenta vacates the 200 acres it now leases in the Petition Area, it is expected that the land will be leased to a farmer until construction on this site is ready to begin.

Future economic activity associated with diversified crop farming on the land to be vacated by Syngenta is estimated at about $600,000 per year in revenues (based on 177 arable acres with one-third in crop, and revenues of about $10,000 per acre per year); about six jobs (based on ten jobs per 100 acres in crop); and a payroll of about $150,000 per year (based on about $25,000 per job).

c. **Reduction in Jefts Farms Operations**

After Syngenta vacates its 'Ewa fields, Jefts Farms will lose the 30 acres it now farms there as part of its land exchange with Syngenta (unless Jefts Farms leases the entire 200 acres). Thus, the economic activity shown in Table 2 for Jefts Farms will decrease slightly: about $100,000 less in annual revenues, about one less job, and about $25,000 less in annual payroll.

d. **Summary of Economic Activity of Agricultural Operations in the Petition Area: 2010**

Table 4 shows the consultant's resulting estimate of the economic activity generated by farming in the Petition Area by about 2010 after Syngenta is replaced by some other farming operation but before the Ho'opili construction begins. As shown, projected economic activity includes approximately $6 million per year in revenues (about $4,373 per acre on average), an average employment of slightly less than 80 jobs (about 5.6 jobs per 100 acres), and about $1.7 million per year in payroll.

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Table 4. Projected Economic Activity Generated by Agricultural Operations in the Petition Area: 2010
(approximate estimates by DAHI)

	Aloun Farms	Fat Law's Farm	Jefts Farms	Interim Farm	TOTAL
Farm acreage					
Total	1,000[1]	100	197	200	1,497
Arable land	903[2]	100	192	177	1,372
Average land in crop					
Percentage in crop	33.3%	60%	33.3%	33.3%	
Acres in crop	301	60	64	59	484
Revenues (average annual)					
Revenue per acre in crop (thousands)	$10	$30	$10	$10	
Total revenues (millions)	$3.0	$1.8	$0.6	$0.6	$6.0
Employment (average)					
Jobs per 100 acres in crop	15	33	10	10	
Total Jobs	45	20	6	6	77
Payroll (average annual)					
Salary per job (thousands)	$22	$22	$25	$25	
Total payroll (millions)	$1.0	$0.4	$0.15	$0.15	$1.7

1. Excludes 100 acres leased to Fat Law's Farm.
2. Excludes 3 acres used for facilities.

Source: Decision Analysts Hawai'i, Inc.

12. AVAILABILITY OF REPLACEMENT LAND

As discussed in Sections 10 and 11, the farms that operate within the Petition Area will lose land to Ho'opili and to other urban projects, and to changes in agricultural uses. The impact of this cumulative loss of land on the affected agricultural operations will depend on the amount and quality of replacement land that will be available to them in the future to offset their land losses. The availability of replacement land Statewide and on O'ahu is reviewed below.

a. Statewide

Statewide, a vast amount of land has been released from plantation agriculture: about 251,800 acres between 1968 and 2005, resulting in an average release of over 6,800 acres per year over a 37-year period (see Figure 11).[10,24] The 2006 Del Monte closure in Kunia increased this figure by another 4,400 acres, resulting in a total release of at least 256,200 acres from plantation agriculture between 1968 and 2007.[25,26] Over the 1968-to-2005 period, the demand for land for diversified crops increased by about 26,300 acres (about 10% of the land released from plantation agriculture).[10]

As the above figures indicate, the acreage released from plantation agriculture has far outpaced the demand for land for diversified crops. The net decrease in diversified crop land amounts to about 229,900 acres. While some of the released land has been converted or is scheduled to be converted to urban uses and tree plantations, an estimated 160,000+ acres remain available for diversified crops.[26] Because of the increased availability of agricultural land, a number of landowners report lower per-acre agricultural land rents on O'ahu and the Neighbor Islands compared to rents charged before the major contraction in plantation agriculture.[27]

If the Hawai'i Superferry is successful, cultivating crops on the Neighbor Islands for the Honolulu market, and vice versa, may become more economically feasible. For a full load carried in a large pick-up truck, the one-way fare will be about 2¢ per pound.[28] However, for some perishable crops, the ferry service may not be sufficiently frequent and/or delivery times may not be sufficiently rapid.

The above information indicates that considerable land is available in Hawai'i to accommodate the relocation of agricultural operations as well as the growth of diversified crop farming (see Sections 13 and 15).

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b. O'ahu

On O'ahu, a similar release of plantation land occurred. Between 1968 and 2007, about 51,900 acres were released from plantation agriculture due to the contraction of five plantations and the closures of all but one of them.[10,26] About 32,700 acres were released after 1990. Much of this land remains available for agriculture, and most of it lies outside the County's Urban Growth Boundary.

The Kunia fields are considered to be among the best farm land in the State, based on the high solar radiation, high-quality soils, and the short trucking distance to the large Honolulu market, the airport, and Honolulu Harbor.[29] Except for lands recently released by Del Monte, all of the better Kunia fields have already been leased for diversified crop farming. However, on average, only about one-third of this land is in crop.[30] The large amount of fallowing reflects best management practices when farm land is abundant and land rents are relatively low. Fallowing increases soil fertility and helps control unwanted volunteer plants, weeds, insects and disease. When demand for farm land is strong and rents are high in response to a strong demand for agricultural products, then more intensive farming of the land may be warranted even if this increases farmers' costs for pest control and soil additives.

Of the estimated 4,400 acres of Kunia land recently farmed by Del Monte, about 3,200 acres remain available. The decrease was due to (1) Monsanto's land purchase in lower Kunia for seed crops, and (2) the U.S. Army's land purchase in upper Kunia for expanding Schofield Barracks. These two purchases involve considerable land, including about 640 acres and 580 acres, respectively, of former pineapple fields.[21,31]

Another possible land purchase could impact the future supply of farm land in Kunia. The Army Hawai'i Family Housing LLC (AHFH), a public/private partnership between the U.S. Army and Actus Lend Lease, plans to acquire about 2,520 acres in northern Kunia from Campbell, including about 1,570 acres of former pineapple land.[21,32] AHFH intends to "bank" the land for future needs, which will allow a portion it to be used for military housing if needed in the distant future. If and when AHFH proposes the land for development, the project will be subject to all State and County development approvals and permits, which could prove difficult since the development would be outside the County's existing Urban Growth Boundary. AHFH has indicated that if the land is purchased, it would remain in agriculture for the foreseeable future.

On the North Shore, various crops are being grown, but about 7,750 acres of the former sugarcane and pineapple lands remain fallow or are in a low-value use.[27,33]

In total, about 10,900 acres of former plantation land remain available on O'ahu for other crops, including about 3,150 acres of former pineapple land in Kunia plus the 7,750 acres on the North Shore. However, this excludes any adjustment for the farm land that is already leased for diversified crops but is not farmed intensively, some arable lands in the foothills that are used for grazing, and a portion of the 2,290 acres (about 1,600 acres arable) purchased by Monsanto that might remain available for crops other than seed crops.

Given the large release of land from plantation agriculture on O'ahu, the amount of available farm land that remains on O'ahu is lower than what might be expected. This is explained by: (1) farmers relocating to or expanding on these high-quality and favorably located lands, thereby reducing the amount of land farmed elsewhere on O'ahu and the Neighbor Islands; (2) extensive fallowing of fields that are under lease; (3) growth of seed operations on O'ahu; (4) transferring land in the foothills from farming to grazing because of the lower demand; (5) urbanization in 'Ewa and Central O'ahu; and (6) military use of some land.

Much of the available 10,900 acres have limitations for growing certain crops. Some limitations reflect permanent agronomic and other conditions. For example, the higher elevation fields in Kunia and on the North Shore have less solar radiation compared to 'Ewa: the average daily insolation is about 400 calories per square centimeter at higher elevations compared to as much as 500 calories in 'Ewa.[7] In addition, fields at higher elevations incur higher pumping costs, although rainfall reduces water requirements. Also, North Shore farmers encounter longer trucking distances to Honolulu markets, the airport, and the harbor.

Nevertheless, some limitations can be overcome with investment in improvements. For example, on the North Shore, portions of the water delivery systems need major repairs to address current leaks and to prevent future ones.[27,34] Because of the leaks, a number of mid-level and high-level fields on the North Shore can no longer be irrigated in the summer months. Also, the types of crops on fields irrigated with water from Wahiawa Reservoir (Lake Wilson) will be restricted as long as partially-treated wastewater continues to be discharged into the lake.[35] Water from the lake can be used to irrigate tree crops (e.g., papaya and coffee) and crops such as sugarcane that are processed sufficiently to kill pathogens. However, the water cannot be used to irrigate the wide variety of fresh vegetable crops that are now grown in 'Ewa and Kunia.

Regardless of the above difficulties, the available supply of farm land on O'ahu will be partially absorbed over time as island farmers expand production.

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This expansion will reflect the advantages to them of farming fields near the large Honolulu markets, and near the State's primary transportation/distribution centers (i.e., Honolulu Harbor, Honolulu International Airport, and many companies involved in distributing goods inter-island and overseas).

13. Direct and Cumulative Impacts on the Affected Agricultural Operations

a. Loss of Land for the Affected Agricultural Operations

The Project will result in a direct loss of about 1,497 acres currently being leased for various agricultural operations. In combination with land lost to other State and private urban projects and to other agricultural uses, the four agricultural operations in the Petition Area will incur a cumulative loss of about 3,600 acres of their leased land (Section 10 and Table 3). The amount of arable land will be somewhat less. However, as noted above, it is expected that Syngenta will relocate for reasons unrelated to and before the Ho'opili construction begins.

b. Required Replacement Land

If Syngenta remains on O'ahu, then about 3,600 acres of replacement land will be needed on O'ahu by the four the affected agricultural operations. But, if Syngenta relocates its O'ahu activities to Kaua'i where most of its operations are located, then the O'ahu demand will be reduced by 740 acres (see Section 9.3), resulting in a need for less than 2,900 acres of replacement land.

Desired physical characteristics of replacement lands include: large gently-sloping fields, good soils, high solar radiation, and affordable irrigation water of sufficient quality to use on any type of crop.

As summarized in the previous section, sufficient land is available on O'ahu and the Neighbor Islands. Nevertheless, major water-related improvements are required before all available agricultural lands on the North Shore of O'ahu will be suitable for growing diversified crops. Also, the available lands possess different agronomic conditions than those found in 'Ewa and lower Kunia.

c. Direct On-site Agricultural Impacts

In isolation, Ho'opili will result in the gradual on-site loss of all agricultural activity in the Petition Area, along with the related gradual loss of approximately $6 million per year in revenues, an average employment of slightly under 80 jobs and about $1.7 million per year in payroll.

In practice, however, most or all of the agricultural operations on the Ho'opili land are expected to relocate to other lands (see the next subsection).

d. Anticipated Changes in Agricultural Operations

Until 2030, the agricultural operations located in the Petition Area are likely to adjust to gradual acreage losses by implementing a combination of the following:

— Leasing replacement lands

As discussed in the previous section, replacement lands are available in Kunia and on the North Shore, subject to (1) water-related improvements on the North Shore, and (2) adjustments that will have to be made by farmers to their crops and farming practices (see below).

— Cultivating remaining lands more intensively

Some farmers may be able to partially offset their acreage losses by fallowing less and keeping more of their land in crop. However, this may increase their costs for pest control and soil additives.

— Reducing operations

If the above two adjustments are not sufficient to offset future acreage losses, then farmers will have to reduce the sizes of their operations.

By 2030, however, Aloun Farms will lose nearly all and Fat Law's Farm will lose all their leased lands, thereby necessitating relocation to Kunia and/or the North Shore.

Assuming that the affected lessees secure replacement lands, and assuming the necessary water improvements are made, then the affected agricultural operations could maintain about the same level of production, sales revenues, employment and payroll. However, major adjustments in their operations will be required since the replacement lands will have different agronomic conditions (e.g., soils, temperature, solar radiation, and rainfall). Adjustments will include growing varieties that are more suitable to the replacement lands, modifying cultivation practices (which will take a few crop cycles to optimize), and changing the mix of crops if suitable varieties are not available. Also, the lessees will incur additional expenses to prepare the soils and irrigation systems for their particular crops, and to move their offices, and cooling and packing facilities.

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If the agricultural operations lease replacement lands in Kunia, their trucking costs will be about the same. If they lease on the North Shore, then they will incur higher costs for hauling produce into Honolulu—costs that would be similar to what North Shore farmers pay, but lower than what Kahuku farmers pay. At the same time, the higher trucking costs could be partially offset by lower land rents on the North Shore as compared to those in Kunia.

If sufficient replacement land is not available on O'ahu due to the unlikely possibility that it will be used to grow an energy crop (explained in Section 15.a), then one or more of the farms could turn to a Neighbor Island. Potential feasibility is illustrated by the fact that two of the lessees already have agricultural operations on Neighbor Islands, while many Neighbor Islands growers supply O'ahu markets. However, the affected companies which may move to the Neighbor Islands will incur higher transportation costs, and delivery times will be longer. The costs and delays will be similar to those that Neighbor Island farmers now incur to supply the Honolulu market. In the future, these costs and delays may be somewhat lower because of the Superferry and the planned improvements to Interisland barge service. The disadvantages of a Neighbor Island location could be partially offset by lower rents. However, for some perishable crops, the ferry service may not be sufficiently frequent or travel may take too long.

e. Flexibility of Affected Agricultural Operations to Resize

Diversified crop farms such as those operating in the Petition Area generally can be flexible as to their size: profitability can be achieved with a farm that becomes smaller, stays about the same sizes, or becomes larger (provided the market can absorb additional product). This differs from the typical sugarcane plantation which relies on economies of scale to maintain economic viability.

Because the affected diversified crop operations can be flexible with regard to their sizes, it is anticipated that they will survive regardless of the amount of replacement land they lease in the future. More to the point, changes in available agricultural land due to the Project are not likely to threaten the survival of Aloun Farms, Fat Law's Farm, or Jefts Farms.

f. Statewide Impacts

From a Statewide perspective, the cumulative agricultural impact of the Project will be modest regardless of how the affected agricultural operations adjust to losing all, or portions of, their leased acreage. Their lost agricultural

production from the Petition Area and from other areas they now lease will be offset largely by (1) maintaining their current levels of operation and production by leasing replacement lands in Kunia and/or the North Shore, and possibly cultivating their remaining lands more intensively; (2) one or more of them relocating all or portions of their operations to a Neighbor Island; (3) other farmers on O'ahu and the Neighbor Islands increasing their production; or (4) some combination of the three.

Thus, it is likely that there will be little or no loss in Statewide agricultural production, revenues, employment or payroll.

g. Urbanization of Agricultural Lands

Reconfigurations of farms such a those described above are common and appropriate when agricultural operations lease land in the path of planned urban expansion. For the affected operations, much of the land they lease is located in areas that the County and, for much of the 'Ewa Plain, the State have designated for eventual expansion of Kapolei. Also, all current tenants entered into lease agreements with this knowledge and, except for Fat Law's Farm, have benefited from rents that are now below market.

For diversified crop farmers who supply nearby markets, locations on the edge of town can be ideal for them because of the lower trucking costs. And until these lands are urbanized, the best "temporary" use of them may be agriculture—a use that may last decades. For example, the affected operations have cultivated their acreage on the 'Ewa Plain for 10 years or more, and some of this land will probably remain available to them for agriculture until as late as 2030.

But when urbanization does occur, the operations will incur the expense and disruption of relocating all their operations or major portions of them to other lands. Since lessees only have temporary rights to the land, the costs of relocating falls on the farmers and are not an obligation of the landowners. If the costs were an obligation of the landowners, they would avoid leasing their land to crop farmers and put their land in a lower value agricultural use such as cattle grazing which has similar land-management and property-tax benefits.

h. Mitigating Measures

The mitigation measures recommended below will contribute to the successful relocation of the four agricultural operations that will be displaced by Ho'opili in combination with other land-use changes in 'Ewa, lower Kunia and Central O'ahu. They are designed to (1) address water issues that limit crop

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production on the North Shore where most available farm lands on O'ahu are located, and (2) provide sufficient time to make the necessary improvements and arrangements for relocating.

The recommended mitigation measures are categorized by those which may be best implemented by government, and those which are within the purview of D.R. Horton:

— Government

- Upgrade the Wahiawa Wastewater Treatment Plant (WWTP) to treat wastewater to the State's R-1 standard, or eliminate discharging wastewater into the Wahiawa Reservoir.

  This recommendation to the County is consistent with a 1998 Consent Decree with the U.S. Environmental Projection Agency (EPA). Its purpose is to allow farmers to use water from the Wahiawa Reservoir to irrigate any type of crop using any type of irrigation system.

  Until the quality of the reservoir water is improved, most of the available agricultural land on the North Shore cannot be used to grow the types of vegetable crops the farmers grow in 'Ewa and lower Kunia. In turn, one or more agricultural operations that will be displaced by Ho'opili and by other projects may not be able to fully relocate to the North Shore until the improvements are made (assuming that relocating to the North Shore is their best option).

- Repair the Wahiawa Irrigation System (WIS)

  Repairs to portions of the WIS are needed to address major and minor leaks and to prevent future leaks. Because of the leaks, a number of mid-level and high-level fields on the North Shore can no longer be irrigated in the summer months with water from Wahiawa Reservoir. Until these repairs are made and more fields can be irrigated reliably, one or more agricultural operations being displaced by Ho'opili and by other projects may not be able to fully relocate to the North Shore (assuming that relocating to the North Shore is their best option).

  Because of the high cost of the repairs, State and Federal funds may be required.

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- To the extent possible, coordinate the development of Ho'opili with the affect agricultural operators and with developers of adjacent lands so as to maintain farming in 'Ewa for as long as possible.

  The development of Ho'opili and of projects on adjacent State lands could continue until 2030. Until then, farming can continue in 'Ewa, provided that Ho'opili works with the agricultural operators and developers of adjacent land to: (1) maintain access to fields and irrigation water, and (2) phase development to minimize the potential for nuisance issues (discussed in the next section). This will allow more time for others to make the necessary improvements to the WWTP and the WIS.

- Continue to lease agricultural land at below-market rents.

  The affected agricultural operators will have to make frequent adjustments to their operations as development proceeds. These adjustments may include contracting their 'Ewa operations, rearranging water systems, building berms to reduce nuisance problems, etc.

  Continued below-market rents will allow the affected agricultural operators to retain more funds to help finance the required adjustments.

14. NUISANCE ISSUES

a. Potential for Nuisance Issues

Nuisances arising from agricultural operations can become an issue for both residents and farmers. Residents who live close to and downwind from agricultural operations may complain about occasional noise, dust, chemical spraying, etc. In turn, the farmers may have to change their operations in order to address these complaints.

Regarding the existing homes that are located downwind of the agricultural operations in the Petition Area, they are buffered from nuisance problems by (1) farming activities on State land, (2) fallow fields on State land, and (3) the Kapolei Golf Course.

However, nuisance issues could arise during the 20 or so years while agricultural operations continue in portions of the Petition Area and homes are built

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and occupied nearby as part of Ho'opili or other projects on adjacent State lands.

Once Ho'opili and adjacent lands are fully developed, nuisance issues arising from agricultural activities will not occur since the lands will no longer be cultivated.

b. Mitigating Measures

To mitigate potential nuisance issues related to agricultural activities near newly built homes, the following mitigation measures are recommended:

- To the extent possible—and subject to transit alignment, water and other infrastructure improvements—phase the development of homes and coordinate agricultural leases to provide wide separations between homes and upwind agricultural activities.
- For each phase of development of Ho'opili and nearby projects, require farmers to provide a buffer of fallow fields and berms upwind of the homes before the homes are occupied.
- As necessary, limit agricultural activities (restricted hours of operation, restricted plowing and use of chemicals on windy days, etc.) so as to avoid or minimize nuisance problems.
- As long as agricultural operations continue in the Petition Area and on adjacent lands, inform home buyers in the area that they will be living near agricultural activities.

15. GROWTH OF DIVERSIFIED CROPS

The Project will commit about 1,554 acres of agricultural land to a non-agricultural use, of which about 1,375 acres are arable. The impact of this commitment on the growth of diversified crops is addressed below. The material covers the (1) amount of land required for the growth of diversified crops, (2) the adjusted supply of land available for the growth of diversified crops, (3) impact of the Project on the growth of diversified crop farming, and (4) mitigating measures.

a. Potential Acreage Requirements for Diversified Crops

Crops to Replace Imports of Fruits and Vegetables[36]

For low-elevation fruits and vegetables that have a history of profitable production in Hawai'i, potential land requirements in 2010 for 100% import substitution for the Hawai'i and O'ahu markets are estimated at 12,700 acres and 8,600 acres, respectively, plus additional acreage for fallowing land between crop plantings. When allowing for competition from imports, these estimates drop to about half. These estimates take into account estimated consumption, production trends, seasonal and annual market shares, yields, and the number of crops per year. Also, these figures are for acreage in crop—not harvested acreage as is typically reported in government publications.

For many crops grown in Hawai'i, market shares for Hawai'i growers are limited by the following factors: (1) local varieties are not perfect substitutes for all imports (e.g., premium-priced sweet Maui onions versus inexpensive storage onions); (2) some crops cannot be produced profitably in the Summer due to competition from low-cost imports of fruits and vegetables from California, other states, and Mexico; and (3) over-production must be avoided in order to maintain profitable price levels.

Since Hawai'i farmers already supply a portion of the Hawai'i market, land requirements for increased import substitution are a fraction of the above estimates.

Export Crops[10,37,38]

The potential market for export crops is far larger than the Hawai'i market. In 2005, the U.S. population was 296.41 million, compared to Hawai'i's resident-plus-visitor population of 1.45 million. To take advantage of this large potential, Hawai'i farmers are exploring various export crops on lands released from plantation agriculture. Over the next 20+ years, one or more of these crops may prove to be successful and may grow into a major export crop.

However, the history of agricultural efforts in Hawai'i reveals that the successful development of major new export crops requiring large amounts of land is difficult and infrequent. For example, over the past 50 years in Hawai'i, farmers have explored numerous possibilities for export crops, but they have developed overseas markets for just one diversified crop that requires more than 10,000 acres (macadamia nuts at 18,300 acres in 2005); one additional crop that requires more than 5,000 acres (coffee at 8,000 acres); and only five additional crops or crop categories that require more than 1,000 acres each (papaya at 2,395 acres, bananas at 1,145 acres, tropical specialty fruits at 1,230 acres, flowers/nursery products at 3,895 acres, and seed crops at 4,220 acres). Tropical specialty fruits include longan, lychee, mango, rambutan, star-fruit, etc.

At 4,220 acres in 2005 and growing at an average rate of 264 additional acres per year, the seed industry is expected to soon become only the third diversified crop that requires more than 5,000 acres. The fourth crop could be nursery and flower products: 3,895 acres and increasing at 235 acres per year.

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Feed Crops[29]

If feed crops could be grown in Hawai'i and priced competitively against mainland imports, they could replace some of the grains and hay that are now being imported to the State. Unfortunately, a number of commercial attempts in Hawai'i to grow grains and alfalfa have been unsuccessful. The major problems have been (1) pests, particularly birds that eat the grains before they are harvested; (2) humidity that is too high for drying alfalfa properly; and (3) high production costs compared to those of mainland farms.

Biofuel Crops

Crops can be grown to produce biomass to fuel a boiler, or as feedstock to produce fuels. Examples of the latter include sugarcane, corn, or sorghum used to produce ethanol. In turn, the ethanol is used to produce E-10 gasohol (90% gasoline and 10% ethanol). Also, palm oil, soybean, sunflower, kukui nut, avocado, coconut, neem and other crops can be grown to produce biodiesel.[39]

In Hawai'i, the common practice has been to produce biomass as a by-product of some principal crop. For example, at HC&S on Maui and at Gay & Robinson on Kaua'i, the sugarcane by-product bagasse is burned to help fuel their respective power plants. In addition, the biofuel company Maui Ethanol plans to use the sugarcane by-product, molasses, from the two sugarcane plantations as feedstock to produce ethanol.[40,41] Using conventional technology, the sugar in the molasses will be fermented to produce ethanol, followed by distillation to extract the alcohol.

However, O'ahu Ethanol Corporation plans to build an ethanol plant at Campbell Industrial Park using conventional technology but, at least initially, using imported molasses as the feedstock.[40,42] The rated capacity will be 15 million gallons of ethanol per year. For the longer term, this company is exploring the economics of growing sweet sorghum to supply feedstock to its ethanol plant. The sorghum would have to be grown on O'ahu because it would be too expensive to ship the sorghum juice from a Neighbor Island to O'ahu. Sorghum juice is mostly water having a low concentration of sugar compared to molasses. Acreage requirements for a new sorghum biofuel plantation on O'ahu would range from about 6,000 acres for viability to 15,000 acres if juice from sorghum were to replace all imported molasses.[32] This acreage comprises a substantial share, if not all, of the estimated 10,900 acres of crop land that is available on O'ahu as of mid-2007. But it is a small share of the 160,000+ acres of crop land available Statewide (see Section 11.b).

Also, Imperium Renewables Hawai'i LLC is proposing to build by 2009 a biodiesel refinery on State land at Kalaeloa Harbor; it would produce about 100 million gallons of biodiesel annually.[43,44] Similarly, BlueEarth Maui Biodiesel LLC plans to build a similar refinery on Maui that would produce about 120 million gallons annually by 2011. Both will use imported palm oil from Malaysia and other countries as their feed stock, but would refine locally produced vegetable oil if available.

A number of substantial difficulties must be overcome in order to develop one or more biofuel plantations to supply feedstock for ethanol or biodiesel production, including:

— Long-term Leases

In many areas of the State, it will be difficult to lease the large amount of land required for a biofuel plantation at low lease rents for the 30 or so years required to capitalize the investment in a new plantation. Over time, other farmers and other users of land are likely to make higher offers to landowners of lease rents or land purchases. In view of this potential for landowners, the current market value of available farm lands is likely to be higher if landowners do not commit long-term to rents that are low enough to be affordable to a biofuel plantation.

— Capital

Substantial investment capital will be required to cover the cost of improvements and equipment such as: a mill to extract the juice from a biofuel crop; a generating plant to provide power; improvements and upgrades to irrigation systems that are in disrepair; trucks and equipment to harvest and haul harvested plants to the mill, and haul the extracted juice to an ethanol plan or the vegetable oil to a refinery, etc.

— Short-term Profitability

Annual revenues from selling the ethanol plus direct subsidies are estimated by the consultant at about $2,430 per acre (based on an estimated 900 gallons per acre per year of ethanol at about $2.70 per gallon). Even with subsidies, this is low compared to revenues from other crops in Hawai'i. Per-acre returns from biodiesel crops are even less.

Furthermore, the cost of importing molasses or palm oil for feedstock, or importing ethanol may prove to be less expensive

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than growing a biofuel crop in Hawai'i. For similar crops (such as feed crops), importing has proven to be less expensive than growing and processing crops locally. Also, the U.S. Department of Agriculture has found sorghum to be an expensive feedstock for producing ethanol—about 3.7 times more expensive than corn and 63% more expensive than molasses.[15]

As ethanol production increases on the mainland and in Hawai'i, there is a risk that the combined Federal and State subsidies for ethanol (over $2 per gallon) could be reduced, thereby compromising the profitability of a biofuel crop.

— Long-term Profitability

Over the long-term, emerging technology holds promise for a cheaper source of feedstock for ethanol than does growing a biofuel crop on a plantation.[16] Instead of producing ethanol using sugars from conventional sources (e.g., molasses, sugarcane, grains, fruits, etc.), the sugar would come from "cellulosic" sources. Using new technology that is in the early stages of commercialization, sugar that is locked in complex carbohydrates of plants is separated into fermentable sugars. Feedstock would include agricultural wastes, yard clippings, discarded paper, wood waste, etc.—i.e., the green waste that is now used for composting. This new technology promises (1) much higher ethanol yields per ton of biomass because the entire plant can be used as feedstock, and (2) lower costs—particularly if there are no growing costs when waste product is used, and if the operator is paid a fee to dispose of municipal and agricultural waste. Eventually, this less expensive source of feedstock could result in unprofitable biofuel plantations. In Hawai'i, this new technology is being explored by ClearFuels Technology Inc.

O'ahu's municipal waste could produce an estimated 160 million gallons of ethanol compared to the current annual consumption of about 400 million gallons of gasoline.

The above difficulties and risks suggest that the probability of successfully developing and sustaining a biofuel plantation in Hawai'i is low. The more likely scenario is that ethanol will be produced as a by-product of sugar and, over the long-term, it will be produced from green waste.

Recent Crop-acreage Trends[19]

For all diversified crops (i.e., all crops other than sugarcane and pineapple, including crops to replace imports and crops for export) Statewide land requirements grew as shown in Figure 11, with the annual growth by selected periods summarized as follows:[1,2]

— 1963 to 1979: about 839 acres per year.

— 1979 to 1983: about 3,450 acres per year.[1]

— 1983 to 2000: about 310 acres per year.[2]

— 2000 to 2005: about 160 acres per year.

As the above illustrates, growth in acreage of diversified crops has slowed over time.

Regarding major export crops and crop categories, acreage increased for four of them from 2000 to 2005: coffee up an average of 20 acres per year; tropical specialty fruits up 54 acres per year, flowers/nursery products up 235 acres per year, and seed crops up 264 acres per year. During this same period, acreage declined for three of the major export crops: macadamia nuts down an average of 20 acres year, papaya down 90 acres per year, and bananas down 113 acres per year. The net change was an average increase of 350 acres per year.

Regarding crops grown for the Hawai'i market, acreage declined by an average of 190 acres per year from 2000 to 2005.

In summary, the major growth in acreage for diversified crops from 2000 to 2005 came from just two crop categories: seed crops and flowers/nursery products.

These trends are consistent with advances in economic development, transportation and overseas trade. In essence, communities increase their standard of living by increasing their economic specialization and their trade with other communities.

1. In Figure 11, the rapid growth in diversified-crop acreage that occurred during the 1979-to-1983 period largely reflects (1) growth in macadamia-nut acreage which continued until about 1986 when tax-shelter advantages were terminated, and (2) a temporary increase in feed-crop acreage that declined after 1983 and offset the acreage gains in macadamia nuts. The growth in feed-crop acreage may reflect the situation addressed in Footnote 2.

2. In Figure 11, the temporary bump in diversified-crop acreage that occurred in the late 1990s reflects the fact that some former sugarcane fields were newly planted with grasses for future cattle grazing. After cattle grazing began in 2000, much of this acreage was recategorized by NASDA from crop land to grazing land.

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Factors Limiting the Growth of Diversified Crops[35]

A great many crops can be grown in Hawai'i's year-round subtropical climate, and a number of them can be grown profitably in volumes that require a few hundred acres. However, the modest growth in land requirements for diversified crops reflects the fact that few crops can be grown profitably on a large scale. The primary factors that have limited the growth of diversified agriculture in Hawai'i are given below:

- Hawai'i's subtropical climate is not well-suited to the commercial production of major crops that grow better in the temperate mainland climates.
- For certain crops, special hybrids adapted to Hawai'i's subtropical climate are yet to be developed.
- Crop pests are more prevalent and more expensive to control in Hawai'i than they are on the mainland where the cold winters kill many pests.
- Fruit-fly infestations prevent exports of many crops, or require expensive treatment.
- Most soils in Hawai'i have low nutrient levels and therefore require high expenditures for fertilizer.
- Hawai'i suffers from high farm-labor costs, largely because the agriculture industry must compete against the visitor industry and related industries for its labor.
- Compared to many other farm areas that supply U.S. markets, the cost of shipping agricultural supplies and equipment to Hawai'i is high, as is the cost of exporting produce from Hawai'i to mainland markets. High shipping costs are a result of Hawai'i's remote location and to Federal regulations that require use of American-built ships and U.S. crews between U.S. ports.
- For a number of crops, consumption volumes in Hawai'i are too small to support large, efficient farms (i.e., the volumes are too small to realize economies of scale).
- On-going trends towards food suppliers purchasing produce that is certified as safe and towards buying from a single supplier of many food items favor large farms.
- Hawai'i farmers must compete against highly efficient mainland and foreign farms which, in a number of cases, can deliver produce to Hawai'i more cheaply than it can be produced locally. This is due to economies of scale and, in comparison to Hawai'i, low costs for land, labor, supplies, fertilizer, pest control, equipment, etc.

b. Adjusted Supply of Land Available for the Growth of Diversified Crops

As discussed Section 12, about 10,900 acres of farm land are available on O'ahu, and over 160,000 acres are available Statewide. Over time, a portion of this available land supply will be leased to the four agricultural operations that will have to relocated as a result of Ho'opili in combination with other land-use changes in 'Ewa, lower Kunia, and Central O'ahu. As discussed in Section 13, the relocation will require about 2,900 to 3,600 acres, depending on whether Syngenta's O'ahu operation remains on O'ahu or relocates to Kaua'i. The adjusted supply of farm land that will remain available for diversified farming will total about 7,300 to 8,000 acres on O'ahu and over 156,000 acres Statewide.

This adjusted supply of available farm land far exceeds the amount of land that will be needed to accommodate the growth of diversified crops, whether demand is based on potential or recent trends. This indicates that the limiting factor to the growth of diversified crops will *not* be the *land supply*. Instead, growth will be limited by the *size of the market* for crops that can be grown *profitably* in Hawai'i.

c. Impact on the Growth of Diversified Crop Farming

The development of Ho'opili—in combination with other development projects in 'Ewa, Central O'ahu and elsewhere—involves the loss of too little good agricultural land to significantly affect the growth of diversified crop farming in Hawai'i. This conclusion is based on the above finding that ample land will remain available for diversified crops, with the available supply far exceeding the likely or potential demand.

However, as discussed in Subsections 12.b and 13.h, water-related improvements are needed to allow full use of some of the available farm lands on the North Shore. These improvements are the responsibility of the landowners and government agencies.

d. Mitigating Measures

In view of the negligible impact of the Project on the growth of diversified agriculture, mitigation measures for the loss of good agricultural land are not recommended beyond the measures in Section 13.h.

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16. OFFSETTING BENEFITS

As previously mentioned, Ho'opili will commit about 1,554 acres of agricultural land to a non-agricultural use, of which about 1,375 acres are arable. In turn, Ho'opili—in combination with other private and State urban projects and changes in agriculture land use in Kunia—will require the the affected agricultural operations to relocate.

These adverse impacts to agriculture will be offset by the following benefits of the Project:

- About 11,750 homes for Hawai'i residents, along with business and commercial space, light-industrial space, parks and open space, and public facilities.
- For 'Ewa, relatively high housing densities which, in turn, will contribute to slower urbanization of agricultural land than would be the case with lower densities.
- Construction jobs provided by the development activity.
- At full development of the Project, on-site jobs provided by business, commercial, industrial, and home-service activities.
- Tax revenues (excise taxes, personal income taxes, corporate income taxes, property taxes, etc.) generated by the development activity.
- Tax revenues generated by the families and businesses that occupy the Project.
- Improved land and partial funding for schools, parks and other public facilities.

17. CONSISTENCY WITH STATE AND COUNTY POLICIES[47]

a. Availability of Lands for Agriculture

The *Hawaii State Constitution*, the *Hawaii State Plan*, the *State Agriculture Functional Plan*, and the *General Plan of the City and County of Honolulu* call directly or implicitly for preserving the economic viability of plantation agriculture and promoting the growth of diversified crops. To accomplish this, an adequate supply of agriculturally suitable lands and water must be assured.

With regard to plantation agriculture, the Petition Area is no longer part of a sugar plantation since O'ahu Sugar Co. closed in 1995 for reasons unrelated to the Project.

With regard to diversified crops, development of the Petition Area will result in a loss of good farm land, and the farms on this land will have to relocate. However, this loss of agricultural land will not limit the growth of diversified crops since ample agricultural land is available on O'ahu and on other islands. This is due to the enormous supply of farm land that is now available following the contraction of plantation agriculture (see Section 15 and Figure 11). However, improvements to the WWTP and the WIS will be needed to allow full use of the available farm lands on the North Shore.

b. Conservation of Agricultural Lands

In addition to the above, State policies call for conserving and protecting prime agricultural lands, including protecting agricultural lands from urban development.

However, these policies—which were written before the major contraction of plantation agriculture in the 1990s—assume implicitly that profitable agricultural activities eventually will be available to use all available agricultural lands. This has proven to be a questionable assumption in view of the enormity of the contraction of plantation agriculture, the abundant supply of land that came available for diversified agriculture, and the slow growth in the amount of land being used for diversified crops (see Section 15 and Figure 11).

Furthermore, discussions in the Agriculture portion of the *State Functional Plan* recognize that redesignation of lands from Agricultural to Urban should be allowed "... upon a demonstrated change in economic or social conditions, and where the requested redesignation will provide greater benefits to the general public than its retention in ...agriculture;" that is, when an "overriding public interest exists." In this regard, major changes in economic and social conditions have occurred as a result of:

- The on-going development of the City of Kapolei and the surrounding 'Ewa region as the second largest urban center in Hawai'i (see the policy discussion in the following subsection).
- Inadequate expansion in the supply of workforce housing which has contributed to high housing prices on O'ahu.
- The enormous contraction in plantation agriculture which has resulted in the supply of agricultural land far exceeding demand.

Moreover, development in the Petition Area will provide community benefits (about 11,750 homes and many on-site jobs) that far exceed those provided by agriculture (about 80 jobs after Syngenta is replaced by a new farm). In prac-

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tice, however, development of the Petition Area is likely to have little or no impact on Statewide agricultural employment.

c. County 'Ewa Development Plan

As shown in Figure 4, the Petition Area is within the County's designated Urban Growth Boundary of the 'Ewa Development Plan in an area designated for residential development. Thus, the Project is consistent with the 'Ewa Development Plan in terms of future land use.

This Plan is part of a broader long-established County policy, with support from the State, to direct urban growth to 'Ewa, to portions of Central O'ahu, and to the primary urban center. In turn, the policy reduces development pressures on the outlying Districts of Ko'olau Loa, Ko'olau Poko, North Shore, and Wai'anae. The policy was designed to provide needed housing, jobs, and commercial and industrial space in compact areas; preserve agricultural lands and open space in Kunia, the North Shore, and outlying areas; preserve the "country" lifestyle of rural communities; and reduce the cost of providing government infrastructure and services.

Portions of the Project could be inconsistent with the phasing component of the currently approved 'Ewa Development Plan which indicates that urban expansion of the northern and eastern portions of the Petition Area is to occur after 2015. This area includes all the fields farmed by Aloun Farms that are between Farrington Highway and the H-1 Freeway, the eastern portion of Aloun lands that are subleased to Fat Law's Farm, and all the lands farmed by Syngenta (see Figure 10). Such phasing in the current 'Ewa Development Plan would create nuisance issues by placing farm areas immediately upwind of the new Ho'opili homes (see Section 14). However, the 'Ewa Development Plan is in the process of being updated which, based on discussions with the County, is expected to reflect the removal of phasing from the Plan.

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FIGURES

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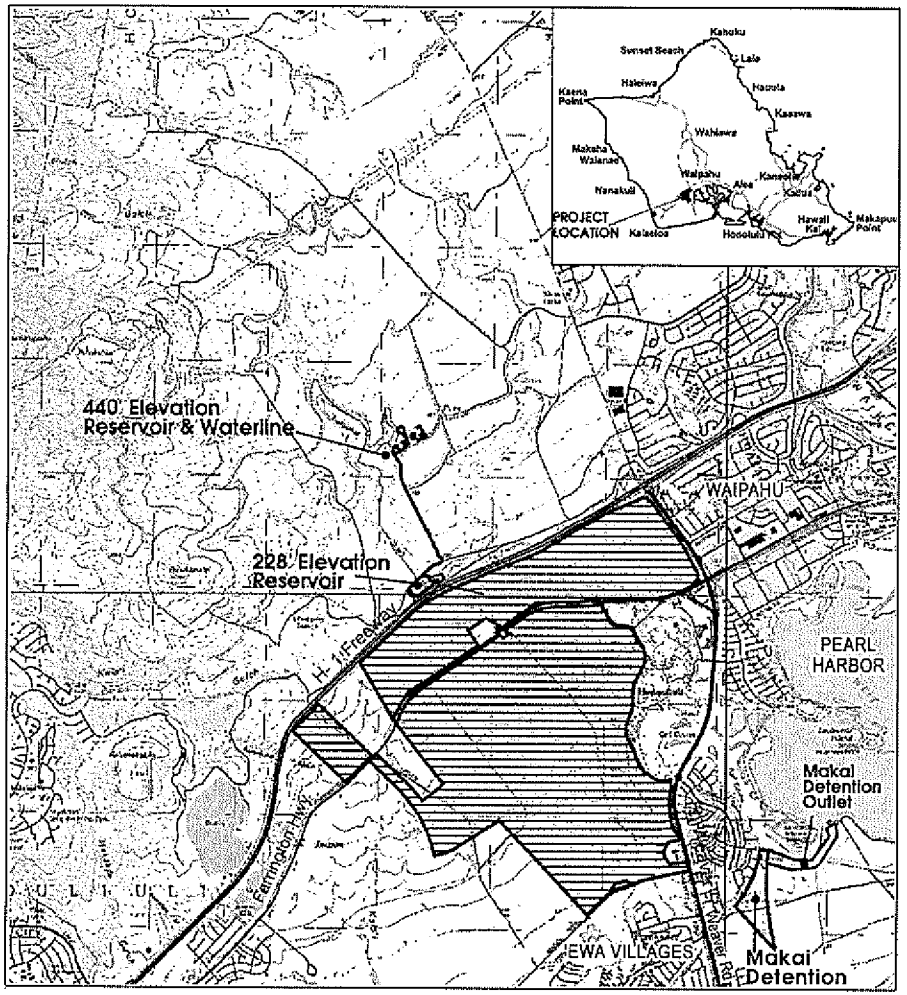


LEGEND

- Project Site Boundary
- Petition Area

Source: US Geological Survey
Disclaimer: This graphic has been prepared for general planning purposes only.

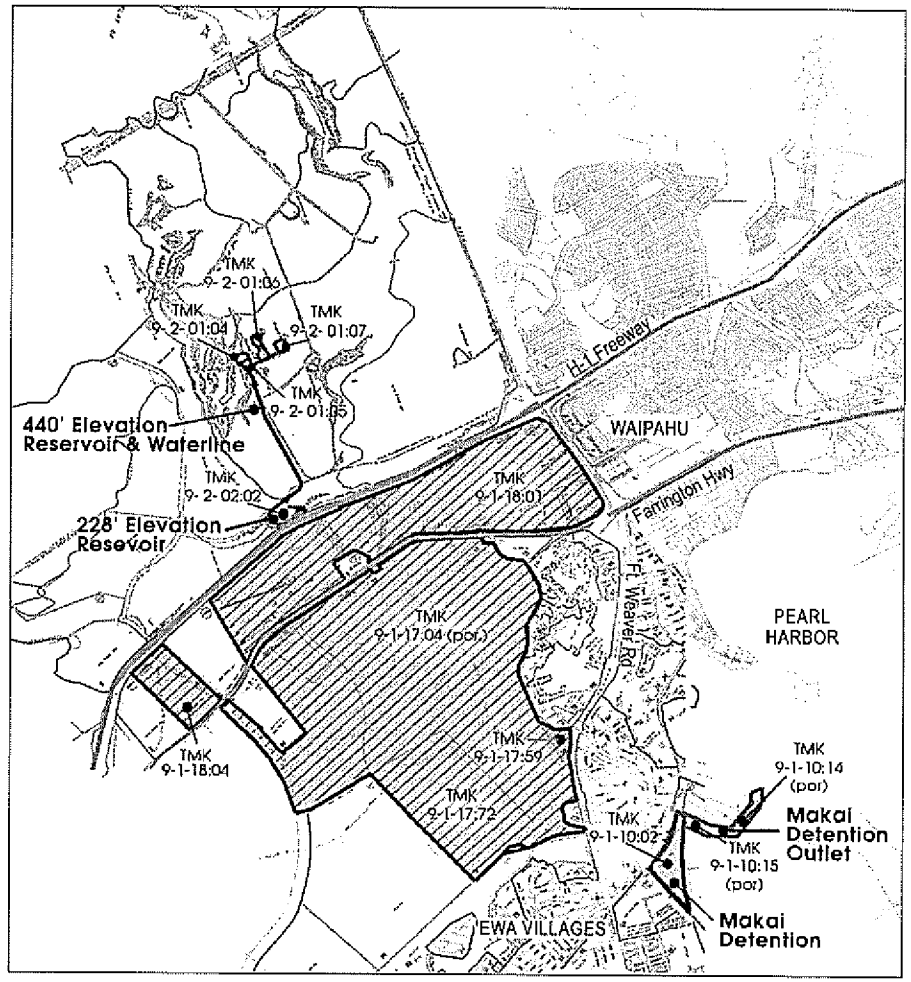
Figure 1: Location Map

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,500 7,000

PBR HAWAII & ASSOCIATES, INC.



LEGEND

- Project Site Boundary
- Petition Area

Source: Tax maps Zone 9, Sec. 1, Plats 10, 17 and 18
Zone 9, Sec. 2, Plat 1 and 2
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 2: Tax Map Key

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

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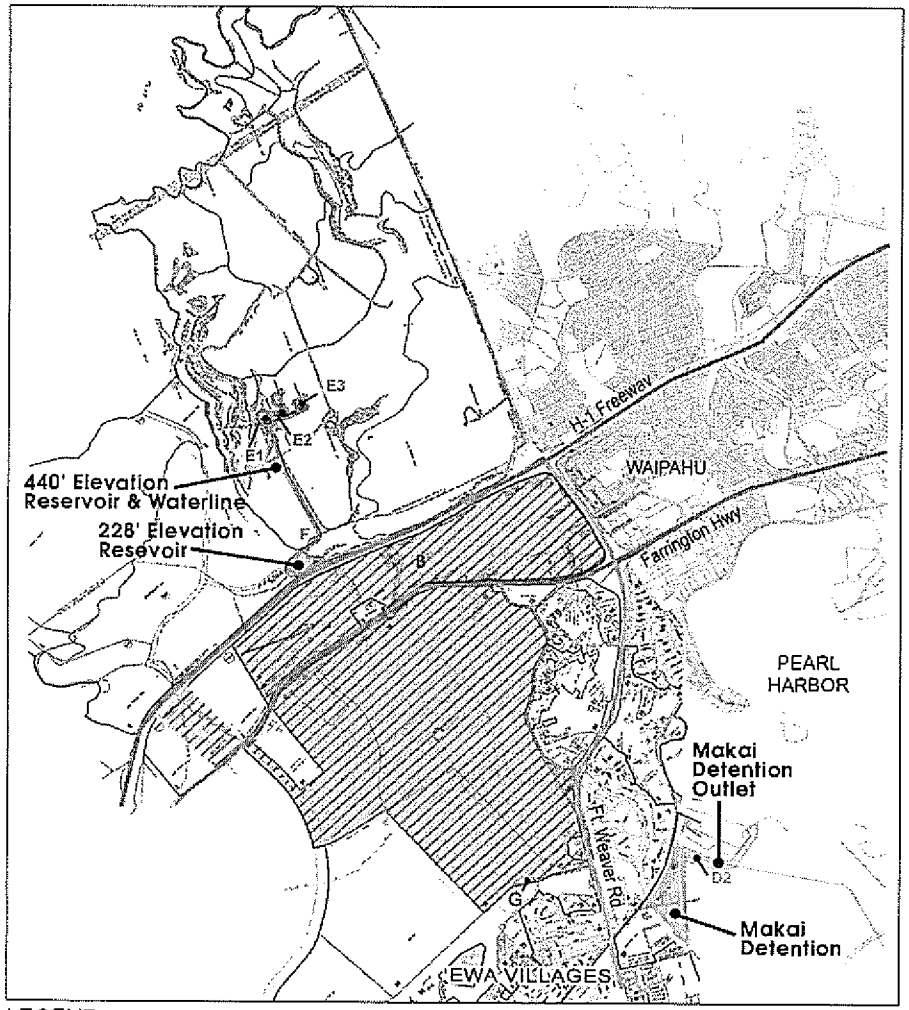


LEGEND

Petition Area

- Parcel A: 52.289 Acres
- Parcel B: 447.592 Acres
- Parcel C: 1,053.563 Acres

Non-petition Area

- Parcel D1: 30.825 Acres
- Parcel D2: 4.5 Acres*
- Parcel E1: .635 Acres
- Parcel E2: 1.49 Acres*
- Parcel E3: .359 Acres
- Parcel F: 7.311 Acres
- Parcel G: 1.301 Acres

* Approx Acres

Source: Tax Maps Zone 9, Sec. 1, Plats 10, 16,17 & 18 and Zone 9, Sec. 2, Plats 1 and 2
Disclaimer: This graphic has been prepared for general planning purposes only

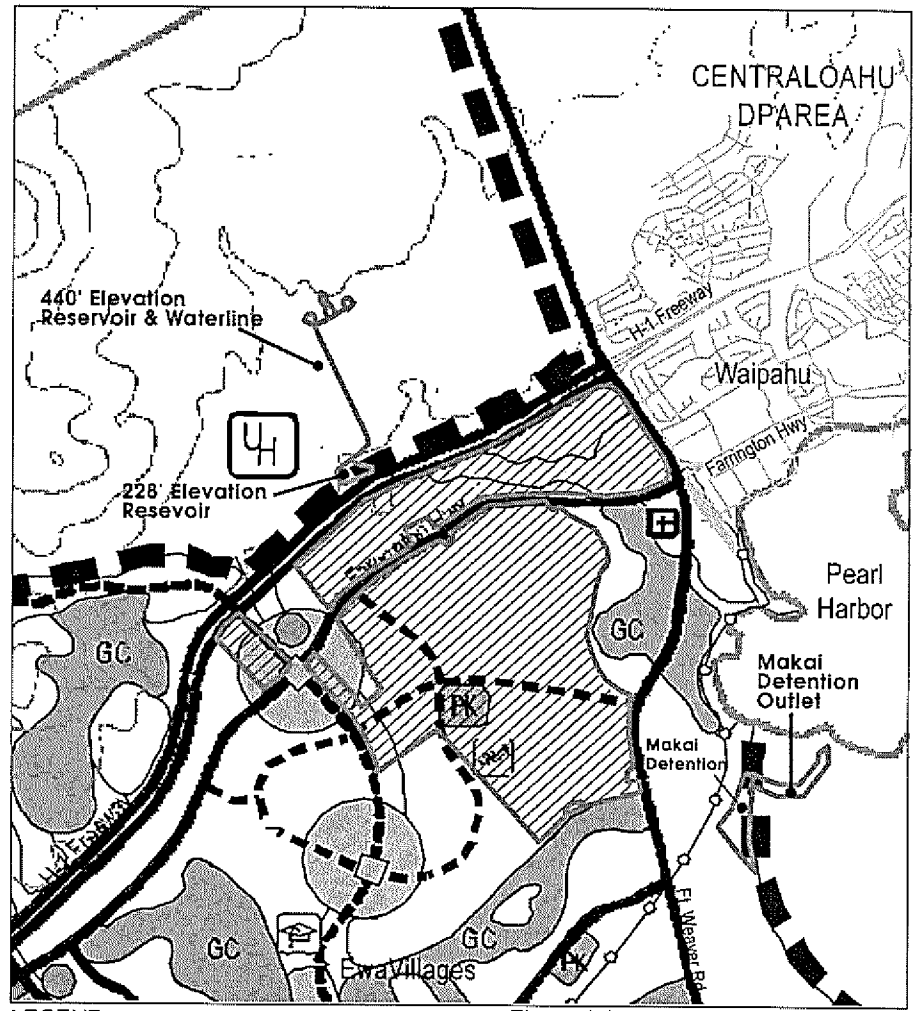
Figure 3: Parcels Map

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC



LEGEND

- Project Site Boundary
- Petition Area
- Low & Medium Density Residential
- High Density Residential
- Community Commercial Center
- Agricultural Land Preservation
- Parks & Golf Courses
- Transit Nodes/ High Density Residential & Commercial
- Urban Growth Boundary

Source: City & County of Honolulu 'Ewa Development Plan Urban Land Use Map (1997)
Disclaimer: This graphic has been prepared for general planning purposes only

Figure 4: 'Ewa Development Plan Land Use Map

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC

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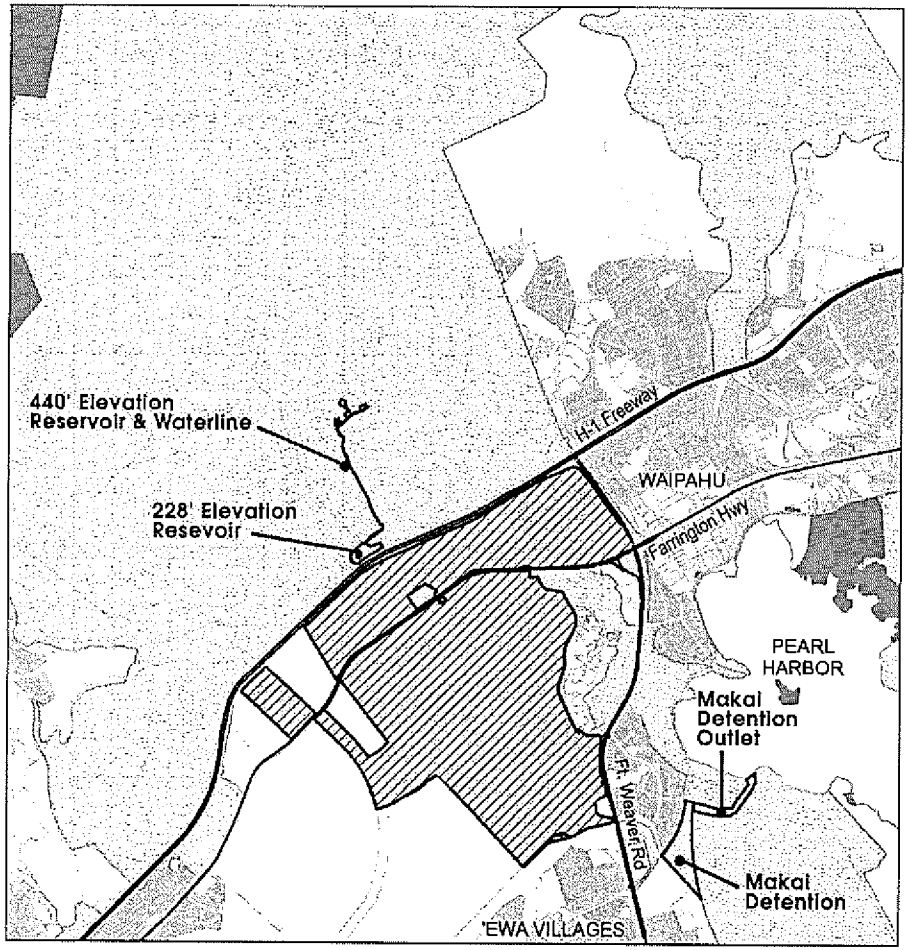

LEGEND

- Project Site Boundary
- Petition Area
- Agricultural
- Conservation
- Urban

Source: State Land Use Commission (2004)
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 5: State Land Use District

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,500 7,000

PBR HAWAII & ASSOCIATES, INC.

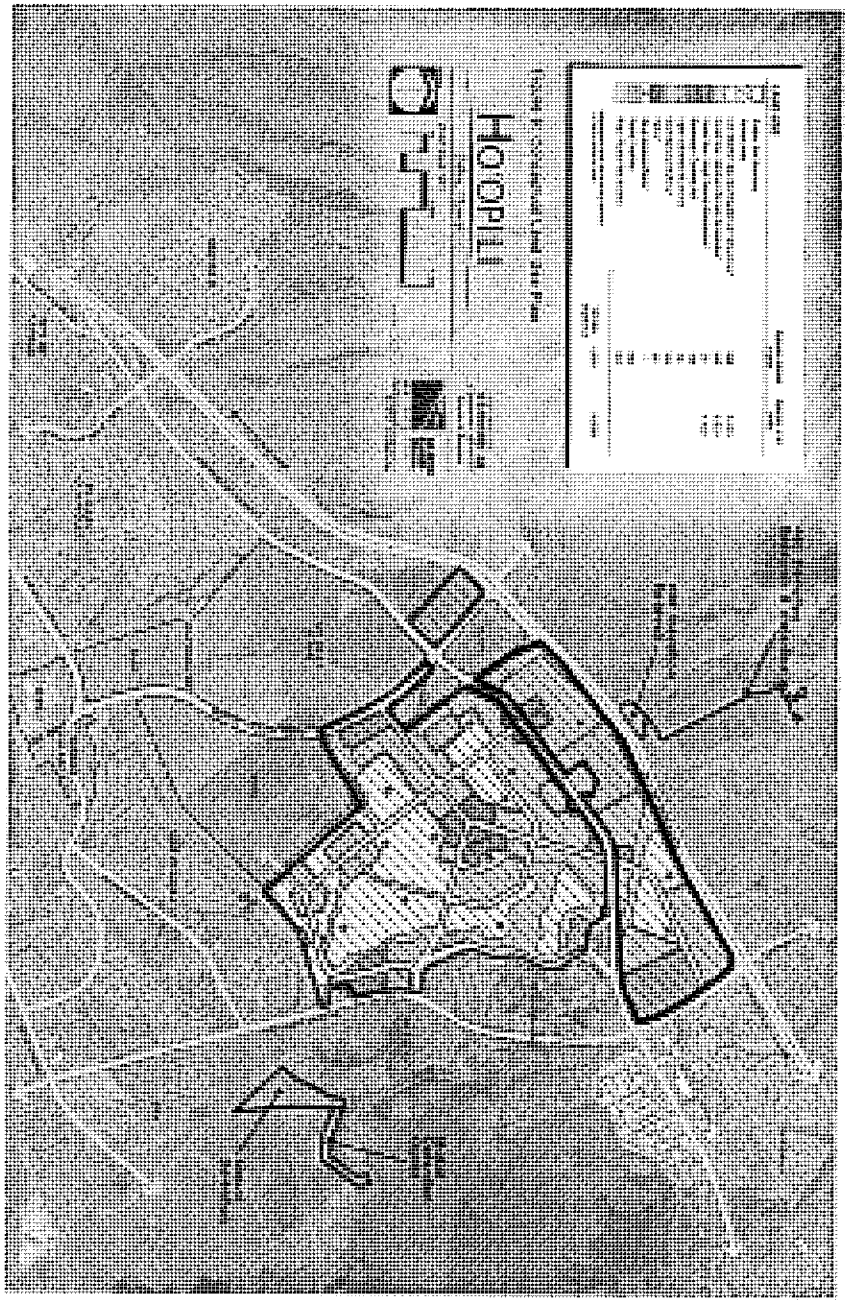

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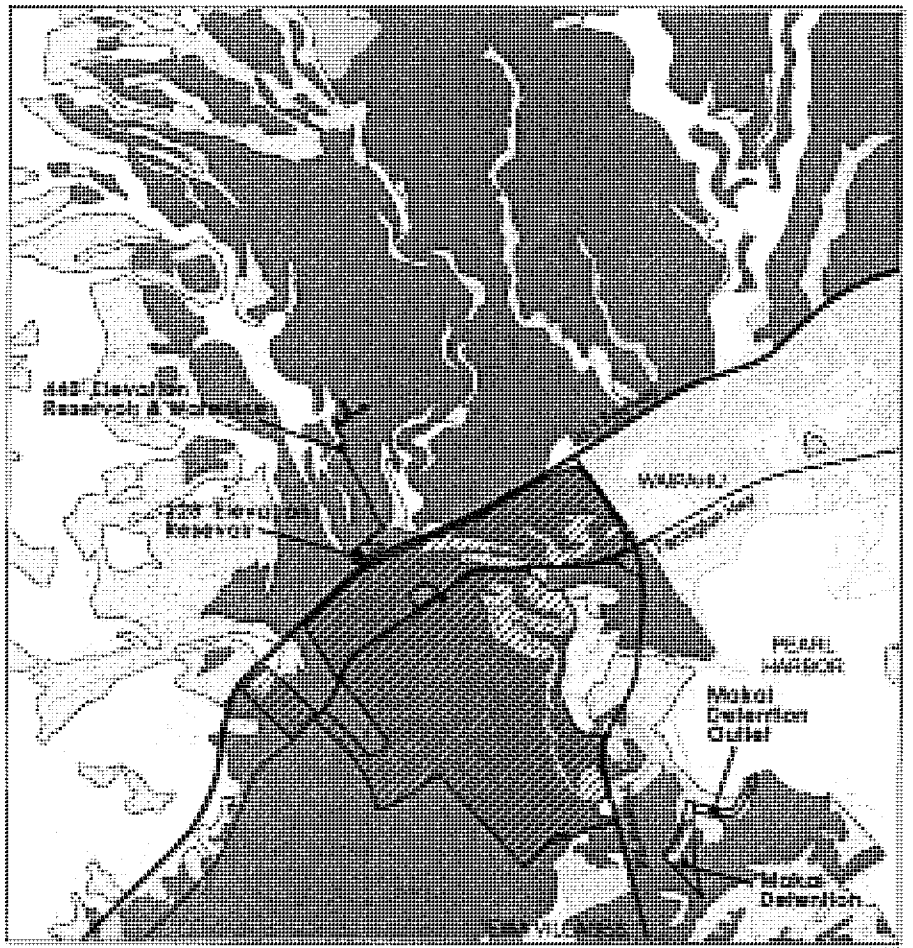
Figure 8: Land Study Bureau Land Classification

Figure 7: Natural Resources Conservation Service Soil Survey Map



LEGEND

- Project Site Boundary
- Petition Area
- Prime Agricultural Lands
- Unique Agricultural Lands
- Other Agricultural Lands
- Unclassified Agricultural Lands

Source: State Dept. of Agriculture (1977).
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 9: Agricultural Lands of Importance to the State of Hawaii (ALISH)

HO'OPILI

O'ahu, Hawai'i

NORTH

LINEAR SCALE (FEET)

0 3,500 7,000

PBR HAWAII & ASSOCIATES, INC.

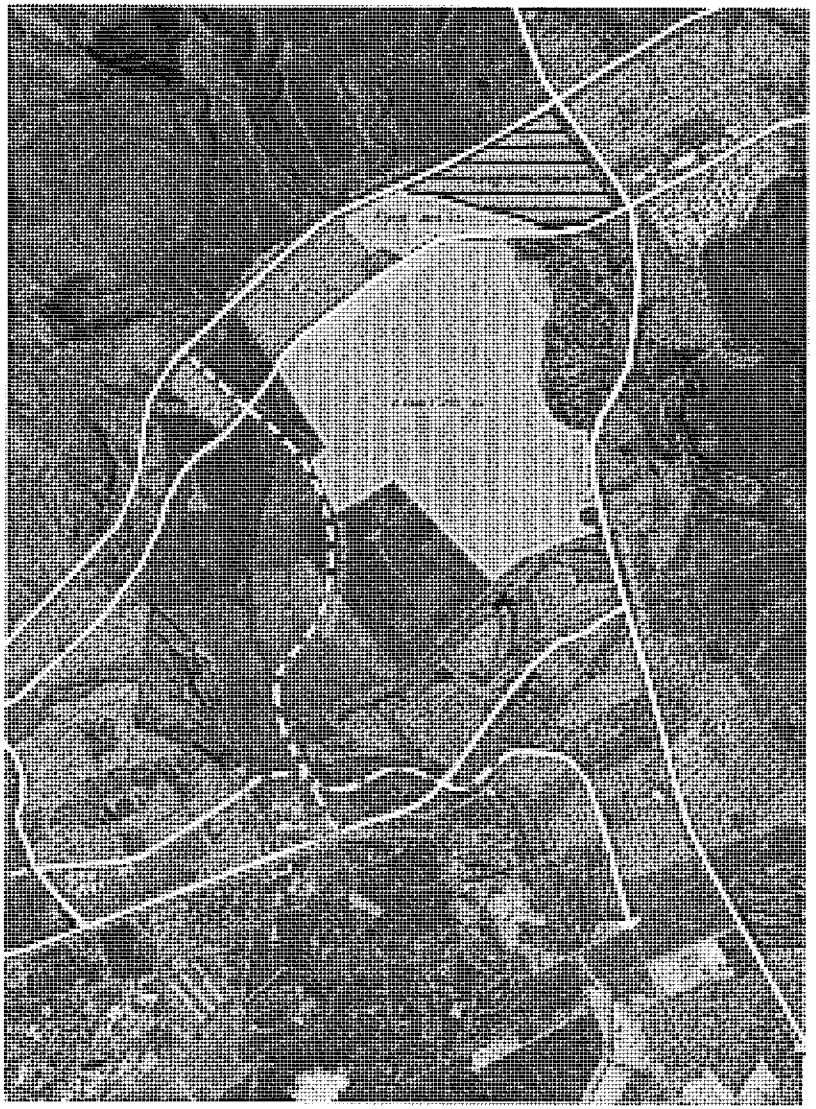


Figure 10: Farm Lease Map

D.R. Horton East Kapolei

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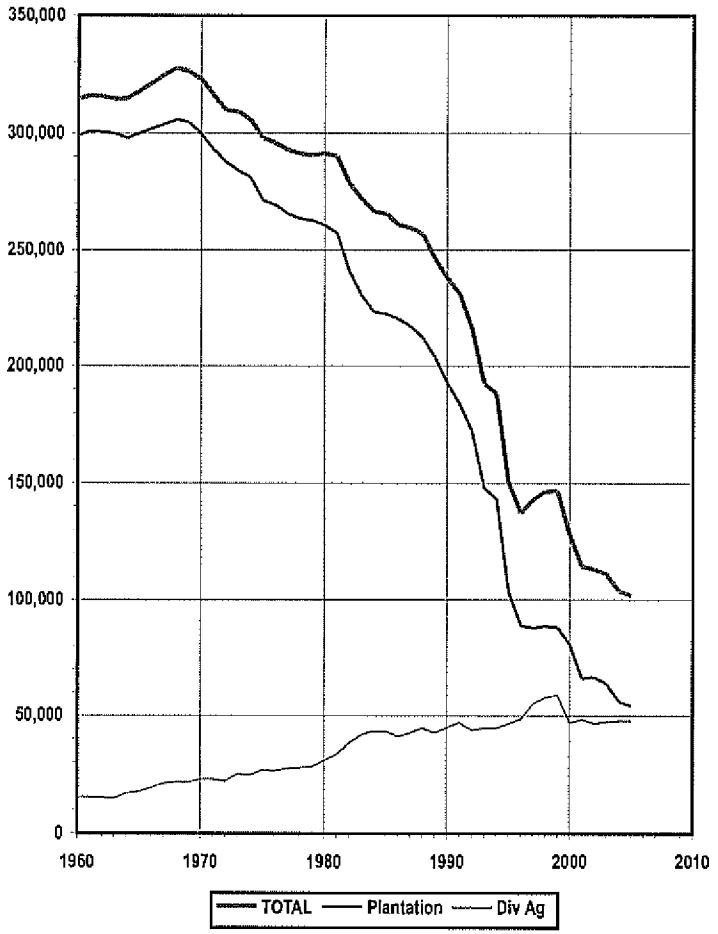
Figure 11 - Statewide Acreage in Crop: 1960 to 2005



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APPENDIX:
SELECTED STATE AND COUNTY GOALS, OBJECTIVES, POLICIES AND GUIDELINES RELATED TO AGRICULTURAL LANDS

1. HAWAI'I STATE CONSTITUTION (Article XI, Section 3):

   ...to conserve and protect agricultural lands, promote diversified agriculture, increase agricultural self-sufficiency and assure the availability of agriculturally suitable lands...

2. HAWAI'I STATE PLAN (Chapter 226, Hawaii Revised Statutes, as amended):[1,2]

   Section 226-7 Objectives and policies for the economy--agriculture.

   (a) Planning for the State's economy with regard to agriculture shall be directed towards achievement of the following objectives:

      (1) Viability in Hawaii's sugar and pineapple industries.

      (2) Growth and development of diversified agriculture throughout the State.

      (3) An agriculture industry that continues to constitute a dynamic and essential component of Hawaii's strategic, economic, and social well-being.

   (b) To achieve the agricultural objectives, it shall be the policy of the State to:

      (2) Encourage agriculture by making best use of natural resources.

      (10) Assure the availability of agriculturally suitable lands with adequate water to accommodate present and future needs.

      (16) Facilitate the transition of agricultural lands in economically nonfeasible agricultural production to economically viable agricultural uses.

   Section 226-103 Economic priority guidelines.

   (c) Priority guidelines to promote the continued viability of the sugar and pineapple industries:

      (1) Provide adequate agricultural lands to support the economic viability of the sugar and pineapple industries.

   (d) Priority guidelines to promote the growth and development of diversified agriculture and aquaculture:

      (1) Identify, conserve, and protect agricultural and aquacultural lands of importance and initiate affirmative and comprehensive programs to promote economically productive agricultural and aquacultural uses of such lands.

      (10) Support the continuation of land currently in use for diversified agriculture.

   Section 226-104 Population growth and land resources priority guidelines.

   (b) Priority guidelines for regional growth distribution and land resource utilization:

      (2) Make available marginal or non-essential agricultural lands for appropriate urban uses while maintaining agricultural lands of importance in the agricultural district.

   Section 226-106 Affordable Housing

   Priority guidelines for the provision of affordable housing:

      (1) Seek to use marginal or nonessential agricultural land and public land to meet housing needs of low- and moderate-income and gap-group households.

3. AGRICULTURAL STATE FUNCTIONAL PLAN (1991)[3]
   (Functional plans are guidelines for implementing the State Plan. They are approved by the Governor, but not adopted by the State Legislature.)

   Objective H: Achievement of Productive Agricultural Use of Lands Most Suitable and Needed for Agriculture.

   Policy H(2): Conserve and protect important agricultural lands in accordance with the Hawaii State Constitution.

      Action H(2)(a): Propose enactment of standards and criteria to identify, conserve, and protect important agricultural lands and lands in agricultural use.

      Action H(2)(c): Administer land use district boundary amendments, permitted land uses, infrastructure standards, and other planning and regulatory functions on important agricultural lands and lands in agricultural use, so as to ensure the availability of agriculturally suitable lands and promote diversified agriculture.

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4. CITY AND COUNTY OF HONOLULU GENERAL PLAN, Objectives and Policies (Resolution No. 87-211)[4]

Economic Activity

Objective C. To maintain the viability of agriculture on Oahu.

Policy 1. Assist the agricultural industry to ensure the continuation of agriculture as an important source of income and employment.

Policy 2. Support agricultural diversification in all agricultural areas on Oahu.

Policy 3. Support the development of markets for local products, particularly those with the potential for economic growth.

Policy 4. Provide sufficient agricultural land in Ewa, Central Oahu, and the North Shore to encourage the continuation of sugar and pineapple as viable industries.

Policy 5. Maintain agricultural land along the Windward, North Shore, and Waianae coasts for truck farming, flower growing, aquaculture, livestock production, and other types of diversified agriculture.

Policy 6. Encourage the more intensive use of productive agricultural land.

Policy 7. Encourage the use of more efficient production practices by agriculture, including the efficient use of water.

Policy 8. Encourage the more efficient use of nonpotable water for agricultural use.

5. CITY AND COUNTY OF HONOLULU 'EWA DEVELOPMENT PLAN[5]

3.1. Open Space Preservation and Development

3.1.1 General Policies

Open space will be used to:

- Provide long range protection for diversified agriculture on lands outside the Urban Growth Boundary.

6. REFERENCES

[1] State of Hawaii, Office of State Planning, Office of the Governor. *The Hawaii State Plan, 1991.* Honolulu, Hawaii. 1991.

[2] Act 25, S.B. No. 1158, April 15, 1993.

[3] Hawaii Department of Agriculture. *The Hawaii State Plan: Agriculture, State Functional Plan.* Honolulu, Hawaii. 1991.

[4] City and County of Honolulu, Department of General Planning. *General Plan Objectives and Policies.* Honolulu, Hawaii. 1992.

[5] City and County of Honolulu, Planning Department. *'Ewa Development Plan.* Honolulu, Hawaii. August 1997 (Revised May 2000).

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APPENDIX B
Botanical Resources Assessment

BOTANICAL RESOURCES ASSESSMENT FOR THE
HO'OPILI PROJECT
HONOULIULI, OAHU

MAIN PARCELS

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August 2006

INTRODUCTION

This report includes the findings of a botanical study conducted within the Honouliuli Region on the island of Oahu, Hawaii. LeGrande Biological Surveys Inc. carried out a botanical field survey of the above location on January18, 19, 23, 24, 30, and 31, and May 6 and 7, 2006, for a total of 8 field days. The primary objectives of the field studies were to:

1) provide a general description of the vegetation on the project site;
2) inventory the flora; and
3) search for threatened and endangered species as well as species of concern.

Federal and State of Hawaii listed species status follows U.S. Fish and Wildlife (USFWS) (1999a and 1999b, 2004) and Federal Register (2002).

GENERAL SITE DESCRIPTION

The area proposed for the Ho'opili Project in Ewa includes three main parcels (covered in this report) and two smaller "Off-Site" areas (separate reports). The main parcels covered in this report include: [A] a rectangular section to the west of Palehua Road, between H-1 Freeway and Farrington Highway (TMK 9-1-18:04);[B] a strip running east-west between H-1 Freeway (to the north) and Farrington Highway (to the south) (TMK 9-1-18:01); and [C] the largest parcel bordered by Farrington Highway to the north, Old Fort Weaver Road to the east, Mango Tree Road to the south, and Palehua Road and the new North-South Road to the west (TMK 9-1-17:04 (por.), 9-1-17:59, and 9-1-17:72). The entire area surveyed (and described in this report) encompasses approximately 1,555 acres

The majority of the surveyed area is either in active cultivation or cleared to bare dirt substrate. The edges of the agricultural fields along with a few small gulches harbor most of the plant diversity. Weedy plant species dominate all areas. The subject property ranges in elevation from near sea level to 250 ft. The Ho'opili parcels have been utilized for agriculture for some time, being planted in sugar cane in the past and now in diversified agriculture. Alteration of native plant habitat has been in place for some time and few of the natural plant elements remain.

SURVEY METHODS

Prior to undertaking the field studies, a search was made of the pertinent literature to familiarize the principal investigator with other botanical studies conducted in the general area. The 2004 Habitat Conservation Plan for *Abutilon menziesii* at Kapolei was reviewed for possible endangered plant locations within the survey area. Information from the Hawaii Biodiverstiy & Mapping Program database was reviewed. Topographic maps were examined to determine terrain characteristics, access, boundaries, and reference points.

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A walk-through survey method was used. The boundaries of all five parcels were surveyed by foot. Roads through the subject property were driven and most were walked as well to survey for roadside plants. Transects on an average of 80 ft apart were surveyed on foot by 2 botanists for the parcel interiors, except in areas where active cultivation was in progress (i.e. cornfields were surveyed from the outer margins.). Special attention was paid to gulch areas and areas that contained scrub vegetation with native plant elements. Notes were made on plant associations and distribution, disturbances, topography, substrate types, exposure, drainage, etc. Plant identifications were made in the field. Plants that were not positively identified were collected for later determination, and for comparison with the recent taxonomic literature.

DESCRIPTION OF THE VEGETATION

The entire survey area is dominated by non-native plant species and agricultural crops. A total of 137 plant species were observed within the survey area. 133 are alien (introduced) and four are indigenous (native to the Hawaiian Islands and elsewhere). Therefore, 97% of the plant species observed were alien and only 3% native.

An inventory of all the plants observed within the five survey areas is presented in the species list at the end of the report.

TMK 9-1-18:04 [A]

This parcel is located between H-1 and Farrington Highway west of Palehua Road with Hunehune Gulch bordering the parcel to the west. The majority of the parcel is either cleared land or planted in corn. The edges of the parcel, including Palehua Road are dominated by weedy species such as, castor bean (*Ricinus* communis), lion's ear (*Leonotis nepetifolia*), partridge pea (*Chamaecrista nictitans*), and kikania (*Xanthium strumarium* var. *canadense*). A few kiawe (*Prosopis pallida*) and opiuma (*Pithecellobium dulce*) trees are scattered along the top of the gulch. Grass species throughout the parcel include natal redtop, sourgrass (*Digitaria insularis*), and swollen fingergrass (*Digitaria insularis*).

TMK 9-1-18:01 [B]

This parcel is a strip running east-west between H-1 Freeway (to the north) and Farrington Highway (to the south) with Fort Weaver Road bordering to the east. Aloun Farms baseyard is located within this section. The majority of this section consists of gently sloping agricultural fields planted with corn. Edges of fields and along roadsides were generally low-growing weedy shrubs dominated by koa haole, Christmas berry (*Schinus terebinthifolius*), sourbush (*Pluchea carolinensis*), castor bean, and guinea grass.

Honouliuli Gulch runs north-south through this section. The gulch is characterized by koa haole scrub at the northern (upper) sections. Along with koa haole and guinea grass as the dominant species several tall tree species reside in the gulch including kukui (*Aleurites moluccana*), kiawe, pride of India (*Melia azerdarach*), and autograph tree (*Clusia rosea*). Lower down the bottom of the gulch has been cleared for a banana (*Musa sp.*) patch that is currently in cultivation. At the lowest point of the gulch where it crosses Farrington Highway several morning-glory species were observed, koali ai (*Ipomoea cairica*), little bell (*I. Triloba*), and *I. obscura*. Primrose willow (*Ludwigia octovalvis*), love-in-a-mist (*Passiflora foetida*), and comb hyptis (*Hyptis pectinata*) were observed in the drainage.

The Aloun baseyard is planted with various cultivars including citrus (*Citrus sp.*), noni (*Morinda citrifolia*), kalo (*Colocasia esculenta*), yellow Poinciana (*Peltophorum pterocarpum*), sugarcane (*Saccharum officinarum*), and lemon grass (*Cymbopogon citratus*). The electric power substation has a hedge of tropical coral tree (*Erythrina variegata*) planted along the fenceline. Along Farrington Highway the vegetation is dominated by non-native grass species with kiawe, monkeypod (*Samanea saman*) trees and bougainvillea (*Bougainvillea sp.*) scattered along the length of the parcel.

TMK 9-1-17:04, 9-1-17:59, & 9-1-17:72 [C]

This is the largest section of the subject property, bordered by Farrington Highway to the north, Old Fort Weaver Road to the east, Mango Tree Road to the south, and Palehua Road and the new North-South Road to the west. The majority of this portion of the surveyed area is under cultivation or cleared to bare soil. Crops observed grown in this area include corn, melons (*Cucumis sp.*), basil (*Ocimum sp.*) and bananas. At the edges of planted areas and in fallow fields weedy species such as kili oopu (*cyperus rotundus*), wild spider flower (*Cleome gynandra*), and cheeseweed (*Malva parviflora*) were observed. There are several flumes running east-west through the property, they have a greater number of plant species due to the availability of water. The flumes are dominated by koa haole and guinea grass with other non-native plant species scattered within the site including, boerhavia (*Boerhavia coccinea*), Australian saltbush (*Atriplex semibaccata*), heliotrope (*Heliotropium procumbens*), coat buttons (*Tridax procumbens*), and slender mimosa (*Desmanthus pernambucans*). Along the flumes there are some larger woody species such as Christmas berry (*Schinus terebinthifolius*), fleabane (*Pluchea* x *fosbergii*), Chinese banyan (*Ficus microcarpa*), and a few mango (*Mangifera indica*) trees. The only indigenous plant species observed within the site are uncommon and include: ilima (*Sida fallax*) and scattered individuals of popolo (*Solanum americanum*) and uhaloa (*Waltheria indica*).

Between the fairly level agricultural fields and Old Fort Weaver Road, the property changes elevation quite drastically, there is a cliff approximately 20 to 30 feet high running the length of the eastern boundary. The majority of the cliff area is dominated by kiawe forest with an understory of guinea grass. Along the top of the cliff where the cultivated fields do not extend to the edge of the cliff, there are pockets of shrub vegetation that contain a few native plant species such as, ilima, uhaloa, and popolo. At the bottom of the cliff faces there are areas of flat land that extend to Old Fort Weaver Road. These areas are being utilized for various purposes including automobile parking, water pumping stations, baseyards, or farming. The area across from Kahi Mohala

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appears to be used for storing and parking large buses and shuttles. Several large trees were observed in this area including earpod tree (*Enterolobium cyclocarpum*), kiawe, African tulip, monkey pod, and Chinese banyan (*Ficus microcarpa*).

The southern section of the parcel between Old Fort Weaver Road and the cliff contain flat areas where there is active farming and equipment buildings. The farm is growing basil, cucumber (*Cucumis sativus*), and horseradish tree (*Moringa oleifera*). Coconut trees (*Cocos nucifera*), papaya (*Carica papaya*), and bamboo (*Bambusa sp.*) are some of the plants observed growing around the farm buildings.

DISCUSSION AND RECOMMENDATIONS

None of the plants which occur on the project site is a threatened or endangered species or a species of concern (U.S. Fish and Wildlife Service, 1999a, 1999b, 2004; Wagner et. al., 1999). HBMP (Hawaii Biodiversity & Mapping Program) supplied historical and present locations of known Threatened and Endangered plant species within the project area for review. The only rare plant mapped near the project area was the kooloaula (*Abutilon menziesii*) population at the southern end of North-South Road. There were no threatened or endangered plants mapped within the Ho'opili project area itself. *A. menziesii* is protected by both the federal Endangered Species Act of 1973, as amended, and Chapter 195D, HRS, as amended. *A. menziesii* is a shrub of the mallow family, growing six to eight feet tall, with coarsely toothed, silvery, heart-shaped leaves that are about one to three inches long. Flowers are medium red to dark red and less than an inch in diameter. It has been sold as an ornamental plant at local nurseries in the past under the name "Red 'ilima." Other extant populations of Kooloaula currently exist on Lāna'i and Maui.

As part of the environmental planning for North-South Road and a portion of Kapolei Parkway, a "Habitat Conservation Plan for *Abutilon menziesii* at Kapolei" was finalized in March 2004. Mitigation measures have already been specified for these populations of *A. menziesii* related to construction of North-South Road. A concerted effort was made in surveying for *Abutilon menziesii* within the survey area. No plants of *A. menziesii* were observed during the survey.

No wetlands were encountered during either the January or May surveys. None of the three essential criteria for defining a federally recognized wetland were present within the study site. Those being hydrophytic vegetation, hydric soils, and wetland hydrology.

A follow up survey for wet season ephemeral plants was conducted in May following the heavy winter and spring rains. All parcels were resurveyed for additional plant species that may have been overlooked or died back during the January survey. No additional species were noted during this follow-up survey.

The proposed development of the surveyed area is not expected to have significant negative impacts on the botanical resources of the site or the general region.

Literature Cited

Evehuis, N.L. and L.G. Eldredge, editors. 1999-2002. Records of the Hawaii Biological Survey. Bishop Museum Occasional Papers Nos. 58-70.

Federal Register. 2002. Department of the Interior, Fish and Wildlife Service, 50 CFR 17. Endangered and Threatened Wildlife and Plants. Review of Species That Are Candidate or Proposed for Listing as Endangered or Threatened; Annual Notice of Findings on Recycled Petition; Annual Description of Progress on Listing Actions. *Federal Register*, 67 No. 14 (Thursday, June 13, 2002): 40657-40679.

Ohashi, Yukie. 2004. Habitat Conservation Plan for Abutilon menziesii at Kapolei. State of Hawaii Department of Transportation. Final HCP.

Staples G. W. and D. R. Herbst. 2005. A Tropical Garden Flora: Plants cultivated in the Hawaiian Islands and other tropical places. Bishop Museum Press.

U.S. Fish and Wildlife Service. 1999a. U.S. Fish and Wildlife Service species list, plants. March 23, 1999. Pacific Islands Office, Honolulu, HI.

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Wagner, W.L. and D.R. Herbst. 1999. Supplement to the Manual of the flowering plants of Hawaii, pp. 1855-1918. In: Wagner, W.L., D.R. Herbst, and S.H. Sohmer. 1990. Manual of the flowering plants of Hawaii. Revised Edition. 2 vols. University of Hawaii Press and Bishop Museum Press, Honolulu.

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PLANTS SPECIES LIST – Ho`opili, Oahu, Hawaii
MAIN PARCELS

The following checklist is an inventory of all the plant species observed within the three parcels of the survey site for the proposed Ho`opili project. The plant names are arranged alphabetically by family and then by species into two groups: Monocots and Dicots. The taxonomy and nomenclature of the flowering plants (Monocots and Dicots) are in accordance with Wagner *et al.* (1990), Wagner and Herbst (1999) and Staples and Herbst (2005). Recent name changes are those recorded in the Hawaii Biological Survey series (Evehuis and Eldredge, eds, 1999-2002).

For each species, the following name is provided:

1. Scientific name with author citation.
2. Common English and/or Hawaiian name(s), when known.
3. Biogeographic status. The following symbols are used:

I= indigenous= native to the Hawaiian Islands and elsewhere.

X=introduced or alien = all those plants brought to the Hawaiian Islands by humans, intentionally or accidentally, after Western contact, that is Cook's arrival in the islands in 1778.

HO`OPILI PLANT SPECIES LIST
MAIN PARCELS
AUGUST 2006

SCIENTIFIC NAME	COMMON NAME	STATUS
MONOCOTS		
AGAVACEAE		
Cordyline fruticosa (L.) A.Chev.	Ti, ki	X
ALOEACEAE		
Aloe vera (L.) N.L.Burm.	Aloe	X
ARACEAE		
Colocasia esculenta(L.) Schott	Kalo, taro	X
Dracaena sp. L.	dracaena	X
ARECACEAE		
Areca catechu L.	Betel nut palm	X
Cocos nucifera L.	coconut	X
Phoenix dactylifera L.	Date palm	X
CYPERACEAE		
Cyperus involucratus Roxb.	Ahuawa haole	X
Cyperus rotundus L.	Kili oopu	X
MUSACEAE		
Musa sp. L.	banana	X
POACEAE		
Bambusa sp. Schreber	bamboo	X
Brachiaria mutica (Forssk.) Stapf	California grass	X
Cenchrus ciliaris L.	Buffelgrass	X
Cenchrus echinatus L.	Common sandbur	X
Chloris barbata (L.) Sw.	Swollen fingergrass	X
Coix lachryma-jobi L.	Job's tears, puoheohe	X
Cymbopogon citratus (DC) Stapf	Lemon grass	X
Cynodon dactylon (L.) Pers	manienie	X
Digitaria insularis (L.) Mez ex Ekman	sourgrass	X
Eleusine indica (L.) Gaertn.	wiregrass	X
Eragrostis tenella (L.) P.Beauv. Ex Roem.&Schult.		X
Melinus repens (Willd.) Zizka	Natal redtop	X
Panicum maximum L.	Guinea grass	X
Paspalum dilatatum Poir.	Dallis grass	X

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Paspalum urvillei Steud.	Vasey grass	X
SCIENTIFIC NAME	**COMMON NAME**	**STATUS**
Pennisetum purpureum Schumach.	Elephant grass	X
Saccharum officinarum L.	Sugar cane, ko	X
Setaria verticillata (L.) P.Beauv.	Bristly foxtail	X
Sorghum bicolor (L.) Moench	Sorghum	X
Sorghum halapense (L.) Pers.	Johnson grass	X
Zea mays L.	corn	X
DICOTS		
ACANTHACEAE		
Asystasia gangetica (L.) T. Anderson	Chinese violet	X
AIZOACEAE		
Trianthema portulacastrum L.		X
AMARANTHACEAE		
Achyranthes aspera L.		X
Alternanthera pungens Kunth	Khaki weed	X
Amaranthus spinosus L.	Spiny amaranth	X
Amaranthus viridis L.	Slender amaranth	X
ANACARDIACEAE		
Mangifera indica L.	mango	X
Schinus terebinthifolius Raddi	Christmas berry	X
ANNONACEAE		
Annona muricata L.	soursop	X
APOCYNACEAE		
Thevetia peruviana (Pers.) K.Schum.	Be-still tree	X
ARALIACEAE		
Schefflera actinophylla (Endl.) Harms	Octopus tree	X
ASCLEPIADACEAE		
Stapelia gigantea N.E.Br.	Zulu-giant	X
ASTERACEAE		
Bidens alba (L.) DC. var. *radiata* (Sch. Bip.) Ballard ex Melchert	Beggar tick	X
Bidens pilosa L.	Spanish needle	X
Conyza bonariensis (L.) Cronq.	Hairy horseweed	X
Crassocephalum crepidioides (Benth.) S.Moore	crassocephalum	X
Emilia fosbergii Nicolson	Red pualele	X

Lactuca serriola L.	Prickly lettuce	X
SCIENTIFIC NAME	**COMMON NAME**	**STATUS**
Pluchea carolinensis (Jacq.) G. Don	sourbush	X
Pluchea indica (L.) Less.	Indian fleabane	X
Pluchea x fosbergii Coopper. & Galang	fleabane	X
Sonchus oleraceus L.	pualele	X
Tridax procumbens (L.)	Coat buttons	X
Verbesina encelioides (Cav.) Benth. & Hook	Golden crown-beard	X
Xanthium strumarium L. var. *canadense* (Miller)	kikania	X
BIGNONIACEAE		
Spathodea campanulata P. Beauv.	African tulip	X
BORAGINACEAE		
Heliotropium curassavicum L.	kipukai	I
Heliotropium procumbens Mill. var. *depressum* (Cham.) Fosberg		X
BUDDLEIACEAE		
Buddleia asiatica Lour.	Dog tail	X
CACTACEAE		
Opuntia ficus-indica (L.) Mill.	panini	X
CAPPARACEAE		
Cleome gynandra L.	Wild spider flower	X
CARICACEAE		
Carica papaya L.	papaya	X
CASUARINACEAE		
Casuarina equisetifolia L.	ironwood	X
CHENOPODIACEAE		
Atriplex semibaccata R.Br.	Australian saltbush	X
Chenopodium murale L.	aheahea	X
CLUSIACEAE		
Clusia rosea Jacq.	Autograph tree	X
CONVOLVULACEAE		
Ipomoea cairica (L.) Sweet	Ivy leaved morning glory, koali ai	X
Ipomoea obscura (L.) Ker Gawl.		X
Ipomoea triloba L.	Little bell	X

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Merremia aegyptia (L.) Urb.	Hairy merremia	X
SCIENTIFIC NAME	**COMMON NAME**	**STATUS**
CUCURBITACEAE		
Coccinea grandis (L.) Voigt	Ivy gourd	X
Cucumis dipsaceus ehrenb. Ex Spach	Hedgehog gourd	X
Cucumis melo L.	melon	X
Cucumis sativus L.	cucumber	X
Cucurbita sp. L.	Gourd, pumpkin	X
Momordica charantia L.	Balsam pear	X
EUPHORBIACEAE		
Aleurites moluccana (L.) Willd.	kukui	X
Chamaesyce hirta (L.) Millsp.	hairy spurge, garden spurge	X
Chamaesyce hypercifolia (L.) Millsp.	graceful spurge	X
Chamaesyce hyssopifolia (L.) Small		X
Euphorbia heterophylla L.	kaliko	X
Ricinus communis L.	Castor bean	X
FABACEAE		
Acacia farnesiana (L.) Willd.	Klu, aroma, kolu	X
Chamaecrista nictitans (L.) Moench	Partridge pea	X
Clitoria ternatea L.	Blue pea	X
Crotalaria incana L.	Fuzzy rattlepod	X
Crotalaria pallida Aiton	Smooth rattlepod	X
Desmanthus pernambucanus (L.) Thell.	Slender or virgate mimosa	X
Desmodium tortuosum (Sw.) DC	Florida beggarweed	X
Enterolobium cyclocarpum (N.Jacquin) Grisebach	Earpod	X
Erythrina variegata L.	Tropical coral tree	X
Indigofera hendecaphylla Jacq.	Creeping indigo	X
Indigofera suffritocosa Mill.	Iniko	X
Leucaena leucocephala (Lam.) de Wit	Koa haole	X
Macroptilium lathyroides (L.) Urb.	Wild bean	X
Peltophorum pterocarpum (A.P. de Candolle) K. Heyne	Yellow poinciana	X
Pithecellobium dulce (Roxb.) Benth.	opiuma	X
Prosopis pallida (Humb. & Bonpl. Ex Willd.) Kunth	Kiawe, algaroba	X
Samanea saman (Jacq.) Merr.	monkeypod	X
LAMIACEAE		
Hyptis pectinata (L.) Poit.	Comb hyptis	X
Leonotis nepetifolia (L.) R.Br.	Lion's ear	X

Ocimum basilicum L.	Sweet basil	X
SCIENTIFIC NAME	**COMMON NAME**	**STATUS**
Ocimum tenuifolium L.	Holy basil	X
MALVACEAE		
Abutilon grandifolium (Willd.) Sweet	Hairy abutilon	X
Abutilon incanum (Link.) Sweet	Hoary abutilon	X
Malva parviflora L.	Cheese weed	X
Malvastrum coromandelianum (L.) Garcke	False mallow	X
Sida ciliaris L.		X
Sida fallax Walp.	'ilima	I
Sida rhombifolia L.		X
Sida spinosa L.	Prickly sida	X
MELIACEAE		
Melia azerdarach L.	Pride of India	X
MORACEAE		
Ficus microcarpa L.f.	Chinese banyan	X
Morus sp. L.	Mulberry	X
MORINGACEAE		
Moringa oleifera Lamark	Horseradish tree	X
MYRTACEAE		
Eucalyptus degulpta Blume	Painted gum	X
Psidium guajva L.	Common guava	X
Syzigium cumini (L.) Skeels	Java plum	X
NYCTAGINACEAE		
Boerhavia coccinea Mill.		X
Bougainvillea sp. A.L. Jussieu	bougainvillea	X
ONAGRACEAE		
Ludwigia octovalvis (Jacq.) Raven	Primrose willow	X
PASSIFLORACEAE		
Passiflora foetida L.	Love-in-a-mist	X
POLYGONACEAE		
Antigonon leptopus Hook&Arnott	Mexican creeper	X
PORTULACACEAE		
Portulaca oleracea L.	pigweed	X

AR00027570

SCIENTIFIC NAME	COMMON NAME	STATUS
RUBIACEAE		
Morinda citrifolia L.	noni	X
RUTACEAE		
Citrus xparadisi MacFadyen	grapefruit	X
Citrus sp. L.	citrus	X
SOLANACEAE		
Datura stramonium L.	Jimson weed	X
Nicandra physalodes (L.) Gaertn.	Apple of Peru	X
Nicotiana glauca R.C. Graham	Tree tobacco	X
Solanum americanum Mill.	Glossy nightshade, popolo	I
Solanum lycopersicum L. var. *cerasiforme* (Dunal) Spooner, G.J. Anderson & R.K. Jansen	Cherry tomato	X
Solanum torvum Sw.		X
STERCULIACEAE		
Waltheria indica L.	ʻuhaloa	I
VERBENACEAE		
Stachytarpheta jamaicensis (L.) Vahl	Jamaican vervain	X
ZYGOPHYLLACEAE		
Tribulus terrestris L.	Puncture vine	X

AR00027571

APPENDIX C

Survey of Avian & Mammalian Resources

A Survey of Avian and Mammalian Resources for the Ho'opili Development Project, 'Ewa District, O'ahu, Hawai'i.

-

Main Parcels

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February 11, 2008

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AR00027573

Introduction

D. R. Horton – Schuler Division is proposing to develop a residential community on approximately 1,555-acres of land in the 'Ewa District, O'ahu (Figure 1). This report summarizes the findings of the avian and mammalian surveys that were conducted on the subject property to determine the potential effects of the proposed development on biological resources present on the site and within the general project area.

A primary goal of the surveys was to determine if there were any avian or mammalian species currently listed as endangered, threatened, or proposed for listing under either Federal or State of Hawaii endangered species statutes. Listed species status follows species identified in the following referenced documents (Division of Land and Natural Resources (DLNR) 1998, Federal Register 2005, U. S. Fish & Wildlife Service (USFWS) 2005, 2006). Fieldwork was conducted on July 20, and 21, 2006.

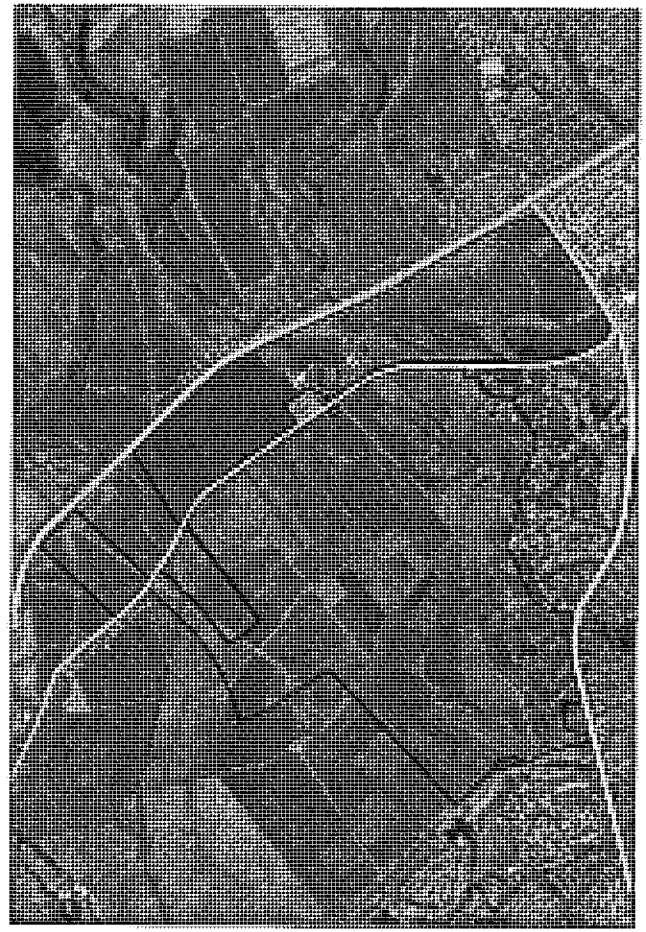
The avian phylogenetic order and nomenclature used in this report follows *The American Ornithologists' Union Checklist of North American Birds 7th Edition* (American Ornithologists' Union 1998), and the 42nd through the 47th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005, 2006). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Plant names follow *Manual of the Flowering Plants of Hawai'i* (Wagner et al. and Wagner and Herbst, 1990, 1999). Place names follow *Place Names of Hawaii* (Pukui et al. 1974).

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text on Page 11.

General Site Description

The proposed Ho'opili Development includes five main parcels which are identified as (TMK: 9-1-17:04 (por.), 9-1-17:59 and 9-1-17:72, 9-1-18:01 and 9-1-18:04, and two smaller "off-site" parcels, which are covered in two separate reports (David 2008a, 2008b). This reports covers the approximately 1555-acres, which make up the main development area (Figure 1).

The project site is made up primarily of former sugar cane fields, most fallow now, though some are being farmed for various diversified agricultural crops. The site is bound to the north by the H-1 Freeway, to the east by Fort Weaver Road and to the west by additional former sugar cane lands. Farrington Highway transects the side from east to west (Figure 1). The terrain slopes gently from the north-to-south, from an elevation of approximately 200-feet above mean sea level (MSL) at the north corner of the site, adjacent to Fort Weaver Road and H-1 Freeway off ramp, down to approximately 60-feet MSL at the southwestern corner of the site located along Mango Tree Road (Figure 1).



AR00027574

Much of the site is made up of former sugar cane land, some of which is bare, (Figure 2), and some of which is under active cultivation of various diversified crops, such as corn, and bananas (Figure 3). Areas along roads and between fields are vegetated with a mix of predominantly alien ruderal species typical of disturbed former sugar fields on O'ahu (Figure 2). The vegetation present on the project site is almost completely dominated by alien species. The botanical surveys conducted on the site identified 137-plant species, four of which are considered indigenous, the remainder alien to the Hawaiian Islands (LeGrande 2006).

Mammalian Survey Methods

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of O'ahu are alien species, and most are ubiquitous. Two hours were spent within the project area on the evenings of August 30 and 31, 2006 and again in the early morning hours of August 31, and September 1, 2006, in an attempt to detect Hawaiian hoary bats. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal signs. A running tally was kept of all vertebrate species observed and heard within the study area.

Mammalian Survey Results

Five mammalian species were detected within the project site. Numerous European house mice (*Mus musculus domesticus*) were seen at several locations during the course of this survey. A total of five domestic dogs (*Canis f. familiaris*) were seen within, or adjacent to the study area. Nine small Indian mongooses (*Herpestes a. auropunctatus*) were seen at various locations within the site, as were three cats (*Felis catus*). Many more dogs and cats were seen and or heard within existing developments located to the northeast and southeast of the proposed project site. Additionally, tracks, scat and sign of dog, mongoose, cat, and horse (*Equus c. caballus*) were observed in numerous locations within the project site.

The endangered Hawaiian hoary bat was not recorded during the course of this survey. This finding is not surprising given that this species has rarely been documented from the Island of O'ahu (Tomich 1986, USFWS 1998).

Avian Survey Methods

Twenty-seven avian count stations were sited along linear transects within the subject property. Six-minute point counts were made at each of the 27-count stations. Field observations were made using Leitz 10 X 42 binoculars and by listening for avian vocalizations. Counts took place between 06:30 a.m. and 11:00 a.m., the peak of daily bird activity. An additional two hours was spent within the project area on the evenings of August 30 and 31, 2006 and again in the early morning hours of August 31, and September 1, 2006 in an attempt to detect crepuscular and/or nocturnally flying seabirds and owls. Time not spent conducting station counts was used to search the subject property for species and habitats not detected during count sessions.

Figure 2 – Cleared former sugar cane fields and ruderal vegetation along road

Figure 3 – Cornfields typical of diversified crops to the south of Farrington Hwy.

AR00027575

Avian Survey Results

A total of 831 individual birds, of 24 different avian species, representing 15 separate families were recorded during station counts. These results are summarized in Table 1. Two of the species recorded, Pacific Golden-Plover (*Pluvialis fulva*) and Ruddy Turnstone (*Arenaria interpres*), are indigenous migratory shorebird species. Both species breed in the high Arctic, and spend their winters in Hawai'i and the tropical Pacific. The remaining 22 species detected are considered to be alien to the Hawaiian Islands (Table 1).

Avian diversity and densities were relatively low, not surprising given the depauperate state of the habitat found on most of the site. Four species, Common Waxbill (*Estrilda astrild*), Red-vented Bulbul (*Pycnonotus cafer*), Common Myna (*Acridotheres tristis*), and Spotted Dove (*Streptopelia chinensis*) accounted for slightly less than 43% of the total number of individual birds recorded. Common Waxbills were the most frequently recorded species, accounting for more than 13% of the total number of individual birds recorded during station counts. We recorded an average of 23 birds per station count.

Table 1. Avian Species Detected Ho'opili Project – Main Sites

Common Name	*Scientific Name*	*ST*	*RA*
	GALLIFORMES		
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Gray Francolin	*Francolinus pondicerianus*	A	0.15
Black Francolin	*Francolinus francolinus*	A	0.26
Erckel's Francolin	*Francolinus erckelii*	A	0.56
Ring-necked Pheasant	*Phasianus colchicus*	A	0.19
	CICONIIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	0.74
	CHARADRIIFORMES		
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	0.37
	SCOLOPACIDAE - Sandpipers, Phalaropes & Allies		
	Scolopaeinae - Sandpipers & Allies		
Ruddy Turnstone	*Arenaria interpres*	IM	0.41

Common Name	*Scientific Name*	*ST*	*RA*
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	2.81
Zebra Dove	*Geopelia striata*	A	2.15
Morning Dove	*Zenaida macroura*	A	0.15
	PASSERIFORMES		
	ALAUDIDAE - Larks		
Sky Lark	*Alauda arvensis*	A	1.63
	PYCNONOTIDAE - Bulbuls		
Red-vented Bulbul	*Pycnonotus cafer*	A	3.22
	ZOSTEROPIDAE - White-Eyes		
Japanese White-eye	*Zosterops japonicus*	A	2.41
	MIMIDAE - Mockingbirds & Thrushes		
Northern Mockingbird	*Mimus polyglottos*	A	2.89
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	2.89
	EMBERIZIDAE - Emberizids		
Red-crested Cardinal	*Paroaria coronata*	A	0.70
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	0.74
	FRINGILLIDAE - Fringilline And Carduline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	1.85
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*		0.67
	ESTRILDIDAE - Estrildid Finches		
	Estrildinae - Estrildine Finches		
Common Waxbill	*Estrilda astrild*	A	4.11
Red Avadavat	*Amandava amandava*	A	0.78
Nutmeg Mannikin	*Lonchura punctulata*	A	1.41
Chestnut Munia	*Lonchura atricapilla*	A	0.48
Java Sparrow	*Padda oryzivora*	A	1.04

KEY TO TABLE 1

ST Status

A Alien – introduced to the Hawaiian Islands by humans

IM Indigenous Migrant – a native migratory species that winters in Hawai'i but breeds elsewhere

RA Relative Abundance – number of birds detected divided by the number of count stations (27)

AR00027576

Discussion

Mammalian Resources

The findings of the mammalian survey are consistent with the findings of at least one other recent survey conducted on lands immediately adjacent to the subject property (David 2005a), as well as with several others faunal surveys conducted in the general vicinity of the subject property in the recent past (David 2000, 2001, 2005b, 2008a, 2008b, David and Guinther 2000, 2005, 2006, 2007).

As previously mentioned we did encounter several European house mice within the project site. It is also likely that the other three established *muridae* in Hawaii, roof rats (*Rattus r.rattus*), Norway rats (*Rattus norvegicus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*), use resources present within the project site. These commensal species are all but ubiquitous on the island of O'ahu. All of these introduced rodents are deleterious to remaining native ecosystems and the native floral and faunal species that are dependant on them for their survival.

Avian Resources

The findings of the avian survey are consistent with the findings of at least one other recent avian survey conducted on lands immediately adjacent to the subject property (David 2005a), as well as with several others avian surveys conducted in the general vicinity of the subject property in the recent past (David 2000, 2001, 2005b, 2008a, 2008b, David and Guinther 2000, 2005, 2006, 2007).

Only two of the 24-avian species recorded during the course of this survey are native species. The two species in question, Pacific Golden-Plover, and Ruddy Turnstone are indigenous migratory shorebird species that breed in the high Arctic and spend the winter months in Hawai'i and the tropical Pacific. Both species are readily seen throughout the Hawaiian Islands between late July and the end of April each year. The remaining 22-species detected are considered to be alien to the Hawaiian Islands (Table 1).

Although not detected during this survey, it is likely that the Hawaiian endemic sub-species of the Short-eared Owl *Asio flammeus sandwichensis*), or *pueo* use resources within the general project area. This species is regularly seen along the Wai'anae coast from the Lualualei Naval Reservation to Waimānalo Gulch (David 2005c). The O'ahu population of the short-eared Owl is listed as an endangered species under the State of Hawai'i's endangered species program, though; it is not protected under the federal endangered species statutes (DLNR 1998).

From an avian and native mammalian perspective there is nothing unique about the subject property, and none of the study area is important habitat for any listed avian or mammalian species currently known from the Island of O'ahu.

Conclusions

It is not expected that the modification of the project area or the development of the site will have a negative impact on any avian or mammalian species currently listed as endangered, threatened, or any that are currently proposed for listing under either Federal or State of Hawai'i endangered species statutes.

AR00027577

Glossary

Alien - Introduced to Hawai'i by humans
Commensal - Animals that share human food such as rats and mice
Crepuscular – Twilight hours
Depauperate – Lacking in numbers or variety of species
Endangered – Listed and protected under the ESA as an endangered species
Endemic – Native and unique to the Hawaiian Islands
Indigenous - Native to the Hawaiian Islands, but also found elsewhere naturally
Muridae - Rodents, including rats, mice and voles, one of the most diverse families of mammals.
Nocturnal – Night-time, after dark
'ope'ape'a – Hawaiian hoary bat (*Lasiurus cinereus semotus*)
pueo – Hawaiian endemic sub-species of the Short-eared Owl (*Asio flammeus sandwichensis*)
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Threatened - Listed and protected under the ESA as a threatened species

DLNR – Hawaii State Department of Land & Natural resources
TMK – Tax Map Key
USFWS – U.S. Fish & Wildlife Service

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AR00027578

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AR00027579

A Survey of Avian and Mammalian Resources for the Ho'opili Development Project, 'Ewa District, O'ahu, Hawai'i.

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Makai Detention Site

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Figure 1. Ho'opili Makai Detention Site 4

Table 1. Avian Species Detected Ho'opili Makai Detention Site 6

AR00027580

Introduction

D. R. Horton – Schuler Division is proposing to use a triangular parcel of land located to the east of Fort Weaver Road as a storm water retention basin for their proposed Ho'opili Development in East Kapolei, 'Ewa District, O'ahu (Figure 1). A portion of the site is currently being used as such by developments to the north and west of the site. This report summarizes the findings of the avian and mammalian surveys that were conducted within this site to determine the potential effects of the proposed development on biological resources present on the site and within the general project area (Figure 1).

A primary goal of the surveys was to determine if there were any avian or mammalian species currently listed as endangered, threatened, or proposed for listing under either Federal or State of Hawaii endangered species statutes present on, or close to the proposed project areas. Listed species status follows species identified in the following referenced documents (Division of Land and Natural Resources (DLNR) 1998, Federal Register 2005, U. S. Fish & Wildlife Service (USFWS) 2005, 2006). Fieldwork was conducted on August 15, 2006.

The avian phylogenetic order and nomenclature used in this report follows *The American Ornithologists' Union Checklist of North American Birds 7th Edition* (American Ornithologists' Union 1998), and the 42nd through the 47th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005, 2006). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Plant names follow *Manual of the Flowering Plants of Hawai'i* (Wagner et al. and Wagner and Herbst, 1990, 1999). Place names follow *Place Names of Hawaii* (Pukui et al. 1974).

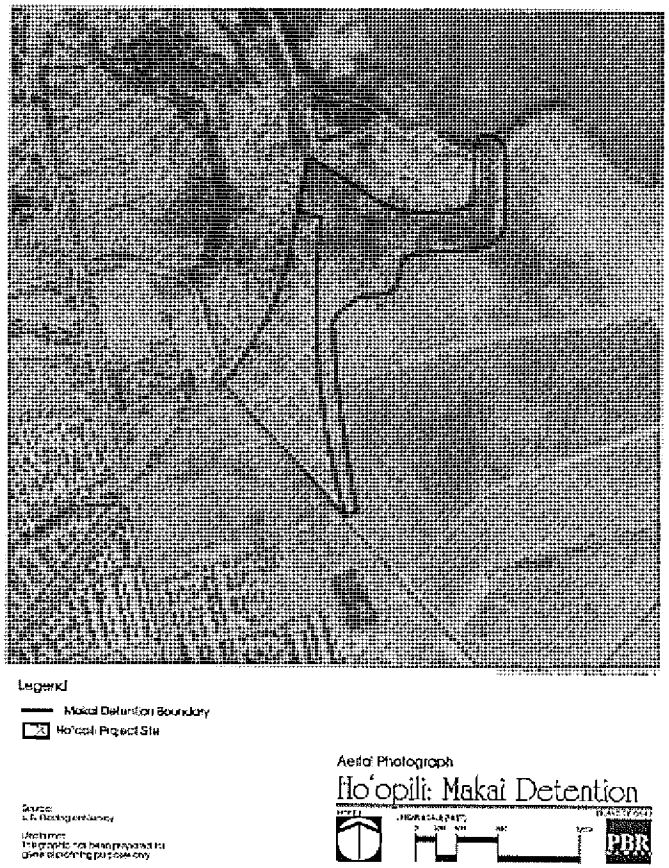
Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text on Page 9.

General Site Description

The proposed Ho'opili Development includes five main parcels, which are covered in a separate report, and two smaller "off-site" parcels, which are covered in two separate reports (David 2008a, 2008b). This report covers a proposed storm water detention basin which is to be located to the east of Fort Weaver Road, and south of the Honouliuli Unit of the Pearl Harbor National Wildlife Refuge (Figure 1). The site is transected by the former OR&L railway line. A corridor running from the original detention site to Pearl Harbor was not surveyed, as we were unable to secure access to the area, which is controlled by the U. S. Navy.

The project site is made up of an approximately 2-acre detention basin on the northern third of the site. The southern third of the site is in active cultivation of corn (*Zea mays*) and tomatoes (*Solanum lycopersicum*). The vegetation present on the project site is almost completely dominated by alien species. The botanical surveys conducted on the site identified 73-plant species, three of which are considered indigenous, the remainder being alien to the Hawaiian Islands (LeGrande 2006).

Figure 1 – Ho'opili Makai Detention Site



AR00027581

Mammalian Survey Methods

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of O'ahu are alien species, and most are ubiquitous. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all vertebrate species observed and heard within the study area.

Mammalian Survey Results

Three mammalian species were detected within the project site. Three small Indian mongooses (*Herpestes a. auropunctatus*) were seen at various locations within the site. Several dogs (*Canis f. familiaris*) were heard barking from within existing developments located to the northwest of the site. Tracks, scat and sign of mongoose cat (*Felis catus*) and dog were encountered in several locations within the site. The endangered Hawaiian hoary bat was not recorded during the course of this survey. This finding is not surprising given that this species has rarely been documented from the Island of O'ahu (Tomich 1986, USFWS 1998).

Avian Survey Methods

Five avian count stations were sited along two linear transects running the length of the site. Stations were sighted approximately 300-meters apart. Six-minute point counts were made at each of the nine-count stations. Field observations were made using Leitz 10 X 42 binoculars and by listening for avian vocalizations. Counts took place between 06:30 a.m. and 11:00 a.m., the peak of daily bird activity. Time not spent conducting station counts was used to search the subject property for species and habitats not detected during count sessions.

Avian Survey Results

A total of 170 individual birds, of 20-different avian species, representing 13-separate families were recorded during station counts. These results are summarized in Table 1. One of the species recorded, Black-crowned Night-Heron (*Nycticorax nycticorax hoactli*), is a resident indigenous breeding species. Two others, Pacific Golden-Plover (*Pluvialis fulva*) and Ruddy Turnstone (*Arenaria interpres*), are indigenous migratory shorebird species. Both of which breed in the high Arctic, and spend their winters in Hawai'i and the tropical Pacific. The remaining 17-species detected are considered to be alien to the Hawaiian Islands (Table 1).

The survey results were in keeping with the habitat present on the site, and it's location on the Island of O'ahu. Three species, Common Waxbill (*Estrilda astrild*), Zebra Dove (*Geopelia striata*), and Spotted Dove (*Streptopelia chinensis*), accounted for more than 45% of the total number of individual birds recorded. Common Waxbills were the most frequently recorded species, accounting for more slightly less that 19% of the total number of individual birds recorded during station counts. We recorded an average of 20 birds per station count.

Table 1. Avian Species Detected Ho'opili Project - Makai Detention Site

Common Name	*Scientific Name*	*ST*	*RA*
	GALLIFORMES		
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Red Junglefowl	*Gallus gallus*	D	0.80
	CICONIIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	1.40
Black-crowned Night-Heron	*Nycticorax nycticorax hoactli*	IR	0.20
	CHARADRIIFORMES		
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	0.80
	SCOLOPACIDAE - Sandpipers, Phalaropes & Allies		
	Scolopacinae - Sandpipers & Allies		
Wandering tattler	*Tringa incana*	IM	0.20
Ruddy Turnstone	*Arenaria interpres*	IM	0.60
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Rock Pigeon	*Columba livia*	A	1.60
Spotted Dove	*Streptopelia chinensis*	A	3.00
Zebra Dove	*Geopelia striata*	A	6.00
	PASSERIFORMES		
	PYCNONOTIDAE - Bulbuls		
Red-vented Bulbul	*Pycnonotus cafer*	A	0.40
	ZOSTEROPIDAE - White-Eyes		
Japanese White-eye	*Zosterops japonicus*	A	2.40
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	1.60
	EMBERIZIDAE - Emberizids		
Red-crested Cardinal	*Paroaria coronata*	A	1.00
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	0.40

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Common Name	Scientific Name	ST	RA
	FRINGILLIDAE - Fringilline And Cardueline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Carpodacus mexicanus*	A	1.00
	PASSERIDAE - Old World Sparrows		
House Sparrow	*Passer domesticus*	A	1.40
	ESTRILDIDAE - Estrildid Finches		
	Estrildinae - Estrildine Finches		
Common Waxbill	*Estrilda astrild*	A	6.40
Nutmeg Mannikin	*Lonchura punctulata*	A	1.00
Chestnut Munia	*Lonchura atricapilla*	A	1.00
Java Sparrow	*Padda oryzivora*	A	2.80

KEY TO TABLE 1

ST Status

D Domesticated Species – Not currently considered to be established on the Island of O'ahu

A Alien – introduced to the Hawaiian Islands by humans

IM Indigenous Migrant – a native migratory species that winters in Hawai'i but breeds elsewhere

RA Relative Abundance – number of birds detected divided by the number of count stations (5)

Discussion

Mammalian Resources

The findings of the mammalian survey are consistent with the findings of several others faunal surveys conducted in the general vicinity of the subject property in the recent past (David 2000, 2001, 2005a, 2005b, 2007, 2008a, 2008b, David and Guinther 2000, 2005, 2006, 2007).

Although none of the four established *muridae* were detected during the course of this survey, it is likely that, European house mice (*Mus musculus domesticus*), Hawai'i, roof rats (*Rattus r. rattus*), Norway rats (*Rattus norvegicus*), and possibly Polynesian rats (*Rattus exulans hawaiiensis*), use resources present within the project site. These commensal species are all but ubiquitous on the island of O'ahu. All of these introduced rodents are deleterious to remaining native ecosystems and the native floral and faunal species that are dependant on them for their survival.

Avian Resources

The findings of the avian survey are consistent with the findings of several others avian surveys conducted in the general vicinity of the subject property in the recent past (David 2000, 2001, 2005a, 2005b, 2007, 2008a, 2008b, David and Guinther 2000, 2005, 2006, 2007).

Three of the 20-avian species recorded during the course of this survey are native species. Black-crowned Night-Herons are an indigenous resident breeding species. They are regularly seen in

and around just about any kind of standing or running water present on O'ahu. The other two native species recorded, Pacific Golden-Plover and Ruddy Turnstone, are indigenous migratory shorebird species that breed in the high Arctic and spend the winter months in Hawai'i and the tropical Pacific. Both species are readily seen throughout the Hawaiian Islands between late July and the end of April each year. The remaining 17-species detected are considered to be alien to the Hawaiian Islands (Table 1).

Four waterbird species that are currently listed as endangered under both the Federal and State of Hawai'i's endangered species statutes, Hawaiian Duck x Mallard hybrids (*Anas wyvilliana x platyrhynchos*), Common Moorhen (*Gallinula chloropus sandvicensis*), Hawaiian Coot (*Fulica alai*), and Black-necked Stilt (*Himantopus mexicanus knudsen*), are present within the general project area, although there currently is no suitable habitat within the project site for them. All four species breed within the Honouliuli unit of the Pearl Harbor National Wildlife Refuge, which is located some 250-meters north of the proposed site. They are also regularly encountered on the golf course located to the northwest of the project site. At such time as the detention basin is enlarged, and when water ponds within it, it is likely that one or more of these species may start to use resources present within the expanded detention basin. According to the projects' civil engineer, Bills Engineering Inc. this is likely to happen very infrequently.

Although not detected during this survey, it is likely that the Hawaiian endemic sub-species of the Short-eared Owl (*Asio flammeus sandwichensis*), or *pueo* use resources within the general project area occasionally. This species is regularly seen along the Wai'anae coast from the Lualualei Naval Reservation to Waimānalo Gulch (David 2005c). I have also seen them within the Honouliuli unit of the Pearl Harbor National Wildlife Refuge upon occasion (David 2007e). The O'ahu population of the short-eared Owl is listed as an endangered species under the State of Hawai'i's endangered species program, though; it is not protected under the federal endangered species statutes (DLNR 1998).

From an avian and native mammalian perspective there is nothing unique about the habitat present within the *makai* detention site. None of the habitat present on the project site is important habitat for any listed avian or mammalian species currently known from the Island of O'ahu.

Conclusions

It is not expected that the modification of the habitat currently found within the proposed makai detention site will result in any deleterious impacts to any avian or mammalian species currently listed as endangered, threatened, or any that are currently proposed for listing under either Federal or State of Hawai'i endangered species statutes.

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Glossary

Alien - Introduced to Hawai'i by humans
Commensal - Animals that share human food such as rats and mice
Crepuscular – Twilight hours
Endangered – Listed and protected under the ESA as an endangered species
Endemic – Native and unique to the Hawaiian Islands
Indigenous - Native to the Hawaiian Islands, but also found elsewhere naturally
makai – Down-slope, towards the ocean
mauka – Upslope, towards the mountains
Muridae - Rodents, including rats, mice and voles, one of the most divers families of mammals.
Nocturnal – Night-time, after dark
'ōpe'ape'a – Hawaiian hoary bat (*Lasiurus cinereus semotus*)
pueo – Hawaiian endemic sub-species of the Short-eared Owl (*Asio flammeus sandwichensis*)
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Threatened - Listed and protected under the ESA as a threatened species

ESA – Endangered Species Act of 1973, as amended
DLNR – Hawaii State Department of Land & Natural resources
USFWS – U.S. Fish & Wildlife Service

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A Survey of Avian and Mammalian Resources for the Ho'opili Development Project, 'Ewa District, O'ahu, Hawai'i.

-

New 440 Tank, Transmission Line and New 228 Tank

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Introduction

D. R. Horton – Schuler Division is proposing to develop two new potable water tanks (440 and 228) as well as approximately 5600-feet of waterline to service their proposed Ho'opili Development which is to be located *makai* of the water infrastructure in the 'Ewa District, O'ahu (Figure 1). This report summarizes the findings of the avian and mammalian surveys that were conducted along the proposed waterline routes and on the proposed water tank sites, to determine the potential effects of the proposed development on biological resources present on the site and within the general project area (Figure 1).

A primary goal of the surveys was to determine if there were any avian or mammalian species currently listed as endangered, threatened, or proposed for listing under either Federal or State of Hawaii endangered species statutes present on, or close to the proposed project areas. Listed species status follows species identified in the following referenced documents (Division of Land and Natural Resources (DLNR) 1998, Federal Register 2005, U. S. Fish & Wildlife Service (USFWS) 2005, 2006). Fieldwork was conducted on July 20, and 21, 2006.

The avian phylogenetic order and nomenclature used in this report follows *The American Ornithologists' Union Checklist of North American Birds 7th Edition* (American Ornithologists' Union 1998), and the 42nd through the 47th supplements to *Check-list of North American Birds* (American Ornithologists' Union 2000; Banks et al. 2002, 2003, 2004, 2005, 2006). Mammal scientific names follow *Mammals in Hawaii* (Tomich 1986). Plant names follow *Manual of the Flowering Plants of Hawai'i* (Wagner et al. and Wagner and Herbst, 1990, 1999). Place names follow *Place Names of Hawaii* (Pukui et al. 1974).

Hawaiian and scientific names are italicized in the text. A glossary of technical terms and acronyms used in the document, which may be unfamiliar to the reader, are included at the end of the narrative text on Page 10.

General Site Description

The proposed Ho'opili Development includes five main parcels, which are covered in a separate report, and two smaller "off-site" parcels, which are covered in two separate reports (David 2008a, 20008b). This reports covers two proposed above ground reservoir sites and associated water transmission line routes, all of which are located *mauka*, or north of the H-1 Freeway (Figure 1 and 2).

The project site is made up primarily of a dirt road, which extends some 4000-feet *mauka* from the H-1 Freeway. The proposed 228 water tank site is located on a previously graded pad, immediately adjacent to an existing Board of Water Supply (BWS) water tank just *mauka* of the H-1 Freeway. The proposed 440 water tank is located adjacent to yet another BWS water tank in a former pineapple field, which was fallow at the time of this survey. The proposed water transmission line will be located parallel to the existing BWS transmission line which currently runs along the dirt road between the two existing tanks (Figure 1).

Figure 1 – New 440 Tank, Transmission Line and New 228 Tank Schematic

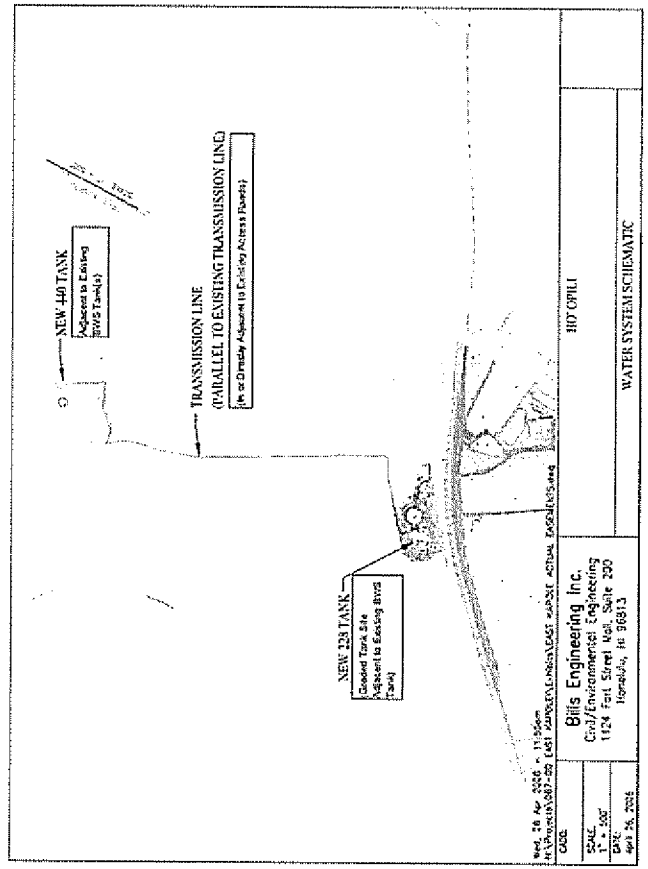

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Figure 2
Aerial Photograph Showing Transmission Line and Tank Sites

The termin on the project site slopes from north-to-south, from an elevation of approximately 440-feet above mean sea level (MSL) at the northern terminus of the site, down to approximately 200-feet MSL along the H-1 Freeway (Figure 1).

As can clearly be seen in Figure 2 the habitat present within the general project site is made up of former sugar cane lands, some of which have in recent years been used to grow various diversified agricultural crops. The new 440 tank site is located on a relatively flat parcel of land formerly used to grow pineapple. The entire project site has been heavily disturbed by agricultural activities and the existing water supply infrastructure. The vegetation present on the project site is almost completely dominated by alien species. The botanical surveys conducted on the site identified 56-plant species, two of which are considered indigenous, the remainder alien to the Hawaiian Islands (LeGrande 2006).

Mammalian Survey Methods

All observations of mammalian species were of an incidental nature. With the exception of the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*), or *'ōpe'ape'a* as it is known locally, all terrestrial mammals currently found on the Island of O'ahu are alien species, and most are ubiquitous. Two hours were spent within the project area on the evening of July 20, 2006 and again in the early morning hours of July 21, 2006, in an attempt to detect Hawaiian hoary bats. The survey of mammals was limited to visual and auditory detection, coupled with visual observation of scat, tracks, and other animal sign. A running tally was kept of all vertebrate species observed and heard within the study area.

Mammalian Survey Results

Three mammalian species were detected within the project site. Several small Indian mongooses (*Herpestes a. auropunctatus*) were seen at various locations along the dirt road and close to the Hawaiian Electric Companies switching station located at the *mauka* end of the site. We also encountered tracks, scat and sign of dog (*Canis f. familiaris*), cat (*Felis catus*), and mongoose at several locations along the dirt road.

The endangered Hawaiian hoary bat was not recorded during the course of this survey. This finding is not surprising given that this species has rarely been documented from the Island of O'ahu (Tomich 1986, USFWS 1998).

Avian Survey Methods

Seven avian count stations were sited along a linear transect running the length of the dirt road and extending east from the *mauka* water tank site. Stations were sighted approximately 900-feet apart. Six-minute point counts were made at each of the seven-count stations. Field observations were made using Leitz 10 X 42 binoculars and by listening for avian vocalizations. Counts took place between 06:30 a.m. and 11:00 a.m., the peak of daily bird activity. An additional two hours was spent within the project area on the evening of July 20, 2006 and again in the early morning hours of July 21, 2006, in an attempt to detect crepuscular and/or nocturnally flying seabirds and

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owls. Time not spent conducting station counts was used to search the subject property for species and habitats not detected during count sessions.

Avian Survey Results

A total of 152 individual birds, of 13 different avian species, representing 11-separate families were recorded during station counts. These results are summarized in Table 1. One of the species recorded, Pacific Golden-Plover (*Pluvialis fulva*), is an indigenous migratory shorebird species. Pacific Golden-Plover breed in the high Arctic, and spend their winters in Hawai'i and the tropical Pacific. The remaining 12 species detected during the course of this survey are considered to be alien to the Hawaiian Islands (Table 1).

Avian diversity and densities were relatively low, not surprising given the depauperate state of the habitat found on most of the site. Three species, Common Waxbill (*Estrilda astrild*), Zebra Dove (*Geopelia striata*), and Japanese White-eye (*Zasteropus japonicus*) accounted for slightly less than 41% of the total number of individual birds recorded. Common Waxbills were the most frequently recorded species, accounting for more than 15% of the total number of individual birds recorded during station counts. We recorded an average of 22 birds per station count.

Discussion

Mammalian Resources

The findings of the mammalian survey are consistent with the findings of at least two other recent surveys conducted on lands immediately adjacent to the subject property (David 2005a, 2007a), as well as with several others faunal surveys conducted in the general vicinity of the subject property in the recent past (David 2000, 2001, 2005b, 2008a, 2008b, David and Guinther 2000, 2005, 2006, 2007).

Although we did not record any of the four muridae species currently considered to be established on O'ahu, it is likely that, European house mouse (*Mus musculus domesticus*) Hawai'i, roof rat (*Rattus r. rattus*), Norway rat (*Rattus norvegicus*), and possibly Polynesian rats (*Rottus exulans hawaiiensis*) use resources present within the project site. These commensal species are all but ubiquitous on the island of O'ahu. All of these introduced rodents are deleterious to remaining native ecosystems and the native floral and faunal species that are dependant on them for their survival.

Avian Resources

The findings of the avian survey are consistent with the findings of at least two other recent avian surveys conducted on lands immediately adjacent to the subject property (David 2005a, 2007a), as well as with several others avian surveys conducted in the general vicinity of the subject property in the recent past (David 2000, 2001, 2005b, 2008a, 2008b, David and Guinther 2000, 2005, 2006, 2007).

Table 1. Avian Species Detected Ho'opili Project; Offsite Reservoirs and Waterline Routes

Common Name	*Scientific Name*	*ST*	*RA*
	GALLIFORMES		
	PHASIANIDAE - Pheasants & Partridges		
	Phasianinae - Pheasants & Allies		
Gray Francolin	*Francolinus pondicerianus*	A	0.86
	CICONIIFORMES		
	ARDEIDAE - Herons, Bitterns & Allies		
Cattle Egret	*Bubulcus ibis*	A	0.57
	CHARADRIIFORMES		
	CHARADRIIDAE - Lapwings & Plovers		
	Charadriinae - Plovers		
Pacific Golden-Plover	*Pluvialis fulva*	IM	0.43
	COLUMBIFORMES		
	COLUMBIDAE - Pigeons & Doves		
Spotted Dove	*Streptopelia chinensis*	A	1.71
Zebra Dove	*Geopelia striata*	A	2.86
	PASSERIFORMES		
	PYCNONOTIDAE - Bulbuls		
Red-vented Bulbul	*Pycnonotus cafer*	A	2.14
	ZOSTEROPIDAE - White-Eyes		
Japanese White-eye	*Zosterops japonicus*	A	2.71
	STURNIDAE - Starlings		
Common Myna	*Acridotheres tristis*	A	2.29
	EMBERIZIDAE - Emberizids		
Red-crested Cardinal	*Paroaria coronata*	A	1.00
	CARDINALIDAE - Cardinals Saltators & Allies		
Northern Cardinal	*Cardinalis cardinalis*	A	0.57
	FRINGILLIDAE - Fringilline And Carduelline Finches & Allies		
	Carduelinae - Carduline Finches		
House Finch	*Corpodacus mexicanus*	A	2.43
	ESTRILDIDAE - Estrildid Finches		
	Estrildinae - Estrildine Finches		
Common Waxbill	*Estrilda astrild*	A	3.29
Red Avadavat	*Amandava amandava*	A	0.86

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KEY TO TABLE 1

ST Status
A Alien – introduced to the Hawaiian Islands by humans
IM Indigenous Migrant – a native migratory species that winters in Hawai'i but breeds elsewhere
RA Relative Abundance – number of birds detected divided by the number of count stations (7)

Only one of the 13-avian species recorded during the course of this survey, Pacific Golden-Plover, is a native species. Pacific Golden-Plover are an indigenous migratory shorebird species that breed in the high Arctic and spends the winter months in Hawai'i and the tropical Pacific. This species is readily seen throughout the Hawaiian Islands between late July and the end of April each year. The remaining 12-species detected during the course of this survey are considered to be alien to the Hawaiian Islands (Table 1).

Although not detected during this survey, it is likely that the Hawaiian endemic sub-species of the Short-eared Owl (*Asio flammeus sandwichensis*), or *pueo* use resources within the general project area occasionally. This species is regularly seen along the Wai'anae coast from the Lualualei Naval Reservation to Waimānalo Gulch (David 2005c). The O'ahu population of the short-eared Owl is listed as an endangered species under the State of Hawai'i's endangered species program, although it is not protected under the federal endangered species statutes (DLNR 1998).

From an avian and native mammalian perspective there is nothing unique about the project area or within the reservoir site, and none of the habitat present within the study area is important habitat for any listed avian or mammalian species currently known from the Island of O'ahu.

Conclusions

It is not expected that the modification of the project area will have a deleterious impact on any avian or mammalian species currently listed as endangered, threatened, or any that are currently proposed for listing under either Federal or State of Hawai'i endangered species statutes.

Glossary

Alien - Introduced to Hawai'i by humans
BWS – Board of Water Supply
Commensal - Animals that share human's food such as rats and mice
Crepuscular – Twilight hours
Endangered – Listed and protected under the ESA as an endangered species
Endemic – Native and unique to the Hawaiian Islands
Indigenous - Native to the Hawaiian Islands, but also found elsewhere naturally
makai – Down-slope, towards the ocean
mauka – Upslope, towards the mountains
Muridae - Rodents, including rats, mice and voles, one of the most diverse families of mammals.
Nocturnal – Night-time, after dark
'ōpe'ape'a – Hawaiian hoary bat (*Lasiurus cinereus semotus*)
pueo – Hawaiian endemic sub-species of the Short-eared Owl (*Asio flammeus sandwichensis*)
Ruderal – Disturbed, rocky, rubbishy areas, such as old agricultural fields and rock piles
Threatened - Listed and protected under the ESA as a threatened species

BWS – Honolulu Board of Water Supply
ESA – Endangered Species Act of 1973, as amended
DLNR – Hawaii State Department of Land & Natural resources
TMK – Tax Map Key
USFWS – U.S. Fish & Wildlife Service

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APPENDIX D
Archaeological Inventory Survey

An Archaeological Inventory Survey for the East Kapolei Project, Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu TMK: (1) 9-1-010:002, 9-1-017:004, 059, 072; 9-1-018:001, 004; 9-2-001:001

Prepared for
D. R. Horton – Schuler Division

Prepared by
Constance O'Hare, B.A.,
D.W. Shideler, M.A.,
and
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Management Summary

Reference	An Archaeological Inventory Survey For the East Kapolei Project, Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu, TMK: (1) 9-1-010:001, 9-1-017:004, 059, 072; 9-1-018:001, 004, 9-2-001:001, by Constance R. O'Hare, David W. Shideler, and Dr. Hallett H. Hammatt
Date	February 2006
Project Number (s)	CSH Job Code: HONO 75
Investigation Permit Number	CSH completed the inventory survey fieldwork under state archaeological permit No. 0508 issued by the State Historic Preservation Division, per Hawai'i Administrative Rules (HAR) Chapter 13-13-282.
Project Location	The main project area comprises TMK:(1) 9-1-017:004, 059, 072; 9-1-018:001, 004. The main project area is generally bound on the north by the H-1 Interstate (I H-1), on the south by Mango Tree Road (a dirt road along the Ewa Villages Golf Course), Pelehua Drive on the west, and Old Fort Weaver Road on the east. There are two non-contiguous parcels, one on the east side of new Fort Weaver Road (TMK 9-1-010:002, and one north of the H-1 Interstate around a reservoir (TMK 9-2-001:001).
Land Jurisdiction	The James Campbell Estate, owner
Agencies	State Historic Preservation Division / Department of Land and Natural Resources (SHPD/DLNR)
Project Description	The landowner plans to develop the area into a mixed residential, commercial, and recreational property.
Project Acreage	2625 acres
Area of Potential Effect (APE)	For the purposes of this study the area of potential effect (APE) and the project area are considered one and the same.
Historic Preservation Regulatory Context	The client, D.R. Horton-Schuler Division proposed development of James Campbell Estate East Kapolei lands constitutes a project requiring compliance with and review under State of Hawai'i historic preservation review legislation (Hawai'i Revised Statutes (HRS) Chapter 6E-42 and Hawai'i Administrative Rules (HAR) 13-284). At the request of D.R. Horton-Schuler Division, CSH completed an archaeological inventory survey investigation, per the requirements of HAR Chapter 13-13-276, of the subject 2625-acre parcel. This archaeological inventory survey report was prepared to support the proposed property's historic preservation review and any other project-related historic preservation consultation
Fieldwork Effort	Constance R. O'Hare, B.A., Owen O'Leary, M.A., Guadalupe Ochoa, B.A., Brad Garrett, M.A., and Jen Tulchin, B.A., under the general direction of Hallett H. Hammatt, Ph.D. conducted surface survey and subsurface testing in the project area. Field work was conducted on November 21, 22, 28, on December 8 and 9, 2005, and January 13, 2006..
Number of Historic Properties Identified	Five sites had been previously identified in a 1990 CSH survey (Hammatt and Shideler 1990). One of these sites (50-80-12-4344) was used to denote Ewa Sugar Plantation scattered infrastructure features. Three features (Features A-C) were recorded for this site during the 1990 survey. During the recent 2005 surface survey, four additional sugar plantation features were recorded. These will be considered additional features (Features D-F) of Site -4344.

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Historic Properties Recommended Eligible to the Hawai'i Register of Historic Places (Hawai'i Register)	Sites 50-80-12-4344 (plantation infrastructure), -4345 (railroad berm), -4346 (northern pumping station), -4347 (central pumping station), and -4348 (southern pumping station) have been previously determined during a 1990 survey to be significant under Criteria C and D. Sites -4345 through- 4348 were also recommended for preservation. No further work or preservation was recommended for -4344. All five sites were revisited during the recent 2005 survey; four additional features were added to Site –4344, however, the original three features (Features A-C) have been destroyed since 1990. The significance and recommendations of these five sites remains the same.
Historic Properties Recommended Ineligible to the Hawai'i Register	Four areas of historic habitation (Honouliuli Taro Lands, Kapalani Catholic Church, PipeLine Village, and Drivers/Stable Village) were identified during the 1990 survey of a portion of the project area. No site designations were given, since there were no surface remains found during the survey. During the recent 2005 backhoe testing for the current project, no subsurface remains for these four habitation loci were found in the project area. No site designations are needed.
Mitigation Recommendation	Although no subsurface remains for four habitation loci were found during the recent backhoe testing of the four areas, it is recommended that a program of on-site/on-call monitoring be conducted during any future development of these four specific areas.

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Section 1 Introduction

1.1 Project Background

At the request of D.R. Horton-Schuler Division (828 Fort Street Mall, 4th Floor, Honolulu, HI 96813), Cultural Surveys Hawai'i, Inc. (CSH) has completed this Inventory Survey Report for the East Kapolei Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu Island ([1] 9-1-010:002; 9-1-017:004, 059, 072; 9-1-018:001, 004; 9-2-001:001) (Figures 1 and 2). The main project area is generally bound on the north by the H-1 Interstate (I H-1), on the south by Mango Tree Road (a dirt road along the Ewa Villages Golf Course), Pelehua Drive on the west, and Old Fort Weaver Road on the east. There are two non-contiguous sections, a parcel on the east side of West Loch Estates and a parcel north of the H-1 Interstate, surrounding a reservoir. In all, the project area is approximately 2625 acres. The landowner, the James Campbell estate, plan to develop this area into a mixed residential, commercial, and recreational property (Figure 3).

CSH previously worked on the eastern 546-acres of these lands back in 1990 in association with what was then known as the West Loch Bluffs project (Hammatt and Shideler 1990). In the course of this study, we were able to determine that the eastern lands of the present project area contain more historic resources than one might guess, including such features as:

- A northern pumping station;
- a central pumping station complex;
- a southern pumping station;
- the former site of PipeLine Village;
- the former site of Drivers and Stable Villages;
- the former site of Hawaiian Land Commission Awards and former Hawaiian Homesteads;
- the former site of the Honouliuli "Kapalani" Roman Catholic Church;
- a well preserved portion of the Ewa Plantation Company railroad berm; and,
- the site of the first artesian well in Hawai'i.

Based on the presence of these sites and presumably others, CSH recommended an inventory survey that includes both surface and subsurface investigation. Based on the known data, subsurface testing with a backhoe is needed during the inventory survey. Backhoe testing will focus on locating and evaluating subsurface deposits, such as buried cultural layers, artifacts, and possibly burials that could not be located by surface pedestrian inspection. Backhoe testing will be conducted in four areas, at the site of the nineteenth century Kapalani Church, the area of Hawaiian Land Commission Awards, the location of Drivers/Stable Village, and the location of PipeLine Village, with its associated church.

The archaeological inventory survey and its accompanying report will document all historic properties within the subject parcel. The prepared inventory survey will be in compliance with state standards and will be submitted for review and approval to the State Historic Preservation Division/Department of Land and Natural Resources (SHPD/DLNR).

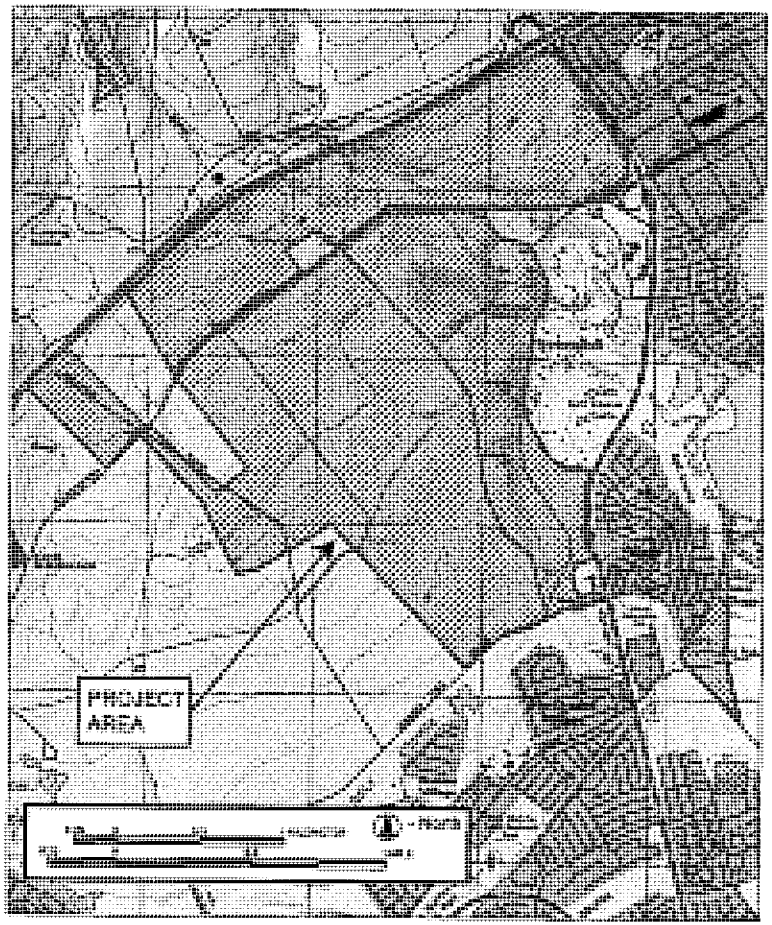

Figure 1. US Geological Survey map (1998), Waipahu and Ewa quadrangles, showing project area (hatched area)

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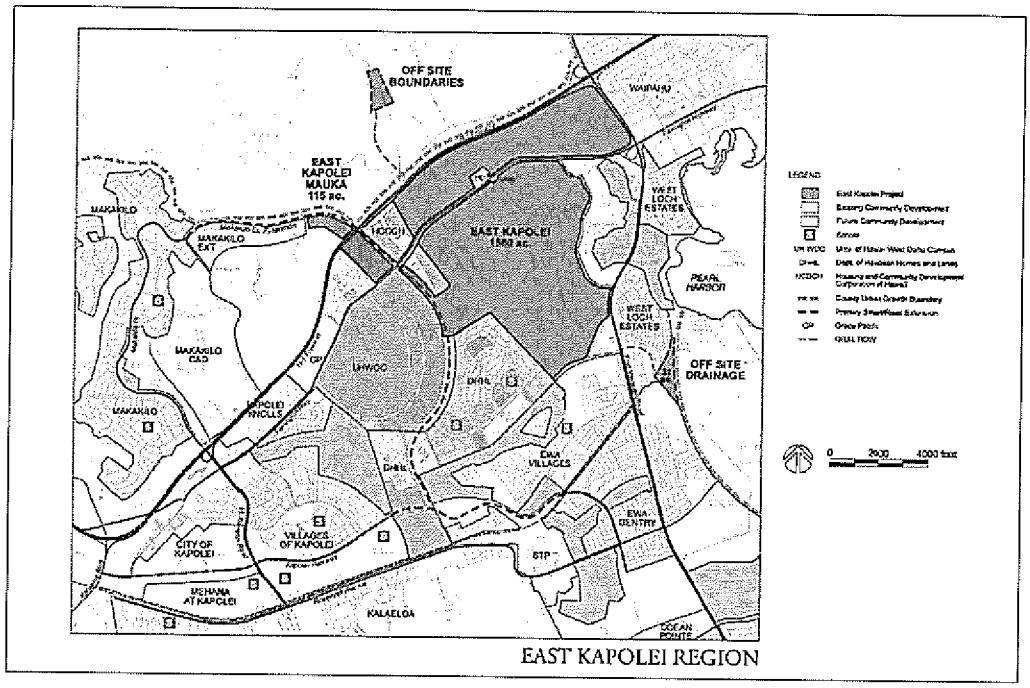

Figure 3. Planned Development for the East Kapolei Region

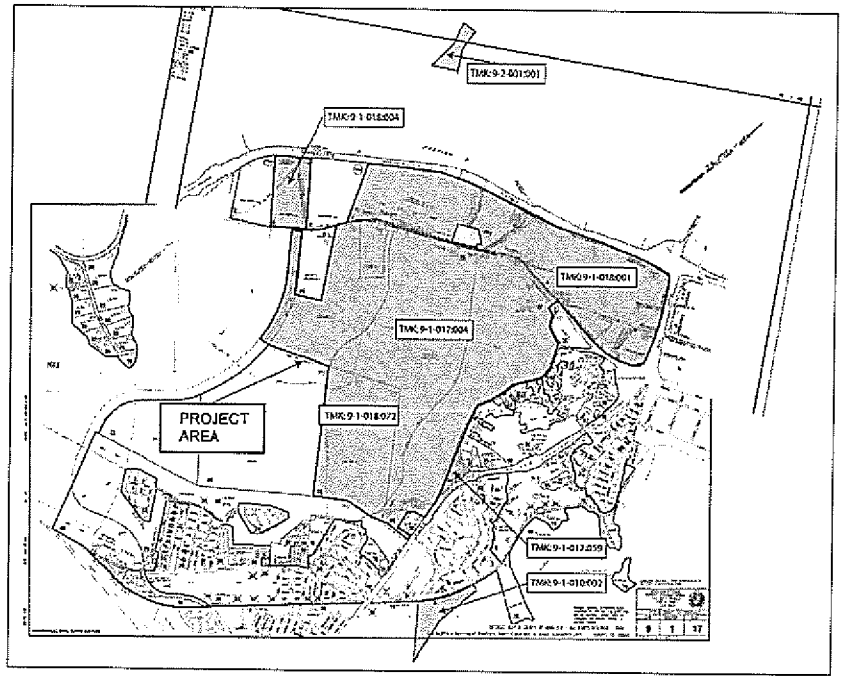

Figure 2. Tax Maps 9-1-010, 9-1-017, 9-1-018, and 9-2-001, showing project area (shaded red)

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1.2 Scope of Work

The following archaeological inventory survey scope of work will satisfy the State and County requirements:

1. State rules have recently been established which require consultation with community members as part of the inventory survey process. This consultation requires contacting knowledgeable members of the community and requesting information on historic and cultural issues related to the property.
2. A complete ground survey of the entire project area for the purpose of site inventory. All sites would be located, described, and mapped with evaluation of function, interrelationships, and significance. Documentation will include photographs and scale drawings of selected sites and complexes. All sites will be assigned State site numbers.
3. Subsurface testing to determine if subsurface deposits are located in the project area, and, if so, evaluate their significance. If appropriate samples from these excavations are found, they will be analyzed for chronological and paleoenvironmental information.
4. Research on historic and archaeological background, including search of historic maps, written records, and Land Commission Award documents. This research will focus on the specific area with general background on the *ahupua'a* and district and will emphasize settlement patterns.
5. Preparation of a survey report which will include the following:
    a. A topographic map of the survey area showing all archaeological sites and site areas;
    b. Results of consultation with knowledgeable community members about the property and its historical and cultural issues.
    c. Description of all archaeological sites with selected photographs, scale drawings, and discussions of function;
    d. Historical and archaeological background sections summarizing prehistoric and historic land use as they relate to the archaeological features;
    e. A summary of site categories and their significance in an archaeological and historic context;
    f. Recommendations based on all information generated that will specify what steps should be taken to mitigate impact of development on archaeological resources - such as data recovery (excavation) and preservation of specific areas. These recommendations will be developed in consultation with the client and the State agencies.

This scope of work also includes full coordination with the State Historic Preservation Division (SHPD), and County relating to archaeological matters. This coordination takes place after consent of the owner or representatives.

Part of the SHPD mandated scope of work for an archaeological inventory survey includes specific documentation of located historic properties. If cultural deposits are located, it is required that appropriate data are collected from them. This includes recording their geographic location on project area maps, general written descriptions, sampling, and section drawings, plan views, and photographs as appropriate. For traditional Hawaiian deposits, this can include analysis of recovered artifacts and midden. It often also includes radiocarbon dating of samples from cultural contexts. If historic-era deposits are located then analysis of associated historic artifacts is sometimes required.

1.3 Environmental Setting

1.3.1 Natural Environment

Honouliuli Ahupua'a is the largest traditional land unit on O'ahu, extending from the West Loch of Pearl Harbor in the east, to the border of Nānākuli Ahupua'a at Pili o Kahe in the west. Honouliuli Ahupua'a includes approximately 19 km (kilometers), or 12 mi (miles) of open coastline from One'ula westward to Pili o Kahe. The *ahupua'a* extends *mauka* (inland) from West Loch nearly to Schofield Barracks in Wahiawā; the western boundary is the Wai'anae Mountain crest running north as far as Pu'u Hāpapa (or to the top of Ka'ala Mountain, according to some).

Topographically, the southern (south of Farrington Highway) project area is most notable for a scarp feature, typically 50 ft (15 m) high, which runs roughly north/south through the southeastern portion of the project area. This scarp is a Pleistocene fossil sea bluff. In the northern section, the land is generally flat, except along Honouliuli Gulch, which runs through the center of this project area section.

Lying in the lee of the Wai'anae mountain range, the project area is one of the driest areas of O'ahu with most of the area averaging about 18 inches of rainfall annually (Juvik and Juvik 1998:56). Temperatures range between 60° to 90° through the year; the highest temperatures are in August and September (Armstrong 1973). Elevation in the project area ranges from 40 ft (feet) AMSL (above mean sea level) to 240 ft, or 12 to 73 m (meters). The project area is located on the 'Ewa Plain, which is a Pleistocene (>38,000 years old) reef platform overlain by alluvium from the southern end of the Wai'anae Mountain Range. This alluvium supported commercial sugar cane cultivation for over a century. Honouliuli Stream extends (roughly northwest to southeast) through the center of the northern section (between I H-1 and Farrington Highway) of the main project area.

In pre-contact Hawai'i the project area would have been mostly lowland dry shrub and grassland, dominated by species such as *wiliwili* (*Erythrina sandwicensis*), *lama* (*Diospyros ferrea*), sandalwood (*Santalum* sp.), *'a'ali'i* (*Dodonea eriocarpa*), scrub *'ōhi'a* (*Metrosideros collina*) and *pili* grass (*Heteropogon contortus*). Today the non-cultivated portions of the project area are dominated by introduced species such as *kiawe* and *koa haole*. Understory plants include *'ilima ku kula* (*Sida cordifola*), cayenne vervain (*Stachytarpheta urticaefolia*), *ko'oko'olau* (*Bidens pilosa*), and morning glory (*Ipomoea indica*) (Moore and Kennedy 2002:3). The vast majority of the project area consists of plowed fields, with crops of pumpkins, squash, cucumbers, bananas, beans, and other vegetable products.

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A total of ten soil series are found in the project area (Figure 4). The Ewa Series consists of well-drained soils in basins and on alluvial fans, developed in alluvium derived from basic igneous rock. They are nearly level to moderately sloping. These soils are used for sugarcane, truck crops, and pasture. The Helemano series consists of well-drained soils on alluvial fans and colluvial slopes on the sides of gulches, which developed in alluvium and colluvium derived from basic igneous rock. They are steep to extremely steep. These soils are used for pasture, woodland, and wildlife habitat. The Honouliuli series consists of well-drained soils on coastal plains; the soils developed in alluvium derived from basic igneous material. They are nearly level and gently sloping. These soils are used for sugarcane, truck crops, orchards, and pasture. The Kaloko Series consists of poorly drained soils on coastal plains. These soils developed in alluvium derived from basic igneous rock; the alluvium has been deposited over marly lagoon deposits. The soils are nearly level. These soils are used for irrigated sugarcane and pasture. The Kawaihapai Series consists of well-drained soils in drainageways and on alluvial fans on the coastal plains. The soils formed in alluvium derived from basic igneous rock in humid uplands. These soils are used for sugarcane, truck crops, and pasture. The Keaau Series consists of poorly drained soils on coastal plains, which developed in alluvium deposited over reef limestone or consolidated coral sand. They are nearly level and gently sloping. These soils are used for sugarcane and pasture. The Kunia Series consists of well-drained soils on upland terraces and fans; the soils developed in old alluvium. They are nearly level to moderately sloping. These soils are used for sugarcane, pineapple, homesites, and military reservations. The Molokai Series consists of well-drained soils on uplands, formed in material weathered from basic igneous rock. They are nearly level to moderately steep. These soils are used for sugarcane, pineapple, pasture, wildlife habitat, and homesites. The Waialua Series consists of moderately well drained soils on alluvial fans; these soils developed in alluvium weathered from basic igneous rock. They are nearly level to steep. These soils are used for sugarcane, truck crops, orchards, and pasture (Foote et al. 1972).

Four sections of the project area were selected for backhoe testing. Honouliuli clay, 0 to 2 percent slopes (HxA) is found adjacent to Old Fort Weaver Road where seven trenches were placed to test for the remains of a nineteenth century Catholic Church (Kapalani Church) and where one trench was placed to test for the remains of a early twentieth century plantation village (Drivers/Stable Village). This soil occurs in the lowlands along the coastal plains. Waialua silty clay, 0 to 3 percent slopes (WkA) is found adjacent (and west) of the HxA soils in the Kapalani Church testing area. This soil is found on smooth coastal plains. Waipahu silty clay, 0 to 2 percent slopes (WzA) is the dominant soil on the top of the scarp. Two areas selected for backhoe testing, the remains of PipeLine Village, and the Honouliuli Taro Lands, had this soil type. This soil is nearly level and occurs on dissected terraces near the ocean. Waipahu silty clay, 2 to 6 percent slopes (WzB) also occurred in the Honouliuli Taro Lands backhoe testing area.

1.3.2 Built Environment

In the post-contact period the project area has been mainly used as pastureland and for sugar cane irrigation and cultivation. Recently (since the 1990 survey of the project) the area has been used for produce farming.

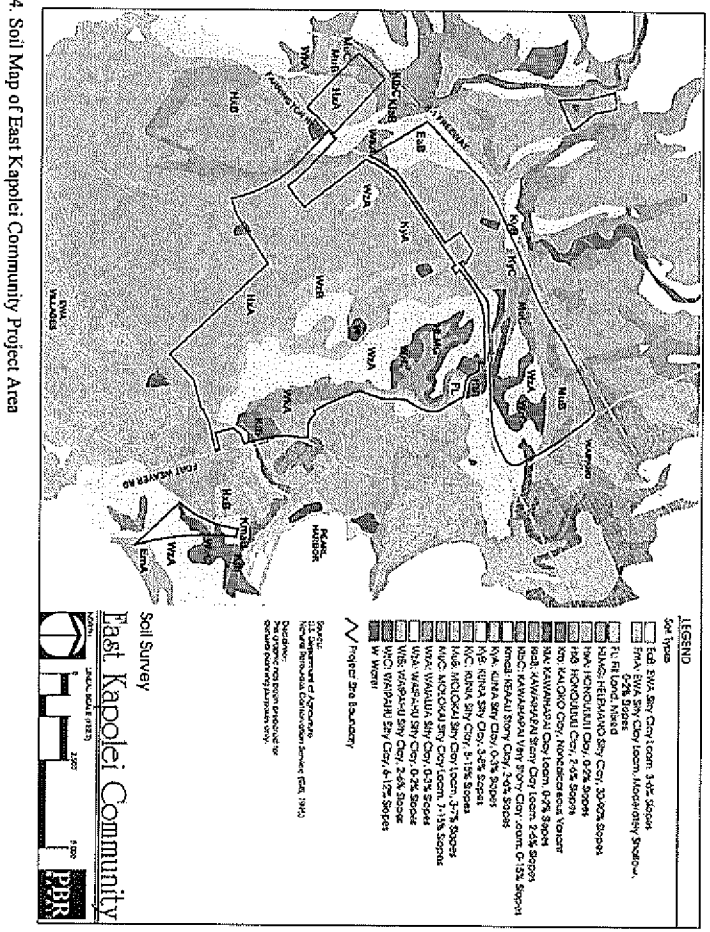

Figure 4. Soil Map of East Kapolei Community Project Area

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Section 2 Methods

Background research included a review of previous archaeological studies on file at the State Historic Preservation Division, and a review of geology and cultural history documents at Hamilton Library at the University of Hawai'i, the Hawai'i State Archives, the Hawai'i Public Library, and the Archives of the Bishop Museum. Further research included a study of historic photographs at the Archives of the Bishop Museum and a study of historic maps at the Survey Office of the Department of Accounting and General Services. Information on LCAs was accessed through Waihona 'Āina Corporation's Māhele Data Base (www.waihona.com).

2.1 Field Methods

The pedestrian inspection of the main project area was conducted on November 21 and 22, 2005 with four Cultural Surveys Hawai'i staff archaeologists, Constance R. O'Hare, B.A., Owen O'Leary, M.A., Guadalupe Ochoa, B.A., and Brad Garrett, M.A., under the general direction of Hallett H. Hammatt, Ph.D. On January 13, 2006, the two small non-contiguous parcels of the project were surveyed (Figures 5 and 6). At least 75% of the project area has been denuded of all natural vegetation and has been recently plowed and planted with pumpkins, squash, and other vegetables (Figure 7). There are a few areas marked off for other crops, such as bananas and beans. All areas outside plowed fields were surveyed on foot. In the northern section of the project area (north of Farrington Highway) the northwest corner and a larger area to the east of Honouliuli Gulch was surveyed by pedestrian sweeps. Honouliuli Gulch was surveyed by a team of three archaeologists, one sweep moving downstream on one bank and a second sweep moving upstream on the opposite bank (Figure 8). In the southern section, the non-plowed areas surrounding the underground pipelines were surveyed. Sites previously identified during the 1990 CSH survey (Hammatt and Shideler 1990) of the eastern 546-acre parcel were revisited and additional notes were taken on their construction and their current condition.

All significant historic properties encountered were recorded and documented with a brief written field description, a sketch map, and photographs. Each site was also located using GPS survey technology. In total, in addition to the five previously identified sites found during the CSH 1990 survey (Hammatt and Shideler 1990; see Introduction section), four new features, all found along Honouliuli Gulch, were recorded. All features were initially given CSH temporary numbers (CSH 1-4), and were later given feature designations as part of a previously designated site, 50-80-12-4344, a site number used for sugar cane plantation infrastructure features.

Sub-surface testing was conducted in four specific portions of the project area; areas that could potentially contain buried cultural layers or artifacts. This testing was conducted on November 28, and December 8 and 9, 2005 by CSH archaeologists Constance R. O'Hare, B.A., Owen O'Leary, M.A., Guadalupe Ochoa, B.A., Brad Garrett, M.A., and Jon Tulchin, B.A., under the general direction of Hallett H. Hammatt, Ph.D. Subsurface testing consisted of the excavation of 19 backhoe trenches. These trenches were excavated to a total depth of 2.0-3.0 m. A 70 cm (centimeter) wide bucket was used on the backhoe, and one-bucket width trenches were dug. All excavations were closely monitored by CSH personnel. Trenches were placed to test for subsurface deposits in four specific former habitation loci, as well as to provide adequate coverage of these four areas.

Figure 5. Non-contiguous parcel east of Fort Weaver Road (TMK 9-1-001:002), showing koa haole on western half and low grass on eastern half

Figure 6. Non-contiguous parcel north of the H-1 interstate, showing bulldozed reservoir area

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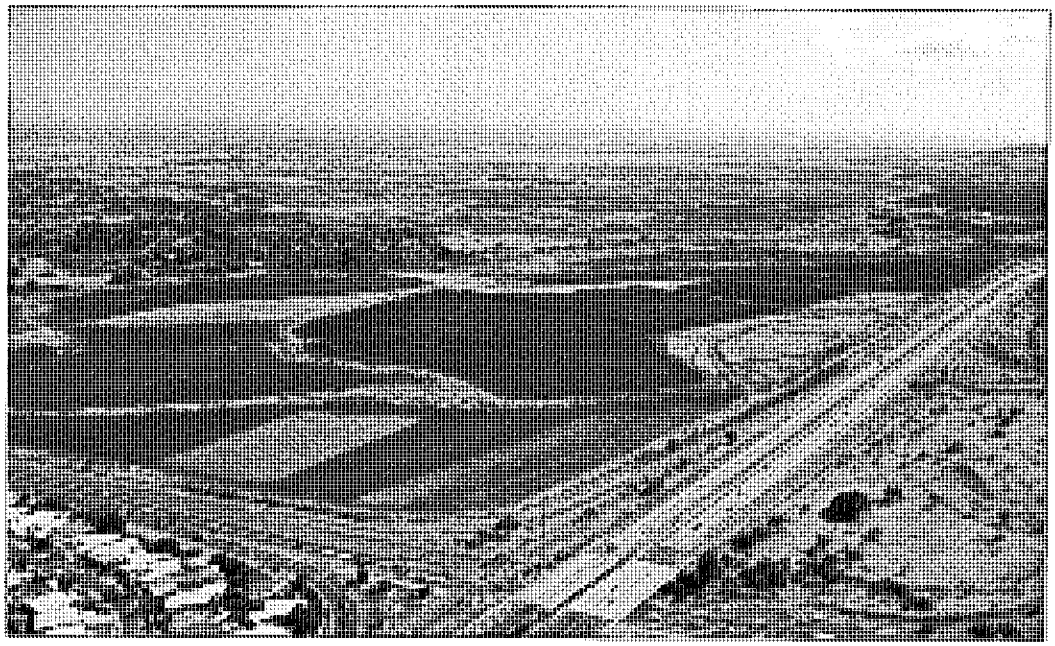

Figure 8. Aerial photograph of northern section of the project area taken near the intersection of H-1 Interstate and Fort Weaver Road; plowed fields in foreground, Honouliuli Gulch in background (shown by the alignment of trees)

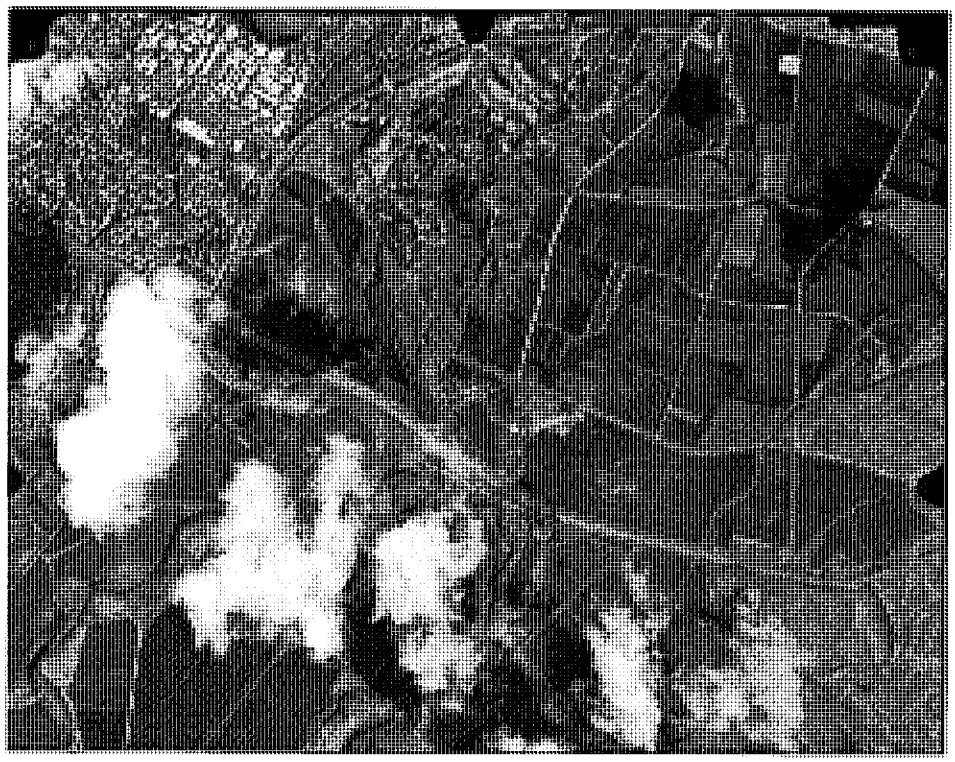

Figure 7. 2000 Aerial photograph of main project area (TMK 9-1-017, 9-1-018), showing plowed fields

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The stratigraphy of one profile wall was drawn and photographed; sediments were described for each of the 19 trenches. Sediment descriptions include Munsell color, texture, consistence, structure, plasticity, cementation, origin of sediments, descriptions of inclusions, lower boundary distinctiveness and topography, and other general observations. Fieldwork was conducted under state archaeological fieldwork permit No. 0508 issued by SHPD, per Hawai'i Administrative Rules (HAR) Chapter 13-13-282. The field effort, the surface pedestrian survey (2 days with a crew of 3-4 people), and the subsurface testing with a backhoe required 23 person-days to complete.

2.2 Laboratory Methods

Because no archaeological artifacts were discovered, no laboratory work was undertaken.

2.3 Consultation

As partial fulfillment for the Scope of Work (SOW), consultation with organizations and the community are currently being conducted to identify *kūpuna* and other individuals with knowledge of the history of the project area and its surroundings. The results of these interviews will be presented in a companion report for this project, titled "Cultural Impact Assessment for the East Kapolei Project." The on-going consultation with organizations include the Office of Hawaiian Affairs, the O'ahu Island Burial Council, 'Ahahui Siwila Hawai'i O Kapolei Hawaiian Civic Club, 'Ewa Task Force, 'Ewa Neighborhood Board, Hawaii Plantation Village, and Immaculate Conception Church in 'Ewa. A table of informants that will be contacted is presented below:

Table 1.Contact List of Community Members and Organizations for a Cultural Impact Assessment

Name	Affiliation
Aila, William	Hui Malama
Alexander, Jeff	'Ewa Neighborhood Board Member
Bautista, Gary	'Ewa Neighborhood Board Member (Chair)
Cayan, Coochie	O'ahu Island Burial Council
Eaton, Arline	*Kūpuna* at Iroquois Elementary School
Hirata, Richard	President of Hawaii Plantation Village; he was raised at the 'Ewa Plantation
Kane, Shad	Makakilo, Kapolei, Honokai Hale Neighborhood Board Member
Malama, Tesha	Former 'Ewa Neighborhood Board member
Nāmu'o, Clyde	Administrator at Office of Hawaiian Affairs
Oshiro, Richard	Former 'Ewa Plantation employee
Paishon, Frank	Raised in Tenney Village
Ramos, Rodolfo	Chair of 'Ewa Task Force
Sato, Melvin	Raised in Ewa Plantation "C" Village
Serrao, Mary	President of Pu'uloa Outrigger Canoe Club
Soma, Millie	Raised in 'Ewa Plantation Tenney Village
Soma, Kenneth	Former 'Ewa Plantation Employee and resident
Quintal, Leti	Raised in 'Ewa Plantation Secretary for the Immaculate Conception Church

Section 3 Background Research

3.1 Mythological and Traditional Accounts

The traditions of Honouliuli Ahupua'a have been compiled by several authors, in studies by Sterling and Summers (1978), Hammatt and Folk (1981), Kelly (1991), Charvet-Pond and Davis (1992), Maly (1992), and Tuggle and Tomonari-Tuggle (1997). Some of the traditional themes associated with this area include connections with Kahiki, the traditional homeland of Hawaiians in central Polynesia. There are several versions of the chief Kaha'i leaving from Kalaeloa for a trip to Kahiki; on his return to the Hawaiian Islands he brought back the first breadfruit (Kamakau 1991a:110) and planted it at Pu'uloa, near Pearl Harbor in 'Ewa (Beckwith 1940:97). Several stories associate places in Honouliuli to the gods Kāne and Kanaloa, with the Hawaiian pig god Kamapua'a and the Hina family, and with the sisters of Pele, the Hawaiian volcano goddess, all of who have strong connections with Kahiki (Kamakau 1991a:111; Pukui et al. 1974:200). The locations of traditional places names for Honouliuli are illustrated in Figure 9.

3.1.1 The Naming of 'Ewa and Honouliuli

Honouliuli is the largest *ahupua'a* in the *moku* (district) of 'Ewa. One translation of the name for this district is given as "unequal" (*Saturday Press* Aug. 11, 1883). Others translate the word as "strayed" and associate it with the legends of the gods, Kāne and Kanaloa.

> When Kane and Kanaloa were surveying the islands they came to Oahu and when they reached Red Hill saw below them the broad plains of what is now Ewa. To mark boundaries of the land they would throw a stone and where the stone fell would be the boundary line. When they saw the beautiful land lying below them, it was their thought to include as much of the flat level land as possible. They hurled the stone as far as the Waianae range and it landed somewhere, in the Waimanalo section. When they went to find it, they could not locate the spot where it fell. So Ewa (strayed) became known by the name. The stone that strayed [Told to E.S. by Simeon Nawaa, March 22, 1954; cited in Sterling and Summers 1978:1].

Honouliuli means "dark water," "dark bay," or "blue harbor" and was named for the waters of Pearl Harbor (Jarrett 1930:22), which marks the eastern boundary of the *ahupua'a*. The Hawaiians called Pearl Harbor, Pu'uloa (*lit.* long hill). Another explanation for the names comes from the "Legend of Lepeamoa", the chicken-girl of Pālama. In this legend, Honouliuli is the name of the husband of the chiefess Kapālama and grandfather of Lepeamoa (Thrum 1923:164-184). "Her grandfather gave his name, Honouliuli to a land district west of Honolulu . . ." (Thrum 1923:170). Westervelt (1963:209) gives an almost identical account.

It seems likely the boundaries of the western-most *ahupua'a* of 'Ewa were often contested with Wai'anae people. The 'Ewa people could cite divine sanction that the dividing point was between two hills at Pili o Kahe:

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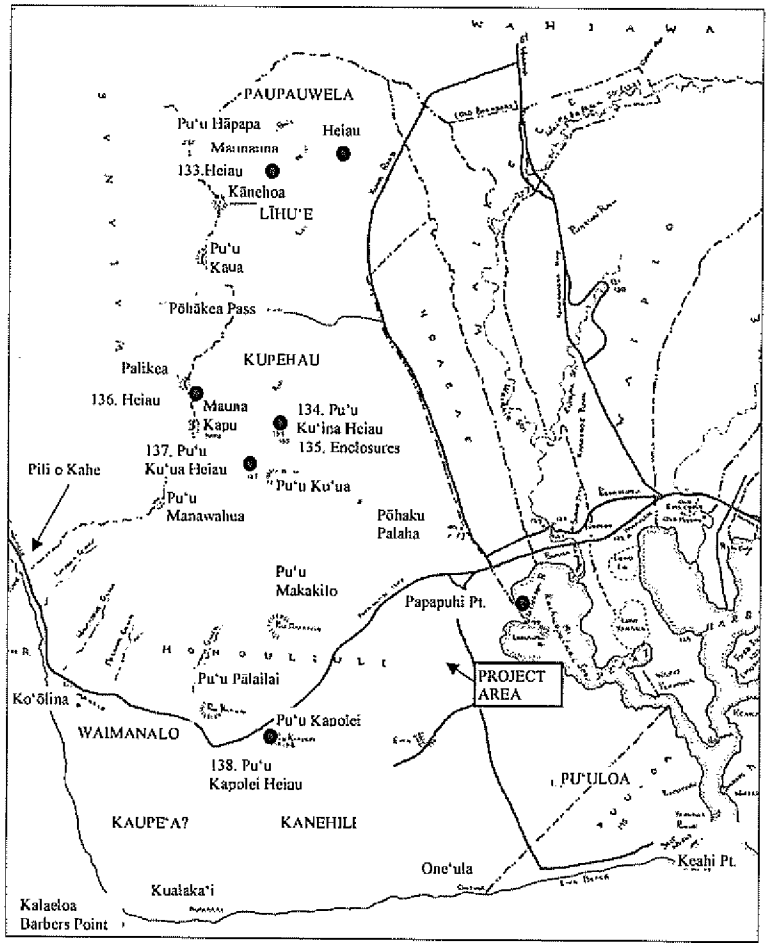

Figure 9. Place Names of Honouliuli (map adapted from Sterling and Summers 1978)

Eventually the stone was found at Pili o Kahe. This is a spot where two small hills of the Wai'anae Range come down parallel on the boundary between Honouliuli and Nānākuli ('Ewa and Wai'anae). The ancient Hawaiians said the hill on the 'Ewa side was the male and the hill on the Wai'anae side was female. The stone was found on the Waianae side hill and the place is known as Pili o Kahe.

> (Pili=cling to, Kahe=flow). The name refers, therefore, to the female or Waianae side hill. And that is where the boundary between the two districts runs [Told to E.S. by Simeon Nawaa, March 22, 1954; cited in Sterling and Summers 1978:1].

3.1.2 Pu'u o Kapolei and the Plains of Kaupa'e

Pu'uokapolei is a prominent hill at the *mauka* edge of the coastal 'Ewa Plains and was the primary landmark for travelers on the trail that ran from Pearl Harbor west to Wai'anae ('T'T 1959:27, 29; Nakuina 1992:54; E.M. Nakuina 1904, in Sterling and Summers 1978:34).

3.1.2.1 Pu'u o Kapolei, Astronomical Marker and Heiau

Pu'u means hill and Kapolei means "beloved Kapo," a reference to the sister of the Hawaiian volcano goddess, Pele. Samuel Kamakau (1976:14) says that ancient Hawaiians used Pu'uokapolei as an astronomical marker to designate the seasons. Samuel Kamakau (1870 *Mo'olelo Hawai'i* Vol. I, Chap. 2, p. 23) relates:

> . . . the people of O'ahu reckoned from the time when the sun set over Pu'uokapolei until it set in the hollow of Mahinaona and called this period Kau [summer], and when it moved south again from Pu'uokapolei and it grew cold and the time came when young sprouts started, the season was called from their germination (*'ōilo*) the season of Ho'oilo [winter, rainy, season].

A *heiau* was once on Pu'uokapolei, but had been destroyed by McAllister's (1933:108) survey of the island in the early 1930s. The hill was used as a point of solar reference or as a place for such observations (Fornander 1919, Vol. VI, Part 2:292). Pu'uokapolei may have been regarded as the gate of the setting sun, just as the eastern gate of Kumukahi in Puna is regarded as the rising sun; both places are associated with the Hawaiian goddess Kapo (Emerson 1915:41). This somewhat contradicts some Hawaiian cosmologies, in which Kū was the god of the rising sun, and Hina, the mother of Kamapua'a was associated with the setting sun. Fornander (Fornander 1919, Vol. VI, Part 2:292) states that Pu'uokapolei may have been a jumping off place (also connected with the setting sun) and associated with the wandering souls who roamed the plains of Kaupe'a and Kāne-hili, *makai* of the hill.

3.1.2.2 Pu'u o Kapolei and the Plains of Kaupe'a and Kāne-hili

Hi'iaka sang this bitter chant addressed to Lohiau and Wahine-oma'o, which uses the association of the Plains of Kaupe'a as a place for the wandering of lost souls:

> *Ku'u aikana i ke awa lau o Pu'uloa,*
> *Mai ke kula o Pe'e-kaua, ke noho oe,*
> *E noho kaua e kui, e lei i ka pua o ke kauno'a,*

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I ka pua o ke akuli-kuli, o ka wili-wili;
O ka iho 'na o Kau-pe'e i Kane-hili,
Ua hili au; akahi no ka hili o ka la pomaika'i;
E Lohiau ipo, e Wahine-oma'o,
Hoe 'a mai ka wa'a i a'e aku au.

We meet at Ewa's leaf-shaped lagoon, friends;
Let us sit, if you will on this lea
And bedeck us with wreaths of Kauno'a,
Of akuli-kuli and wili-wili,
My soul went astray in this solitude;
It lost the track for once, in spite of luck,
As I came down the road to Kau-pe'a.
No nightmare dream was that which tricked my soul.
This way, dear friends; turn the canoe this way;
Paddle hither and let me embark
[Emerson 1915:162-163].

Several other Honouliuli places are mentioned in this chant, including Pe'e-kaua, which may be a variation of Kau-pe'e or Kaupe'a, and the plains of Kānehili, the last of which again refers to wandering, as the word *hili* means "to go astray" (Emerson 1915:162). In the chant, Hi'iaka is moving downhill from Kaupe'a, probably the plains adjacent to Pu'uokapolei, toward the coast, the plain of Kānehili.

3.1.2.3 The plains of Kaupe'a and Pu'u Kapolei and the Realm of Homeless Souls

There are several places on the 'Ewa coastal plain that are associated with *ao kuewa*, the realm of the homeless souls. Samuel Kamakau (1991b:47-49) explains the Hawaiian beliefs in the afterlife:

> . . . There were three realms (*ao*) for the spirits of the dead. . . There were, first, the realm of the homeless souls, the *ao kuewa*; second, the realm of the ancestral spirits, the *ao 'aumakua*; and third, the realm of Milu, *ke ao o Milu* . . .
>
> The *ao kuewa*, the realm of homeless souls, was also called the *ao 'auwana*, the realm of wandering souls. When a man who had no rightful place in the *'aumakua* realm (*kanaka kuleana 'ole*) died, his soul would wander about and stray amongst the underbrush on the plain of Kama'oma'o on Maui, or in the *wiliwili* grove of Kaupe'a on Oahu. If his soul came to Leilono [in Halawa, 'Ewa near Red Hill], there he would find the breadfruit tree of Leiwalo, *ka 'ulu o Leiwalo*. If it was not found by an *'aumakua* soul who knew it (*i ma'a mau iaia*), or one who would help it, the soul would leap upon the decayed branch of the breadfruit tree and fall down into endless night, *the pō pau 'olo o Milu*. Or, a soul that had no rightful place in the *'aumakua* realm, or who had no relative or friend (*makamaka*) there who would watch out for it and welcome it, would slip over the flat lands like a

> wind, until it came to a leaping place of souls, a *leina a ka 'uhane*. . . . [Kamakau 1991b:47].
>
> On the plain of Kaupe'a beside Pu'uloa [Pearl Harbor], wandering souls could go to catch moths (*pulelehua*) and spiders (*nanana*). However, wandering souls could not go far in the places mentioned earlier before they would be found catching spiders by 'aumakua souls, and be helped to escape. . . . [Kamakau 1991b:49].

The breadfruit tree Leilono was said to have been located on the 'Ewa-Kona border, above Āliamanu. In another section of his account of the dead, Kamakau calls the plain of wandering souls the "plain at Pu'uokapolei."

> There are many who have died and have returned to say that they had no claim to an 'aumakua [realm] (*kuleana 'ole*). These are the souls, it is said, who only wander upon the plain of Kama'oma'o on Maui or on the plain at Pu'uokapolei on Oahu. Spiders and moths are their food [Kamakau 1991b:29].

This association of Pu'u Kapolei and Kānehili with wandering souls is also illustrated in a lament on the death of Kahahana, the paramount chief of O'ahu, who was killed by his father, Kahekili, after Kahahana became treacherous and killed the high priest Kaopulupulu.

Go carefully lest you fall dead in the sun,	*E newa ai o hea make i ka la,*
The god that dwells on Kapolei hill.	*Akua noho la i Puuokapolei.*
The sun is wailing on account of the women of Kamao,	*E hanehane mai ana ka la i na wahine o Kamao,*
A hiding god, blossoming ohai of the banks,	*Akua pee, pua ohai o ke kaha,*
Contented among the stones-	*I walea wale i ke a-*
Among the breadfruit planted by Kahai.	*I ka ulu kanu a Kahai.*
Thou wast spoken of by the oo-	*Haina oe e ka oo-*
By the bird of Kanehili.	*E ka manu o Kanehili.*

[Fornander 1919, Vol. VI, Part 2:297]

Fornander provides some notes on this lament. The god dwelling at Kapolei is the god Kahahana, stating that this is where his soul has gone. Kamao is one of the names of the door to the underworld. This lament draws an association with wandering souls and the place where the first breadfruit tree was planted by Kahai at Pu'uloa (Fornander 1919, Vol. VI, Part 2:304).

Pukui (1983:180) offers this Hawaiian saying, which places the wandering souls in a *wiliwili* grove at Kaupe'a.

The wiliwili grove of Kaupe'a	Ka wiliwili of Kaupe'a.

In 'Ewa, O'ahu. Said to be where homeless ghosts wander among the trees.
[Pukui 1983:#1666].

Beckwith (1940:154) has stressed that "the worst fate that could befall a soul was to be abandoned by its *'aumakua* and left to stray, a wandering spirit (*kuewa*) in some barren and desolate place." These wandering spirits were often malicious, so the places that they wandered were avoided.

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3.1.2.4 The Plain of Pukaua

The Hawaiian language newspaper *Ka Loea Kālai'āina*, (January 13, 1900) relates that near Pu'uokapolei, on the plain of Pukaua, on the *mauka* side of the road, there was a large rock. This legend suggests that the plain around Pu'u o Kapolei was called Pukaua. The legend is as follows:

> If a traveler should go by the government road to Waianae, after leaving the village of gold, Honouliuli, he will first come to the plain of Puu-ainako and when that is passed, Ke-one-ae. Then there is a straight climb up to Puu-o-Kapolei and there look seaward from the government road to a small hill, That is Puu-Kapolei. . . . You go down some small inclines, then to a plain. This plain is Pukaua and on the mauka side of the road, you will see a large rock standing on the plain. . . . There were two supernatural old women or rather peculiar women with strange powers and Puukaua belonged to them. While they were down fishing at Kualaka'i [near Barbers Point] in the evening, they caught these things, *'a'ama* crabs, *pipipi* shellfish, and whatever they could get with their hands. As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person [bad omen]. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run - running, leaping, falling, sprawling, rising up and running on, without a thought of the *'a'ama* crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, "Let us hide lest people see us," and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper side of the road and see them standing on the plain [*Ka Loea Kālai'āina*, January 13, 1900, translation in Sterling and Summers 1978:39].

In another version of this story, the two women met Hi'iaka as she journeyed toward the 'Ewa coast. The women were *mo'o* (supernatural beings) and were afraid that Hi'iaka would kill them, so they changed into their lizard form. One of the lizards hid in a little space on a stone beside the coastal trail, and the other hid nearby (*Ka Hōkū o Hawai'i*, February 15, 1927, translated in Maly 1997:19). From that time on the stone was known as *pe'e-kāua*, meaning "we two hidden." Hi'iaka greeted the two women but did not harm them, and passed on.

When she reached Pu'u o Kapolei, she also greeted two old women who lived at a *'ohai* grove on the hill. These women were named Pu'uokapolei and Nāwaineokama'oma'o (*Ka Hōkū o Hawai'i*, February 22, 1927, translated in Maly 1997:19). As she continued her travels, she looked to the ocean and saw the canoe carrying Lohi'au.

My man on the many harbored sea of Pu'uloa	*Ku'u kāne i ke awa lau o Pu'uloa*
As seen from the plain of Pe'ekāua	*Mai ke kula o Pe'ekāua ke noho*
Let us dwell upon the 'ōhai covered shore	*E noho kāua i ke kaha o ka 'ōhai*

Where the noni blossoms are twisted together	*I ka wiliwili i ka pua o ka lau noni*
Descending along Kānehili	*O ka ihona i Kānehili la*
I am winding along	*Ua hili ho'i au-e*

[*Ka Hōkū o Hawai'i*, February 22, 1927, translated in Maly 1997:20].

3.1.2.5 Pu'u Kapolei and Kamapua'a

Pu'uokapolei's was the home of Kamapua'a's grandmother, Kamaunuaniho, who was one of the three migrants from Kahiki that were ancestors to the people of O'ahu (Fornander 1919, Vol. V, Part 2:318; Kahiolo 1978:81, 107). Kamapua'a, the Hawaiian pig god, once lived in Kaluanui on the windward side, but escaped to 'Ewa when he was pursued by the chief Olopana.

> Kamapua'a subsequently conquered most of the island of O'ahu, and, installing his grandmother [Kamaunuaniho] as queen, took her to Pu'uokapolei, the lesser of the two hillocks forming the southeastern spur of the Wai'anae Mountain Range, and made her establish her court there. This was to compel the people who were to pay tribute to bring all the necessities of life from a distance, to show his absolute power over all [Nakuina 1904:50-51].

Emma Nakuina goes on to note: "A very short time ago [prior to 1904] the foundations of Kamaunuaniho's house could still be seen at Pu'uokapolei." Another account (*Ka Loea Kālai'āina* January 13, 1900, from Sterling and Summers 1978:34) speaks of Kekelcaiku, the older brother of Kamapua'a, who also lived on Pu'uokapolei.

3.1.2.6 The Strife at Honouliuli; Kūali'i unites Hawai'i nei (Mo'olelo o Kūali'i)

The celebrated chief, Kūali'i, is said to have led an army of twelve thousand (*'ekolu mano*) against the chiefs of Ko'olauloa with an army of twelve hundred (*'ekolu lau*) upon the plains of Keahumoa (Fornander 1917 Vol. IV, Part 2:364-401). Perhaps because the odds were so skewed the battle was called off and the *ali'i* of Ko'olau ceded (*ha'awi a'e*) the districts of Ko'olauloa, Ko'olaupoko, Waialua and Wai'anae to Kūali'i. When the *ali'i* of Kaua'i heard of this victory at Honouliuli they gave Kaua'i to Kūali'i as well and thus he became possessed of all the islands (*a lilo a'e la nā moku a pau ia Kūali'i mai Hawai'i a Ni'ihau*). The strife at Honouliuli was the occasion of the recitation of a song for Kūali'i by a certain Kapa'ahulani (*Ka Pule Ana a Kapa'ahulani*). This *mele* compares the king to certain places and objects in the islands, in this instance to the first breadfruit planted by Kahai at Pu'uloa, and a pig and a woman on Pu'u Kapolei, possibly a reference to Kamapua'a and his grandmother.

Not like these art thou, Ku.	*Aole I like Ku.*
Not like the pig	*Aole I like i ka puaa,*
Discerning the progeny of the god;	*I ka weke lao a ke akua,*
[Or] The breadfruit planted by Kahai.	*Ka ulu kanu o Kahai;*
Truly, have you not known	*Oi ole ka oe i ike,*
The woman with the dyed garment,	*Ka wahine pau mao*
On the top of Puuokapolei?	*I ka luna o Puuokapolei-la?*

[Fornander 1917, Vol. IV, Part 2:392-393].

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A later section of this *mele* also refers to Pu'u o Kapolei and makes mention of the famous blue poi of Honouliuli.

O Kawelo! Say, Kawelo!	*O Kawelo-e, e Kawelo-e,*
Kawelokiki, the sharp-pointed hill,	*O Kawelaiki puu oioi,*
Hill of Kapolei.	*Puu of Kapolei-e-*
Blue is the poi which appeases [the hunger] of Honouliuli.	*Ulituli ka poi e piha nei-o Honouliuli;*

[Fornander 1917, Vol. IV, Part 2:400-401].

3.1.3 Pearl Harbor (Pu'uloa) and West Loch (Kaihu o pala'ai)

3.1.3.1 The "Silent Fish" of Pearl Harbor

Pearl Harbor was called Pu'uloa or *ke-awa-lau-o-Pu'uloa*, the many harbored-sea of Pu'uloa (Pukui 1983:#1686) by the Hawaiians. An alternate name was Awawa-lei, or "garland (*lei*) of harbors" (Handy and Handy 1972:469). Pukui (1983:#1126] also uses the name *Awalua* for Pearl Harbor, as in the saying "*Huhui na 'ōpua i Awalau*, The clouds met at Pearl Harbor. Said of the mating of two people." Emerson (1915:167) interprets Awalau as "leaf-shaped lagoon."

John Clark (1977:70) says that its English name came from the name Waimomi, or "water of the pearl," an alternate name for the Pearl River (Pearl Harbor). The harbor was named Pearl Harbor after the pearl oysters of the family Pteriidae (mainly *Pinctada radiata*), which were once abundant on the harbor reefs, but were later decimated by over-harvesting. This oyster was supposedly brought from Kahiki, the Hawaiian ancestral lands, by a *mo'o* (lizard or water spirit) named Kane-kua'ana (Handy and Handy 1972:470).

Kanekua'ana was the *kia'i* (food guardian) for 'Ewa. When food was scarce, the descendants of Kanekua'ana built *waihau heiau* (a *heiau* for *mo'o*) for her and lit fires to plead for her blessings. For 'Ewa, the chief *i'a* (marine food) blessing was the famous *pipi*, or pearl oyster. Samuel Kamakau describes the *pipi* of Honouliuli.

> That was the oyster that came in from deep water to the mussel beds near shore, from the channel entrance of Pu'uloa to the rocks along the edges of the fishponds. They grew right on the *nahawele* mussels and thus was this *i'a* obtained. Not six months after the *han* branches [that placed a *kapu* on these waters until the *pipi* should come up] were set up, the *pipi* were found in abundance-enough for all 'Ewa-and fat with flesh. Within the oyster was a jewel (*daimana*) called a pearl (*momi*), beautiful as the eyeball of a fish, white and shining; white as the cuttle fish, and shining with the colors of the rainbow-reds and yellow and blues, and some pinkish white, ranging in size from small to large. They were of great bargaining value (*he waiwai kunuku'ai nui*) in the ancient days, but were just "rubbish" (*'opala*) in 'Ewa [Kamakau 1991b:83].

This oyster, the *pipi*, was sometimes called "the silent fish," or *i'a hamau leo o 'Ewa*, 'Ewa's silent sea creature (Handy and Handy 1972:471), since the collectors were supposed to stay quiet while harvesting the shells, as in the sayings:

> The fish of 'Ewa that silences the voice. *Ka ka'a hāmau leo o 'Ewa.*
> The pearl oyster, which has to be gathered in silence [Pukui 1983:#1331].

> 'Ewa is disturbed by the Moa'e wind. *Haumāele 'Ewa i ka Moa'e.*
> Used about something disturbing, like a violet argument. When the people of 'Ewa went to gather the *pipi* (pearl oyster), they did so in silence, for if they spoke, a Moa'e breeze would suddenly blow across the water, rippling it, and the oysters would disappear [Pukui 1983:5#493].

> Hush, lest the wind rise. *E hāmou o makani mai auane'i.*
> Hold your silence or trouble will come to us. When the people went to gather pearl oysters at Pu'uloa, they did so in silence, for they believed that if they spoke, a gust of wind would ripple the water and the oysters would vanish [Pukui 1983:#274].

> The gesturing fish of 'Ewa. *Ka i'a kuhi lima o 'Ewa.*
> The *pipi*, or pearl oyster. Fishermen did not speak when fishing for them but gestured to each other like deaf-mutes [Pukui 1983:#1357].

Sereno Bishop, an early resident of O'ahu, wrote, of his time in the area around 1836, of the pearl oyster, the *pipi*, and another edible clam, identified by Margaret Titcomb (1979:351) as probably *Lioconcha heiraglyphica.*

> The lochs or lagoons of Pearl River were not then as shoal as now. The subsequent occupation of the uplands by cattle denuded the country of herbage, and caused vast quantities of earth to be washed down by storms into the lagoons, shoaling the water for a long distance seaward. No doubt the area of deepwater and anchorage has been greatly diminished. In the thirties, the small oyster was quite abundant, and common on our table. Small pearls were frequently found in them. No doubt the copious inflow of fresh water favored their presence. I think they have become almost entire extinct, drowned out by the mud. There was also at Pearl River a handsome speckled clam, of a delicate flavor which contained milk white pearls of exquisite luster and perfectly spherical. I think the clam is still found in the Ewa Lochs [Bishop 1901:87].

Older Hawaiians believed that the *pipi* disappeared around the time of the smallpox epidemic of 1850-1853, because Kanekua'ana became displeased at the greed of some *konohiki* (overseer).

> The people of the place believe that the lizard was angry because the konohikis imposed kapus [bans], were cross with the women and seized their catch of oysters. So this "fish" was removed to Tahiti and other lands. When it vanished a white, toothed thing grew everywhere in the sea, of Ewa, which the natives of Ewa had named the pahikaua (sword). It is sharp edged and had come from Kauai-helanai, according to this legend [Manu 1885:50].

Pahikaua is the Hawaiian name for the mussel, *Brachidontes crebristriatus* (Mytilidae), which was also a popular clam eaten by the residents of Pearl Harbor.

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A clarification of the story of Kanekua'ana and the pearl oysters of Pearl Harbor is given, in which it seems an overseer had set a ban on the *pipi* for several months a year so that they could increase. A poor widow, a relation of the *mo'o*, took some of the *pipi* and hid them in a basket. The *konohiki* found the hidden shells, and took them from her, emptying them back into the sea, which was proper. However, after this he followed the woman home and also demanded that she pay a stiff fine in cash, which she did not have. The *mo'o* thought this was unjust and the next night she took possession of a neighbor who was a medium.

> . . . After the overseer had gone back to Palea the lizard goddess possessed her aged keeper [a woman of Ewa] and said to those in the house, "I am taking the pipi back to Kahiki and they will not return until all the deseendants of this man are dead. I go to sleep. Do not awaken my medium until she wakes of her own accord." The command was obeyed and she slept four days and four nights before she awoke. During the time that she slept the pearl oysters vanished from the places where they were found in great numbers, as far as the shore . . . .The few found today are merely nothing . . . [*Ka Loea Kālai'āina*, June 3, 1899, translation in Sterling and Summers 1978:49-50].

3.1.3.2 Kāne and Kanaloa and the Fish Ponds of West Loch

According to an account in the Hawaiian newspaper *Ka Loea Kālai'āina* (June 10, 1899), several of the fishponds in the Pu'uloa area were made by the brother gods, Kāne and Kanaloa. A fisherman living in Pu'uloa, named Hanakahi, prayed to unknown gods, until one day two men came to his house. They revealed to him that they were the gods to whom he should pray. Kāne and Kanaloa then built fishponds at Ke'ana-pua'a, but were not satisfied. Then they built the fishpond, Kepo'okala, but were still not satisfied. Finally they made the pond Kapākule, which they stocked with all manner of fish. They gifted all of these fishponds to Hanakahi and his descendants (Handy and Handy 1972:473; *Ka Loea Kālai'āina*, July 8, 1899).

According to Mary Pukui (1943:56-57), who visited Kapākule fishpond when she was young, the pond was built by the legendary little people of Hawai'i, the *menehune*, under the direction of the gods Kāne and Kanaloa. Pukui describes several unique aspects of this pond:

> On the left side of the pond stood the stone called Hina, which represented a goddess of the sea by that by that name. Each time the sea ebbed, the rock became gradually visible, vanishing again under water at high tide. Ku, another stone on the right, was never seen above sea level. This stone represented Ku'ula, Red Ku, a god for fish and fishermen. From one side of the pond a long wall composed of driven stakes of hard wood, ran toward the island [Laulaunui] in the lochs. When the fish swam up the channel and then inside of this wall, they invariably found themselves in the pond. A short distance from the spot where the pond touched the shore was a small koa or altar composed of coral rock. It was here that the first fish caught in the pond was laid as an offering to the gods [Pukui 1943:56].

The fishpond contained many fish, especially the *akule* (scad fish, *Trachurops crumenophthalmus*), thus its name, "the enclosure for *akule* fish" (Pukui 1943:56-57). The pond was destroyed when the channel to Pearl Harbor was dredged in the early twentieth century. The

caretaker of the pond took the stones Kū and Hina to a deep place in the ocean and sunk them so "none would harm or defile them." Cobb (1903:733) says it was used to catch the larger *akule* (goggler), *opelu* (mackeral scad), *weke* (goat fish), *kawakowa* (bonito), and sharks; it was unusual for having walls made of coral. This contradicts much of the legendary material that says that sharks were not killed within Pearl Harbor; however, Kamakau does relate that Kekuamanoha and Kauhiwawaeono, two conspirators against Kamehameha I, lived at Pu'uloa. The chief Kauhiwawaeono was known to murder people and use their bodies as shark bait (Kamakau 1961:182, 232).

Samuel Kamakau adds more information on the pond Kapākule, and a second one called Kepo'okala.

> At Pu'uloa on Oahu were two unusual ponds [fish traps]—Kapakule and Kepoolala. Kapakule was the better one. The rocks of its walls, *kuapa*, could be seen protruding at high tide, but the interlocking stone walls (*pae niho pohaku*) of the other pond were still under water at high tide. . . . It [Kapakule] was said to have been built by the *'e'epa* people [mysterious people] at the command of Kane ma . . .
>
> This is how the fish entered the pond. At high tide many fish would go past the mauka side of the pond, and when they returned they would become frightened by the projecting shadows of the trunks, and would go into the opening. The fish that went along the edge of the sand reached the seaward wall, then turned back toward the middle and entered the *anapuna* (the arched portion of the trap) A man ran out and placed a "cut-off" seine net (*'omuku lau*) in the opening, and the fish shoved and crowded into it. The fish that were caught in the net were dumped out, and those not caught in the net were attacked with sharp sticks and tossed out, or were seized by those who were strong [Kamakau 1976:88].

3.1.3.3 The Story of Kaihuopala'ai Pond, Honouliuli (Ka'ao no Maikohā)

In the Legend of Maikohā (Fornander 1917, Vol. V, Part 2:270-271), a sister of Maikohā, a deified hairy man who became the god of *tapa* makers, named Kaihuopala'ai, journeys to O'ahu:

> Kaihuopala'ai saw a goodly man by the name of Kapapaapuhi who was living at Honouliuli, 'Ewa; she fell in love with him and they were united, so Kaihuopala'ai has remained in 'Ewa to this day. She was changed into that fishpond in which mullet are kept and fattened, and that fish pond is used for that purpose to this day
>
> *'Ike aku la o Kaihuopala'ai i ka maikai o Kapapaapuhi, he kāne e noho ana ma Honouliuli ma 'Ewa. Moe iho la lāua, a noho iho la o Kaihuopala'ai i laila a hiki i kēia lā. 'Oia kēlā loko kai e ho'opuni ia nei i ka 'anae, nona nā i'a he nui loa, a hiki i kēia kākau ana* [Fornander 1919, Vol. V, Part 2:270].

The name of Maikohā's sister, Kaihu o pala'ai, which means "the nose of Pala'ai" (Pukui et al. 1974:68) is also the name the Hawaiians used for the west loch of Pearl Harbor, adjacent to

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the current study area. McAllister recorded that other Hawaiians say there never was a fishpond by that name. Beckwith (1918) says that Kaihuopala'ai changed into the fishpond near Kapapapuhi, which means "the eel flats." This is identified on old maps as the point northeast of the current study area (sometimes spelled Kapapa'apuhi) that juts into the loch; early Hawaiian settlement was focused on this area.

There is also a famous *pōhaku*, or rock, associated with the traveling mullet of Pearl Harbor.

> . . . I . . . asked the person sitting on my left, "What place is this?" Answer – "This is Pearl City." It was here that mullets were bred in the ancient times and that flat stone there was called Mullet Rock or Pōhaku Anae. It lies near the beach by Ewa mill [*Ka Nūpepa Kū'oko'a*, Oct. 2, 1908, from Sterling and Summers 1978:53].

3.1.3.4 The Traveling Mullet of Honouliuli (Fish Stories and Superstitions)

The story of Kaihuopala'ai, or Ihuopala'ai, is also associated with the tradition of the *anae-holo*, the traveling mullet of Pearl Harbor (Thrum 1998:270-272):

> The home of the *'anae-holo* is at Honouliuli, Pearl Harbor, at a place called Ihuopala'ai. They make periodical journeys around to the opposite side of the island, starting from Pu'uloa and going to windward, passing successively Kumumanu, Kalihi, Kou, Kālia, Waikīkī, Ka'alāwai, and so on, around to the Ko'olau side, ending at Lā'ie, and then returning by the same course to their starting point [Thrum 1998:271].

In Thrum's account, Ihupala'ai is a male who possesses a Kū'ula or fish god that supplied the large mullet known as "*onae*." His sister lived in Lā'ie, and there came a time when there were no fish to be had. She sent her husband to visit Ihupala'ai, who was kind enough to send the fish following his brother-in-law on his trip back to Lā'ie.

This story is associated with a proverb or poetical saying identified with Honouliuli:

> The fish fetched by the wind. *Ka I'a hali a ka makani*
> The *'anaeholo*, a fish that travels from Honouliuli, where it breeds, to Kaipāpa'u, on the windward side of O'ahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong [Pukui 1983:#1330].

Pukui et al. (1974:68) gives the name of the husband in this story as Lā'ie and the name of the wife as Pala'ai, which ties into the name of the west loch of Pearl Harbor, called Ka-ihu o Pala'ai, "the nose of Pala'ai." Another version has a woman named Awawalei (an alternate version for the name of Pearl Harbor), who had a brother named Laniloa (the point on Lā'ie at which the mullet stops its migration and makes its way back to Pearl Harbor), and another brother (a mullet) who lived with an eel named Papa-puhi, which relates to the name of the fishpond in the tale called Kapapapuhi (*Ka Loea Kālai'āina*, Oct. 21, 1899). On historic maps, Kapapapuhi is a point of land that juts into West Loch and was a focus for habitation, taro cultivation, and fishpond maintenance in the early post-Contact (and probably earlier) period.

3.1.3.5 The Caves of Pu'uloa

'Ewa was famous for the many limestone caves formed in the uplifted coral. Some of these caves, called *ka-lua-ōlohe* were inhabited by the *ālohe*, a type of people that looked like other humans but had tails like dogs (Beckwith 1940:343). These people were skilled in wrestling and bone-breaking and often hid along narrow passes to rob travelers; they were also reputed to be cannibals. The famous cannibal king, Kaupe, who lived in Lihu'e in upland Honouliuli, was an *ōlohe*.

There was once a cave named Kapuna on Waipi'o peninsula that was associated with a famous riddle. *No Kapuna kane hale noho ia e ke kai*, or "To Kapuna belongs the house, the sea dwells in it."

> This cave is on the Waipio side and a sea passage separates Waipio and Waikele and Waikele and Honouliuli. The passage is obstructed by three small islands, a middle one and Manana and Laulaunui. These small islands in the middle of the passage to Honouliuli and inside and outside of these small islands is the sea of Kaihuopalaai [Hawaiian name for West Loch] where mullet lived till they whitened with age [*Ka Loea Kālai'āina*, Oct. 7, 1899, translation in Sterling and Summers 1978:24].

Another famous cave of the area was Keanapua'a [in Halawa opposite Waipi'o peninsula], which means "the pig's cave," so named because Kamapua'a once slept there (Pukui et al. 1974:103). This cave was one of the places where the high king of O'ahu, Kahahana, hid after he had killed the priest Kaopulupulu, thus angering the high chief of Maui, Kahekili (Kahahana's father).

> Upon the arrival here at Oahu of Kahekili, Kahahana fled, with his wife Kekuapoi, and friend Alapai, and hid in the shrubbery of the hills. They went to Aliomanu, Moanalua, to a place called Kinimakalehua; them moved along to Keanapuaa and Kepookala, at the lochs of Puuloa, and then from there to upper Waipio; thence to Wahiawa, Helemano, and on to Lihue; thence the came to Poohilo, at Honouliuli, where they first showed themselves to the people and submitted themselves to their care.
>
> Through treachery, Kahahana was induced to leave Po'ohilo, Honouliuli and was killed on the plains of Hō'ae'ae [Thrum 1906:213-214].

The place Pō'o Hilo was somewhere on the border between Honouliuli and Hō'ae'ae (north of the current study area). In the "Legend of the Sacred Spear-point" (Kalākaua 1990:209-225) is a reference to the Hawai'i Island chief, Hilo-a-Lakapu. Following his unsuccessful raid against O'ahu "he was slain at Waimano, and his head was placed upon a pole near Honouliuli for the birds to feed upon"(Kalākaua 1990:224). This place was called Pō'o Hilo, which literally means "the head of Hilo."

The caves of Pu'uloa were sometimes used as burial caves. In 1849, Keali'iahonui, son of Kaua'i's last king, Kaumuali'i, died. He had once been married to the chiefess Kekau'ōnohi, who had stayed with him until 1849. She wanted to bury her ex-husband at sea.

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> It seems that by Kekauonohi's orders, the coffin containing her late husband's remains was removed to Puuloa, Ewa, with the view of having it afterwards taken out to sea and there sunk. It was temporarily deposited in a cavern in the coral limestone back of Puuloa, which has long been used for a burial place, and has lately been closed up [Alexander 1907:27].

After some initial objections by the niece of Kealaiʻiahonui, the body was removed from the outer coffin, the rest was sunk, and the coffin was later buried somewhere in Puʻuloa.

3.2 Historic Background

3.2.1 Pre-Contact and Early Post-Contact Period

By ca. A.D. 1320, ʻEwa, along with Kona, and Koʻolaupoko were the dominant polities, ruled by the sons of a chief named Māweke (Cordy 2002:21). ʻEwa at this time included the traditional districts of ʻEwa, Waiʻanae, and Waialua (Fornander 1880:48). Around A.D. 1400, the entire island was ruled by King Laʻakona; chiefs within his line, the Māweke-Kumuhonua line, reigned until about A.D. 1520-1540, with their major royal center in Līhuʻe, in ʻEwa. (Cordy 2002:24). Haka was the last chief of the Māweke-Kumuhonua line; he was slain by his men at the fortress of Waewae near Līhuʻe (Kamakau 1991a:54-54; Fornander 1880:88). Power shifted between the chiefs of different districts from the 1500s until the early 1700s, when Kūaliʻi achieved control of all of Oʻahu by defeating the Kona chiefs, then the ʻEwa chiefs, and then expanding his control on windward Kauaʻi. Peleiholani, the heir of Kūaliʻi, gained control of Oʻahu ca. 1740, and later conquered parts of Molokaʻi. He was ruler of Oʻahu until his death in ca. 1778 when Kahahana, of the ʻEwa line of chiefs was selected as the ruler of Oʻahu (Cordy 2002:24-41).

After Kamehameha's Oʻahu victory, he gave the *ahupuaʻa* of Honouliuli to Kalanimōkū as part of the *panalāʻau*, or conquered lands, with the right to pass the land on to his heirs rather than having it revert to Kamehameha (Kameʻeleihiwa 1992:58, 112). Kalanimōkū subsequently gave the *ahupuaʻa* to his sister, Wahinepiʻo.

Various Hawaiian legends and early historical accounts indicate that the *ahupuaʻa* (land division) of Honouliuli was once widely inhabited by pre-Contact populations, including the Hawaiian *aliʻi* (chiefly class). This would be attributable for the most part to the plentiful marine and estuarine resources available at the coast, along which several sites interpreted as permanent habitations and fishing shrines have been located. Other attractive subsistence-related features of the *ahupuaʻa* include irrigated lowlands suitable for wetland taro cultivation, as well as the lower forest area of the mountain slopes for the procurement of forest resources. Handy and Handy (1972:429) report:

> The lowlands, bisected by ample streams, were ideal terrain for the cultivation of irrigated taro. The hinterland consisted of deep valleys running far back into the Koʻolau range. Between the valleys were ridges, with steep sides, but a very gradual increase of altitude. The lower part of the valley sides were excellent for the cultivation of yams and bananas. Farther inland grew the ʻawa for which the area was famous.

In addition, breadfruit, coconuts, *wauke* (paper mulberry; *Broussonetia papyrifera*), bananas, and *olona* (*Touchardia latifolia*) and other plants were grown in the interior. ʻEwa was known as one of the best areas to grow gourds and was famous for its *manaki*. It was also famous for a rare taro called the *kai o ʻEwa*, which was grown in mounds in marshy locations (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the saying:

> He has eaten the Kāī-koi taro of ʻEwa. *Ua ʻai i ke kāī-koi o ʻEwa.*
> Kāī is Oʻahu's best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of ʻEwa, who, like the Kāī taro, is not easily forgotten [Pukui 1983:#2770].

The lochs of Pearl Harbor were ideal for the construction fishponds and fishtraps. Forest resources along the slopes of the Waiʻanae Range probably acted as a viable subsistence alternative during times of famine and/or low rainfall (Handy 1940:211; Handy and Handy 1972:469-470). The upper valley slopes may have also been a resource for sporadic quarrying of basalt used in the manufacturing of stone tools. At least one probable quarrying site (SIHP site 50-80-12-4322) is present in Makaʻīwa Gulch at 152 m (500 ft) above mean sea level (Haminatt, Robins, et al. 1990).

John Papa ʻĪʻī describes a network of Leeward Oʻahu trails (Figure 10), which in historic times encircled and crossed the Waiʻanae Range, allowing passage from Lualualei to Honouliuli by three different trails (ʻĪʻī 1959:96-98). The coastal trail skirted Pearl Harbor, passing by Puʻu o Kapolei; this would have been the nearest of three Honouliuli trails to the current project area. Following ʻĪʻī's description, a portion of this trail network would have passed close to the existing Farrington Highway, near the north border of the project area, as seen in an 1825 map (Figure 11) map of the south coast of Oʻahu by Charles Malden of the British ship the *Blonde*.

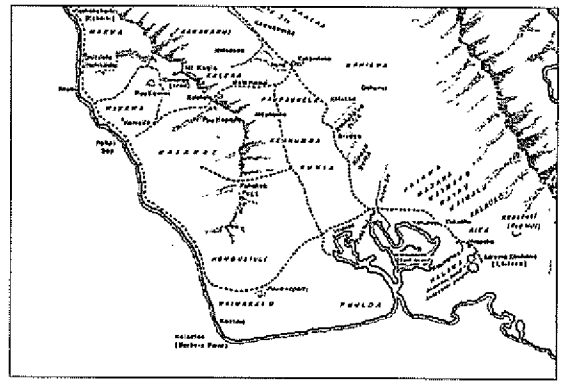

Figure 10. Trails of Leeward Oahu. Map by Paul Rockwood. (ʻĪʻī 1959:96) Mid- to late-1800s

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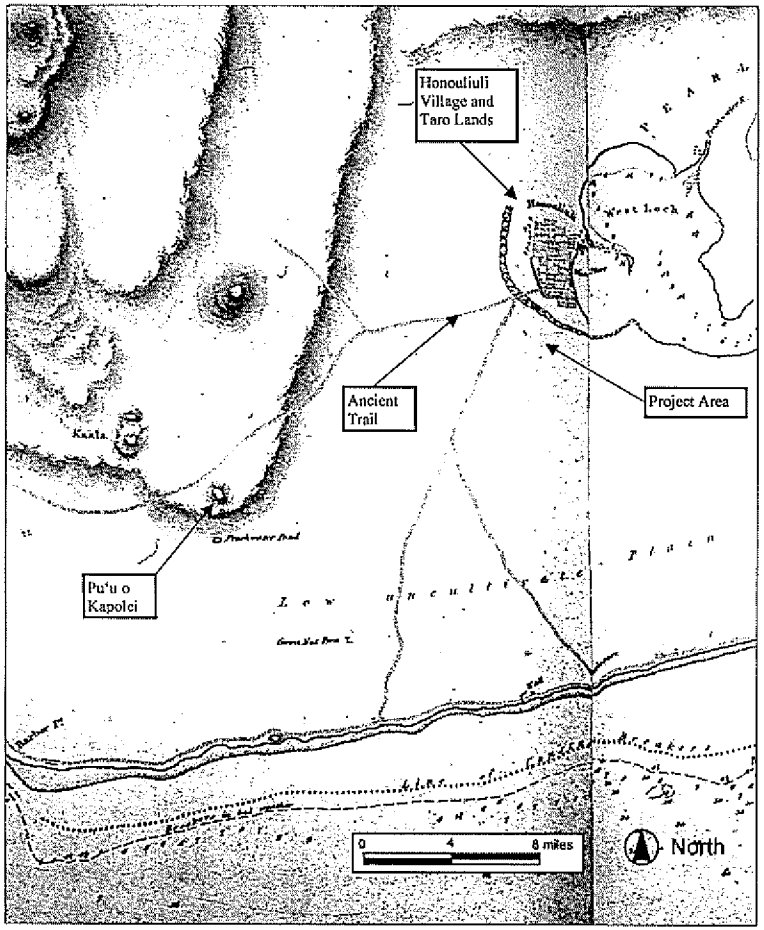

Figure 11. Portion of 1825 Map of the South Coast of Woahoo (O'ahu) and Honolulu by Lieut. C.R. Malden from the British ship the *Blonde*

The trail is described by 'Ī'ī as:

> The trail went down to the stream and up again, then went above the taro patches of Waiau, up to a *makai* field, to Waimano, to Manana, and to Waiawa; then to the stream of Kukehi and up to two other *maika* fields, Puеohulunui and Haupuu. At Puеohulunui was the place where a trail branched off to go Waialua and down to Honouliuli and on to Waianae. As mentioned before, there were three trails to Waianae, one by way of Pu'u o Kapolei, another by way of Pohakea, and the third by way of Kolekole ['Ī'ī 1959:97].

Early historical accounts of the general region typically refer to the more populated areas of the 'Ewa district, where missions and schools were established and subsistence resources were perceived to be greater. However, the presence of archaeological sites along the barren coral plains and coast of southwest Honouliuli Ahupua'a, indicate that prehistoric and early historic populations also adapted to less inviting areas, despite the environmental hardships.

3.2.2 Observations of Early Explorers and Foreign Residents

Captain Vancouver sailed by Kalaeloa (Barbers Point) in 1792, and recorded his impression of the small coastal village of Kualaka'i and the arid Honouliuli coast.

> The point is low flat land, with a reef round it . . . Not far from the S.W. point is a small grove of shabby cocoa-nut trees, and along these shores are a few struggling fishermen's huts [Vancouver 1798, Vol. I:167].
>
> . . . from the commencement of the high land to the westward of Opooroah [Pu'uloa], was composed of one very barren rocky waste, nearly destitute of verdure, cultivation or inhabitants, with little variation all the way to the west point of the island . . . [Vancouver 1798, Vol. II:217].
>
> . . . This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of fertility; although we were told that at a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced . . . [Vancouver 1798, Vol. III:361-363].

Archibald Campbell, an English seamen who was given some land in Waimano Ahupua'a by King Kamehameha in 1809, described his land around Pearl Harbor:

> In the month of November the king was pleased to grant me about sixty acres of land, situated upon the Wymummee [traditional Hawaiian name for Pearl River], or Pearl-water, an inlet of the sea about twelve miles to the west of Hanaroora [Honolulu]. . . . We passed by footpaths, winding through an extensive and fertile plain, the whole of which is in the highest state of cultivation. Every stream was carefully embanked, to supply water for the taro beds. Where there was not water, the land was under crops of yams and sweet potatoes [Campbell 1967:103-104].

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> Pearl and mother of-pearl shells are found here in considerable quantity. Since the king has learned of their value, he has kept the fishing to himself, and employs divers for the purpose [Campbell 1967:114-115].

Subsequent to western contact in the area, the landscape of the 'Ewa plains and Wai'anae slopes was adversely affected by the removal of the sandalwood forest, and the introduction of domesticated animals and new vegetation species. Domesticated animals, including goats, sheep and cattle, were brought to the Hawaiian Islands by Vancouver in the early 1790s, and allowed to graze freely about the land for some time after. It is unclear when the domesticated animals were brought to O'ahu; however, L.A. Henke reports the existence of a longhorn cattle ranch in Wai'anae by at least 1840 (Frierson 1972:10). During this same time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the logging of sandalwood forest and eroded by animal grazing. Within the current project area, the majority of the (non-cultivated) vegetation is comprised of introduced species, mainly grasses.

At contact, the most populous *ahupua'a* on the island was Honouliuli, with the majority of the population centered on Pearl Harbor. In 1832, a missionary census of Honouliuli recorded the population as 1,026. Within four years the population was down to 870 (Schmitt 1973:19, 22). In 1835, there were eight to ten deaths for every birth (Kelly 1991:157-158). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages. In 1853, the population of 'Ewa and Wai'anae combined was 2,451 people. In 1872, it was 1,671 (Schmitt 1968:71). The inland area of 'Ewa was probably abandoned by the mid-nineteenth century, due to population decline and consolidation of the remaining people in the town of Honouliuli (at Papapuhi Point, northeast of the project area). A detailed discussion of the historic population counts in the 'Ewa District has been presented by Charvet-Pond and Davis (1992).

The first mission station in Ewa was established in 1834 at Kalua'aha near Pearl Harbor. Charles Wilkes, of the U.S. Exploring Expedition visited the missionary enclave at Honouliuli town in 1840.

> At Ewa, Mr. Bishop has a large congregation. The village comprises about fifty houses, and the country around is dotted with them. . . . The natives have made some advance in the arts of civilized life; there is a sugar-mill which, in the season, makes two hundred pounds of sugar a day. . . . In 1840, the church contained nine hundred members, seven hundred and sixty of whom belonged to Ewa, the remainder to Waianae; but the Catholics have now established themselves at both these places, and it is understood are drawing off many from their attendance on Mr. Bishop's church [Wilkes 1970:80-81].

The earliest detailed map of the area (Alexander 1873; Figure 12) shows no habitation closer than the western edge of West Loch in the vicinity of Papapuhi Point. A Monsarrat survey map of 1878 documents substantial settlement at the "Honouliuli Taro Land" in the Papapuhi Point area, and it seems clear that in early historic times, this was the focus of the population of Honouliuli. The amenities of the area - including fishponds, taro *lo'i*, abundant shellfish, and salt pans - would have focused population there in pre-Contact times as well.

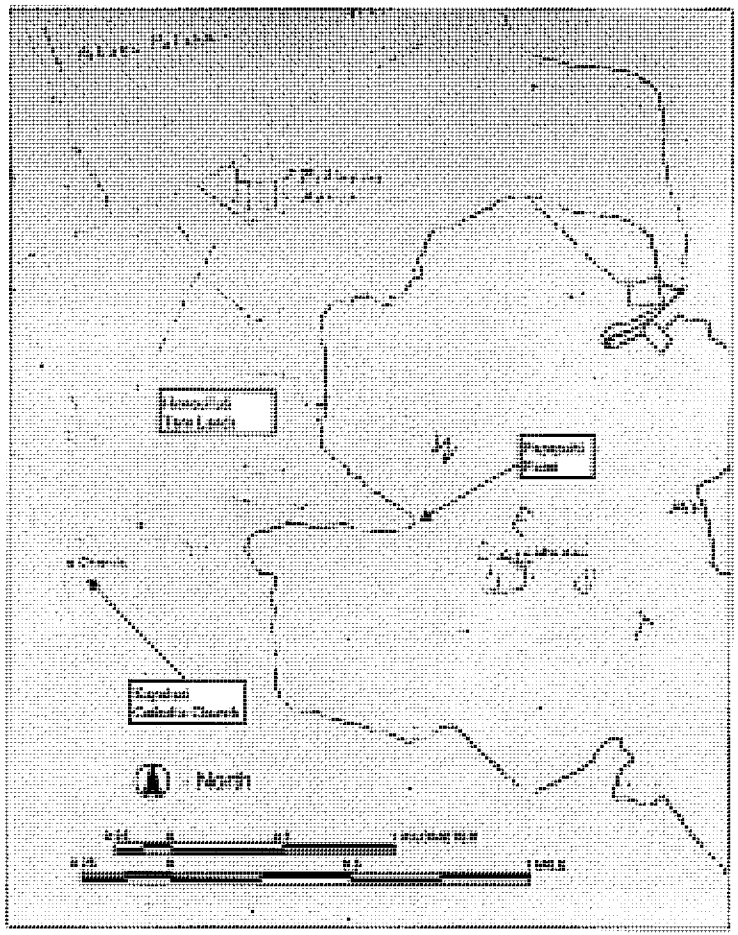

Figure 12. Portion of 1873 W.D. Alexander map of Honouliuli, showing location of Papapuhi Point (habitation symbols are illegible); also note location of Kapalani Catholic Church

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3.2.3 Mid-Nineteenth Century and the Māhele

The Organic Acts of 1845 and 1846 initiated the process of the *māhele* - the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848 the crown and the *ali'i* (chiefly class) received their land titles. The common people received their *kuleana* (individual parcels) in 1850.

During the *Māhele* of 1848, 72 individual land claims in the *ahupua'a* of Honouliuli were registered and awarded by King Kamehameha III (Tuggle and Tomonari-Tuggle 1997:34). The 72 *kuleana* awards were almost all made adjacent to Honouliuli Gulch, which contained fishponds and irrigated taro fields. Kepa Maly (1997, Table 3: 38-42) provides a table recording information on each award, including awardee, *'ili*, and land use of the *'āpana* (lot). A summary of the information on houses, fields, and boundary landmarks noted for each *'ili* is given below in Table 2 and *'ili* locations are shown on Figure 13.

3.2.4 Project Area Māhele Awards

A comparison of project area maps with an 1878 map surveyed by M.D. Monsarrat (Figure 14) clearly show that all or portions of certain land claims belonging to Kelia (LCA 763), Pue (LCA 869), Leleiupa (LCA 1699) and Kua (LCA 5653) lie within the project area. These LCAs were once located on the east side of the main road along Honouliuli town, but now portions lay west of the current alignment of Old Fort Weaver Road. In addition, a portion of the former site of a Catholic church, called Kapalani Catholic Church, also now lies on the west side of the current road alignment, although the church itself was probably covered by the new road itself. This church and associated school house is believed to have been the site of the ministry of a particularly notable person, Kepelino Keauokalani. A brief review of the four known LCAs within the project area follows (see Figure 13 for *'ili* locations):

Kelia's *'Āpana* ('Āp.) 1 (LCA 763)

Kelia's claimed this land situated in the *'ili* of Poohilo and Uani for his houses. His witnesses agreed with his claim, but there was a dispute over whether there were 3 or 4 houses within the parcel. All agreed Kelia has one house there and that his father, Pueeu had two. The west or Wai'anae boundary was described variously as the "*pali* of Makaaku," "a ravine" or "a cliff." The claimant received his house lot from his father Pueeu and "has accepted it ever since 1836."

Pue *'Āpana* 1 and *'Āpana* 2 (LCA 869)

Pue claimed four parcels in the *'ili* of Maui at Honouliuli, 'Ewa. One parcel was a houselot and had two houses on it, one for himself and one for Puali who was his father-in-law. The western side was bounded by the land of Koi, the *luna* (overseer), who gave Pue's family their land in 1842. The other parcel within the project area was *kula*, pasture land to the east of the houselot.

Leleiupa *'Āpana* 1 and *'Āpana* 2 (LCA 1699)

Leleiupa 'Āpana 1 and 2 were claims for two parcels situated in the *'ili* of Maui. 'Āpana 1 was bordered on the west by the land of Koi, the overseer.

Table 2. Summary of land use and boundary landmarks recorded in Honouliuli LCA awards

'Ili	Land Use and Boundary Landmarks
Hiwalalo	*kou* trees
Ka'aumakua	houselots, *kalo* (taro) patches; *kula* (pasture/dryland agriculture), two fishponds called Mokumeha; landmarks - *kula ālialia* (salt plains), land division wall, Pānūhāhā *loko* (fishpond), Kalahu fishpond, Naholowaa pond, Honouliuli Stream (called stream of Makai'i), or *'aka'akai* (bulrush growth) of Kamo'okahi
Kailuopala'ai	*mo'i* (arable land in a long strip); on lot bounded by *'auwai* (irrigation ditch) called Panaenui
Ka'ilikahi	houselot and *kalo* patches; landmarks – highway, Kauhipuna cliff, *kapulapa* (*pamay*) thickets, meeting house
Kamilomilo	houselot and *kalo* patches
Kamoku	fenced *mo'o kalo*, *lo'i* (irrigated fields) *kalo*, houselot; landmarks – Kauhipuna pali
Kamo'okahi	bulrushes
Kapāpahi	houselots, *kalo* patches; bounded by ponds of Healani
Kapapapūhi	houselots, vineyard, *kula*, pond, trails, hog pens, and salt beds
Ka'ula'ula	*mo'o* next to Kaufaula (cliff) with a houselot and a wall
Loloulu	*kalo* patches, 1/3 of a fishpond (in land of Kahakuli'ili'i), hala grove, pig pens, breadfruit, bulrushes
Maka'u	houselot and *kalo* patches
Maui	*kalo* patches, *kula*, houselots, bounded by *pā'āina a ke Aupini* (land division wall of the government)
Mokumeha	2 fishponds, salt beds (western one called Kohumakahou)
Niuke'e	*kalo* patches, *kula*, potato field, houselots; landmarks - *loko kalo* (taro/ fishpond) of Nihola, Loko'eli pond, Kehewanakawalu pond, Kalokoiki pond, *pali* of Kihewamakawela; Ka'akau *pali*; Ka'akau community, meeting house, prison plot, cattle fences
Pulapola	*kalo* patches; houselots, school house, prison plot; some bounded by *pā'āina a ke Aupini*, or high road from the sea, or Catholic Chapel yard
Pō'ohilo	*kula*, *kalo* patches, *loko kalo*, houselots; landmarks - *pā'āina*, Ka'aimanō fishpond, *kula* of Kahakai, *loko kalo* of Kalokoloa, Aimea Pond, Waianu pond, Kahui pond, Ka'aimano fishpond, *pupuhi* cave (wet cave?), prison plot, Makaakua pali, Puehuehu Stream, Puehuehu road
Pua'alu'u	*lo'i*, houselot
Pu'ulua	houselots; boundaries include the sea, a *kula* called Waioipu, and the plain of Kaluanohu

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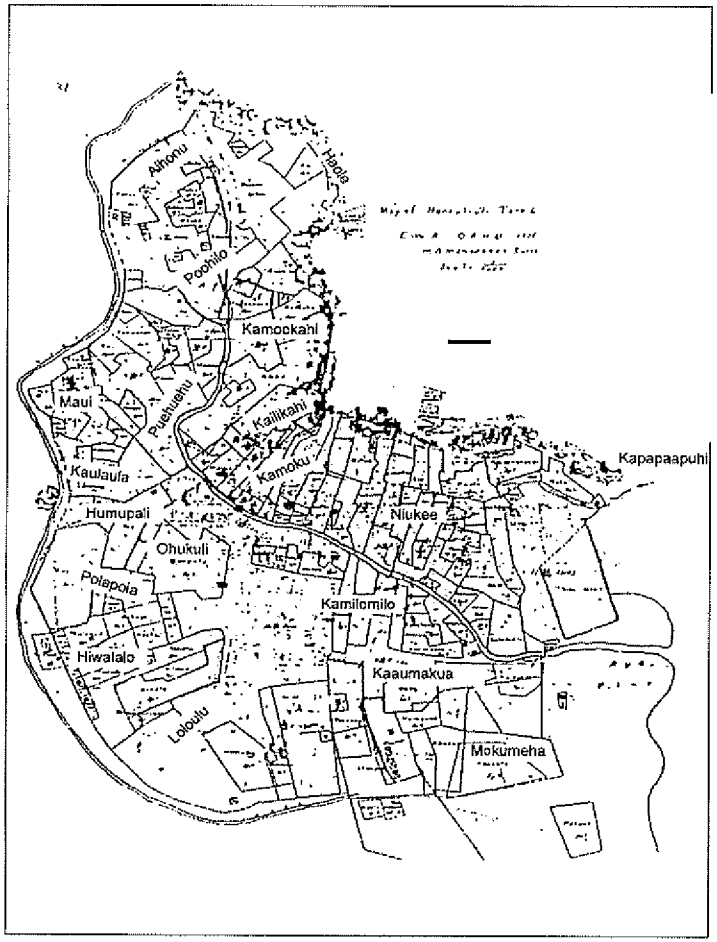

Figure 13. 1878 Map of Honouliuli Taro Lands (LCAs) by M.D. Monsarrat, with inserted '*ili* names

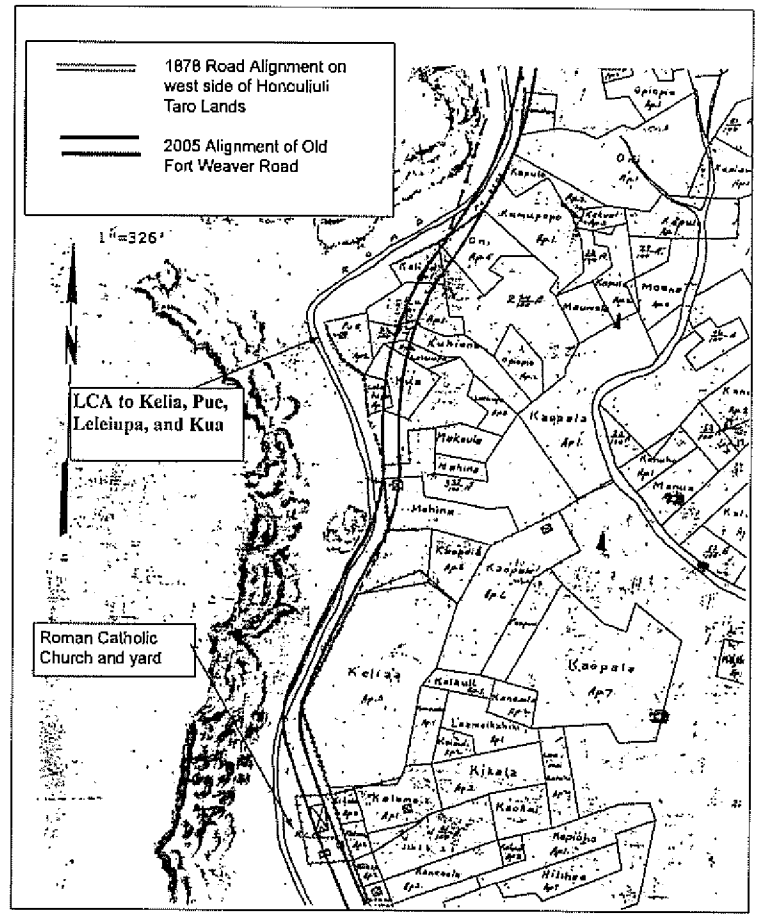

Figure 14. Portion of 1878 Monsarrat map, showing portion of Honouliuli Taro Lands in Relation to current alignment of Old Fort Weaver Road (eastern boundary of the project area)

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Kua (LCA 5623)

Kua claimed two taro patches and a *kula* land called Kahui in the '*ili* of Maui. Of note was the sworn testimony of Maakuia on the Land Court Application for Mahina (LCA 749), which stated that the western boundary of Mahina's land was [Kaulaula] Pali, which had a wall on its top.

3.2.5 The Catholic Church

There are two land applications that make reference to a Catholic Church near the town of Honouliuli. Kaohai in April of 1850 (LCA 5670B) claimed a house site in the '*ili* of Polapola "adjoining the Catholic Chapel yard." Hilinae (LCA 1720) in November of 1847 made a houselot claim in the '*ili* of Polapola bounded on the west by the Kapalani Church. Little is known about the Kapalani Roman Catholic Church. It is clearly annotated on Monsarrat's 1878 map (see Figure 14) and is the lone "church" pictured on an 1873 map of the Honouliuli district by Alexander (Figure 15). Even the name is uncertain, as Kapalani probably means "the Frenchmen's" church. Efforts to found a Catholic Mission in Hawai'i were initially met with hostility until the issuing of an edict of toleration in 1839. The establishment of the Catholic Mission in Hawai'i in May of 1849 initiated an active period of building churches and schools. The Kapalani church (and school house) cited in the Land Court Application of Hilinae in November of 1847 must have been constructed within the previous seven years. Father Raymond Delande was pastor of the Leeward District of the church from 1857-1885 and, operating out of Honouliuli, he covered an area extending as far as Makaha and Waialua. "Up to 1877, he had baptized 600 children and adults, all living along the SW coast of Oahu" (Schoofs 1978:110).

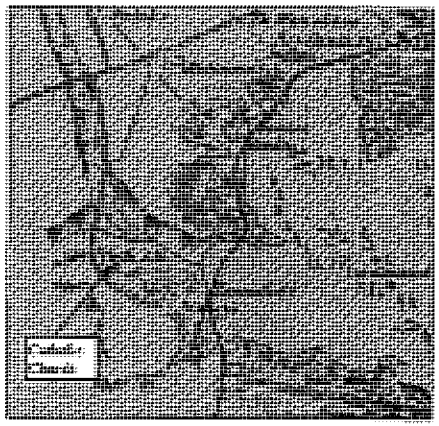

Figure 15. Portion of 1881 Hawai'i Government Survey Map (Alexander) showing location of the Catholic Church

Of particular interest is the association with this church of Kahoali'ikumaieiwakamoku Kepelino (Zepherino) Keauokalani, whose name means "to-be-the-chief-of-the-nine-districts" (Beckwith 1978:4). His father was Namiki, of the lineage of the high priest Pa'ao and his mother, Kahiwa Kaneikopulei, was a daughter of Kamehameha I. They had two children, the son Kepelino, and a daughter named Puahau. Namiki was the "old savage" whose narratives were collected by Jules Remy as "Contributions of a Venerable Savage to the Ancient History of the Hawaiian Islands" during his travels in the islands between 1851 and 1855. In a note on a section concerning the priest Pā'ao, the author talks about Namiki's son, who he met in 1853.

> The old historian Namiki, an intelligent man, and well versed in the secrets of Hawaiian antiquity, has left precious unedited documents, which have fallen into our hands. His son, Kuikauai, a school-master at Kailua, one of the true historico-sacerdotal race, has given us a genealogy of his ancestors which ascends without break to Paao [Remy 1857, in Nordhoff 1974:253].

The family was of Kailua, Kona, Hawai'i and converted to Catholicism very quickly after the arrival of Fathers Walsh and Ernest Herutel of the Catholic Mission to Kona in 1840. His parents sent him to Catholic school in Honolulu in 1845 to become a teacher. Father Ernest writes:

> Father Martial writes me about our little Zepherin, telling me that he has been received as teacher but that because they have no school to give him as yet, he has not received his diploma. Father Desire wants to keep him to send to the High School; but when will you have a High School? Perhaps not so soon. I think therefore that Zepherin would be more useful here as we lack teachers [cited in Beckwith 1978:4].

As noted above, Remy claims that at some point, Kepelino was a school teacher in Kailua; although Remy is believed to have met Kepelino in 1853, his teaching position at Kailua could have dated to an earlier period, possibly around 1845, when Father Ernst suggested that he return to the island of Hawai'i from Honolulu. At some point he attended the Catholic High School at Ahuimanu (established in 1846), where he is said "to have acquired English, French, Latin, and Greek" (Beckwith 1978:5). In 1847, at the age of 17, he was sent briefly with Father Ernest to Tahiti to help establish a Catholic mission. He developed a reputation for his pranks and was sent back to his parents (Beckwith 1978:5).

Controversial letters under the name of Z. Kahoali'i, addressed from the town of Honouliuli on O'ahu, were published in Catholic newspapers from 1860-1869. A letter in the Public Instruction Correspondence filed and dated 11/26/1851, written by a school teacher name Naheona to the Minister of Public Education, state his reasons for the rejection of a teacher "Kepilina" and accuses Kepilina of "dancing and thieving while employed as teacher of Honouliuli School and of general improper conduct." The letter also mentions "Catholic priests in the area who have been among the people for a while who do not recommend retaining Kepilina" (In Silva 1987:A8). It seems quite probable that Kepelino lived at Honouliuli from 1851 into the 1870s and that as a devout Catholic and teacher that he taught at the school house next to Kapalani Church.

Detailed biographic information on Kepelino is not readily available, which is probably due in part to the fact that he was "controversial" for the Catholics and for the government. He went on

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to become Queen Emma's secretary (by at least 1874) and was one of the most important documenters about Hawaiian beliefs and traditions. He supported Queen Emma as the heir of King Lunalilo over David Kalākaua, and wrote letters to the king of Italy and the queen of England, asking for warships to support Queen Emma's cause. In 1874, the newly elected King Kālakaua had him tried for high treason and sentenced him to hanging, but the sentence was commuted and he was released from prison in 1876; he died in 1878 (Day 1984:77).

"The Honouliuli church . . . had by the 1880s outlived its usefulness and become dilapidated. It was therefore abandoned and replaced by a simple structure close, too close to the mill" [at 'Ewa Village, south of the project area] (Schoofs 1978:111). However, "in 1891 Honouliuli was still important enough to acquire its own Catholic cemetery" (Schoofs 1978:110). Whether this cemetery or any other Catholic cemetery was on the grounds of the Kapalani Church in unknown. In the late 1920s, Bishop Alencastre exchanged land at Honouliuli with Campbell Estate for land at 'Ewa Village to establish a new church.

3.2.6 Honouliuli Māhele Awards to *Ali'i*

In 1855 the Land Commission awarded all of the unclaimed lands in Honouliuli, 43,250 acres, to Miriam Ke'ahikuni Kekau'ōnohi (Royal Patent #6971 in 1877; Parcel #1069 in the Land Court office), a granddaughter of Kamehameha I, and the heir of Kalanimōkū, who had been given the land by Kamehameha after the conquest of O'ahu (Indices of Awards 1929; Kame'eleihiwa 1992). Kekau'ōnohi was also awarded the *ahupua'a* of Pu'uloa, but she sold this land in 1849 to Isaac Montgomery, a British lawyer.

Kekau'ōnohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu'u Kahalai'a, who was governor of Kaua'i (Hammatt and Shideler 1990:19-20:20). Subsequently, Kekau'ōnohi ran away with Queen Ka'ahumanu's stepson, Keli'iahonui, and then became the wife of Chief Levi Ha'alelea. Upon her death on June 2, 1851, all her property was passed on to her husband and his heirs. A lawsuit (Civil Court Case No. 348) was brought by Ha'alelea in 1858, to reclaim the fishing rights of the Pu'uloa fisheries from Isaac Montgomery, and the court ruled in Ha'alaea's favor. In 1863, the owners of the *kuleana* lands deeded their lands back to Ha'alelea to pay off debts owed to him (Frierson 1972:12). In 1864, Ha'alelea died, and his second wife, Anadelia Amoe, transferred ownership of the land to her sister's husband John Coney (Yoklavich et al 1995:16).

3.2.7 Early Ranching in on the 'Ewa Plain

John Coney rented the land to James Dowsett and John Meek in 1871, who used the land for cattle grazing. In 1877, the land, except for the *'ili* of Pu'uloa, was sold to James Campbell. He drove off 32,237 head of stock belonging to Dowsett and Meek and to James Robinson and constructed a fence around the outer boundary of his property (Bordner and Silva 1983:C-12). He let the land rest for one year and then began to restock the ranch, so that he had a head of 5,500 head after a few years (Dillingham 1885, cited in Frierson 1972:14)

In 1880-81, the Honouliuli ranch was described as:

> . . . Acreage, 43,250, all in pasture, but possessing fertile soils suitable for agriculture; affords grazing for such valuable stock. The length of this estate is no less than 18 miles. It extends to within less than a mile of the sea coast, to the westward of the Pearl River inlet. . . . There are valuable fisheries attached to this estate . . . . [Bowser 1880:489].
>
> From Mr. Campbell's veranda, looking eastward, you have one of the most splendid sights imaginable. Below the house there are two lochs, or lagoons, covered with water fowl, and celebrated for their plentiful supply of fish, chiefly mullet. . . . Besides Mr. Campbell's residence, which is pleasantly situated and surrounded with ornamental and shade trees, there are at Honouliuli two churches and a school house, with a little village of native huts [Bowser 1880:495].

Most of Campbell's lands in Honouliuli were used exclusively for cattle ranching. At that time, one planter remarked "the country was so dry and full of bottomless cracks and fissures that water would all be lost and irrigation impracticable" (Ewa Plantation Co. 1923:6-7). In 1879, Campbell brought in a well-driller from California to search the 'Ewa plains for water, and the well, drilled to a depth of 240 feet near Campbell's home in 'Ewa, resulted in ". . . a sheet of pure water flowing like a dome of glass from all sides of the well casing" (The Legacy of James Campbell n.d., cited in Pagliaro 1987:3). Following this discovery, plantation developers and ranchers drilled numerous wells in search of the valuable resource. A Hawai'i Visitor Bureau, marker, located in the southwestern portion of the project area, bears the inscription "Site of First Artesian Well in the Hawaiian Islands drilled by James Ashley for James Campbell owner of Honouliuli Ranch brought in on Sept. 22, 1879." Kuykendall (1967:III, 67) states that this well was "near Campbell's ranch house" but Campbell's ranch house, which is shown on Monsarrat's 1878 map, was located outside the project area.

3.2.8 History of the Ewa Sugar Plantation

3.2.8.1 General History of the Plantation

In 1886, Campbell and B. F. Dillingham put together the "Great Land Colonization Scheme," which was an attempt to sell Honouliuli land to homesteaders (Thrum 1886:74). This homestead idea failed, but with the water problem solved by the drilling of artesian wells, Dillingham decided that the area could be used instead for large-scale cultivation (Pagliaro 1987:4). During the last decade of the nineteenth century, the railroad would reach from Honolulu to Pearl City in 1890, to Wai'anae in 1895, to Waialua Plantation in 1898, and to Kahuku in 1899 (Kuykendall 1967:100). This railroad line eventually ran across the center of the 'Ewa Plain at the lower boundary of the sugar fields.

To attract business to his new railroad system, Dillingham subleased all land below 200 ft to William Castle, who in turn sublet the area to the newly-formed Ewa Plantation Company (Frierson 1972:15). Dillingham's Honouliuli lands above 200 ft that were suitable for sugar cane cultivation were sublet to the Oahu Sugar Company (Figure 16). Throughout this time, and continuing into modern times, cattle ranching continued in the area, and Honouliuli Ranch - established by Dillingham was - the "fattening" area for the other ranches (Frierson 1972:15).

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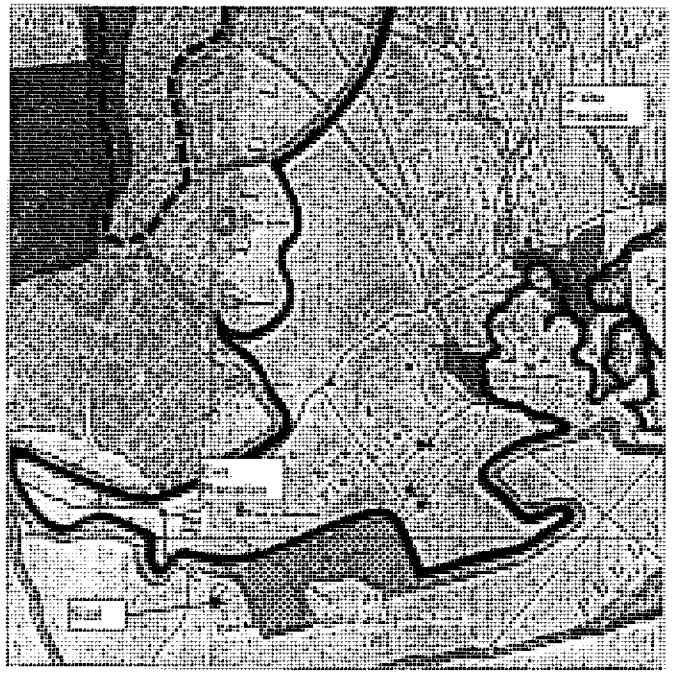

Figure 16. 1902 map showing relationship of Ewa Plantation and the Oahu Sugar Co. plantation; also note location of sisal growing area

Ewa Plantation Company (Figure 17) was incorporated in 1890 for sugar cane cultivation. The first crop, 2,849 tons of sugar, was harvested in 1892 at the Ewa Plantation. Ewa was the first all-artesian plantation, and it gave an impressive demonstration of the part artesian wells were to play in the later history of the Hawaiian sugar industry (Kuykendall 1967:69). As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Company installed ditches running from the lower slopes of the mountain range to the lowlands. When the rainy season began, they plowed ground perpendicular to the slope so that soil would be carried down the drainage ditches into the lower coral plain. After a few years, about 373 acres of coral wasteland were reclaimed in this manner (Immisch 1964). It is uncertain if there was also a deliberate effort to induce erosion on the scarp (called Evans Bluff by the Campbell Estate), near the eastern boundary of the project area, but it would have been easy to do and probably very effective. By the 1920s, Ewa Plantation was generating large profits and was the "richest sugar plantation in the world" (*Paradise of the Pacific*, Dec. 1902:19-22, cited in Kelly 1985:171).

Just north of 'Ewa Plantation was the equally sprawling O'ahu Sugar Company which "covered some 20 square miles . . . ranging in elevation from 10 feet at the Waipio Peninsula . . . to 700 feet at the Waiahole Ditch" (Condé and Best 1973:313) (see Figure 16). The Oahu Sugar

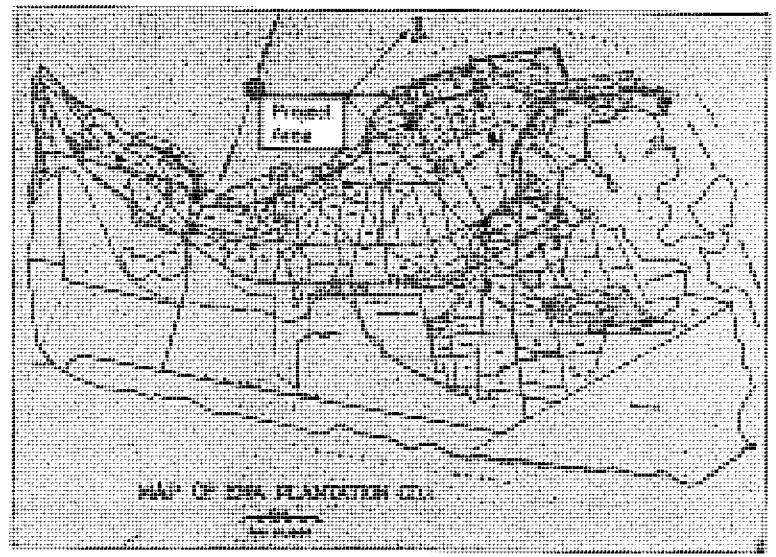

Figure 17. 1939 map of the Ewa Plantation Co. lands, showing project area

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Company was incorporated in 1897. Prior to commercial sugar cultivation, the lands occupied by the Oahu Sugar Company were described as being "of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project" (Condé and Best 1973:313). The Oahu Sugar Company took control of the Ewa Plantation lands in 1970 and continued operations until 1995, when they decided to shut down sugar cane production in the combined plantation area (Dorrance and Morgan 2000:45, 50).

3.2.8.2 History of PipeLine Village

During the twentieth century, the Ewa Plantation would continue to grow and, by the 1930s, would encompass much of the eastern half of Honouliuli Ahupua'a. This growth impelled the creation of plantation villages to house the growing immigrant labor force working the fields. In the decade of the 1890s, the plantation built 72 houses, cottages or dwellings; in the first decade of this century, 536; in the second decade, 132; in the 1920s, 285; in the 1930s, 168; and, in the 1940s, only 35. Censuses of the Ewa Plantation population record 4,967 persons in 1928, 4,477 in 1929, and 4,100 in 1932. After the outbreak of World War II, which siphoned off much of the plantation's manpower, along with the changeover to almost complete reliance on mechanical harvesting in 1938, there was little need for the large multi-racial (Japanese, Chinese, Okinawan, Korean, Portuguese, Spanish, Hawaiian, Filipino, European) labor force that had characterized most of the early history of the plantation.

It is to be noted that in the history of construction, buildings were moved, demolished, and replaced all the time. As early as 1899, the plantation moved "the lower camp of thirty houses [believed to be duplexes built in 1890] to a position on the bluffs nearby . . . principally for sanitary reasons" (Ewa Plantation Company Annual Report for 1890).

The original location of these thirty houses is unknown. They probably were not in the area later known as "Lower Camp" and may have been in the Honouliuli Taro lands. It is also unknown where they moved to "on the bluffs," but it seems probable that they were moved to what became the west central portion of PipeLine Village near the present water pumping station in that vicinity. A 1908/1913 U.S. Army Fire Control map shows 47 houses in the area of PipeLine Village (Figure 18).

PipeLine Village was a major plantation community that lay in the central southern portion of the present project area and is shown in detail in a 1928 USGS map (Figure 19), which documents the location of about 160 houses, a church and a school. This was probably the great extent of PipeLine Village. An entry in the 1931 Annual Report of Ewa Plantation Company records that "The PipeLine Village of 162 cottages built in 1906" was dismantled and that "other cottages near [near the factory, south of the project area] were erected using the reclaimed lumber from the PipeLine Villages. Photos (Bishop Museum Visual Collection) dated 1906 (Figure 20) show what appears to be brand new single family residences at PipeLine Village, but the Annual Report for 1906 documents the construction of only 47 houses and many of there were probably not built in PipeLine Village. Photos dated 1907 (Figure 21) show houses at PipeLine village with very well established garden and tall banana, papaya, and many mango trees, suggesting that they are significantly older. Another photo dated January 1910 (Figure 22) shows a line of ten new cottages with the caption "Pipe Line Village (Family houses built

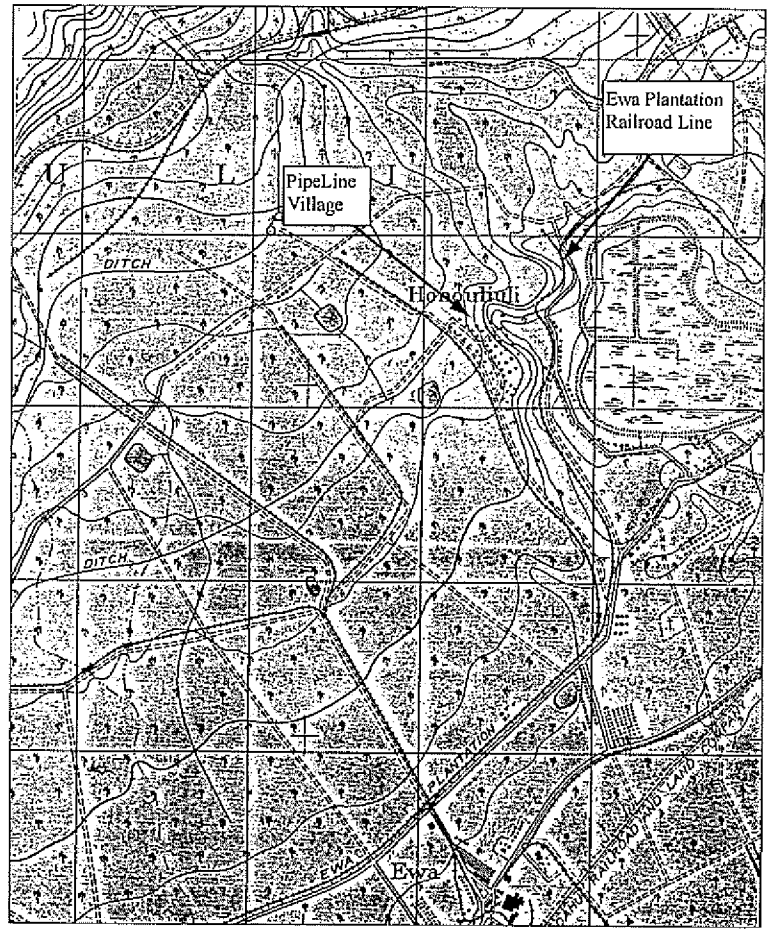

Figure 18. Portion of an 1908/1913 U.S. Army Fire Control map, showing 47 houses in PipeLine Village; map also shows the alignment for the Ewa Plantation railway

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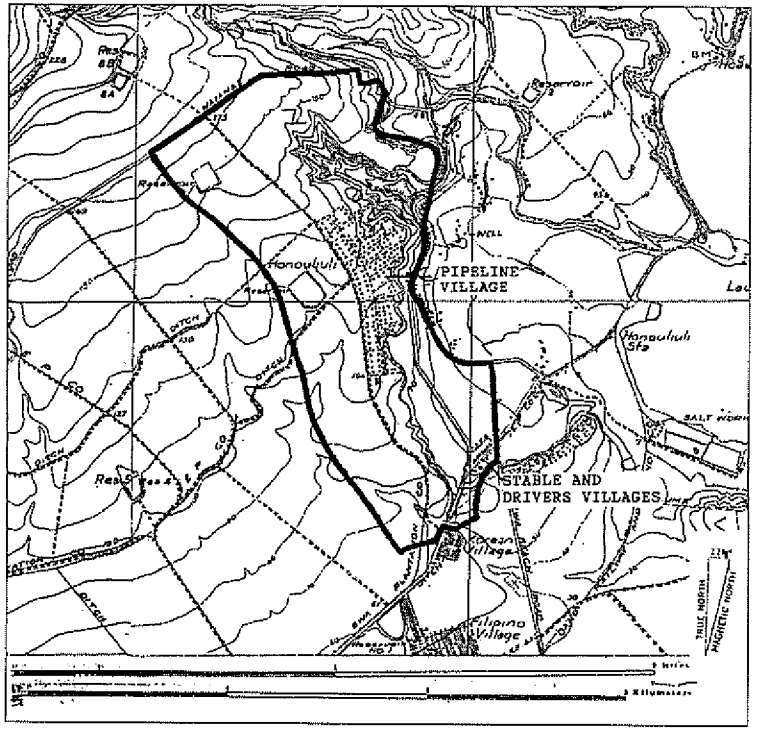

Figure 19. 1927/1928 US Geological Survey map, showing location of PipeLine Village, Stable Village, Driverss Village, and other Ewa Plantation structures

Figure 20. Portuguese family residence at PipeLine Village 1906

Figure 21. Discharge Pump No. 5, PipeLine Village 1907

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Figure 22. PipeLine Village, family houses built in 1909, photograph taken on January 1910

Figure 23. PipeLine Village, April 7, 1907; forno at center of photograph

during 1909)." A 1907 photo (Figure 23) shows blocks of houses separated by wooden fences, and a *forno*, a brick Portuguese bread oven in the center. One hundred and twenty-nine cottages were built for married laborers in that year and they include the majority of the houses at PipeLine Village. In 1911 "60 new houses, principally for Spanish and Portuguese workmen with families" were erected. Thus, it seems highly probable that PipeLine village was largely constructed between 1906 and 1911, but may have incorporated a number of relocated structures dating to 1890. The demolition of 1931 was probably quite thorough, and not a trace of the structures was found on later maps.

3.2.8.3 History of Stable Village and Drivers Village

The Ewa Plantation housing located in the southeastern corner of the project area, just north of the present Hale o Ulu School, is not well-documented. It appears that there were at least two small villages located here: "Stable Village" and "Drivers Village." The Ewa Plantation Company Annual Report for 1931 states that "The Drivers Village, located near the main stable was in such a bad location that it was decided to move all the fourteen cottages down to 'B' village near the factory." Drivers Village doubtlessly corresponds to the site of the 14 houses shown on the 1927/1928 map (see Figure 19), with Stable Village probably referring to the structures just to the south across the street. The date of construction of these villages is unknown. No houses are shown in this area on the 1908/1913 Fire Control map (see Figure 18). The villages were probably built in that flurry of construction in the first decade of this century. All of the structures of Stable Village and Drivers Village are shown on the War Department Map of 1943, but this map may be another example of a lack of military intelligence regarding the Pearl Harbor area; records indicate that the houses were probably all demolished around 1931.

3.2.8.4 Other Enterprises in Campbell Lands

As noted above, part of Mr. Campbell's lands were also used to grow rice. By 1885, 200 acres in Honouliuli were used for rice and 50 acres were used to grow bananas (article in *Pacific Commercial Advertiser*, August 15, 1885, summarized in Silva 1987:A-12). These rice fields were planted in former taro fields or in undeveloped swamps, such as those near the project area in the former Honouliuli Taro lands. The rice fields in 1882 were described by Frank Damon, during a tour of the area.

> . . . Towards evening we reached Honouliuli, where the whole valley is leased to rice planters . . . This was one of the largest rice plantations we visited. Sometimes two or three men only, have a few fields which they cultivate for themselves, and we often too came upon houses where there were eight or ten men working their own land. But the larger plantations are owned by merchants in Honolulu, who have a manager acting for them. . . . [Damon 1882:37].

In 1890, Dillingham leased all land below 200 ft to William Castle, who used most of the land for sugar cane, but also leased some lands for rice cultivation, pasture, wood lots, bee-keeping, garden crops, and quarries. Some land above 650 ft was also leased for the cultivation of canaigre, which may be a word used for pineapple (Frierson 1972:15-16).

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An additional agricultural trial was conducted in the Honouliuli area for the cultivation of sisal, a plant used to make fibers for rope and other material. Some sisal was planted before 1898 and production continued until the 1920s (Frierson 1972:16). This was grown mainly on the coastal plain of Honouliuli in Kānehili, just *mauka* of Kualaka'i Beach (now Nimitz Beach). An article in the *Paradise of the Pacific* in 1902 described this venture in glowing terms.

> . . . The venture was made and a tract of land containing a large percentage of disintegrated coral, in the neighborhood of Ewa Plantation, where nothing else would grow, was chosen for the planting. . . . The Hawaiian Fiber Co., which Mr. Turner organized, and of which he is now manager, has 755 acres under fence, two and a half miles of which is stone wall with good gates at convenient places. . . . In a large field containing 130 acres, mauka of the Oahu Railway & Land Co. track, the first harvest is to be gathered in a few months. . . . Out of this section of 130 acres the company has figured on securing 50 tons of clean fiber, for which it is offered eight cents per pound in Honolulu or nine cents per pound in San Francisco . . . . [*Paradise of the Pacific* March 1902:17].

Although many of the fishponds at Pearl Harbor deteriorated from lack of care and lack of people to maintain them in the early nineteenth century, there was some action to reclaim these areas in the later part of the century. Some were converted to rice fields, but others were maintained as fish ponds or duck ponds. Records of the Minister of Public Instruction (1848) show that some ponds were maintained by local teachers and students, with the funds generated used for the upkeep of the school system. Some ponds as early as 1848 were also maintained by prisoners, possibly from the women's prison located at Honouliuli. In 1852, however, Levi Ha'alelea reasserted his claims to these neglected lands, when he claimed all of the mullet from this area be reserved to him (Hawaii Kingdom files, cited in Silva 1987:A-7 to A-9). During James Campbell's tenure of the land, fish ponds and Pu'uloa fishing rights were leased out to various entrepreneurs (Kelly 1985:175).

Into the early twentieth century, some Hawaiian families continued to live in Honouliuli and preserve the traditional lifestyle, including at the fishing village of Kualaka'i. One resident, Mrs. Eli Williamson, recalled:

> In the Honouliuli area the train stopped among the *kiawe* (algaraboa) trees and *molina* (sisal) thickets. We disembarked with the assorted food bundles and water containers. Some of the Kualaka'i *'ohana* (family) met us to help carry the *'ukana* (bundles) along a sandstone pathway through the *kiawe* and *molina*. The distance to the frame house near the shore seemed long. When we departed our *'ukana* contained fresh lobsters, *limu* (algae), fish and *i'a malo'o* (dried fish) . . . [Williamson in Kelly 1985:160].

3.2.9 The Military and Modern Developments

In 1891, Russian explorer Otto Von Kotzebue tried to observe Pearl River, but his group could not obtain a canoe. What he was told, however, led him to speculate on the possible importance of Pearl Harbor to the future.

> In the mouth of this river are several islands; it is so deep, that the greatest ship of the line can lie at anchor a few fathoms from the shore; and so broad, that a hundred vessels can conveniently find room in it. The entrance into the Pearl Rivers is in the same situation as the harbour of Hana-ruru; but the windings between the reefs are, however, said to render a passage more difficult. If this place were in the hands of the Europeans, they would certainly employ means to make this harbour the finest in the world [Von Kotzebue 1821:338-348].

The early missionary Levi Chamberlain was able to take an outrigger canoe trip to Pearl River, and noted the difficulty of access for larger ships.

> Kawaa took passage in our canoe to go down the harbor to a place where oysters are abundant to give orders to his people to gather a mess. The sail down the harbor was delightful . . . The passage down the creek for a number of miles was very pleasant till we got down near the reef and our course altered. We then could sail no longer as the wind was against us. The sail was lowered the mast taken down and secured across the outrigger and the rowers plied their paddles [Journal of Levi Chamberlain 1822-1849, Hawaiian Mission Schools, Storage Case 4, p. 899, from Sterling and Summers 1978:51].

The first foreign attempt to survey Pearl Harbor was made in 1840 during the U.S. Exploring Expedition, led by Charles Wilkes.

> In this district is a large inlet of the sea, into which the river Ewa empties; at the entrance of this inlet is the village of Laeloa (at Kalaeloa Point): the shore is known by the name of Pearl River or harbour, from the circumstance that the pearl oyster is found here; and it is the only place in these islands where it occurs.
>
> The inlet has somewhat the appearance of a lagoon that has been partly filled up by alluvial deposits. At the request of the king, we made a survey of it: the depth of water at its mouth was found to be only fifteen feet; but after passing this coral bar, which is four hundred feet wide, the depth of water becomes ample for large ships, and the basin is sufficiently extensive to accommodate any number of vessels. If the water upon the bar should be deepened, which I doubt not can be effected, it would afford the best and most capacious harbour in the Pacific. . . . [Wilkes 1970:79].

Although Wilkes was impressed by the harbor, he was not at this time thinking of how this survey could benefit the American government in the future. In fact, Wilkes (1970:79) concluded, "As yet there is no necessity for such an operation, for the port of Honolulu is sufficient for all the present wants of the islands, and the trade that frequents them."

This had changed in less than 30 years, however. The U.S. military had tried to make a coaling station on Midway Island in 1869 by blasting through the coral reef to make a harbor; this plan failed. In 1873, General Schofield presented a confidential report to the U.S Secretary of War, recommending that Pearl Harbor should be available to the U.S. Navy. Schofield wrote:

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> In case it should become the policy of the Government of the United States to obtain the possession of this harbor for naval purposes, jurisdiction over all the waters of Pearl River with the adjacent shores to the distance of 4 miles from any anchorage should be ceded to the United States by the Hawaiian Government. . . .
>
> The cession of Pearl River could probably be obtained by the United States in consideration of the repeal of the duty of Sandwich Island sugar. Indeed, the sugar –planters are so anxious for a reciprocity treaty, or so anxious rather for free trade in sugar with the United States, that many of them openly proclaim themselves in favor of annexation of these islands of the United States [Sen. Ex. Docs, 52nd Cong. 2nd Sess. No. 77, pp. 150-154, reproduced in Judd 1971:Appendix 3].

This reciprocity treaty was concluded in 1876 with the provision that Hawai'i would not "lease or relinquish sovereignty to another country or any harbor, etc." In 1887, the treaty was renewed and amended and allowed the United States the "exclusive right to enter the harbor of Pearl River, in the Island of Oahu, to establish and to maintain there a coaling and repair station for the use of vessels of the United States" (Judd 1971:128).

After annexation of the islands to the United States in 1899, development began in order to make a Pacific base that could be used as a staging area for the Spanish-American War (Coletta 1985:433). Dredging of the harbor began in 1901, and additional dredging to deepen and widen the channel was conducted in 1908 and again in the 1920s. Money for the funding of the construction of dry docks and other support facilities was approved in 1908. In 1931 the Navy built an ammunition depot at West Loch on a 213-acre parcel that it had bought from the Campbell Estate. Construction of a new depot in Lualualei Valley and at West Loch Harbor began in 1931.

In the early 1930s, the U.S. Navy leased 700 acres of the Campbell Estate to build Ewa Field, a base with a mooring mast for Navy dirigibles. Although the mast was completed, the program was abandoned before the *Akron*, the designated airship for the mast, was built. In 1937, 18 miles of roads were built in the coastal Honouliuli area, and in 1939-1940 the U.S. bought 3,500 acres of land in this area (Landrum et al 1997:62-67), to build several other military camps and installations, including Barbers Point Naval Air Station, at the site of the old mooring mast.

On December 7, 1941 the Japanese Navy launched the devastating surprise attack on the United States base at Pearl Harbor and other military facilities. Although the major battle damage to the US Pacific Fleet was at its base at Ford Island in the Middle Loch of Pearl Harbor, Honouliuli did not escape unscathed.

> The Waipahu and Ewa sugar plantation, next to Pearl Harbor and the town of Wahiawa, adjoining Schofield Barracks, saw more action than did Honolulu.
>
> At Waipahu, machine gun bullets, shrapnel, and shells started two cane fires, riddled the sugar mill, hit the plantation hospital in four places, went through the roof of the company store, exploding in an electric supply warehouse, and narrowly missed many houses. In nearly all of the fields of tall cane, many of which contained terrified women and children, shells buried themselves-dozens of

> them in some concentrated areas-blasting holes in the ground the size of barrels, and flattening cane for several square yards.
>
> At Ewa, after bombing the nearby Marine airfield [at Barbers Point], enemy planes machine-gunned the plantation's main street, the mill and power plant and some 30 houses and started two cane fires [Allen 1999:20].

The attack had consequences not only for the military, but also for the civilians, mostly Japanese, who lived around West Loch.

> Two permanent local evacuations were ordered in the first month of the war, partly to remove civilians from areas which might be dangerous in event of further attack and partly to protect installations from possible sabotage or espionage activities. On a Thursday less than two weeks after the bombing, farmers adjacent to West Loch at Pearl Harbor were ordered to leave their farms by sundown. The order was modified to allow two days to prepare and the men were permitted to return to their farms during daylight until livestock could be moved and crops harvested. The displaced farmers, who had only recently been established at West Loch by the Farm Security Administration were forced to seek temporary housing with friends and relatives at Ewa plantation. Since they had invested in the enterprises practically all of their life's savings and considerable money borrowed from the FSA as well, several suffered heavy losses [Allen 1999:122].

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Section 4 Previous Archaeological Research

4.1 Early Archaeological Surveys

All archaeological projects conducted in Honouliuli and Pu'uloa are listed in Table 1. Two archaeological features, a boundary *pōhaku* or rock and a *hōlua*, or sledding site, are recorded only in the Boundary Commission Reports establishing the division lines between the *ahupua'a* of Honouliuli and Hō'ae'ae (to the east). The surveyor wrote of the southern point of this boundary:

> In regard to Hoaeae . . . the point of commencement is Pōhaku Palahalaha, a well known rock, now marked by an arrow and the name "Honouliuli" on one side and "Hoaeae" on the other, which I have made the initial point of the survey . . . [Boundary Commission Vol. 1:243].

This rock is shown on the Sterling and Summer map (see Figure 9) as Pōhaku Palaha. In another boundary survey, the *pōhaku* is called a "large, flat rock" (Boundary Commission Vol. 1:249), which may indicate the origin of the name from the Hawaiian word *pālaha*, which means "flattened, wide" (Pukui and Elbert 1986:307). As the surveyor continued to walk the Honouliuli/Hō'ae'ae boundary, he marked the northern point of the division as:

> The Kamaaaina took me to the corner of Pauhala (?)-Hoaeae and Honouliuli – there is an ancient holua or sleding [*sic*] place near this – which is agreed for the ancient corner. . . [Boundary Commission Vol. 1:243].

The earliest attempt to record archaeological remains in Honouliuli Ahupua'a was made by Thrum (1906:46). He reported the existence of a *heiau* located on Pu'uokapolei, west of the present study area. In a second monograph on *heiau*, Thrum (1917) called this *heiau* Palole'i (Kapolei). Emory mapped and photographed these structures in 1933 (field notes), but they were dismantled and destroyed sometime before McAllister's survey of the islands in the 1930s. According to legend, Pu'u Kapolei was the location on which Kamapua'a, the pig-god, resided with his grandmother, Kamaunuahihio (McAllister 1933:108).

In his surface survey of the 1930s, archaeologist J. Gilbert McAllister recorded the specific locations of important sites, and the general locations of less important sites (at least at Honouliuli). McAllister recorded seven specific sites at Honouliuli (numbered 133-139; McAllister 1933:107-108) (see Figure 9), and these became the first seven sites in the Bishop Museum's Site Numbering System (OA-B6-1 through OA-B6-7).

The first six sites are in the upland section of Honouliuli, *mauka* of the 'Ewa coral plain and Pu'u o Kapolei. Site 133 is a possible *heiau*, a small enclosure at the foot of Pu'u Kānehoa. It was still standing during McAllister's day, and local residents informed him of its sacred nature. Site 134 is Pu'u Kuina Heiau, located in a gulch at the foot of Mauna Kapu. Only traces of a large terrace remained. Site 135 is a series of enclosures *makai* of Pu'u Kuina Heiau. McAllister believed that the walls marked *kuleana* lots. Site 136 is a small platform near Mauna Kapu, a sacred site, possibly an altar. Site 137 is Pu'u Ku'ua Heiau, plotted on a ridge near Pu'u Ku'ua; it

Table 3. Previous archaeological work in Honouliuli and Pu'uloa

Author	Report Type	Location
Thrum 1906	Heiau study	Hawaiian Islands
McAllister 1933	All island survey	O'ahu Island
Kikuchi 1959	Site letter report	Barbers Point
Bowen and Soehren 1962	Burial Discovery	Barbers Point
Soehren 1964	Site letter report	Waimanalo Gulch
Lewis 1970	Reconnaissance survey	Barbers Point (harbor area)
McCoy 1972	Survey	Pu'uloa Elementary School Site
Hommon 1973	Survey and Excavations	Honouliuli
Barrera 1975	Reconnaissance survey	Barbers Point (harbor area)
Clark and Connolly 1975	Reconnaissance survey	Barbers Point (harbor area)
Oshima 1975	Reconnaissance survey	Barbers Point
Sinoto 1976	Cultural resources survey	Barbers Point (harbor area)
Bordner 1977a	Reconnaissance survey	Kalo'i Gulch
Bordner 1977b	Reconnaissance survey	Makaiwa Gulch
Clark 1977	Reconnaissance survey	Puu O Kapolei
Connolly and Clark 1977	Reconnaissance survey	Puu O Kapolei
Davis 1978	Scholarly paper	Barbers Point (harbor area)
Davis and Griffin 1978	Archaeological Survey	Barbers Point (harbor area)
Hawai'i Marine Research Inc. 1978	Geoarchaeological reconnaissance	Barbers Point (harbor area)
Kirch 1978	Land snail study	Barbers Point (harbor area)
Sinoto 1978a	Reconnaissance Survey and Burial Salvage	NAVMAG -West Loch
Sinoto 1978b	Archaeological & Paleontological salvage	Barbers Point (harbor area)
Barrera 1979	Archaeological Survey	West Beach
Clark 1979	Reconnaissance survey	Barbers Point (harbor area)
Cleghorn 1979	Reconnaissance survey	Barbers Point
Davis 1979a	Emergency excavations	Barbers Point (harbor area)
Davis 1979b	Emergency excavations	Barbers Point (harbor area)
Davis 1979c	Emergency excavations	Barbers Point (harbor area)
Jourdane 1979	Reconnaissance Survey	'Ewa Marina Community
Komori and Dye 1979	Archaeological testing	West Beach
Sinoto 1979	Cultural resources survey	Barbers Point (harbor area)
Ahlo 1980	Reconnaissance survey	Solid Waste Processing Facility
Davis 1980	Research design	Barbers Point
Kirch and Christensen 1980	Land snail study	Barbers Point (harbor area)
Christensen and Kirch 1981	Land snail study	Barbers Point (harbor area)
Hammatt and Folk 1981	Archaeological and Paleontological	Barbers Point (harbor area)
Davis 1982	Academic paper	Barbers Point
McCoy et al. 1982	Proposal for investigations	Barbers Point (harbor area)
Neller 1982	Scholarly study	Barbers Point
Ahlo and Hommon 1983	Reconnaissance survey	Barbers Point (harbor area)
Bordner and Silva 1983	Reconnaissance survey	Waimānalo Gulch
Davis 1983	Archaeological & Paleontological Excavations	Barbers Point
Ahlo and Hommon 1984	Test excavations	Barbers Point (harbor area)

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Author	Report Type	Location
Hammatt 1984a	Reconnaissance survey	Kahe Point
Hammatt 1984b	Reconnaissance survey	Ewa Marina Community
Haun and Kelly 1984	Research design	Naval Air Station
Tuggle 1984	Survey report	Naval Air Station
Barrera 1985	Survey report	West Beach
Neller 1985	Review and evaluation	West Beach
Barrera 1986	Archaeological Investigations	West Beach
Davis and Haun 1986	Intensive survey and test excavations	West Beach
Davis et al. 1986a, b	Research design	West Beach
Haun 1986a	Reconnaissance survey	Kapolei Town
Haun 1986b	Reconnaissance survey	Kapolei Town
Athens & Pietrusewsky 1987	Burial documentation	Iroquois Point
Davis and Haun 1987	Intensive survey & test excavations	West Beach
Dicks et al. 1987	Reconnaissance survey	West Loch
Rosendahl 1987a	Reconnaissance survey	Kapolei Town
Rosendahl 1987b	Reconnaissance survey	Ko Olina Resort
Rosendahl 1987c	Reconnaissance survey	West Loch
Rosendahl 1987d	Reconnaissance survey	Kapolei Golf Course
Welch 1987	Reconnaissance survey	Naval Air Station
Davis 1988a	Subsurface Survey	'Ewa Gentry
Davis 1988b	Reconnaissance survey	Barbers Point HECO
Kennedy 1988a	Reconnaissance survey	'Ewa Gentry
Kennedy 1988b	Field Report	Waiau-Campbell Industrial Park
Rosendahl 1988	Reconnaissance survey	Camp Malakole
Sinoto 1988a	Reconnaissance survey	'Ewa Golf Course
Sinoto 1988b	Reconnaissance survey	Makakilo Golf Course
Bath 1989a	Petroglyph study	Waimānalo Gulch
Bath 1989b	Burial documentation	Kahe
Bath 1989c	Burial documentation	West Loch – Hō'ae'ae Point
Burgett and Rosendahl 1989	Subsurface archaeological testing	North of O.R.&L.
Hammatt and Shideler 1989a	Archaeological assessment	Barbers Point (harbor area)
Hammatt and Shideler 1989b	Reconnaissance survey	Kahe Point
Carlson and Rosendahl 1990	Inventory survey	Kaomi Loop Subdivision
Cleghorn and Davis 1990	Archaeological and paleontological	Barbers Point (harbor area)
Collin and Kennedy 1990	Burial documentation	Pu'uloa Golf Course
Davis 1990a	Archaeological and paleontological study	Barbers Point (harbor area)
Davis 1990b	Archaeological and paleontological	Barbers Point (HECO area)
Davis et al. 1990	Survey and Test Excavations	Ewa Marina Community
Hammatt and Shideler 1990	Inventory survey	West Loch Bluffs
Hammatt, Robins, et al. 1990	Inventory survey	Makaiwa Hills
Hammatt, Shideler, et al. 1990	Inventory Survey	'Ewa Villages
Kawachi 1990	Inadvertent Burial find	Campbell Industrial Park
Miller 1990	Inadvertent Burial find	Barbers Point, Nimitz Beach
Rosendahl 1990a	Letter report	Kapolei Golf Course
Rosendahl 1990b	Archaeological Survey and Test Excavations	'Ewa Marina Community
Davis and Burtchard 1991	Inventory Survey	NAVMAG-West Loch
Dunn et al. 1991	Inventory Survey and Test Excavations	'Ewa Marina Community

Author	Report Type	Location
Folk 1991	Reconnaissance Survey	Kapolei Town
Goodman and Cleghorn 1991	Surface Survey	Laulani Fairways Housing
Kennedy 1991	Subsurface testing	Pu'u o Kapolei
Hammatt 1991	Reconnaissance Survey	Honouliuli Livestock Park
Hammatt and Shideler 1991a	Archaeological assessment	Barbers Point (harbor area)
Hammatt and Shideler 1991b	Inventory Survey	St. Francis Medical Center West
Haun et al. 1991	Survey report	Naval Air Station
Burgett and Rosendahl 1992	Inventory survey	Barbers Point (harbor area)
Charvet-Pond and Davis 1992	Data Recovery	West Beach
Cleghorn and Anderson 1992	Inventory survey	Kahe Point
Hammatt and Folk 1992	Subsurface testing	Barbers Point (harbor area)
Erkelens 1992	Archaeological survey	Naval Air Station
Folk 1992	Subsurface Testing	Barbers Point
Hammatt 1992	Inventory Survey	Palikea
Jayatilaka et al. 1992	Survey and Test Excavations	Hawai'i Prince Golf Course
Kennedy et al. 1992	Inventory Survey	Pu'uloa Golf Course
Shideler et al. 1992	Assessment	Kahe Point
Trembly et al. 1992	Burial documentation	West Beach
Davis 1993	Archaeological and paleontological	Barbers Point (harbor area)
Glidden et al. 1993	Data recovery excavations	Paradise Cove
Goodman et al. 1993	Reconnaissance Survey	20-acre Commercial Project
Jones 1993	Fossil coral reefs study (Ph.D. dissertation)	Hawaiian Islands
Landrum and Schilz 1993	Reconnaissance and subsurface testing	Naval Air Station
Miller et al. 1993	Data recovery	Barbers Point (harbor area)
Nakamura et al. 1993	Inventory survey	Makakilo
Pantaleo and Sinoto 1993	Inventory survey	Ewa Gentry
Hammatt and Shideler 1994	Archaeological assessment	Barbers Point (harbor area)
Hammatt et al. 1994	Inventory survey	Barbers Point (harbor area)
Tuggle 1994	Inventory survey	Barbers Point
Davis et al. 1995	Archaeological & Paleontological Investigations	Barbers Point (harbor area)
Dye 1995	Burial documentation	Barbers Point
Franklin 1995	Data Recovery	Ewa Marina Community
Hammatt and Shideler 1995	Data recovery plan	Barbers Point (harbor area)
Jourdane 1995	Burial documentation	Paradise Cove
Yoklavich et al. 1995	CRM Overview	Barbers Point
Corbin et al. 1996	Reconnaissance Survey	Laulaunui Island
O'Hare et al. 1996	Intensive survey and testing	Naval Air Station
Spear 1996	Archaeological Survey	Honouliuli Treatment Plant
Athens et al. 1997	Cultural resources, paleoenvironmental	'Ewa Plain: Naval Air Station
Schilz and Landrum 1996	Test Excavations	Barbers Point
Spear 1996	Reconnaissance Survey	Kapolei Town
Borthwick 1997	Assessment	Palehua, Honouliuli
Hammatt 1997	Inventory survey	Pu'uloa
Hammatt and Chiogioji 1997	Reconnaissance Survey	Corridor in Honouliuli
Jensen and Head 1997	Reconnaissance Survey	NAVMAG-West Loch
Tuggle 1997a	Cultural resource inventory	Naval Air Station
Tuggle 1997b	Synthesis	'Ewa Plain

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Author	Report Type	Location
Tuggle and Tomonari 1997a,b	Cultural resource inventory survey	Naval Air Station
Wickler and Tuggle 1997	Cultural resources, Inventory Survey	Naval Air Station
Wolforth and Wulzen 1997	Data Recovery	West Loch Estates
Wulzen and Rosendahl 1997	Data Recovery	Barbers Point Nimitz Beach
Goodfellow et al.	1998	West Loch
Hammatt and Shideler 1999	Inventory survey	Waimanalo Gulch
Magnuson 1999	Reconnaissance Survey	Farrington Hwy.
McDermott et al. 2000	Data recovery	Barbers Point (harbor area)
Elmore et al. 2001	Honouliuli	Pu'u Kapolei/Fort Barrette
Ostroff *et al.* 2001	Inventory survey	Pu'uokapolei
Tulchin et al. 2001	Inventory survey	'Ewa Shaft Renovation
McIntosh and Cleghorn 2003	Inventory survey	'Ewa Gentry Makai
Cordy and Hammatt 2003	Archaeological assessment	Barbers Point, North of O.R.&L.
O'Hare et al. 2005	Field Check	Kapolei Property
O'Hare et al. 2004	Documentation of Plantation Infrastructure	North of O.R.&L.
Terry et al. 2004	Archaeological Inventory Survey of Two	North of O.R.&L.
Hoffman et al. 2004	Archaeological inventory Survey	Between OR&L and Barbers Point

had been modified for use as a cattle pen; some areas had been cleared for pineapple cultivation or planted with ironwoods. Site 138 is Pu'u Kapolei Heiau, which had been on the *makai* side of the hill before it was destroyed. The stones of the structure had been crushed in a nearby rock crusher. McAllister was also told that there was once a cave on the hill, in which Kamapua'a and his grandmother lived (McAllister 1933:107-108).

The remaining eight sites recorded by McAllister are adjacent to Pearl Harbor or the coast. Site 139 is Kalanamaihiki Ko'a (fishing shrine) at Kapapapuhi Point (north of the current study area). McAllister described it as "two large rough stones about 2.5 feet in size, with six or seven smooth stones averaging 1 foot in size in a small pile adjoining the larger stones." Site 140 is a 4-5 acre fishpond on Laulaunui Island in West Loch, opposite Kapapapuhi Point. McAllister recorded the entire West Loch of Pearl Harbor as Site 141, Kaihuopala'ai. Although some versions of the legend of the traveling mullet (see Section 3.1, Mythological and Traditional Accounts) say that there was a fishpond called Kaihuopala'ai, McAllister recorded that local informants said there was never a fishpond by that name here; rather it was the name for the loch. Site 142 is Kapamuku, or Pamoku fishpond, a 3-acre fishpond, located south of the current study area, opposite the tip of Waipi'o peninsula. Site 143 is 'Oki'okiolepe fishpond, south of Loko Pamoku. The walls of this 6-acre fishpond were made of coral.

McAllister records Site 144 as the location of fish traps and a fishing shrine described by Stokes in his study of the fishtraps of Pearl Harbor. This is the location of the fishtraps Kapäkule (Päkule) and Kepo'okala, as described by Samuel Kamakau (1976:88). McAllister listed Site 145 as Pu'uloa, a legendary site where the first breadfruit was planted. It is not known whether Pu'uloa referred to is the '*ili* of Pu'uloa or the harbor of Pu'uloa, or an area within the '*ili* near the harbor. Site 146 covers the entire 'Ewa coral plain. This includes historic features, such as cattle walls and the walls near the Pu'uloa Salt Works, pre-Contact sites such as habitation,

agricultural, and fishpond sites recorded by early European explorers, and paleontological sites, where in recent years many fossil bird bones have been discovered (McAllister 1933:108-110).

Between McAllister's 1930s study and the flurry of work that began in 1969, there are only a few sporadic pieces of research, which are not well documented. In 1933, Dr. Kenneth P. Emory recorded a well-preserved house site and a possible *heiau* (later destroyed by sugar cane cultivation) in the western part of the coral plains (Sinoto 1976:1). In 1959, William Kikuchi removed a number of burials from a burial cave site (Bishop Museum Site OA-B6-10) at the Standard Oil Refinery, which was subsequently destroyed (Barrera 1975:1). Kikuchi recovered 12-16 incomplete primary and/or secondary burials cached in a sinkhole or crevice exposed during construction activities near the big bend in Malakole Road (Kikuchi 1959; Davis 1990b: 146, 147). In 1960, Yoshi Sinoto and Elspeth Sterling visited a house site (BPBM. Site OA-B6-8) within 'Ēkaha Nui Gulch. "Around this elevation (1200 feet), along the sides of the stream, were seen remains of many terraces and some house sites" (Sterling and Summers 1978:37). In 1962, Lloyd Soehren recorded another secondary human burial in a sinkhole at the Barbers Point Naval Air Station (Davis 1990a:147). In 1966, Lloyd Soehren carried out salvage excavations at a possible fishing shrine (BPBM. Site # 50-OA-B6-13). The site was reported as destroyed by construction (Barrera 1975:1), but Davis relocated the shrine and performed additional excavations in 1982 (Davis 1990a;148).

4.2 Previous Archaeological Work near Honouliuli town

Beginning in the late 1970s, archaeological research has been conducted in Honouliuli in the general vicinity of the present study area (Figure 24). Work has been focused on the West Loch Estates (east of the current project area), Pearl Harbor Naval Magazine (NAVMAG) – West Loch (east of the current project area), the 'Ewa Gentry project (south of the current study area), and 'Ewa Villages (south of the project area).

4.2.1 West Loch Estates

An archaeological reconnaissance survey (Rosendahl 1987c) was conducted in association with the development of the 232-acre "West Loch Estates" Residential Increments I and II (golf course and parks) project, which lies to the east of the present study area, in the section of the Honouliuli Taro lands adjacent to Pearl Harbor. This project covered portions of the old town of Honouliuli, the focus of population in the early historic period (and possibly earlier). This study identified a modern cemetery (Site 3319) with a remnant pre-Contact deposit, two historic sites of minimal integrity with some possible pre-Contact deposits (Site 3318 and 3320) at Kapapapuhi Point, a significant pre-Contact deposit with trash pits, fire pits and at least one human burial (Site 3321), a buried fishpond (Site 3322), an historic fishpond (Site 3323) built in the 1890s during the construction of the OR& L railroad, and a buried pond field system (Site 3324) (Rosendahl 1987c:7, 9). It was noted that some artifacts "indicate the possibility of pre-1900 occupation" (Rosendahl. 1987c:8). As noted in the final reconnaissance survey report (Dicks et al. 1987:28) for the surface and subsurface reconnaissance survey, an effort was also made to relocate McAllister's Site 139, Kalanamaihiki Ko'a (fishing shrine). The archaeologists

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Figure 24. U.S. Geological Survey topographic map, showing previous archaeological project areas near the current study area

found a small boathouse and dock in the area and concluded that the shrine had been destroyed since McAllister's survey in the 1930s.

A total of 21 radiocarbon dates were determined; at Site 3321, the cultural deposit, the age of a lower cultural deposit was dated to A.D. 540-880, while an upper deposit was dated to A.D. 1327-1640. For the buried fishpond (Site 3322), ages ranged from A.D. 70-610 in the lowest layer to A.D. 1160-1410 in the upper layer. For the buried pond field systems (Site 3324), ages ranged from B.C. 400-A.D. 240 (interpreted as the original surface of the upper valley) in the lowest layers to A.D. 1430-1952 in the upper layers of upper valley area and A.D. 1020-1280 in lower valley area. In summary, the authors (Dicks et al. 1987:78-79) concluded that agricultural use of the Honouliuli Stream floodplain for pondfield cultivation of taro may have begun in the lower valley segment as early as A.D. 1000, while cultivation of the upper valley pondfields may have begun as early as the thirteenth and fourteenth centuries. Site 3321in the upper valley may have been a habitation locus established as early as the mid-sixth to mid-ninth century (Wolforth et al. 1998).

In 1989, a burial was found on Ho'ae'ae Point (formerly called Papapuhi Point), when someone was digging under a mango tree on a residential property. There is no follow-up report (Bath 1989) to whether the bones were left in place or disinterred. The burial was given the site designation 50-80-13-4816.

4.2.2 NAVMAG – West Loch

In 1978, Sinoto conducted an archaeological reconnaissance survey on a 32-acre portion of NAVMAG-West Loch. A sinkhole 200 m inland and northwest of 'Oki'okiolepe Fishpond was found, containing ten human burials (Site 50-80-13-2310). Historic artifacts were found in the pit, enough to determine that the pit was probably used by the Chinese in the historic period as a family crypt (Sinoto 1978a).

Davis and Burtchard (1991) conducted an archaeological inventory survey of a 36-acre lot for a proposed housing area in the Pu'uloa portion of NAVMAG-West Loch in 1991. No archaeological sites were found. They concluded that extensive alteration to the landscape due to military land disturbance had erased all surface traces of pre-Contact habitation.

In 1992, a crew from Archaeological Consultants of Hawai'i, Inc. (ARCH) conducted an archaeological inventory survey with subsurface testing, and later data recovery at the proposed Pu'uloa Golf Course (Kennedy et al. 1992). A total of 72 sites were identified, 47 from the pre-Contact/early historic period and 25 sites associated with ranching, military training, and modern quarrying. Radiocarbon dates of these habitation, agricultural, and ceremonial sites indicate that traditional Hawaiian use extended from A.D. 1090 to 1695.

An overview survey of the NAVMAG Lualualei was completed by Ogden Environmental and Energy Services in 1977 (Landrum et al. 1977). A total of ten sites had been previously recorded in the West Loch project area, three in the Honouliuli section, one within Pearl Harbor (Site 140, Laulaunui Island), five on Waipi'o peninsula, one in both (salt works), and one encompassing all lands (Pearl Harbor Navy Base). In Honouliuli, the sites were Site 141, Kaihuopala'ai (West Loch), Site 142, Loko Pamoku or Kapamuku, Site 143, 'Oki'okiolepe Fishpond, and salt works at Honouliuli (no site designation). NAVMAG-West Loch is considered part of the Pearl Harbor Navy Base (Site 50-80-13-9992) due to its importance during World War II. The site was listed

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as a National Historic Landmark in 1966, on the National Register of Historic Places (NRHP) in 1966, on the State Inventory of Historic Places (SIHP), in 1971, and on the State Register of Historic Places in 1971 (Landrum et al. 1977:160).

In 1996, a crew from Paul H. Rosendahl, Ph.D., Inc. (PHRI) completed a Phase I archaeological reconnaissance survey of the 1,483 acres of land at the U.S. Naval Magazine – West Loch Branch (Jensen and Head 1997). This survey covered the southern section of Waipi'o peninsula on the east side of West Loch, Laulaunui Island, the Naval Reservation on the west side of West Loch, and the West Loch Outleased Cultivated Lands, which included the National Wildlife Refuge. Only 25% of the outleased lands were actually surveyed. The PHRI crew found that most of the outleased area had been bulldozed for sugarcane cultivation. Only a small strip adjacent to West Loch was unmodified. In the West Loch Outleased Lands, eight features were recorded; all but one was associated with military use of the area. The seven military sites consisted of six concrete slabs (Sites 50-80-13-5040, 5080, 5081, 5133, 5134), a metal container (5080), and a pressure tank (5133). The one non-military site (4971) was a cave with a partially blocked (blocked with roof fall) entrance that the crew members believed should be investigated in the future to see if it at one time was used as a pre-Contact or historic burial site (Jensen and Head 1997:85).

In 1996, a field reconnaissance of Laulaunui Island and fishpond was conducted by the State Historic Preservation Division (Corbin et al. 1996) to determine if restoration of the fishpond was possible and if the site would be a good candidate to be used as an educational tool. The crew simply walked to the island from the West Loch Waterfront Park; water depth varied from one to four ft. Five concrete structures, probably built by the military, were observed. The fishpond was surrounded by mangroves and was silted in; portions of a coral wall (about 500 ft long) around the pond were still intact, and a concrete gate allowed water to circulate into the pond.

4.2.3 'Ewa Villages

In 1990, Cultural Surveys Hawaii conducted an archaeological reconnaissance survey of a 616-acre area, which included three extant plantation villages, (Renton, Tenney, and Varona Village), the sites of three former plantation villages (C Village, Mill Village, Middle Village), and other sites associated with the 'Ewa Plantation infrastructure (Hammatt, Shideler, et al. 1990:i). The survey found no evidence of any pre-Contact activity within the project area and recommended further documentation of some of the ruined plantation structure sites.

In 1996, Scientific Consultant Services (Spear 1996) conducted an archaeological survey in an area west of the Tenney and Varona plantation villages and north of the Honouliuli Treatment Plant. No archaeological sites were identified.

4.2.4 'Ewa Gentry Project

In the initial reconnaissance (Kennedy 1988a) of the 1,016 acre 'Ewa Gentry project area, no surface evidence of potentially significant pre-Contact remains was found. The old OR&L railroad bed/right of way (Site 50-80-12-9714) did form a portion of the *mauka* boundary. According to historic maps, a Filipino Camp for sugarcane workers once existed near the

intersection of the OR&L bed and a cane road near Ft. Weaver Road, but the archaeologists could find no surface remains for this camp.

A subsequent subsurface exploration was undertaken. Eighteen backhoe trenches were excavated; however, "no evidence of past in situ cultural activity was found anywhere in the Ewa Gentry project area" (Davis 1988).

An inventory survey was conducted in 1993 by Aki Sinoto Consulting (ASC) (Pantaleo and Sinoto 1993) for the 'Ewa Gentry Off-Site Drainage System. This proposed drainage project area is a narrow strip that extends along the western boundary NAVMAG West Loch, and is adjacent to the southern non-contiguous parcel (TMK 9-1-010:002) for the current study. An 1897 map of Pearl Harbor indicated that the OR&L railroad, salt pans, and a fishpond were within this project area; only the railroad bed was found during the ASC survey. Iron flumes and concrete culverts (one with an inscribed date of July 1935) used for sugarcane irrigation were found bulldozed to the edge of the sugar cane fields near the dropoff to the shoreline of Pearl Harbor. These were not considered historically significant due to the absence of structural and locational integrity. No further archaeological work was recommended for this project prior to commencement of construction of the drainage system.

In 2003, Pacific Legacy (McIntosh and Cleghorn 2003) conducted an archaeological survey of the proposed 'Ewa Gentry Makai Development project area, which is adjacent to the southern (*makai*) boundary of the 'Ewa Gentry project area for the 1988 surface and subsurface inventory surveys (Kennedy 1988a; Davis 1988).

4.2.5 Previous Archaeology in the Current Project Area

As noted previously, and as discussed in more detail in the next section, a 546-acre portion of the current project area (the southeastern section) was previously surveyed in 1990 by a crew from Cultural Surveys Hawai'i. In 2005, a field assessment was conducted over the entire current project area by archaeologists from the firm Archaeological Consultants of the Pacific, Inc. (Elison and Kouneski 2005). The archaeologists found one "stone-faced hill" in the northern section of the project area (north of Farrington Highway), but did not describe it further. The report presents recommendations for field work in the different sections of the project area, concluding that the majority of the project area is farm land and did not need to be surveyed. Only the area around Honouliuli Gulch, and other areas of natural vegetation in the northern section needed to be surveyed.

4.3 Background Summary and Predictive Model

4.3.1 Honouliuli Settlement Patterns

The *ahupua'a* of Honouliuli is the largest traditional land unit on the island of O'ahu. Honouliuli includes all the land from the western boundary of Pearl Harbor (West Loch) westward to the 'Ewa/Wai'anae District Boundary with the exception of the west side of the harbor entrance, which is in the *ahupua'a* of Pu'uloa (the 'Ewa Beach/Iroquois Point area). This comprises approximately 12 miles of open coastline from One'ula westward to Pili O Kahe. The *ahupua'a* extends *mauka* (almost pie-shaped) from West Loch nearly to Schofield Barracks, and

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the western boundary is the Wai'anae Mountain crest running *makai* to the east ridge of Nānākuli Valley.

Not only is there a long coastline fronting the normally calm waters of leeward O'ahu, but there are also four miles of waterfront along West Loch. The land immediately *mauka* of the Pacific coast consists of a flat karstic raised limestone reef forming a level nearly featureless "desert" plain marked in pre-Contact times (previous to alluviation caused by sugar cultivation) by a thin or non-existent soil mantle. The microtopography is notable in containing countless sinkholes in some areas caused by chemical weathering (dissolution) of the limestone shelf.

Along the eastern flank of the Wai'anae Mountains, numerous gulches have contributed to the alluvial deposits over the coastal limestone shelf. The largest of the gulches is Honouliuli Gulch, which drains into West Loch. The gulches are generally steep-sided in the uplands and generally of a high gradient until they emerge onto the flat 'Ewa plain. The alluvium they have carried has spread out in delta fashion over the *mauka* portions of the plain, which comprises a dramatic depositional environment at the stream gradient change. These gulches are generally dry, but during seasonal Kona storms carry immense quantities of runoff onto the plain and into the ocean. As typical drainages in arid slopes they are either raging uncontrollably, or are dry and, as such, do not form stable water sources for traditional agriculture in their upper reaches. The Honouliuli gulches generally do not have valleys suitable for extensive irrigated agriculture; however, this lack is more than compensated for by the rich watered lowlands near West Loch.

Honouliuli Ahupua'a, as a traditional land unit, had abundant and varied resources available for exploitation by early Hawaiians. The "karstic desert" and marginal characterization of the limestone plain, which is the most readily visible terrain, does not do justice to the *ahupua'a* as a whole. The richness of this land unit is marked by the following available resources:

1) 12 miles of coastline with continuous shallow fringing reef, which offered rich marine resources.

2) Four miles of frontage on the waters of West Loch, which offered extensive fisheries (mullet, *awa*, shellfish), as well as frontage suitable for development of fishponds.

3) The lower portion of Honouliuli Valley in the 'Ewa plain offered rich level alluvial soils with plentiful water for irrigation from the stream as well as abundant springs. This land would have stretched well up the valley.

4) A broad limestone plain, which because of innumerable limestone sinkholes, offered a nesting home for a large population of avifauna. This resource may have been one of the early attractions to human settlement.

5) An extensive upland forest zone extending as much as 12 miles inland from the edge to the coastal plain. As Handy and Handy (1972:469) have pointed out, the forest was much more distant from the lowlands here than it was on the windward side, but on the leeward side was more extensive. Much of the upper reaches of the *ahupua'a* would have had species-diverse forest with *kukui*, *'ōhia*, sandalwood, *hau*, *ti*, banana, etc.

Within this natural setting, archaeological and traditional sources show a general pattern of three main areas of settlement within the *ahupua'a*: a coastal zone, the Honouliuli taro lands, and inland settlement at Pu'u Ku'ua.

4.3.2 The Coastal Zone - Kalaeloa (Barbers Point), Ko'ōlina (West Beach)

Kalaeloa (Barbers Point)

Archaeological research at Barbers Point has focused on the areas in and around the newly constructed Deep Draft Harbor (Barrera 1975; Davis and Griffin, 1978; Hammatt and Folk, 1981, McDermott et al. 2000). Series of small clustered shelters, enclosures and platforms show limited but recurrent use at the shoreline zone for marine-oriented exploitation. This settlement covers much of the shoreline with more concentrated features around small marshes and wet sinks. Immediately behind the shoreline, under a linear dune deposit, is a buried cultural layer believed to contain some of the earliest habitation evidence in the area.

The attraction of the area to early Hawaiians was the plentiful and easily exploited bird population. Particular evidence for taking of petrels occurs at Site -2763 (Hammatt and Folk, 197:213). Initial heavy exploitation of nesting seabirds and other species in conjunction with habitat destruction probably led to early extinction. There is some indication of limited agriculture in mulched sinkholes and limited soil areas. Considering rainfall, this activity would have been limited, but probably involved tree crops and roots (sweet potatoes). The archaeological content of the sites indicates a major focus on marine resources.

Davis and Griffin (1978) distinguish functional classes of sites, based on surface area size and argues that the Barbers Point settlement consists of functionally integrated multi-household residence groups. Density contours of midden (by weight) and artifacts (by numbers) plotted for residence sites by Hammatt and Folk (1981) generally indicate narrowly defined spatial foci of discard, possibly indicating continuous use, or at least with no refurbishing or additions to the structures through time (Hammatt and Folk 1981). The focus is small habitation sites, typically lacking the full range of features found in large permanent residence complexes such as high platforms, complex enclosures, and ceremonial sites.

Ko'ōlina (West Beach)

There are three available studies on the Ko'ōlina project area (Davis et a. 1986a; Davis et al. 1986b; and Davis and Haun 1987).

Davis documents around 180 component features at 48 sites and site complexes consisting of habitation sites, gardening areas, and human burials. Chronologically the occupation covers the entire span of Hawaiian settlement, in what Davis and Haun describe as "one of the longest local sequences in Hawaiian prehistory" (Davis and Haun 1987:37). The earliest part of the sequence relates to the discovery of an inland marsh, and early dates were also obtained for the beachfront site and an inland rock shelter.

4.3.3 Honouliuli Taro Lands

Centered around the west side of Pearl Harbor at Honouliuli Stream and its broad outlet into the West Loch are the rich irrigated lands of the *'ili* of Honouliuli, which give the *ahupua'a* its name. The major archaeological reference to this area is Dicks, Haun, and Rosendahl (1987) who

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documented remnants of a once-widespread wetland system (*lo'i* and fishponds) as well as dryland cultivation of the adjacent slopes. The current study area is within this environmental zone.

The area bordering West Loch was clearly a major focus of population within the Hawaiian Islands, and this was a logical response to the abundance of fish and shellfish resources in close proximity to a wide expanse of well-irrigated bottomland suitable for wetland taro cultivation. The earliest detailed map (Malden 1825) shows all the roads of southwest O'ahu coalescing and descending the *pali* (cliff) as they funnel into the locality (i.e. Honouliuli Village). Dicks et al. (1987:78-79) conclude, on the basis of 19 carbon isotope dates and 3 volcanic glass dates that "Agricultural use of the area spans over 1,000 years." Undoubtedly, Honouliuli was a locus of habitation for thousands of Hawaiians. Pre-Contact population estimates are a matter of some debate but it is worth pointing out that in the earliest mission census (Schmitt 1973:19) 1831-1832, the land (*'āina*) of Honouliuli contained 1026 men, women, and children. It is not clear whether this population relates to Honouliuli Village or the entire *ahupua'a*, but the village probably contained the vast majority of the district's population. The nature of the reported population structure for Honouliuli (less than 20% children under 12 years of age) and the fact that the population decreased more than 15% in the next 4 years (Schmitt 1973:22) suggests that the prehistoric population of Honouliuli Village may well have been significantly greater than it was in 1831-1832. A conservative estimate would be that tens of thousands of Hawaiians lived and died at Honouliuli Village.

4.3.4 Pu'uku'ua: Inland Settlement

Documentation of inland settlement in Honouliuli Ahupua'a is more problematic in that there are relatively few documented archaeological sources. However, it is probable that the area around Pu'uku'ua, on the east side of the Wai'anae Ridge seven miles inland of the coast, was a Hawaiian place of some importance.

In 1899, Hawaiian Newspaper *Ka Loea Kālai'āina* relates a story of Pu'uku'ua as "a place where chiefs lived in ancient times" and a "battle field," "thickly populated." The article summarizes:

> There were two important things concerning this place. (1) This place was entirely deserted and left uninhabited and it seems that this happened before the coming of righteousness to Hawai'i Nei. Not an inhabitant is left. (2) The descendants of the people of this place were so mixed that they were all of one class. Here the gods became tired and returned to Kahiki [*Ka Loea Kālai'āina*, July 8, 1899, translated in Sterling and Summers 1978:33].

McAllister recorded three sites in this area, two *heiau* (134, 137) (Pu'u Kuina and Pu'uku'ua, both destroyed) and a series of enclosures in Kukuilua which he called "kuleana sites" (McAllister 1933). On the opposite side of the Wai'anae range, along the trail to Pōhākea Pass, Cordy (2002:36) states "Kākuihihewa was said to have built (or rebuilt) Nōi'ula, a *pō'okanaka heiau* (1,300 sq. m.) in Hālona in upper Lualualei, along the trail to Pōhākea Pass leading into 'Ewa, ca. A.D. 1640-1660" (Cordy 2002:36). There is no direct archaeological evidence available to the authors' knowledge that intensive Hawaiian settlement occurred here, but it is considered as a place of high probability, based on the above indications. John Papa 'Ī'ī (1959)

described a journey that Liholiho took which led him and an entourage through inland Honouliuli and over Pōhākea Pass. Geographically, the area receives sufficient quantities of water and would have had abundant locally available forest resources.

4.3.5 Summary

On the basis of archaeological studies, informed by historic records, the following may be concluded:

1) There are three areas of Hawaiian settlement in the *ahupua'a*; two are well-documented and one is problematic:
   a. the extensive limestone plain with recurrent use habitations for fishermen and gatherers and sometime gardeners;
   b. the rich cultivated lands of Honouliuli 'ili for extensive wetland taro and clearly the *ahupua'a* population center; and,
   c. the uplands around Pu'uku'ua associated with *kauwā* residence but probably used for agriculture and forest resources.

2) Honouliuli is designed as a unit to contain all the geographic elements of a typical Hawaiian valley *ahupua'a*, except they are arranged geomorphically in an atypical relationship. The *ahupua'a* is not organized around a single drainage network but shares the west portions of Waikele drainage in its upper reaches. A typical and highly advantageous characteristic for human subsistence is included in a vast coastline and fringing reef, an extensive limestone plain which would support only limited agriculture but would be excellent for bird catching in early times, and a huge expanse of sloping forest land. The richest forest land for foraging for wood, birds, feathers, etc. would have been the east slope of the Wai'anae Range. The surveys by Bordner (1983) and Hammatt and Shideler (1999) at Waimānalo Gulch indicated no evidence of Hawaiian occupation, but the gulch has been impacted in modern times (Bordner 1983).

3) The *makai* slope was not a major thoroughfare. We can see some very limited evidence of part-time agriculture in and around gulches and two foci of sparse habitation. The first is limited to *makai* portions of gulches and lava flats. This habitation is considered a *mauka* component or continuing of the Ko'olina coastal settlement rather than an independent focus. The second focus, separated from the first by a barren zone, is generally above the 800-foot elevation. This *mauka* habitation which could have been supported by seasonal dry land planting and forest foraging may be the lower portion of a thinly scattered, but widespread zone of settlement which stretches eastward and northeast along the east Wai'anae Range slopes and may increase in intensity along the more watered lands forming the *mauka* western boundary of Honouliuli.

4) There is to date no archaeological evidence of high status residence in Honouliuli. Large residential structures are not present along the Pacific shoreline where they would be expected. The late prehistoric occurrence of chiefs' houses is not apparent, perhaps because the ocean shoreline, although rich in marine resources, is uninviting for sport and

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unsuitable for fishponds. The chiefly focus of 'Ewa District was Waipi'o. Whatever activities of this class occurred in Honouliuli would have been in or near the rich lands fronting West Loch (the *'ili* of Honouliuli). Concerning status associations with Honouliuli, it is interesting to note the connection of the Pu'uku'ua settlement with slaves (*kauwā*), the lowest class of Hawaiians (Sterling and Summers 1978:33).

5) The focus of population and agriculture within the *ahupua'a* of Honouliuli was the *'ili* of Honouliuli. There is good reason to assume, given the lack of intensive agricultural resources in other prehistoric times, all other habitation zones were economically and socially co-dependent.

Section 5 Results of Fieldwork

5.1 1990 Survey Findings of the West Loch Bluffs Project Area

In 1990, the southeastern portion of the project area (a 546-acre parcel south of Farrington Highway then called West Loch Bluffs) was surveyed by CSH members (Hammatt and Shideler 1990). Five sites were recorded and given SIHP permanent site numbers (Figures 25-29). In addition, four areas of historical importance were researched. For the recent survey, these five previously identified sites were revisited and notes were made on their current condition. In addition, during the recent inventory survey, backhoe testing was conducted in the four areas identified in the 1990 CSH report as possibly containing important historical deposits or artifacts. Table 4 summarizes the findings of the 1990 survey and Figure 25 shows the location of sites and historically documented areas from the 1990 CSH survey.

Table 4. Sites Previously Identified during the 1990 CSH survey

SIHP 50-80-12-	Description	Function	Age
4344	Plantation infrastructure; 3 pipe features (destroyed sometime between 1990 and 2005)	Sugar cane cultivation and irrigation	Ewa and Oahu Plantation operated from 1890 to 1995
4345	Stone-faced Berm	Ewa Plantation Railroad Berm	The Ewa Plantation Railroad operated from 1890 to 1947
4346	Stone-lined Well & Associated Features	Pumping Station (Northern)	Pre-1928 to present
4347	Stone-lined Well & Associated Features	Pumping Station (Central)	Pre-1928 to present
4348	Stone-lined Well & Associated Features	Pumping Station (Southern)	ca. 1928 to present
No SIHP numbers were assigned to the next four areas since there were no surface remains			
	Land Court Awards (LCAs) in Honouliuli Taro Lands	Habitation and Agriculture	Documented in 1848; surviving to at least 1890 (founding of Ewa Plantation)
	Kapalani Catholic Church	Church, School, Residence; possibly cemetery	Built between 1840 and 1847 and destroyed between 1885 and 1890
	PipeLine Village	Plantation Camp for Portuguese and Puerto Rican workers; also a school and church	Some houses possibly built in 1890; main construction phase of 162 houses from 1906 to 1911; demolished in 1931
	Drivers and Stable Villages	Plantation Camp	Drivers Village probably built between 1900 and 1910; it was moved to a new location (outside the project area) in 1931; Stable Village seems to have consisted of only four houses

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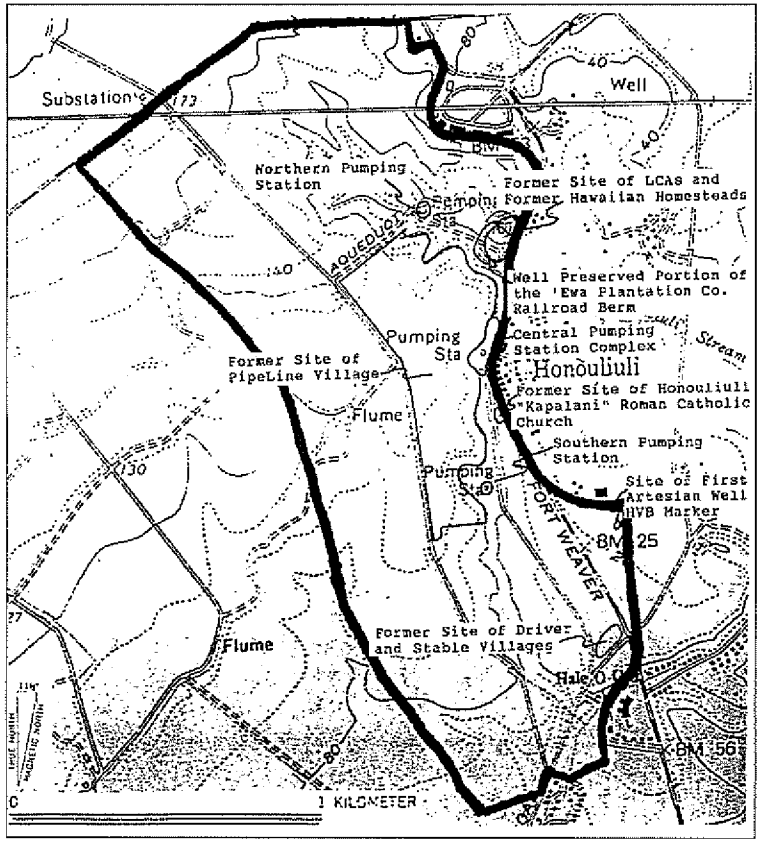

Figure 25. Map of sites and historically documented areas of interest identified during the 1990 CSH survey of a 546-acre parcel of the current project area

Figure 26. Site 50-80-12-4345, Stone-faced berm for Ewa Plantation railroad, view to the north

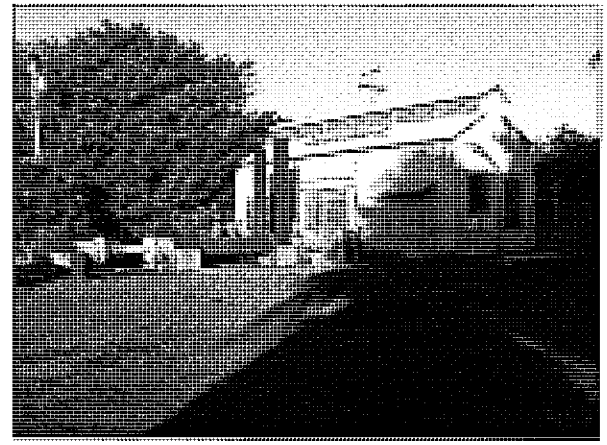

Figure 27. Site 50-80-12-4346, northern pumping station, view to the northwest

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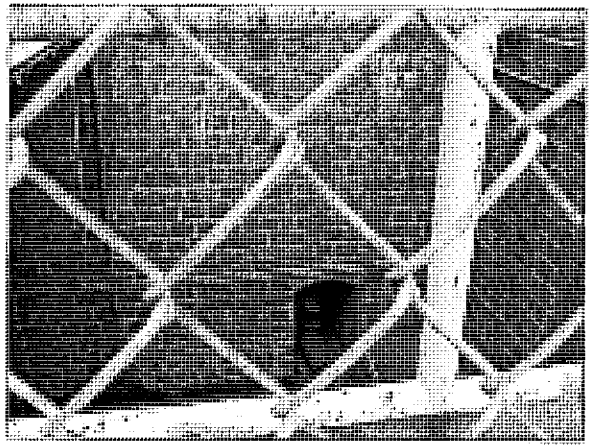

Figure 28. Site 50-80-12-4347, well wall of central pumping station, view to the north

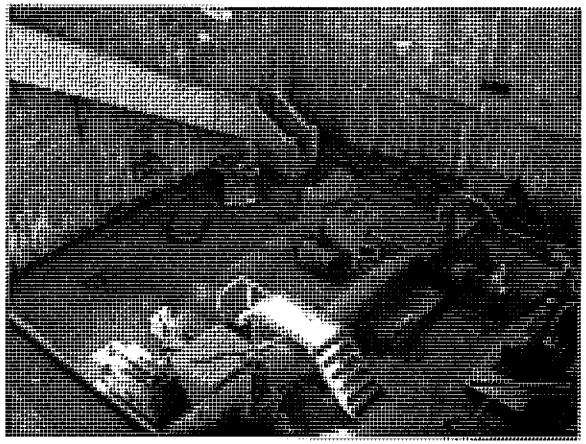

Figure 29. Site 50-80-12-4348, interior well of southern pumping station, view to the west

5.1.1 Sites Recorded during the 1990 Survey

There are three pumping stations within the project area, all which feature rectangular stone faced pits 9 m deep. The northern two (but not the southern one) appear on the 1927/28 USGS map. The southern one was built before 1946. A photo (Bishop Museum Visual Collection) dated 1923 shows what appears to be a brand new "Riedlier Steam Pump Driven by Triple Expansion Corlis Engine" in one of these large stone-faced rectangular wells.

An important part of life within the camps of the project area was the Ewa Plantation Company Railroad, which operated from 1890-1947. Near its peak in 1931, the Plantation Railway system included 18.95 miles of 36" gauge permanent track, 8 miles of portable track, seven oil-burning Baldwin locomotives, and 705 cars (Conde and Best 1974:283). Permanent rail lines ran from the southwest to the northeast up through the middle of the project area along the present can-haul road alignment and also near the eastern margin of the project area. In 1947, the rails were sold for scrap.

During the subsequent decades of the twentieth century, sugar cane operations in 'Ewa phased out and, more recently, former cane lands have been rezoned for residential development. Structures in the area of the former plantation villages have fallen into disrepair or have been demolished. However, portions of the area - including Varona Village, Tenney Village, and Renton Village - have been designated the 'Ewa Villages Historic District (State site 50-80-12-9786), which has been nominated for National Historic Landmark status. Additionally, the still-extant OR&L rail line through Honouliuli has been placed on the National Register of Historic Places (Site 50-80-12-9714).

5.1.1.1 Ewa Plantation Infrastructure (Site 50-80-12-4344)

In the immediate vicinity of the site of Drivers and Stable Villages, the 1990 CSH survey found three iron pipe features, including a tall metal post and two welded pipe constructions. These were collectively given SIHP number 50-80-12-4344, because they were tangible features, which by appearance and location, appeared to be more than 50 years old. The significance of these constructions is thought to exist only in so far as further determination of their age and function elucidate out record of Ewa Plantation life. During the recent CSH 2005 inventory survey, these features could not be refound; the area of their former location had been bulldozed and they had been destroyed.

5.1.1.2 Ewa Plantation Railroad (Site 50-80-12-4345)

The Ewa Plantation Co. ran a private railroad for the primary purpose of hauling cane; it included nearly 30 miles of permanent track. The railroad operated from 1890 to 1947, but most of the permanent track was in place by 1910 (Conde and Best 1973:280). It has been the policy of the Historic Sites section of the SHPD to encourage the retention of particularly good section of railroad berm. While many kilometers of permanent track ran through the project area, a particularly good example is only to be found in the northeastern portion of the project area in the mouth of the dry stream valley, in the traditional *'ili* of Maui. This stretch of the Ewa Plantation Railway was given SIHP number 50-80-12-4345. The railroad berm on either side of the valley access road features well-preserved facings commonly 2 m high. It is recommended that if the railroad berm in this area can be incorporated into development plans and preserved,

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that this be done. If development plans require the demolition of a portion of this stretch of railroad berm then mitigation should be worked out with the State Historic Preservation Office in advance.

5.1.1.3 Ewa Plantation Pumping Stations (Sites 50-80-12–4346, -4347, and- 4348)

There are three pumping stations within the project area, all of which feature a deep rectangular basalt block, faced wall. The northern two (Sites -4346 and –4347) are thought to pre-date 1928 and the southern well (Site –4348) is thought to date to shortly thereafter. All three are still extant in the project area. The wells are very impressive structures and are of particular importance to the history of 'Ewa. It is recommended that these wells be preserved. If these wells are deemed a hazard or these area are required by development plants, it might be possible to fill, mark, and cover the wells. All three of the site designations for these wells include adjacent structures. In the case of the northernmost (Site –4346) and the southernmost (Site –4348) wells, the adjacent structure is limited to a single pump house, which has an exterior or corrugated sheet metal panel construction. Evaluation of possible historic significance of these structures is beyond our area of expertise, and it is recommended that issues of significance and proper historic documentation be resolved with the SHPD office in advance of any development of these areas to avoid adverse impacts.

The case of the Central Pump house (Site –4347) is more complicated, in that there are eight features related to the well. In addition, there are a number of small architectural and/or industrial features in the immediate vicinity of the well. In some cases, the age and exact function of these features in unclear. We recommend preservation of at least portions of this site. The significance of the area of Site –4347 would be evaluated after an assessment of the significance of its architectural features and the assessment of the significance of the Ewa Village area. If development of this area is desired, mitigation should be discussed with the SHPD Office.

5.1.2 Historically Documented Areas Identified during the West Loch Bluffs Project

Background research for the West Loch Bluffs report (Hammatt and Shideler 1990) also highlighted four other areas of concern:

5.1.2.1 Hawaiian Land Court Awards in the Honouliuli Taro Lands

An area along the northern portion of Old Fort Weaver Road that was once called the '*ili* of Maui. It contained house sites and taro patches tended by native Hawaiians, according to 1848 Māhele LCA testimony.

A house site (belonging to Pue) is shown on Monsarrat's map of 1878, and the presence of several more house sites in this area is clearly indicated in land records circa 1848. It seems very likely that any stones from pre-contact or early historic foundations would have been removed to facilitate cane cultivation and possibly for used in the construction of the adjacent Ewa Plantation railway berm. Is seems highly probably that plowing associated with pre-drip irrigation cane cultivation has badly disturbed sediments to a depth of nearly a meter (36 inches). However, it was thought possible that slope wash from induced erosion had sealed and protected these deposits and had thus insulated these deposits from the impact of subsequent plowing.

There many be intact gravels or other cultural deposits associated with this area. Thus it was recommended in the 1990 survey report that subsurface testing take place in this area before development.

5.1.2.2 Kapalani Catholic Church

There is an area along the southern portion of Old Fort Weaver Road that once had a Roman Catholic Church, shown on the Monsarrat map of 1878 as a fenced area enclosing three structures believed to include a church, a school, and a residence. This church (Kapalani Church) was built between 1840 and 1847 and is believed to have been destroyed between 1885 and 1890. From old survey maps, it appears that part or all of the site of the church structure is directly under Old Fort Weaver Road. However, this area is still of archaeological concern for its association with an important person in the history of Hawai'i and because there may be associated historic graves.

It seems highly probable that the Honouliuli Roman Catholic church site within the project area was a major focus of the life of Kahoaliikunaiewakamoku Kepelino (Zepherino) Keauokalani, who is best known by the name Kepelino. Kepelino was a major historian and the author of four fascicles that appeared from 1858-1860, called Hooiliili Hawaii "Hawaiian Collection" and his Mo'olelo Hawaii "Traditions of Hawaii" in 1868 (Valeri 1985:xxv-xxvi). He is of particular importance because he came from a family of high priests, he was a grandson of Kamehameha, he was Queens Emma's secretary, and he was the only major Hawaiian historic of the time who was not a pupil of the Lahainaluna School. Letters to Catholic newspapers dated 1860-1869, under the name Z. Kahoali'i place him in Honouliuli, and it seems probable that he lived in Honouliuli from 1851 into the 1870s. As he was known as an ardent Catholic and a school teacher, it seems likely that he taught for many years at the school within the Roman Catholic Church compound at Honouliuli (now covered by Old Fort Weaver Road).

Another issue regarding the Roman Catholic Church site area is that of graves. A history of the Roman Catholic Church in Hawai'i (Schoofs 1978:110) reports that, after the abandonment of the church, "in 1891 Honouliuli was still important enough to acquire its own Catholic cemetery." We know of only on Roman Catholic Church property in Honouliuli, and that is the church property within and adjacent to the project area. It is possible, therefore, that this cemetery was adjacent or on these church grounds. While the site of the Honouliuli church has been under sugar cane cultivation for many decades, the 36-inch plow zone many not have disturbed any historic interments, if present. Because no trace of this church was found on the surface during the CSH 1990 survey, no site number was given, however, additional background research into this church and subsurface backhoe testing before any development was recommended (Hammatt and Shideler 1990:55).

5.1.2.3 Ewa Plantation PipeLine Village

PipeLine Village was a substantial community including 162 houses (some duplexes), a school, and a church. PipeLine Village was also known as Spanish Camp because its residents were largely of Puerto Rican and Portuguese ancestry. Most of the structures in PipeLine Village are believed to have been built between 1906 and 1911, but it seems highly probably that there were a few older structures, possibly including some of the oldest structures of Ewa Plantation, dating to 1890. The village is believed to have been completely demolished in 1931.

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All of the many photos of PipeLine Village houses (Figure 30, Figure 31, Figure 32, and Figure 33) show house foundations consisting of wood posts resting on small light colored blocks (tofu block construction). Thus, there would be virtually no trace of a building footprint after the building was dismantled. The only archaeological remains associated with this village that would be likely to survive 60 years of subsequent cane cultivation would probably be related to the privies, which were typically detached outhouses. If these were pit privies, there should be more than 160 discernible pits with associated durable artifacts, which might include bottles, coins, and personal effects. Some plantation privies had detachable compartments, which would be periodically emptied. If this type of privy was utilized, there would probably be no trace left. It is believed that refuse collection was highly organized by the plantation from early times and this disposal was outside of the present project area. There could however, be small trash pits.

The Ewa Plantation Company Annual Report for 1923 states that "coral roads were laid through villages" and it may well be that the grid of streets shown on the 1928 USGS map could be determined on the ground once the cane was cleared. There are also photos of Portuguese bread ovens (*forno*), which appear to be constructed of brick and plaster, but these were probably all demolished and completely removed. There may have been building slabs or other more durable features to the schoolhouse and church, but there are believed to have been bulldozed as well. It is anticipated that with the possible exception of privy pits and associated artifacts, that the thoroughness of demolition, the light nature of construction, and the sixty years of continuous cane cultivation would have removed almost all other traces of PipeLine Village.

Subsurface reconnaissance of the site of PipeLine Village was recommend in this area for the purpose of gaining further data regarding the layout of the village and for the recovery of artifacts, which might be useful in the study of ethnicity and the interpretation of Ewa Plantation village life. In the absence of any identifiable intact surface cultural features, no site number during the 1990 CSH survey was given to the former site of PipeLine Village.

5.1.2.4 Drivers and Stable Villages

Drivers Village and Stable Village were small communities previously located in the southeastern corner of the project area. Little is known about these villages. A 1931 Ewa Plantation Report states "The Drivers Village, located near the main stables was in such a bad location that it was decided to move all the fourteen cottages . . ." It seems highly probable that Drivers Village consisted of the fourteen structures shown on the 1928 map, that it was constructed between 1900 and 1910 and that it was moved in 1931. Stable Village seems to refer to the few structures just across the street to the south. As with PipeLine Village, the 1990 CSH report recommended reconnaissance after the removal of sugar cane and subsurface testing for the purpose of gaining further data regarding the layout of the village and the recovery of artifacts, which might be useful in the study of ethnicity and in the interpretation of Ewa Plantation village life. No site number were assigned to these village in the absence of any tangible clearly-related remains.

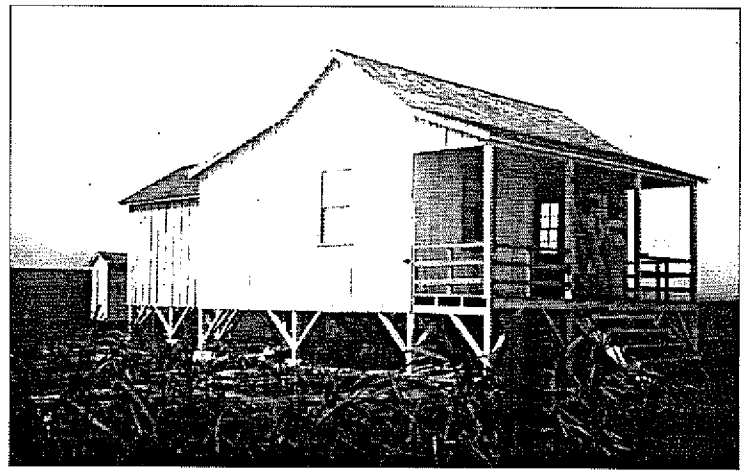

Figure 30. 1907 photograph of residence at PipeLine Village

Figure 31. Undated photo of PipeLine Village, showing rows of houses

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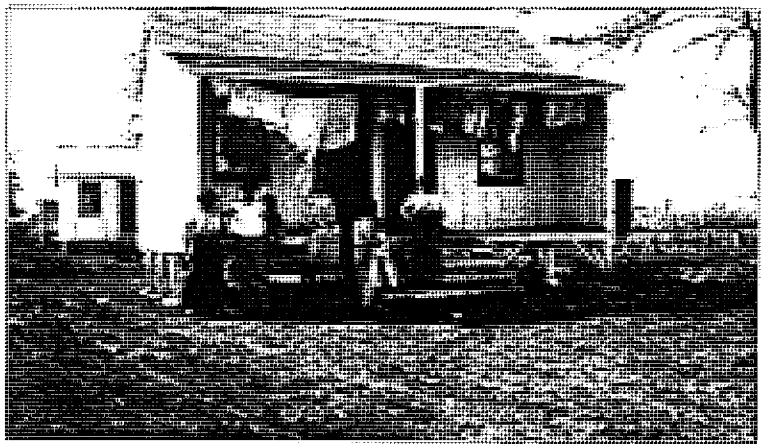

Figure 32. 1910 photograph of Puerto Rican family in PipeLine Village

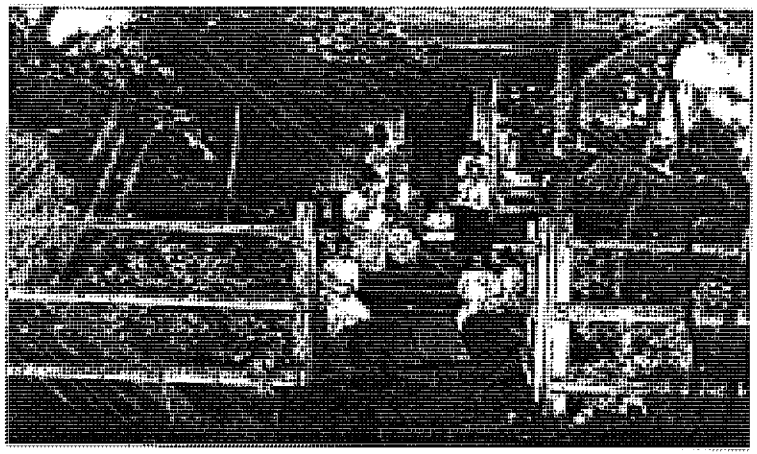

Figure 33. 1907 photograph of Portuguese family at PipeLine Village

5.2 2005 Surface Inventory Survey Findings

A surface pedestrian survey was conducted in the main project area on November 21 and 22, 2005 and January 13, 2006. Approximately 75% of the project area consists of plowed fields with low vegetation (pumpkins, squash and other ground vegetables). All roads surrounding these plowed fields were surveyed by car or by foot. In the southwestern section of the project area (south of Farrington Highway), only a linear corridor along an irrigation ditch had some (natural) weedy vegetation. This area was surveyed by foot. The southeastern section of the project area is a 546-acre parcel that was previously surveyed by CSH in 1990. Those areas with previously identified sites and areas selected for backhoe testing were revisited and additional notes were taken on the present condition of sites and areas. In the northern section of the project area (between I H-1 and Farrington Highway), larger sections of the project area were traversed on foot. Both banks of the Honouliuli Gulch were surveyed, the entire project area east of the gulch was surveyed, and a small weedy area in the northwestern corner of the project area was surveyed. The remaining portions of the main project area are plowed fields planted in crops or land covered with farm buildings.

Two non-contiguous parcels were surveyed by foot on January 13, 2006. The southern parcel (TMK 9-1-010:002) consisted of a triangular area bounded by a residential area, the West Loch Estates, on the west and Plantation Road on the west and south. The east side is bounded by the proposed Ewa Gentry Drainage Ditch, which was surveyed in 1993 (Sinoto and Pantaleo 1993). It is bisected by Arizona Road. The section south of Arizona Road is plowed fields; the northern section is covered with low grass and *koa haole* trees; the ground is extremely hummocky, as if it has been recently bulldozed (see Figure 5). Based on historic maps, Sinoto and Pantaleo (1993) thought they might find the remains of a portion of the OR&L track and sugar cane irrigation flumes in their project area. They found part of the OR&L roadbed berm, and also found the remains of metal flumes and concrete culverts, but these had been bulldozed into piles near the West Loch shoreline. These remains were not considered significant due to the absence of structural and locational integrity. During the recent CSH survey of the area, only a few concrete culverts, bulldozed into a ditch along the western border of the parcel, were found. The northern non-contiguous parcel (TMK 9-2-001:001) surrounds a reservoir north of the H-1 Interstate. This area has also been extensively bulldozed; the reservoir has been filled (is level with the surrounding ground) and a berm has been constructed around the former rim. There were no structural remains found in this area.

Four new features were recently identified in the project area. All four were found in the northern portion of the main project area along Honouliuli Gulch (Figure 34 and Figure 35). During the 1990 inventory survey of the West Loch Bluffs (southeastern 546-acre parcel), three sugar cane plantation infrastructure features (three pipe features) were grouped into Site 50-80-12-4344. Since all four new features found during the recent 2005 inventory survey are also related to sugar cane plantation infrastructure, these features have been subsumed into the same site designation. In this portion of the project area, Honouliuli Stream extends generally from the northwest to the southeast, but one portion is oriented east-west.

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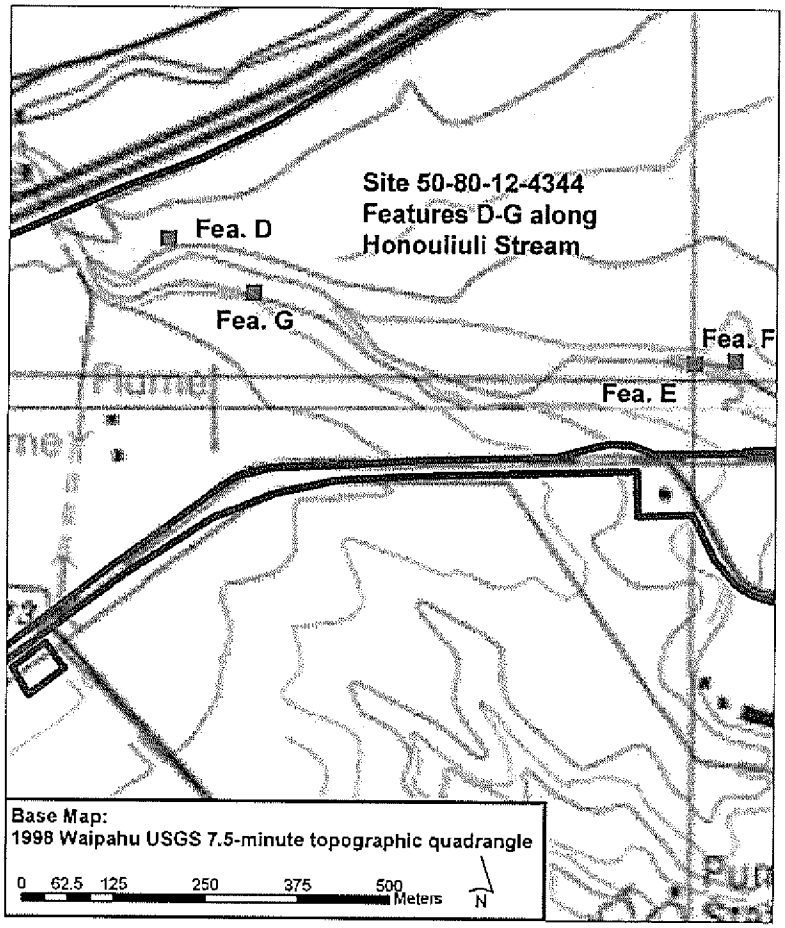

Figure 34. US Geological Survey map, showing location of Features D-F of Site 50-80-12-4344 along Honouliuli Stream

Figure 35. Typical vegetation in Honouliuli Gulch, view to the south

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Site 50-80-12-4344, Features D-G

Feature D is a linear wall built against (parallel) to the east (or north) bank of Honouliuli Gulch (Figure 36 and Figure 37). It is 16 m long, 90 cm wide, 1.1 m high, and is oriented at a 77/277° angle. The wall is at the rim of the gulch. It is constructed of subangular basalt cobbles and boulders, 30-60 cm in diameter, stacked five to six courses high. One side abuts the gulch rim and the other side is faced; in some cases, the rocks have been split with metal tools, so that the outer side has a vertical face. Based on the location and construction, the wall functioned for erosion control.

Feature E is a linear wall on the west (or south) bank of Honouliuli Stream (Figure 38 and Figure 39). It is built perpendicular to the orientation of the gulch and is built on a slightly sloping terrace area near the top rim of the gulch. The wall is 4.5 m high, 55 cm wide, and 50 cm high. It is a core-filled wall, with basalt boulders 30-60 cm in diameter on the sides, and smaller cobbles in the interior. The function is unknown, but core-filled walls are usually historic in age. Its location near Honouliuli Gulch suggests it functioned for water or erosion control.

Feature F is a stone-faced berm on the west (south) bank of Honouliuli Stream at the top of the gulch rim (Figure 40 and Figure 41). It is constructed perpendicular to the orientation of the stream. The berm is faced with stones (some cut with metal tools to make a vertical face) on the northern side, stacked 6 to 8 courses high. The wall is not vertical, but slopes outward at the base. The construction is somewhat unusual in that the largest stones (up to 70 cm in diameter) are placed in the middle courses, not at the base, as is usual. The top of the berm is not particularly even and slopes down towards the gulch. The construction of this berm suggests it was constructed as some type of loading area, so that some type of vehicle could be parked or structure could be constructed on top of the berm, possible for loading or storing sugar cane or water.

Feature G consists of a concrete ditch and a concrete masonry catchment basement on the west (or south) bank of Honouliuli Gulch (Figure 42 and Figure 43). A metal pipe at the base of the flume and basin extends underground towards Honouliuli Gulch down a 45° slope at a due north/south orientation. The ditch is rectangular and 5.5 m long, 40 cm wide and 30 cm deep. The top of the ditch is covered with concrete slab lids, 90 cm long, 40 cm wide and 7 cm thick. The ditch itself is made with separate Waialua-type modal concrete units, which were made at the Ewa Plantation for their irrigation projects. The basin is C-shaped, constructed of rocks and mortar. The basin is 1.35 m long north/south, 1.3 m wide, 90 cm deep, with walls 28 cm thick. The outer side has an inset area that may once have had some type of sign or plaque. The ditch was used for irrigation or water control by the Ewa Plantation Company.

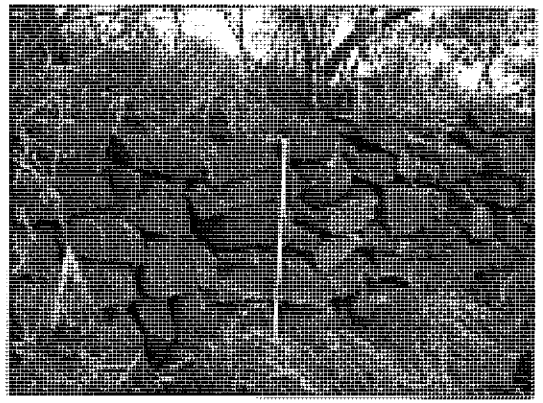

Figure 36. Feature D, Linear Wall abutting gulch rim, view to the north (upslope)

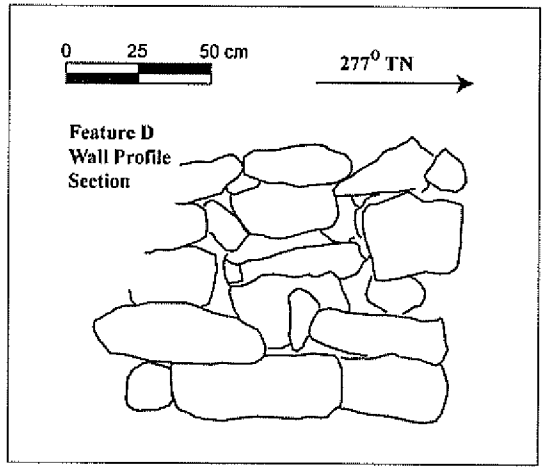

Figure 37. Feature D, Linear Wall, profile of 1.0 meter section

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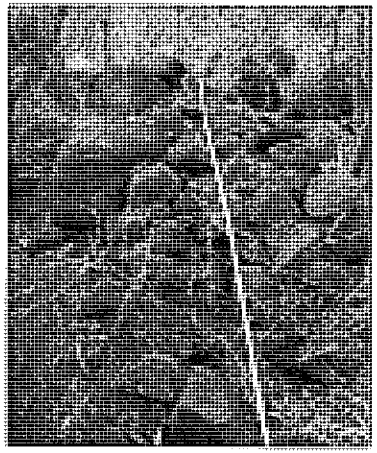

Figure 38. Feature E, Linear Wall, built perpendicular to orientation of Honouliuli Gulch, view to the east (upslope)

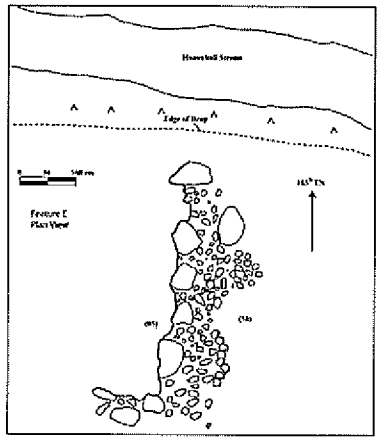

Figure 39. Feature E, Linear Wall, plan view

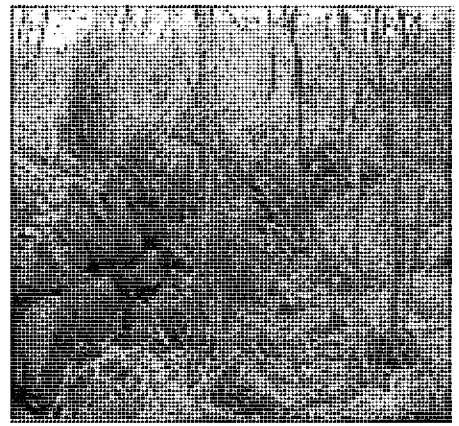

Figure 40. Feature F, Stone-faced berm, built perpendicular to orientation of Honouliuli Stream, view to the west (downlsope)

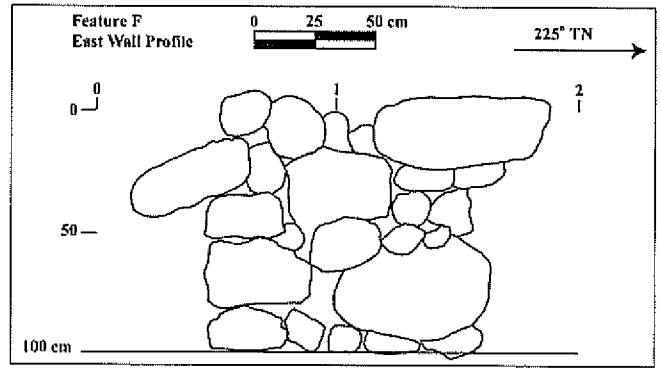

Figure 41. Feature F, Linear Wall of Berm, profile of 1.0 m faced wall section

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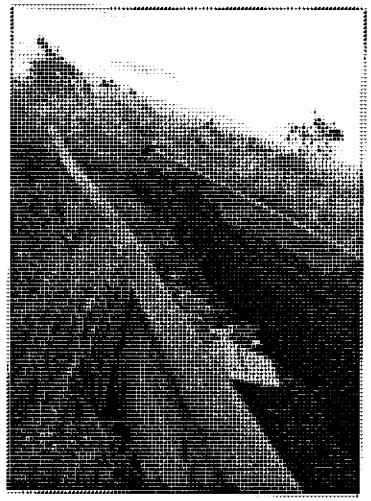

Figure 42. Feature G, concrete ditch, view to the west (upslope)

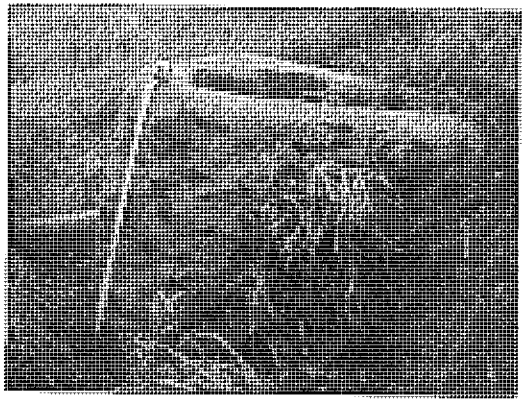

Figure 43. Feature G basin, showing steel pipe extending downslope to Honouliuli Stream, view to the south

5.3 2005 Backhoe Test Excavations Findings

Backhoe testing was conducted in four selected portions of the project area on November 28 and December 7 and 8, 2005. A total of 19 trenches were excavated in the project area in four specific areas (Figure 44 and Figure 45), the Honouliuli Taro Lands (5 trenches) adjacent to the northern portion of Old Fort Weaver Road, the probable location of the Kapalani Catholic Church (7 trenches) adjacent to the southern portion of Old Fort Weaver Road, the former site of Drivers and Stable Villages (1 trench) near the southeastern corner of the project area, and the former site of PipeLine Village (6 trenches) in the south-central section of the project area.

5.3.1 Roman Catholic Churchyard

Seven trenches (BHT 1-6, BHT 19) were excavated around the probable site of the Roman Catholic churchyard. As noted previously, a comparison of modern and nineteenth century maps indicates that the church building itself was once located under the present alignment of Old Fort Weaver Road. Only a small portion of the churchyard extended on the west side of the present road. There are fenced-in fields in this portion of the project area where staked beans are planted. There is only a small portion of open ground between this fenced-in area and a tall berm along the road. The seven trenches were placed around the sides of the fenced field and between the fields and the road berm. No shaped stones, mortar, cultural layers, or artifacts were found in any of the seven trenches.

Trenches 1-3, on the north side of the bean field, had complex stratigraphies with several silty loam or silty clay layers, probably deposited during flooding episodes. An old roadbed was present as the upper stratum of Trenches 4, 5, 6, and 19 (along the east side of the field adjacent to Old Fort Weaver Road). This is probably the old alignment of Fort Weaver Road, thus the yard of the Roman Catholic Road was probably located east of our trench placement. Either it was located under the present alignment of Old Fort Weaver Road, under the shoulder of the road, or under the earth berm adjacent to the road shoulder. Trench 4 had modern black plastic fragments (used for weed control in the gardens) at a depth of 210 cm. Another trench (Trench 3) had coral cobbles or boulders at depths of 150 cmbs, indicating a significant amount of soil disturbance in these trenches adjacent to the road.

Stratigraphic profiles for these seven trenches are illustrated in Figure 46 to Figure 52, with the stratigraphic soil descriptions following.

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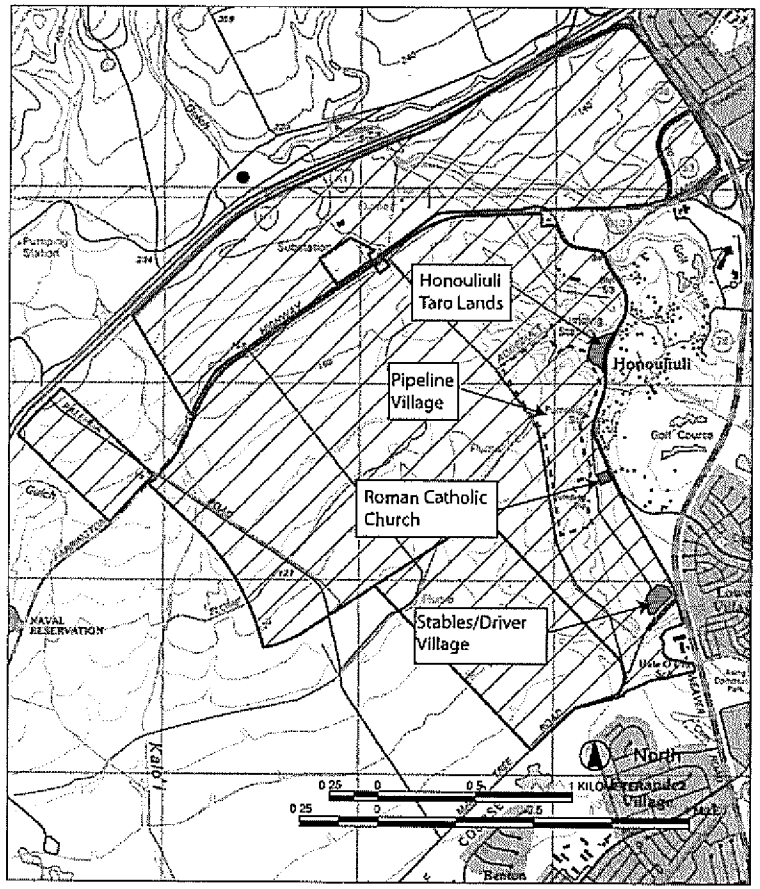

Figure 44. US Geological Survey map, showing four areas selected for backhoe testing

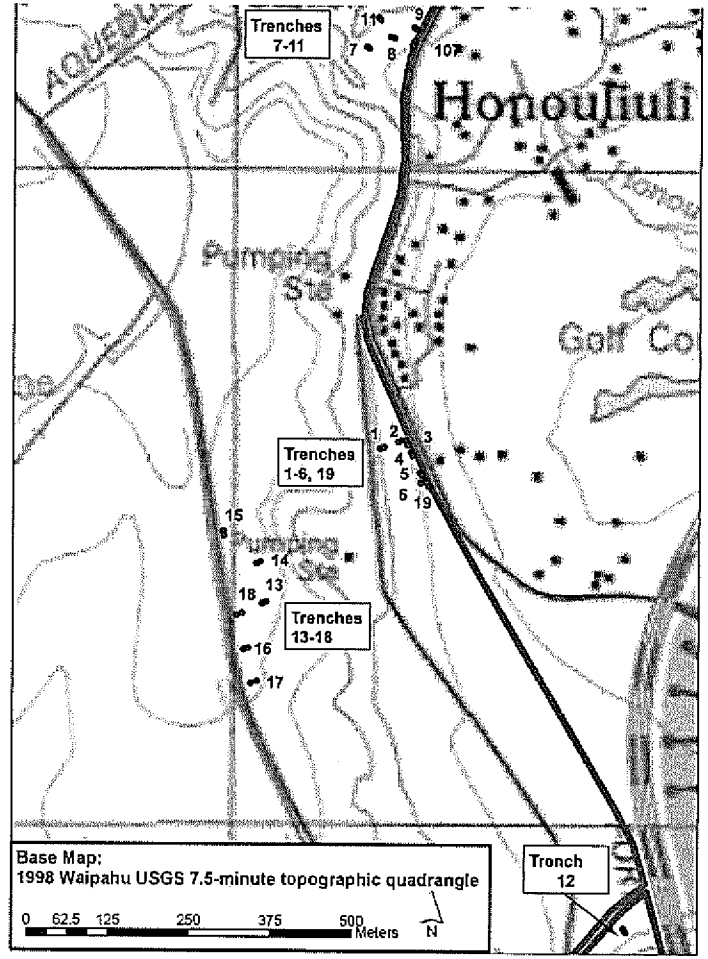

Figure 45. US Geological Survey map, showing location of Backhoe Trenches 1-19

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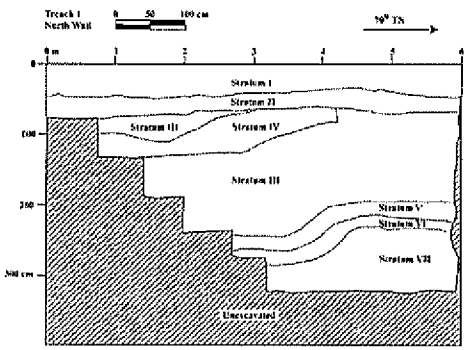

Figure 46. Backhoe Trench 1, north wall profile

Backhoe Trench 1
Stratum-Depth

I	0-60 cmbs	Very dark grayish brown (10YR3/2) silty clay loam; weak, fine, subangular blocky structure; very firm when moist, very sticky and moderately plastic consistence; terrestrial origin; abrupt, smooth boundary;
II	60-70 cmbs	Brown (10YR4/3) silty clay loam; moderate, medium subangular blocky structure; very hard when dry, slightly sticky and slightly plastic consistence; terrestrial origin; abrupt, smooth boundary;
III	60-240 cmbs	Very dark gray (10YR3/1) clay loam; strong, coarse, angular blocky structure; extremely hard when moist, slightly sticky and slightly plastic consistence; terrestrial origin; very abrupt, wavy boundary;
IV	65-120 cmbs	Gray (10YR6/1) ashy silt; structureless; slightly hard when moist; very sticky and slightly plastic consistence; terrestrial origin; abrupt, wavy boundary; stratum is between two Stratum III layers;
V	240-260 cmbs	Dark yellowish brown (10YR3/4) silty loam; structureless; loose when moist; slightly sticky and moderately plastic; terrestrial origin; very abrupt, wavy boundary;
VI	260-290 cmbs	Dark reddish brown (5YR3/2) silty loam; structureless; soft when dry, slightly sticky and moderately plastic; terrestrial origin; very abrupt, wavy boundary;
VII	290-330+ cmbs	Dark brown (10YR3/3) silty clay; moderate, medium angular blocky structure; hard when dry, slightly sticky and plastic; terrestrial origin; excavation arbitrarily terminated at 330 cmbs.

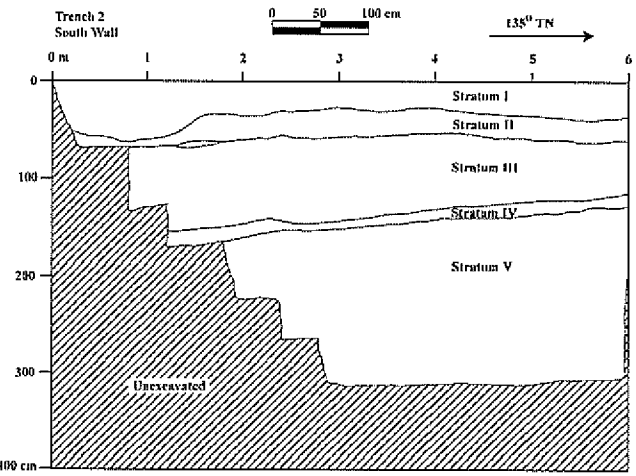

Figure 47. Backhoe Trench 2, south wall profile

Backhoe Trench 2
Stratum-Depth

I	0-25 cmbs	Very dark grayish brown (10YR3/2) silty clay loam; moderate, medium, subangular blocky structure; very firm when moist, very sticky and moderately plastic consistence; terrestrial origin; extensive charcoal flecking; abrupt, wavy boundary;
II	25-53 cmbs	Dark brown (7.5YR3/2) clay loam; moderate, medium subangular blocky structure; friable when moist, sticky and moderately plastic consistence; terrestrial origin; clear, smooth boundary;
III	53-140 cmbs	Very dark gray (10YR3/1) clay loam; strong, coarse, angular blocky structure; extremely hard when moist, sticky and slightly plastic consistence; terrestrial origin; very abrupt, wavy boundary;
IV	140-147 cmbs	Gray (10YR6/1) ashy silt; structureless; slightly hard when moist; very sticky and slightly plastic consistence; terrestrial origin; abrupt, wavy boundary;
V	147-310+ cmbs	Dark yellowish brown (10YR3/4) silty loam; structureless; loose when moist; slightly sticky and moderately plastic; terrestrial origin; excavation arbitrarily terminated at 310 cmbs.

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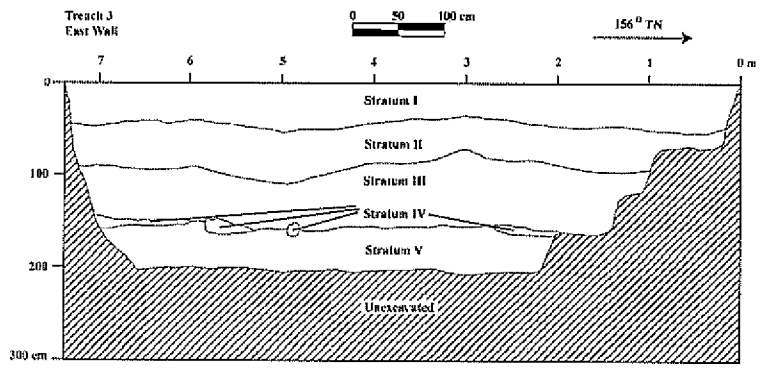

Figure 48. Backhoe Trench 3, north wall profile

Backhoe Trench 3
Stratum-Depth

I	0-41 cmbs	Very dark grayish brown (10YR3/2) silty clay loam with 90% gravel (old road bed); moderate, medium subangular blocky structure; very firm when moist, sticky and moderately plastic consistence; terrestrial origin; abrupt, smooth boundary;
II	40-85 cmbs	Dark brown (7.5YR3/2) clay loam; moderate, medium subangular blocky structure; friable when moist, sticky and moderately plastic consistence; terrestrial origin; abrupt, wavy boundary;
III	85-155 cmbs	Dark yellowish brown (10YR4/4) silty clay loam; moderate, medium structure; friable when moist, sticky and plastic; very abrupt, irregular boundary;
IV	145-162 cmbs	Gray (10YR6/1) ashy silt; structureless; slightly hard when moist; very sticky and slightly plastic consistence; terrestrial origin; abrupt, wavy boundary, several large coral borders at boundary;
V	155-200+ cmbs	Dark yellowish brown (10YR3/4) silty loam with 25% coral cobbles; structureless; loose when moist; slightly sticky and moderately plastic; terrestrial origin; excavation arbitrarily terminated at 200 cmbs.

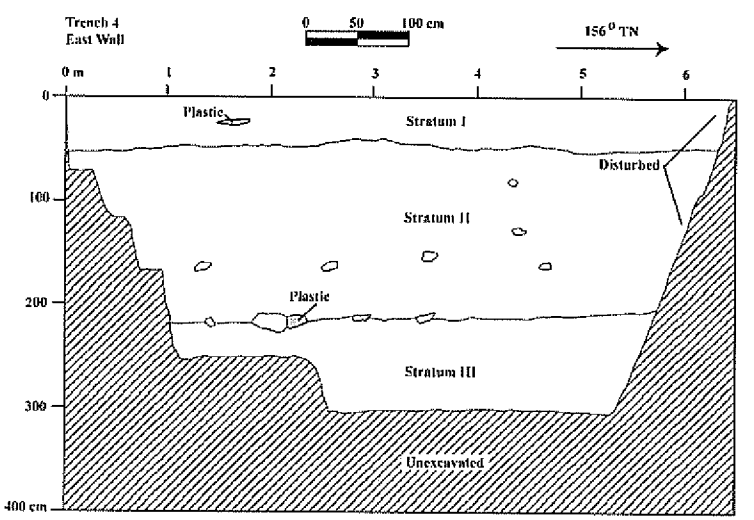

Figure 49. Backhoe Trench 4, north wall profile

Backhoe Trench 4
Stratum–Depth

I	0-48 cmbs	Very dark grayish brown (10YR3/2) silty clay loam with 25% gravel (old road bed); moderate, medium subangular blocky structure; very firm when moist, sticky and moderately plastic consistence; terrestrial origin; abrupt, smooth boundary;
II	40-210 cmbs	Dark brown (7.5YR3/2) clay loam; moderate, medium subangular blocky structure; friable when moist, sticky and moderately plastic consistence; terrestrial origin; scattered coral cobbles; abrupt, wavy boundary, modern plastic found at II/III interface at 210 cmbs;
III	210-300+ cmbs	Dark yellowish brown (10YR3/4) silty loam with 25% coral cobbles; structureless; loose when moist; slightly sticky and moderately plastic; terrestrial origin; excavation arbitrarily terminated at 300 cmbs.

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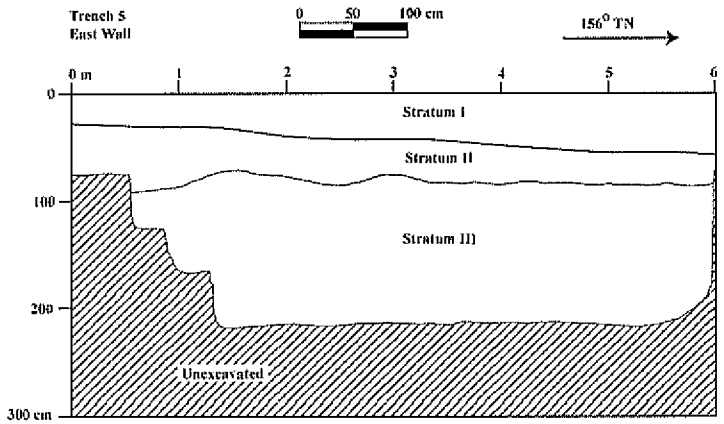

Figure 50. Backhoe Trench 5, east wall profile

Backhoe Trench 5
Stratum--Depth

I	0-50 cmbs	Old asphalt fragments;
II	50-82 cmbs	Very dark grayish brown (10YR3/2) clay loam with 1% basalt cobbles; moderate, medium angular blocky structure; extremely hard when dry, sticky and plastic consistence; terrestrial origin; diffuse, wavy boundary;
III	82-213+ cmbs	Dark brown (10YR3/3) silty clay loam; weak, fine subangular blocky structure; hard when dry, sticky and moderately plastic consistence; terrestrial origin; excavation arbitrarily terminated at 213 cmbs.

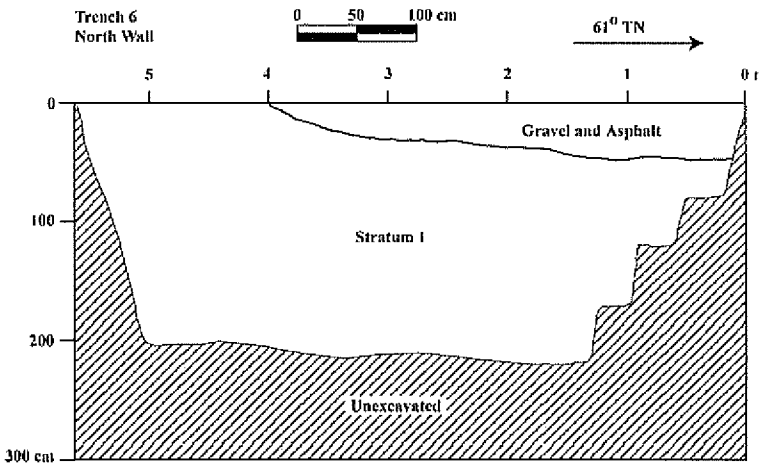

Figure 51. Backhoe Trench 6, north wall profile

Backhoe Trench 6
Stratum-Depth

I	0-48 cmbs	Old asphalt fragments;
II	48-119+ cmbs	Brown (10YR4/3) clay loam; medium moderate subangular blocky structure; moderately firm when moist, sticky and very plastic consistence; terrestrial origin; excavation arbitrarily terminated at 119 cmbs.

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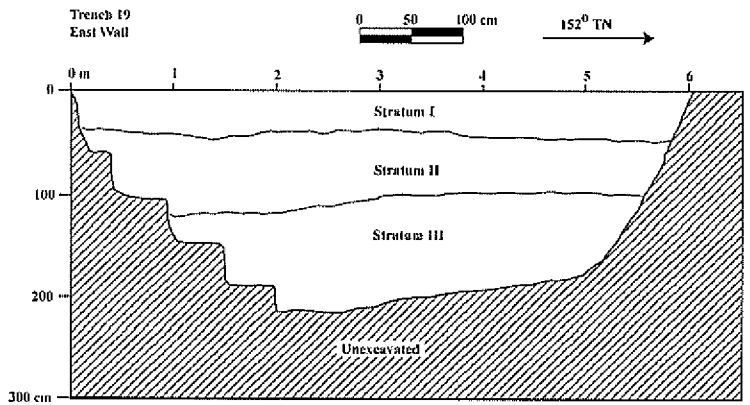

Figure 52. Backhoe Trench 19, east wall profile

Backhoe Trench 19
Stratum--Depth

I	0-48 cmbs	Old asphalt fragments;
II	48-102 cmbs	Very dark grayish brown (10YR3/2) clay loam with 1% basalt cobbles; moderate, medium angular blocky structure; extremely hard when dry, sticky and plastic consistence; terrestrial origin; diffuse, wavy boundary;
III	102-210+ cmbs	Dark brown (10YR3/3) silty clay loam; weak, fine subangular blocky structure; hard when dry, sticky and moderately plastic consistence; terrestrial origin; excavation arbitrarily terminated at 210 cmbs.

5.3.2 Honouliuli Taro Land Trenches

Five trenches (BHT 7-11) were excavated in the Honouliuli Taro Lands area. This portion of the project area was thickly vegetated with low (ca. 1 m tall) *koa haole* trees and larger '*opiuma* (*Pithecellobium dulce*) trees. The area available for backhoe testing was circumscribed by the presence of these larger trees; trenches could only be placed in areas where the smaller *koa haole* trees could be knocked down with the backhoe. There was also a large pit in the southwestern section of this area used for flood control. This area is adjacent and east of the Ewa Plantation Railroad berm (Site 50-80-12-4345).

No shaped stones, cultural layers, '*auwai* (irrigation ditches used in wetland cultivation) organic soils (soils once used for wetland agriculture), walls, habitation platforms, boundary walls or alignments, or artifacts were found in any of the five trenches; however, many of the trenches did contain fragments of limestone mortar, asphalt, and slag to a depth of 1.7 m below surface. One *Tellina* sp. bivalve shell was found at a depth of 150 cmbs, but it was adjacent to a fragment of slag at 170 cmbs, and thus was deposited in modern times (or is in a disturbed stratum). Only one stratum of soil was found in each of the five trenches; some trenches had trash deposits. The disturbed nature of the top stratum may be related to the nearby railroad berm. Stones and even soil may have been moved and excavated from this area to build the earth and rock berm for the railway bed. The presence of limestone mortar, slag, asphalt, and charcoal lenses found in several trenches may also be associated with this berm construction and use.

The stratigraphic profiles (Figure 53 to Figure 57) and soil descriptions for the five trenches follows.

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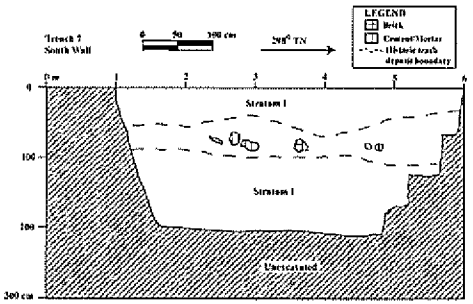

Figure 53. Backhoe Trench 7, south wall profile

Backhoe Trench 7
Stratum-Depth

I 0-210+ cmbs Very dark brown (7.5YR5/3) silt loam; moderate, medium, subangular blocky structure; slightly hard when moist, non-sticky and non-plastic consistence; terrestrial origin; layer containing brick, cement, and mortar extending within Stratum 1 from 40-100 cmbs; excavation arbitrarily terminated at 210 cmbs.

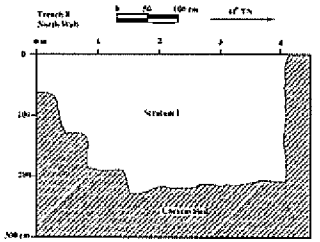

Figure 54. Backhoe Trench 8, north wall profile

Backhoe Trench 8
Stratum-Depth

I 0-230+ cmbs Very dark brown (7.5YR5/3) silt loam; moderate, medium, subangular blocky structure; slightly hard when moist, non-sticky and non-plastic consistence; terrestrial origin; cement fragments only on surface and top; has slag and decomposing limestone fragments throughout; excavation arbitrarily terminated at 230 cmbs.

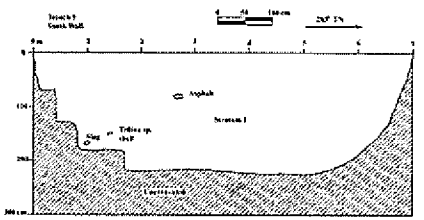

Figure 55. Backhoe Trench 9, south wall profile

Backhoe Trench 9
Stratum- Depth

I 0-227+ cmbs Very dark brown (7.5YR5/3) silt loam; moderate, medium, subangular blocky structure; slightly hard when moist, non-sticky and non-plastic consistence; terrestrial origin; decomposing limestone fragments throughout; *Tellina* sp. marine bivalve shell found at 150 cmbs; slag found at 170 cmbs; excavation arbitrarily terminated at 227 cmbs.

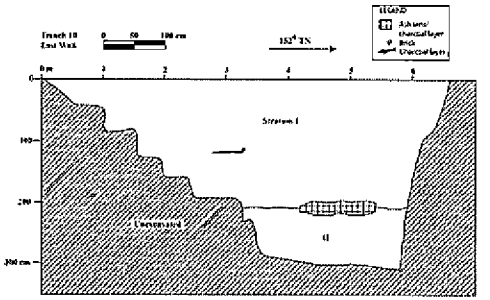

Figure 56. Backhoe Trench 10, east wall profile

Backhoe Trench 10
Stratum-Depth

I 0-305+ cmbs Very dark brown (7.5YR5/3) silt loam; moderate, medium, subangular blocky structure; slightly hard when moist, non-sticky and non-plastic consistence; terrestrial origin; slag, brick fragments, charcoal flecks, and decomposing limestone fragments throughout; charcoal lens at 120 cmbs and ash/charcoal lens at 200-220 cmbs; excavation arbitrarily terminated at 305 cmbs.

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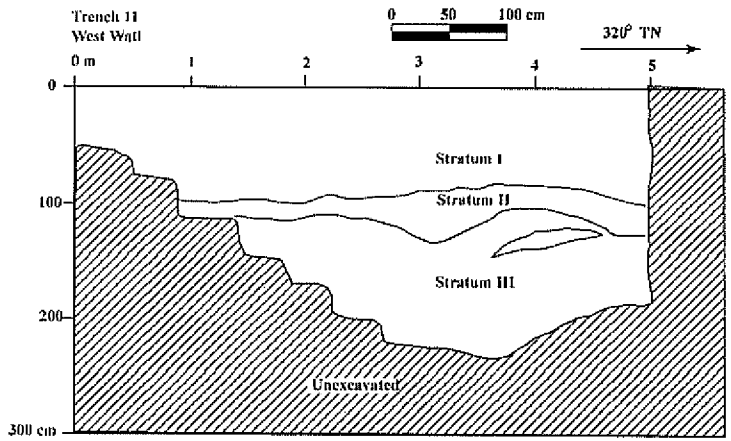

Figure 57. Backhoe Trench 11, west wall profile

Backhoe Trench 11
Stratum-Depth

I	0-88 cmbs	Very dark brown (7.5YR5/3) silt loam; moderate, medium, subangular blocky structure; slightly hard when moist, non-sticky and non-plastic consistence; terrestrial origin; slag, brick fragments, charcoal flecks, and decomposing limestone fragments throughout; clear, wavy boundary;
II	88-110 cmbs	Brown (10YR4/3) silty clay loam; moderate, medium subangular blocky structure; very hard when dry, slightly sticky and slightly plastic consistence; terrestrial origin; abrupt, smooth boundary;
III	110-240+ cmbs	Very dark gray (10YR3/1) clay loam; strong, coarse, angular blocky structure; extremely hard when moist, slightly sticky and slightly plastic consistence; terrestrial origin; excavation arbitrarily terminated at 240 cmbs.

5.3.3 Drivers and Stable Villages

One trench (BHT-12) was excavated in the Drivers/Stable Villages area. In the last ten years, this area has been very susceptible to floods, so much so that when water would come into this area it would wash soil onto Old Fort Weaver Road. To control these floods, the majority of this area had been bulldozed, excavated, and filled with gravel. Only a small portion of this area near the extreme southeastern corner of the project area still had some vegetation and was thought to have been undisturbed by this excavation and filling. The one trench (BHT-12) excavated in this area had two strata, separated by an asphalt layer, possibly an old roadbed. It is unlikely that this road was built for the Drivers/Stable Village, since the name "Stable" suggests that horses and mules were still the predominant method of hauling and travel in this period, not car or tractors. There were no other artifacts or material from the villages indicated by this trench excavation. The stratigraphic profile (Figure 58) and soil descriptions for Trench 12 are presented below:

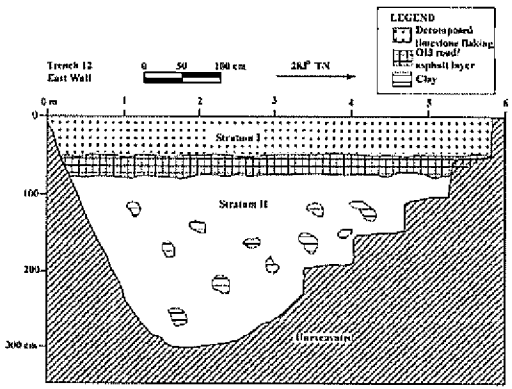

Figure 58. Backhoe Trench 12, east wall profile

Backhoe Trench 12
Stratum-Depth

I	0-50 cmbs	Very dark brown (7.5YR5/3) silt loam; moderate, medium, subangular blocky structure; slightly hard when moist, non-sticky and non-plastic consistence; terrestrial origin; with many small fragments of decomposed limestone; abrupt, smooth, boundary; old road/asphalt bed at 50-70 cmbs;
II	70-300+ cmbs	Dark brown (7.5YR3/4) silty clay loam; strong, medium blocky structure; friable when moist, slightly sticky and plastic consistence; strong cementation; terrestrial origin; soil intermixed with 50% pockets of clay; excavation arbitrarily terminated at 300 cmbs.

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5.3.4 PipeLine Village

Six trenches (BHT-13-18) were excavated in the former location of PipeLine Village. The first trench was placed in the area thought to be the former location of the church shown on the 1927 USGS map (see Figure 19). This section of the project area is flat, open, plowed fields planted in pumpkins and squash. Trenches were placed on roads along the sides and between the plowed fields. The surface and the plow zone had a dense concentration of concrete fragments (less than 20 cm in diameter), especially near the southern section of the project area (near where the church may have been). Two to three strata were found in the six trenches. The concrete fragments were only found on the ground surface or within the loose soil, the top 20 cm of the plow zone. None were found any deeper. No privy pits were found, no food remains, no historic artifacts, and no firepits or other habitation features were found. In conclusion, it seems that when the houses of PipeLine Village were moved in 1931, little remained behind. The concrete fragments are probably fragments of the blocks on which the wooden houses rested, or are part of some of the coral/gravel roads between the house roads. The stratigraphic profiles for these six trenches (Figure 59 to Figure 64) are presented below, with the soil descriptions following.

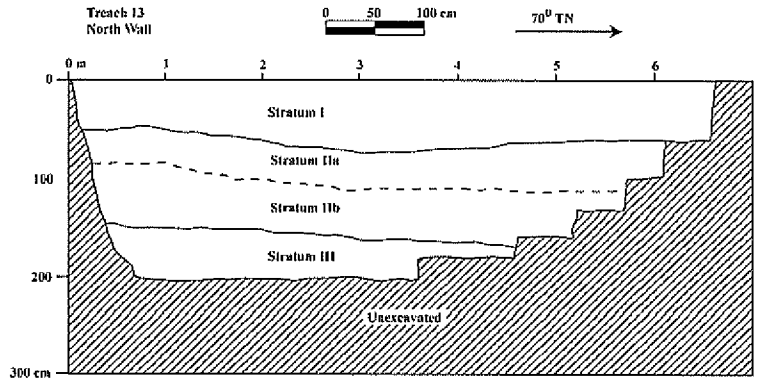

Figure 59. Backhoe Trench 13, north wall profile

Backhoe Trench 13
Stratum-Depth

I	0-60 cmbs	Dark yellowish brown (10YR3/4) silty clay loam; moderate, medium, subangular blocky structure; friable when moist, sticky and moderately non-plastic consistence; terrestrial origin; cobble-size concrete fragments found only on the surface and the upper 20 cm of loose soil; abrupt, smooth, boundary;
IIA	60-100 cmbs	Strong brown (7.5YR4/6) sandy loam; moderate, fine, subangular blocky structure; firm when moist, slightly sticky and slightly plastic consistence; terrestrial origin, diffuse, irregular boundary;
IIB	100-150 cmbs	Brown (7.5YR4/3) sandy loam; strong, medium blocky structure; friable when moist, non-sticky and non-plastic consistence; 60% gravel; terrestrial origin; clear, wavy boundary;
III	150-200+cmbs	Brown (7.5YR4/2) clay; weak, very fine prismatic structure; friable when moist, sticky and very plastic consistence; terrestrial origin; excavation arbitrarily terminated at 200 cmbs.

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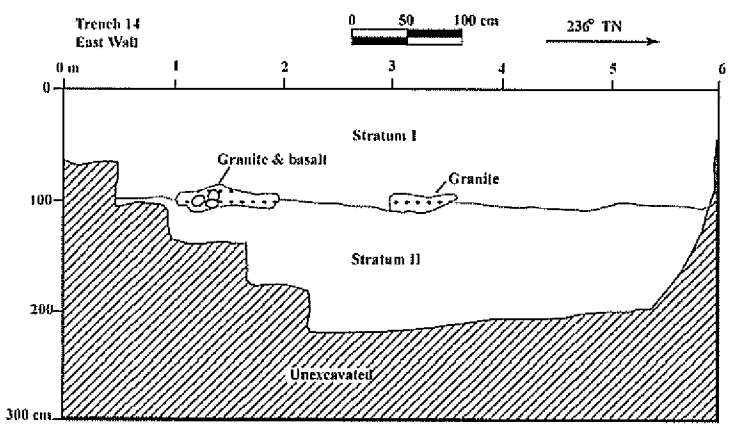

Figure 60. Backhoe Trench 14, east wall profile

Backhoe Trench 14
Stratum-Depth

I	0-110 cmbs	Dark yellowish brown (10YR3/4) silty clay loam; moderate, medium, subangular blocky structure; friable when moist, sticky and moderately non-plastic consistence; terrestrial origin; cobble-size concrete fragments found on the surface and the upper 20 cm of loose soil; basalt cobbles and boulders at I/II interface; abrupt, smooth, boundary;
II	110-220+cmbs	Brown (7.5YR4/2) clay; weak, very fine prismatic structure; friable when moist, sticky and very plastic consistence; terrestrial origin; excavation arbitrarily terminated at 220 cmbs.

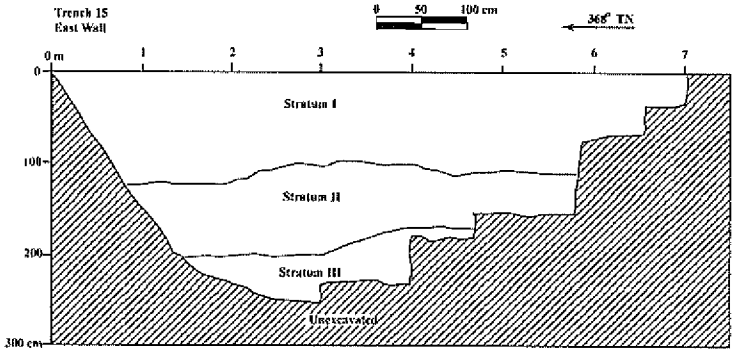

Figure 61. Backhoe Trench 15, east wall profile

Backhoe Trench 15
Stratum-Depth

I	0-98 cmbs	Dark yellowish brown (10YR3/4) silty clay loam; moderate, medium, subangular blocky structure; friable when moist, sticky and moderately non-plastic consistence; terrestrial origin; cobble-size concrete fragments found on the surface and the upper 20 cm of loose soil; abrupt, smooth, boundary;
II	90-200 cmbs	Yellowish red (5YR4/6) clay loam (50% clay); moderate, medium, blocky structure; firm when moist; sticky and plastic; strong cementation; terrestrial origin; abrupt, wavy boundary;
III	200-255+ cmbs	Brown (7.5YR4/2) clay; weak, very fine prismatic structure; friable when moist, sticky and very plastic consistence; terrestrial origin; excavation arbitrarily terminated at 255 cmbs.

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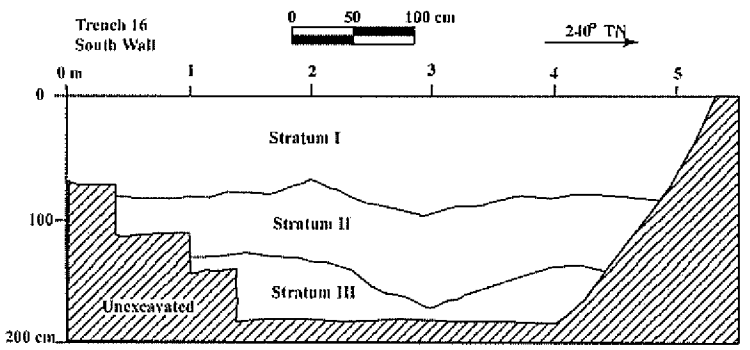

Figure 62. Backhoe Trench 16, south wall profile

Backhoe Trench 16
Stratum-Depth

I	0-100 cmbs	Dark Yellowish Brown (10YR3/4) silty clay loam; moderate, medium, subangular blocky structure; friable when moist, sticky, moderately plastic consistence; terrestrial origin; cobble-size concrete fragments found on the surface and the upper 20 cm of loose soil; abrupt, smooth boundary;
II	100-200 cmbs	Yellowish red (5YR4/6) clay loam; moderate, medium, subangular blocky structure; firm when moist, sticky and plastic consistence; terrestrial origin; abrupt, wavy boundary;
III	200-255+ cmbs	Brown (7.5YR4/2) clay; weak, very fine, platy structure; friable when moist; sticky and very plastic consistence; terrestrial origin; excavation arbitrarily terminated at 255 cmbs.

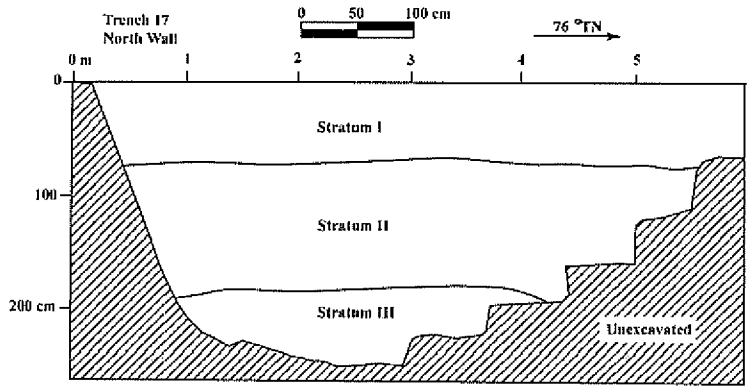

Figure 63. Backhoe Trench 17, north wall profile

Backhoe Trench 17
Stratum-Depth

I	0-41 cmbs	Dark yellowish brown (10YR3/4) silty clay loam; moderate, medium, subangular blocky structure; friable when moist, sticky and moderately non-plastic consistence; terrestrial origin; cobble-size concrete fragments found on the surface and the upper 20 cm of loose soil; abrupt, smooth, boundary;
II	41-132 cmbs	Yellowish red (5YR4/6) clay loam (50% clay); moderate, medium, blocky structure; firm when moist; sticky and plastic; strong cementation; terrestrial origin; abrupt, wavy boundary;
III	132-200+ cmbs	Brown (7.5YR3/2) clay loam; weak, medium subangular blocky structure; friable when moist; sticky and slightly plastic consistence; weak cementation; terrestrial origin; excavation arbitrarily terminated at 200 cmbs.

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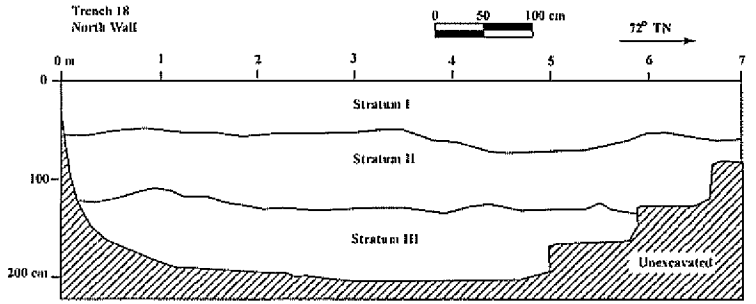

Figure 64. Backhoe Trench 18, north wall profile

Backhoe Trench 18
Stratum-Depth

I	0-70 cmbs	Dark yellowish brown (10YR3/4) silty clay loam; moderate, medium, subangular blocky structure; friable when moist, sticky and moderately non-plastic consistence; terrestrial origin; cobble-size concrete fragments found only on the surface and the upper 20 cm of loose soil; abrupt, smooth, boundary;
IIA	70-183 cmbs	Strong brown (7.5YR4/6) sandy loam; moderate, fine, subangular blocky structure; firm when moist, slightly sticky and slightly plastic consistence; terrestrial origin, diffuse, irregular boundary;
III	183-250+cmbs	Brown (7.5YR4/2) clay; weak, very fine prismatic structure; friable when moist, sticky and very plastic consistence; terrestrial origin; excavation arbitrarily terminated at 250 cmbs.

Section 6 Project Summary and Mitigatiou Recommendations

During a 1990 inventory survey of the southeastern portion of the current project area (West Loch Bluffs area), five sites, a railroad berm (Site 50-80-12-4345), three pumping station (Sites 50-80-12-4346, -4347, and -4348), and three features related to plantation infrastructure (Site 50-80-12-4344) were recorded and assigned SIHP permanent site numbers. During this survey, four historic documented areas of Hawaiian and later immigrant residence were also identified: the former sites of Honouliuli Taro Lands, Kapalani Church, PipeLine Village, and Drivers/Stable Village. Further work, especially subsurface testing, was recommended for these four areas.

During the recent 2005 surface survey of non-plowed areas of the 1594-acre East Kapolei project area, four new features related to sugar cane cultivation or irrigation were recorded. These four features (Features D-G) were subsumed under the previous site number, Site 50-80-12-4344, used for scattered plantation infrastructure features.

A total of 19 trenches were excavated in the four areas of historic habitation and/or agriculture identified in the 1990 CSH survey to determine if there were any subsurface remains of: (1) nineteenth century (or earlier) habitation and agricultural lots in the Honouliuli Taro Lands; (2) structures or burials associated with the nineteenth century Kapalani Catholic Church; (3) structures or historic domestic artifacts associated with the early twentieth century Drivers and Stable Village; and, (4) structures or historic domestic artifacts or pit/privy features associated with the early twentieth century PipeLine Village. No cultural deposits, no privy pits, no burials, and no artifacts or any type were found or recovered from the 19 trenches. It seems that sugarcane cultivation, irrigation, flood control, railroad construction, later road construction, the demolition and movement of workers camps, and other factors have obliterated all, or almost all, traces of these former traditional Hawaiian habitation and agricultural lands and the later sugar cane plantation workers camps, churches, and schools.

6.1 Significance Assessments

Sites are evaluated for significance according to the broad criteria established for the National and State Registers. The five criteria are:

A	Site reflects major trends or events in the history of the state or nation.
B	Site is associated with the lives of persons significant in our past.
C	Site is an excellent example of a site type.
D	Site may be likely to yield information important in prehistory or history.
E	Site has cultural significance; probable religious structures and/or burials present.

During the 1990 survey of the West Loch Bluffs project area (southeastern section of the current project area) five sites were identified and given SIHP site designations. All five sites were determined as significant under criteria C and D. The three features (Features A-C) of Site

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50-80-12-4344 (plantation infrastructure) were not recommended for any further work or for preservation. Sites 50-80-12-4345 (railroad berm), and Sites 70-12-4346, -4347, and -4348 (three pumping stations) were all recommended for preservation.

During the recent 2005 survey of the East Kapolei project area, four additional plantation infrastructure features adjacent to Honouliuli Gulch were identified. These features (Features D-G) were added to the Site –4344 description. The significance and recommendation for this site remains the same (no further work and no preservation); they have all had adequate documentation and do not need to be preserved.

The four areas of historic interest identified in the 1990 West Loch Bluffs survey (Honouliuli Taro lands, Kapalani Catholic Church, PipeLine Village, and Drivers/Stable Village) were not given site designations in the 1990 report since there were no surface remains. In the recent 2005 subsurface inventory of these four areas, no trace of any remains (charcoal, food remains, structural remains, cultural layers, firepits, artifacts, burials, etc.) associated with these four former habitation areas could be found. Therefore, again, these four areas are not assigned permanent state site numbers.

6.2 Mitigation Recommendations

Five sites have been previously identified in the project area during a 1990 CSH survey. Four new features were found for one of these sites during the current 2005 survey. No subsurface remains were found within 19 trenches during the recent backhoe testing of four habitation loci (Honouliuli Taro Lands, Kapalani Catholic Church, PipeLine Village, Drivers/Stable Village) (see Figure 44 for location of four habitation loci). However, it is possible that some traces of these habitation areas remain in subsurface deposits in areas not covered by the test trenches. Thus, an on-call/on-site monitoring program is recommended for these four specific areas during any future development. A summary of findings and recommendations for the project area is presented in Table 5; areas of concern for mitigation recommendations are shown on Figure 65.

Table 5. Significance and Mitigation Recommendations

Site (50-80-12)	Description	Significance	Further Work	Mitigation Recommendation
-4344 Fea. A-C	3 pipe features	C, D	None. Features were destroyed sometime between the 1990 and 2005 survey	None
-4344 Fea. D-G	Sugar cane cultivation/ irrigation features	C, D	None. The features were adequately recorded during the 2005 survey.	No preservation
-4345	Ewa Plantation Railroad Berm	C, D	Architectural Evaluation	Preservation
-4346	Northern Pumping Station	C, D	Architectural Evaluation	Preservation
-4347	Central Pumping Station	C, D	Architectural Evaluation	Preservation
-4348	Southern Pumping Station	C, D	Architectural Evaluation	Preservation
Honouliuli Taro Lands	Nineteenth century (and earlier) Hawaiian Habitation/Agricultural Area	None	No surface or subsurface remains were found during a recent 2005 inventory survey. No additional testing is necessary.	On-call/on-site archaeological monitoring during future development of the area
Kapalani Church	Nineteenth century Hawaiian Catholic Church, schoolhouse, and possible cemetery area	None	No surface or subsurface remains were found. No additional inventory survey is necessary.	On-call/on-site archaeological monitoring during future development of the area
PipeLine Village	Early twentieth century immigrant plantation habitation camp	None	No surface or subsurface remains were found. No additional inventory survey is necessary.	On-call/on-site archaeological monitoring during future development of the area
Drivers/Stable Villages	Early twentieth century immigrant plantation habitation camps	None	No surface or subsurface remains were found. No additional inventory survey is necessary.	On-call/on-site archaeological monitoring during future development of the area

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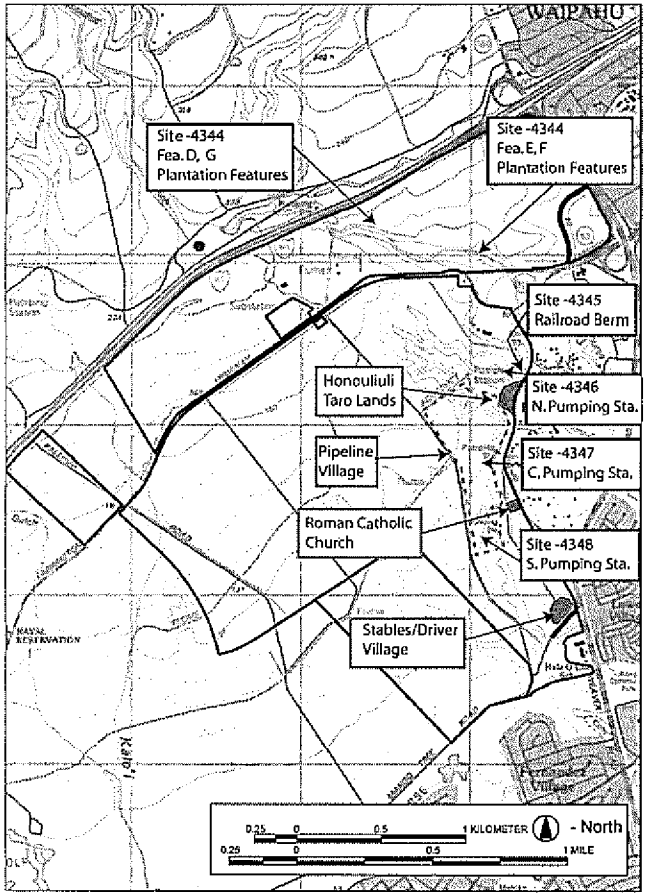

Figure 65. Areas of concern for significance and mitigation recommendations

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AR00027662

An Archaeological Assessment for the Ho'opili Project 440-Foot Elevation Reservoir and Waterline Project, Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu

TMK (1) 9-2-001:001 (por.), 004, 005, 006, 007 (por.); 9-2-002:002

Prepared for
PBR Hawai'i, Inc.

Prepared by
Randy Groza, M.A.,
Constance O'Hare, B.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai'i, Inc.
Kailua, Hawai'i
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Management Summary

Reference	An Archaeological Assessment for the Ho'opili Project 440-Foot Elevation Reservoir and Waterline Project, Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu TMK (1) 9-2-001:001 (por.), 004, 005, 006, 007 (por.); 9-2-002:002, by Randy Groza, Constance R. O'Hare, and Dr. Hallett H. Hammatt
Date	November 2006
Project Number (s)	CSH Job Code: HONOU 14
Investigation Permit Number	CSH completed the inventory survey fieldwork under state archaeological permit No. 0605 issued by the State Historic Preservation Division, per Hawai'i Administrative Rules (HAR) Chapter 13-13-282.
Project Location	The project area consists of several parcels which are identified by the following tax map key numbers: TMK (1) 9-2-001:001 (por.), 004, 005, 006, 007 (por.); 9-2-002:002. The project area is located within agricultural lands that are generally bound on the south by the H-1 Interstate (I H-1), on the east by Kunia Road, on the north by Kupehau Road, and the Honouliuli Gulch to the west. There are two non-contiguous sections linked by a waterline. The area of development immediately north of H-1 contains an existing reservoir, and the proposed waterline will run parallel to an existing waterline in the middle of an existing dirt road. The mauka area of development contains a pump house and is within a former pineapple field north of an existing dirt road.
Land Owner	TMK (1) 9-2-001:001 (por.), Monsanto Company TMK (1) 9-2-001: 004, HECO TMK (1) 9-2-001: 005, Monsanto Company TMK (1) 9-2-001:006, City & County of Honolulu TMK (1) 9-2-001:007 (por.) City & County of Honolulu TMK (1) 9-2-002:002 City & County of Honolulu
Reviewing Agencies	State Historic Preservation Division / Department of Land and Natural Resources (SHPD/DLNR)
Project Description	The client, PBR Hawai'i, Inc. plans to develop the project area with a 440-foot elevation reservoir and waterline in support of a new mixed residential, commercial, and recreational property (the Ho'opili project).
Project Acreage	Approximately 6 acres
Area of Potential Effect (APE)	For the purposes of this study the area of potential effect (APE) and the project area are considered one and the same.
Historic Preservation Regulatory Context	The client, PBR Hawai'i, Inc. proposed development of the Ho'opili Reservoir and Waterline Project constitutes a project requiring compliance with and review under State of Hawai'i historic preservation review legislation (Hawai'i Revised Statutes (HRS) Chapter 6E-42 and Hawai'i Administrative Rules (HAR) 13-284). At the request of PBR Hawai'i, CSH completed an archaeological assessment, per the requirements of HAR Chapter 13-13-276, of the subject 6-acre parcel. This archaeological assessment report was prepared to support the proposed property's historic preservation review and any other project-related historic preservation consultation.
Fieldwork Effort	Constance R. O'Hare, B.A., and Randy Groza, M.A. under the general direction of Hallett H. Hammatt, Ph.D. conducted surface survey in the project area. Fieldwork was conducted on November 7, 2006.
Number of Historic Properties Identified	No sites had been previously identified in the project area. During the recent 2006 surface survey, no sites were identified. No historic properties are believed to be present.
Mitigation Recommendation	No further work is recommended for the project area.

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Section 1 Introduction

1.1 Project Background

At the request of PBR Hawai'i, Inc. (1001 Bishop Street, Suite 650, Honolulu, Hawai'i 96813), Cultural Surveys Hawai'i, Inc. (CSH) has completed this archaeological assessment for the Ho'opili 440-Foot Elevation Reservoir and Waterline Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu Island (TMK:(1) 9-2-001:001, 004, 005, 006, 007 (por.); 9-2-002:002) (Figures 1 through 3). The project area is located within agricultural lands that are generally bound on the south by the H-1 Interstate (I H-1), on the east by Kunia Road, on the north by Kupehau Road, and the Honouliuli Gulch to the west. There are two non-contiguous areas linked by a waterline. The area of development immediately north of H-1 contains an existing reservoir, and the proposed waterline will run parallel to an existing waterline in the middle of an existing dirt road extending approximately 4,000 ft (1200 m) to the northeast. The *mauka* area of development contains two substations and is within a former pineapple field north of an existing dirt road. In all, the project area is approximately 6 acres. Plans are to develop these areas with two new reservoirs and a waterline for a mixed residential, commercial, and recreational property located south of H-1.

There seems to be little likelihood that this undertaking will impact any ongoing cultural practices. No traditional Hawaiian sites have been previously reported in the project area, and no new traditional Hawaiian or post-contact sites were found during the recent fieldsurvey; thus, this report is considered an archaeological assessment, not an inventory survey in the parlance of the State Historic Preservation Division. This archaeological assessment details the research and field inspection methods, presents a summary of all field inspection findings, and assesses the potential for significant historic properties (archeological/ historical potential) and potential impacts to cultural practices.

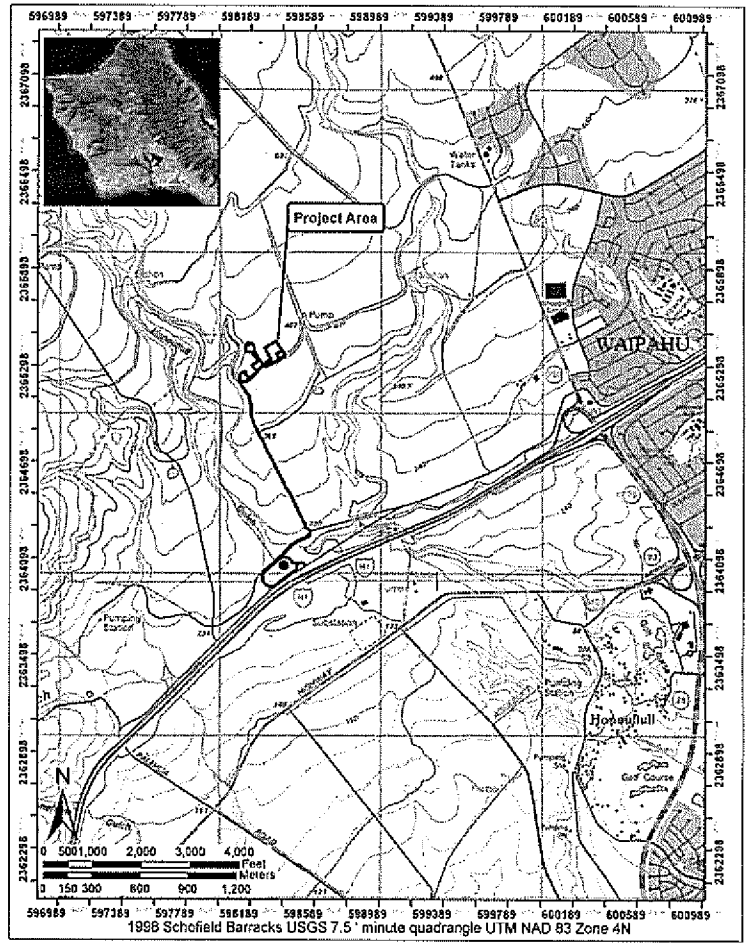

Figure 1. US Geological Survey map (1998), Schofield Barracks quadrangle, showing project area

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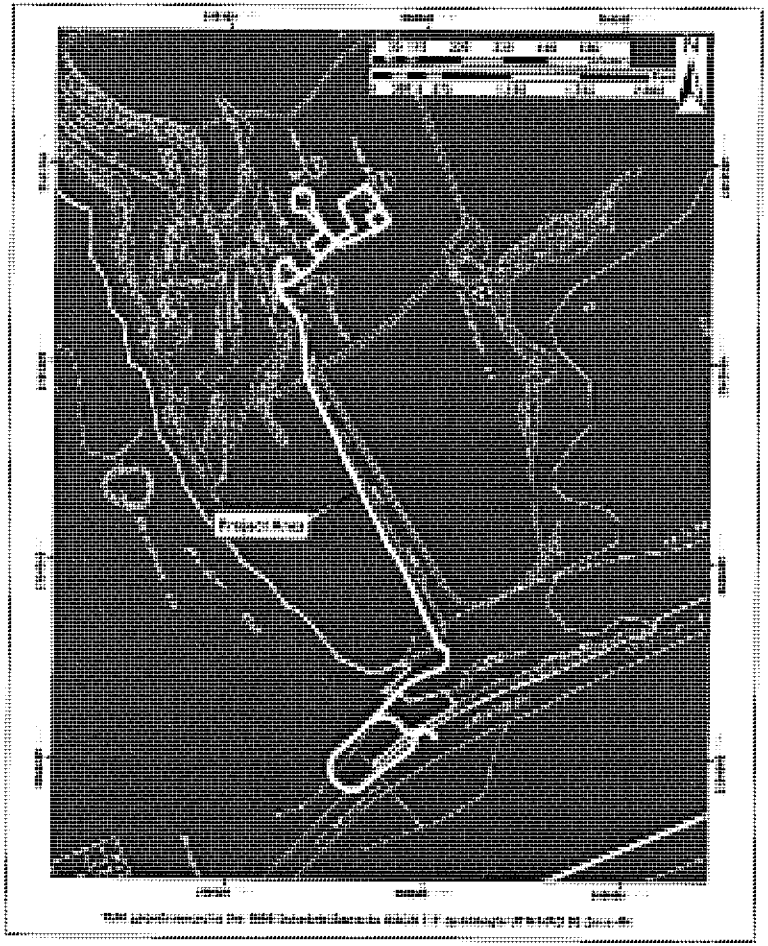

Figure 2. Portion of Tax Map Keys (TMK) Plats 9-2-001 and 9-2-002, showing project area

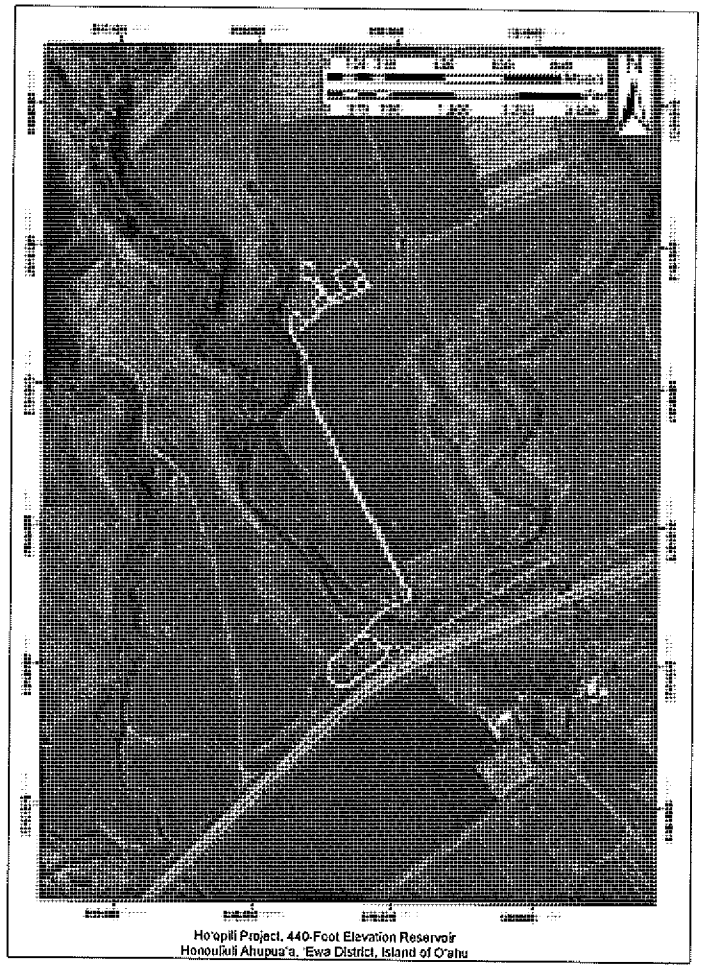

Figure 3. Aerial photograph showing the project area

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1.2 Scope of Work

This archaeological assessment report details results of research and present conditions of the property. This report assesses both the potential for significant historic properties (archaeological/historical potential) and potential impacts to cultural practices.

The scope of work for this assessment includes:

a. Historical and previous archaeological background research to include study of archival sources, historic maps, Land Commission Awards, and previous archaeological reports to construct a history of land use and to determine if archaeological sites have been recorded on or near this property.

b. A complete ground survey of the entire project area for the purpose of site inventory was conducted to identify any surface archaeological features and to investigate and assess the potential for impact to such sites.

c. The report assesses the likelihood that the proposed project will not impact cultural practices. This assessment is based on the background research, and the review of land use within the vicinity of the project area.

d. Preparation of a report to include the results of the historical research and the fieldwork, with an assessment of archaeological potential based on that research, with recommendations for further archaeological work, if appropriate. This report was also to provide mitigation recommendations if there were any archaeologically sensitive areas that need to be taken into consideration.

1.3 Environmental Setting

1.3.1 Natural Environment

Honouliuli Ahupua'a is the largest traditional land unit on O'ahu, extending from the West Loch of Pearl Harbor in the east, to the border of Nānākuli Ahupua'a at Pili o Kahe in the west. Honouliuli Ahupua'a includes approximately 19 km (kilometers), or 12 mi (miles) of open coastline from One'ula westward to Pili o Kahe. The *ahupua'a* extends *mauka* (inland) from West Loch nearly to Schofield Barracks in Wahiawā. The western boundary is the Wai'anae Mountain crest running north as far as Pu'u Hāpapa (or to the top of Ka'ala Mountain, according to some).

Topographically, the southern portion of the project area, north of H-1, and the northern portion are generally flat. The approximately 4,000-ft (1300 m) of existing dirt road that connects the northern and southern portions of the project area climbs from 220 to 400 feet (ft) or 67-122 meters (m).

Lying in the lee of the Wai'anae mountain range, the project area is one of the driest areas of O'ahu with most of the area averaging about 18 inches of rainfall annually (Juvik and Juvik 1998:56). Temperatures range between 60° to 90°F through the year; the highest temperatures are in August and September (Armstrong 1973). Elevation in the project area ranges from 220 ft

AMSL (above mean sea level) to 400 ft (67-122 m). Intermittently running Honouliuli Stream is approximately 500 ft (150 m) north of the southern portion of the project area, 1000 ft (300 m) west of the waterline, and 1300 ft (400 m) west of the northern portion of the project area.

A total of five soil series are found in the project area (Figure 4). The Kawaihapai Series consists of well-drained soils in drainage ways and on alluvial fans on the coastal plains, which formed in alluvium derived from basic igneous rock in humid uplands. The annual rainfall amounts to 30 to 50 inches. The natural vegetation consists of *kiawe*, *koa haole*, lantana, and bermudagrass. Kawaihapai clay loam (KiB), 2 to 6 percent slope, is used for sugarcane, truck crops, and pasture. The Kunia Series consists of well-drained soils on upland terraces and fans; the soils developed in old alluvium. They are nearly level to moderately sloping. Kunia silty clay, 0 to 3 percent slopes (KyA) and 3 to 8 percent slopes (KyB), are used for sugarcane, pineapple, and homesites. The Lahaina Series consists of well-drained soils on uplands that developed in material weathered from basic igneous rock. They are nearly level to steep. Lahaina silty clay, 7 to 15 percent slopes, is used for sugarcane and pineapple. Small acreages are used for truck crops, pasture, and wildlife habitat. The Molokai Series consists of well-drained soils on uplands, formed in material weathered from basic igneous rock. They are nearly level to moderately steep. Molokai silty clay loam, 3 to 7 percent (MuA) and 7 to 15 percent slopes (MuB), are used for sugarcane, pineapple, pasture, wildlife habitat, and homesites. The natural vegetation consists of *kiawe*, *ilima*, *uhaloa*, feather fingergrass, and buffelgrass (Foote et al. 1972).

1.3.2 Built Environment

During the post-contact period, the project area was used for cattle grazing. In 1890, the land was primarily used for sugar cane and pineapple cultivation by the Ewa Plantation Company. Currently, the mauka area of the project area is fallow and contains low grass (Figure 5). There are also two substations within that northernmost portion (Figures 6 and 7). The central portion, the location of the water line, is an existing dirt road (Figure 8), and the southernmost portion is fenced and contains a water retention tank (Figure 9).

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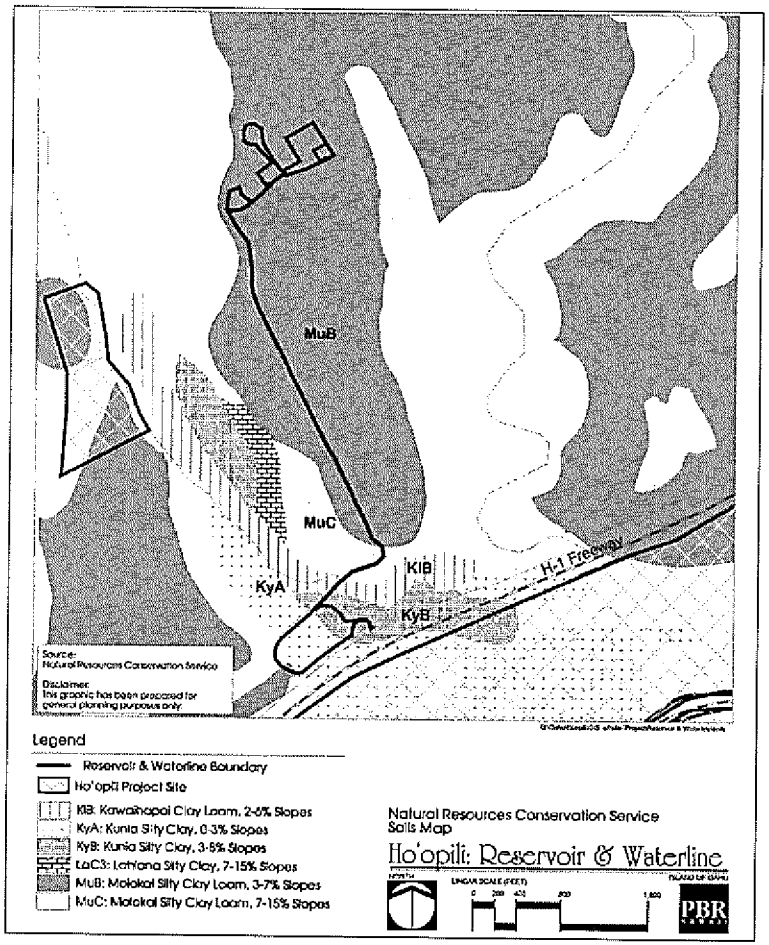

Figure 4. Soil Map of Ho'opili 440-Foot Elevation Reservoir and Waterline Project Area

Figure 5. Northern parcel, view to northeast

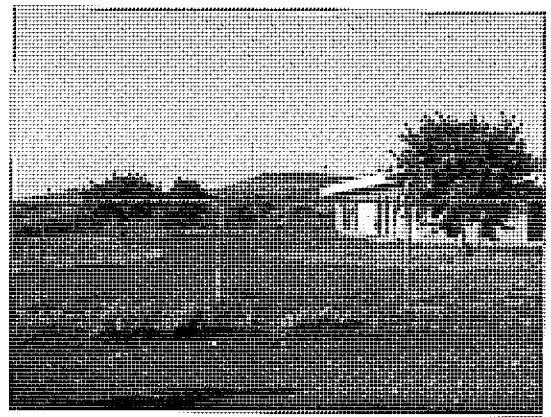

Figure 6. Substation within central portion of northern parcel, view to west

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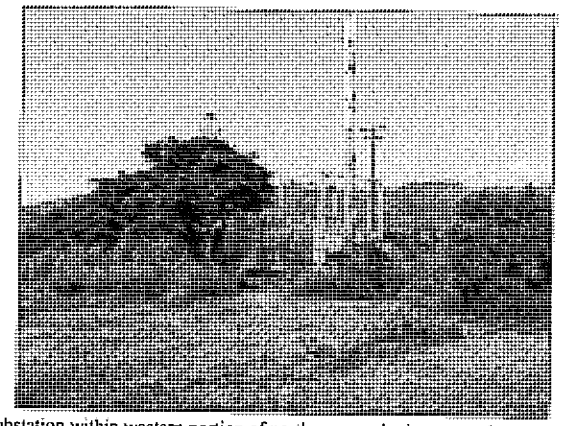

Figure 7. Substation within western portion of northern parcel, view to north

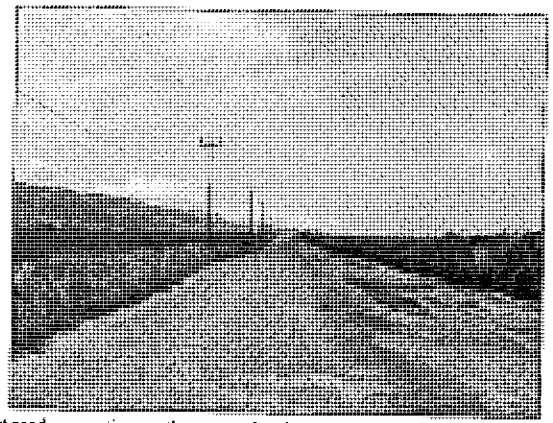

Figure 8. Dirt road connecting northern parcel and southern parcel, view to northwest

Figure 9. Southern parcel showing existing tank and location of planned tank, view to south/southeast

Figure 10. Southern parcel showing western portion and location of planned tank, view to southwest

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Section 2 Methodology

For this report, CSH reviewed previous archaeological studies on file at the State Historic Preservation Division. CSH also reviewed geology and cultural history documents at Hamilton Library at the University of Hawai'i, the Hawai'i State Archives, the Hawai'i Public Library, and the Archives of the Bishop Museum. Additional researeh included a study of historic maps at the Survey Office of the Department of Accounting and General Services. Information regarding LCAs was obtained from the Waihona 'Āina Corporation's Māhele Data Base (www.waihona.āina.com).

2.1 Field Methods

The pedestrian inspection of the project area was conducted on November 7, 2006 with two Cultural Surveys Hawai'i staff archaeologists, Constance R. O'Hare, B.A., and Randy Groza, M.A., under the general direction of Hallett H. Hammatt, Ph.D. The entire northern portion of the project area was surveyed by pedestrian sweeps. CSH archaeologists conducted a windshield survey of the approximately 4,000 ft (1200 m) of existing road, where the new water line will run parallel to the existing water line in the center of the road and connect the northern portion of the project area with the southern portion. The southern section of the project area was reviewed through the chain link fence.

No historic properties were encountered and the pedestrian inspection was documented with field notes, maps, and photographs.

2.2 Laboratory Methods

Because no archaeological artifacts, midden, or soil samples were recovered, no laboratory work was undertaken.

2.3 Consultation

Pre-contact sites were not perceived to be present nor were any pre-contact sites found within the project area, and there appears to be little likelihood that the undertaking will impact any ongoing cultural practices. Pursuant to Chapter 13-276-5 (g), there was no need indicated for consultation, and a summary of findings has been sent to the Office of Hawaiian Affairs (see Appendix A).

Section 3 Documentary Research

3.1 Mythological and Traditional Accounts

The traditions of Honouliuli Ahupua'a have been compiled by several authors, in studies by Sterling and Summers (1978), Hammatt and Folk (1981), Kelly (1991), Charvet-Pond and Davis (1992), Maly (1992), and Tuggle and Tomonari-Tuggle (1997). Some of the traditional themes associated with this area include connections with Kahiki, the traditional homeland of Hawaiians in central Polynesia. There are several versions of the chief Kaha'i leaving from Kalaeloa for a trip to Kahiki; on his return to the Hawaiian Islands he brought back the first breadfruit (Kamakau 1991a:110) and planted it at Pu'uloa, near Pearl Harbor in 'Ewa (Beckwith 1940:97). Several stories associate places in Honouliuli to the gods Kāne and Kanaloa, with the Hawaiian pig god Kamapua'a and the Hina family, and with the sisters of Pele, the Hawaiian volcano goddess, all of who have strong connections with Kahiki (Kamakau 1991a:111; Pukui et al. 1974:200). The locations of traditional places names for Honouliuli are illustrated in Figure 11.

3.1.1 The Naming of 'Ewa and Honouliuli

Honouliuli is the largest *ahupua'a* in the *moku* (district) of 'Ewa. One translation of the name for this district is given as "unequal" (*Saturday Press* Aug. 11, 1883). Others translate the word as "strayed" and associate it with the legends of the gods, Kāne and Kanaloa.

> When Kane and Kanaloa were surveying the islands they came to Oahu and when they reached Red Hill saw below them the broad plains of what is now Ewa. To mark boundaries of the land they would throw a stone and where the stone fell would be the boundary line. When they saw the beautiful land lying below them, it was their thought to include as much of the flat level land as possible. They hurled the stone as far as the Wai'anae range and it landed somewhere, in the Waimānalo section. When they went to find it, they could not locate the spot where it fell. So Ewa (strayed) became known by the name. The stone that strayed [Told to E.S. by Simeon Nawaa, March 22, 1954; cited in Sterling and Summers 1978:1].

Honouliuli means "dark water," "dark bay," or "blue harbor" and was named for the waters of Pearl Harbor (Jarrett 1930:22), which marks the eastern boundary of the *ahupua'a*. The Hawaiians called Pearl Harbor, Pu'uloa (*lit.* long hill). Another explanation for the names comes from the "Legend of Lepeamoa", the chicken-girl of Pālama. In this legend, Honouliuli is the name of the husband of the chiefess Kapālama and grandfather of Lepeamoa (Thrum 1923:164-184). "Her grandfather gave his name, Honouliuli to a land district west of Honolulu . . ." (Thrum 1923:170). Westervelt (1963:209) gives an almost identical account.

It seems likely the boundaries of the western-most *ahupua'a* of 'Ewa were often contested with Wai'anae people. The 'Ewa people could cite divine sanction that the dividing point was between two hills at Pili o Kahe:

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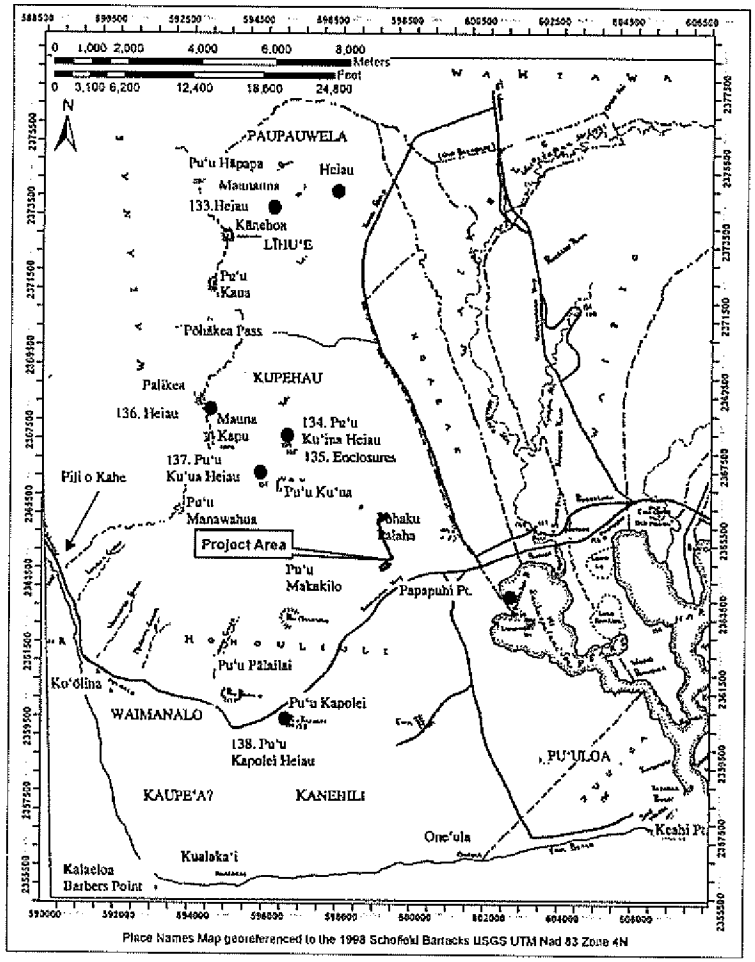

Figure 11. Place Names of Honouliuli (map adapted from Sterling and Summers 1978)

Eventually the stone was found at Pili o Kahe. This is a spot where two small hills of the Wai'anae Range come down parallel on the boundary between Honouliuli and Nānākuli ('Ewa and Wai'anae). The ancient Hawaiians said the hill on the 'Ewa side was the male and the hill on the Wai'anae side was female. The stone was found on the Wai'anae side hill and the place is known as Pili o Kahe.

> (Pili = cling to, Kahe = flow). The name refers, therefore, to the female or Wai'anae side hill. And that is where the boundary between the two districts runs [Told to E.S. by Simeon Nawaa, March 22, 1954; cited in Sterling and Summers 1978:1].

3.2 Historic Background

3.2.1 Pre-Contact and Early Post-Contact Periods

By ca. A.D. 1320, 'Ewa, along with Kona, and Ko'olaupoko were the dominant polities, ruled by the sons of a chief named Māweke (Cordy 2002:21). 'Ewa at this time included the traditional districts of 'Ewa, Wai'anae, and Waialua (Fornander 1880:48). Around A.D. 1400, the entire island was ruled by King La'akona; chiefs within his line, the Māweke-Kumuhonua line, reigned until about A.D. 1520-1540, with their major royal center in Līhu'e, in 'Ewa. (Cordy 2002:24). Haka was the last chief of the Māweke-Kumuhonua line; he was slain by his men at the fortress of Waewae near Līhu'e (Kamakau 1991b:54-54; Fornander 1880:88). Power shifted between the chiefs of different districts from the 1500s until the early 1700s, when Kūali'i achieved control of all of O'ahu by defeating the Kona chiefs, then the 'Ewa chiefs, and then expanding his control on windward Kaua'i. Peleiholani, the heir of Kūali'i, gained control of O'ahu ca. 1740, and later conquered parts of Moloka'i. He was ruler of O'ahu until his death in ca. 1778 when Kahahana, of the 'Ewa line of chiefs was selected as the ruler of O'ahu (Cordy 2002:24-41).

After Kamehameha's O'ahu victory, he gave the *ahupua'a* of Honouliuli to Kalanimōkū as part of the *panalā'au*, or conquered lands, with the right to pass the land on to his heirs rather than having it revert to Kamehameha (Kame'eleihiwa 1992:58, 112). Kalanimōkū subsequently gave the *ahupua'a* to his sister, Wahinepi'o.

Various Hawaiian legends and early historical accounts indicate that the *ahupua'a* (land division) of Honouliuli was once widely inhabited by pre-Contact populations, including the Hawaiian *ali'i* (chiefly class). This would be attributable for the most part to the plentiful marine and estuarine resources available at the coast, along which several sites interpreted as permanent habitations and fishing shrines have been located. Other attractive subsistence-related features of the *ahupua'a* include irrigated lowlands suitable for wetland taro cultivation, as well as the lower forest area of the mountain slopes for the procurement of forest resources. Handy and Handy (1972:429) report:

> The lowlands, bisected by ample streams, were ideal terrain for the cultivation of irrigated taro. The hinterland consisted of deep valleys running far back into the Ko'olau range. Between the valleys were ridges, with steep sides, but a very

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> gradual increase of altitude. The lower part of the valley sides were excellent for the cultivation of yams and bananas. Farther inland grew the 'awa for which the area was famous.

In addition, breadfruit, coconuts, *wauke* (paper mulberry; *Broussonetia papyrifera*), bananas, and *olona* (*Touchardia latifolia*) and other plants were grown in the interior. 'Ewa was known as one of the best areas to grow gourds and was famous for its *mamaki*. It was also famous for a rare taro called the *kai o 'Ewa*, which was grown in mounds in marshy locations (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the saying:

> He has eaten the Kāī-koi taro of 'Ewa. *Ua 'ai i ke kāī-koi o 'Ewa.*
> Kāī is O'ahu's best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of 'Ewa, who, like the Kāī taro, is not easily forgotten [Pukui 1983:#2770].

The lochs of Pearl Harbor were ideal for the construction of fishponds and fish traps. Forest resources along the slopes of the Wai'anae Range probably acted as a viable subsistence alternative during times of famine and/or low rainfall (Handy 1940:211; Handy and Handy 1972:469-470). The upper valley slopes may have also been a resource for sporadic quarrying of basalt used in the manufacturing of stone tools. At least one probable quarrying site (SIHP site 50-80-12-4322) is present in Maka'īwa Gulch at 152 m (500 ft) above mean sea level (Hammatt, et al. 1990).

John Papa 'Ī'ī described a network of Leeward O'ahu trails, which in historic times encircled and crossed the Wai'anae Range, allowing passage from Honouliuli to Wai'anae by three different trails. "As mentioned before, there were three trails to Wai'anae, one by way of Pu'u o Kapolei, another by way of Pohakea, and the third by way of Kolekole" ('Ī'ī 1959:97). Following 'Ī'īs description, a portion of the coastal trail would have passed close to the existing Farrington Highway, approximately 1 km (.6 mi) south of the southern portion of the project area, as seen in an 1825 map (Figure 12) map of the south coast of O'ahu by Charles Malden of the British ship the *Blonde*.

Early historical accounts of the general region typically refer to the more populated areas of the 'Ewa district, where missions and schools were established and subsistence resources were perceived to be greater. However, the presence of archaeological sites along the barren coral plains and coast of southwest Honouliuli Ahupua'a, indicate that prehistoric and early historic populations also adapted to less inviting areas, despite the environmental hardships.

3.2.2 Observations of Early Explorers and Foreign Residents

Captain Vancouver sailed by Kalaeloa (Barbers Point) in 1792, and recorded his impression of the small coastal village of Kualaka'i and the arid Honouliuli coast.

> The point is low flat land, with a reef round it . . . Not far from the S.W. point is a small grove of shabby cocoa-nut trees, and along these shores are a few struggling fishermen's huts [Vancouver 1798, Vol. I:167].
>
> . . . from the commencement of the high land to the westward of Opooroah [Pu'uloa], was composed of one very barren rocky waste, nearly destitute of

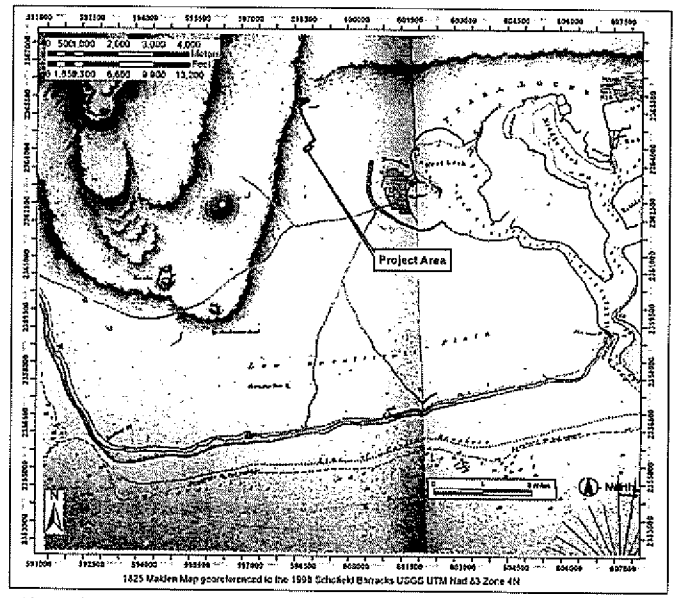

Figure 12. Portion of 1825 Map of the South Coast of Woahoo (O'ahu) and Honolulu by Lieut. C.R. Malden from the British ship the *Blonde*

> verdure, cultivation or inhabitants, with little variation all the way to the west point of the island . . . [Vancouver 1798, Vol. II:217]. . . . This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of fertility; although we were told that at a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced . . . [Vancouver 1798, Vol. III:361-363].

Archibald Campbell, an English seamen who was given some land in Waimano Ahupua'a by King Kamehameha in 1809, described his land around Pearl Harbor:

> In the month of November the king was pleased to grant me about sixty acres of land, situated upon the Wymummee [traditional Hawaiian name for Pearl River], or Pearl-water, an inlet of the sea about twelve miles to the west of Hanaroora [Honolulu]. . . . We passed by footpaths, winding through an extensive and fertile

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> plain, the whole of which is in the highest state of cultivation. Every stream was carefully embanked, to supply water for the taro beds. Where there was not water, the land was under crops of yams and sweet potatoes [Campbell 1967:103-104].

Pearl and mother-of-pearl shells are found here in considerable quantity. Since the king has learned of their value, he has kept the fishing to himself, and employs divers for the purpose [Campbell 1967:114-115].

Subsequent to western contact in the area, the landscape of the 'Ewa plains and Wai'anae slopes was adversely affected by the removal of the sandalwood forest, and the introduction of domesticated animals and new vegetation species. Domesticated animals, including goats, sheep and cattle, were brought to the Hawaiian Islands by Vancouver in the early 1790s, and allowed to graze freely about the land for some time after. It is unclear when the domesticated animals were brought to O'ahu, however, L.A. Henke reports the existence of a longhorn cattle ranch in Wai'anae by at least 1840 (Frierson 1972:10). During this same time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the logging of sandalwood forest and eroded by animal grazing. Within the current project area, the majority of the (non-cultivated) vegetation is comprised of introduced species, mainly grasses.

At contact, the most populous *ahupua'a* on the island was Honouliuli, with the majority of the population centered on Pearl Harbor. In 1832, a missionary census of Honouliuli recorded the population as 1,026. Within four years the population was down to 870 (Schmitt 1973:19, 22). In 1835, there were eight to ten deaths for every birth (Kelly 1991:157-158). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages. In 1853, the population of 'Ewa and Wai'anae combined was 2,451 people. In 1872, it was 1,671 (Schmitt 1968:71). The inland area of 'Ewa was probably abandoned by the mid-nineteenth century, due to population decline and consolidation of the remaining people in the town of Honouliuli (at Kapapapuhi Point, southeast of the project area). A detailed discussion of the historic population counts in the 'Ewa District has been presented by Charvet-Pond and Davis (1992).

The first mission station in 'Ewa was established in 1834 at Kalua'aha near Pearl Harbor. Charles Wilkes, of the U.S. Exploring Expedition visited the missionary enclave at Honouliuli town in 1840.

> At Ewa, Mr. Bishop has a large congregation. The village comprises about fifty houses, and the country around is dotted with them. . . . The natives have made some advance in the arts of civilized life; there is a sugar-mill which, in the season, makes two hundred pounds of sugar a day. . . . In 1840, the church contained nine hundred members, seven hundred and sixty of whom belonged to Ewa, the remainder to Wai'anae; but the Catholics have now established themselves at both these places, and it is understood are drawing off many from their attendance on Mr. Bishop's church [Wilkes 1970:80-81].

A portion of the 1825 map of the South Coast of Woahoo (O'ahu) and Honolulu by Lieut. C.R. Malden from the British ship the *Blonde* (see Figure 12) depicts substantial settlement at the "Honouliuli Taro Land" in the Kapapapuhi Point area, and it seems clear that in early historic

times, this was the focus of the population of Honouliuli. The amenities of the area - including fishponds, taro *lo'i*, abundant shellfish, and salt pans - would have focused population there in pre-Contact times as well.

3.2.3 Mid-Nineteenth Century and the Māhele

The Organic Acts of 1845 and 1846 initiated the process of the *māhele* - the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848, the crown and the *ali'i* (chiefly class) received their land titles. The common people received their *kuleana* (individual parcels) in 1850.

During the *Māhele* of 1848, 72 individual land claims in the *ahupua'a* of Honouliuli were registered and awarded by King Kamehameha III (Tuggle and Tomonari-Tuggle 1997:34). The 72 *kuleana* awards, awards given to commoners, were almost all made adjacent to Honouliuli Gulch, which contained fishponds and irrigated taro fields. Kepā Maly (1997, Table 3: 38-42) provides a table recording information on each award, including awardee, *'ili*, and land use of the *'āpana* (lot). Project area lands were unclaimed and subsequently were granted to Miriam Ke'ahi-Kuni Kekau'ōnohi.

3.2.4 Honouliuli Māhele Awards to *Ali'i*

In 1855, the Land Commission awarded all of the unclaimed lands in Honouliuli, 43,250 acres, to Miriam Ke'ahikuni Kekau'ōnohi (Royal Patent #6971 in 1877; Parcel #1069 in the Land Court office), a granddaughter of Kamehameha I, and the heir of Kalanimōkū, who had been given the land by Kamehameha after the conquest of O'ahu (Indices of Awards 1929; Kame'eleihiwa 1992). Kekau'ōnohi was also awarded the *ahupua'a* of Pu'uloa, but she sold this land in 1849 to Isaac Montgomery, a British lawyer.

Kekau'ōnohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu'u Kahalai'a, who was governor of Kaua'i (Hammatt and Shideler 1990:19-20:20). Subsequently, Kekau'ōnohi ran away with Queen Ka'ahumanu's stepson, Keli'iahonui, and then became the wife of Chief Levi Ha'alelea. Upon her death on June 2, 1851, all her property was passed on to her husband and his heirs. A lawsuit (Civil Court Case No. 348) was brought by Ha'alelea in 1858, to reclaim the fishing rights of the Pu'uloa fisheries from Isaac Montgomery, and the court ruled in Ha'alaea's favor. In 1863, the owners of the *kuleana* lands deeded their lands back to Ha'alelea to pay off debts owed to him (Frierson 1972:12). In 1864, Ha'alelea died, and his second wife, Anadelia Amoe, transferred ownership of the land to her sister's husband John Coney (Yoklavich et al 1995:16).

3.2.5 Early Ranching on the 'Ewa Plain

John Coney rented the land to James Dowsett and John Meek in 1871, who used the land for cattle grazing. In 1877, the land, except for the *'ili* of Pu'uloa, was sold to James Campbell. He drove off 32,237 head of stock belonging to Dowsett and Meek and to James Robinson and constructed a fence around the outer boundary of his property (Bordner and Silva 1983:C-12). He let the land rest for one year and then began to restock the ranch, so that he had a head of 5,500 head after a few years (Dillingham 1885, cited in Frierson 1972:14)

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In 1880-81, the Honouliuli ranch was described as:

> . . . Acreage, 43,250, all in pasture, but possessing fertile soils suitable for agriculture; affords grazing for such valuable stock. The length of this estate is no less than 18 miles. It extends to within less than a mile of the sea coast, to the westward of the Pearl River inlet. . . . There are valuable fisheries attached to this estate . . . . [Bowser 1880:489].
>
> From Mr. Campbell's veranda, looking eastward, you have one of the most splendid sights imaginable. Below the house there are two lochs, or lagoons, covered with water fowl, and celebrated for their plentiful supply of fish, chiefly mullet. . . . Besides Mr. Campbell's residence, which is pleasantly situated and surrounded with ornamental and shade trees, there are at Honouliuli two churches and a school house, with a little village of native huts [Bowser 1880:495].

Most of Campbell's lands in Honouliuli were used exclusively for cattle ranching. At that time, one planter remarked "the country was so dry and full of bottomless cracks and fissures that water would all be lost and irrigation impracticable" (Ewa Plantation Co. 1923:6-7). In 1879, Campbell brought in a well-driller from California to search the 'Ewa plains for water, and the well, drilled to a depth of 240 feet near Campbell's home in 'Ewa, resulted in ". . . a sheet of pure water flowing like a dome of glass from all sides of the well casing" (The Legacy of James Campbell n.d., cited in Pagliaro 1987:3). Following this discovery, plantation developers and ranchers drilled numerous wells in search of the valuable resource.

3.2.6 History of Oahu Sugar Company

3.2.6.1 General History of the Company

In 1897, B. F. Dillingham established the Oahu Sugar Company on 12,000 acres leased from the John Papa 'Ī'ī, Bishop, and Robinson estates. Prior to commercial sugar cultivation, these lands were described as being "of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project" (Condé and Best 1973:313). Dillingham had successfully promoted the Ewa Plantation Company in 1890; the sprawling sugar company was just south of and adjacent to the Oahu Sugar Company. Artesian wells had converted those arid Eva lands into a thriving plantation and Dillingham recognized the same potential in the northern area.

The project area is located in the western portion of the Oahu Sugar Company, which was also known as the Oahu Plantation (Figure 13and Figure 14). The northern portion of the project area is within Field 37; the central portion of the project area extends from Field 27 to Field 37, and the southern portion of the project area is within Field 28. Water to irrigate the upper cane fields was initially pumped to levels of 500 ft (150 m) by some of the "largest steam pumps ever manufactured" (Dorrance and Morgan 2000:49). Oahu Sugar Company's innovations to utilize the arid Ewa Plains and increase production within the plantation were so successful that the improvements were incorporate throughout the sugar cane industry. The Oahu Sugar Company constructed Hawai'i's first 12-roller mill in 1907, and P.A. Messchaert, the plantation's chemist,

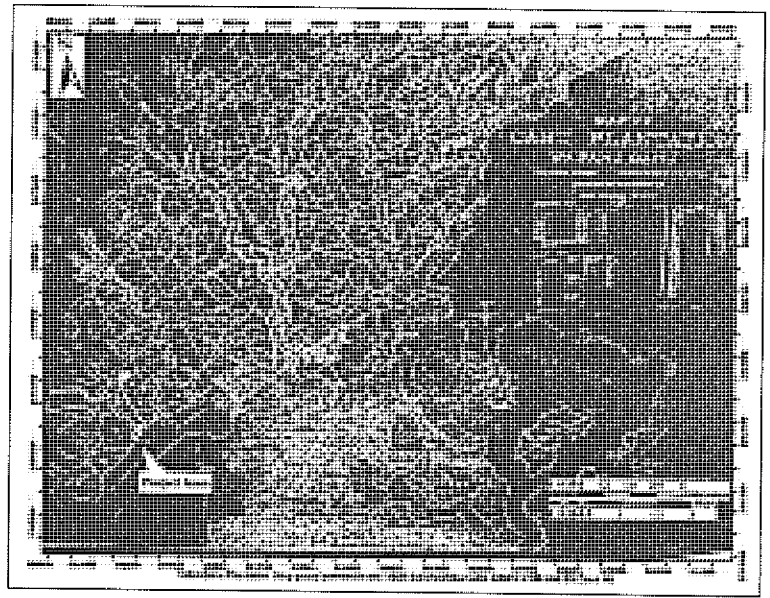

Figure 13. Oahu Plantation, 1909

invented a mechanized grooving method in 1913 that maintained pressure on the processing cane while allowing the cane juice to flow (Dorrance and Morgan 2000:49).

The expense of pumping water to the high elevations of the plantation led to the proposal to transport water from the windward side of the Koolaus. The Waiahole Water Company was formally incorporated in 1913 and was originally a subsidiary of the Oahu Sugar Company. The Waiahole Ditch was designed by engineer Jorgen Jorgensen, with recommendations by engineer J.B. Lippencott and assisted by W.A. Wall. The ditch began in Kahana Valley at an elevation of 790 ft (240 m), and ran almost entirely through tunnels through the Waikane and Waiahole valleys, the Koolaus, and was finally captured in a reservoir at 600-foot (180 m) elevation in the Wai'anae Range. Upon its completion in 1916, the Waiahole Ditch was 21.9 miles long (35 kilometers) and cost $2.3 million. The 32 million gallons of daily water enabled the O'ahu Sugar Company to grow to "some 20 square miles . . . ranging in elevation from 10 feet at the Waipio Peninsula . . . to 700 feet at the Waiahole Ditch" (Condé and Best 1973:313).

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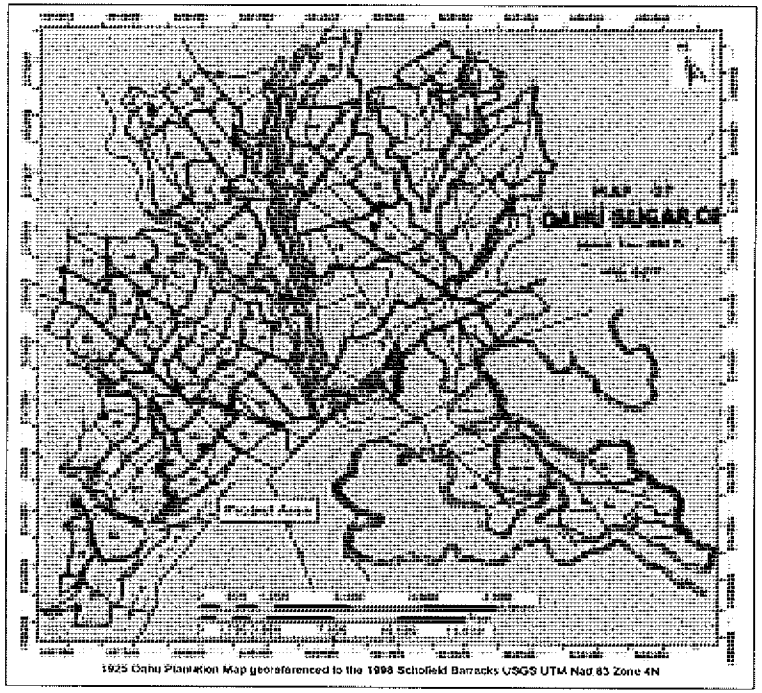

Figure 14. Oahu Sugar Company 1925, project area depicted in white

Annual sugar production increased to over 50,000 tons in 1918 and exceeded 40,000 tons annually for decades. In 1928, the Oahu Sugar Company broke a world's record by averaging more than 12 tons of sugar per acre. Mechanical harvesting innovations within the industry continued to develop and further increased production. They included mechanically loading cane in 1924, the removal of impurities during processing with an Oliver filer in 1926, and, during World War II, all cane was mechanically harvested. In 1950, sugar railroads were replaced with trucks.

By 1960, the Oahu Sugar Company was the largest producer on Oahu, with 75,000 tons annually. The company took control of the Ewa Plantation lands (Figure 15) in 1970 and continued operations until 1995, when sugar cane production in the combined plantation area ended (Dorrance and Morgan 2000:45, 50).

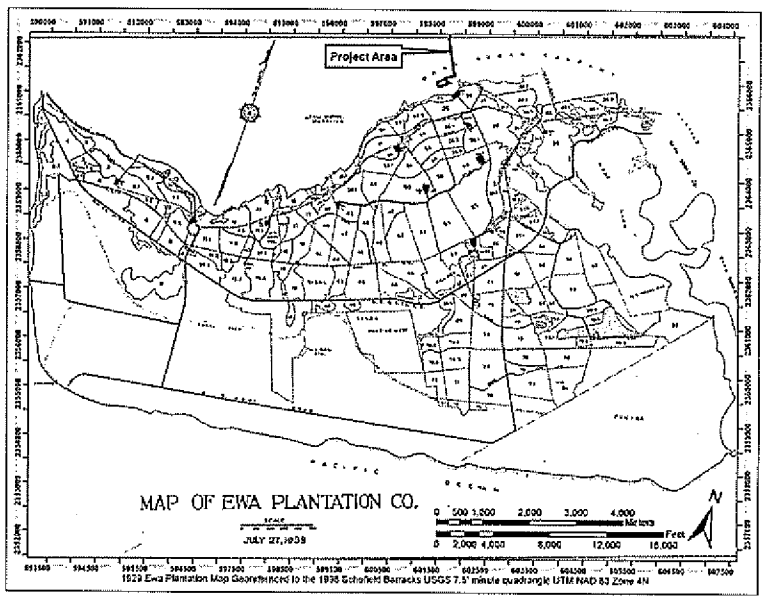

Figure 15. 1939 map of the Ewa Plantation Co. lands, showing project area

3.2.7 History of the Ewa Sugar Plantation

In 1886, James Campbell and B. F. Dillingham put together the "Great Land Colonization Scheme," which was an attempt to sell Honouliuli land to homesteaders (Thrum 1886:74). This homestead idea failed, but with the water problem solved by the drilling of artesian wells, Dillingham decided that the area could be used instead for large-scale cultivation (Pagliaro 1987:4). During the last decade of the nineteenth century, the railroad would reach from Honolulu to Pearl City in 1890, to Wai'anae in 1895, to Waialua Plantation in 1898, and to Kahuku in 1899 (Kuykendall 1967:III, 100). This railroad line eventually ran across the center of the 'Ewa Plain at the lower boundary of the sugar fields.

To attract business to his new railroad system, Dillingham subleased all land below 200 ft to William Castle, who in turn sublet the area to the newly-formed Ewa Plantation Company (Frierson 1972:15). Dillingham's Honouliuli lands above 200 ft that were suitable for sugar cane cultivation were sublet to the Oahu Sugar Company. Throughout this time, and continuing into

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modern times, cattle ranching continued in the area, and Honouliuli Ranch - established by Dillingham - was the "fattening" area for the other ranches (Frierson 1972:15).

Ewa Plantation Company was incorporated in 1890 for sugar cane cultivation. As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Company installed ditches running from the lower slopes of the mountain range to the lowlands. When the rainy season began, they plowed ground perpendicular to the slope so that soil would be carried down the drainage ditches into the lower coral plain. After a few years, about 373 acres of coral wasteland were reclaimed in this manner (Immisch 1964). By the 1920s, Ewa Plantation was generating large profits and was the "richest sugar plantation in the world" (*Paradise of the Pacific*, Dec. 1902:19-22, cited in Kelly 1985:171).

3.2.8 Pineapple Production

Although the northern portion of the project area was within the Oahu Sugar Company on the 1925 map (see Figure 14), these lands have been under pineapple cultivation for decades. Libby, McNeill and Libby began leasing the lands in 1921 (Smith 1924:133).

The first pineapples to arrive in Hawai'i may have been transported as early as 1527 by the Spanish. In 1794, a Spanish horticulturalist, Francisco de Paula Marin, immigrated to Hawai'i; he began experimentally raising pineapples in the early 1800s. Captain John Kidwell began pineapple crop development trials in 1885. Kidwell is considered to by the founder of Hawai'i's pineapple industry although James Drummond Dole is credited with advancing the industry. Dole became Hawai'i's "Pineapple King" after incorporating the Hawaiian Pineapple Company and commercially growing pineapples in 1901. Pineapple production grew to be Hawai'i's second largest industry (Fisher 2006).

Recently, the northern portion of the project area has been within pineapple fields cultivated by Del Monte. Del Monte had planned on harvesting their last crop of pineapple within the vicinity of the project area in 2008. However, the current crop has just been abandoned and future plans for the vicinity are unknown.

Section 4 Previous Archaeological Research

4.1 Overview of Archaeological Studies in Honouliuli

Two archaeological features, a boundary *pōhaku* or rock and a *hōlua*, or sledding site, are recorded only in the Boundary Commission Reports establishing the division lines between the *ahupua'a* of Honouliuli and Hō'ae'ae (to the east). The surveyor wrote of the southern point of this boundary:

> In regard to Hoaeae . . . the point of commencement is Pōhaku Palahalaha, a well known rock, now marked by an arrow and the name "Honouliuli" on one side and "Hoaeae" on the other, which I have made the initial point of the survey . . . [Commission on Boundaries, Vol. 1:243].

This rock is shown on the Sterling and Summer map (see Figure 11) as Pōhaku Palaha, east of the project area. In another boundary survey, the *pōhaku* is called a "large, flat rock" (Boundary Commission Vol. 1:249), which may indicate the origin of the name from the Hawaiian word *pālaha*, which means "flattened, wide" (Pukui and Elbert 1986:307). As the surveyor continued to walk the Honouliuli/Hō'ae'ae boundary, he marked the northern point of the division as:

> The Kamaaaina took me to the corner of Pauhala (?)-Hoaeae and Honouliuli – there is an ancient holua or sleding [*sic*] place near this – which is agreed for the ancient corner. . . [Commission on Boundaries Vol. 1:243].

The earliest attempt to record archaeological remains in Honouliuli Ahupua'a was made by Thrum (1906:46). He reported the existence of a *heiau* located on Pu'u Kapolei, southwest of the present study area. In a second monograph on *heiau*, Thrum (1917) called this *heiau* Palole'i [Kapolei]. Emory mapped and photographed these structures in 1933 (field notes), but they were dismantled and destroyed sometime before McAllister's survey of the islands in the 1930s. According to legend, Pu'u Kapolei was the location on which Kamapua'a, the pig-god, resided with his grandmother, Kamaunuahihio (McAllister 1933:108).

In his surface survey of the 1930s, archaeologist J. Gilbert McAllister recorded the specific locations of important sites, and the general locations of less important sites (at least at Honouliuli). McAllister recorded six sites (see Figure 11 for site locations) in the upland section of Honouliuli, *mauka* of the 'Ewa coral plain and Pu'u o Kapolei. Site 133 is a possible *heiau*, a small enclosure at the foot of Pu'u Kānehoa. It was still standing during McAllister's day, and local residents informed him of its sacred nature. Site 134 is Pu'u Kuina Heiau, located in a gulch at the foot of Mauna Kapu. Only traces of a large terrace remained. Site 135 is a series of enclosures *makai* of Pu'u Kuina Heiau. McAllister believed that the walls marked *kuleana* (commoner) lots. Site 136 is a small platform near Mauna Kapu, a sacred site, possibly an altar. Site 137 is Pu'u Ku'ua Heiau, plotted on a ridge near Pu'u Ku'ua. This *heiau* had been modified for use as a cattle pen; some areas had been cleared for pineapple cultivation or planted with ironwoods (McAllister 1933:107-108).

Between McAllister's 1930s study and the flurry of work that began in 1969, there are only a few sporadic pieces of research, which are not well documented. In 1933, Dr. Kenneth P. Emory

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recorded a well-preserved house site and a possible *heiau* (later destroyed by sugar cane cultivation) in the western part of the coral plains (Sinoto 1976:1). In 1959, William Kikuchi removed a number of burials from a burial cave site (Bishop Museum Site OA-B6-10) at the Standard Oil Refinery, which was subsequently destroyed (Barrera 1975:1). Kikuchi recovered 12-16 incomplete primary and/or secondary burials cached in a sinkhole or crevice exposed during construction activities near the big bend in Malakole Road (Kikuchi 1959; Davis 1990b: 146, 147): In 1960, Yoshi Sinoto and Elspeth Sterling visited a house site (BPBM. Site OA-B6-8) within 'Ekaha Nui Gulch, "Around this elevation (1200 feet), along the sides of the stream, were seen remains of many terraces and some house sites" (Sterling and Summers 1978:37). In 1962, Lloyd Soehren recorded another secondary human burial in a sinkhole at the Barber's Point Naval Air Station (Davis 1990a:147). In 1966, Lloyd Soehren carried out salvage excavations at a possible fishing shrine (BPBM. Site # 50-OA-B6-13). The site was reported as destroyed by construction (Barrera 1975:1), but Davis relocated the shrine and performed additional excavations in 1982 (Davis 1990a:148). In 1969, artifacts were recovered by Roger Green from a beach midden site (B6-14), south of the barge harbor.

4.2 Previous Archaeological Work in the Vicinity of the Project Area

Beginning in the late 1970s, archaeological research has been conducted in Honouliuli south and east of the general vicinity of the project area (Figure 16).

CHS has recently completed an archaeological inventory survey just south of H-1 and the current project area (O'Hare, et al 2006). The reported findings are based on a 1990 CSH inventory survey and a 2005 CSH surface survey. A total of five sites, a railroad berm (Site 50-80-12-4345), three pumping stations (Sites 50-80-12-4346, -4347, and -4348), and three features related to plantation infrastructure (Site 50-80-12-4344) were recorded and assigned SIHP permanent site numbers. During the 1990 survey, four historic documented areas of Hawaiian and later immigrant residence were also identified: the former sites of Honouliuli Taro Lands, Kapalani Church, PipeLine Village, and Drivers/Stable Village. Further work, especially subsurface testing, was recommended for these four areas. During the recent 2005 surface survey of 1,630-acres, four new features related to sugar cane cultivation or irrigation were recorded. These four features (Features D-G) were subsumed under the previous site number, Site 50-80-12-4344, used for scattered plantation infrastructure features. A total of 19 trenches were excavated in the four areas of historic habitation and/or agriculture identified in the 1990 CSH survey to determine if there were any subsurface remains of: (1) nineteenth century (or earlier) habitation and agricultural lots in the Honouliuli Taro Lands; (2) structures or burials associated with the nineteenth century Kapalani Catholic Church; (3) structures or historic domestic artifacts associated with the early twentieth century Drivers and Stable Village; and, (4) structures or historic domestic artifacts or pit/privy features associated with the early twentieth century PipeLine Village. No cultural deposits, no privy pits, no burials, and no artifacts of any type were found or recovered from the 19 trenches.

The recent CHS survey included a non-contiguous northern parcel that is approximately 1640 feet (500 meters) west of the current project area (O'Hare, et al. 2006). No evidence of historic or prehistoric activity was identified within that portion of the project area.

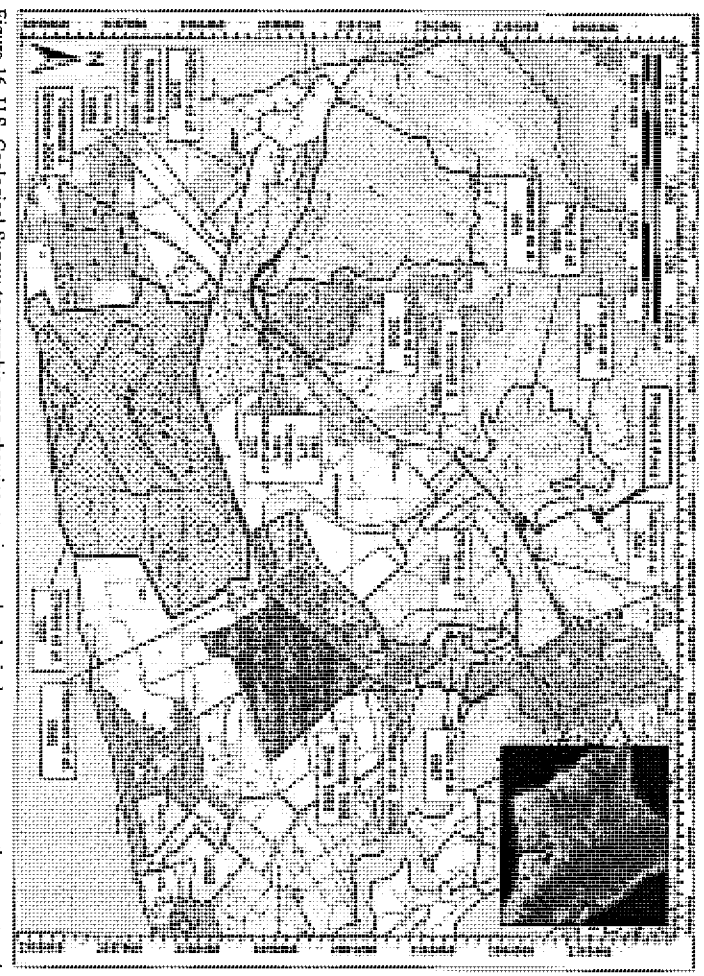

Figure 16. U.S. Geological Survey topographic map, showing previous archaeological survey areas near the current project area

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In 1987, a reconnaissance survey was conducted on an approximately 200-acre property in 'Ewa (Kennedy 1987). The land is east of the current project area and within the *ahupua'a* of Hū'ae'ae, adjacent to the boundary of Honouliuli Ahupua'a. No prehistoric properties were found during the survey. The Waiahole ditch runs through the project area and two recently constructed reservoirs are within the project area. No further work was recommended since ground visibility was 100% and there was no indication the property contained subsurface deposits.

In 1991, Cultural Surveys Hawai'i conducted an archaeological inventory survey of the "Makaīwa Hills" development project (Hammatt, et al. 1991). The project area included a 1,915 acre parcel in Honouliuli *Ahupua'a*, between the town of Makakilo and Waimānalo Gulch (to the west of the current project area). 34 sites were located, including habitation structures (temporary and permanent), agricultural features (terrace and mounds), rock shelters, petroglyphs, and various other structures associated with sugar cane cultivation attributable to the Ewa Plantation Company. Eighteen of the recorded sites were considered significant and preservation was recommended. Sixteen of the sites, including cattle walls and other structures associated with the 'Ewa Plantation Co., were considered to be no longer significant and no further work was recommended.

An archaeological inventory survey of the University of Hawai'i, West O'ahu Campus, was conducted adjacent to and west of the southern portion of the current project area in 1998 (Dega, et al. 1998). Many historical features associated with sugarcane production and irrigation were identified and recorded as State Site Number 50-80-08-5593. Since sufficient data was collected, the site was considered no longer significant and no further work was required

In 2001, Cultural Surveys Hawai'i conducted an archaeological inventory survey of the proposed 'Ewa Shaft Renovation Project (Tulchin, et al. 2001). The approximately 1-acre project area is approximately 2,500 ft (750 m) east of the southern portion of the current project area. No prehistoric or historic properties were observed during the surface survey or subsequent subsurface testing.

4.3 Background Summary and Predictive Model

4.3.1 Honouliuli Settlement Patterns

The *ahupua'a* of Honouliuli is the largest traditional land unit on the island of O'ahu. Honouliuli includes all the land from the western boundary of Pearl Harbor (West Loch) westward to the 'Ewa/Wai'anae District Boundary with the exception of the west side of the harbor entrance, which is in the *ahupua'a* of Pu'uloa (the 'Ewa Beach/Iroquois Point area). This comprises approximately 12 miles of open coastline from One'ula westward to Pili O Kahe. The *ahupua'a* extends *mauka* (almost pie-shaped) from West Loch nearly to Schofield Barracks, and the western boundary is the Wai'anae Mountain crest running *makai* to the east ridge of Nānākuli Valley.

Not only is there a long coastline fronting the normally calm waters of leeward O'ahu, but there are also four miles of waterfront along West Loch. The land immediately *mauka* of the Pacific coast consists of a flat karstic raised limestone reef forming a level nearly featureless "desert" plain marked in pre-Contact times (previous to alluviation caused by sugar cultivation)

by a thin or non-existent soil mantle. The microtopography is notable in containing countless sinkholes in some areas caused by chemical weathering (dissolution) of the limestone shelf.

Along the eastern flank of the Wai'anae Mountains, numerous gulches have contributed to the alluvial deposits over the coastal limestone shelf. The largest of the gulches is Honouliuli Gulch, which drains into West Loch. The gulches are generally steep-sided in the uplands and generally of a high gradient until they emerge onto the flat 'Ewa plain. The alluvium they have carried has spread out in delta fashion over the *mauka* portions of the plain, which comprises a dramatic depositional environment at the stream gradient change. These gulches are generally dry, but during seasonal Kona storms carry immense quantities of runoff onto the plain and into the ocean. As typical drainages in arid slopes, they are either raging uncontrollably, or are dry and, as such, do not form stable water sources for traditional agriculture in their upper reaches. The Honouliuli gulches generally do not have valleys suitable for extensive irrigated agriculture; however, this lack is more than compensated for by the rich watered lowlands near West Loch.

Honouliuli Ahupua'a, as a traditional land unit, had abundant and varied resources available for exploitation by early Hawaiians. The "karstic desert" and marginal characterization of the limestone plain, which is the most readily visible terrain, does not do justice to the *ahupua'a* as a whole. The richness of this land unit is marked by the following available resources:

1) 12 miles of coastline with continuous shallow fringing reef, which offered rich marine resources.

2) Four miles of frontage on the waters of West Loch, which offered extensive fisheries (mullet, *awa*, shellfish), as well as frontage suitable for development of fishponds.

3) The lower portion of Honouliuli Valley in the 'Ewa plain offered rich level alluvial soils with plentiful water for irrigation from the stream as well as abundant springs. This land would have stretched well up the valley.

4) A broad limestone plain, which because of innumerable limestone sinkholes, offered a nesting home for a large population of avifauna. This resource may have been one of the early attractions to human settlement.

5) An extensive upland forest zone extending as much as 12 miles inland from the edge to the coastal plain. As Handy and Handy (1972:469) have pointed out, the forest was much more distant from the lowlands here than it was on the windward side, but on the leeward side was more extensive. Much of the upper reaches of the *ahupua'a* would have had species-diverse forest with *kukui*, *'ōhia*, sandalwood, *hau*, *ti*, banana, etc.

Within this natural setting, archaeological and traditional sources show a general pattern of settlement within the *ahupua'a* that includes the inland settlement at Pu'u Ku'ua.

4.3.2 Pu'u Ku'ua: Inland Settlement

Documentation of inland settlement in Honouliuli Ahupua'a is problematic in that there are relatively few documented archaeological sources. However, it is probable that the area around Pu'u Ku'ua, on the east side of the Wai'anae Ridge, was a Hawaiian place of some importance.

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Pu'u Ku'ua is approximately 8,000 ft (2.5 km) west-south-west of the project area and is separated from the project area by Honouliuli Gulch.

There are two aspects of the stories related to Pu'u Ku'ua. One story relates that Pu'u Ku'ua was formerly a place of chiefs that was named for a chiefess. The other story relates that Pu'u Ku'ua was populated by the kauwa, or slaves.

In 1899, Hawaiian Newspaper *Ka Loea Kālai'āina* relates a story of Pu'uku'ua as "a place where chiefs lived in ancient times" and a "battle field," "thickly populated." The article summarizes:

There were two important things concerning this place. (1) This place was entirely deserted and left uninhabited and it seems that this happened before the coming of righteousness to Hawai'i Nei. Not an inhabitant is left. (2) The descendants of the people of this place were so mixed that they were all of one class. Here the gods became tired and returned to Kahiki [*Ka Loea Kālai'āina*, July 8, 1899, translated in Sterling and Summers 1978:32-33].

Thrum (1998:93) also mentions the hill Pu'uku'ua in the legend of the hero Kalelealuaka. In this legend, Kalelealuaka, who resides in Keahumoe in Waipi'o, 'Ewa, can transport himself long distances across the island of O'ahu. On a day before he is to meet the local chief, he transports to Helemano (near Wahiawa town) for a purifying bath, next transports himself to a place behind the visiting chief's retinue, and then flies with them to Pu'uloa (the east coastal area of Honouliuli).

> Returning from his purification, Kalelealuaka alighted just to the rear of the party, who had not noticed his absence, and becoming impatient at the tedious slowness of the journey, --for the day was waning, and the declining sun was already standing over a peak of the Wai'anae Mountains called Puukuua,--this marvelous fellow caught up the lame marshal [of the chief] in one hand and his two comrades in the other, and, flying with them, set them down at Puuloa. But the great marvel was, that they knew nothing about being transported, yet they had been carried and set down as from a sheet [Thrum 1998:93].

The same Hawaiian Newspaper *Ka Loea Kālai'āina* article cited above also states that the term *kauwā* (meaning slave or outcast) was first used to identify Pu'u Ku'ua because of a one armed chiefess who was ashamed and ran when other chiefs would visit. She was not a *kauwā* she only behaved as one [*Ka Loea Kālai'āina*, July 8, 1899, translated in Sterling and Summers 1978:33].

Another description of the *kauwā* residing in the vicinity of Pu'u Ku'ua follows:

> . . If you are above Puuloa, you will see Pu'u-o-Kapolei, a small hill. Lying below and back of that hill is the government road going to Wai'anae. Above that is also a small hill and back of that, is a big hill and above it is a large hollow. That is Pu'u-Kuua where the very dirty ones lived [*Ka Loea Kālai'āina* July 15, 1899, translation in Sterling and Summers 1978:32].

Kamakau says that the *kauwā* of O'ahu used the disruptions caused by the inter-island wars against several chiefs to assimilate into the general Hawaiian society.

The *kauwa* of Oah'u became "lost in the shuffle" (*huikau*) when Kahahana and the Oah'u chiefs died and Kahekili and his Maui chiefs took over the kingdom in 1783, and again when Kamehameha and his Hawai'i chiefs took the kingdom in 1795. The *kauwa* hid themselves until the time when the *kapu akua*, the god's kapus, were overthrown, and the kingdom became a "free-eating' one, *ke aupuni 'ainoa* [one without gods]. That released the *kauwa*. . . . By mixing here, mixing there, the blood of lords has become mixed with the blood of *kauwa*, and there is nothing that can cleanse it (*'a'ole mea nana i hiukala*) [Kamakau1991a:9].

Additionally, Kapo, Pele's sister, is believed to have left her flying vagina (*kohe lele*) at Pu'uku'ua.

McAllister recorded three sites in the vicinity of the project area and Pu'uku'ua, two *'heiau* (134, 137) (Pu'u Kuina and Pu'uku'ua, both destroyed) and a series of enclosures in Kukuilua which he called "kuleana sites" (McAllister 1933). McAllister (1933) noted that most of the stones of heiau 137 were used for a cattle pen located on the sea-side of the site; the portion of *heiau* that was cleared for pineapples has been planted in ironwood. On the opposite side of the Wai'anae range, along the trail to Pōhākea Pass, Cordy (2002:36) states "Kākuihihewa was said to have built (or rebuilt) Nōi'ula, a *pō'okanaka heiau* (1,300 sq. m.) in Hālona in upper Lualualei, along the trail to Pōhākea Pass leading into 'Ewa, ca. A.D. 1640-1660" (Cordy 2002:36). There is no direct archaeological evidence available to the authors' knowledge that intensive Hawaiian settlement occurred here, but it is considered as a place of high probability, based on the above indications. John Papa 'Ī'ī (1959) described a journey that Liholiho took which led him and an entourage through inland Honouliuli and over Pōhākea Pass. Geographically, the area receives sufficient quantities of water and would have had abundant locally available forest resources.

4.3.3 Project Area Predictive Model

Although the project area is near the Pu'uku'ua settlement area, approximately 8,000 ft (2.5 kilometers) west-south-west of the project area, it is separated from the project area by Honouliuli Gulch. The project area is not located near a source of water and was probably outside the boundary of the Pu'uku'ua population center. The project area was therefore not likely a focus for permanent habitation or agriculture.

Previous archaeological work conducted within the vicinity of the current project area also indicates that the project area is unlikely to contain subsurface prehistoric deposits.

4.3.4 Summary

On the basis of archaeological studies, informed by historic records, the following may be concluded:

1) There are three areas of Hawaiian settlement in the *ahupua'a* indicated in the historic record:
    a. the extensive limestone plain with recurrent ose habitations for fishermen and gatherers and sometime gardeners;

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b. the rich cultivated lands of Honouliuli 'ili for extensive wetland taro and clearly the *ahupua'a* population center; and,

c. the uplands around Pu'uku'ua associated with *kauwā* residence but probably used for agriculture and forest resources.

2) Honouliuli is designed as a unit to contain all the geographic elements of a typical Hawaiian valley *ahupua'a*, except they are arranged geomorphically in an atypical relationship. The *ahupua'a* is not organized around a single drainage network but shares the west portions of Waikele drainage in its upper reaches. A typical and highly advantageous characteristic for human subsistence is included in a vast coastline and fringing reef, an extensive limestone plain which would support only limited agriculture but would be excellent for bird catching in early times, and a huge expanse of sloping forest land. The richest forest land for foraging for wood, birds, feathers, etc. would have been the east slope of the Wai'anae Range. The surveys by Bordner and Silva (1983) and Hammatt and Shideler (1999) at Waimānalo Gulch indicated no evidence of Hawaiian occupation, but the gulch has been impacted in modern times.

3) The *makai* slope was not a major thoroughfare. We can see some very limited evidence of part-time agriculture in and around gulches and two foci of sparse habitation. The first is limited to *makai* portions of gulches and lava flats. This habitation is considered a *mauka* component or continuing of the Ko'ōlina coastal settlement rather than an independent focus. The second focus, separated from the first by a barren zone, is generally above the 800-foot elevation. This *mauka* habitation which could have been supported by seasonal dry land planting and forest foraging may be the lower portion of a thinly scattered, but widespread zone of settlement which stretches eastward and northeast along the east Wai'anae Range slopes and may increase in intensity along the more watered lands forming the *mauka* western boundary of Honouliuli.

4) There is to date no archaeological evidence of high status residence in Honouliuli. Large residential structures are not present along the Pacific shoreline where they would be expected. The late prehistoric occurrence of chiefs' houses is not apparent, perhaps because the ocean shoreline, although rich in marine resources, is uninviting for sport and unsuitable for fishponds. The chiefly focus of 'Ewa District was Waipi'o. Whatever activities of this class occurred in Honouliuli would have been in or near the rich lands fronting West Loch (the *'ili* of Honouliuli). Concerning status associations with Honouliuli, it is interesting to note the connection of the Pu'uku'ua settlement with slaves (*kauwā*), the lowest class of Hawaiians (Sterling and Summers 1978:33).

5) The focus of population and agriculture within the *ahupua'a* of Honouliuli was the *'ili* of Honouliuli. There is good reason to assume, given the lack of intensive agricultural resources in other prehistoric times, all other habitation zones were economically and socially co-dependent.

Section 5 Results of Fieldwork

The pedestrian inspection of the project area was conducted on November 7, 2006 with two Cultural Surveys Hawai'i staff archaeologists, Constance R. O'Hare, B.A., and Randy Groza, M.A., under the general direction of Hallett H. Hammatt, Ph.D. At least 90% of the project area has been denuded of all natural vegetation and had been previously planted with pineapple. The entire northern portion of the project area, which appeared to have been bulldozed and contained remnants of black plastic for weed control, was surveyed by pedestrian sweeps. CSH archaeologists conducted a windshield survey of the approximately 4,000 ft (1200 m) of existing road, where the new water line will run parallel to the existing water line in the center of the road and connect the northern portion of the project area with the southern portion. The southern section of the project area was fenced; it contains an existing water tank and is the proposed location of the new water tank. This southern portion was reviewed through the chain link fence.

No historic properties were encountered and the pedestrian inspection was documented with field notes, maps, and photographs.

Section 6 Summary and Mitigation Recommendations

Background historical research for this project indicates that this area of the 'Ewa Plain was not a locus for traditional Hawaiian habitation, agriculture, or ceremonial activities. No historic properties were found in the project area during the recent field survey. Based on the results of the background research, previous work conducted by CSH within the vicinity of the project area, and the field assessment of the project area, it appears that no further archaeological or cultural work is appropriate for this project. The proposed construction of the new reservoirs and waterline to support a mixed residential, commercial, and recreational property that is located south of the H-1 will have no effect on any historic properties or on any on-going cultural practices in the project area.

As always, if in the unlikely event that development activities uncover significant subsurface finds, all work in the immediate vicinity should stop and the State Historic Preservation Division should be promptly notified.

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Appendix A

Letter to OHA

Cultural Surveys Hawai'i, Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

P.O. Box 1114 • Kailua, Hawai'i 96734 • Ph.: (808) 262-9972 • Fax: (808) 262-4950
dshideler@culturalsurveys.com • www.culturalsurveys.com

December 15, 2006

Clyde Nāmu'o, Administrator
Office of Hawaiian Affairs
711 Kapi'olani Boulevard
Honolulu, HI 96813

Dear Mr. Nāmu'o:

A complementary copy of our archaeological assessment, *An Archaeological Assessment for the Ho'opili Project 440-Foot Elevation Reservoir and Waterline Project,Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu, TMK:(1) 9-2-001:001, 004, 005, 006, 007 (por.); 9-2-002:002*, is enclosed.

No sites or cultural materials were found during the survey and background information also indicated that no sites were present.

If you have any questions or concerns about the location of the proposed project, please call me.

Sincerely,

David W. Shideler

David Shideler

AR00027684

APPENDIX E

SHPD Archaeological Inventory Acceptance Letter

LINDA LINGLE
GOVERNOR OF HAWAII

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR - LAND

DEAN NAKANO
ACTING DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
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BUREAU OF CONVEYANCES
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CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

November 3, 2006

Dr. Hallett H. Hammatt
Cultural Surveys of Hawai'i, Inc.
P.O. Box 1114
Kailua, Hawai'i 96734

LOG NO: 2006.3670
DOC NO: 0611amj01
Archaeology

Dear Dr. Hammatt:

SUBJECT: **Chapter 6E-42 Historic Preservation Review –**
Revised Archaeological Inventory Survey for the Ho'opili Project
Hono'uli'uli Ahupua'a, 'Ewa District, Island of O'ahu
TMK: (1) 9-1-010:002, 9-1-017:004, 059, 072, 9-1-018:001, 004, 9-2-002:004, 005

Thank you for submitting the revised report by O'Hare *et al.* (2006), which we received on September 6, 2006. We apologize for the delay in responding. Five historic properties (SIHP Nos. 50-80-12-4344, 4345, 4346, 4347, and 4348) were documented during inventory survey of a 2625-acre project area. In a letter (LOG NO. 2006.1523, DOC NO: 0605CM22) dated June 6, 2006, we reviewed a previous version of this report, and requested a number of revisions, which you have now made to our satisfaction.

All five historic properties have been assessed as eligible for the State Register of Historic Places under criteria C and D, except for Site 4344, which is only eligible under criterion D. We concur with these significance assessments.

We also concur with your mitigation recommendations, which include: (1) no further archaeological work at Site 4344, (2) preservation of Sites 4345, 4346, 4347, and 4348, and (3) archaeological monitoring in the vicinity of the four areas of historic habitation (Hono'uli'uli taro lands, Kapalani Catholic Church, Pipeline Village, and Drivers/Stable Village).

The report is now accepted in fulfillment of HAR 13-284 and 13-276. We look forward to receipt of a preservation plan and an archaeological monitoring plan.

Please contact Mr. Adam Johnson (O'ahu Assistant Archaeologist) at (808) 692-8015 if you have any questions or concerns regarding this letter.

Aloha,

Melanie Chinen, Administrator
State Historic Preservation Division

amj:

APPENDIX F
Cultural Impact Assessment

Cultural Impact Assessment
for the Ho'opili Project,
Honouliuli Ahupua'a, 'Ewa District, Island of O'ahu
TMK: [1] 9-1-010:002; 9-1-017:004 & 059; 9-1-018:001, 004 & 072; and 9-2-001:001 (por)

Prepared for
D. R. Horton – Schuler Division

Prepared by
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai'i, Inc.
Kailua, Hawai'i
(Job Code: HONO 76)

December 2006

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Maui Office
16 S. Market Street, Suite 2N
Wailuku, Hawai'i 96793
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Fax: (808) 244-1994

Section 1 Management Summary

Reference	A Cultural Impact Assessment Report for the Ho'opili Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu Island TMK: TMK: [1] 9-1-010:002; 9-1-017:004 & 059; 9-1-018:001, 004 & 072; and 9-2-001:001 (por)
Date	December 2006
Project Number (s)	CSH Job Code: HONO 76
Project Area	The Project Areaproposed Project Area consists of several parcels which are identified by the following Tax Map Key numbers TMK: [1] 9-1-010:002; 9-1-017:004, 059; 9-1-018:001, 004 & 072.
Project Location	East Kapolei, 'Ewa District, O'ahu. The Project Area is generally bound on the north by the H-1 Interstate (I H-1), on the south by Mango Tree Road (a dirt road along the 'Ewa Villages Golf Course), Palehua Drive on the west, and Old Fort Weaver Road on the east There are two non-contiguous parcels,the first is located on the east side of new Fort Weaver Road (TMK 9-1-010:002), and the second is north of the H-1 Interstate in proximity to a reservoir (TMK 9-2-001:001).
Land Owner	TMK: [1] 9-1-010:002 D.R. Horton-Schuler Homes LLC 9-1-017:004 & 059; D.R. Horton-Schuler Homes LLC 9-1-018:001, 004 & 072; D.R. Horton-Schuler Homes LLC 9-2-001:001 (por) Monsanto Company
Reviewing Agencies	State of Hawai'i Department of Health (DOH)/ Office of Environmental Quality Control (OEQC)
Project Description	The landowner plans to develop the project area into a mixed residential, commercial, and recreational property.
Project Acreage	1,630 acres
Document Purpose	Article IX and XII of the state constitution, other state laws, and the courts of the state require government agencies to promote and preserve cultural beliefs, practices and resources of native Hawaiians and other ethnic groups pursuant to this legal mandate, cultural Surveys Hawai'i Inc. (CSH) conducted an analysis of the proposed projects impacts on cultural practices and features identified within the Project Area. CSH prepared this report in accordance with the requirement set forth under Hawaii revised status as amended (HRS), Chapter 343 and the OEQC's guidelines for assessing cultural impacts.

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Consultation Effort	CSH consulted with various Hawaiian organizations, agencies and community members were contacted in order to identify potentially knowledgeable individuals with cultural expertise and/or knowledge of the Project Area and the surrounding area. CSH consulted with the State Historic Preservation Division, the Office of Hawaiian Affairs, the O'ahu Island Burial Council, and the 'Ewa Neighborhood Board. Information gathering sessions with the following community members: Arline Eaton, Richard Hirata, Richard Oshiro, Kenneth Soma, and Charles Nakamatsu along with many others in the community.
Summary and Recommendation	No contemporary or continuing cultural practices currently occur within the Project Area. It should be noted that subsurface historic properties associated with former traditional Hawaiian activities in the Project Area, such as artifacts and cultural layers, may be present despite the decades of modern activities such as ranching and sugar cane. As a precautionary measure, personnel involved in future development should be informed of the possibility of inadvertent cultural finds, and should be made aware of the appropriate notification measures to follow.

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Section 2 Introduction

2.1 Project Background

At the request of D.R. Horton-Schuler Division (828 Fort Street Mall, 4th Floor, Honolulu, HI 96813), Cultural Surveys Hawai'i, Inc. (CSH) has completed this Cultural Impact Assessment Report for the East Kapolei Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu Island TMK: TMK: [1] 9-1-010:002; 9-1-017:004 & 059; 9-1-018:001, 004 & 072; and 9-2-001:001 (por) (Figure 1 and Figure 2).

The H-1 Interstate (I H-1) runs along the northern boundry of the project area. Mango Tree Road (i.e. a dirt road along the 'Ewa Villages Golf Course) is on the south. Pefehua Drive on the west, and Old Fort Weaver Road on the east.

Article IX and XII of the state constitution, other state laws, and the courts of the state require government agencies to promote and preserve cultural beliefs, practices and resources of native Hawaiians and other ethnic groups pursuant to this legal mandate, cultural Surveys Hawaii Inc. (CSH) conducted an analysis of the proposed projects impacts on cultural practices and features identified within the Project Area. CSH prepared this report in accordance with the requirement set forth under Hawaii revised status as amended (HRS), Chapter 343 and the OEQC's guidelines for assessing cultural impacts

2.2 Scope of Work

The scope for the Cultural Impact Assessment is summarized as follows:

1) Examined historical documents, Land Commission Awards, historic maps, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal and other resources or agricultural pursuits, as may be indicated in the historic record.
2) Reviewed the existing archaeological information pertaining to the sites within the profect area as they allowed us to reconstruct traditional land use activities and identify and describe the cultural resources, practices, and beliefs associated with the parcel and identify present uses, if appropriate.
3) Conducted oral interviews with persons knowledgeable about the historic and traditional practices in the Project Area and the surrounding region. We experienced both formal and informal interviews.
4) Preparaed a report on items 1-3 summarizing the information gathered related to traditional practices and land use. The report assessed the impact of the proposed action on the cultural practices and any features identified.

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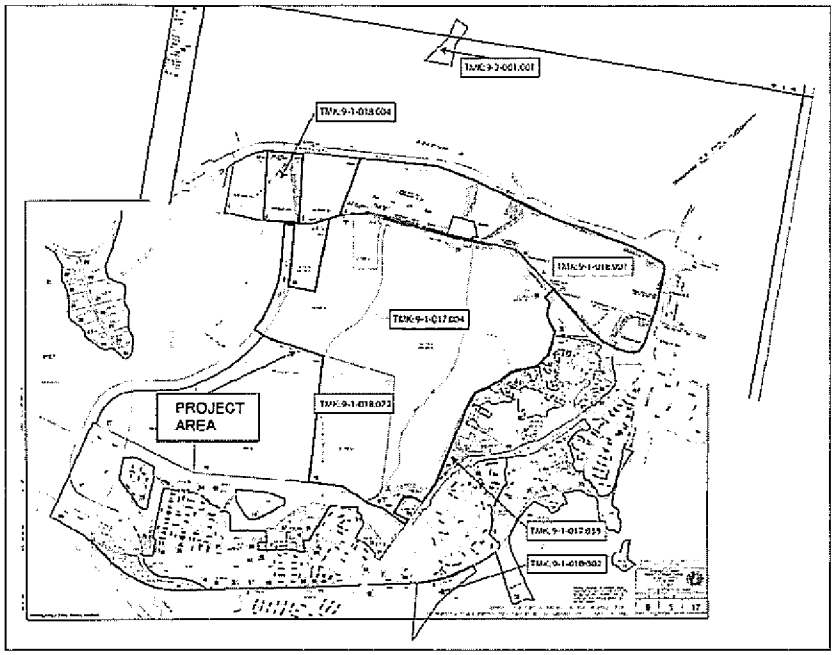

Figure 2. Tax Map Key (1) 9-1-010, 9-1-17, 9-1-018 and 9-2-002, showing Project Area

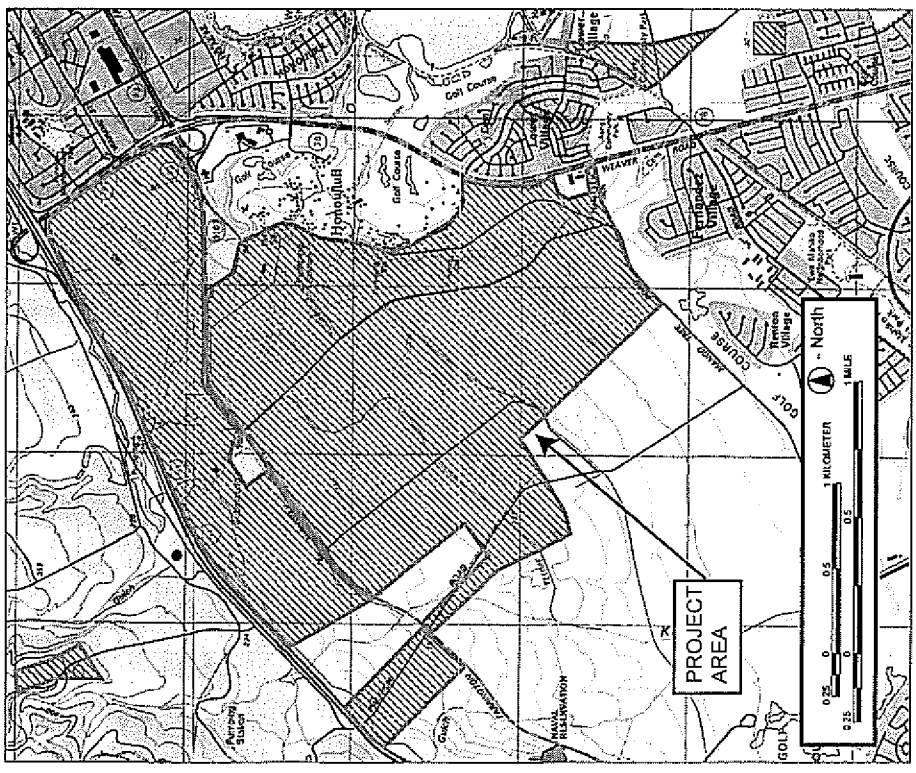

Figure 1. US Geological Survey map (2002), Waipahu quadrangle, showing Project Area (hatched area)

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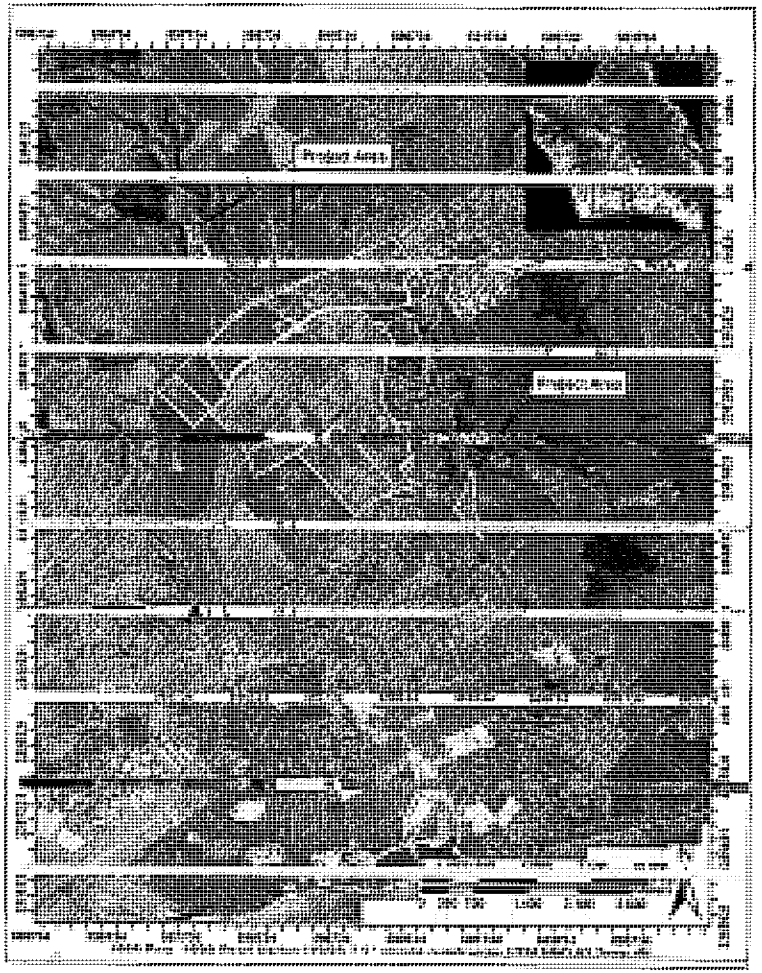

Figure 3. 2000 Aerial photograph of the Project Area, showing plowed fields

2.3 Environmental Setting

2.3.1 Natural Environment

Honouliuli Ahupua'a is the largest traditional land unit on O'ahu, extending from the West Loch of Pearl Harbor in the east, to the border of Nānākuli Ahupua'a at Pili o Kahe in the west. Honouliuli Ahupua'a includes approximately 19 km (kilometers), or 12 mi (miles) of open coastline from One'ula westward to Pili o Kahe. The *ahupua'a* extends *mauka* (inland) from West Loch nearly to Schofield Barracks in Wahiawā; the western boundary is the Wai'anae Mountain crest running north as far as Pu'u Hāpapa (or to the top of Ka'ala Mountain, according to some).

Topographically, the portion of the Project Area to the south of Farrington Highway is most notable for a scarp feature, typically 50 ft (15 m) high, the feature runs roughly north/south through the southeastern portion of the Project Area. This scarp is a Pleistocene fossil sea bluff. The northern portion of the Project Area is generally flat, except along Honouliuli Gulch, which runs through the center of this western portion.

Lying in the lee of the Wai'anae mountain range, the Project Area is one of the driest areas of O'ahu with most of the area averaging about 18 inches of rainfall annually (Juvik and Juvik 1998:56). Temperatures range between 60° to 90° Fahrenheit through the year; the highest temperatures are in August and September (Armstrong 1973). Elevation in the Project Area ranges from 40 ft (feet) AMSL (above mean sea level) to 240 feet, or 12 to 73 meters. The Project Area is located within the 'Ewa Plain, which is a Pleistocene (>38,000 years old) reef platform overlain by alluvium from the southern end of the Wai'anae Mountain Range. This alluvium supported commercial sugar cane cultivation for over a century.

In pre-contact Hawai'i the Project Area would have been mostly lowland dry shrub and grassland, dominated by species such as *wiliwili* (*Erythrina sandwicensis*), *lama* (*Diospyros ferrea*), sandalwood (*Santalum* sp.), *'a'ali'i* (*Dodonea eriocarpa*), scrub *'ōhi'a* (*Metrosideros collina*) and *pili* grass (*Heteropogon contortus*). Today in contrast, the non-cultivated portions of the Project Area are dominated by introduced species such as *kiawe* and *koa haole*. Understory plants include *'ilima ku kula* (*Sida cordifola*), cayenne vervain (*Stachytarpheta urticaefolia*), *ko'oko'olau* (*Bidens pilosa*), and morning glory (*Ipomoea indica*) (Moore and Kennedy 2002:3). The vast majority of the Project Area consists of plowed fields, with crops of pumpkins, squash, cucumbers, bananas, beans, and other vegetable products.

A total of ten soil series are found in the Project Area (Figure 4). The Ewa Series consists of well-drained soils in basins and on alluvial fans, developed in alluvium derived from basic igneous rock. They are nearly level to moderately sloping. These soils are used for sugarcane, truck crops, and pasture. The Helemano Series consists of well-drained soils on alluvial fans and colluvial slopes on the sides of gulches, which developed in alluvium and colluvium derived from basic igneous rock. They are steep to extremely steep. These soils are used for pasture, woodland, and wildlife habitat. The Honouliuli Series consists of well-drained soils on coastal plains; which developed in alluvium derived from basic igneous material. They are nearly level and gently sloping. These soils are used for sugarcane, truck crops, orchards, and pasture. The Kaloko Series consists of poorly drained soils on coastal plains which developed in alluvium

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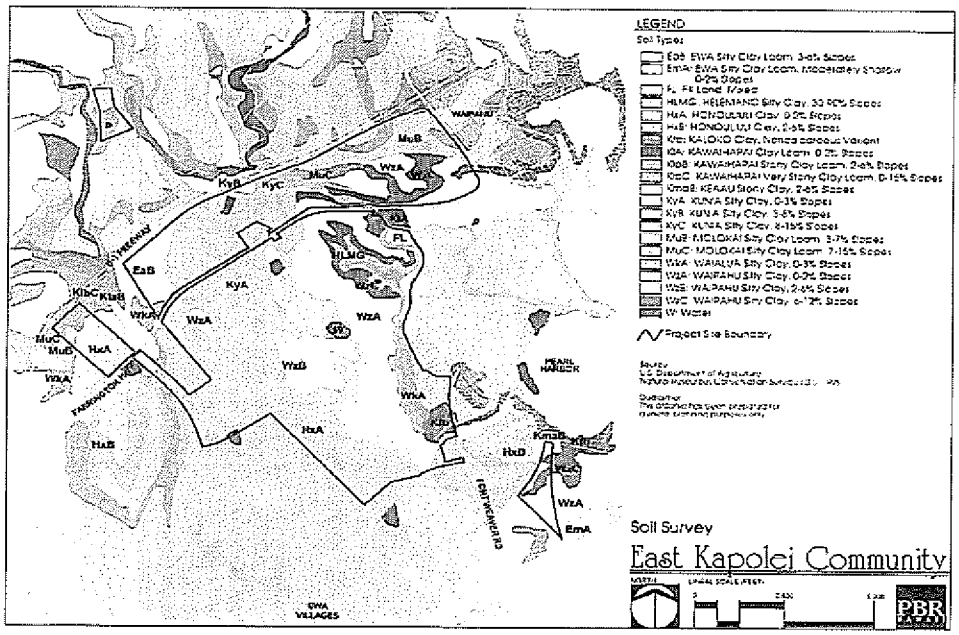

Figure 4. Soil Map of the Ho'opili Community Project Area

derived from basic igneous rock; the alluvium has been deposited over marly lagoon deposits. The soils are nearly level. These soils are used for irrigated sugarcane and pasture. The Kawaihapai Series consists of well-drained soils in drainageways and on alluvial fans on the coastal plains. The soils formed in alluvium derived from basic igneous rock in humid uplands. These soils are used for sugarcane, truck crops, and pasture. The Keaau Series consists of poorly drained soils on coastal plains, which developed in alluvium deposited over reef limestone or consolidated coral sand. They are nearly level and gently sloping. These soils are used for sugarcane and pasture. The Kunia Series consists of well-drained soils on upland terraces and fans; the soils developed in old alluvium. They are nearly level to moderately sloping. These soils are used for sugarcane, pineapple, homesites, and military reservations. The Molokai Series consists of well-drained soils on uplands, formed in material weathered from basic igneous rock. They are nearly level to moderately steep. These soils are used for sugarcane, truck crops, orchards, and pasture. The Waipahu Series consists of well-drained soils on marine terraces, which developed in old alluvium derived from basic igneous rock. They are nearly level to moderately sloping. These soils are used for sugarcane and homesites (Foote et al. 1972).

2.3.2 Built Environment

During the post-contact period the Project Area was primarily used for pastureland and for sugar cane irrigation and cultivation. At present, the Project Area is currently used for diversified agricultural activities, pastureland, seed cultivation, etc.

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2.4 Methods

2.4.1 Documentary Research

CSH reviewed previous archaeological studies on file at the State Historic Preservation Division, CSH also reviewed geology and cultural history documents at Hamilton Library at the University of Hawai'i, the Hawai'i State Archives, the Mission House Museum Library, the Hawai'i Public Library, and the Archives of the Bishop Museum. Further research included a study of historic photographs at the Hawai'i State Archives and the Archives of the Bishop Museum, a study of historic maps at the Hawai'i State Archives and the Archives of the Bishop Museum, and a study of historic maps at the Survey Office of the Department of Accounting and General Services. Information regarding LCAs was obtained from Waihona 'Āina Corporation's Māhele Data Base (www.waihona.com).

2.4.2 Identification of Knowledgeable Informants

CSH consulted with various organizations and member of the community in order to identify *kūpuna* and other individuals with historic knowledge with respect to the Project Area and the surroundings. CSH consulted the Office of Hawaiian Affairs, the O'ahu Island Burial Council, 'Ahahui Siwila Hawai'i O Kapolei Hawaiian Civic Club, and the 'Ewa Neighborhood Board.

Based on recommendations from organizations and the community, the following individuals were contacted for information gathering sessions Arline Eaton, Richard Hirata, Richard Oshiro, Kenneth Soma, Charles Nakamatsu and many other talk story sessions (see Section 7 Community Consultation). These sessions were conducted in-person or by telephone.

Cultural anthropologist Kēhaulani Souza, B.A. conducted information gathering sessions under the general supervision of Hallett H. Hammatt, Ph.D. (Principal Investigator).

Section 3 Mythological and Traditional Accounts

The traditions of Honouliuli Ahupua'a have been compiled by several authors, in studies by Sterling and Summers (1978), Hammatt and Folk (1981), Kelly (1991), Charvet-Pond and Davis (1992), Maly (1992), and Tuggle and Tomonari-Tuggle (1997). Some of the traditional themes associated with this area include connections with Kahiki, the traditional homeland of Hawaiians in central Polynesia. There are several versions of the chief Kaha'i leaving from Kalaeloa for a trip to Kahiki; on his return to the Hawaiian Islands he brought back the first breadfruit (Kamakau 1991a:110) and planted it at Pu'uloa, near Pearl Harbor in 'Ewa (Beckwith 1940:97). Several stories associate places in Honouliuli to the gods Kāne and Kanaloa, with the Hawaiian pig god Kamapua'a and the Hina family, and with the sisters of Pele, the Hawaiian volcano goddess, all of who have strong connections with Kahiki (Kamakau 1991a:111; Pukui et al. 1974:200). The locations of traditional places names for Honouliuli are illustrated in Figure5.

3.1 The Naming of 'Ewa and Honouliuli

Honouliuli is the largest *ahupua'a* in the *moku* (district) of 'Ewa. One translation of the name for this district is given as "unequal" (*Saturday Press* Aug. 11, 1883). Others translate the word as "strayed" and associate it with the legends of the gods, Kāne and Kanaloa.

> When Kane and Kanaloa were surveying the islands they came to Oahu and when they reached Red Hill saw below them the broad plains of what is now Ewa. To mark boundaries of the land they would throw a stone and where the stone fell would be the boundary line. When they saw the beautiful land lying below them, it was their thought to include as much of the flat level land as possible. They hurled the stone as far as the Waianae range and it landed somewhere, in the Waimanalo section. When they went to find it, they could not locate the spot where it fell. So Ewa (strayed) became known by the name. The stone that strayed [Told to E.S. by Simeon Nawaa, March 22, 1954; cited in Sterling and Summers 1978:1].

Honouliuli means "dark water," "dark bay," or "blue harbor" and was named for the waters of Pearl Harbor (Jarrett 1930:22), which marks the eastern boundary of the *ahupua'a*. The Hawaiians called Pearl Harbor, Pu'uloa (*lit.* long hill). Another explanation for the names comes from the "Legend of Lepeamoa", the chicken-girl of Pālama. In this legend, Honouliuli is the name of the husband of the chiefess Kapālama and grandfather of Lepeamoa (Thrum 1923:164-184). "Her grandfather gave his name, Honouliuli to a land district west of Honolulu . . ." (Thrum 1923:170). Westervelt (1963:209) gives an almost identical account.

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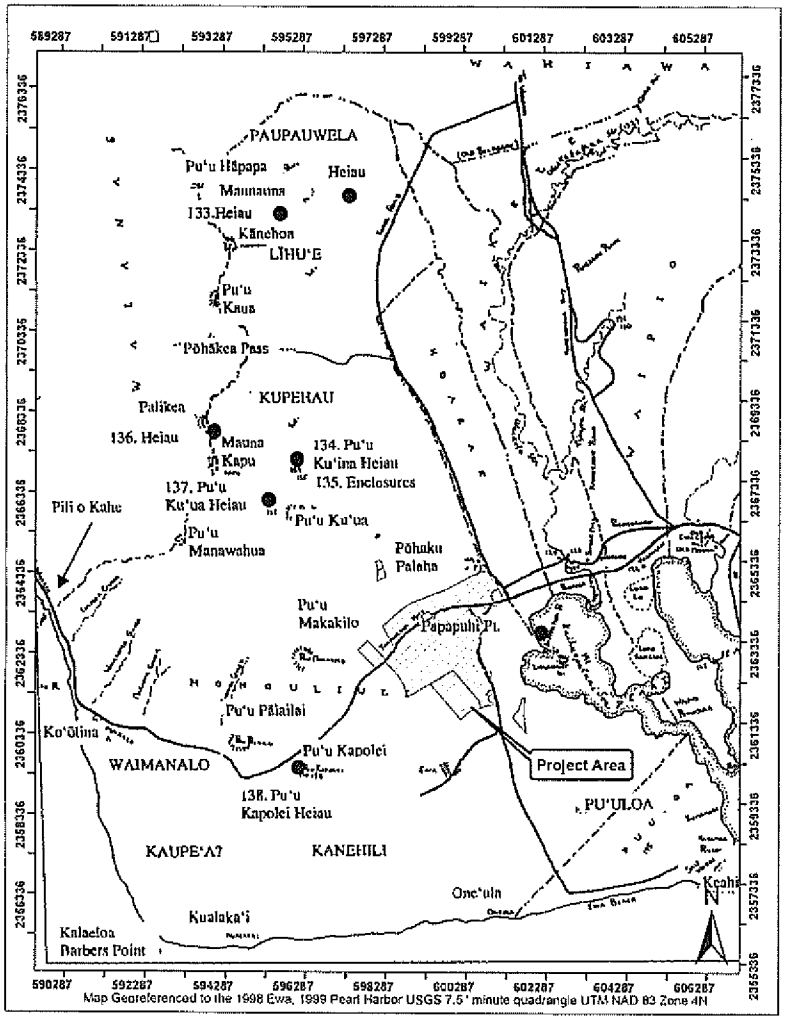

Figure 5. Place Names of Honouliuli (map adapted from Sterling and Summers 1978

It seems likely the boundaries of the western-most *ahupua'a* of 'Ewa were often contested with Wai'anae people. The 'Ewa people could cite divine sanction that the dividing point was between two hills at Pili o Kahe:

Eventually the stone was found at Pili o Kahe. This is a spot where two small hills of the Wai'anae Range come down parallel on the boundary between Honouliuli and Nānākuli ('Ewa and Wai'anae). The ancient Hawaiians said the hill on the 'Ewa side was the male and the hill on the Wai'anae side was female. The stone was found on the Waianae side hill and the place is known as Pili o Kahe.

> (Pili=cling to, Kahe=flow). The name refers, therefore, to the female or Waianae side hill. And that is where the boundary between the two districts runs [Told to E.S. by Simeon Nawaa, March 22, 1954; cited in Sterling and Summers 1978:1].

3.2 Legends and Place Name Meanings of the Upland Hills of Honouliuli

Honouliuli is divided from Wai'anae Ahupua'a on the west by a ridge with several prominent hills. From north (*mauka*) to south (*makai*) these peaks are: Hāpapa, which means "rock stratum (Pukui et al. 1974:42) or "shallow soil (Sterling and Summers 1978:1); Kānehoa (which will be discussed in more detail below); Pu'u Kaua, which means "war hill or fort hill" (Pukui et al. 1974:199); Palikea, which means "white cliff" (Pukui et al. 1974:177); Mount Kapu (meaning "tabu mountain"); and, Pu'u Manawahua, which means "great grief hill or nausea hill" (Pukui et al. 1974:203).

The central section of 'Ewa is divided by a series of northeast-southwest trending gulches that intermittently carry rainwater towards the coast. In this area there are several other notable hills; Pu'u Makakilo, which translates as "observing eyes hill" (Pukui et al. 1974:201); Pu'u Kapua'i, or "footprint hill" (Pukui et al. 1974:199); and, Pu'u Pālailai, probably meaning the young *lai* (*Scomberoides* sp.) fish (Pukui et al. 1974:205).

To the north (*mauka*) is Kānehoa, which can be translated as "companion of Kāne" (Pukui et al. 1974:84), "Kāne, the divine companion or friend," or Kāne, the divine fire-maker" (Westervelt 1999:64). This peak was named for a god (Kāne-hoa-lani), who was said to be the father of Pele (Emerson 1915:ix) in some versions, and the brother of Pele in others (Westervelt 1999:64). The hill Kānehoa is mentioned in the following hula chant.

Anklet Song	*Mele Ku-pe'e*
Fragrant the grasses of high Kanehoa.	*Aala kupukupu ka uka o Kane-hoa*
Bind on the anklets, bind!	*E ho-a!*
Bind with finger deft as the wind	*Hoa na lima o ka makani, he Wai- kaloa.*
That cools the air of this bower.	*He Wai-kaloo ka makani anu Lihue.*
Lehua blooms pale at my flower,	*Alina lehua i kau ka opua-*
O sweet heart of mine,	*Ku'u pua,*
Bud that I'd pluck and wear in my wreath.	*Ku'u puai'ini e ku-i a lei.*

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If thou wert but a flower! *Ina ia oe ke lei 'a mai la.*

[Emerson 1998:49]

A similar chant is found in the Legend of Pamano, which mentions the *kupukupu* (fern), a fragrant flowering shrub.

The uplands of Kanehoa are scented with kupukupu.
Bind on, the hands of the Waikoloa wind are binding,
The Waikoloa wind is the cold wind of Lihue,
Withering the branches in the uplands of Waiopua,
My flower I said I would string into garlands. If you have it,
You would have worn it.

Aala kupukupu ka uka a Kanehoa la!
Hoa! Hoa na lima o ka makani Waikoloa,
He Waikoloa ka makani anu, o Lihue,
Weli no loha ka uka o Waiopua la,
Kuu pua i i ai e kui e lei, I na ia oe ke lei ia ala

[Fornander 1919, Vol. V, Part 2:310-311].

3.2.1 Pōhākea Pass

Pōhākea Pass lies between the peaks of Pu'u Kaua and Palikea along the Wai'anae Mountain range. Pōhākea means "white stone" (Pukui et al. 1974:185).

3.2.1.1 Hi'iaka at the summit of Pōhākea Pass (Pele and Hi'iaka)

Pōhākea Pass was one of the resting places of Pele's sister, Hi'iaka, as she was returning from Kaua'i with Pele's lover Lohiau (Fornander 1918 Vol. V, Part 1:188 note 6). Hi'iaka elected to travel overland, while her companions traveled by canoe. A considerable number of *mele* (songs) and *pule* (prayers) are ascribed to Hi'iaka as she stood at the summit of Pōhākea (*Aluna au a Pōhākea, Kū au, nānā ia Puna . . .*) (Emerson 1915:162-168). From this vantage point Hi'iaka could see through her powers of vision that her beloved *lehua* groves and friend Hōpoe at Puna, Hawai'i Island had been blasted by Pele. She could also see that in her canoe, off the coast of Wai'anae, Lohiau was seducing her traveling companion Wahine'ōma'o.

3.2.1.2 Keahumoa, Residence of Māui's Grandfather

In the Legend of Māui's Flying Expedition (Thrum 1923:252-259) Māui-kupua looked toward Pōhākea Pass and saw his wife, Kumulama, being carried away by chief Peapeamakawalu. After failing to recover her, Māui returned and told his problems to his mother, Hina. Hina instructed her son to go to Keahumoa and visit his grandfather, Kuolokele, who lived there in a large hut. The hump-backed Kuolokele returned home with a load of potato leaves, and Māui cured him by striking him in the back with a stone (which Kuolokele threw to Waipahu, where it remains). Kuolokele had Māui gather *kī* leaves, *'ie'ie* vines and bird feathers, from which the old man fabricated a "bird-ship" (*moku-manu*), which Māui used to defeat Peapeamakawalu and recover his wife. They returned to Kuolokele's house, where they feasted, and Māui ate Peapeamakawalu's eyeballs.

3.2.1.3 The Frightened Populace of Honouliuli

In the Legend of Palila (Fornander 1918, Vol. V, Part 1:136-153), the *kupua*, or demigod hero, of Kaua'i landed at Ka'ena Point with his fabulous war club (*lā'au pālau*), which required eighty men to carry, and crossed into Honouliuli through Pōhākea Pass. He traveled by throwing his supernatural war club and hanging on to one end. The first throw was to Ka'ena Point, Oahu.

> After leaving Kaena he came to Kalena, then on to Pohakea, then to Maunauna, then to Kanehoa, then to the plain of Keahumoa and looking toward Ewa. At this place he stood and looked at the dust as it ascended into the sky caused by the people who had gathered there; he then pushed his war club toward Honouliuli.
>
> *Haalele keia ia Kaena, hele mai la a Kalena, a Pohakea, maunauna, kanehoa, a ke kula o Keahumoa, nana ia Ewa. Ku keia I laila nana I ke ku a ka ea o ka lepo I na kanaka, e pahu aku ana keia I ka laau palau aia nei I kai o Honouliuli. . . .*
> [Fornander 1918, Vol. V, Part I:142-143]

He descended to the plain of Keahumoa:

> At this place he stood and looked at the dust as it ascended to the sky caused by the people who had gathered there; he then pushed his war club toward Honouliuli. When the people heard something roar like an earthquake they were afraid and they all ran to Waikele . . .
>
> *Kū kēia i laila nānā i ke kū ka ea o ka lepo i nā kānaka, e pahu aku ana kēia i ka lā'au pālau aia nei i kai o Honouliuli, kū ka ea o ka lepo o ka honua, me he ōla'i la, maka'u nā kānaka holo a hiki i Waikele.*
> [Fornander 1918, Vol. V, Part I:142-143]

3.2.1.4 Kahalaopuna at Pōhākea Pass

One of the most popular legends of O'ahu is that of Kahalaopuna (or Kaha), a young woman of Mānoa who was slandered by others and then killed by her betrothed, Kauhi, a chief from Ko'olau. While the numerous accounts (Day 1906:1-11, Fornander 1918 Vol. V, Part 1:188-193, Kalākaua 1888:511-522, Nakuina 1904:41-45, Patton 1932:41-49, Skinner 1971:220-223, Thrum 1907:118-132, Westervelt 1987 127-137, Westervelt 1998:84-93) vary in details, they typically have Kahalaopuna slain and then revived repeatedly with the aid of a protective owl. Kauhi forced her to hike west from Mānoa through the uplands until they got to Pōhākea Pass through the southern Wai'anae Range in north Honouliuli. At Pōhākea Pass, Kauhi beat her with a stick until she was dead (*Ia hahau ana a Kauhi i ka lā'au, make loa o Kahalaopuna*). Her spirit (*'uhane*) flew up into a *lehua* tree and chanted for someone to go notify her parents:

E hai aku oukou ua make o Kahalaopuna;	And tell them that Kahalaopuna is dead
Aia la i ka uka o Pohakea,	For she lies in the uplands of Pohakea
I ke kumu lehua la o lalo iho.	Beneath the lehua tree.

[Fornander 1918, Vol. V, part 1:192

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Upon hearing the news, her parents fetched Kahalaopuna back to Mānoa, and she was restored.

3.2.2 Paupauwela and Līhu'e

Paupauwela, also spelled Popouwela (derivation unknown), is the name of the land area in the extreme *mauka* section of Honouliuli *Ahupua'a*. The land area of Līhu'e is just *makai* of this land, and extends into the *ahupua'a* of Waipi'o (adjacent to the eastern border of Honouliuli). Both place names are mentioned in a chant recorded by Abraham Fornander, which was composed as a *mele* for the O'ahu king, Kūali'i, as he was preparing to battle Kuiaia, the chief of Wai'anae:

Where? Where is the battle field	*Ihea, ihea la ke kahua,*
Where the warrior is to fight?	*Paio ai o ke koa-a?*
On the field of Kalena, I	*kai i kahua i Kalena,*
At Manini, at Hanini,	*I Manini, i Hanini*
Where was poured the water of the god	*I ninia i ka wai akua,*
By your work at Malamanui;	*I ka hana i Malamanui*
On the heights of Kapapa, at Paupauwela,	*Ka luna o Kapapa, i Paupauwela,*
Where they lean and rest;	*I ka hilinai i ke kalele,*
At the hala trees of indolent Halahalanui,	*Ka hala o Halahalanui maauea,*
At the ohia grove of Pule-e	*E kula ohia ke Pule-e,*
The god of Lono, of Makalii	*Ke 'kua o Lono o Makalii*
Thr fragrant branch of the Ukulonoku,	*Ka lala aalao Ukulonoku,*
Mayhap from Kona, from Lihue,	*No Kona paha, no Lihue.*
For the day at Maunauna	*No ka la i Maunauna,*
For the water at Paupauwela.	*No ka wai i Paupauwela.*

[Fornander 1917, Vol. IV, Part 2:384-386].

Red is the water of Paupauwela,	*Ula ka wai i Paupauwela,*
From the slain at Malamani,	*Ke kilau o Malamani,*
The slain on the ridge at Kapapa.	*Ka moo kilau I Kapapa.*

The derivation of the place name Līhu'e (meaning "cold chill") is illustrated in the following poem; all other places names mentioned in this poem are in Waipio:

The icy wind of Lihue plied its spurs,
Pulling up the bridle of Haleauau,
Speeding headlong over Kalena
And running over the plain of Kanoenoe

[*Ko Loea Kālai'āina*, July 22, 1899, translated in Sterling and Summers 1978:21].

This explains the meaning of a Hawaiian saying "*Hao na kēpā o Līhu'e i ke anu.* The spurs of Līhu'e dig in with cold" [Pukui 1983:#479].

The icy winds of Honouliuli are also noted in a *mele* for the high king Kūali'i. In this *mele*, the cold winds of Kumomoku and Leleiwe, near Pu'uloa in Honouliuli are compared unfavorably to the god Kū.

Not like these are thou,	*Ku Aole i like Ku.*
[Nor] the rain that brings the land breeze,	*Ia ua hoohali kehau,*
Like a vessel of water poured out.	*Mehe ipu wai ninia la,*
Nor to the mountain breeze of Kumomoku,	*Na hau o Kumomoku;*
[The] land breeze coming round to Leleiwi.	*Kekee na hou o Leleiwi,*
Truly, have you not known?	*Oi ole ka oe i ike*
The mountain breezes, that double up your back,	*I ka hau kuapuu.*
[That make you] sit crooked and cramped at Kaimohala,	*Kekee noho kee, o Kaimohala,*
The Kanehili at Kaupea?	*O Kanehili i Kaupea-la*
Not like these are thou, Ku.	*Aole i like Ku.*

[Fornander 1917, Vol. IV, Part II:390-391]

In the Legend of Halemano (Fornander 1919, Vol. V, Part II:252), the romantic O'ahu anti-hero chanted a love song with a reference to the winds of Līhu'e:

Search is made to the top of Ka'ala,	*Huli a'e la Ka'ala kau i luna,*
The lower end of Pōka'ī is plainly seen.	*Waiho wale kai o Pōka'ī,*
Love looks in from Honouliuli,	*Nānā wale ke aloha i Honouliuli,*
The dew comes creeping, it is like the wind of Līhu'e...	*Kokolo kēhau he makani no Līhu'e.*

The wind of Lihu'e and others in the region are also named by Moses K. Nakuina, as follows:

Moa'e-kū is of 'Ewaloa
Kēhau is of Waiopua
Waikōloa is of Līhu'e
Kona is of Pu'uokapolei
Maununu is of Pu'uloa

[Nakuina 1992:43]

The *ali'i* (chiefly class) were closely associated with Līhu'e, which had habitation areas and playing grounds set aside for their sports.

> Lolale was the father and Keleanohoapiapi the mother of Ka-lo-kaholi-a-Lale. He was born in the land of Lihue and there he was reared into manhood. He excelled in good looks and greatly resembled his mother.
>
> In the olden days the favorite occupation of Lihue chiefs was spear throwing and the best instructors hailed from this locality [*Ka Nūpepa Kū'oko'a*, Aug. 26, 1865, translation in Sterling and Summers 1978:23].

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Līhu'e was also the home of a famous cannibal king-man, Kaupe, who overthrew the ruling chiefs to become the paramount power between Nu'uanu and the sea. He had a home and a *heiau* in Līhu'e. Kaupe was a *kapua*, a supernatural being who could take the form of a man or a dog; this type of dog man was known as an *'ālohe*. Although he left the O'ahu *ali'i* alone, he killed many commoners in the area, and eventually sailed to the island of Hawai'i on a raid, where he captured a chief's son; he planned to sacrifice this boy at his *heiau* in Līhu'e. The father came to O'ahu, and with the help of the priests of the Hawaiian hero, Kahanaiakeakua, was able to free his son, escape back to Hawai'i, and eventually kill the dog-man, Kaupe (Westervelt 1963:90-96).

3.2.3 Hill of Maunauna

The hill Maunauna lies between the lands Paupauwela and Līhu'e. It was at Maunauna, according to one tradition, that the forces of the chiefs of Kūali'i and Kuiaia of Waianae met to do battle, but was averted when a *mele* honoring the god Kū was chanted (see previous section). (Fornander 1917, Vol IV, Part 2:348). In the Legend of Ke-ao-melemele, a woman named Paliuli traveled in this area.

> In a very short time she [Paliuli] walked over the plain of Ewa; Ewa that is known as the land of the silent fish [pearl oysters] . . . She went on to the plain of Punalu'u and turned to gaze at Maunauna point and the plain of Lihue [Manu 1885, translation in Sterling and Summers 1978:21].

According to the surveyor W. D. Alexander (1903:367-425), Maunauna means "waste."

Certain place names in the uplands, including Maunauna, are also mentioned in the story of Lo-lae's Lament. The place of Lolale's residence is given in King Kalākaua's version of this story. According to him (Kalākaua 1990:232): "There lived there at that time in Lihue, in the district of Ewa, on the island of Oahu, a chief named Lo-lale, son of Kalona-iki, and brother of Piliwale, the *alii-nui*, or nominal sovereign, of the island, whose court was established at Waialua."

In this story, Lolale was a chief of O'ahu who asked his friend Kalamakua to find him a bride (Kalākaua 1990:228-246; Skinner 1971:217-219). Kalamakua traveled to Maui and chose Kelea, the chief's sister, and returned with her to O'ahu; during this time the two grew close. Kelea lived with Lolale for a while, but he was a silent type that was often away from home playing sports and walking in the woodlands. Longing for Kalamakua, Kelea decided to leave her husband, Lolale voiced no "spoken bitterness;" however, after she left, he sang this lament:

Farewell, my partner of the lowland plains,
On the waters of Pohakeo, above Kanehoa,
On the dark mountain spur of Mauna-una!
O, Lihue, she is gone!
Sniff the sweet scent of the grass,
The sweet scent of the wild vines
That are twisted by Waikoloa,
By the winds of Waiopua,
My flower!

As if a mote were in my eye.
The pupil of my eye is troubled.
Dimness covers my eyes. Woe is me!

[Kalākaua 1990:244-245].

3.2.4 Pu'u Ku'ua

Makai of the land of Lihu'e was the land of Kupehau, which was itself *mauka* of Pu'u Ku'ua. Divine sanction was also given to social stratification and the designation of a land for *kauwā* (outcastes, pariahs), a low, slave caste of Hawai'i, in the vicinity of Pu'u Ku'ua:

> . . . If you are above Puuloa, you wil see Pu'u-o-Kapolei, a small hill. Lying below and back of that hill is the government road going to Waianae. Above that is also a small hill and back of that, is a big hill and above it is a large hollow. That is Pu'u-Kuua where the very dirty ones lived [*Ka Loea Kālai'āina* July 15, 1899, translation in Sterling and Summers 1978:32].

The creation of the *kauwā* class is told in a tradition of the gods Kāne and Kanaloa:

> *A penei na'e i kauwā loa [sic. "loa'a"] ai, Aia a mana'o ke Ali'i Nui (Mō'ī) e 'au'au kai i Waikīkī. Eia ka nīnau a ke Ali'i Nui i ke ali'i ma lalo iho ana, "Pehea āu mau wahi lepo kanu o Pu'u Ku'ua? 'A'ole paha he mau wahi pōhulī?" Eia ka pane a ke ali'i ma lalo iho ona, "He Pōhuli nō. 'O ke kauoha ia akula nō ia e ki'i. 'Oiai ko kāne me ka wahine e nanea ana me nā keiki, a hiki 'ana ke ki'i i mau keiki. 'O ke kū a'ela nō ia o ka makuakāne a lawe 'ana i kāna mau keiki a hiki i Waikīkī. Aia ho'i a hiki i ka wā a ke Ali'i e hele ai i ka 'au'au kai, a laila, hoouna 'ia mai ke kahu e ki'i mai i ua keiki a lawe aku ia ma kahi pāpa'u o ke kai, ma kahi a ke Ali'i nui e hele kū 'ana, a laila kau nā lima o ka Mō'ī i luna o kahi keiki a me kahi keiki, ma nā 'ā'ī o nā keiki a pa'a ai. 'O ka hua 'ōlelo ma ka waha o ke Ali'i nui e 'ōlelo ai, "'A'ole pau ku'u loa!' 'A'ole pau ku'u loa!" 'Oiai 'o ia e 'au ana me ka pa'a nō o nā lima i nā keiki a hiki i ka umauma ke kai o ke ali'i. Ua lana a'ela nā keiki i luna o ka 'ilikai, aia ke alo i lalo. Eia ho'i ka 'ōlelo a ka makuakāne ma kula aku nei, "Moe mālie i ke kai o ko Haku," a pēlā aku.*

'O ke kai o Waikīkī ke kai i 'ōlelo 'io he kai lumaluma'i kanaka o ka lua, aia i Kualoa [*Ka Loea Kālai'āina*, July 8, 1899].

Translation:

> The chiefs of old, who lived at that time, were of divine descent. The two gods [Kāne and Kanaloa] looked down on the hollow [vicinity of Pu'u Ku'ua] and saw how thickly populated it was. The mode of living here was so that chiefs and commoners mixed freely and they were so like the lowest of people (*kauwā*). That is what these gods said and that was the time when the term *kauwā* was first used, and was used for many years afterwards. . . . This was how they were made to be *kauwā*. When the ruling chief wished to go to Waikīkī for sea bathing he asked the chief just below him in rank, "How are my planting places at Pu'u Ku'ua,

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have they not produced young suckers?" The chief next to him answered, "There are some suckers," and sent someone for them. When the men, women and children least expected it, the messenger came to get some of the children. The father stood up and took his sons to Waikīkī. Then, when the ruling chief went sea bathing, he sent an attendant to get the boys and take them to a shallow place where the ruling chief would come. Then the ruler placed a hand on each of the boys, holding them by the necks. The words he uttered were, "My height has not been reached! My height has not been reached!" He advanced and held onto the boys until the sea was up to his chest. The boys floated on the water face down. The father on shore called out, "Lie still in the sea of your Lord," and so on.

The Sea of Waikīkī is said to have been used to kill men in and the other place is Kualoa. The inhabitants of Pu'u-Kuua were so mixed, like taro beside an imu [translation in Sterling and Summers 1978:32-33].

A Hawaiian saying concerning 'Ewa suggests that this drowning also took place in this *ahupua'a*.

'Ewa of the drowning sea *'Ewa kai lumaluma'i*

An epithet applied to 'Ewa, where *kauwā* were drowned prior to offering their bodies in sacrifice [Pukui 1983:#385].

On Hi'iaka's journey as she leaves 'Ewa and descends to the coast, she sees some women stringing *lei* and offered a chant, naming several place names in the area:

Rising in the presence of the	*Ke ku no i ke alo o*
cliff of Pu'uku'ua	*pali o Pu'uku'ua*
The land is indeed a chief	*He ali'i nona'e ka 'āina*
Man is indeed a slave	*He kauwā no na'e kanaka*
I am indeed a slave to aloha – love	*I kauwā no na'e wau i ke aloha*

[*Ka hōkū o Hawai'i* February 22, 1927, translation in Maly 1997:17]

The great fisherman, Nihookeki, was born in Keauhou, Kona, but traveled to O'ahu and lived in Wai'anae and became a great chief. Fornander (1917, Vol. IV, Part 3:488) places his home at Pu'u ku'ua, in Pu'u o Kapolei in Wai'anae, possibly during one of the times that both Wai'anae and 'Ewa were ruled by one chief.

O Keauhou, i Kona, Hawaii, ka aina hanau o Nihooleki, a malaila mai ka hele ana a noho i Kuukuua, i Puuokapolei ma Waianae, no laila ka wahine.

Keauhou in Kona, Hawaii, was the birthplace of Nihooleki and it was from this place that he moved to Kuukuua, in Puuokapolei at Waianae, where he took unto himself a wife [Fornander 1917, Vol. IV, Part 3:488-489].

Keahaikiaholeha, the paramount chief of Wai'anae, owned a famous mother-of-pearl fishhook, called Pahuhu, which he used to catch many *aku* (bonito, *Katsuwonus pelamis*). He later sailed to Waimea, Kaua'i, where his wife had been born, and there also became the ruling

chief of Kaua'i. When Keahaikiaholeha died, his body was brought back to Kuukuua and placed in a *pu'āo* (*A make o Kaehaikiaholeha, hoihoi ia mai a Kuukuua, i Waianae, waiho ia kona kino kupapau; i loko o ka hale, puoa . . .*). A *pu'āo* is an open, small, temporary cone-shaped structure, of poles; in this case, this *pu'āo* was used as his tomb. The parents of the chief worshiped the spirit (*'uhane*) of their son, until it became strong enough to go about in the form of a live person. The spirit took the name of Nihooleki, traveled to Kaua'i, and married his wife, although she was unaware that this was the spirit of her dead husband. Nihooleki used his magic fishhook to catch canoes full of *aku* until it became the wonder of the islands. The piles of fish that he caught and gave away came to the ears of Kamapua'a, who was then living at Waiohuli, sick with dropsy.

Nihooleki told his wife that if a man with dropsy came to the door, to ask him in because he was a friend. But when Kamapua'a arrived, the wife would not let him in since he was so dirty. Kamapua'a had to wait in the pig pen for the return of his friend. Nihooleki was angry about the treatment of his friend when he returned and left the island with Kamapua'a.

Lohe aku la na 'lii, a me na kaikoeke, a ke 'lii no keia, aualu mai la lakou, luu laua nei i ke kai, a ea ana i Kuukuua, ma Waianae. . . .

A kokake laua i ka hale o na mauka a me ke kaikuahine, a e ku ana hoi ka puoa hale o ke kino kupapau ona. ". . . A o ke kaikuahine o kaua, o kau wahine no ia, no ka mea, he wahine maikai, ua nui no ke kino."

O Kaehaikiaholeha, oia o Nihooleki, komo aku la ia i kona puoa kupapau a nalo iho la, oia ka pau o kona kaao ana.

He [Nihooleki] and his friend [Kamapua'a] then dove into the sea and swam under water until they came up at Kuukuua, at Waianae. . .. As they drew near to the house where the parents and sister of Nihooleki were living and near to the tomb where his dead body was laid, Nihooleki then turned to his friend. " . . . Take our sister and make her your wife as she is fair to look upon and is also of proper age." . . . Keahaikiaholeha, who was Nihooleki, entered the tomb and disappeared. Thus ends the story [Fornander 1917, Vol. IV, Part 3:496].

This legend suggests associations with Pu'u ku'ua to Pu'uokapolei , worship of the dead, and wandering souls, all of which are prominent themes associated with Pu'u Kapolei, as seen in the next section. It also ties the pig god Kamapua'a to Pu'uokapolei in 'Ewa.

3.3 Pu'uokapolei and the Plains of Kaupe'a

Pu'uokapolei is a prominent hill at the *mauka* edge of the coastal 'Ewa Plains and was the primary landmark for travelers on the trail that ran from Pearl Harbor west to Wai'anae ('I'I 1959:27, 29; Nakuina 1992:54; E.M. Nakuina 1904, in Sterling and Summers 1978:34).

3.3.1 Pu'uokapolei , Astronomical Marker and Heiau

Pu'u means hill and Kapolei means "beloved Kapo," a reference to the sister of the Hawaiian volcano goddess, Pele. Samuel Kamakau (1976:14) says that ancient Hawaiians used Pu'u o

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Kapolei as an astronomical marker to designate the seasons. Samuel Kamakau (1870 *Mo'olelo Hawai'i* Vol. I, Chap. 2, p. 23) relates:

> . . . the people of O'ahu reckoned from the time when the sun set over Pu'uokapolei until it set in the hollow of Mahinaona and called this period Kau [summer], and when it moved south again from Pu'uokapolei and it grew cold and the time came when young sprouts started, the season was called from their germination (*'ōilo*) the season of Ho'oilo [winter, rainy, season].

A *heiau* was once on Pu'u o Kapolei, but had been destroyed by McAllister's (1933:108) survey of the island in the early 1930s. The hill was used as a point of solar reference or as an observation place for such observations (Fornander 1919, Vol. VI, Part 2:292). Pu'uokapolei may have been regarded as the gate of the setting sun, just as the eastern gate of Kumukahi in Puna is regarded as the rising sun; both places are associated with the Hawaiian goddess Kapo (Emerson 1915:41). This somewhat contradicts some Hawaiian cosmologies, in which Kū was the god of the rising sun, and Hina, the mother of Kamapua'a was associated with the setting sun. Fornander (Fornander 1919, Vol. VI, Part 2:292) states that Pu'uokapolei may have been a jumping off place (also connected with the setting sun) and associated with the wandering souls who roamed the plains of Kaupe'a and Kāne-hili, *makai* of the hill.

3.3.2 Pu'uokapolei and the Plains of Kaupe'a and Kāne-hili

Hi'iaka sang this bitter chant addressed to Lohiau and Wahine-oma'o, which uses the association of the Plains of Kaupe'a as a place for the wandering of lost souls:

Ku'u aikana i ke awa lau o Pu'uloa,
Mai ke kula o Pe'e-kaua, ke noho oe,
E noho kaua e kui, e lei i ka pua o ke kauno'a,
I ka pua o ke akuli-kuli, o ka wili-wili;
O ka iho'na o Kau-pe'e i Kane-hili,
Ua hili au; akahi no ka hili o ka la pomaika'i;
E Lohiau ipo, e Wahine-oma'o,
Hoe 'a mai ka wa'a i a'e aku au.

We meet at Ewa's leaf-shaped lagoon, friends;
Let us sit, if you will on this lea
And bedeck us with wreaths of Kauno'a,
Of akuli-kuli and wili-wili,
My soul went astray in this solitude;
It lost the track for once, in spite of luck,
As I came down the road to Kau-pe'a.
No nightmare dream was that which tricked my soul.
This way, dear friends; turn the canoe this way;
Paddle hither and let me embark

[Emerson 1915:162-163].

Several other Honouliuli places are mentioned in this chant, including Pe'e-kaua, which may be a variation of Kau-pe'e or Kaupe'a, and the plains of Kānehili, the last of which again refers to wandering, as the word *hili* means "to go astray" (Emerson 1915:162). In the chant, Hi'iaka is moving downhill from Kaupe'a, probably the plains adjacent to Pu'uokapolei , toward the coast, the plain of Kānehili.

3.3.3 The plains of Kaupe'a and Pu'uokapolei and the Realm of Homeless Souls

There are several places on the 'Ewa coastal plain that are associated with *ao kuewa*, the realm of the homeless souls. Samuel Kamakau (1991b:47-49) explains the Hawaiian beliefs in the afterlife:

> . . . There were three realms (*ao*) for the spirits of the dead. . . There were, first, the realm of the homeless souls, the *ao kuewa*; second, the realm of the ancestral spirits, the *ao 'aumakua*; and third, the realm of Milu, *ke ao o Milu* . . .
>
> The *ao kuewa*, the realm of homeless souls, was also called the *ao 'auwana*, the realm of wandering souls. When a man who had no rightful place in the *'aumakua* realm (*kanaka kuleana 'ole*) died, his soul would wander about and stray amongst the underbrush on the plain of Kama'oma'o on Maui, or in the *wiliwili* grove of Kaupe'a on Oahu. If his soul came to Leilono [in Halawa, 'Ewa near Red Hill], there he would find the breadfruit tree of Leiwalo, *ka'ulu o Leiwalo*. If it was not found by an *'aumakua* soul who knew it (*i ma'a mau iaia*), or one who would help it, the soul would leap upon the decayed branch of the breadfruit tree and fall down into endless night, *the pō pau 'olo o Milu*. Or, a soul that had no rightful place in the *'aumakua* realm, or who had no relative or friend (*makamaka*) there who would watch out for it and welcome it, would slip over the flat lands like a wind, until it came to a leaping place of souls, a *leina a ka 'uhane*. . . [Kamakau 1991b:47].
>
> On the plain of Kaupe'a beside Pu'uloa [Pearl Harbor], wandering souls could go to catch moths (*pulelehua*) and spiders (*nanana*). However, wandering souls could not go far in the places mentioned earlier before they would be found catching spiders by 'aumakua souls, and be helped to escape. . . . [Kamakau 1991b:49].

The breadfruit tree Leilono was said to have been located on the 'Ewa-Kona border, above Āliamanu. In another section of his account of the dead, Kamakau calls the plain of wandering souls the "plain at Pu'uokapolei."

> There are many who have died and have returned to say that they had no claim to an 'aumakua [realm] (*kuleana'ole*). These are the souls, it is said, who only wander upon the plain of Kama'oma'o on Maui or on the plain at Pu'uokapolei on Oahu. Spiders and moths are their food [Kamakau 1991b:29].

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This association of Pu'uokapolei and Kanehili with wandering souls is also illustrated in a lament on the death of Kahahana, the paramount chief of O'ahu, who was killed by his father, Kahekili, after Kahahana became treacherous and killed the high priest Kaopulupulu.

Go carefully lest you fall dead in the sun,	*E newa ai o hea moke i ka la,*
The god that dwells on Kapolei hill.	*Akuo noho la i Puuokapolei.*
The sun is wailing on aecount of the women of Kamao,	*E honehane mai ana ka la i na wahine o Kamao,*
A hiding god, blossoming ohai of the banks,	*Akua pee, pua ohai o ke kaha,*
Contented among the stones-	*I walea wale i ke a-*
Among the breadfruit planted by Kahai.	*I ka ulu kanu a Kahai.*
Thou wast spoken of by the oo-	*Haina oe e ka oo-*
By the bird of Kanehili.	*E ka manu o Kanehili.*

[Fornander 1919, Vol. VI, Part 2:297]

Fornander provides some notes on this lament. The god dwelling at Kapolei is the god Kahahana, stating that this is where his soul has gone. Kamao is one of the names of the door to the underworld. This lament draws an association with wandering souls and the place where the first breadfruit tree was planted by Kahai at Pu'uloa (Fornander 1919, Vol. VI, Part 2:304).

Pukui (1983:180) offers this Hawaiian saying, which places the wandering souls in a *wiliwili* grove at Kaupe'a.

The wiliwili grove of Kaupe'a *Ka wiliwili of Kaupe'a.*
In 'Ewa, O'ahu. Said to be where homeless ghosts wander among the trees.

[Pukui 1983:#1666].

Beckwith (1940:154) has stressed that "the worst fate that could befall a soul was to be abandoned by its '*aumakua* and left to stray, a wandering spirit (*kuewa*) in some barren and desolate place." These wandering spirits were often malicious, so the places that they wandered were avoided.

3.3.4 The Plain of Pukaua

The Hawaiian language newspaper *Ka Loea Kālai'āino*, (January 13, 1900) relates that near Pu'uokapolei , on the plain of Pukaua, on the *mauka* side of the road, there was a large rock. This legend suggests that the plain around Pu'uokapolei was called Pukaua. The legend is as follows:

> If a traveler should go by the government road to Waianae, after leaving the village of gold, Honouliuli, he will first come to the plain of Puu-ainako and when that is passed, Ke-one-ae. Then there is a straight climb up to Puu-o-Kapolei and there look seaward from the government road to a small hill, That is Puu-o-Kapolei. . . . You go down some small inclines, then to a plain. This plain is Pukaua and on the mauka side of the road, you will see a large rock standing on the plain. . . . There were two supernatural old women or rather peculiar women with strange powers and Puukaua belonged to them. While they were down fishing at Kualaka'i [near BarbersPoint] in the evening, they caught these things, *'a'ama* crabs, *pipipi* shellfish, and whatever they could get with their hands. As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person [bad omen]. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run - running, leaping, falling, sprawling, rising up and running on, without a thought of the *'a'ama* crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, "Let us hide lest people see us," and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper side of the road and see them standing on the plain [*Ka Loea Kālai'āina*, January 13, 1900, translation in Sterling and Summers 1978:39].

In another version of this story, the two women met Hi'iaka as she journeyed toward the 'Ewa coast. The women were *mo'o* (supernatural beings) and were afraid that Hi'iaka would kill them, so they changed into their lizard form. One of the lizards hid in a little space on a stone beside the coastal trail, and the other hid nearby (*Ka Hōkū o Hawai'i*, February 15, 1927, translated in Maly 1997:19). From that time on the stone was known as *pe'e-kāua*, meaning "we two hidden." Hi'iaka greeted the two women but did not harm them, and passed on.

When she reached Pu'uokapolei , she also greeted two old women who lived at an '*ohai* grove on the hill. These women were named Pu'uokapolei and Nāwaineokama'oma'o (*Ka Hōkū o Hawai'i*, February 22, 1927, translated in Maly 1997:19). As she continued her travels, she looked to the ocean and saw the canoe carrying Lohi'au.

My man on the many harbored sea of Pu'uloa	*Ku'u kāne i ke awa lau o Pu'uloa*
As seen from the plain of Pe'ekāua	*Mai ke kula o Pe'ekāua ke noho*
Let us dwell upon the 'ōhai covered shore	*E noho kāua i ke kaha o ka 'āhai*
Where the noni blossoms are twisted together	*I ka wiliwili i ka pua o ka lau noni*
Descending along Kānehili	*O ka ihona i Kānehili la*
I am winding along	*Ua hili ho'i au-e*

[*Ka Hākū o Hawai'i*, February 22, 1927, translated in Maly 1997:20].

3.3.5 Pu'uokapolei and Kamapua'a

Pu'uokapolei was the home of Kamapua'a's grandmother, Kamaunuaniho, who was one of the three migrants from Kahiki that were ancestors to the people of O'ahu (Fornander 1919, Vol. V, Part 2:318; Kahiolo 1978:81, 107). Kamapua'a, the Hawaiian pig god once lived in Kaluanui on the windward side, but escaped to 'Ewa when he was pursued by the chief Olopana.

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> Kamapua'a subsequently conquered most of the island of O'ahu, and, installing his grandmother [Kamaunuaniho] as queen, took her to Pu'uokapolei, the lesser of the two hillocks forming the southeastern spur of the Wai'anae Mountain Range, and made her establish her court there. This was to compel the people who were to pay tribute to bring all the necessities of life from a distance, to show his absolute power over all [Nakuina 1904:50-51].

Emma Nakuina goes on to note: "A very short time ago [prior to 1904] the foundations of Kamaunuaniho's house could still be seen at Pu'uokapolei." Another account (*Ka Loea Kālai'āina* January 13, 1900, from Sterling and Summers 1978:34) speaks of Kekeleaiku, the older brother of Kamapua'a, who also lived on Pu'uokapolei .

3.3.6 The Strife at Honouliuli; Kūali'i unites Hawai'i *nei* (*Mo'olelo o Kūali'i*)

The celebrated chief, Kūali'i, is said to have led an army of twelve thousand (*'ekolu mano*) against the chiefs of Ko'olauloa with an army of twelve hundred (*'ekolu lau*) upon the plains of Kealiumoa (Fornander 1917 Vol. IV, Part 2:364-401). Perhaps because the odds were so skewed the battle was called off and the *ali'i* of Ko'olau ceded (*ha'awi a'e*) the districts of Ko'olauloa, Ko'olaupoko, Waialua and Wai'anae to Kūali'i. When the *ali'i* of Kaua'i heard of this victory at Honouliuli they gave Kaua'i to Kūali'i as well and thus he became possessed of all the islands (*a lilo a'e la nā moku a pau ia Kūali'i mai Hawai'i a Ni'ihau*). The strife at Honouliuli was the occasion of the recitation of a song for Kūali'i by a certain Kapa'ahulani (*Ka Pule Ana a Kapa'ahulani*). This *mele* compares the king to certain places and objects in the islands, in this instance to the first breadfruit planted by Kahai at Pu'uloa, and a pig and a woman on Pu'uokapolei, possibly a reference to Kamapua'a and his grandmother.

Not like these art thou, Ku.	*Aole I like Ku.*
Not like the pig	*Aole I like i ka puaa,*
Discerning the progeny of the god;	*I ka weke loo a ke akua,*
[Or] The breadfruit planted by Kahai.	*Ka ulu kanu a Kahai;*
Truly, have you not known	*Oi ole ka oe i ike,*
The woman with the dyed garment,	*Ka wahine pau mao*
On the top of Puuokapolei?	*I ka luna o Puuokapolei-la?*

[Fornander 1917, Vol. IV, Part 2:392-393].

A later section of this *mele* also refers to Pu'uokapolei and makes mention of the famous blue poi of Honouliuli.

O Kawelo! Say, Kawelo!	*O Kawelo-e, e Kawelo-e,*
Kawelokiki, the sharp-pointed hill,	*O Kaweloiki puu oioi,*
Hill of Kapolei.	*Puu of Kapolei-e-*
Blue is the poi which appeases	*Uliuli ka poi e piha nei-o Honouliuli;*
[the hunger] of Honouliuli.	

[Fornander 1917, Vol. IV, Part 2:400-401].

3.4 Pearl Harbor (Pu'uloa) and West Loch (Kaihu o pala'ai)

3.4.1 The "Silent Fish" of Pearl Harbor

Pearl Harbor was called Pu'uloa or *ke-awa-lau-o-Pu'uloa*, the many harbored-sea of Pu'uloa (Pukui 1983:#1686) by the Hawaiians. An alternate name was Awawa-lei, or "garland (*lei*) of harbors" (Handy and Handy 1972:469). Pukui (1983:#1126) also uses the name *Awaluo* for Pearl Harbor, as in the saying "*Huhui na 'ōpua i Awalau*, The clouds met at Pearl Harbor. Said of the mating of two people." Emerson (1915:167) interprets Awalau as "leaf-shaped lagoon."

John Clark (1977:70) says that its English name came from the name Waimomi, or "water of the pearl," an alternate name for the Pearl River (Pearl Harbor). The harbor was named Pearl Harbor after the pearl oysters of the family Pteriidae (mainly *Pinctada radiata*), which were once abundant on the harbor reefs, but were later decimated by over-harvesting. This oyster was supposedly brought from Kahiki, the Hawaiian ancestral lands, by a *mo'o* (lizard or water spirit) named Kane-kua'ana (Handy and Handy 1972:470).

Kanekua'ana was the *kia'i* (food guardian) for 'Ewa. When food was scarce, the descendants of Kanekua'ana built *waihau heiau* (a *heiau* for *mo'o*) for her and lit fires to plead for her blessings. For 'Ewa the chief *i'a* (marine food) blessing was the famous *pipi*, or pearl oyster. Samuel Kamakau describes the *pipi* of Honouliuli.

> That was the oyster that came in from deep water to the mussel beds near shore, from the channel entrance of Pu'uloa to the rocks along the edges of the fishponds. They grew right on the *nahawele* mussels and thus was this *i'a* obtained. Not six months after the *hau* branches [that placed a *kapu* on these waters until the *pipi* should come up] were set up, the *pipi* were found in abundance-enough for all 'Ewa-and fat with flesh. Within the oyster was a jewel (*daimana*) called a pearl (*mami*), beautiful as the eyeball of a fish, white and shining; white as the cuttle fish, and shining with the colors of the rainbow-reds and yellow and blues, and some pinkish white, ranging in size from small to large. They were of great bargaining value (*he waiwai kumuku'ai nui*) in the ancient days, but were just "rubbish" (*'opala*) in 'Ewa [Kamakau 1991b:83].

This oyster, the *pipi*, was sometimes called "the silent fish," or *i'a hamau leo o 'Ewa*, 'Ewa's silent sea creature (Handy and Handy 1972:471), since the collectors were supposed to stay quiet while harvesting the shells, as in the sayings:

The fish of 'Ewa that silences the voice.	*Ka ka'a hāmau leo o 'Ewa.*

The pearl oyster, which has to be gathered in silence [Pukui 1983:#1331].

'Ewa is disturbed by the Moa'e wind.	*Hannāele 'Ewa i ka Moa'e.*

> Used about something disturbing, like a violet argument. When the people of 'Ewa went to gather the *pipi* (pearl oyster), they did so in silence, for if they spoke, a Moa'e breeze would suddenly blow across the water, rippling it, and the oysters would disappear [Pukui 1983:5#493].

Hush, lest the wind rise.	*E hāmau o makani mai auane'i.*

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> Hold your silence or trouble will come to us. When the people went to gather pearl oysters at Pu'uloa, they did so in silence, for they believed that if they spoke, a gust of wind would ripple the water and the oysters would vanish [Pukui 1983:#274].

The gesturing fish of 'Ewa. *Ka i'a kuhi lima o 'Ewa.*

> The *pipi*, or pearl oyster. Fishermen did not speak when fishing for them but gestured to each other like deaf-mutes [Pukui 1983:#1357].

Sereno Bishop, an early resident of O'ahu, wrote, of his time in the area around 1836, of the pearl oyster, the *pipi*, and another edible clam, identified by Margaret Titcomb (1979:351) as probably *Lioconcha heiroglyphica.*

> The lochs or lagoons of Pearl River were not then as shoal as now. The subsequent occupation of the uplands by cattle denuded the country of herbage, and caused vast quantities of earth to be washed down by storms into the lagoons, shoaling the water for a long distance seaward. No doubt the area of deepwater and anchorage has been greatly diminished. In the thirties, the small oyster was quite abundant, and common on our table. Small pearls were frequently found in them. No doubt the copious inflow of fresh water favored their presence. I think they have become almost entire extinct, drowned out by the mud. There was also at Pearl River a handsome speckled clam, of a delicate flavor which contained milk white pearls of exquisite luster and perfectly spherical. I think the clam is still found in the Ewa Lochs [Bishop 1901:87].

Older Hawaiians believed that the *pipi* disappeared around the time of the smallpox epidemic of 1850-1853, because Kanekua'ana became displeased at the greed of some *konohiki* (overseer).

> The people of the place believe that the lizard was angry because the konohikis imposed kapus [bans], were cross with the women and seized their catch of oysters. So this "fish" was removed to Tahiti and other lands. When it vanished a white, toothed thing grew everywhere in the sea, of Ewa, which the natives of Ewa had named the pahikaua (sword). It is sharp edged and had come from Kauai-helanai, according to this legend [Manu 1885:50].

Pahikaua is the Hawaiian name for the mussel, *Brachidontes crebristriatus* (Mytilidae), which was also a popular clam eaten by the residents of Pearl Harbor.

A clarification of the story of Kanekua'ana and the pearl oysters of Pearl Harbor is given, in which it seems an overseer had set a ban on the *pipi* for several months a year so that they could increase. A poor widow, a relation of the *mo'o*, took some of the *pipi* and hid them in a basket. The *konohiki* found the hidden shells, and took them from her, emptying them back into the sea, which was proper. However, after this he followed the woman home and also demanded that she pay a stiff fine in cash, which she did not have. The *mo'o* thought this was unjust and the next night she took possession of a neighbor who was a medium.

> . . . After the overseer had gone back to Palea the lizard goddess possessed her aged keeper [a woman of Ewa] and said to those in the house, "I am taking the

> pipi back to Kahiki and they will not return until all the descendants of this man are dead. I go to sleep. Do not awaken my medium until she wakes of her own accord." The command was obeyed and she slept four days and four nights before she awoke. During the time that she slept the pearl oysters vanished from the places where they were found in great numbers, as far as the shore . . . .The few found today are merely nothing . . .[*Ka Loea Kālai'āina*, June 3, 1899, translation in Sterling and Summers 1978:49-50].

3.4.2 Ka'ahupāhau, the Queen Shark of O'ahu

Pearl Harbor in legendary traditions is closely associated with shark *'aumakua*, guardian spirits for specific Hawaiian families or clans. Pukui (1943:56) and others (Sheldon 1883) claim that the sharks of Pearl Harbor were so tame that people used to ride on their backs, and that their human relatives would feed them with *awa*. The most famous guardian shark was Ka'ahupāhau, the queen shark of O'ahu, who lived in Pu'uloa, now called Pearl Harbor. Her name means "cloak well cared for" (Pukui 1943:56), or "well cared-for feather cloak;" the feather cloak was a symbol of royalty.

Ka'ahupāhau and her brother, Kahi'uka, had been born as humans and were turned into sharks (Mary Kawena Pukui, March 29, 1954, from Sterling and Summers 1978:56).

> The mother, who was a chiefess, of Ka'ahupahau was gathering limu [seaweed] in the waters of Pearl Harbor when she had a miscarriage. Thinking the baby dead she left it in the water to be washed away. Later she went again to gather limu and was bitten by a shark. She went to a kahuna [priest] who told her that the shark was Ka'ahupahau who was her own daughter, the baby she thought was dead. The kahuna advised her to go to the place and build and ahu (heap) of hau a sort of landing from which she could feed the shark and care for it. It was from that time by command of the mother that all people of Ewa were to be always be protected from sharks whether in Pearl Harbor or outside [E.S. as told by Simeon Nawaa, Mar. 22, 1954, from Sterling and Summers 1978:56].

This explains the meaning of the shark's name Ka'ahupāhau, "the mound (*ahu*) of *hau*" (*Hibiscus tiliaceus*). The grandmother of Ka'ahupāhau and her brother, Koihala, lived in Honouliuli and one day was making *lei* for her shark grandchildren. A young girl named Pāpio rudely begged for one of the *lei*, but Koihala refused. On her way to her favorite surfing spot at Keahi Point, Pāpio snatched up one of the *lei*, and laughingly went surfing. Koihala angrily told Ka'ahupāhua about the stolen *lei*, and the shark killed the girl, grabbing her from a rock in the sea where she was resting.

> Ka'ahupahau soon recovered from her anger and became very sorry. She declared that from hence forth all sharks in her domain should not destroy, but protect the people round about. As flowers were the cause of the trouble she forbade their being carried or worn on the water of Pu'uloa. From that time all the people of that locality and the sharks in the lochs were the best of friends . . . . [Pukui 1943:56].

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In a second version of this story, the shark gods Kanehunamoku and Kamohoali'i were the ones that had placed a *kanawai* (decree) against the attack of men by all sharks around O'ahu. As the result of the attack of the chiefess Pāpio, Ka'ahupāhau was put on trial and tried at Uluka'a [the realm of the gods]. She escaped the punishment of death, but was placed in confinement. In his writing of 1870 (*Ke Au 'Oko'a* April 7, 1870), Samuel Kamakau asserted:

> After her confinement ended several years later Ka'ahupahau was very weak. She went on a sightseeing trip, got into trouble, and was almost killed. But she received great help from Kupiapia and Laukahi'u, sons of Kuhaimoana, when their enemies were all slain the *kanawai* was firmly established. This law-that no shark must bite or attempt to eat a person in Oahu waters-is well known from Pu'uloa to the Ewas. Anyone who doubts my work must be a *malihini* [recent resident] there. Only in recent times have sharks been known to bite people in Oahu waters or to have devoured them; it was not so in old times [Kamakau 1991b:73].

This information on the protective nature of Ka'ahupāhau is somewhat contradicted by the writings of the Russian explorer Otto Von Kotzebue, who walked to Pearl Harbor in 1821, but was unable to actually sail on the waters. He was told that people were thrown into the water as sacrifices to the sharks; however, it is uncertain if the person who told him this was an actual resident of 'Ewa, who would know the real truth. Kotzebue's account is:

> In the Pearl River there are sharks of remarkable size, and there have made on the banks an artificial pond of coral stones, in which a large shark is kept, to which, I was told, they often threw grown-up people, but more frequently children, as victims [Kotzebue 1821:338-348].

The protection of Ka'ahupāhau is emphasized in many other Hawaiian traditions. One time a man-eating shark called Mikololou from the Ka'ū district of the island of Hawai'i, came visiting at Pearl Harbor with other sharks, some man-eating, some not. Mikololou remarked "What fine, fat crabs you have here," from which Ka'ahupāhau knew that some of the sharks were man-eaters, since they referred to fishermen as "fat crabs." She directed the fishermen to place a barrier of nets across the entrance to the harbor, and when the sharks left her home, they could not get back out to the ocean.

> The sharks of the lochs attacked the man-eaters from outside and beat them unmercifully. A shark from Ka'u, Hawaii, who was not a man-eater, threw his weight over the nets and pressed them down. His sons changed themselves into pao'o [blennies] fishes and leaped where the net was forced down, thus escaping from the place where the battle of sharks was raging. Mikololou was caught fast in the nets and dragged ashore where his head was cut off and his body burned [Pukui 1943:56].

In another version of this story, Mikololou is accompanied to Pearl Harbor with his shark friends Kua, Keali'ikauaoka'ū, Pākaiea, and Kalani; Mikololou was the only man-eater. To escape the nets:

> Keali'ikauaoka'ū changed himself into a pao'o fish, which lives among the rocks, and leapt out of the net. Kua changed into a lupe, as the spotted stingray is called, and weighted down the net on one side, helping his son Kalani and nephew Pākaiea, who were half human, to escape [Pukui and Green 1995:40].

Only Mikololou was caught in the nets, and his body was tossed on shore to rot, until only the tongue was left. In some versions of this story, the tongue immediately jumps into the water and then becomes a shark again (Pukui and Green 1995:41); in other versions (Pukui 1943:56), the tongue is eaten by a dog, which then jumps into the water, turns into a shark, and escapes. In both versions, Mikololou returns to Ka'ū, never to bother Ka'ahupāhau again.

In Thrum's (1923:308) version, Mikololou went back to his home island of Hawai'i and organized an army of sharks to return to Pearl Harbor, but he was again defeated by the fishermen of 'Ewa under the command of Ka'ahupāhau, who slaughtered so many of the sharks that from then on "the sea of Pu'uloa is safe and peaceful through her law that sharks shall not attack man. That is why these waters are safe for people to swim from shore to shore without fear" (Thrum 1923:308). The watchful eye of Ka'ahupāhau led to these Hawaiian sayings:

Everywhere in Pu'uloa is the trail...of Ka'ahupāhau — *Alahula Pu'uloa, he alahelena Ka'ahupāhau*

Said of a person who goes everywhere, looking, peering, seeing all, or of a person familiar with every nook and corner of a place. Ka'ahupāhau is the shark goddess of Pu'uloa (Pearl Harbor) who guarded the people from being molested by sharks. She moved about, constantly watching [Pukui 1983:#105].

The man-eating sharks blamed Ka'ahupāhau. — *Ho'ahewa na niuhi ia Ka'ahupāhau.*

Evil-doers blame the person who safeguards the rights of others. Ka'ahupāhau was the guardian shark goddess of Pu'uloa (Pearl Harbor) who drove out or destroyed all the man-eating sharks [Pukui 1983:#1014].

Pu'uloa became lonely when — *Mehameha wale no o Pu'uloa,*

Ka'ahupāhau went away. — *i ka hele a Ka'ahupāhau.*The home is lonely when a loved one has gone. Ka'ahupāhau, guardian shark of Pu'uloa (Pearl Harbor), was dearly loved by the people [Pukui 1983:#2152].

Mikololou died and came to life again... through his tongue. — *Make o Mikololou a ola i ke ale lo.*

Said of one who talks himself out of a predicament [Pukui 1983:#2111].

There were other guardian sharks in Pearl Harbor, including a brother of Ka'ahupāhau's named Kahi'ukā (the smiting tail), and a son name Kūpīpī (Pukui 1943:57), or, in some versions, twin sons, named Kūpīpī and Kūmaninini (Pukui and Green 1995:41). In one version of the

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Story of Pāpio, recounted above, it is said the Ka'ahupāhau later turned into a stone, although the people of Pu'uloa continued to feed her (Martha Beckwith notes to Samuel Kamakau n.d., *Mo 'olelo Hawaii*, vol. II:23, from Sterling and Summers 1978:56).

> Kahi'ukā was the brother of Ka'ahupahau. The name means "smiting tail." This shark was called by this name because it was his duty to warn the people of Ewa of the presence of strange and unfriendly sharks in these waters and he did so by nudging them or striking at them with his tail When ever anyone was fishing and felt a nudge they would know it was Kahi'uka, warning them and they would leave the water immediately [E.S. as told by Simeon Nawaa, Mar. 22, 1954, from Sterling and Summers 1978:56].

There are two different accounts of the home of this shark brother. The above reference says that Kahi'uka lived at the site of the old dry dock. Mary Pukui disagrees, and says the site of the old dry dock was the home of the son, not the brother of Ka'ahupāhau. Mary Pukui says Kahi'ukā lived in a cavern under water off Moku'ume'ume (Ford Island) near Keanapua'a Point; he had a stone form in deep water some distance from the cave that could be seen from the surface (Mary Kawena Pukui, Mar. 29, 1954, from Sterling and Summers 1978:56). J. S. Emerson (1892) wrote in the late nineteenth century that Kahi'uka's keeper, Kimona, would often find fish nets missing and knew that Kahi'ukā had carried them upshore to a place of safety. Pukui also relates that the shark was named "smiting tail" because one side was longer than the other, and the shark would use his tail to smite unfriendly sharks.

3.4.3 Story of Ka'ehu-iki-manō-o-Pu'uloa, the Little Yellow Shark

One of the shark *'aumakua* associated with Pearl Harbor, was the little yellow shark called Ka'ehu, who was born on the Big Island, but later traveled to O'ahu and settled at Pu'uloa. His ancestor was Kama'ili'ili, the Hawaiian shark god, brother of the Hawaiian volcano goddess, Pele. Ka'ehu was a guardian of the Hawaiian people and once saved several surf riders at Waikīkī from a man-eating shark called Pehu (Knudsen 1946:9-13; Westervelt 1963:55-58).

In Thrum's version of this legend, the shark's name is Ka-ehu-iki-mano-o-Puuloa, meaning "the small, blonde shark of Pu'uloa." He was born in Puna, Hawai'i, but soon left on a tour of all of the islands, so that he could call and pay respects to all of the king-sharks of Hawai'i.

> . . . Puuloa, Oahu, was the next objective. Reaching its entrance they visited the pit of Komoawa, where Kaahupahua's watcher lived. Here the young shark made himself known, as usual; the object of the journey, and the desire to meet the famous queen-shark protector of Oahu's waters. . . . Welcome greetings were sent by the messenger, who was bid entertain the visitors in the outer cave, and on the morrow the party could come up the lochs to meet the queen. . . .The company then repaired to the royal cave at Honouliuli, where the visitors were supplied with soft coconut and *awa*, their home food and beverage [Thrum 1923:301-302].

The cave of Komoawa may be the Hawaiian words for "channel" or harbor" entrance (Pukui and Elbert 1986). In another version of this story, the shark watcher himself is named Komoawa and the cave that he lives in is called Kenali'i. Keaali'i guards the entrance to Pearl Harbor,

while the home of Ka'ahupāhau is deeper into Honouliuli lagoon (*Saturday Press*, Dec. 29, 1883).

In 1823, the missionary Hiram Bingham accompanied Liholiho (King Kamehameha II) and his company to the royal compound at Pu'uloa, where he was shown a cave that was home to a shark god.

> I one day accompanied the king and others by boat to see the reputed habitation of an Hawaiian deity, on the bank of the lagoon of Ewa. It was a cavern or fissure in a rock, chiefly under water, where, as the traditions teach, and as some then affirmed, a god, once in human form, taking the form of a shark, had his subterraqueous abode. Sharks were regarded by the Hawaiians as gods capable of being influenced by prayers and sacrifices, either to kill those who hate and despise them, or to spare those who respect and worship them . . . [Bingham 1847:177].

Although Bingham stated in this year that no one any longer believed these stories, there were some who kept the beliefs of the guardian sharks alive. In 1912, dredging in Pearl Harbor was completed and a large drydock was completed, but collapsed the very next year. The native Hawaiians believed that the dock had collapsed because it had been built over the home of Kūpipi the shark son of Ka'ahupāhau's, who lived in a cavern near the harbor entrance at Pu'uloa. "Angered by the violation of his home, the shark prince destroyed the imposing structure" (Clark 1977:69-70). The dock was rebuilt in the same year, but this time only after a blessing on the construction was made by Hawaiian traditional practioners.

In other versions of this story, the name of the shark is interpreted as "the little ruddy shark" (Emerson n.d.), or the "little reddish-haired shark," named for the reddish (*'ehu*) hair of Ka'ahupāhau. In this version, the cave of Ka'ehu is called Pānau, and the human mother and father of the little shark are Kapukapu and Holei of Pānau, in Puna, Hawai'i (Emory et al. 1959:63).

3.4.4 Kāne and Kanaloa and the Fish Ponds of West Loch

According to an account in the Hawaiian newspaper *Ka Loea Kālai'āina* (June 10, 1899), several of the fishponds in the Pu'uloa area were made by the brother gods, Kāne and Kanaloa. A fisherman living in Pu'uloa, named Hanakahi, prayed to unknown gods, until one day two men came to his house. They revealed to him that they were the gods to whom he should pray. Kāne and Kanaloa then built fishponds at Ke'ana-pua'a, but were not satisfied. Then they built the fishpond, Kepo'okala, but were still not satisfied. Finally they made the pond Kapākule, which they stocked with all manner of fish. They gifted all of these fishponds to Hanakahi and his descendants (Handy and Handy 1972:473; *Ka Loea Kālai'āina*, July 8, 1899).

According to Mary Pukui (1943:56-57), who visited Kapākule fishpond when she was young, the pond was built by the legendary little people of Hawai'i, the *menehune*, under the direction of the gods Kāne and Kanaloa. Pukui describes several unique aspects of this pond:

> On the left side of the pond stood the stone called Hina, which represented a goddess of the sea by that by that name. Each time the sea ebbed, the rock became

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> gradually visible, vanishing again under water at high tide. Ku, another stone on the right, was never seen above sea level. This stone represented Ku'ula, Red Ku, a god for fish and fishermen. From one side of the pond a long wall composed of driven stakes of hard wood, ran toward the island [Laulaunui] in the lochs. When the fish swam up the channel and then inside of this wall, they invariably found themselves in the pond. A short distance from the spot where the pond touched the shore was a small koa or altar composed of coral rock. It was here that the first fish caught in the pond was laid as an offering to the gods [Pukui 1943:56].

The fishpond contained many fish, especially the *akule* (scad fish, *Trachurops crumenophthalmus*), thus its name, "the enclosure for *akule* fish" (Pukui 1943:56-57). The pond was destroyed when the channel to Pearl Harbor was dredged in the early twentieth century. The caretaker of the pond took the stones Kū and Hina to a deep place in the ocean and sunk them so "none would harm or defile them." Cobb (1903:733) says it was used to catch the larger *akule* (goggler), *opelu* (mackeral scad), *weke* (goat fish), *kawakawa* (bonito), and sharks; it was unusual for having walls made of coral. This contradicts much of the legendary material that says that sharks were not killed within Pearl Harbor; however, Kamakau does relate that Kekuamanoha and Kauhiwawaeono, two conspirators against Kamehameha I, lived at Pu'uloa. The chief Kauhiwawaeono was known to murder people and use their bodies as shark bait (Kamakau 1961:182, 232).

Samuel Kamakau adds more information on the pond Kapākule, and a second one called Kepo'okala.

> At Pu'uloa on Oahu were two unusual ponds [fish traps]—Kapakule and Kepoolala. Kapakule was the better one. The rocks of its walls, *kuapa*, could be seen protruding at high tide, but the interlocking stone walls (*pae niho pohaku*) of the other pond were still under water at high tide. . . . It [Kapakule] was said to have been built by the *'e'epa* people [mysterious people] at the command of Kane....This is how the fish entered the pond. At high tide many fish would go past the mauka side of the pond, and when they returned they would become frightened by the projecting shadows of the trunks, and would go into the opening. The fish that went along the edge of the sand reached the seaward wall, then turned back toward the middle and entered the *anapuna* (the arched portion of the trap) A man ran out and placed a "cut-off" seine net (*'amuku lau*) in the opening, and the fish shoved and crowded into it. The fish that were caught in the net were dumped out, and those not caught in the net were attacked with sharp sticks and tossed out, or were seized by those who were strong [Kamakau 1976:88].

3.4.5 The Story of Kaihuopala'ai Pond, Honouliuli (*Ka'ao no Maikohā*)

In the Legend of Maikohā (Fornander 1917, Vol. V, Part 2:270-271), a sister of Maikohā, a deified hairy man who became the god of *tapa* makers, named Kaihuopala'ai, journeys to O'ahu:

> Kaihuopala'ai saw a goodly man by the name of Kapapaapuhi who was living at Honouliuli, 'Ewa; she fell in love with him and they were united, so

> Kaihuopala'ai has remained in 'Ewa to this day. She was changed into that fishpond in which mullet are kept and fattened, and that fish pond is used for that purpose to this day,
>
> *'Ike aku la o Kaihuopala'ai i ka maikai o Kapapaapuhi, he kāne e noho ana ma Honouliuli ma 'Ewa. Moe iha la lāua, a noho iho la o Kaihuopala'ai i laila a hiki i kēia lā. 'Oia kēlā loko kai e ho'opuni ia nei i ka 'anae, nona nā i'a he nui loa, a hiki i kēia kākau ana* [Fornander 1919, Vol. V, Part 2:270].

The name of Maikohā's sister, Kaihuopala'ai, which means "the nose of Pala'ai" (Pukui et al. 1974:68) is also the name the Hawaiians used for the west loch of Pearl Harbor, adjacent to the Project Area. McAllister recorded that other Hawaiians say there never was a fishpond by that name Beckwith (1918) says that Kaihuopala'ai changed into the fishpond near Kapapapuhi, which means "the eel flats." This is identified on old maps as the point north of the Project Area (sometimes spelled Kapapa'apuhi) that juts into the loch; early Hawaiian settlement was focused on this area.

There is also a famous *pōhaku*, or rock, associated with the traveling mullet of Pearl Harbor.

> . . .I . . .asked the person sitting on my left, "What place is this?" Answer – "This is Pearl City." It was here that mullets were bred in the ancient times and that flat stone there was called Mullet Rock or Pōhaku Anae. It lies near the beach by Ewa mill [*Ka Nūpepa Kū'oka'a*, Oct. 2, 1908, from Sterling and Summers 1978:53].

3.4.6 The Traveling Mullet of Hononlinli (Fish Stories and Superstitions)

The story of Kaihuopala'ai, or Ihuopala'ai, is also associated with the tradition of the *anae-holo*, the traveling mullet of Pearl Harbor (Thrum 1998:270-272):

> The home of the *'anae-holo* is at Honouliuli, Pearl Harbor, at a place called Ihuopala'ai. They make periodical journeys around to the opposite side of the island, starting from Pu'uloa and going to windward, passing successively Kumumanu, Kalihi, Kou, Kālia, Waikīkī, Ka'alāwai, and so on, around to the Ko'olau side, ending at Lā'ie, and then returning by the same course to their starting point [Thrum 1998:271].

In Thrum's account, Ihuopala'ai is a male who possesses a Kū'ula or fish god that supplied the large mullet known as "*anae*." His sister lived in Lā'ie, and there came a time when there were no fish to be had. She sent her husband to visit Ihuopala'ai, who was kind enough to send the fish following his brother-in-law on his trip back to Lā'ie.

This story is associated with a proverb or poetical saying identified with Honouliuli:

The fish fetched by the wind. *Ka I'a hali a ka makani*

> The *'anaeholo*, a fish that travels from Honouliuli, where it breeds, to Kaipāpa'u, on the windward side of O'ahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong [Pukui 1983:#1330].

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Pukui et al. (1974:68) gives the name of the husband in this story as Lā'ie and the name of the wife as Pala'ai, which ties into the name of the west loch of Pearl Harbor, called Ka-ihu o Pala'ai, "the nose of Pala'ai." Another version has a woman named Awawalei (an alternate version for the name of Pearl Harbor), who had a brother named Laniloa (the point on Lā'ie at which the mullet stops its migration and makes its way back to Pearl Harbor), and another brother (a mullet) who lived with an eel named Papa-puhi, which relates to the name of the fishpond in the tale called Kapapapuhi (*Ka Loea Kālai'āina*, Oct. 21, 1899). On historic maps, Kapapapuhi is a point of land that juts into West Loch and was a focus for habitation, taro cultivation, and fishpond maintenance in the early post-Contact (and probably earlier) period.

3.4.7 The Caves of Pu'uloa

'Ewa was famous for the many limestone caves formed in the uplifted coral. Some of these caves, called *ka-lua-ōlohe* were inhabited by the *ōlohe*, a type of people that looked like other humans but had tails like dogs (Beckwith 1940:343). These people were skilled in wrestling and bone-breaking and often hid along narrow passes to rob travelers; they were also reputed to be cannibals. As mentioned in a previous section of this report, the famous cannibal king, Kaupe, who lived in Līhu'e in upland Honouliuli, was an *ōlohe*.

There was once a cave named Kapuna on Waipi'o peninsula that was associated with a famous riddle. *No Kapuna kane hale noho ia e ke kai*, or "To Kapuna belongs the house, the sea dwells in it."

> This cave is on the Waipio side and a sea passage separates Waipio and Waikele and Waikele and Honouliuli. The passage is obstructed by three small islands, a middle one and Manana and Laulaunui. These small islands in the middle of the passage to Honouliuli and inside and outside of these small islands is the sea of Kaihuopalaai [Hawaiian name for West Loch] where mullet lived till they whitened with age [*Ka Loea Kālai'āina*, Oct. 7, 1899, translation in Sterling and Summers 1978:24].

Another famous cave of the area was Keanapua'a [in Halawa opposite Waipi'o peninsula], which means "the pig's cave," so named because Kamapua'a once slept there (Pukui et al. 1974:103). This cave was one of the places that the high king of O'ahu, Kahahana, hid after he had killed the priest Kaopulupulu, thus angering the high chief of Maui, Kahekili (Kahahana's father).

> Upon the arrival here at Oahu of Kahekili, Kahahana fled, with his wife Kekuapoi, and friend Alapai, and hid in the shrubbery of the hills. They went to Aliomanu, Moanalua, to a place called Kinimakalehua; then moved along to Keanapuaa and Kepookala, at the lochs of Puuloa, and then from there to upper Waipio; thence to Wahiawa, Helemano, and on to Lihue; thence they came to Poohilo, at Honouliuli, where they first showed themselves to the people and submitted themselves to their care.
>
> Through treachery, Kahahana was induced to leave Po'ohilo, Honouliuli and was killed on the plains of Hō'ae'ae [Thrum 1906:213-214].

The place Pō'o Hilo was somewhere on the border between Honouliuli and Hō'ae'ae (north of the Project Area). In the "Legend of the Sacred Spear-point" (Kalākaua 1990:209-225) is a reference to the Hawai'i Island chief, Hilo-a-Lakapu. Following his unsuccessful raid against O'ahu "he was slain at Waimano, and his head was placed upon a pole near Honouliuli for the birds to feed upon"(Kalākaua 1990:224). This place was called Pō'o Hilo, which literally means "the head of Hilo."

The caves of Pu'uloa were sometimes used as burial caves. In 1849, Keali'iahonui, son of Kaua'i's last king, Kaumuali'i, died. He had once been married to the chiefess Kekau'ōnohi, who had stayed with him until 1849. She wanted to bury her ex-husband at sea.

> It seems that by Kekauonohi's orders, the coffin containing her late husband's remains was removed to Puuloa, Ewa, with the view of having it afterwards taken out to sea and there sunk. It was temporarily deposited in a cavern in the coral limestone back of Puuloa, which has long been used for a burial place, and has lately been closed up [Alexander 1907:27].

After some initial objections by the niece of Kealai'iahonui, the body was removed from the outer coffin, the rest was sunk, and the coffin was later buried somewhere in Pu'uloa.

3.4.8 Coastal Honouliuli

The coastal area of Honouliuli is a triangular area that stretches from Pili o Kahe on the northwestern corner that marks the boundary with the Wai'anae District to Kalaeloa (now Barbers Point) on the southwestern corner, to Keahi Point on the southeastern corner at the mouth of Pearl Harbor. There were likely Hawaiian settlements at Ko'ōlina on the west side, at Kualaka'i on the south, at the royal residence in Pu'uloa near the mouth of the harbor, and at Honouliuli town at the upper end of West Loch, surrounding Kapapapuhi Point, north of the Project Area.

Kalaeloa literally means "the long point" (Pukui et al. 1974:72), but Raphaelson (1925) has a different translation. He says the name of the point is Kalaiekao, meaning "sky rocket cape," because it was on this point that signal fires were set to signal canoes to go out to meet European boats during the early historic period. Kalaeloa Point was the home of Uhu makaikai, a *kupua* (supernatural being) who could take the form of a man or a giant parrotfish (*uhu*). He is mentioned in several legends concerning the hero Kawelo and his struggles with the ruling chief of Kaua'i, Aikanaka.

> This friend was Kauahoa also an alii of Wailua (Kauai). Their king, Aikanaka, in the time of Kākuhihewa of Oahu and Lonoikamakahiki of Hawaii. Aikanaka got offended with Kawelo and sent him to live at Waikiki. The king at a surf bathing told Kawelo to get a calabash of water for him to wash off with, but on Kawelo's failing to do it, he took a calabash of soft poi and threw it over Kawelo and sent him off as already stated. At Waikiki, Kawelo studied the art of fighting to be revenged on Aikanaka. A *kupua*, Uhu makaikai, a fish was his teacher. Makuakeke was his helper in the canoe. The fish lived at Pōhaku o Kawai near Kalailoa (Kalaeloa), Oahu (BarbersPoint) . . . . [Hawaiian Ethnological Notes, Bishop Museum Vol. II:114, translation in Sterling and Summers 1978:41].

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One historical account of particular interest refers to an *ali'i* residing in Ko'ōlina, within Waimanalo (meaning "brackish water").

> Ko'ōlina is in Waimānalo near the boundary of 'Ewa and Wai'anae. This was a vacationing place for chief Kākuhihewa and the priest Napuaikamao was the caretaker of the place. Remember reader, this Ko'ōlina is not situated in the Waimānalo on the Ko'olau side of the island but the Waimānalo in 'Ewa. It is a lovely and delightful place and the chief, Kākuhihewa loved this home of his [*Ke Au Hou* July 13, 1910, from Sterling and Summers 1978:41].

Between Pili o Kahe and Kalaeloa there is Kahe Point, which was formerly marked by two drainage ditches called Keone'ō'io and Limaloa, which may explain the name Kahe, which means "flow" (Pukui et al. 1974:64). Keone'ō'io means "the *'ō'io* sand; this area once had large schools of *'ō'io* (bonefish; Albulidae), a fish usually found on sandy-bottom areas (Clark 1977:77). Kalaeloa, meaning "the long point", got its present name Barbers Point from Captain Henry Barber of the brig *Arthur*, who ran aground on October 31, 1796 on a shoal west of the entrance to Pearl Harbor. Hawaiians, under the command of Kamehameha I, salvaged the cannon from the ship and used them to man a new fort on Lahaina, Maui (Clark 1977:75-76).

Kualaka'i is the name of the beach area on the south ocean coast of Honouliuli. Clark (1977:74) says it is named for a type of sea cucumber that squirts a purple fluid when squeezed, but, the book *Hawaiian Place Names* (Pukui et al. 1974:119) identifies the sea creature as 'tethys," a member of the invertebrate family Aplysiidae, commonly called sea hares. In the legend of Hi'iaka, there was a spring located at Kualaka'i named Hoaka-lei (*lei* reflection) where Hi'iaka picked *lehua* flowers to make a *lei* and saw her reflection in the water (*Ka Hākū o Hawai'i*, February 22, 1927, translated in Maly 1997:20).

Keahi Point, at the entrance to Pearl Harbor, has already been noted as the surf spot for the chiefess Pāpio who was killed by the queen shark of Pearl Harbor, Ka'ahupāhau. It was also known as a good fishing spot for the *'ō'io* (bonefish, *Albula vulpes*). The *'ō'io* from Keahi were famed for their fragrance, like that of the *līpoa* (*Dictyopteris* spp.) seaweed (Pukui 1943:56).

In pre-Contact times, Pu'uloa was an *'ili* of Honouliuli, but sometime after 1868, it was designated as a separate *ahupua'a* (Maly 1997:9). Pu'uloa was a royal habitation area, and according to one tradition, was the first place that "human beings" landed on O'ahu (Beckwith 1940:343). Within Pu'uloa (meaning "long hill") on the seashore side was a beach area called One'ula, which means "red sand," possibly named for a large drainage ditch which carried red dirt from the inlands to the seashore (Clark 1977:73).

3.4.8.1 The Strife of Nāmakaokapāo'o and Puali'i (*Ka'ao no Nāmakaokapāo'o*)

In the Legend of Nāmakaokapāo'o (Fornander 1919, Vol. V, Part 2:274-277), the brave boy, Nāmakaokapāo'o, and his mother, Pokai, appear to have been living near the coast but were quite destitute (*'ilihune loa*). His mother met Puali'i when he came from Līhu'e to fish at Honouliuli, the two married, and the new family went to live on the plains of Keahumoa (*ke kula o Keahumoa*). Puali'i kept sweet potato patches (*māla uala*) and fished for *ulua*. Following a dispute over sweet potatoes, Nāmakaokapāo'o defeated his step-father, Puali'i and:

> Nāmakaokapāo'o picked up Puali'i's head and threw it towards Waipouli, a cave situated on the beach at Honouliuli (a distance of about five miles).
>
> *Lālau aku la o Nāmakaokapāo'o i ke po'o o Puali'i a kiola aku la i kai o Waipouli, he ana ma kahakai o Honouliuli, o kona loa, 'elima mile ka loa* [Fornander 1919, Vol. V, Part 2:276-277].

3.4.8.2 Coastal Village of Kualaka'i

In the Legend of the Children, is a tale that foretold the later breaking of the eating *kapu* by the *ali'i*. A young brother and sister always fished at Kualaka'i, a beach area on the southern coast of Honouliuli. One day they laid out their nets, but all they caught was one *palani* (surgeonfish), a fish that was *kapu* (tabu) for men; only women could eat it.

> . . . They fished again and again until the afternoon and nothing was caught. The children were weary and went home without fish. When they came as far as Pu'u-o-Kapolei where the blossoms of the ma'o looked golden in the sunlight, the sister sat down to make ma'o leis for themselves. When the leis were made they went across the breadth of Kanpe'a to Waipio [*Ka Loea Kālai'āina*, July 22, 1899:15; translation in Sterling and Summers 1978:7].

They stopped at the stream of Ka'aimalu on the way to their home, and the sister convinced her brother to share the fish between the two, thus breaking the *kapu*. "Because these children ate fish secretly, the spot is called Ka'ai-malu (Secret eating) to this day" (Sterling and Summers 1978:7). This legend also shows the relation of several landmarks on the coastal plain, as the children travel from the coast at Kualaka'i, across the plain of Kaupe'a to Waipi'o, passing next to Pu'uokapolei .

3.4.8.3 Pu'uloa and the Breadfruit

Pu'uloa was noted as one of the first places to have breadfruit. It was brought to the islands by Kaha'i, son of Ho'okamali'i and grandson of Moikehā, who brought the plant from Upolu (central Polynesia) to Hawai'i and planted it at Pu'uloa (Beckwith 1940:97).

Two other versions can be found in Fornander. In the first, the location of the first planting is in Pu'uloa, but does not mention Kaha'i (Fornander 1919, Vol. V, Part 3:678):

> At Puuloa, Oahu. Its breadfruit plant came from Kanehunaamoku [a mythical land supposed to have been hidden by the god Kāne], brought by two men at Puuloa who were out fishing and were blown off by a heavy wind and rainstorm and landed at the uninhabited land, save gods only. Therefore by them it was introduced at Puuloa and planted in a large excavation where it grew and bore fruit, which they ate.
>
> *Ma Puuloa i Oahu. Ko laila ulu no Kanehunamoku mai, na kekahi mau kanaka o Puuloa i hele i ka lawaia a puhia e ka ino nui, makani a me ka ua, a pae i keia aina kanaka ole, he akua wale no; nolaila mai ka laua lawe ana mai i keia ulu a hiki i Puuloa, kanu a ulu i kekahi lua niu a hua, ai keia mau kanaka.*

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[Fornander 1919, Vol. V, Part 3:678-679].

A second version associates the breadfruit tree in 'Ewa to the chief Namaka-o-ka-paoo, the Hawaiian born son of Ka-ulu-o-kaha'i, which means "Breadfruit of Kaha'i." Kauluokaha'i had left O'ahu to return to his ancestral lands of Kahiki (Hawaiian ancestral land). Once Namakaokapa'o had conquered the island of O'ahu, he wanted to travel to Hawai'i in secret to spy on the land.

> . . . He [Namakaokapaoo] then went and got a small gourd wherein to place his garments which his father had left him. This gourd was deposited at Kualakai, where a breadfruit tree is standing to this day. This is the breadfruit impersonation of his father, Kahaiulu. When the real person went home the breadfruit tree remained, being in the supernatural state.
>
> . . *Alaila, kii aku la ia he wahi hokeo waiho kapa nona, na kona mokuakane i waiho nona. O kahi i waiho ai ua wahi hokeo la, makai o Kualakai, oia kelo ulu e ku nei a hiki i keia la ma Kualakai. Oia ke kino ulu o kona makuokane o Kahaiulu. Hoi ke kino maoli, koe ke kino ulu, ma ke ano akua keia kino* [Fornander 1919, Vol. V, Part 2:279-280].

Section 4 Historic Background

4.1 Pre-Contact and Early Post-Contact Period

By ca. A.D. 1320, 'Ewa, along with Kona, and Ko'olaupoko were the dominant polities, ruled by the sons of a chief named Māweke (Cordy 2002:21). 'Ewa at this time included the traditional districts of 'Ewa, Wai'anae, and Waialua (Fornander 1880:48). Around A.D. 1400, the entire island was ruled by King La'akona; chiefs within his line, the Māweke-Kumuhonua line, reigned until about A.D. 1520-1540, with their major royal center in Līhu'e, in 'Ewa. (Cordy 2002:24). Haka was the last chief of the Māweke-Kumuhonua line; he was slain by his men at the fortress of Waewae near Līhu'e (Kamakau 1991a:54-54; Fornander 1880:88). Power shifted between the chiefs of different districts from the 1500s until the early 1700s, when Kūali'i achieved control of all of O'ahu by defeating the Kona chiefs, then the 'Ewa chiefs, and then expanding his control on windward Kaua'i. Peleiholani, the heir of Kūali'i, gained control of O'ahu ca. 1740, and later conquered parts of Moloka'i. He was ruler of O'ahu until his death in ca. 1778 when Kahahana, of the 'Ewa line of chiefs was selected as the ruler of O'ahu (Cordy 2002:24-41).

After Kamehameha's O'ahu victory, he gave the *ahupua'a* of Honouliuli to Kalanimōkū as part of the *panalā'au*, or conquered lands, with the right to pass the land on to his heirs rather than having it revert to Kamehameha (Kame'eleihiwa 1992:58, 112). Kalanimōkū subsequently gave the *ahupua'a* to his sister, Wahinepi'o.

Various Hawaiian legends and early historical accounts indicate that the *ahupua'a* (land division) of Honouliuli was once widely inhabited by pre-contact populations, including the Hawaiian *ali'i* (chiefly class). This would be attributable for the most part to the plentiful marine and estuarine resources available at the coast, along which several sites interpreted as permanent habitations and fishing shrines have been located. Other attractive subsistence-related features of the *ahupua'a* include irrigated lowlands suitable for wetland taro cultivation, as well as the lower forest area of the mountain slopes for the procurement of forest resources. Handy and Handy report:

> The lowlands, bisected by ample streams, were ideal terrain for the cultivation of irrigated taro. The hinterland consisted of deep valleys running far back into the Ko'olau range. Between the valleys were ridges, with steep sides, but a very gradual increase of altitude. The lower part of the valley sides were excellent for the cultivation of yams and bananas. Farther inland grew the 'awa for which the area was famous. [1972:429]

In addition, breadfruit, coconuts, *wauke*, bananas, and *olona* and other plants were grown in the interior. 'Ewa was known as one of the best areas to grow gourds and was famous for its *mamaki*. It was also famous for a rare taro called the *kai o 'Ewa*, which was grown in mounds in marshy locations (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the saying:

He has eaten the Kāī-koi taro of 'Ewa. *Ua 'ai i ke kāī-koi o 'Ewa.*

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> Kāī is O'ahu's best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of 'Ewa, who, like the Kāī taro, is not easily forgotten [Pukui 1983:#2770].

The lochs of Pearl Harbor were ideal for the construction fishponds and fishtraps. Forest resources along the slopes of the Wai'anae Range probably acted as a viable subsistence alternative during times of famine and/or low rainfall (Handy 1940:211; Handy and Handy 1972:469-470). The upper valley slopes may have also been a resource for sporadic quarrying of basalt used in the manufacturing of stone tools. At least one probable quarrying site (SIHP site 50-80-12-4322) is present in Maka'īwa Gulch at 152 m (500 ft) above mean sea level (Hammatt, Robins, et al. 1990).

John Papa 'Ī'ī describes a network of Leeward O'ahu trails (Figure 6), which in historic times encircled and crossed the Wai'anae Range, allowing passage from Lualualei to Honouliuli by three different trails ('Ī'ī 1959:96-98). The coastal trail skirted Pearl Harbor, passing by Pu'uokapolei ; this would have been the nearest of three Honouliuli trails to the current Project Area. Following 'Ī'ī's description, a portion of this trail network, would have passed close to the existing Farrington Highway, near the northern border of the Project Area, as seen in an 1825 map

The trail is described by 'Ī'ī as:

> The trail went down to the stream and up again, then went above the taro patches of Waiau, up to a *makai* field, to Waimano, to Manana, and to Waiawa; then to the stream of Kukehi and up to two other *maika* fields, Pueohulunui and Haupuu. At Pueohulunui was the place where a trail branched off to go Waialua and down to Honouliuli and on to Waianae. As mentioned before, there were three trails to Waianae, one by way of Pu'u o Kapolei, another by way of Pohakea, and the third by way of Kolekole ['Ī'ī 1959:97].

Early historical accounts of the general region typically refer to the more populated areas of the 'Ewa district, where missions and schools were established and subsistence resources were perceived to be greater. However, the presence of archaeological sites along the barren coral plains and coast of southwest Honouliuli Ahupua'a, indicate that prehistoric and early historic populations also adapted to less inviting areas, despite the environmental hardships.

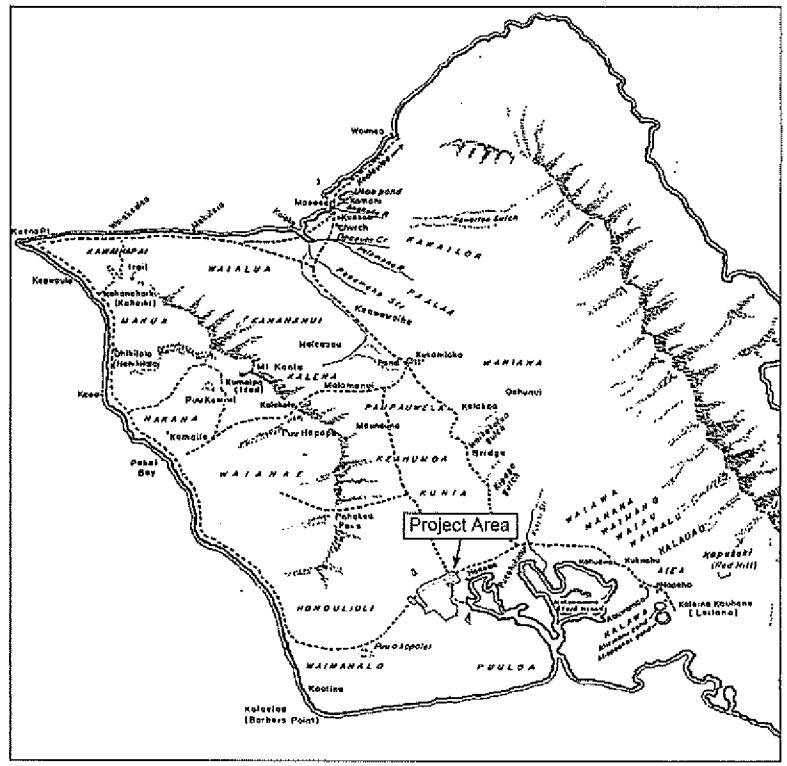

Figure 6. Trails of Leeward Oahu. Map by Paul Rockwood. ('Ī'ī 1959:96) Mid- to late-1800s

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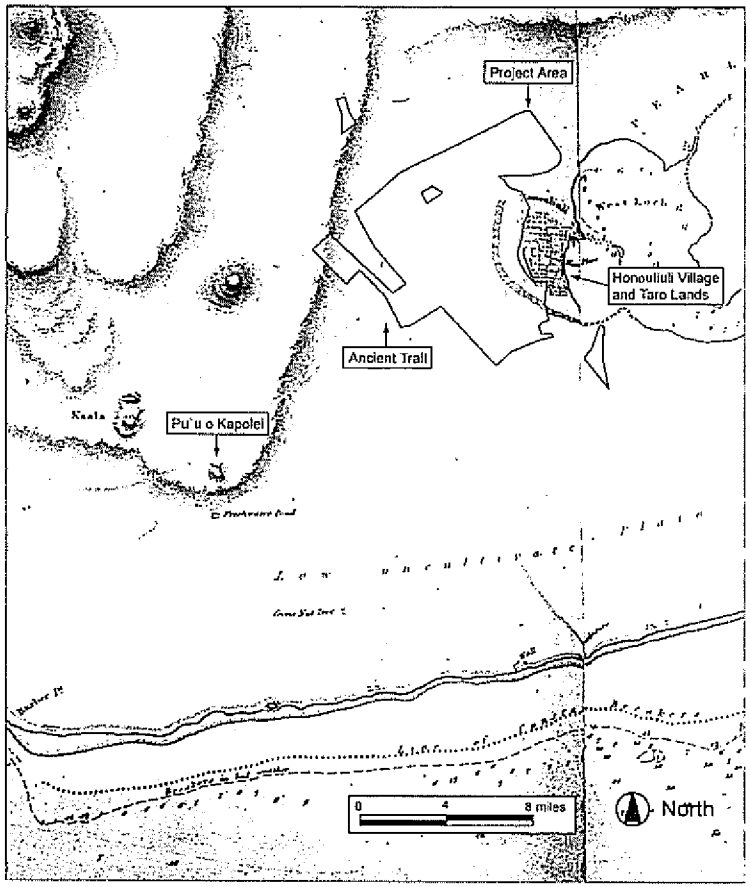

Figure 7. Portion of 1825 Map of the South Coast of Woahoo (O'ahu) and Honolulu by Lieut. C.R. Malden from the British ship the *Blonde* showing Honouliuli, the ancient trail, Pu'uokapolei, and the Project Area

4.1.1 Observations of Early Explorers and Foreign Residents

Captain Vancouver sailed by Kalaeloa (Barbers Point) in 1792, and recorded his impression of the small coastal village of Kualaka'i and the arid Honouliuli coast.

> The point is low flat land, with a reef round it. . . Not far from the S.W. point is a small grove of shabby cocoa-nut trees, and along these shores are a few struggling fishermen's huts [Vancouver 1798, Vol. I:167].
>
> . . .from the commencement of the high land to the westward of Opooroah [Pu'uloa], was composed of one very barren rocky waste, nearly destitute of verdure, cultivation or inhabitants, with little variation all the way to the west point of the island . . .[Vancouver 1798, Vol. II:217].
>
> . . .This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of fertility; although we were told that at a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced . . . [Vancouver 1798, Vol. III:361-363].

Archibald Campbell, an English seamen who was given some land in Waimano Ahupua'a by King Kamehameha in 1809, described his land around Pearl Harbor:

> In the month of November the king was pleased to grant me about sixty acres of land, situated upon the Wymummee [traditional Hawaiian name for Pearl River], or Pearl-water, an inlet of the sea about twelve miles to the west of Hanaroora [Honolulu]. . . .We passed by footpaths, winding through an extensive and fertile plain, the whole of which is in the highest state of cultivation. Every stream was carefully embanked, to supply water for the taro beds. Where there was not water, the land was under crops of yams and sweet potatoes [Campbell 1967:103-104].
>
> Pearl and mother of-pearl shells are found here in considerable quantity. Since the king has learned of their value, he has kept the fishing to himself, and employs divers for the purpose [Campbell 1967:114-115].

Subsequent to western contact in the area, the landscape of the 'Ewa plains and Wai'anae slopes was adversely affected by the removal of the sandalwood forest, and the introduction of domesticated animals and new vegetation species. Domesticated animals, including goats, sheep and cattle, were brought to the Hawaiian Islands by Vancouver in the early 1790s, and allowed to graze freely about the land for some time after. It is unclear when the domesticated animals were brought to O'ahu; however, L.A. Henke reports the existence of a longhorn cattle ranch in Wai'anae by at least 1840 (Frierson 1972:10). During this same time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the logging of sandalwood forest and eroded by animal grazing. Within the current Project Area, the majority of the vegetation is comprised of introduced species, mainly grasses.

At contact, the most populous *ahupua'a* on the island was Honouliuli, with the majority of the population centered on Pearl Harbor. In 1832, a missionary census of Honouliuli recorded the

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population as 1,026. Within four years the population was down to 870 (Schmitt 1973:19, 22). In 1835, there were eight to ten deaths for every birth (Kelly 1991:157-158). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages. In 1853, the population of 'Ewa and Wai'anae combined was 2,451 people. In 1872, it was 1,671 (Schmitt 1968:71). The inland area of 'Ewa was probably abandoned by the mid-nineteenth, due to population decline and consolidation of the remaining people in the town of Honouliuli (at Papapuhi Point, east of the Project Area). A detailed discussion of the historic population counts in the 'Ewa District has been presented by Charvet-Pond and Davis (1992).

The first mission station in 'Ewa was established in 1834 at Kalua'aha near Pearl Harbor. Charles Wilkes, of the U.S. Exploring Expedition visited the missionary enclave at Honouliuli town in 1840.

> At Ewa, Mr Bishop has a large congregation. The village comprises about fifty houses, and the country around is dotted with them. . . . The natives have made some advance in the arts of civilized life; there is a sugar-mill which, in the season, makes two hundred pounds of sugar a day. . . . In 1840, the church contained nine hundred members, seven hundred and sixty of whom belonged to Ewa, the remainder to Waianae; but the Catholics have now established themselves at both these places, and it is understood are drawing off many from their attendance on Mr. Bishop's church [Wilkes 1970:80-81].

The earliest detailed map of the area (Alexander 1873 Figure 8) shows no habitation closer than the western edge of West Loch in the vicinity of Pāpapuhi Point. A Monsarrat survey map of 1878 documents substantial settlement at the "Honouliuli Taro Land" in the Pāpapuhi Point area, and it seems clear that in early historic times, this was the focus of the population of Honouliuli. The amenities of the area - including fishponds, taro *lo'i*, abundant shellfish, and salt pans - would have focused population there in pre-Contact times as well.

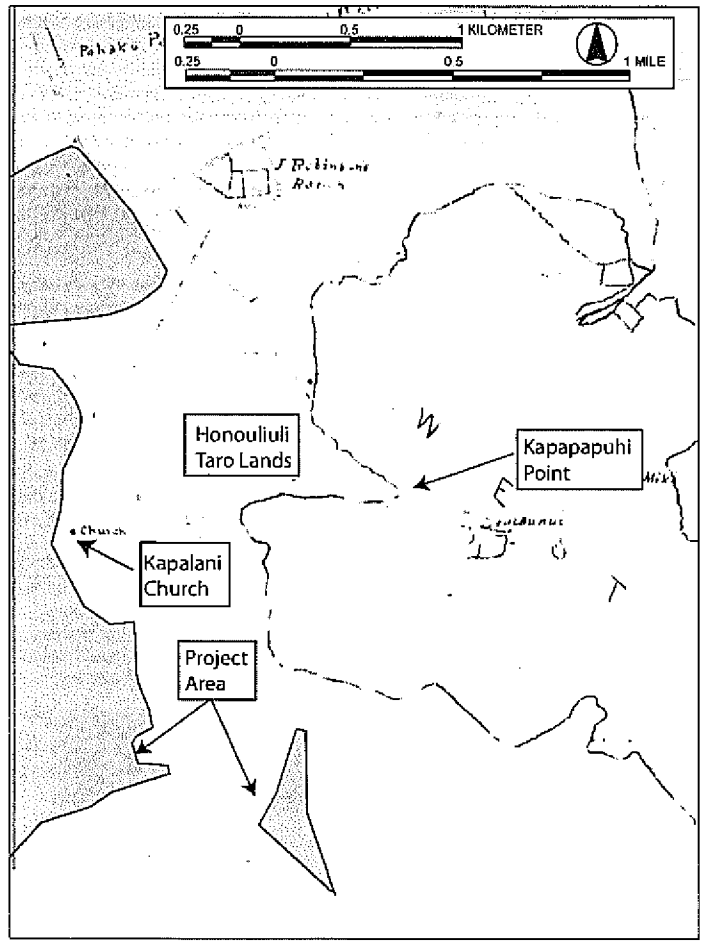

Figure 8. Portion of 1873 W.D. Alexander map of Honouliuli, showing location of Papapuhi Point (habitation symbols are illegible); also note location of Kapalani Catholic Church

AR00027713

4.2 Mid-Nineteenth Centnry and the Māhele

The Organic Acts of 1845 and 1846 initiated the process of the *māhele* - the division of Hawaiian lands, which introduced private property into Hawaiian society. In 1848 the crown and the *ali'i* (chiefly class) received their land titles. The eommon people received their *kuleana* (individual parcels) in 1850.

During the *Māhele* of 1848, 72 individual land claims in the *ahupua'a* of Honouliuli were registered and awarded by King Kamehameha III (Tuggle and Tomonari-Tuggle 1997:34). The 72 *kuleana* awards were almost all made adjacent to Honouliuli Gulch, which contained fishponds and irrigated taro fields. Kepa Maly (1997: 38-42) provides a table recording information on each award, including awardee, *'ili*, and land use of the *'āpana* (lot). A summary of the information on houses, fields, and boundary landmarks noted for each *'ili* is given below in Table 1 and *'ili* locations are shown on Figure 9.

4.2.1 Project Area Māhele Awards

A comparison of Project Area maps with an 1878 map surveyed by M.D. Monsarrat (Figure 10) clearly show that all or portions of certain land claims belonging to Kelia (LCA 763), Pue (LCA 869), Leleiupa (LCA 1699) and Kua (LCA 5653) lie within the Project Area. These LCAs were once located on the east side of the main road along Honouliuli town, but now portions lay west of the current alignment of Old Fort Weaver Road. A brief review of the four known LCAs within the Project Area follows (see Figure 10):

Kelia'a *'Āpana* (*'Āp.*) 1 (LCA 763)

Kelia's claimed this land situated in the *'ili* of Poohilo and Uani for his houses. His witnesses agreed with his claim, but there was a dispute over whether there were 3 or 4 houses within the parcel. All agreed Kelia has one house there and that his father, Pueeu had two. The west or Wai'anae boundary was described variously as the "*pali* of Makaaku," "a ravine" or "a cliff." The claimant received his house lot from his father Pueeu and "has accepted it ever since 1836."

Pue *'Āpana* 1 and *'Āpana* 2 (LCA 869)

Pue claimed four parcels in the *'ili* of Maui at Honouliuli, 'Ewa. One parcel was a houselot and had two houses on it, one for himself and one for Puali who was his father-in-law. The western side was bounded by the land of Koi, the *luna* (overseer), who gave Pue's family their land in 1842. The other parcel within the Project Area was *kula*, pasture land to the east of the houselot.

Leleiupa *'Āpana* 1 and *'Āpana* 2 (LCA 1699)

Leleiupa 'Āpana 1 and 2 were claims for two parcels situated in the *'ili* of Maui. 'Āpana 1 was bordered on the west by the land of Koi.

Kua (LCA 5623)

Kua claimed two taro patches and a *kula* land called Kahui in the *'ili* of Maui. Of note was the sworn testimony of Maakuia on the Land Court Application for Mahina (LCA 749), which stated that the western boundary of Mahina's land was [Kaulaula] Pali, which had a wall on its top.

Table 1. Summary of land use and boundary landmarks recorded in Honouliuli LCA awards

'Ili	Land Use and Boundary Landmarks
Hiwalalo	kou trees
Ka'aumakua	houselots, *kalo* (taro) patches; *kula* (pasture/dryland agriculture), two fishponds called Mokumeha; landmarks - *kula ālialia* (salt plains), land division wall, Pānāhāhā *loko* (fishpond), Kalahu fishpond, Naholowaa pond, Honouliuli Stream (called stream of Makai'i), or *'aka'akai* (bulrush growth) of Kamo'okahi
Kaihuopala'ai	*mo'i* (arable land in a long strip); on lot bounded by *'auwai* (irrigation ditch) called Panaenui
Ka'ilikahi	houselot and *kalo* patches; landmarks – highway, Kauhipuna cliff, *lapalapa* (*panax*) thickets,meeting house
Kamilomilo	houselot and *kalo* patches
Kamoku	fenced *mo'o kalo*, *lo'i* (irrigated fields) *kalo*, houselot; landmarks – Kauhipuna pali
Kamo'okahi	bulrushes
Kapāpahi	houselots, *kalo* patches; bounded by ponds of Healani
Kapapapūhi	houselots, vineyard, *kula*, pond, trails, hog pens, and salt beds; a church and cemetery are shown on Figure 10 but not mentioned in testimony; therefore it was probably built in the post-Māhele period
Ka'ula'ula	*mo'o* next to Kaulaula (cliff) with a houselot and a wall
Loloulu	*kalo* patches, 1/3 of a fishpond (in land of Kahakuli'ili'i), hala grove, pig pens, breadfruit, bulrushes
Maka'u	houselot and *kalo* patches
Maui	kalo patches, *kula*, houselots, bounded by *pā'āina a ke Aupini* (land division wall of the government)
Mokumeha	2 fishponds, salt beds (western one called Kohumakahou)
Niuke'e	*kalo* patches, *kula*, potato field, houselots; landmarks - *loko kalo* (taro/ fishpond) of Nihola, Loko'eli pond, Kehewanakawalu pond, Kalokoiki pond, *pali* of Kihewamakawela; Ka'akau pali; Ka'akau community, meeting house, prison plot, cattle fences
Polapola	*kalo* patches; houselots, school house, prison plot; some bounded by *pā'āina a ke Aupini*, or high road from the sea, or Catholic Chapel yard
Pō'ohilo	*kula*, *kalo* patches, *loko kalo*, houselots; landmarks - *pā'āina*, Ka'aimanō fishpond, *kula* of Kahakai, *loko kalo* of Kalokoloa, Aimea Pond, Waianu pond, Kahui pond, Ka'aimano fishpond, *pupulu* cave (wet cave?), prison plot, Makaakua pali, Puehuehu Stream, Puehuehu road
Pua'aiu'u	*lo'i*, houselot
Pu'uloa	houselots; boundaries include the sea, a *kula* called Waioipu, and the plain of Kaluanohu

AR00027714

Figure 9. Portion of 1878 Monsarrat map, showing portion of Honouliuli Taro Lands in Relation to current alignment of Old Fort Weaver Road (eastern boundary of the Project Area)

Figure 10. 1878 Map of Honouliuli Taro Lands (LCAs) by M.D. Monsarrat, with inserted *'ili* names

AR00027715

4.2.2 The Catholic Church

A portion of the former site of a Catholic church, called Kapalani Catholic Church, also now lies on the west side of the current road alignment, although the church itself was probably covered by the new road itself. This church and associated school house is believed to have been the site of the ministry of a particularly notable person, Kepelino Keauokalani.

There are two land applications that make reference to a Catholic Church near the town of Honouliuli. Kaohai in April of 1850 (LCA 5670B) claimed a house site in the *'ili* of Polapola "adjoining the Catholic Chapel yard." Hilinae (LCA 1720) in November of 1847 made a houselot claim in the *'ili* of Polapola bounded on the west by the Kapalani Church. Little is known about the Kapalani Roman Catholic Church. It is clearly annotated on Monsarrat's 1878 map (see) and is the lone "church" pictured on an 1873 and 1881 map of the Honouliuli district by Alexander (Figure 11). Even the name is uncertain, as Kapalani probably means "the Frenchmen's" church. Efforts to found a Catholic Mission in Hawai'i were initially met with hostility until the issuing of an edict of toleration in 1839. The establishment of the Catholic Mission in Hawai'i in May of 1849 initiated an active period of building churches and schools. The Kapalani church (and school house) cited in the Land Court Application of Hilinae in November of 1847 must have been constructed within the previous seven years. Father Raymond Delande was pastor of the Leeward District of the church from 1857-1885 and, operating out of Honouliuli, he covered an area extending as far as Makaha and Waialua. "Up to 1877, he had baptized 600 children and adults, all living along the SW coast of Oahu" (Schoofs 1978:110).

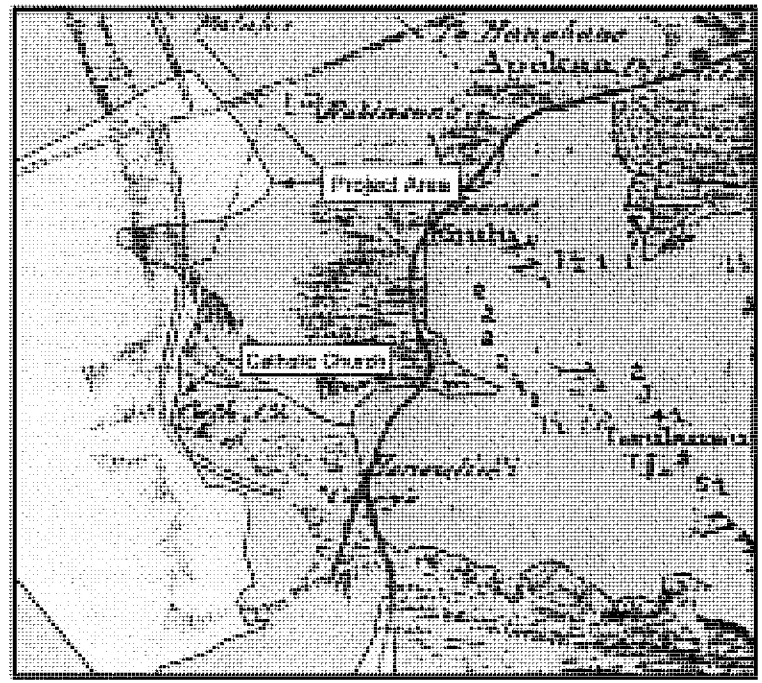

Figure 11. Portion of 1881 Hawai'i Government Survey Map (Alexander) showing location of the Catholic Church

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Of particular interest is the association with this church of Kahoali'ikumaieiwakamoku Kepelino (Zepherino) Keauokalani, whose name means "to-be-the-chief-of-the-nine-districts" (Beckwith 1978:4). His father was Namiki, of the lineage of the high priest Pa'ao and his mother, Kahiwa Kaneikopulei, was a daughter of Kamehameha I. They had two children, the son Kepelino, and a daughter named Puahau. Namiki was the "old savage" whose narratives were collected by Jules Remy as "Contributions of a Venerable Savage to the Ancient History of the Hawaiian Islands" during his travels in the islands between 1851 and 1855. In a note on a section concerning the priest Pā'ao, the author talks about Namiki's son, who he met in 1853.

> The old historian Namiki, an intelligent man, and well versed in the secrets of Hawaiian antiquity, has left precious unedited documents, which have fallen into our hands. His son, Kuikauai, a school-master at Kailua, one of the true historico-sacerdotal race, has given us a genealogy of his ancestors which ascends without break to Paao [Remy 1857, in Nordhoff 1974:253].

The family was of Kailua, Kona, Hawai'i and converted to Catholicism very quickly after the arrival of Fathers Walsh and Ernest Herutel of the Catholic Mission to Kona in 1840. His parents sent him to Catholic school in Honolulu in 1845 to become a teacher. Father Ernest writes:

> Father Martial writes me about our little Zepherin, telling me that he has been received as teacher but that because they have no school to give him as yet, he has not received his diploma. Father Desire wants to keep him to send to the High School; but when will you have a High School? Perhaps not so soon. I think therefore that Zepherin would be more usful here as we lack teachers [cited in Beckwith 1978:4].

As noted above, Remy claims that at some point, Kepelino was a school teacher in Kailua; although Remy is believed to have met Kepelino in 1853, his teaching position at Kailua could have dated to an earlier period, possibly around 1845, when Father Ernst suggested that he return to the island of Hawai'i from Honolulu. At some point he attended the Catholic High School at Ahuimanu (established in 1846), where he is said "to have acquired English, French, Latin, and Greek" (Beckwith 1978:5). In 1847, at the age of 17, he was sent briefly with Father Ernest to Tahiti to help establish a Catholic mission. He developed a reputation for his pranks and was sent back to his partents (Beckwith 1978:5).

Controversial letters under the name of Z. Kahoali'i, addressed from the town of Honouliuli on O'ahu, were published in Catholic newspapers from 1860-1869. A letter in the Public Instruction Correspondence filed and dated 11/26/1851, written by a school teacher name Naheona to the Minister of Public Education, state his reasons for the rejection of a teacher "Kepilina" and accuses Kepilina of "dancing and thieving while employed as teacher of Honouliuli School and of general improper conduct." The letter also mentions "Catholic priests in the area who have been among the people for a while who do not recommend retaining Kepilina" (In Silva 1987:A8). It seems quite probable that Kepelino lived at Honouliuli from 1851 into the 1870s and that as a devout Catholic and teacher that he taught at the school house next to Kapalani Church.

Detailed biographic information on Kepelino is not readily available, which is probably due in part to the fact that he was "controversial" for the Catholics and for the government. He went on

to become Queen Emma's secretary (by at least 1874) and was one of the most important documenters about Hawaiian beliefs and traditions. He supported Queen Emma as the heir of King Lunalilo over David Kalākaua, and wrote letters to the king of Italy and the queen of England, asking for warships to support Queen Emma's cause. In 1874, the newly elected King Kālakaua had him tried for high treason and sentenced him to hanging, but the sentence was commuted and he was released from prison in 1876; he died in 1878 (Day 1984:77).

"The Honouliuli church . . . had by the 1880s outlived its usefulness and become dilapidated. It was therefore abandoned and replaced by a simple structure close, too close to the mill" [at 'Ewa Village, south of the Project Area] (Schoofs 1978:111). However, "in 1891 Honouliuli was still important enough to acquire its own Catholic cemetery" (Schoofs 1978:110). Whether this cemetery or any other Catholic cemetery was on the grounds of the Kapalani Church in unknown. In the late 1920s, Bishop Alencastre exchanged land at Honouliuli with Campbell Estate for land at 'Ewa Village to establish a new church.

4.2.3 Honouliuli Māhele Awards to *Ali'i*

In 1855, the Land Commission awarded all of the unclaimed lands in Honouliuli, 43,250 acres, to Miriam Ke'ahikuni Kekau'ōnohi (Royal Patent #6971 in 1877; Parcel #1069 in the Land Court office), a granddaughter of Kamehameha I, and the heir of Kalanimōkū, who had been given the land by Kamehameha after the conquest of O'ahu (Indices of Awards 1929; Kame'eleihiwa 1992). Kekau'ōnohi was also awarded the *ahupua'a* of Pu'uloa, but she sold this land in 1849 to Isaac Montgomery, a British lawyer.

Kekau'ōnohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu'u Kahalai'a, who was governor of Kaua'i (Hammatt and Shideler 1990:19-20:20). Subsequently, Kekau'ōnohi ran away with Queen Ka'ahumanu's stepson, Keli'iahonui, and then became the wife of Chief Levi Ha'alelea. Upon her death on June 2, 1851, all her property was passed on to her husband and his heirs. A lawsuit (Civil Court Case No. 348) was brought by Ha'alelea in 1858, to reclaim the fishing rights of the Pu'uloa fisheries from Isaac Montgomery, and the court ruled in Ha'alaea's favor. In 1863, the owners of the *kuleana* lands deeded their lands back to Ha'alelea to pay off debts owed to him (Frierson 1972:12). In 1864, Ha'alelea died, and his second wife, Anadelia Amoe, transferred ownership of the land to her sister's husband John Coney (Yoklavich et al 1995:16).

4.2.4 Early Ranching on the 'Ewa Plain

John Coney rented the land to James Dowsett and John Meek in 1871, who used the land for cattle grazing. In 1877, the land, except for the *'ili* of Pu'uloa, was sold to James Campbell for $95,000. He drove off 32,237 head of stock belonging to Dowsett and Meek and to James Robinson and constructed a fence around the outer boundary of his property (Bordner and Silva 1983:C-12) (Figure 12). He let the land rest for one year and then began to restock the ranch, so that he had a head of 5,500 head after a few years (Dillingham 1885, cited in Frierson 1972:14). A 1880s photograph of James Campbell's residence in Honouliuli shows the open, sparsely vegetated plain of 'Ewa, likely an effect of the years of cattle grazing across the plain.

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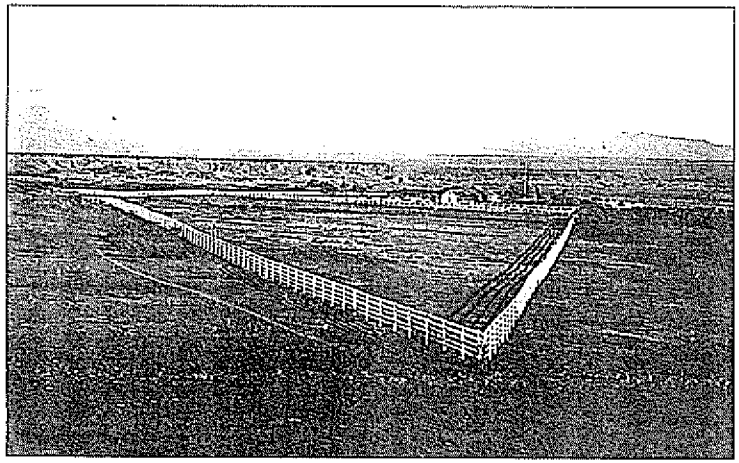

Figure 12. 1880s photograph of James Campbell's residence on the 'Ewa Plain (Bishop Museum Archives)

In 1880-81, the Honouliuli ranch was described as:

> . . . Acreage, 43,250, all in pasture, but possessing fertile soils suitable for agriculture; affords grazing for such valuable stock. The length of this estate is no less than 18 miles. It extends to within less than a mile of the sea coast, to the westward of the Pearl River inlet. . . . There are valuable fisheries attached to this estate . . . . [Bowser 1880:489].
>
> From Mr. Campbell's veranda, looking eastward, you have one of the most splendid sights imaginable. Below the house there are two lochs, or lagoons, covered with water fowl, and celebrated for their plentiful supply of fish, chiefly mullet. . . . Besides Mr. Campbell's residence, which is pleasantly situated and surrounded with ornamental and shade trees, there are at Honouliuli two churches and a school house, with a little village of native huts [Bowser 1880:495].

Most of Campbell's lands in Honouliuli were used exclusively for cattle ranching. At that time, one planter remarked "the country was so dry and full of bottomless cracks and fissures that water would all be lost and irrigation impracticable" (Ewa Plantation Co. 1923:6-7). In 1879, Campbell brought in a well-driller from California to search the 'Ewa plains for water, and the well, drilled to a depth of 240 feet near Campbell's home in 'Ewa, resulted in ". . . a sheet of pure water flowing like a dome of glass from all sides of the well casing" (The Legacy of James Campbell n.d., cited in Pagliaro 1987:3). Following this discovery, plantation developers and ranchers drilled numerous wells in search of the valuable resource. A Hawai'i Visitor Bureau,

marker, located in the southwestern portion of the Project Area, bears the inscription "Site of First Artesian Well in the Hawaiian Islands drilled by James Ashley for James Campbell owner of Honouliuli Ranch brought in on Sept. 22, 1879." Kuykendall (1967:III, 67) states that this well was "near Campbell's ranch house" but Campbell's ranch house, which is shown on Monsarrat's 1878 map, was located outside the Project Area.

4.3 History of the Ewa Sugar Plantation

4.3.1 General History of the Plantation

In 1886, Campbell and B. F. Dillingham put together the "Great Land Colonization Scheme," which was an attempt to sell Honouliuli land to homesteaders (Thrum 1886:74). This homestead idea failed, but with the water problem solved by the drilling of artesian wells, Dillingham decided that the area could be used instead for large-scale cultivation (Pagliaro 1987:4). During the last decade of the nineteenth century, the railroad would reach from Honolulu to Pearl City in 1890, to Wai'anae in 1895, to Waialua Plantation in 1898, and to Kahuku in 1899 (Kuykendall 1967:100). This railroad line eventually ran across the center of the 'Ewa Plain at the lower boundary of the sugar fields.

To attract business to his new railroad system, Dillingham subleased all land below 200 ft to William Castle, who in turn sublet the area to the newly-formed Ewa Plantation Company (Frierson 1972:15). Dillingham's Honouliuli lands above 200 ft that were suitable for sugar cane cultivation were sublet to the Oahu Sugar Company (Figure 13). Throughout this time, and continuing into modern times, cattle ranching continued in the area, and Honouliuli Ranch - established by Dillingham was - the "fattening" area for the other ranches (Frierson 1972:15).

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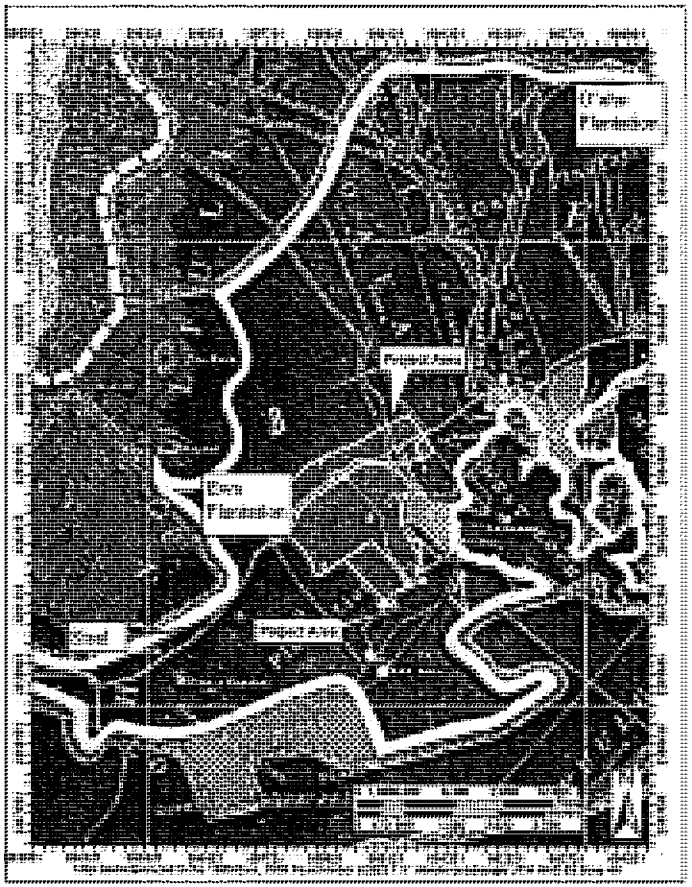

Figure 13. 1902 map showing relationship of Ewa Plantation and the Oahu Sugar Co. plantation; also note location of sisal growing area

4.3.2 History of the Ewa Sugar Plantation

Ewa Plantation Company (Figure 14) was incorporated in 1890 for sugar cane cultivation. The first crop, 2,849 tons of sugar, was harvested in 1892 at the Ewa Plantation. 'Ewa was the first all-artesian plantation, and it gave an impressive demonstration of the part artesian wells were to play in the later history of the Hawaiian sugar industry (Kuykendall 1967:69). As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Company installed ditches running from the lower slopes of the mountain range to the lowlands. When the rainy season began, they plowed ground perpendicular to the slope so that soil would be carried down the drainage ditches into the lower coral plain. After a few years, about 373 acres of coral wasteland were reclaimed in this manner (Immisch 1964). By the 1920s, Ewa Plantation was generating large profits and was the "richest sugar plantation in the world" (*Paradise of the Pacific,* Dec. 1902:19-22, cited in Kelly 1985:171).

Just north of 'Ewa Plantation was the equally sprawling O'ahu Sugar Company which "covered some 20 square miles . . . ranging in elevation from 10 feet at the Waipio Peninsula . . . to 700 feet at the Waiahole Ditch" (Condé and Best 1973:313). The Oahu Sugar Company was incorporated in 1897. Prior to commercial sugar cultivation, the lands occupied by the Oahu Sugar Company were described as being "of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project" (Condé and Best 1973:313). The Oahu Sugar Company took control of the Ewa Plantation lands in 1970 and continued operations until 1995, when they decided to shut down sugar cane production in the combined plantation area (Dorrance and Morgan 2000:45, 50).

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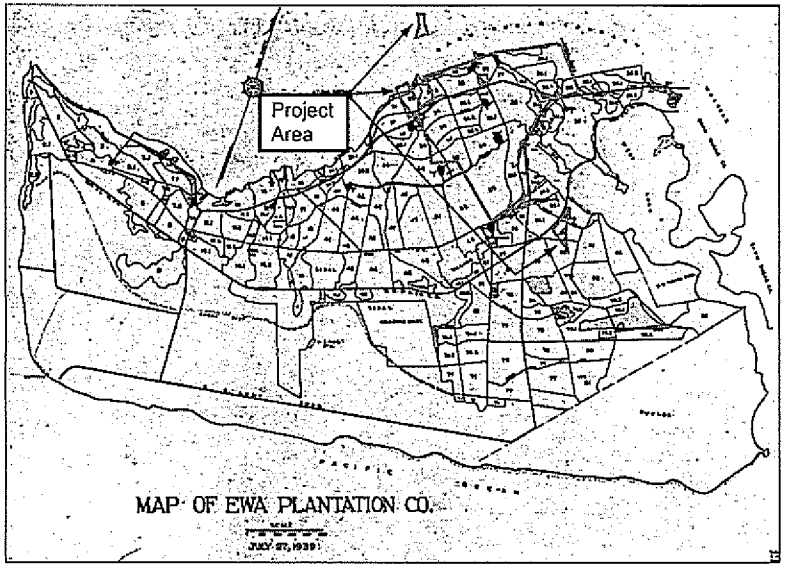

Figure 14. 1939 map of the Ewa Plantation Co. lands, showing Project Area and alignment of railroad.

During the subsequent decades of the twentieth century, sugar cane operations in 'Ewa phased out and, more recently, former cane lands have been rezoned for residential development. Structures in the area of the former plantation villages have fallen into disrepair or have been demolished. However, portions of the area - including Varona Village, Tenney Village, and Renton Village - have been designated the 'Ewa Villages Historic District (State site 50-80-12-9786), which has been nominated for National Historic Landmark status. Additionally, the still-existing O.R.&L. rail line through Honouliuli has been placed on the National Register of Historic Places (Site 50-80-12-9714).

4.3.3 History of PipeLine Village

During the twentieth century, the Ewa Plantation would continue to grow and, by the 1930s, would encompass much of the eastern half of Honouliuli Ahupua'a. This growth compelled the creation of plantation villages to house the growing immigrant labor force working the fields. In the decade of the 1890s, the plantation built 72 houses, cottages or dwellings; in the first decade of this century, 536; in the second decade, 132; in the 1920s, 285; in the 1930s, 168; and, in the 1940s, only 35. Censuses of the Ewa Plantation population record 4,967 persons in 1928, 4,477 in 1929, and 4,100 in 1932. After the outbreak of World War II, which siphoned off much of the

plantation's manpower, along with the changeover to almost complete reliance on mechanical harvesting in 1938, there was little need for the large multi-racial (Japanese, Chinese, Okinawan, Korean, Portuguese, Spanish, Hawaiian, Filipino, European) labor force that had characterized most of the early history of the plantation.

It is also important to note that in the history of construction, buildings were moved, demolished, and replaced all the time. As early as 1899, the plantation moved "the lower camp of thirty houses [believed to be duplexes built in 1890] to a position on the bluffs nearby . . . principally for sanitary reasons" (Ewa Plantation Company Annual Report for 1890).

The original location of these thirty houses is unknown. They probably were not in the area later known as "Lower Camp" and may have been in the Honouliuli Taro lands. It is also unknown where they moved to "on the bluffs," but it seems probable that they were moved to what became the west central portion of PipeLine Village near the present water pumping station in that vicinity. A 1908/1913 U.S. Army Fire Control map shows 47 houses in the area of Pipeline Village (Figure 15)

PipeLine Village was a major plantation community that lay in the central southern portion of the present Project Area and is shown in detail in a 1928 USGS map (Figure 16), which documents the location of about 160 houses, a church and a school. This was probably the great extent of PipeLine Village. An entry in the 1931 Annual Report of Ewa Plantation Company records that "The PipeLine Village of 162 cottages built in 1906" was dismantled and that "other cottages near [near the factory, south of the Project Area] were erected using the reclaimed lumber from the PipeLine Villages". Photos (Bishop Museum Visual Collection) (Figure 17) dated 1906 show what appear to be brand new single family residences at PipeLine Village, but the Annual Report for 1906 documents the construction of only 47 houses and many of there were probably not built in PipeLine Village. Some photos dated 1907 (Figure 18) show houses at PipeLine village with very well established gardens and tall banana, papaya, and many mango trees, suggesting that they are significantly older. Another photo dated January 1910 (Figure 19) shows a line of ten new cottages with the caption "Pipe Line Village (Family houses built during 1909)." One hundred and twenty-nine cottages were built for married laborers in that year and they well include the majority of the houses at PipeLine Village.

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Figure 15. Portion of an 1908/1913 U.S. Army Fire Control map, showing 47 houses in Pipeline Village; map also shows the alignment for the Ewa Plantation railway

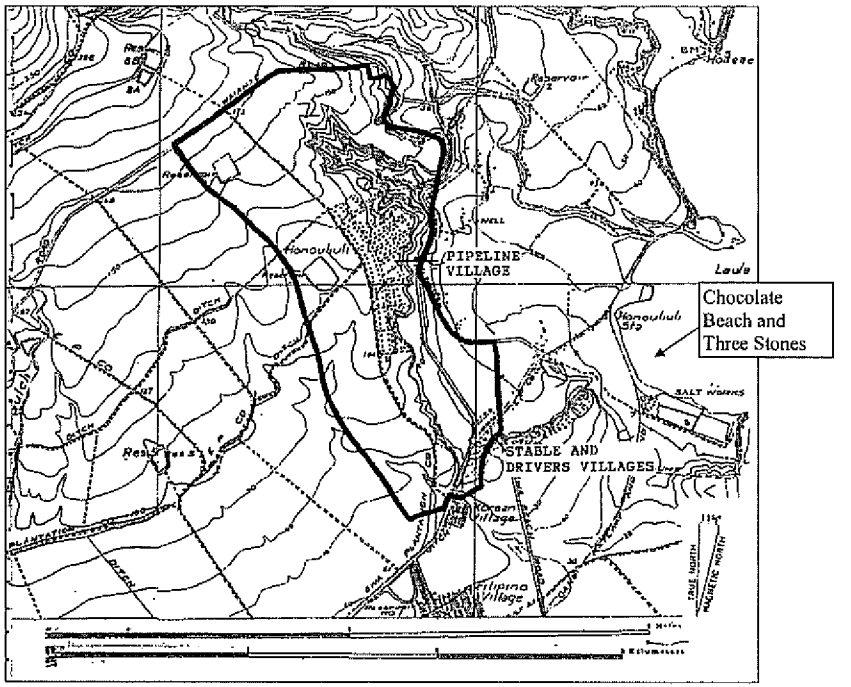

Figure 16. 1927/1928 US Geological Survey map, showing location of PipeLine Village, Stable Village, Drivers's Village, and other Ewa Plantation structures, Salt Works and location of Chocolate Beach and Three Stones.

In 1911 "60 new houses, principally for Spanish and Portuguese workmen with families" were erected. Thus, it seems highly probable that PipeLine village was largely constructed between 1906 and 1911, but may have incorporated a number of relocated structures dating to 1890. The demolition of 1931 was probably quite thorough, and not a trace of the structures was found on later maps.

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Figure 17. Portuguese family residence at PipeLine Village. 1906

Figure 18 Discharge Pump No. 5, PipeLine Village 1907

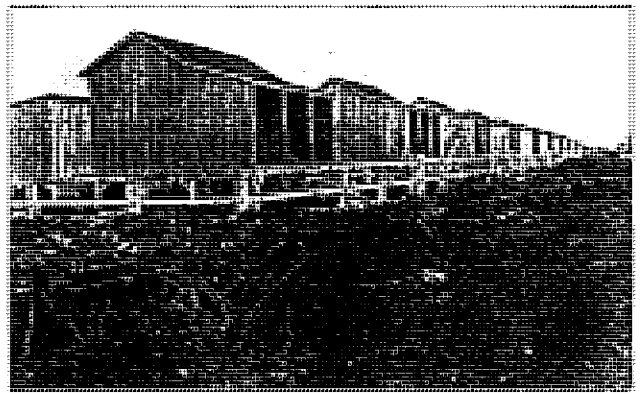

Figure 19. PipeLine Village, family houses built in 1909, photograph taken on January 1910

Figure 20. PipeLine Village, April 7, 1907; *forno* (Portuguese brick bread oven) at center of photograph

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4.3.4 History of Stable Village and Drivers Village

The Ewa Plantation housing located in the southeastern corner of the Project Area, just north of the present Hale O Ulu School, is not well-documented. It appears that there were at least two small villages located here: "Stable Village" and "Drivers Village." The Ewa Plantation Company Annual Report for 1931 states that "The Drivers Village, located near the main stable was in such a bad location that it was decided to move all the fourteen cottages down to 'B" village near the factory." Drivers Village doubtlessly corresponds to the site of the 14 houses shown on the 1927/1928 map (see Figure 16), with Stable Village probably referring to the structures just to the south across the street. The date of construction of these villages is unknown. No houses are shown in this area on the 1908/1913 Fire Control map (see Figure 15). The villages were probably built in that flurry of construction in the first decade of this century. All of the structures of Stable Village and Drivers Village are shown on the War Department Map of 1943, but this map must be another example of a lack of military intelligence regarding the Pearl Harbor area; records indicate that the houses were probably all demolished around 1931.

4.3.5 Other Enterprises in Honouliuli

One of the first enterprises in Honouliuli in the post-Contact period was the making of salt. Soon after Kekau'ōnohi sold the land of Pu'uloa to Isaac Montgomery in 1849, the king (Kamehameha III) and Montgomery entered into a partnership to run the salt works in Pu'uloa. Kamakau (1961:409) reported "The king and Isaac of Pu'uloa are getting rich by running the salt water into patches and trading salt with other islands." The salt was also sent to Russian settlements in the Pacific Northwest, where it was used to pack salmon (*Hawaiian Gazette,* January 29, 1897). An 1853 newspaper article (*Polynesian,* August 20, 1853) on the "Puuloa Salt Works" says that this was the only place "where large quantities of salt were manufactured. Kelly (1991:160) says that there was another salt works at Kualaka'i (Nimitz Beach), but does not give a reference for this claim.

There reference concerning salt works in 'Ewa by Carol Silva (1987:A-4):

> An extensive and antiquated system of salt works operated on the shore of the Honouliuli lobe of West Loch. Another salt works was situated further seaward at Puuloa. The Puuloa Salt Works had beginnings that were traceable to the 1820's and possibly even much earlier. By 1861, 100 acres had been devoted to the production of salt [*Pacific Commercial Advertiser* 4/18/1861:1].

A 1927/1928 US Geological Survey map (see Figure 16) shows several rectangles labeled "Salt Works" on the right side of the map.

The Chinese were involved in salt production around Pearl Harbor, usually in concert with their management of fishponds. One son of one Chinese resident of the area, Mau Yung Kui, the groundkeeper of the John 'I'ī estate on Waipi'o, remembered [for ca. 1900] the Chinese form of salt production for salt pans bordering the sea, which were continually fed seawater by the tides.

Figure 21. 1881 photo of salt pans near Kaunakakai, Moloka'i (Dorothe B. Curtis collection)

> Both the natural tides and the Chinese method of peddling a wooden wheel that transported water upward, helped to keep the salt beds damp with about three inches of water. After a few months, the senior Mau would drain off the remaining water and use a wooden rake with deep prongs to break up the salt. When the bed was dry a flat rake was used to flatten and smooth out the salt. Later it was raked into piles, packed in cloth bags and distributed. . . . Past the rice fields of Ho'ae'ae and the beginning of Honouliuli were a number of productive salt flats adjacent to the ancient fishponds operated by Chinese at the turn of the century [Chong 1988:108].

As noted above, part of Mr. Campbell's lands were also used to grow rice. By 1885, 200 acres in Honouliuli were used for rice and 50 acres were used to grow bananas (article in *Pacific Commercial Advertiser*, August 15, 1885, summarized in Silva 1987:A-12). These rice fields were planted in former taro fields or in undeveloped swamps, such as those in the Project Area in the former Honouliuli Taro lands. The rice fields in 1882 were described by Frank Damon, during a tour of the area.

> . . . Towards evening we reached Honouliuli, where the whole valley is leased to rice planters . . . This was one of the largest rice plantations we visited. Sometimes two or three men only, have a few fields which they cultivate for themselves, and we often too came upon houses where there were eight or ten men working their own land. But the larger plantations are owned by merchants in Honolulu, who have a manager acting for them. . . . [Damon 1882:37].

In 1890, Dillingham leased all land below 200 ft to William Castle, who used most of the land for sugar cane, but also leased some lands for rice cultivation, pasture, wood lots, bee-keeping, garden crops, and quarries. Some land above 650 ft was also leased for the cultivation of "canaigre", which may be a word used for pineapple (Frierson 1972:15-16).

An additional agricultural trial was conducted in the Honouliuli area for the cultivation of sisal, a plant used to make fibers for rope and other material. Some sisal was planted before 1898

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and production continued until the 1920s (Frierson 1972:16). This was grown mainly on the coastal plain of Honouliuli in Kānehili, just *mauka* of Kualaka'i Beach (now Nimitz Beach). An article in the *Paradise of the Pacific* in 1902 described this venture in glowing terms.

> . . . The venture was made and a tract of land containing a large percentage of disintegrated coral, in the neighborhood of Ewa Plantation, where nothing else would grow, was chosen for the planting. . . . The Hawaiian Fiber Co., which Mr. Turner organized, and of which he is now manager, has 755 acres under fence, two and a half miles of which is stone wall with good gates at convenient places. . . . In a large field containing 130 acres, mauka of the Oahu Railway & Land Co. track, the first harvest is to be gathered in a few months. . . . Out of this section of 130 acres the company has figured on securing 50 tons of clean fiber, for which it is offered eight cents per pound in Honolulu or nine cents per pound in San Francisco . . . . [*Paradise of the Pacific* March 1902:17].

Although many of the fishponds at Pearl Harbor deteriorated from lack of care and lack of people to maintain them in the early nineteenth century, there was some action to reclaim these areas in the later part of the century. Some were converted to rice fields, but others were maintained as fish ponds or duck ponds. Records of the Minister of Public Instruction (1848) show that some ponds were maintained by local teachers and students, with the funds generated used for the upkeep of the school system. Some ponds as early as 1848 were also maintained by prisoners, possibly from the women's prison located at Honouliuli. In 1852, however, Levi Ha'alelea reasserted his claims to these neglected lands, when he claimed all of the mullet from this area be reserved to him (Hawaii Kingdom files, cited in Silva 1987:A-7 to A-9). During James Campbell's tenure of the land, fish ponds and Pu'uloa fishing rights were leased out to various entrepreneurs (Kelly 1985:175).

Into the early twentieth century, some Hawaiian families continued to live in Honouliuli and preserve the traditional lifestyle, including at the fishing village of Kualaka'i (see Figure 5). One resident, Mrs. Eli Williamson, recalled:

> In the Honouliuli area the train stopped among the *kiawe* (algaraboa) trees and *malina* (sisal) thickets. We disembarked with the assorted food bundles and water containers. Some of the Kualaka'i '*ohana* (family) met us to help carry the '*ukana* (bundles) along a sandstone pathway through the *kiawe* and *malina*. The distance to the frame house near the shore seemed long. When we departed our '*ukana* contained fresh lobsters, *limu* (algae), fish and *i'a malo'o* (dried fish) . . . [Williamson in Kelly 1985:160].

4.3.6 The Military and Modern Developments

In 1891, Russian explorer Otto Von Kotzebue tried to observe Pearl River, but his group could not obtain a canoe. What he was told, however, led him to speculate on the possible importance of Pearl Harbor to the future.

> In the mouth of this river are several islands; it is so deep, that the greatest ship of the line can lie at anchor a few fathoms from the shore; and so broad, that a hundred vessels can conveniently find room in it. The entrance into the Pearl Rivers is in the same situation as the harbour of Hana-rura [Honolulu]; but the windings between the reefs are, however, said to render a passage more difficult. If this place were in the hands of the Europeans, they would certainly employ means to make this harbour the finest in the world [Von Kotzebue 1821:338-348].

The early missionary Levi Chamberlain was able to take an outrigger canoe trip to Pearl River, and noted the difficulty of access for larger ships.

> Kawaa took passage in our canoe to go down the harbor to a place where oysters are abundant to give orders to his people to gather a mess. The sail down the harbor was delightful . . . The passage down the creek for a number of miles was very pleasant till we got down near the reef and our course altered. We then could sail no longer as the wind was against us. The sail was lowered the mast taken down and secured across the outrigger and the rowers plied their paddles [Journal of Levi Chamberlain 1822-1849, Hawaiian Mission Schools, Storage Case 4, p. 899, from Sterling and Summers 1978:51].

The first foreign attempt to survey Pearl Harbor was made in 1840 during the U.S. Exploring Expedition, led by Charles Wilkes.

> In this district is a large inlet of the sea, into which the river Ewa empties; at the entrance of this inlet is the village of Laeloa (at Kalaeloa Pont): the shore is known by the name of Pearl River or harbour, from the circumstance that the pearl oyster is found here; and it is the only place in these islands where it occurs.
>
> The inlet has somewhat the appearance of a lagoon that has been partly filled up by alluvial deposits. At the request of the king, we made a survey of it: the depth of water at its mouth was found to be only fifteen feet; but after passing this coral bar, which is four hundred feet wide, the depth of water becomes ample for large ships, and the basin is sufficiently extensive to accommodate any number of vessels. If the water upon the bar should be deepened, which I doubt not can be effected, it would afford the best and most capacious harbour in the Pacific. . . . [Wilkes 1970:79].

Although Wilkes was impressed by the harbor, he was not at this time thinking of how this survey could benefit the American government in the future. In fact, Wilkes (1970:79) concluded, "As yet there is no necessity for such an operation, for the port of Honolulu is sufficient for all the present wants of the islands, and the trade that frequents them."

This had changed in less than 30 years, however. The U.S. military had tried to make a coaling station on Midway Island in 1869 by blasting through the coral reef to make a harbor; this plan failed. In 1873, General Schofield presented a confidential report to the U.S Secretary of War, recommending that Pearl Harbor should be available to the U.S. Navy. Schofield wrote:

> In case it should become the policy of the Government of the United States to obtain the possession of this harbor for naval purposes, jurisdiction over all the

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> waters of Pearl River with the adjacent shores to the distance of 4 miles from any anchorage should be ceded to the United States by the Hawaiian Government. . . .
>
> The cession of Pearl River could probably be obtained by the United States in consideration of the repeal of the duty of Sandwich Island sugar. Indeed, the sugar –planters are so anxious for a reciprocity treaty, or so anxious rather for free trade in sugar with the United States, that many of them openly proclaim themselves in favor of annexation of these islands of the United States [Sen. Ex. Docs, 52nd Cong. 2nd Sess. No. 77, pp. 150-154, reproduced in Judd 1971:Appendix 3].

This reciprocity treaty was concluded in 1876 with the provision that Hawai'i would not "lease or relinquish sovereignty to another country or any harbor, etc." In 1887, the treaty was renewed and amended and allowed the United States the "exclusive right to enter the harbor of Pearl River, in the Island of Oahu, at to establish and to maintain there a coaling and repair station for the use of vessels of the United States" (Judd 1971:128).

After annexation of the islands to the United States in 1899, development began in order to make a Pacific base that could be used as a staging area for the Spanish-American war (Coletta 1985:433). Dredging of the harbor began in 1901, and additional dredging to deepen and widen the channel was conducted in 1908 and again in the 1920s. Money for the funding of the construction of dry docks and other support facilities was approved in 1908. In 1931 the Navy built an ammunition depot at West Loch on a 213-acre parcel that it had bought from the Campbell Estate. Construction of a new depot in Lualualei Valley and at West Loch Harbor began in 1931.

In the early 1930s, the U.S. Navy leased 700 acres of the Campbell Estate to build 'Ewa Field, a base with a mooring mast for Navy dirigibles. Although the mast was completed, the program was abandoned before the *Akron*, the designated airship for the mast, was built. In 1937, 18 miles of roads were built in the coastal Honouliuli area, and in 1939-1940 the U.S. bought 3,500 acres of land in this area (Landrum et al 1997:62-67), to build several other military camps and installations, including Barbers Point Naval Air Station, at the site of the old mooring mast.

On December 7, 1941 the Japanese Navy launched the devastating surprise attack on the United States base at Pearl Harbor and other military facilities. Although the major battle damage to the US Pacific Fleet was at its base at Ford Island in the Middle Loch of Pearl Harbor, Honouliuli did not escape unscathed.

> The Waipahu and Ewa sugar plantation, next to Pearl Harbor and the town of Wahiawa, adjoining Schofield Barracks, saw more action than did Honolulu.
>
> At Waipahu, machine gun bullets, shrapnel, and shells started two cane fires, riddled the sugar mill, hit the plantation hospital in four places, went through the roof of the company store, exploding in an electric supply warehouse, and narrowly missed many houses. In nearly all of the fields of tall cane, many of which contained terrified women and children, shells buried themselves-dozens of them in some concentrated areas-blasting holes in the ground the size of barrels, and flattening cane for several square yards.

> At Ewa, after bombing the nearby Marine airfield [at Barbers Point], enemy planes machine-gunned the plantation's main street, the mill and power plant and some 30 houses and started two cane fires [Allen 1999:20].

The attack had consequences not only for the military, but also for the civilians, mostly Japanese, who lived around West Loch.

> Two permanent local evacuations were ordered in the first month of the war, partly to remove civilians from areas which might be dangerous in event of further attack and partly to protect installations from possible sabotage or espionage activities. On a Thursday less than two weeks after the bombing, farmers adjacent to West Loch at Pearl Harbor were ordered to leave their farms by sundown. The order was modified to allow two days to prepare and the men were permitted to return to their farms during daylight until livestock could be moved and crops harvested. The displaced farmers, who had only recently been established at West Loch by the Farm Security Administration, were forced to seek temporary housing with friends and relatives at Ewa Plantation. Since they had invested in the enterprises practically all of their life's savings and considerable money borrowed from the FSA as well, several suffered heavy losses [Allen 1999:122].

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Section 5 Previous Archaeological Research

5.1 Early Archaeological Surveys

All archaeological projects previously conducted in Honouliuli and Pu'uloa are listed below in Table 2. Two archaeological features, a boundary *pōhaku* or rock and a *hōlua*, or sledding site, are recorded only in the Boundary Commission Reports establishing the division lines between the *ahupua'a* of Honouliuli and Hō'ae'ae (to the east). The surveyor wrote of the southern point of this boundary:

> In regard to Hoaeae . . . the point of commencement is Pōhaku Palahalaha, a well known rock, now marked by an arrow and the name "Honouliuli" on one side and "Hoaeae" on the other, which I have made the initial point of the survey . . . [Boundary Commission Vol. 1:243].

This rock is shown on the Sterling and Summer map as Pōhaku Palaha (see Figure 5). In another boundary survey, the *pōhaku* is called a "large, flat rock" (Boundary Commission Vol. 1:249), which may indicate the origin of the name from the Hawaiian word *pālaha*, which means "flattened, wide" (Pukui and Elbert 1986:307). As the surveyor continued to walk the Honouliuli/Hō'ae'ae boundary, he marked the northern point of the division as:

> The Kamaaaina took me to the corner of Pauhala (?)-Hoaeae and Honouliuli – there is an ancient holua or sleding [*sic*] place near this – which is agreed for the ancient corner. . . [Boundary Commission Vol. 1:243].

The earliest attempt to record archaeological remains in Honouliuli Ahupua'a was made by Thrum (1906:46). He reported the existence of a *heiau* located on Pu'uokapolei , west of the present Project Area. In a second monograph on *heiau*, Thrum (1917) called this *heiau* Palole'i (Kapolei). Emory mapped and photographed these structures in 1933 (field notes), but they were dismantled and destroyed sometime before McAllister's survey of the islands in the 1930s. According to legend, Pu'uokapolei was the location on which Kamapua'a, the pig-god, resided with his grandmother, Kamaunuahihio (McAllister 1933:108).

In his surface survey of the 1930s, archaeologist J. Gilbert McAllister recorded the specific locations of important sites, and the general locations of less important sites (at least at Honouliuli). McAllister recorded 14 specific sites at Honouliuli, numbered Sites 133-146 (McAllister 1933:107-108) Site 146, which McAllister used to denote the entire 'Ewa coral plains, is the only one of these sites in the Project Area. This "site," which is more of a general area covering all the coastal flatlands of 'Ewa would include portions of the current Project Area (all area outside the Honouliuli Gulch). Within Site 146, McAllister noted old ranching walls, salt work reminas, and coral pits used by the Hawaiians for cultivation of certain plants, such as bananas and sugar cane. The other thirteen sites are all outside of the Project Area.

The first six sites are in the upland section of Honouliuli, *mauka* of the 'Ewa coral plain and Pu'uokapolei . Site 133 is a possible *heiau*, a small enclosure at the foot of Pu'u Kānehoa. It was still standing during McAllister's day, and local residents informed him of its sacred nature. Site 134 is Pu'u Kuina Heiau, located in a gulch at the foot of Mauna Kapu. Only traces of a

largeterrace remained. Site 135 is a series of enclosures *makai* of Pu'u Kuina Heiau. McAllister believed that the walls marked *kuleana* lots. Site 136 is a small platform near Mauna Kapu, a sacred site, possibly an altar. Site 137 is Pu'u Ku'ua Heiau, plotted on a ridge near Pu'u Ku'ua; it had been modified for use as a cattle pen; some areas had been cleared for pineapple cultivation or planted with ironwoods. Site 138 is Pu'uokapolei Heiau, which had been on the *makai* side of the hill before it was destroyed. The stones of the structure had been crushed in a nearby rock crusher. McAllister was also told that there was once a cave on the hill, in which Kamapua'a and his grandmother lived (McAllister 1933:107-108).

The last eight sites recorded by McAllister are adjacent to Pearl Harbor or the coast. Site 139 is Kalanamaihiki Ko'a (fishing shrine) at Kapapapuhi Point (north of the current study area). McAllister described it as "two large rough stones about 2.5 feet in size, with six or seven smooth stones averaging 1 foot in size in a small pile adjoining the larger stones." Site 140 is a 4-5 acre fishpond on Laulaunui Island in West Loch, opposite Kapapapuhi Point. McAllister recorded the entire West Loch of Pearl Harbor as Site 141, Kaihuopala'ai. Although some versions of the legend of the traveling mullet (see Section 3.1, Mythological and Traditional Accounts) say that there was a fishpond called Kaihuopala'ai, McAllister recorded that local informants said there was never a fishpond by that name here; rather it was the name for the loch. Site 142 is Kapamuku, or Pamoku fishpond, a 3-acre fishpond, located south of the current study area, opposite the tip of Waipi'o peninsula. Site 143 is 'Oki'okiolepe fishpond, south of Loko Pamoku. The walls of this 6-acre fishpond were made of coral. As mentioned, Site 146 was used to represent the entire 'Ewa Plain.

McAllister records Site 144 as the location of fish traps and a fishing shrine described by Stokes in his study of the fishtraps of Pearl Harbor. This is the location of the fishtraps Kapākule (Pākule) and Kepo'okala, as described by Samuel Kamakau (1976:88). McAllister listed Site 145 as Pu'uloa, a legendary site where the first breadfruit was planted. It is not known whether Pu'uloa referred to is the *'ili* of Pu'uloa or the harbor of Pu'uloa, or an area within the *'ili* near the harbor. Site 146 covers the entire 'Ewa coral plain. This includes historic features, such as cattle walls and the walls near the Pu'uloa Salt Works, pre-Contact sites such as habitation, agricultural, and fishpond sites recorded by early European explorers, and paleontological sites, where in recent years many fossil bird bones have been discovered (McAllister 1933:108-110).

Between McAllister's 1930s study and the flurry of work that began in 1969, there are only a few sporadic pieces of research, which are not well documented. In 1933, Dr. Kenneth P. Emory recorded a well-preserved house site and a possible *heiau* (later destroyed by sugar cane cultivation) in the western part of the coral plains (Sinoto 1976:1). In 1959, William Kikuchi removed a number of burials from a burial cave site (Bishop Museum Site OA-B6-10) at the Standard Oil Refinery, which was subsequently destroyed (Barrera 1975:1). Kikuchi recovered 12-16 incomplete primary and/or secondary burials cached in a sinkhole or crevice exposed during construction activities near the big bend in Malakole Road (Kikuchi 1959; Davis 1990b: 146, 147). In 1960, Yoshi Sinoto and Elspeth Sterling visited a house site (BPBM. Site OA-B6-8) within 'Ēkaha Nui Gulch. "Around this elevation (1200 feet), along the sides of the stream, were seen remains of many terraces and some house sites" (Sterling and Summers 1978:37). In 1962, Lloyd Soehren recorded another secondary human burial in a sinkhole at the BarbersPoint Naval Air Station (Davis 1990a:147). In 1966, Lloyd Soehren carried out salvage excavations at a possible fishing shrine (BPBM. Site # 50-OA-B6-13). The site was reported as destroyed by

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construction (Barrera 1975:1), but Davis relocated the shrine and performed additional excavations in 1982 (Davis 1990a:148).

Table 2. Previous archaeological work in Honouliuli and Pu'uloa

Author	Report Type	Location
Thrum 1906	Heiau study	Hawaiian Islands
McAllister 1933	All island survey	O'ahu Island
Kikuchi 1959	Site letter report	Barbers Point
Bowen and Soehren 1962	Burial Discovery	Barbers Point
Soehren 1964	Site letter report	Waimanalo Gulch
Lewis 1970	Reconnaissance survey	Barbers Point (harbor area)
McCoy 1972	Survey	Pu'uloa Elementary School
Hommon 1973	Survey and Excavations	Honouliuli
Barrera 1975	Archaeological & reconnaissance	Barbers Point (harbor area)
Clark and Connolly 1975	Reconnaissance survey	Barbers Point (harbor area)
Oshima 1975	Reconnaissance survey	Barbers Point
Sinoto 1976	Cultural resources survey	Barbers Point (harbor area)
Bordner 1977a	Reconnaissance survey	Kalo'i Gulch
Bordner 1977b	Reconnaissance survey	Makaiwa Gulch
Clark 1977	Reconnaissance survey	Puu O Kapolei
Connolly and Clark 1977	Reconnaissance survey	Puu O Kapolei
Davis 1978	Scholarly paper	Barbers Point (harbor area)
Davis and Griffin 1978	Archaeological Survey	Barbers Point (harbor area)
Hawai'i Marine Research Inc.	Geoarchaeological reconnaissance	Barbers Point (harbor area)
Kirch 1978	Land snail study	Barbers Point (harbor area)
Sinoto 1978a	Reconnaissance Survey and Burial	NAVMAG -West Loch
Sinoto 1978b	Archaeological & Paleontological	Barbers Point (harbor area)
Barrera 1979	Archaeological survey	West Beach
Clark 1979	Reconnaissance survey	Barbers Point (harbor area)
Cleghorn 1979	Reconnaissance survey	Barbers Point
Davis 1979a	Emergency excavations	Barbers Point (harbor area)
Davis 1979b	Emergency excavations	Barbers Point (harbor area)
Davis 1979c	Archaeological survey	'Ewa Marina Community
Jourdane 1979	Reconnaissance Survey	'Ewa Marina Community
Komori and Dye 1979	Archaeological testing	West Beach
Sinoto 1979	Cultural resources survey	Barbers Point (harbor area)
Ahlo 1980	Reconnaissance survey	Solid Waste Processing
Davis 1980	Research design	Barbers Point
Kirch and Christensen 1980	Land snail study	Barbers Point (harbor area)
Christensen and Kirch 1981	Land snail study	Barbers Point (harbor area)
Hammatt and Folk 1981	Archaeological and Paleontological	Barbers Point (harbor area)
Davis 1982	Academic paper	Barbers Point
McCoy et al. 1982	Proposal for investigations	Barbers Point (harbor area)
Neller 1982	Scholarly study	Barbers Point
Ahlo and Hommon 1983	Reconnaissance survey	Barbers Point (harbor area)
Bordner and Silva 1983	Reconnaissance survey	Waimānalo Gulch

Author	Report Type	Location
Davis 1983	Archaeological & Paleontological Excavations	Barbers Point
Ahlo and Hommon 1984	Test excavations	Barbers Point (harbor area)
Hammatt 1984a	Reconnaissance survey	Kahe Point
Hammatt 1984b	Reconnaissance survey	Ewa Marina Community
Haun and Kelly 1984	Research resign	Naval Air Station
Tuggle 1984	Survey report	Naval Air Station
Barrera 1985	Archaeological survey	West Beach
Neller 1985	Review and evaluation	West Beach
Barrera 1986	Archaeological Investigations	West Beach
Davis and Haun 1986	Intensive survey and test excavations	West Beach
Davis et al. 1986a, b	Research design	West Beach
Haun 1986a	Reconnaissance survey	Kapolei Town
Haun 1986b	Reconnaissance survey	Kapolei Town
Athens & Pietrusewsky 1987	Burial documentation	Iroquois Point
Davis and Haun 1987	Intensive survey & test excavations	West Beach
Dicks et al. 1987	Reconnaissance survey	West Loch
Rosendahl 1987a	Reconnaissance survey	Kapolei Town
Rosendahl 1987b	Reconnaissance survey	Ko Olina Resort
Rosendahl 1987c	Reconnaissance survey	West Loch
Rosendahl 1987d	Reconnaissance survey	Kapolei Golf Course
Welch 1987	Reconnaissance survey	Naval Air Station
Davis 1988a	Subsurface Survey	'Ewa Gentry
Davis 1988b	Reconnaissance survey	Barbers Point HECO
Kennedy 1988a	Reconnaissance survey	'Ewa Gentry
Kennedy 1988b	Field Report	Waiau-Campbell Industrial
Rosendahl 1988	Reconnaissance survey	Camp Malakole
Sinoto 1988a	Reconnaissance survey	'Ewa Golf Course
Sinoto 1988b	Reconnaissance survey	Makakilo Golf Course
Bath 1989a	Petroglyph study	Waimānalo Gulch
Bath 1989b	Burial documentation	Kahe
Bath 1989c	Burial documentation	West Loch – Hō'ae'ae
Burgett and Rosendahl 1989	Subsurface archaeological testing	North of O.R.&L.
Hammatt and Shideler 1989a	Archaeological assessment	Barbers Point (harbor area)
Hammatt and Shideler 1989b	Reconnaissance survey	Kahe Point
Carlson and Rosendahl 1990	Inventory survey	Kaomi Loop Subdivision
Cleghorn and Davis 1990	Archaeological and paleontological	Barbers Point (harbor area)
Collin and Kennedy 1990	Burial documentation	Pu'uloa Golf Course
Davis 1990a	Archaeological and paleontological	Barbers Point (harbor area)
Davis 1990b	Archaeological and paleontological	Barbers Point (HECO area)
Davis et al. 1990	Survey and Test Excavations	Ewa Marina Community
Hammatt and Shideler 1990	Inventory survey	West Loch Bluffs
Hammatt, Robins, et al. 1990	Inventory survey	Makaiwa Hills
Hammatt, Shideler, et al. 1990	Inventory Survey	'Ewa Villages
Kawachi 1990	Inadvertent Burial find	Campbell Industrial Park
Miller 1990	Inadvertent Burial find	Barber's Point, Nimitz
Rosendahl 1990a	Letter report	Kapolei Golf Course

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Author	Report Type	Location
Rosendahl 1990b	Archaeological Survey and Test	'Ewa Marina Community
Davis and Burtchard 1991	Inventory Survey	NAVMAG-West Loch
Dunn et al. 1991	Inventory Survey and Test	'Ewa Marina Community
Folk 1991	Reconnaissance Survey	Kapolei Town
Goodman and Cleghorn 1991	Surface Survey	Laulani Fairways Housing
Kennedy 1991	Subsurface testing	Pu'uokapolei
Hammatt 1991	Reconnaissance Survey	Honouliuli Livestock Park
Hammatt and Shideler 1991a	Archaeological assessment	Barbers Point (harbor area)
Hammatt and Shideler 1991b	Inventory Survey	St. Francis Medical Center
Haun et al. 1991	Survey report	Naval Air Station
Burgett and Rosendahl 1992	Inventory survey	Barbers Point (harbor area)
Charvet-Pond and Davis 1992	Data Recovery	West Beach
Cleghorn and Anderson 1992	Inventory survey	Kahe Point
Hammatt and Folk 1992	Subsurface testing	Barbers Point (harbor area)
Erkelens 1992	Archaeological survey	Naval Air Station
Folk 1992	Subsurface Testing	Barbers Point
Hammatt 1992	Inventory Survey	Palikea
Javatilaka et al. 1992	Survey and Test Excavations	Hawai'i Prince Golf
Kennedy et al. 1992	Inventory Survey	Pu'uloa Golf Course
Shideler et al. 1992	Assessment	Kahe Point
Trembly et al. 1992	Burial documentation	West Beach
Davis 1993	Archaeological and paleontological	Barbers Point (harbor area)
Glidden et al. 1993	Data recovery excavations	Paradise Cove
Goodman et al. 1993	Reconnaissance Survey	20-acre Commercial
Jones 1993	Fossil coral reefs study (Ph.D.	Hawaiian Islands
Landrum and Schilz 1993	Reconnaissance and subsurface	Naval Air Station
Miller 1993	Data recovery	Barbers Point (harbor area)
Nakamura et al. 1993	Inventory survey	Makakilo
Pantaleo and Sinoto 1993	Inventory survey	Ewa Gentry
Hammatt and Shideler 1994	Archaeological assessment	Barbers Point (harbor area)
Hammatt et al. 1994	Inventory survey	Barbers Point (harbor area)
Tuggle 1994	Inventory survey	Barbers Point
Davis et al. 1995	Archaeological & Paleontological	Barbers Point (harbor area)
Dye 1995	Burial documentation	Barbers Point
Franklin 1995	Data Recovery	Ewa Marina Community
Hammatt and Shideler 1995	Data recovery plan	Barbers Point (harbor area)
Jourdane 1995	Burial documentation	Paradise Cove
Yoklavich et al. 1995	CRM Overview	Barbers Point
Corbin et al. 1996	Reconnaissance Survey	Laulaunui Island
O'Hare et al. 1996	Intensive survey and testing	Naval Air Station
Athens et al. 1997	Cultural resources,	'Ewa Plain:Naval Air
Schilz and Landrum 1996	Test Excavations	Barbers Point
Spear 1996	Reconnaissance Survey	Kapolei Town
Borthwick 1997	Archaeological assessment	Palehua, Honouliuli
Hammatt 1997	Inventory survey	Pu'uloa
Hammatt and Chiogioii 1997	Reconnaissance Survey	Corridor in Honouliuli
Jensen and Head 1997	Reconnaissance Survey	NAVMAG-West Loch

Author	Report Type	Location
Tuggle 1997a	Cultural resource inventory	Naval Air Station
Tuggle 1997b	Synthesis	'Ewa Plain
Tuggle and Tomonari 1997a,b	Cultural resource inventory survey	Naval Air Station
Wickler and Tuggle 1997	Cultural resources, Inventory Survey	Naval Air Station
Wolforth and Wulzen 1997	Data Recovery	West Loch Estates
Wulzen and Rosendahl 1997	Data Recovery	Barbers Point Nimitz
Goodfellow et al. 1998	Data Recovery	West Loch
Hammatt and Shideler 1999	Inventory survey	Waimanalo Gulch
Magnuson 1999	Reconnaissance Survey	Farrington Hwy.
McDermott et al. 2000	Data recovery	Barbers Point (harbor area)
Elmore et al. 2001	Honouliuli	Pu'u Kapolei/Fort Barrette
Ostroff et al. 2001	Inventory survey	Pu'uokapolei
Tulchin et al. 2001	Inventory survey	'Ewa Shaft Renovation
McIntosh and Cleghorn 2003	Inventory survey	'Ewa Gentry Makai
Cordy and Hammatt 2003	Archaeological assessment	Barbers Point, North of
O'Hare et al. 2005	Field Check	Kapolei Property
O'Hare et al. 2004	Documentation of Plantation	North of O.R.&L.
Terry et al. 2004	Archaeological Inventory Survey of	North of O.R.&L.
Hoffman et al. 2004	Archaeological Inventory Survey	Between OR&L and

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5.2 Previous Archaeological Work near Honouliuli town

Beginning in the late 1970s, archaeological research has been conducted in Honouliuli in the general vicinity of the present study area (Figure 22). Work has been focused on the West Loch Estates (east of the current Project Area), Pearl Harbor Naval Magazine (NAVMAG) – West Loch (east of the current Project Area), the 'Ewa Gentry project (south of the Project Area), and 'Ewa Villages (south of the Project Area).

5.2.1 West Loch Estates

An archaeological reconnaissance survey (Rosendahl 1987c) was conducted in association with the development of the 232-acre "West Loch Estates" Residential Increments I and II (including golf course and parks) project, which lies to the east of the present study area, in the section of the Honouliuli Taro lands adjacent to Pearl Harbor. This project covered portions of the old town of Honouliuli, the focus of population in the early historic period (and possibly earlier). This study identified a modern cemetery (Site 3319) with a remnant pre-Contact deposit, two historic sites of minimal integrity with some possible pre-Contact deposits (Site 3318 and 3320) at Kapapapuhi Point, a significant pre-Contact deposit with trash pits, fire pits and at least one human burial (Site 3321), a buried fishpond (Site 3322), an historic fishpond (Site 3323) built in the 1890s during the construction of the OR& L railroad, and a buried pond field system (Site 3324) (Rosendahl 1987c:7, 9). It was noted that some artifacts "indicate the possibility of pre-1900 occupation" (Rosendahl. 1987c:8). As noted in the final reconnaissance survey report (Dicks et al. 1987:28) for the surface and subsurface reconnaissance survey, an effort was also made to relocate McAllister's Site 139, Kalanamaihiki Ko'a (fishing shrine). The archaeologists found a small boathouse and dock in the area and concluded that the shrine had been destroyed since McAllister's survey in the 1930s.

A total of 21 radiocarbon dates were determined; at Site 3321, the cultural deposit, the age of a lower cultural deposit was dated to A.D. 540-880, while an upper deposit was dated to A.D. 1327-1640. For the buried fishpond (Site 3322), ages ranged from A.D. 70-610 in the lowest layer to A.D. 1160-1410 in the upper layer. For the buried pond field systems (Site 3324), ages ranged from B.C. 400-A.D. 240 (interpreted as the original surface of the upper valley) in the lowest layers to A.D. 1430-1952 in the upper layers of upper valley area and A.D. 1020-1280 in lower valley area. In summary, the authors (Dicks et al. 1987:78-79) concluded that agricultural use of the Honouliuli Stream floodplain for pondfield cultivation of taro may have begun in the lower valley segment as early as A.D. 1000, while cultivation of the upper valley pondfields may have begun as early as the thirteenth and fourteenth centuries. Site 3321in the upper valley may have been a habitation locus established as early as the mid-sixth to mid-ninth century (Wolforth et al. 1998).

In 1989, a burial was found on Ho'ae'ae Point (formerly called Papapuhi Point), when someone was digging under a mango tree on a residential property. There is no follow-up report (Bath 1989) to whether the bones were left in place or disinterred. The burial was given the site designation 50-80-13-4816.

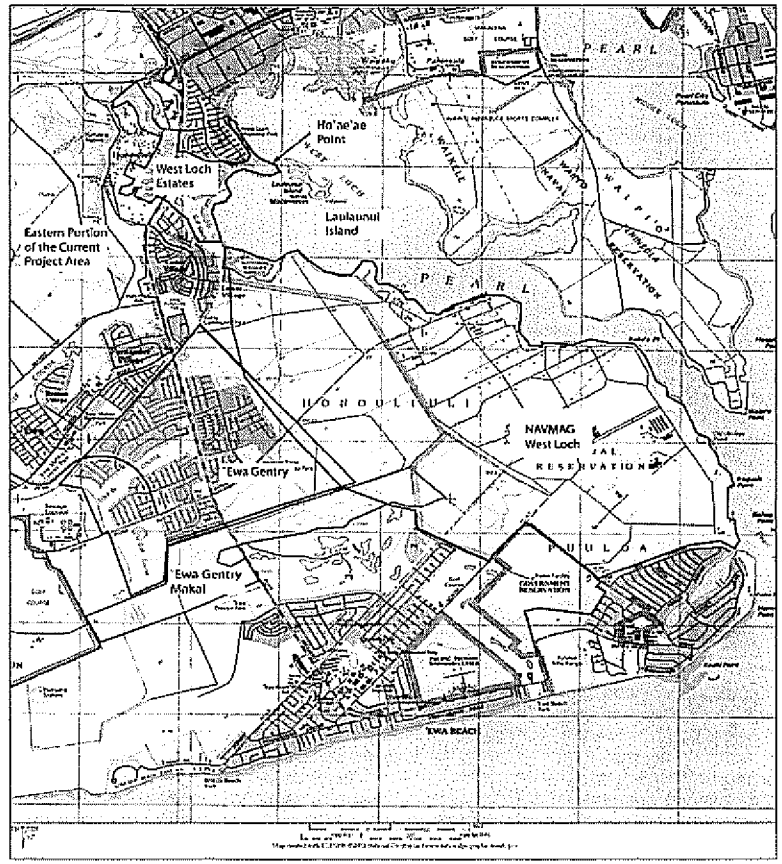

Figure 22. U.S. Geological Survey topographic map, showing previous archaeological survey areas in relation to the Project Area

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5.2.2 NAVMAG – West Loch

In 1978, Sinoto conducted an archaeological reconnaissance survey on a 32-acre portion of NAVMAG-West Loch. A sinkhole 200 miles inland and northwest of 'Oki'okiolepe Fishpond was found, containing ten human burials (Site 50-80-13-2310). The historic artifacts found in the pit, indicated that the pit was probably used by the Chinese in the historic period as a family crypt (Sinoto 1978a).

Davis and Burtchard (1991) conducted an archaeological inventory survey of a 36-acre lot for a proposed housing area in the Pu'uloa portion of NAVMAG-West Loch in 1991. No archaeological sites were found. They concluded that extensive alteration to the landscape due to military land disturbance had erased all surface traces of pre-Contact habitation.

In 1992, a crew from Archaeological Consultants of Hawai'i, Inc. (ARCH) conducted an archaeological inventory survey with subsurface testing, and later data recovery at the proposed Pu'uloa Golf Course (Kennedy et al. 1992). A total of 72 sites were identified, 47 from the pre-Contact/early historic period and 25 sites associated with ranching, military training, and modern quarrying. Radiocarbon dates of these habitation, agricultural, and ceremonial sites indicate that traditional Hawaiian use extended from A.D. 1090 to 1695.

An overview survey of the NAVMAG Lualualei was completed by Ogden Environmental and Energy Services in 1977 (Landrum et al. 1977). A total of ten sites had been previously recorded during the West Loch survey, three in the Honouliuli section, one within Pearl Harbor (Site 140, Laulaunui Island), five on Waipi'o peninsula, one in both (salt works), and one encompassing all lands (Pearl Harbor Navy Base). In Honouliuli, the sites were Site 141, Kaihuopala'ai (West Loch), Site 142, Loko Pamoku or Kapamuku, Site 143, 'Oki'okiolepe Fishpond, and salt works at Honouliuli (no site designation). NAVMAG-West Loch is considered part of the Pearl Harbor Navy Base (Site 50-80-13-9992) due to its importance during World War II. The site was listed as a National Historic Landmark in 1966, on the National Register of Historic Places (NRHP) in 1966, on the State Inventory of Historic Places (SIHP), in 1971, and on the State Register of Historic Places in 1971 (Landrum et al. 1977:160).

In 1996, a crew from Paul H. Rosendahl, Ph.D., Inc. (PHRI) completed a Phase I archaeological reconnaissance survey of the 1,483 acres of land at the U.S. Naval Magazine – West Loch Branch (Jensen and Head 1997). This survey covered the southern section of Waipi'o peninsula on the east side of West Loch, Laulaunui Island, the Naval Reservation on the west side of West Loch, and the West Loch Outleased Cultivated Lands, which included the National Wildlife Refuge. Only 25% of the outleased lands were actually surveyed. The PHRI crew found that most of the outleased area had been bulldozed for sugarcane cultivation. Only a small strip adjacent to West Loch was unmodified. In the West Loch Outleased Lands, eight features were recorded; all but one was associated with military use of the area. The seven military sites consisted of six concrete slabs (Sites 50-80-13-5040, 5080, 5081, 5133, 5134), a metal container (5080), and a pressure tank (5133). The one non-military site (4971) was a cave with a partially blocked (blocked with roof fall) entrance that the crew members believed should be investigated in the future to see if it at one time was used as a pre-Contact or historic burial site (Jensen and Head 1997:85).

In 1996, a field reconnaissance of Laulaunui Island and fishpond was conducted by the State Historic Preservation Division (Corbin et al. 1996) to determine if restoration of the fishpond was possible and if the site would be a good candidate to be used as an educational tool. The crew simply walked to the island from the West Loch Waterfront Park; water depth varied from one to four feet. Five concrete structures, probably built by the military, were observed. The fishpond was surrounded by mangroves and was silted in; portions of a coral wall (about 500 ft long) around the pond were still intact, and a concrete gate allowed water to circulate into the pond.

5.2.3 'Ewa Villages

In 1990, Cultural Surveys Hawaii conducted an archaeological reconnaissance survey of a 616-acre area, which included three extant plantation villages, (Renton, Tenney, and Varona Village), the sites of three former plantation villages (C Village, Mill Village, Middle Village), and other sites associated with the Ewa Plantation infrastructure (Hammatt, Shideler, et al. 1990:i). The survey found no evidence of any pre-Contact activity within the survey area and recommended further documentation of some of the ruined plantation structure sites.

In 1996, Scientific Consultant Services (Spear 1996) conducted an archaeological survey in an area west of the Tenney and Varona plantation villages and north of the Honouliuli Treatment Plant. No archaeological sites were identified.

5.2.4 'Ewa Gentry Project

In the initial reconnaissance (Kennedy 1988a) of the 1,016 acre 'Ewa Gentry survey area, no surface evidence of potentially significant pre-Contact remains was found. The old OR&L railroad bed/right of way (Site 50-80-12-9714) did form a portion of the *mauka* boundary. According to historic maps, a Filipino Camp for sugarcane workers once existed near the intersection of the OR&L bed and a cane road near Ft. Weaver Road, but the archaeologists did not find any surface remains for this camp.

A subsequent subsurface exploration was undertaken. Eighteen backhoe trenches were excavated; however, "no evidence of past in situ cultural activity was found anywhere in the 'Ewa Gentry Project Area" (Davis 1988).

An inventory survey was conducted in 1993 by Aki Sinoto Consulting (ASC) (Pantaleo and Sinoto 1993) for the 'Ewa Gentry Off-Site Drainage System. This proposed drainage Project Area is a narrow strip that extends along the western boundary of NAVMAG West Loch, and is adjacent to the southern non-contiguous parcel (TMK 9-1-010:002) for the current Project Area. An 1897 map of Pearl Harbor indicated that the OR&L railroad, salt pans, and a fishpond were within this Project Area; only the railroad bed was found during the ASC survey. Iron flumes and concrete culverts (one with an inscribed date of July 1935) used for sugarcane irrigation were found bulldozed to the edge of the sugar cane fields near the dropoff to the shoreline of Pearl Harbor. These were not considered historically significant due to the absence of structural and locational integrity. No further archaeological work was recommended for this project prior to commencement of construction of the drainage system.

In 2003, Pacific Legacy (McIntosh and Cleghorn 2003) conducted an archaeological survey of the proposed 'Ewa Gentry Makai Development Project Area, which is adjacent to the southern

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(*makai*) boundary of the 'Ewa Gentry Project Area for the 1988 surface and subsurface inventory surveys (Kennedy 1988a; Davis 1988).

5.2.5 Previous Archaeology in the Current Project Area

As noted previously, and as discussed in more detail in the next section, a 546-acre portion of the current Project Area (the southeastern section) was previously surveyed in 1990 by a crew from Cultural Surveys Hawai'i. In 2005, a field assessment was conducted over the entire current Project Area by archaeologists from the firm Archaeological Consultants of the Pacific, Inc. (Elison and Kouneski 2005). The archaeologists found one "stone-faced hill" in the northern section of the Project Area (north of Farrington Highway), but did not describe it further. The report presents recommendations for field work in the different sections of the Project Area, concluding that the majority of the Project Area is farm land and did not need to be surveyed. Only the area around Honouliuli Gulch, and other areas of natural vegetation in the northern section needed to be surveyed.

Section 6 Traditional Land Use In Honouliuli Ahupua'a

The *ahupua'a* of Honouliuli is the largest traditional land unit on the island of O'ahu. Honouliuli includes all the land from the western boundary of Pearl Harbor (West Loch) westward to the 'Ewa/Wai'anae District Boundary with the exception of the west side of the harbor entrance, which is in the *ahupua'a* of Pu'uloa (the 'Ewa Beach/Iroquois Point area). This comprises approximately 12 miles of open coastline from One'ula westward to Pili O Kahe. The *ahupua'a* extends *mauka* (almost pie-shaped) from West Loch nearly to Schofield Barracks, and the western boundary is the Wai'anae Mountain crest running *makai* to the east ridge of Nānākuli Valley.

Not only is there a long coastline fronting the normally calm waters of leeward O'ahu, but there are also four miles of waterfront along West Loch. The land immediately *mauka* of the Pacific coast consists of a flat karstic raised limestone reef forming a level nearly featureless "desert" plain marked in pre-contact times (previous to sugar cultivation) by a thin or non-existent soil mantle. The microtopography is notable in containing countless sinkholes in some areas caused by chemical weathering (dissolution) of the limestone shelf.

Along the eastern flank of the Wai'anae Mountains, numerous gulches have contributed to the alluvial deposits over the coastal limestone shelf. The largest of the gulches is Honouliuli Gulch, which drains into West Loch. The gulches are generally steep-sided in the uplands and generally of a high gradient until they emerge onto the flat 'Ewa plain. The alluvium they have carried has spread out in delta fashion over the *mauka* portions of the plain, which comprises a dramatic depositional environment at the stream gradient change. These gulches are generally dry, but during seasonal Kona storms carry immense quantities of runoff onto the plain and into the ocean. As typical drainages in arid slopes they are either raging uncontrollably, or are dry and, as such, do not form stable water sources for traditional agriculture in their upper reaches. The Honouliuli gulches generally do not have valleys suitable for extensive irrigated agriculture; however, this lack is more than compensated for by the rich watered lowlands near West Loch.

Honouliuli Ahupua'a, as a traditional land unit, had abundant and varied resources available for exploitation by early Hawaiians. The "karstic desert" and marginal characterization of the limestone plain, which is the most readily visible terrain, does not do justice to the *ahupua'a* as a whole. The richness of this land unit is marked by the following available resources:

1) 12 miles of coastline with continuous shallow fringing reef, which offered rich marine resources.

2) Four miles of frontage on the waters of West Loch, which offered extensive fisheries (mullet, *awa*, shellfish), as well as frontage suitable for development of fishponds.

3) The lower portion of Honouliuli Valley in the 'Ewa plain offered rich level alluvial soils with plentiful water for irrigation from the stream as well as abundant springs. This land would have stretched well up the valley.

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4) A broad limestone plain, which because of innumerable limestone sinkholes, offered a nesting home for a large population of avifauna. This resource may have been one of the early attractions to human settlement.

5) An extensive upland forest zone extending as much as 12 miles inland from the edge to the coastal plain. As Handy and Handy (1972:469) have pointed out, the forest was much more distant from the lowlands here than it was on the windward side, but on the leeward side was more extensive. Much of the upper reaches of the *ahupua'a* would have had species-diverse forest with *kukui*, *'ōhia*, sandalwood, *hau*, *ti*, banana, etc.

Within this natural setting, archaeological and traditional sources show a general pattern of three main areas of settlement within the *ahupua'a*: a coastal zone, the Honouliuli taro lands, and inland settlement at Pu'u Ku'ua.

6.1.1 The Coastal Zone - Kalaeloa (Barbers Point), Ko'olina (West Beach)

Kalaeloa (Barbers Point)

Archaeological research at Barbers Point has focused on the areas in and around the newly constructed Deep Draft Harbor (Barrera 1975; Davis and Griffin, 1978; Hammatt and Folk, 1981, McDermott et al. 2000). Series of small clustered shelters, enclosures and platforms show limited but recurrent use at the shoreline zone for marine-oriented exploitation. This settlement covers much of the shoreline with more concentrated features around small marshes and wet sinks. Immediately behind the shoreline, under a linear dune deposit, is a buried cultural layer believed to contain some of the earliest habitation evidence in the area.

The attraction of the area to early Hawaiians was the plentiful and easily exploited bird population. Particular evidence for taking of petrels occurs at Site -2763 (Hammatt and Folk, 197:213). Initial heavy exploitation of nesting seabirds and other species in conjunction with habitat destruction probably led to early extinction. There is some indication of limited agriculture in mulched sinkholes and limited soil areas. Considering rainfall, this activity would have been limited, but probably involved tree crops and roots (sweet potatoes). The archaeological content of the sites indicates a major focus on marine resources.

Davis and Griffin (1978) distinguish functional classes of sites, based on surface area size and argues that the Barbers Point settlement consists of functionally integrated multi-household residence groups. Density contours of midden (by weight) and artifacts (by numbers) plotted for residence sites by Hammatt and Folk (1981) generally indicate narrowly defined spatial foci of discard, possibly indicating continuous use, or at least with no refurbishing or additions to the structures through time (Hammatt and Folk 1981). The focus is small habitation sites, typically lacking the full range of features found in large permanent residence complexes such as high platforms, complex enclosures, and ceremonial sites.

Ko'ōlina (West Beach)

There are three available studies on the Ko'ōlina Project Area (Davis et a. 1986a; Davis et al. 1986b; and Davis and Haun 1987).

Davis documents around 180 component features at 48 sites and site complexes consisting of habitation sites, gardening areas, and human burials. Chronologically the occupation covers the

entire span of Hawaiian settlement, in what Davis and Haun describe as "one of the longest local sequences in Hawaiian prehistory" (Davis and Haun 1987:37). The earliest part of the sequence relates to the discovery of an inland marsh, and early dates were also obtained for the beachfront site and an inland rock shelter.

6.1.2 Honouliuli Taro Lands

Centered around the west side of Pearl Harbor at Honouliuli Stream and its broad outlet into the West Loch are the rich irrigated lands of the *'ili* of Honouliuli, which give the *ahupua'a* its name. The major archaeological reference to this area is Dicks, Haun, and Rosendahl (1987) who documented remnants of a once-widespread wetland system (*lo'i* and fishponds) as well as dryland cultivation of the adjacent slopes. The Project Area is within this environmental zone.

The area bordering West Loch was clearly a major focus of population within the Hawaiian Islands, and this was a logical response to the abundance of fish and shellfish resources in close proximity to a wide expanse of well-irrigated bottomland suitable for wetland taro cultivation. The earliest detailed map (Malden 1825) shows all the roads of southwest O'ahu coalescing and descending the *pali* (cliff) as they funnel into the locality (i.e. Honouliuli Village). Dicks et al. (1987:78-79) conclude, on the basis of 19 carbon isotope dates and 3 volcanic glass dates that "Agricultural use of the area spans over 1,000 years." Undoubtedly, Honouliuli was a locus of habitation for thousands of Hawaiians. Pre-Contact population estimates are a matter of some debate but it is worth pointing out that in the earliest mission census (Schmitt 1973:19) 1831-1832, the land (*'āina*) of Honouliuli contained 1026 men, women, and children. It is not clear whether this population relates to Honouliuli Village or the entire *ahupua'a*, but the village probably contained the vast majority of the district's population. The nature of the reported population structure for Honouliuli (less than 20% children under 12 years of age) and the fact that the population decreased more than 15% in the next 4 years (Schmitt 1973:22) suggests that the prehistoric population of Honouliuli Village may well have been significantly greater than it was in 1831-1832. A conservative estimate would be that tens of thousands of Hawaiians lived and died at Honouliuli Village.

6.1.3 Pu'uku'ua: Inland Settlement

Documentation of inland settlement in Honouliuli Ahupua'a is more problematic in that there are relatively few documented archaeological sources. However, it is probable that the area around Pu'uku'ua, on the east side of the Wai'anae Ridge seven miles inland of the coast, was a Hawaiian place of some importance.

In 1899, Hawaiian Newspaper *Ka Loea Kālai'āina* relates a story of Pu'uku'ua as "a place where chiefs lived in ancient times" and a "battle field," "thickly populated." The article summarizes:

> There were two important things concerning this place. (1) This place was entirely deserted and left uninhabited and it seems that this happened before the coming of righteousness to Hawai'i Nei. Not an inhabitant is left. (2) The descendants of the people of this place were so mixed that they were all of one class. Here the gods became tired and returned to Kahiki [Sterling and Summers 1978:33].

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McAllister recorded three sites in this area, two *heiau* (134, 137) (Pu'u Kuina and Pu'uku'ua, both destroyed) and a series of enclosures in Kukuihua which he called "kuleana sites" (McAllister 1933). On the opposite side of the Wai'anae range, along the trail to Pōhākea Pass, Cordy (2002:36) states "Kākuihihewa was said to have built (or rebuilt) Nōi'ula, a *pō'okanaka heiau* (1,300 sq. m.) in Hālona in upper Luahualei, along the trail to Pōhākea Pass leading into 'Ewa, ca. A.D. 1640-1660" (Cordy 2002:36). There is no direct archaeological evidence available to the authors' knowledge that intensive Hawaiian settlement occurred here, but it is considered as a place of high probability, based on the above indications. John Papa 'Ī'ī (1959) described a journey that Liholiho took which led him and an entourage through inland Honouliuli and over Pōhākea Pass. Geographically, the area receives sufficient quantities of water and would have had abundant locally available forest resources.

6.1.4 Summary

On the basis of archaeological studies, informed by historic records, the following may be concluded:

1) There are three areas of Hawaiian settlement in the *ahupua'a*; two are well-documented and one is problematic:
    a. the extensive limestone plain with recurrent use habitations for fishermen and gatherers and sometime gardeners;
    b. the rich cultivated lands of Honouliuli 'ili for extensive wetland taro and clearly the *ahupua'a* population center; and,
    c. the uplands around Pu'uku'ua associated with *kauwā* residence but probably used for agriculture and forest resources.

2) Honouliuli is designed as a unit to contain all the geographic elements of a typical Hawaiian valley *ahupua'a*, except they are arranged geomorphically in an atypical relationship. The *ahupua'a* is not organized around a single drainage network but shares the west portions of Waikele drainage in its upper reaches. A typical and highly advantageous characteristic for human subsistence is included in a vast coastline and fringing reef, an extensive limestone plain which would support only limited agriculture but would be excellent for bird catching in early times, and a huge expanse of sloping forest land. The richest forest land for foraging for wood, birds, feathers, etc. would have been the east slope of the Wai'anae Range. The surveys by Bordner (1983) and Hammatt and Shideler (1999) at Waimānalo Gulch indicated no evidence of Hawaiian occupation, but the gulch has been impacted in modern times (Bordner 1983).

3) The *makai* slope was not a major thoroughfare. We can see some very limited evidence of part-time agriculture in and around gulches and two foci of sparse habitation. The first is limited to *makai* portions of gulches and lava flats. This habitation is considered a *mauka* component or continuing of the Ko'olina coastal settlement rather than an independent focus. The second focus, separated from the first by a barren zone, is generally above the 800-foot elevation. This *mauka* habitation which could have been supported by seasonal dry land planting and forest foraging may be the lower portion of a

thinly scattered, but widespread zone of settlement which stretches eastward and northeast along the east Wai'anae Range slopes and may increase in intensity along the more watered lands forming the *mauka* western boundary of Honouliuli.

4) There is to date no archaeological evidence of high status residence in Honouliuli. Large residential structures are not present along the Pacific shoreline where they would be expected. The late prehistoric occurrence of chiefs' houses is not apparent, perhaps because the ocean shoreline, although rich in marine resources, is uninviting for sport and unsuitable for fishponds. The chiefly focus of 'Ewa District was Waipi'o. Whatever activities of this class occurred in Honouliuli would have been in or near the rich lands fronting West Loch (the *'ili* of Honouliuli). Concerning status associations with Honouliuli, it is interesting to note the connection of the Pu'uku'ua settlement with slaves (*kauwā*), the lowest class of Hawaiians (Sterling and Summers 1978:33).

5) The focus of population and agriculture within the *ahupua'a* of Honouliuli was the *'ili* of Honouliuli. There is good reason to assume, given the lack of intensive agricultural resources in other prehistoric times, all other habitation zones were economically and socially co-dependent.

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Section 7 Community Consultation

Throughout the course of this study, an effort was made to contact and consult with Hawaiian cultural organizations, government agencies, and individuals who might have knowledge of and/or concerns about traditional cultural practices associated with the Project Area. CSH contacted the individuals listed on Table 3 by letter, e-mail, telephone, and in personal contact. In the majority of cases, a letter along with a TMK map and a USGS topographical map of the Project Area were mailed with the following text:

> In collaboration with Environmental Communications, Inc., Cultural Surveys Hawai'i (CSH) is conducting a Cultural Impact Assessment for the proposed East Ho`opili Project, 'Ewa District, Honouliuli Ahupua'a, O'ahu Island (TMK: [1] 9-1-010:002; 9-1-017:004, 059; 9-1-018:001, 004, 072; 9-2-001:001). A map of the Project Area is enclosed for your reference.
>
> The purpose of this assessment is to identify any traditional cultural practices associated with the Project Area, past or present, pursuant to Hawaii revised Statutes 343. We are seeking your *kokua* and guidance regarding the following aspects of our study:
>
> General history and present and past land use of the study area;
>
> Knowledge of cultural sites that may be impacted by the project, for example historic sites, archaeological sites, and burials;
>
> Knowledge of traditional gathering practices in the study area, both past and on-going;
>
> Cultural associations with the study area through legends, traditional use or otherwise;
>
> Referrals of *kūpuna* or anyone else who might be willing to share their general cultural knowledge of the study area, and the surrounding *ahupua'a* lands.
>
> Any other cultural concerns the community might have related to cultural practices within or in the vicinity of the Project Area.
>
> The focus of this study is to document the potential impacts to cultural practices or resources of the proposed Project Area. If you wish to voice any cultural concerns or provide input on any of the above, please contact Kēhaulani Souza of Cultural Surveys Hawai'i at (808) 262-9972. Ms. Souza may also be contacted by e-mail at ksouza@culturalsurveys.com.

The individuals, organizations, and agencies attempted to be contacted and the results of any consultations are presented in Table 3: Community Contact List

Cultural Surveys Hawai'i Inc.
Archaeological and Cultural Impact Studies
Hallett H. Hammatt, Ph.D., President

Providing Excellence in Cultural Resource Management

O'ahu P.O.Box 1114 Kailua, HI 96734 Ph.: (808) 262-9972 Fax.: (808) 262-4950

Maui 16 S. Market St., #2N Wailuku, HI 96793 Ph.: (808) 242-9882 Fax.: (808) 244-1994

Kaua'i P.O.Box 498 Lawai, HI 96765 Ph.: (808) 245-4885

(November 17, 2005 date first sent)
January 26, 2006

Subject: **Cultural Impact Assessment for the East Kapolei Community Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu Island [TMK9-1-010:001, 9-1-017:004, 059, 072; 9-1-018:001, 004, 9-2-001:001] approximately 1,585-acres**

Aloha:

At the request of D. R. Horton-Schuler Division, Cultural Surveys Hawai'i is conducting a Cultural Impact Assessment (CIA) for the East Kapolei Community Project, Honouliuli Ahupua'a, 'Ewa District, O'ahu (TMK: 9-1-010:001, 9-1-017:004, 059, 072; 9-1-018:001, 004, 9-2-001:001) (Figure 1 and 2).

The purpose of the Cultural Impact Assessment is to assess potential impacts to traditional cultural practices as a result of future development of the proposed East Kapolei Community Project. The development will include residential, commercial, educational and recreational facilities.

We are seeking your *kōkua* or help and guidance regarding the following aspects of our study:

- **General history and present and past land use of the project area.**
- **Knowledge of cultural sites which may be impacted by future development of the project area - for example, historic sites, archaeological sites, and burials.**
- **Knowledge of traditional gathering practices in the project area – both past and ongoing.**
- **Cultural associations of the project area, such as legends and traditional uses.**
- **Referrals of *kūpuna* or elders who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands.**
- **Any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the project area.**

I invite you to contact me, Kēhaulani Souza at (808) 262-9972 or send me an e-mail at ksouza@culturalsurveys.com if you have any information you would like to share.

Me ka ha'aha'a,

Kēhaulani Souza

www.culturalsurveys.com info@culturalsurveys.com

Figure 23: Contact letter sent to organizations and individuals in Table 3

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Table 3: Community Contact List

Name	Affiliation	Comments
Ailā Willliam	Hui Mālama I Nā Kūpuna O Hawai'i Nei, Wai'anae Representative	Made referral: Shad Kane
Cayan, Coochie	Former O'ahu Island Burial Council member	Made referrals: Shad Kane, Nettie Tiffany, and the Neighborhood Board.
Crail, Gail	Former resident of Honouliuli	Mrs. Crail remembers the Project Area always covered with sugar cane. She suggested that we contact the Murata and the Iwata families who have lived in Honouliuli a long time.
Eaton, Arline	*Kupuna* at Iroquois Elementary School	See Traditional Cultural Practices below for response.
Futoshi, Shinogi	Resident of Honouliuli	Mr. Futoshi mentioned that the east side of old Fort Weaver Road was all wetlands. He also mentioned that this area was well know for artesian wells and the current site of the first artesian well is not the original site, it was further back near the current *lo'i* (taro pond).
Hirata, Richard "Dickey"	President of Hawaii Plantation Village; Raised at the 'Ewa Plantation	Made referral: Arakawa family.
Iwata, Tom	Resident of Honouliuli for 90 years	Mr. Iwata has lived in Honouliuli all his life and remembers Pipeline Village above old Fort Weaver Road; *lo'i* behind his house; and the entire Project Area being covered with sugar cane.
Ka'eliwai, George	Hawaiian Civic Club of 'Ewa/Pu'uloa	Mr. Ka'eliwai would gather oysters from Pu'uloa.
Kalili, Christina	Raised in Tenney Village	Made referral: Soma 'Ohana
Kane, Shad	Makakilo, Kapolei, Honokai Hale Neighborhood Board Member	Made referral
Malama, Tesha	Former 'Ewa Neighborhood Board member	Made referrals: Mary Serrao, Arline Eaton.
Murakami, Mae	Raised in Honouliuli. Grandparents and parents owned Honouliuli Shokai Store	Mrs. Murakami's grandfather Katsuhei Murata started the Honouliuli Shokai store on Old Fort Weaver road. She noted: "the store was like a little Wal-Mart with its own tailor, butcher and groceries. They also

Name	Affiliation	Comments
		imported and exported to Japan. It was "ahead if its time." She also mentioned that her grandfather set up a credit system for the people in the community. Mae also added that Chocolate Beach was a childhood place where they would often go to gather clams, and fish from the ocean.
Nāmu'o, Clyde	Administrator at Office of Hawaiian Affairs	In a letter to CSH dated 2-20-06 Office of Hawaiian Affairs stated that they had no comment at this time.
Nakamatsu, Charles	Raised in the 'Ewa Plantation in "C" Village.	See Traditional Cultural Practices below for response
Oshiro, Richard	Former 'Ewa Plantation employee	See Traditional Cultural Practices below for response
Paishon, Frank	Raised in Tenney Village	Mr. Paishon mentioned east of the Project Area was a great place to go fishing AT Choeolate Beach. They would catch oysters, clams, and all types of crabs.
Ramos, Rodolfo	Chair of 'Ewa Task Force	Mr. Ramos mentioned that they would go fishing at Chocolate Beach, east of the Project Area, and they would catch all types of crabs and pick oysters and clams. He said as far as he remembers that area was always sugar cane.
Sato, Melvin	Raised in Ewa Plantation "C" Village	Mr. Sato mentioned that Chocolate Beach was a great place to fish and gather oysters and clams. He said his uncle Charles Nakamatsu would know more about the Project Area.
Soma, Kenneth	Retired 'Ewa Plantation and current resident	See Traditional Cultural Practices below for response
Soma, Millie	Raised in 'Ewa Plantation Tenney Village	Mrs. Soma was born in 1935 and has lived in 'Ewa Plantation ever since. She has no major concerns.
Tiffany, Nettie	O'ahu Island Burial Council, Kahu for Lanikuhonua	Mrs. Tiffany commented the land has been altered over the years by the plantation. She suggested that consultation be conducted with people from the plantation
Quintal, Leti	Raised in 'Ewa Plantation, Secretary for the Immaculate Conception Church in 'Ewa	Mrs. Quintal remembers the Project Area always covered with sugar cane. She also made referrals of people in the community Mr. Kojima and his wife, Shgeru Yawata, and Lida and Pio Barbieto.

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7.1.1 Biographical Sketches of the Interview Informants

Aunty Arline Waimaha Pu'uloa Eaton

Aunty Arline Eaton is 79 years old, born in 1927. She was raised in the old traditional Hawaiian style, speaking her native language (Hawaiian) and traveling by canoe. She was raised in the area known as Keahi and Kūpaka, now known as Iroquois Point/'Ewa. She also lived for a short time in Kalihi before moving to Keahi. Her Papa Brede was the head of operations for the Dowsett Ranch. She has been the *kupuna* at Iroquois Elementary School for 19 years. Aunty Arline is one of the oldest and most knowledgeable Hawaiians for this area of O'ahu.

Richard "Dickey" Hirata

Mr. Hirata is 72, born in 1934 at the 'Ewa Plantation with the assistance of a midwife. He was raised in one of the many 'Ewa Plantation Villages called Lower Village, which was adjacent to the Project Area. Mr. Hirata's parents came to O'ahu to work in the plantation. Mr. Hirata worked for the 'Ewa Plantation for nine months then went into the army for three years. He then graduated from North Carolina State with a Bachelors Degree in Electrical Engineering. He later returned home and accepted a job with the State of Hawai'i as a Development Manager. He retired from the State of Hawai'i and now is the President of the Hawai'i Plantation Village, located in Waipahū.

Charles Yosei Nakamatsu

Mr. Nakamatsu is 85 years old, born in 1920. He was raised in the Ewa Plantation in "C" Village. He is second generation Okinawan and his parents came to Hawaii to work in the plantation. Mr. Nakamatsu worked for the plantation for 18 years as a welder then went to work for an air conditioning company.

Richard Oshrio

Mr. Oshiro is 78, born in 1928. His parents, Guikichi and Kamado Oshiro, were first generation immigrants from Okinawa. They came to Hawaii to work at the 'Ewa Plantation. Mr. Oshiro has a long history with the 'Ewa Plantation; for 77 years he has lived and worked in 'Ewa. He first lived in the Waimānalo Village, which is now known as the Ko'ōlina area, then in 1943 his family moved closer to the plantation's "C" Village, then to Tenney Village where he resides today. He retired in 1990 from the plantation.

Kenneth Soma

Mr. Soma is 80, born in 1926. He is full-blooded Japanese. His parents came from Japan to work at the 'Ewa Plantation. He was raised in the plantation and later worked for the plantation as a heavy equipment operator. After the Ewa Plantation closed, Oahu Sugar took over so he retired from Oahu Sugar. He also worked as a director at the Mililani Mortuary for 26 years. Today he enjoys his life in the same area that he was raised in 'Ewa.

Section 8 Traditional Cultural Practices

The northern portion of the Project Area is adjacent to Farrington Highway and the east end of the Project Area is on the boundary of the Honouliuli Taro Lands; a once-widespread wetland used for the cultivation of taro (*lo'i* and fishponds), as well as dryland cultivation of the adjacent slopes, which may have been utilized as early as A.D. 1000 (Dicks et al. 1987:78-79). East of the Project Area is West Loch (Kaihuopala'ai) of Pearl Harbor, which offered extensive fishponds (mullet, milkfish, shellfish), as well as shoreline frontage suitable for development of more fishponds. However, the majority of the Project Area is plateau land which would not have been as extensively modified or utilized based on environmental factors.

Discussions of specific aspects of traditional Hawaiian culture during information gathering interviews and "talk story" sessions are incorporated throughout this section as they may relate to the Project Area. The interviewees are represented by first and last initials with CSH denoting the Cultural Surveys Hawai'i interviewer. Some interviewees gave permission for CSH to include pertinent excerpts from interviews on Honouliuli conducted by CSH in the past for this assessment.

8.1 Gathering for Plant Resources

In the Māhele records it was documented that taro was primarily abundantly grown on the eastern edge of the Project Area (see Figure 9 & 10). Also, according to a documentation included in a study of land use in Honouliuli, it was mentioned that Kukui trees were abundant in the area, "...and of an 'old kukui tree' which was one of the boundary markers between Honouliuli and Hoaeae. This boundary runs along the present Kunia Road, and the tree is another indication that there was once a forest at this point" (Frierson 1972:12).

Given the ecosystem diversity of coastal lowland, transition, and upland forest zones in Honouliuli Ahupua'a, it is likely that one of the primary traditional cultural practices associated with the present project area would have been the gathering of native plant resources. Table 4 lists Honouliuli lowland plants and uses with columns for "common/Hawaiian name", "scientific name" and "use" based on research conducted by Barbara Frierson (1973) on native plant species present in Honouliuli before 1790, in addition to plant use recorded by Isabella Abbott (1992).

Table 4. Native Plants in Honouliuli

Hawaiian/Common Name	Scientific Name	Use
Hala, pandanus	*Pandanus odoratissimus*	Weaving
Hau, hibiscus	*Hibiscus tiliaceus*	Cordage
Milo	*Thespesia paradisiaca*	Wood used for bowls
Neneleau, Sumac	*Rhus sandwicensis* *Rhus chinensis*	Unknown
'Ilima	*Sida cordifolia*	Leis, medicine

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Hawaiian/Common Name	Scientific Name	Use
Kou	*Cordia subcordata*	Bowls
Makaloa, sedge	*Cyperus laevigatus*	Mats (Abbott)
Pili grass	*Heteropogon contortus*	Thatch
Kakonakona, grass	*Panicum torridum*	Unknown
Honohonowai	*Commelina nudiflora*	Unknown
Ma'o, cotton	*Gossypium tomentosum* *Abutilon incanum*	Flowers used as dye for kapa (Abbott)
'Olei	*Osteomeles anthyllidifolia*	Branches used for fishing nets (Abbott)
'Uhaloa	*Waltheria americana*	Medicine (Abbott)
Koali 'ai	*Ipomoea cairica*	Cordage (Abbott)
Pā'ū o Hiiaka	*Jacquemontia sandwicensis*	Unknown
Ko'oko'olau	*Bidens* sp.	Used as tea (Abbott)
'Ulu, breadfruit	*Artocarpus incisus*	Food
Taro	*Colocasia esculenta*	Food
Niu, coconut	*Cocos nucifera*	Food, liquid

The accessibility of Honouliuli lands, including the present Project Area, to the Hawaiians for gathering or other cultural purposes would be radically curtailed during the second half of the nineteenth century. As noted above in this evaluation, by the 1870s, herds of cattle grazing across the 'Ewa Plain likely denuded the landscape of much of the native vegetation. Subsequently, during the last decade of the nineteenth century, the traditional Hawaiian landscape was further altered by the introduction and rapid development of commercial sugar cane cultivation. Throughout the twentieth century, sugar cane cultivation was the dominating land use activity within the Project Area. Cane cultivation. –and the sense that the Project Area was private property– made it difficult for employees of the 'Ewa Plantation to get access inside the Project Area, restricting right of entry. .

Based on the evidence gathered for this evaluation, at present no contemporary or continuing cultural practices occur within the Project Area specifically.

8.2 Taro in Hawaiian Culture in Regards to the Project Area

It has been documented that taro was grown in the wetlands adjacent to the Project Area and a few interviewees remembered those times as well. In this section, the cultural connections of Hawaiians to taro will be discussed.

Taro has an intimate connection to the Hawaiian culture. Taro (*kalo*; *Colocassia esculenta*) was probably brought to Hawai'i by the earliest Polynesian voyagers and has been a staple crop on the islands ever since. Taro is intimately connected through myth to the origins of Hawaiians as a people. There are different versions of this myth, but all of them make the connection between the first-born Hawaiian and the taro plant, according to Mary Kawena Pukui:

> The first Hāloa, born to Wākea and Ho'ohoku-ka-lani, became a taro plant. His younger brother, also named Hāloa, became the ancestor of the people. In this way, taro was the elder brother and man the younger-both being children of the same parents [Handy and Handy 1972:80].

The physical attributes, the growth patterns, and the propagation of taro all reflect the structure of Hawaiian kinship and an obvious relationship to the human body. The main plant in the center is the *makua* (parent), the smaller plants budding out of the *makua* are the *'ohā* (offspring). The center of the leaf where it connects to the stem is the growth center of the veins of the leaf and is called the *piko* (belly button). The stem is called *ha*, which is also a word for breath, the basis of life. The cycle of planting is a reflection of the human life cycle. When the taro is harvested the *kalo* (corm) is cut right below the green top, the cut top is called the *huli* (turning, returning or transforming). The *huli* is replanted and the family of taro once again continues its growth cycle. The generations of taro are thought of interchangeably with the generations of Hawaiians as reflected in the saying "*Kalo kanu o ka 'āina*"-literally "taro planted on the land" but figuratively referring to successive generations of natives (Pukui 1983:157). Both the *'ohā* and the *makua* can be used as *huli*, but as in a family, the *'oha* (child) must be separated to become independent of the parent and -- to become a parent itself. If it is not, it remains a dependent attachment, overshadowed by the leaves of the *makua*. Another saying, *I makika'I kekalo I ka 'ohā*-"the goodness of the taro is judged by the young plant it produces" (Pukui 1983:133), is a metaphor for the parents being judged by the behavior of their children.

All parts of the taro plant are used for food: the corm is cooked and eaten as table taro or steamed and pounded into *poi*; the stem can be steamed and used in various soup and stew dishes; the young leaves are used for *laulau* and *lū'au* dishes mixed with fish, squid, pork, chicken or beef. Generally, the leaves are not harvested from the plants designated for corm production because continuous cutting makes the corms soft and tasteless (*loli*). Taro growers who grow leaf for home use or commercial purpose always have specially designated *lū'au* patches. It is traditional Hawaiian practice to use all the coarse green cuttings that are the by-product of the harvesting of the corms as food for the pigs. This green material, when cooked and fed to the animals, is highly nutritious. For this reason, raising pigs is traditionally is symbiotic relationship to taro production. In a traditional taro field, no space is wasted. The *lo'i* are used for the taro and any extra space on the banks is used for subsistence, utilitarian and medicinal plants, such as bananas, *noni*, and *ti*.

The practice of taro cultivation most resembles gardening in its scale and methods. Much of the work is undertaken by an individual or family, and is performed by hand. The *lo'i* and banks are beautifully manicured, ostensibly for weed control but the result is aesthetically like a garden. Yet, taro production remains viable even on this small scale because of its high per-acre productivity.

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Nowhere else in the world was taro cultivation more developed than in Hawai'i (Kirch 1985:215). It was the staple for the hundreds of thousands of Hawaiians before European contact. It was grown in areas with sufficient rainfall (above 30-50 inches per annum) or under dryland management. In areas of suitable water sources extensive and sophisticated irrigated systems were developed for its cultivation. The social requirement for the planning, development, and maintenance of theses irrigated systems was a stable political system and community cooperation. Although the cultivation and maintenance of individual fields could be the purview of single families or individuals, the maintenance of the water supply system on which the entire system depended had to be organized on a community level.

Although less than 100 varieties of taro survive today, there may have been, at one time, as many as 300 varieties in the islands, distinguished by leaf shape, corm, morphology, color and use. The labels of wetland and dryland taro do not refer to different taro varieties, but only to different cultivation practices. All varieties of taro can be grown in dryland fields and all but a few in *lo'i* (flooded fields). Today there are only a few widely-grown commercial varieties. Mechanical devices are used, such as tillers and small tractors; in some cases PVC pipes have replaced earthen or stone lined *'auwai* or waterways, and commercial fertilizers are routinely used. A typical taro crop will take from 10 to 14 months to mature. With modern farming methods taro is one of the most productive per-acre staple crops in the world. However, in spite of these modern overlays, the bulk of the labor is done by hand in the context of the family and the essence of a traditional taro growing community. Cooperation in management of water and land resources remains an integral part of this lifestyle.

In pre-contact Hawaii, during the late prehistoric era, as documented by archaeological studies, taro cultivation was practiced in virtually every suitable locality, including floodplains in windward valleys with perennial streams, open lava and beach flats near stream systems, and moist leeward slopes. Taro was such an important crop it was even grown in artificial microenvironments created by mulching pits in lava fields.

Since European contact there has been a slow but steady decline in taro cultivation. In the late nineteenth and early twentieth centuries, many of the large taro growing areas were given over to rice planting. Taro cultivation returned on a smaller scale to these areas after development of the California rice industry. Today, commercial Hawaiian taro cultivation is confined to a few areas in the islands: Hānalei/Waioli, Hanapēpē and Waimea on Kaua'i, Waikāne/Waiāhole and Haleiwa on O'ahu, Honokohau, Ke'anae/Wailuanui on Maui, and Waipi'o Valley on the island of Hawai'i.

Taro cultivation was a recurrent theme of the LCA testimonies for individual kuleana in Honouliuli. There were four individual kuleana LCAs in the Project Area. The testimonies indicated that these LCA's contained at least one *lo'i* as well as house lots, *kula* and fishponds (see Figure 10 and Table 1). The LCA's and assorted taro patches are depicted on a 1878 map of Honouliuli Taro Lands (see Figure 9)

'Ewa was well known for its rare *kai* variety of taro that was very flavorful as well as the ability to reproduce itself over a ten year span. The taro of 'Ewa was poetically referred to a man's love for a 'Ewa women that was so strong he would never leave:

> "The *kai* was native to 'Ewa and was often referred to as Kai o 'Ewa. . . . An 'Ewa *kama'āina* described this in 1899: When planted, it sends up shoots, more shoots and still more shoots. Again and again it will send up new shoots, filling the mounds until they mixed with the taro of other mounds. . . . This description (*Ka Loea Kalaní'āina*), June 3, 1899) indicates that in the flat, wet lowlands of 'Ewa this famous taro was grown in mounds (*pu'epu'e*) as in marshy localities. The article quoted above says that '*Kai koi* multiplies itself over and over with one planting and often last as long as ten years. No other variety or locality can equal this. This fragrant taro was likened to a woman with whom a man falls in love, and it was said that anyone who married a native of 'Ewa would come and settle there and would never leave, because of the *kai koi* of 'Ewa. Our Hawaiian writer describes two other varieties of *kai: Kai 'ele'ele*, black *kai*, has a black stalk, with dark skin on stems and leaves; its corm was tough and hard to pound. *Kai kea*, white *kai*, had a light-colored stem and leaves; the skin (of the corm) was red, but the flesh was dark like that of black *kai*, the corm likewise tough. In 1931 we collected four varieties of *kai: kai koi*, whose corm was white, vase of stalk pink, petiole pink, with a pink edge on the leaf; *koi kea* or *keokeo* with white corm, white base, whitish stalk with red margin, and a leaf with white edge and white center and pinkish veins; *kai 'ula'ula* (red *koi*) with corm flesh purplish white, and cortex of corm reddish purple, base red, stalk green with black streaks becoming light green and pink above, and finally, *kai-uliuli* (dark-*kai)* with white corm and lavender cortex, red to pink base, whitish and dusky green petiole with red and white margin, and leaf with a slightly reddish center. It was the *kai keokeo* which was described as being fragrant *('ala)*. From this was made the *poi* reserved for the chiefs (*poi ali'i)* [Handy and Handy 1972:471].

As indicated earlier the traditional settlement patterns as depicted in mid 1800s, *Mahele* documents was focused on taro cultivation in the wetlands of Honouliuli Ahupua'a.

Mr. Soma and Mr. Oshiro both mentioned a *lo'i* near Korean Camp (see Figure 19), which was adjacent to the south end of the Project Area. Aunty Arline Eaton shared her memories of gathering taro in the Honouliuli taro lands while looking at an 1825 (see Figure 7) map during the interview:

> AE: Oh, well then I wasn't even born but I know it (taro) was there, because even up to my time we had to go up there. Even though they had over there, they also had it down here, this was dry land taro. And everybody said, taste good to me. You know I never died, I'm still here. . . . All this has to do with water, fresh water, because this is where they used to have the *lo'i* . . . that's why these areas, were well water, but people don't use the names. Hey, have certain *kalo*, cause when you pick the ones over here it's a reddish color, and if you go up here (Project Area) it's a more purple color. It's the soil I think, and each one has a different taste. It's still *ono* [good], its *poi*! Yeah and the purple. I remember they having all these different *kine* [kinds] like *ulaula kalo*, *poneia*, I like the *poniponi* [taro varieties] one. But people never know, you tell them and they tell you its

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> something else. I don't like to explain because people don't understand. But now that your coming with this stuff [maps], now you know that its there.

Currently there is no taro cultivation in the Honouliuli Taro Lands that is within the Project Area.

8.3 Pa'akai (Salt Making)

Pa'akai (salt) was one of the condiments used by Hawaiians for curing fish and other foods. Out of all Polynesia, Hawaiians were the only group of people to produce salt from the sea by properly constructing salt pans. These salt pans were noticed and described by Reverend William Ellis:

> We saw a number of their pans, in the disposition of which they display great ingenuity. They have generally one large pond near the sea, into which the water flows by a channel cut through the rocks, or is carried thither by natives in large calabashes. After remaining there some time, it is conducted into a number of smaller pans, about six to eight inches in depth, which are made with great care, and frequently lined with large evergreen leaves, in order to prevent absorption. Along the narrow banks or partitions between the different pans, we saw a number of large evergreen leaves placed. They were tied up at each end, so as to resemble a shallow dish, and filled with sea water, in which the crystals of salt were abundant [Ellis 1839 in Buck 1964:71].

Salt making was abundant through out the 'Ewa district as documented on old maps. Mr. Oshiro mentioned that there was a Chinese man that would gather salt near the shore, at Chocolate Beach. He stated "there were 12 salt beds, the man would let the water in and trap the salt, then the salt would dry up and he would shovel the salt." Aunty Arline Eaton also mentioned that they never had to worry about not having enough salt growing up as a child:

> AE: During that period of time they had salt works in the area (looking at the 1927 map see figure 16). . . . yeah that's what it was, and there's that flume. We used to ride on this thing . . .you go right under here . . . but they don't have the salt works anymore, sad yeah? Yeah, that had the salt pans, all the way down to Ku'alaka'i, all the way to Kalaeloa, the whole thing. From Pu'uloa, which is Pearl Harbor, working all the way around pass Keone'ula, all the way down past where Ku'alaka'i is. That's almost the ending, though they maybe had one or two close to Kalaeloa. Because a lot of the boats came in there. I think, like how they have, [on the map]. That's true, exactly what you have over there. See it has Ewa Plantation, but there was water all in this area. The salt pans are really, actually, no more pan, but its coral, and you can see. But they called it that ["salt pans"]. But now that's all made out of the reef, the coral, all in that area.
>
> CSH: *So your family would gather salt?*
>
> AE: Oh, yeah. We never worried about salt, because it's right there. And had the *'alaea* [type of ocherous earth, mixed with the salt] down at Keone'ula, we go

> pick that up too. Because the water comes all in here it [the map] doesn't show you that. But water used to come all in that area. I tell people, this whole area here had water before we even had the *paniolo* here.

The most coastal portion of the Project Area is approximately 600 m (2,000 feet) from the West Loch of Pearl Harbor and the environment is not conducive to the "old" style of salt making.

8.4 Marine Resources

The sea and West Loch was a rich resource and the Hawaiian people were traditionally expert fishermen. Fish, shellfish, and other invertebrates of all types supplied the Hawaiian diet with a rich source of protein. The gathering of seaweed and salt was practiced by Hawaiian women. Today many people continue to fish along the shoreline south of the Project Area. In traditional Hawaiian times, Hawaiians going to and from marine resources at the coast, fishery resources of West Loch and its fishponds, and the low-lying mud-flats used for salt production may have crossed the present Project Area.

All the interviewees shared information about the abundant marine life just east of the Project Area, at Pu'uloa. They (Arline Eaton, Richard Oshiro, Kenneth Soma, Charles Nakamatsu and Dickey Hirata and many others) all mentioned a beach called Chocolate Beach and a well-known place to go fishing called Three Stones (see figure 16). At these places, they would often catch *pāpio*, mullet, oysters, clams, and all types of crab such as Hawaiian crab and *haole* crab and *limu* as well. They would use shrimp for bait, or as Mr. Soma mentioned "we would often get guts from the slaughter house and use that for bait." Mr. Nakamatsu also added " we would go get meat or slop from Kahuā Ranch or the Hawaiian Meat Market then we would go catch crab, such as Haole Crab, Kanaka Crab which is the reddish brown Crab and we would dig for clams and oysters". Mr. Nakamatsu and Mr. Soma both mentioned that on the way to the beach they would cut the Koa Haole tree before they would go fishing to use as a fishing pole". Below, Aunty Arline Eaton expresses her *mana'o* (thoughts) on different fishing resources:

> . . .That was beautiful, because you can get like *'ō'io* [bonefish], *u'u* [soldierfish], *enenue* [pilotfish], *kala* [surgeonfish], *manini* [surgeonfish], *moano* [goatfish], *he'e* [octopus], *pāpa'i* [crabs], and many others. And it was clean, and nowadays I don't know about what you'd get. . . . Moku'ume'ume we called it, Ford Island. And had oysters, you know they said never had, but they had oysters over there. But you know we never went over there and took a lot, we'd just take what you want, that's all. Why you need plenty, you don't need them all. You want some more, then you could always go back over there and go get some more. Each area had its own certain kind. . . . It's different from the one over here, because of the kind of *limu* [seaweed] they eat. Cause over here is lots of *līpo'a* [brown seaweed], so you can smell them [in the fish, yeah?]. Yeah, and you could smell it at high tide too. But now, you no can smell the *limu*. And when you open up *manini* you can look inside what they eat. They only eat *limu*, they only eat certain kinds, and they're clean. That's why you can just take 'em and throw them on the fire, you no need clean 'em. *Manini* don't eat just any kind stuff, still *ono*.

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CSH: *I remember last time I talked to you, you said your tutu papa would go to Waikiki in a canoe?*

AE: . . . and go out to Kou, to Waikiki, yeah, to Kahanamoku's place. Bernice Kahanamoku and I are good friends, that's Duke's only sister. He only had one sister out of all of them. When we went down there we couldn't come home, cause it would take time to get over there. So, we would sleep over night over there.

CSH: *He would paddle all the way over there in a four man canoe?*

AE: Well, I was young, but yeah I would just go with him, and he would paddle. I guess he would take stuff over there, not that they didn't have fish over there, but certain places get certain kinds. We have all different kinds of *limu* over here, any kind you could think of, but if you want to get *limu kohu*, good *kine*, you go Kaua'i. We have over here, but not as *ono*, you know what I'm saying? Like here the *'ō'io* was known to be one of the best in Pu'uloa, so that's why *tutu papa* would bring. That's what Duke's papa used to like.

Limu was very important in the Hawaiian diet and is defined by Pukui & Elbert (1971) "A general name for all kinds of plants living under water, both fresh and salt, also algae growing in any damp place in the air, as on the ground, on rocks and other plants." Aunty Arline spoke of the different types of *limu* in the 'Ewa area:

This whole area was known as the house of the *limu*. You can imagine the smell, but we never bothered. And now no more *limu*. Had plenty . . . and now no more. Well you know, there was a heavy influx of immigrants coming in. First they look at it, oh this is plenty, lets pick em *(limu)* all up, and they'd go and sell em. They'd never think about just pick their part, no they'd take the whole thing. So when they'd go, they'd pick up everything. Oh no, had in the locks, in Hō'ae'ae, had to have *limu* over here, all the way out. You know, maybe not as much as you see out there, but they did have *limu* in there because you had the fish. As long as you have the fish inside there, gotta have the *limu* inside there. That's why I said the *limu* is very important. That's why we were teaching the children. Had *lipo'a*, plentiful, but not as much as you would find in Pu'uloa, because of the changing of the ocean and the tide.

You need to have lots of running water back and forth, like waves coming in, going out. That's how that *limu* is strong and fresh. But we also had it in here too, all into this area. Mostly, the kind of *limu* you would find in here is *'ele'ele*. They had, cause of the water, there was a lot of fresh water that went in there. You would find it close up into an area where there is a lot of running water. That's how we knew there had fresh water coming out, can't live without fresh water, all of it needs it.

The Project Area is approximately 600 m (2,000 feet) back from the coast therefore marine resources will not be affected.

8.5 Burials

East of the Project Area, a pre-contact Native Hawaiian burial was found at Hō'ae'ae Point (Papapūhi Point) in West Loch Estates, and a historic Chinese crypt was found in a cave in the NAVMAG-West Loch area, (see Figure 22). Though none of the interviewees knew of any burials in the Project Area or in the vicinity, Aunty Arline did suggest that if people were living in the area, there is a possibility of burials:

My only thought is that for every person that lives in that area, that's where they bury their people . . .We never said anything. if people died, we'd go over there and they'd bury them right there where the house is. We'd never go four-hundred-million-miles away, its right there. All your *'ohana* stay right in the same area. We never went afar, not in the rural areas.

8.6 Historic Properties

CSH previously performed an assessment of 546-acres of the Project Area in 1990 as part of the West Loch Bluffs project, which was postponed. During the previous survey CSH identified the following historic features:

Sites 50-80-12-4344 (plantation infrastructure), -4345 (railroad berm), -4346 (northern pumping station), -4347 (central pumping station), and -4348 (southern pumping station).

8.7 Stream Resources

William Puleloa of the DLNR, Division of Aquatic Resources summarizes the importance of streams as a traditional Native Hawaiian cultural resource:

From the earliest days, streams were among the most important natural resources sought after by native Hawaiians. Battles were fought and lives sacrificed for the right to use stream water. The Hawaiians called freshwater wai, and considered it to be sacred. People using wai from streams took only what was absolutely necessary. They were expected to share the wai with others. This was done without greed or selfishness. Such practices gave Hawaiians their word for law, which is kanawai, or the "equal sharing of water." Water was so valuable to Hawaiians that they used the word "wai" to indicate wealth. Thus to signify abundance and prosperity, Hawaiians would say waiwai.

The Honouliuli Stream passes through the northeastern side of the Project Area (north of Farrington Highway), extends through the Honouliuli Taro Lands east of the Project Area and then empties into Pearl Harbor. The stream was the main water source for the lo'i in the Honouliuli Taro Lands. Aunty Arline spoke about the days that her *tutupa* and herself would go up stream in his four-man canoe. The canoe was filled with *i'a* (fish) and *limu* to trade with the people who lived near Honouliuli Stream who cultivated taro. She mentioned that as children they would often gather *'ōpae* and *'o'opu* from the stream. Aunty Arline also stated, "my *tutupa* would visit these people and he would chant in Hawaiian and the people on shore would chant back." This was a common practice of asking for permission to come ashore, visit, and trade. She

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also mentioned that the same thing would happen when people would come and visit her and her family in Keahi (Keahi Point in Pu'uloa; see Figure 5). At this time we have not found evidence of any cultural activity currently being practiced within the stream.

8.8 Trails

Trails served to connect the various settlements throughout the District of 'Ewa. Based on nineteenth and twentieth century maps, the primary transportation routes *mauka/makai* and cross-*ahupua'a* correlated closely to the existing major roadways (see Figure 6). John Papa 'I'ī describes a network of Leeward O'ahu trails that in later historic times encircled and crossed the Wai'anae Range, allowing passage from West Loch to the Honouliuli lowlands, past Pu'uokapolei and Waimānalo Gulch to the Wai'anae coast and onward, circumscribing the shoreline of O'ahu ('I'ī 1959:96-98). It seems clear that a major east/west artery from 'Ewa and Kona O'ahu to Wai'anae was the pre-cursor trail that 'I'ī was referring to, and what could possibly be the current Farrington High Way. However, today no remnants of the trail remain. (Figure 6). Trails in relation to the Project Area

8.9 *Wahi Pana* (Storied Places)

The concept of *wahi pana* (a place with a story or legend attached to it) is very important in the Hawaiian culture because it is a connection to the past and, therefore, the ancestors. From the name of a place one can know intimate details about the people who lived there, the environment, cultural practices, and historical events that took place. In Hawaiian culture, if a particular spot is given a name, it is because an event occurred there that has meaning for the people of that time. Because Hawaiian culture was based on oral traditions, place names and their stories were an important way of remembering these traditions and ensuring these stories would be passed on to future generations. In Hawaiian thinking, the fact that a place has a name deems it important. Often, spiritual power or *mana* is attached to a place, which increases its importance. On the subject of *wahi pana*, Edward Kanahele writes:

> As a native Hawaiian, a place tells me who I am and who my extended family is. A place gives me my history, the history of my clan, and the history of my people. I am able to look at a place and tie in human events that affect me and my loved ones. A place gives me a feeling of stability and of belonging to my family, those living and dead. A place gives me a sense of well-being and of acceptance of all who have experienced that place [Kanahele, in James 1995:6].

Aunty Arline agrees that it is very important to use the old place names that were given by Hawaiian people because it gives meaning to a specific area (see Figure 5):

> CSH: *How come they don't have Kūpaka on the map? Here's Ke'ahi and Kūpaka, so you lived near the beach then?*
>
> AE: [showing on map] right here, in this area, 'Ewa beach road. Kūpaka goes all the way up to where Parish Drive is. And it was named after Mr. Dowsett and the Parish's, cause they're related, they were the ones that came with Kamehameha. So he lived here, in Ke'ahi, and it was him who gave that name, Kūpaka, for that

> area. So that's why he named that area, and yet there was nothing [nothing there], These people came and they gave all that land to the Dowsetts and the Parish's. [CSH: Liholiho] Yeah, he gave it to them.
>
> CSH: *What did you call this beach?*
>
> AE: Keone O Keahi and Keone O Kūpaka, all of this is Pu'uloa. All the way down till you come to Keone'ula. Actually, it's Keone'ula because that's where that '*alaea* was. A lot of people don't know, but that's the reason why it was named that. It should not be One'ula, it should be Keone'ula. I keep saying that over and over they say, why you have to put that, Keone'ula?
>
> CSH: *So, it's the beach-that-is-red, the red beach?*
>
> AE: Yeah. But of course it doesn't show it now, but at that time, even when I was young, I remember seeing that big mound. Because all of this was fishponds. All in this area, this whole place all the way going down to, I don't like to say, Pearl Harbor the name should be Pu'uloa, until even Manana, all of that had fishponds. This whole area was like that, and salt pans.

Kapapapūhi is a point just east of the Project Area and Aunty Arline Eaton shared a story about this special place that was told to her as a child:

> Oh yeah, you talking about the outside area. Had *pūhi* [eel] all over, but mainly they used that point. There's a *ma'olelo* [story] that goes with that. There was this *pūhi* who is supposed to be, like, king of the area, and the *Tutukane* and the *Tutuwahine* came over there, and the *pūhi* looked and said oooh that *wahine*, I like that one. Well so the *pūhi* make sure plenty *i'a* [marine creatures] around, and one day the *Tutukane* never came, only her went over there, and she was picking '*opihi* [limpets]. Pretty soon she went underneath the water, and he saved her. . . . He loved her, he fell in love with her [*pūhi* king]. And he didn't want to let her go. And she said, Oh please I want to go home, and he said, no you stay with me, don't go, I'll give you everything you want, and you don't have to worry. And she cried, and she cried. Then he found out that boy that came down was not her sweet heart or anything, that was her brother. But you know Hawaiian style! And together they would always go out and go fishing because the father had gone out fishing and got lost, and only had the mama. And the mama wasn't feeling well. So these two [the brother and sister] would help out the grandmama and grandfather and go out. And the *pūhi* felt so sorry, so he said okay but anytime you need help I will always be here. And so every time I see this place and see this name I think of that. I could imagine him just standing over there and looking at her and thinking, oh how he loved her. Yeah that's one of the stories that they had about that. And that was told to me, I don't see it in a book. My papa told me that so I always remembered that. Then there was a song . . . that they would sing, it was so pretty.

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Section 9 Conclusion and Recommendations

9.1 Conclusion

Honouliuli is associated with a number of legendary accounts. Many of these concern the actions of gods or demi-gods such as Kāne, Kanaloa, *Māui*, Kamapua'a, the reptile deity (*mo'o*) Maunauna, the shark deity Ka'ahupāhau, and the demigod hero Palila. While there are several references to chiefly lineages and references to the ruling chiefs Hilo-a-Lakapu and Kūali'i, there is no clear reference to powerful chiefs living permanently in Honouliuli.

The accessibility of Honouliuli lands, including the proposed Project Area, to the Hawaiians for gathering or other cultural purposes was radically curtailed during the second half of the nineteenth century. As noted above in this assessment, by the 1870s, herds of cattle grazing across the 'Ewa Plain likely denuded the landscape of much of the native vegetation. Subsequently, during the last decade of the nineteenth century, the traditional Hawaiian landscape was further distorted by the introduction and rapid development of commercial sugar cane cultivation. Throughout the twentieth century, sugar cane cultivation was the dominating land use activity within the Project Area. Cane cultivation – and the sense that the Project Area was private property – restricted access inside the Project Area to employees of 'Ewa Plantation.

Hawaiian organizations, government agencies, community members, and cultural and lineal descendants with ties to 'Ewa were contacted to: (1) identify potentially knowledgeable individuals with cultural expertise and knowledge of the Project Area and its surroundings, and (2) identify cultural concerns and potential impacts within the Project Area. An effort was made to locate informants with ties to 'Ewa and neighboring *ahupua'a* who live, or had lived in the region or who, in the past, used the area for traditional and cultural purposes. For this assessment, Arline Eaton, Richard Hirata, Richard Oshiro, Kenneth Soma, Charles Nakamatsu and other *kūpuna* were interviewed. They mentioned that in the past there was traditional gathering of taro and salt, along with fish such as *pāpio*, mullet, as well as oysters, clams and a variety of crab near the Project Area. They all referred to this area of rich marine resources as Chocolate Beach and Three Stones. The people contacted were not aware of any on-going cultural practices, archaeological sites, trails, or burials within the Project Area. Most of the people contacted mentioned that the Project Area was heavily altered by plantation activities.

Based on what was gathered from the consultation process and the evidence of LCA's and lack of resources, the vast majority of the Project Area was utilized less intensively during traditional times. Additionally the years of sugar cane cultivation left no reason for access. Most of the resources such as taro farming and gathering of marine resources were on the fringing edge or outside of the Project Area. Based on the evidence gathered for this evaluation, at present no contemporary or continuing cultural practices occur within the Project Area specifically.

9.2 Recommendations

No contemporary or continuing cultural practices currently occur within the proposed Project Area. It should be noted that subsurface historic properties associated with former traditional Hawaiian activities in the project area, such as artifacts and cultural layers, may be present despite the decades of modern activities such as ranching and sugar cane. As a precautionary measure, personnel involved in future development should be informed of the possibility of inadvertent cultural finds, and should be made aware of the appropriate notification measures to follow.

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APPENDIX G
Environmental Noise Assessment

D. L. ADAMS ASSOCIATES, LTD.
Consultants in Acoustics and Performing Arts Technologies

Environmental Noise Assessment Report
Ho'opili
Ewa, Oahu, Hawaii

February 2008

DLAA Project No. 06-34

Prepared for:
PBR Hawaii
Honolulu, Hawaii

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1.0 EXECUTIVE SUMMARY

1.1 The project area is currently exposed to varying daytime ambient noise levels, depending on the proximity to major roadways. The areas adjacent to H-1 Freeway and Farrington Highway experience high ambient noise levels during peak traffic hours. Ambient noise levels range from 59 to 72 dBA adjacent to the H-1 Freeway and 44 to 59 dBA adjacent to Farrington Highway. The ambient noise environment is relatively low in areas that are far from the major roadways, where ambient noise levels range from 37 to 60 dBA. The dominant noise sources are traffic, wind, birds, occasional distant aircraft flyovers, and farm equipment.

1.2 Development of project areas will involve excavation, grading, and other typical construction activities. The Ho'opili project is not expected to impact adjacent properties, however, residences from the initial phases may be impacted by construction noise from subsequent phases due to their proximity to the construction site. Noise from construction activities should be short term and must comply with State Department of Health noise regulations.

1.3 The proposed land uses may include noise generating activities which could impact adjacent residences. Noise mitigation measures should be incorporated into the project design to prevent such impacts, such as creating buffer zones, installing mufflers and/or erecting barriers around noisy equipment. Consideration should also be given to the layout of the commercial areas to meet State Department of Health noise regulations and reduce the noise impact. Restrictions may need to be placed on commercial uses allowed in the commercial areas in order to strictly control development of potential noise producing industries.

1.4 Increases in peak hour traffic noise along Fort Weaver Road due to the project are estimated to be less than 1 dB. Increases in peak hour traffic noise along Old Fort Weaver Road due to the project are estimated to be between 3 and 8 dB. This is a significant increase for homes currently located along Old Fort Weaver Road.

1.5 Vehicular traffic noise from the H-1 Freeway may significantly impact the proposed development. Traffic noise mitigation will be necessary to satisfy the FHWA maximum exterior L_{eq} noise limit of 67 dBA for parcels adjacent to H-1 Freeway. Because of its vicinity to the H-1, much of the project site will be impacted by noise from the freeway. The construction of a noise barrier wall, as well as the construction of buildings, along H-1 will mitigate traffic noise for most of the impacted area. However, the parcels that are very close to the H-1 are the most impacted by traffic noise. Homes and schools that are built within 120 feet of the H-1 Freeway will not satisfy the FHWA maximum exterior L_{eq} noise limit of 67 dBA, even if noise mitigation (i.e., noise barrier wall) are implemented. To limit the noise impact on the project, the 120 foot buffer zone is best suited for structures that are less sensitive to noise, such as commercial and light industrial uses. The FHWA noise criterion is less stringent for commercial and light industrial uses. However, even for these uses located within 120 feet from the H-1 Freeway, noise mitigation (i.e., noise barrier wall) will be needed to meet the FHWA maximum exterior Leq noise limit of 72 dBA. Although the FHWA criteria is not a regulatory requirement for this project, as it has no authority to enforce land use, its noise limit criteria is recommended by the FHWA to be used as a guideline for consideration of land use and the impact of traffic noise.

1.6 Vehicular traffic noise from Farrington Highway and Fort Weaver Road may significantly impact the proposed development. Any homes, schools, or parks within 80 feet of Farrington Highway and 70 feet of Fort Weaver Road will require traffic noise mitigation to meet the FHWA maximum exterior L_{eq} noise limit of 67 dBA.

1.7 The addition of the proposed transit system is not expected to cause a significant change in traffic noise levels from roadways within the project site.

1.8 Aircraft noise due to operations at nearby Kalaeloa Airport and the Honolulu International Airport may be audible at the project site. However, flights directly above the site are infrequent and the project site is outside of the L_{dn} 55 noise contour for both airports. Therefore, a significant noise impact due to aircraft noise is not expected.

1.9 The proposed alignments of the future Honolulu rail transit system run along Farrington Highway and North-South Road and may include two transit stations. Design of the Ho'opili development should include a minimum setback distance between the nearest residences and the transit guideway and stations to minimize the impact due to transit system related noise. The City and County of Honolulu is currently developing an Environmental Impact Statement for the proposed transit system. We assume that transit noise mitigation measures and appropriate setback distances will be addressed in the EIS.

1.10 Exterior noise levels at two school sites (H-1 Freeway/Kunia Road and Farrington Highway) will exceed the Hawaii State Board of Education (BOE) Policy 6700 noise limit of $L_{10} = 65$ dBA. Policy 6700 requires that air conditioning be provided to schools that are exposed to exterior noise levels in excess of the noise limit. The layout and construction of the school should be carefully designed such that exterior noise will not disturb learning activities and interfere with speech intelligibility. To reduce ambient noise levels at the school site, traffic noise mitigation measures may also be necessary, such as an earthen berm or noise barrier wall.

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2.0 PROJECT DESCRIPTION

The Ho'opili project is a proposed Transit-Oriented-Development (TOD) that is a mixed-use, transit-ready community including residential (approx. 11,750 units, including affordable housing), business and commercial areas (approx. 145 acres), light industrial/business areas (approx. 50 acres), transit stops, schools and other public facilities (approx. 100 acres), parks (approx. 60 acres), and large amounts of open space (approx. 150 acres). The project area is located in the Ewa District, on the island of Oahu and is bounded by several major roadways: H-1 Freeway, the proposed North-South Road, and Fort Weaver Road. Other major roadways contained within the site include Farrington Highway, Old Fort Weaver Road and the proposed East-West Road.

Historically, the site was cultivated in sugarcane and is currently utilized for diversified agriculture. The proposed project involves the reclassification of approximately 1,554 acres from the Agricultural District to the Urban District.

3.0 NOISE STANDARDS

Various local and federal agencies have established guidelines and standards for assessing environmental noise impacts and have set noise limits as a function of land use. A brief description of common acoustic terminology used in these guidelines and standards is presented in Appendix A.

3.1 State of Hawaii, Community Noise Control

The State of Hawaii, Community Noise Control Rule [Reference 1] defines three classes of zoning districts and specifies corresponding maximum permissible sound levels due to *stationary* noise sources such as air-conditioning units, exhaust systems, generators, compressors, pumps, etc. The Community Noise Control Rule does not address most *moving* sources, such as vehicular traffic noise, air traffic noise, or rail traffic noise. However, the Community Noise Control Rule does regulate noise related to agricultural, construction, and industrial activities, which may not be stationary.

The maximum permissible noise levels are enforced by the State Department of Health (DOH) for any location at or beyond the property line and shall not be exceeded for more than 10% of the time during any 20-minute period. The specified noise limits which apply are a function of the zoning and time of day as shown in Figure 1. With respect to mixed zoning districts, the rule specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. In determining the maximum permissible sound level, the background noise level is taken into account by the DOH.

3.2 U.S. Federal Highway Administration (FHWA)

The FHWA defines four land use categories and assigns corresponding maximum hourly equivalent sound levels, $L_{eq(h)}$, for traffic noise exposure [Reference 2], which are listed in Figure 2. For example, Category B, defined as picnic and

recreation areas, parks, residences, motels, hotels, schools, churches, libraries, and hospitals, has a corresponding maximum exterior L_{eq} of 67dBA and a maximum interior L_{eq} of 52 dBA. These limits are viewed as design goals, and all projects meeting these limits are deemed in conformance with FHWA noise standards. Calculation of traffic noise levels should be conducted using a Federal Highway Administration traffic noise model [Reference 3].

3.3 State of Hawaii Department of Transportation (HDOT)

The HDOT has adopted FHWA's design goals for traffic noise exposure in its noise analysis and abatement policy [Reference 4]. According to this policy, a traffic noise impact occurs when the predicted traffic noise levels "approach" or exceed FHWA's design goals or when the predicted traffic noise levels "substantially exceed the existing noise levels." The policy also states that "approach" means at least 1 dB less than FHWA's design goals and "substantially exceed the existing noise levels" means an increase of at least 15 dB.

3.4 U.S. Environmental Protection Agency (EPA)

The U.S. EPA has identified a range of yearly day-night equivalent sound levels, L_{dn}, sufficient to protect public health and welfare from the effects of environmental noise [Reference 5]. The EPA has established a goal to reduce exterior environmental noise to an L_{dn} not exceeding 65 dBA and a future goal to further reduce exterior environmental noise to an L_{dn} not exceeding 55 dBA. Additionally, the EPA states that these goals are not intended as regulations as it has no authority to regulate noise levels, but rather they are intended to be viewed as levels below which the general population will not be at risk from any of the identified effects of noise.

3.5 U.S. Department of Housing and Urban Development (HUD)

HUD's environmental noise criteria and standards in 24 CFR 51 [Reference 6] were established for determining housing project site acceptability. These standards are based on day-night equivalent sound levels, L_{dn}, and are not limited to traffic noise exposure. However, for project sites in the vicinity of highways, the L_{dn} may be estimated to be equal to the design hour $L_{eq(h)}$, provided "heavy trucks (vehicles with three or more axles) do not exceed 10 percent of the total traffic flow in vehicles per 24 hours and the traffic flow between 10:00 p.m. and 7:00 a.m. does not exceed 15 percent of the average daily traffic flow in vehicles per 24 hours." For these same conditions, L_{dn}, may also be estimated as 3 dB less than the design hour L_{10}.

HUD site acceptability criteria rank sites as Acceptable, Normally Unacceptable, or Unacceptable. "Acceptable" sites are those where exterior noise levels do not exceed an L_{dn} of 65 dBA. Proposed housing projects on "Acceptable" sites do not require additional noise attenuation other than that provided by customary building techniques. "Normally Unacceptable" sites are those where the L_{dn} is above 65 dBA, but does not exceed 75 dBA. Housing on "Normally

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Unacceptable" sites requires some form of noise abatement, either at the property line or in the building construction, to ensure the interior noise levels are acceptable. "Unacceptable" sites are those where the L_{dn} is 75 dBA or higher. The term "Unacceptable" does not necessarily mean that housing cannot be built on those sites; however, more elaborate sound attenuation will likely be needed.

3.6 Federal Aviation Administration (FAA)

The FAA addresses guidelines for compatible land use that surrounds airports [Reference 7]. Noise contour maps are expressed in terms of yearly day-night average sound levels, L_{dn}, due to aircraft operations. The FAA states that residences outside of the L_{dn} 65 noise contour are compatible without restrictions. Residences between the L_{dn} 65 and 75 contours are only compatible if noise mitigation measures are incorporated into the building structure. Residences inside of the L_{dn} 75 noise contour are generally not compatible. The compatibility of other land uses, such as commercial, manufacturing, public, and recreation, are shown in Table 1.

3.7 State of Hawaii Department of Transportation (HDOTA), Airports Division

The State of Hawaii, Department of Transportation, Airports Division has adopted noise restrictions that are similar to the FAA's, but more stringent [Reference 8]. Similar to the FAA, HDOTA expresses land use compatibility guidelines based on yearly day-night average sound levels, L_{dn}, due to aircraft operations. In most cases, the HDOTA states maximum noise limits that are 5 dB lower than the FAA. For example, the HDOTA states that residences outside of the 60 L_{dn} noise contour are compatible. Residences between 60 and 70 L_{dn} contours are only compatible if noise mitigation treatments are implemented. However, HDOTA states:

> "Where the community determines that these uses must be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 L_{dn} or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure, plus air conditioning, may be required to provide additional outdoor to indoor NLR, and will not eliminate outdoor noise problems."

The HDOTA guidelines also specify 60 dBA as the maximum allowable L_{dn} level for school, day care center, and church uses without any mitigation measures. Commercial uses such as retail shops, restaurants, shopping centers, etc. are compatible with L_{dn} levels up to 65 dBA without any mitigation measures. With noise mitigation measures implemented, such commercial uses are allowed in areas exposed to an L_{dn} as high as 75 dBA. The compatibility of other land uses, such as manufacturing, public, and recreation, are shown in Table 2.

In addition to the HDOTA compatibility guidelines, The Hawaii Revised Statutes, Chapter 0508D, Section 15 states a notification is required to the buyer for real estate property that lies,

> "Within the boundaries of the noise exposure area shown on maps prepared by the department of transportation in accordance with Federal Aviation Regulation Part 150-Airport Noise Compatibility Planning (14 Code of Federal Regulations Part 150) for any public airport;"

The FAR Part 150 noise exposure area boundary is defined as the 55 L_{dn} noise contour. Therefore, a notification to the buyer is required for all real estate transactions within the 55 L_{dn} noise contour.

3.8 Federal Transit Administration (FTA)

The FTA defines three land use categories and provides guidance in the assessment of noise and vibration due to transit systems based on an increase in cumulative noise. Methods for determining noise and vibration impacts and possible mitigation measures for typical transit projects are provided in the Transit Noise and Vibration Impact Assessment report [Reference 9]. One set of criteria defined in the report applies to all rail projects (including light rail transit, rapid rail transit, etc.) and their fixed facilities. The criteria, specified in maximum hourly equivalent sound levels, $L_{eq(h)}$, and day-night equivalent sound levels, L_{dn}, varies according to the existing noise levels, the predicted transit system project noise levels, and the land use category, as shown in Figure 3. The area between the two curves labeled as "Impact" is a transitional area where the change in cumulative noise level will be noticeable to most individuals, but may not be sufficient to cause adverse reactions from the community.

The FTA criteria were developed to recognize the heightened community annoyance caused by late night and early morning transit service and the varying sensitivity of communities to transit systems under different background noise conditions and is concurrent with various noise standards defined by other Federal agencies. It is important to note that the criteria are not enforceable regulations, but design goals that are useful tools for assessing the noise environment.

3.9 State of Hawaii State Board of Education (BOE)

BOE policy 6700 [Reference 10] sets four classroom noise level requirements:

1. Soundproofing design shall be used to reduce the noise level whenever the internal noise level exceeds 50 dBA.

2. Noise control shall be provided for all school facilities which generate exterior noise levels at the property line exceeding DOH standards.

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3. Noise control measures shall be installed in classrooms and administration/staff facilities (excluding shop classrooms) whenever 50 percent of the intruding noise level measurements exceed 55 dBA when inside the classroom with windows and doors open and the room empty.

4. Air conditioning shall be provided to facilities exposed to exterior noise levels greater than L_{10} = 65dBA.

4.0 EXISTING ACOUSTICAL ENVIRONMENT

Two types of noise measurements were conducted to assess the existing acoustical environment in the vicinity of the project location. The first noise measurement type consisted of continuous long-term ambient noise level measurements (Locations L1, L2, L3 and L4), as shown in Figure 4. The second type of noise measurement was short-term and included traffic counts (Locations S1, S2, S3, and S4), also shown in Figure 4. The purpose of the short-term noise measurements and corresponding traffic counts were to calibrate a traffic noise prediction model. The noise measurements were conducted between October 9, 2006 and October 15, 2006.

4.1 Noise Measurement Procedures

Long-Term Noise Measurements

Continuous, hourly, statistical sound levels were recorded for approximately 3 days at each location. The measurements were taken using a Larson-Davis Laboratories, Model 820, Type-1 Sound Level Meter together with a Larson-Davis, Model 2560 Type-1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended calibration period. The microphone was mounted on a tripod, approximately 6 feet above grade. A windscreen covered the microphone during the entire measurement period. The sound level meter was secured in a weather resistant case.

Short-Term Noise Measurements

An approximate 30-minute equivalent sound level, L_{eq}, was measured at each location. Vehicular traffic counts and traffic mix were documented during the measurement period. The noise measurement was taken using a Larson-Davis Laboratories, Model 824, Type-1 Sound Level Meter together with a Larson-Davis, Model 2541 Type-1 Microphone. Calibration was checked before and after the measurements with a Larson-Davis Model CAL200 calibrator. Both the sound level meter and the calibrator have been certified by the manufacturer within the recommended calibration period. The microphone and sound level meter were mounted on a tripod, approximately 5 feet above grade. A windscreen covered the microphone during the entire measurement period.

4.2 Noise Measurement Locations

Long-Term Noise Measurements

Location L1: Approximately 200 feet makai of the H-1 Freeway. The dominant noise source was vehicular traffic from the H-1 Freeway. Secondary noise sources included aircraft flyovers, birds, wind, and farm equipment.

Location L2: Approximately 150 ft makai of Farrington Highway near the HECO Station. The dominant noise source was vehicular traffic from Farrington Highway. Secondary noise sources included farm equipment, birds, wind, and aircraft flyovers.

Location L3: Near the eastern edge of the project area, approximately 0.7 miles makai of Farrington Highway. The dominant noise sources were birds, wind, aircraft flyovers, and farming equipment that may have been operated in the vicinity of the sound meter.

Location L4: Near the western edge of the project, approximately 0.9 miles makai of Farrington Highway and 0.25 miles east of the proposed North-South Road. The dominant noise sources were birds, wind, aircraft flyovers, and farming equipment that may have been operated in the vicinity of the sound meter.

Short-Term Noise Measurement Locations

Location S1: Positioned adjacent to Old Fort Weaver Road, approximately 40 feet west of the edge-of-pavement.

Location S2: Positioned adjacent to Fort Weaver Road, approximately 50 feet west of the edge-of-pavement.

Location S3: Positioned adjacent to Farrington Highway, approximately 35 feet makai of the edge-of-pavement.

Location S4: Positioned adjacent to H-1 Freeway, approximately 50 feet makai of the edge-of-pavement.

4.3 Long-Term Noise Measurement Results

The ambient sound levels at locations L1 and L2 are relatively dynamic and depend significantly on the vehicular traffic patterns of the surrounding roadways. Thus, the areas adjacent to H-1 Freeway and Farrington Highway experience high ambient noise levels during peak traffic hours. The ambient noise environment is relatively low in areas that are far from the major roadways, i.e. locations L3 and L4, where ambient sound levels do not vary significantly during the daytime hours but drop off at night. The measured equivalent sound levels, L_{eq}, in A-weighted decibels (dBA) are graphically presented in Figures 5 for locations L1

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and L2 and Figure 6 for locations L3 and L4. Noise measurement results are also summarized in Table 3.

Adverse weather was experienced between October 12, 2006 and October 17, 2006. The sound level meter experienced several overloads, likely due to rainfall. The portions of data from the meters at location L3 and L4 that may be erroneous have been indicated on Figure 6. However, the overall trend in noise levels is still apparent.

4.4 Project Vicinity

Existing residential developments immediately surrounding the project site include Waipahu and West Loch to the east and Ewa Villages to the south. Vehicular noise from Fort Weaver Road, Farrington Highway and the H-1 Freeway dominate the ambient environment in the vicinity of these roadways. The future UH West Oahu and DHHL sites, west of the Ho'opili project site, experience an acoustical environment similar to the project site with wind and occasional aircraft flyovers being dominant noise sources. In addition, a quarry and a recycling plant located west of the project site may contribute to some of the ambient noise. Heavy trucks, which generate more noise than automobiles, travel to and from the quarry and recycling plant and constitute 10% of the AM peak hour traffic total on Farrington Highway. Heavy trucks also constitute 10% of the AM peak hour traffic total on H-1 Freeway.

4.5 Kalaeloa Airport and Honolulu International Airport Noise Contours

The project is several miles northeast of the Kalaeloa Airport and west of Honolulu International Airport. Therefore, the project site was assessed for aircraft noise using airport noise contour maps. The Kalaeloa Master Plan [Reference 11] includes year 2020 projections of airport operations and noise contour maps for airport alternates. Also included in the airport noise contour maps is the effect of the Honolulu International Airport operations [Reference 8]. A complete description of the Kalaeloa Airport alternatives can be found in the Kalaeloa Master Plan. The Ho'opili project site is outside of the L_{dn} 55 noise contours for both airports.

5.0 POTENTIAL NOISE IMPACTS

5.1 Project Construction Noise

Development of project areas will involve excavation, grading, and other typical construction activities during construction. The various construction phases of the project will generate significant amounts of noise. Depending on when construction occurs, the Ho'opili development and construction of the transit corridor may impact existing adjacent properties, such as the homes adjacent to Fort Weaver Road and Old Fort Weaver Road. Future developments such as UH West Oahu and DHHL on adjacent properties that are completed before the Ho'opili development may also be impacted by construction noise. Similarly, residences from the initial phases may be impacted by construction noise from

subsequent phases due to their proximity to the construction site. The actual noise levels produced during construction will be a function of the methods employed during each stage of the construction process. Typical ranges of construction equipment noise are shown in Figure 7. Pile driving, if employed, and earthmoving equipment, e.g., bulldozers and diesel-powered trucks, will probably be the loudest equipment used during construction.

5.2 Project Generated Stationary Mechanical Noise and Compliance with State of Hawaii Community Noise Control Rule

The Ho'opili project is proposed to be a mixed-use development of which 80 percent of the residential units will be multi-family. Approximately 195 acres of the project site is proposed for commercial, business, or light industrial development which will be distributed throughout the residential and open space areas located within the project site. Noise emanating from these commercial uses could significantly impact the proposed adjacent noise sensitive residential areas. The various phases in the long range development plan will incorporate stationary mechanical equipment that is typical for residential and commercial buildings. Expected mechanical equipment may include air handling equipment, condensing units, refrigeration units, etc.

Noise from this mechanical equipment and other equipment must meet the State noise rules, which stipulate maximum permissible noise limits at the property line. For multi-family dwellings, business, and commercial areas, the noise limits are 60 dBA during the day and 50 dBA during the night, as shown in Figure 1. For residential areas (i.e., single-family homes), noise limits are 55 dBA during the day and 45 dBA during the night. For industrial areas, the noise limit is 70 dBA during the day and night. For mixed zoning districts, the primary land use designation is used to determine the maximum permissible noise limits. However, the DOH takes into consideration background noise levels when assessing noise infractions. Mitigation of mechanical noise to meet the State DOH noise rules should be incorporated into the project design.

5.3 Compliance with FHWA/HDOT Noise Limits

A vehicular traffic noise analysis was completed using the FHWA Traffic Noise Model Look-up Tables Software Version 2.5 (2004) [Reference 12] for the existing conditions, future year 2030 projections with the "No Build" condition, and future year 2030 projections with the "Build" condition under Scenario A (with Transit) and Scenario B (without Transit). The traffic noise analysis is based on the peak hour traffic volumes provided by the Traffic Consultant [Reference 13]. Intersection geometric configurations and future speed limits were also provided by the traffic consultant.

Vehicular traffic noise levels were calculated for 7 locations, Locations A, B, C, D, E, F, and G as shown in Figure 8. Table 4 summarizes the constraints used in the traffic noise analysis. The short-term noise measurement and corresponding traffic counts were used to validate the software at noise prediction locations A,

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B, C, and D. Only future noise level predictions were made for Locations E, F, and G. The results of the traffic noise analysis for the existing and future year projections are described below and summarized in Tables 5 and 6.

5.3.1 Vehicular Traffic Noise Impacts on the Surrounding Community

Noise Prediction Location A - Old Fort Weaver Road

Existing residences located adjacent to Old Fort Weaver Road currently experience traffic noise levels well below the FHWA maximum noise limit of 67 dBA. Future improvements to roadways in the area (under the "no build" condition) will actually reduce the traffic volume on Old Fort Weaver Road, thereby reducing traffic noise by 1 to 3 dB. A 3 dB change or less in noise level is not considered to be significant. Traffic noise is expected to increase by 3 to 8 dB in the future due to the project, which is a significant noise increase.

Noise Prediction Location B - Fort Weaver Road

Existing residences located adjacent to Fort Weaver Road currently experience high traffic noise levels. Residences located farther than 70 feet from the edge-of-pavement (EOP) experience traffic noise levels that satisfy the FHWA maximum noise limit of 67 dBA. Residences that are located closer than 70 feet from the EOP exceed the FHWA noise limit. There is currently a noise barrier wall along Fort Weaver Road that shields the adjacent homes from traffic noise such that the FHWA noise limit is satisfied. However, the barrier has no effect on the upper levels of two story homes that still have a line-of-sight to Fort Weaver Road.

Future improvements to roadways in the area will reduce the traffic volume slightly on Fort Weaver Road, thereby reducing traffic noise by less than 1 dB. The future increase due to the project is an insignificant increase of less than 1 dB.

5.3.2 Vehicular Traffic Noise Impacts on the Project

Noise Prediction Location A - Old Fort Weaver Road

Future year traffic projections show that the FHWA maximum noise limit of 67 dBA will be satisfied for residences or schools that are built on the project site more than 25 feet from the EOP of Old Fort Weaver Road.

Noise Prediction Location B - Fort Weave Road

Future year traffic projections show that the FHWA maximum noise limit of 67 dBA will not be satisfied for the parks that are located within 70 feet from the EOP of Fort Weaver Road. In order to reduce the impact of traffic noise, the park should be designed such that a buffer zone (e.g., a parking lot) is constructed between the roadway and the park area.

The FHWA maximum noise limit of 72 dBA will be satisfied for commercial areas adjacent to Fort Weaver Road.

Noise Prediction Location C - Farrington Highway

For the parcels adjacent to Farrington Highway, vehicular traffic noise levels are expected to increase by up to 2 dB in the future under the "No Build" condition. The increase in traffic noise due to the Ho'opili project is 4 to 6 dB. A 3 dB change or more in noise level is considered significant.

Future year traffic projections show that the FHWA maximum noise limit of 67 dBA will not be satisfied for residences or schools that are built within 80 feet from the EOP of Farrington Highway unless noise mitigation treatments are implemented.

Noise Prediction Location D - H-1 Freeway

For the parcels adjacent to the H-1 Freeway, vehicular traffic noise levels are expected to increase by up to 3 dB in the future. The increase in traffic noise due to the Ho'opili project is less than 1 dB which is insignificant.

Because of its vicinity to the H-1, much of the project site will be impacted by noise from the freeway. Future year traffic projections show that the FHWA maximum exterior L_{eq} noise limit of 67 dBA will not be satisfied for parcels adjacent to the H-1 Freeway without traffic noise mitigation. Possible mitigation measures are described in Section 6.3.2. However, the parcels that are very close to the H-1 are the most impacted by traffic noise. Homes and schools that are built within 120 feet of the H-1 Freeway will not satisfy the FHWA maximum exterior Leq noise limit of 67 dBA, even if noise mitigation is implemented.

To limit the noise impact on the project, the 120 foot buffer zone is best suited for structures that are less sensitive to noise, such as commercial and light industrial uses. The FHWA noise criterion is less stringent for commercial and light industrial uses. However, even for these uses located within 120 feet from the H-1 Freeway, noise mitigation will be needed to meet the FHWA maximum exterior Leq noise limit of 72 dBA.

Although the FHWA criteria is not a regulatory requirement for this project, as it has no authority to enforce land use, its noise limit criteria is recommended by the FHWA to be used as a guideline for consideration of land use and the impact of traffic noise.

Noise Prediction Locations E and F - Road B and East-West Road

The Ho'opili development will provide single and multi-family housing, schools, and commercial businesses, all which will create vehicular traffic

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on minor roadways in the project area. Noise levels due to vehicular traffic were predicted for locations 25 feet from Roads B and East-West Road, noise prediction location E and F, respectively, and are below the FHWA maximum noise limit of 67 dBA.

Noise Prediction Location G - Fort Weaver/Kunia Road

Future year traffic projections show that the FHWA maximum noise limit of 67 dBA will be satisfied for schools that are built on the project site more than 40 feet from the EOP of Fort Weaver/Kunia Road.

Commercial areas located adjacent to Fort Weaver/Kunia Road are not expected to experience traffic noise levels that exceed the FHWA maximum noise limit of 72 dBA.

5.3.3 Effect of Rail Transit on Vehicular Traffic Noise

The vehicular traffic noise analysis for future year 2030 projections with the "Build" condition under Scenario A (with Transit) was compared to the Scenario B (without Transit) condition in order to evaluate the effect of the proposed high capacity transit service between Kapolei and Ala Moana Shopping Center. Rows "i" and "f" of Tables 5 and 6, respectively, show the change in noise level due to the proposed transit system. As shown in the tables, there is not a significant difference in traffic noise due to the addition of transit in the area.

5.4 Compliance with EPA and HUD Noise Guidelines

The results from the long-term noise measurements conducted at the proposed Ho'opili site show calculated day-night levels, L_{dn}, that vary between 48 dBA and 74 dBA, as shown in Table 3. As described in the section above, noise levels at the proposed project site are predicted to increase due to the projected increase in vehicular traffic along all roadways. Day-night noise levels are expected to exceed the HUD noise guidelines, which state an exterior design goal of $L_{dn} \leq 65$ dBA, for homes adjacent to the following roadways:

- Within 100 feet from Fort Weaver Road
- Within 125 feet from Farrington Highway
- Within 350 feet from the H-1 Freeway
- Within 25 feet from any minor roadway within the project site, e.g., 1st Ave, A Street, as well as Old Fort Weaver Road.

Traffic noise mitigation measures should be considered to reduce the aforementioned setback distances or to satisfy HUD noise guidelines within the setbacks. Traffic noise mitigation options such as noise barrier walls are discussed in detail in section 6.3.2 below.

It is important to note that the HUD and EPA noise guidelines are design goals and not enforceable regulations, although the HUD noise guidelines must be satisfied for projects involving HUD or federal financing. However, these guidelines and design goals are useful tools for assessing the noise environment.

5.5 Compliance with FAA and HDOT Airports Division Guidelines

The Ho'opili project site is outside of the 55 L_{dn} noise contours of both Honolulu International Airport and Kalaeloa Airport. Therefore, the project will not be impacted by aircraft noise. However, aircraft flyovers may be audible at the project site at times. These flyovers should be infrequent, and therefore, should not significantly impact the proposed development.

5.6 Honolulu High Capacity Transit Project and Compliance with FTA Guidelines

The City and County of Honolulu, Department of Transportation Services has evaluated alternatives for a high capacity transit service between Kapolei and Ala Moana Shopping Center. The most current alignment alternative runs along Farrington Highway and the proposed North-South Road and may include more than one station in the vicinity of the Ho'opili project site. A complete description of the most recent alignment and current planning documents can be found on the Honolulu High Capacity Transit Project website [Reference 15]. Typical sound exposure levels of various transit systems are shown in Table 7.

The day-night level, L_{dn}, along Farrington Highway is estimated to be 64 dBA at the project site due to increased traffic noise levels, not including rail transit noise. The FTA noise impact criteria shown in Figure 3 shows that an impact will occur if the rail transit project noise exceeds 60 dBA and a severe impact will occur if the transit project noise exceeds 66 dBA. This means the overall noise level increase of 1 dB due to the transit line will become noticeable to residents closest to the transit line. Residents will likely complain if the overall noise levels increase by more than 4 dB.

5.7 Compliance with State of Hawaii BOE Noise Guidelines

The State of Hawaii, Board of Education (BOE) Policy 6700 [Reference 10] requires that air conditioning be installed for schools exposed to an exterior noise level of L_{10}=65dBA. There are 5 schools planned within the Ho'opili project site. Most schools sites will experience L_{10} less than 65 dBA if they are located adjacent to minor roadways such as B Street and East-West Road. The school site located adjacent to Fort Weaver/Kunia Road and the H-1 Freeway and the school site adjacent to Farrington Highway are both expected to exceed the exterior noise BOE Policy 6700 of L_{10}=65dBA unless traffic noise mitigation is included. Noise mitigation options are discussed in detail in Section 6.6.

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6.0 NOISE MITIGATION

6.1 Mitigation of Construction Noise

In cases where construction noise exceeds, or is expected to exceed the State's "maximum permissible" property line noise levels [Reference 1], a permit must be obtained from the State DOH to allow the operation of vehicles, cranes, construction equipment, power tools, etc., which emit noise levels in excess of the "maximum permissible" levels.

In order for the State DOH to issue a construction noise permit, the Contractor must submit a noise permit application to the DOH, which describes the construction activities for the project. Prior to issuing the noise permit, the State DOH may require action by the Contractor to incorporate noise mitigation into the construction plan. The DOH may also require the Contractor to conduct noise monitoring or community meetings inviting the neighboring residents and business owners to discuss construction noise. The Contractor should use reasonable and standard practices to mitigate noise, such as using mufflers on diesel and gasoline engines, using properly tuned and balanced machines, etc. However, the State DOH may require additional noise mitigation, such as temporary noise barriers, or time of day usage limits for certain kinds of construction activities.

Specific permit restrictions for construction activities [Reference 1] are:

> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels ... before 7:00 a.m. and after 6:00 p.m. of the same day, Monday through Friday."
>
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels... before 9:00 a.m. and after 6:00 p.m. on Saturday."
>
> "No permit shall allow any construction activities which emit noise in excess of the maximum permissible sound levels on Sundays and on holidays."

The use of hoe rams and jack hammers 25 lbs. or larger, high pressure sprayers, chain saws, and pile drivers are restricted to 9:00 a.m. to 5:30 p.m., Monday through Friday. In addition, construction equipment and on-site vehicles or devices whose operations involve the exhausting of gas or air, excluding pile hammers and pneumatic hand tools weighing less than 15 pounds, must be equipped with mufflers [Reference 1].

The DOH noise permit does not limit the noise level generated at the construction site, but rather the times at which noisy construction can take place. Therefore, noise mitigation for construction activities should be addressed using project management, such that the time restrictions within the DOH permit are followed.

Temporary noise mitigation measures will be required if construction activities occur in the vicinity of the schools. Construction and/or occupancy of the schools should occur after other construction activities near the school sites are completed.

6.2 Mitigation of the Ho'opili Development Noise

The design of the new development should give consideration to controlling the noise emanating from stationary mechanical equipment so as to comply with the State Department of Health *Community Noise Control* rules [Reference 1]. In order for the commercial areas to be compatible with the adjacent residential areas, noise mitigation measures should be implemented. Typical noise mitigation for stationary equipment such as air-conditioning and ventilation equipment, refrigerators, compressors, etc, includes mufflers, silencers, acoustical enclosures, noise barrier walls, etc. However, other noise sources may include non-stationary equipment such as trucks loading and unloading supplies. Additional light industrial and commercial noise sources may include ambulance sirens and backup alarms on trucks and forklifts, which are exempt from DOH noise regulations. Consideration could also be given to the layout of the commercial areas to meet DOH noise regulations and reduce the noise impact. For example, noisier activities, such as traffic access and loading areas, should be located away from adjacent residential areas. Enclosed mechanical rooms may be required for some equipment.

Restrictions may need to be placed on all commercial uses allowed in the commercial areas in order to strictly control development of potential noise producing industries. For example, sale and lease documents for the commercial property should disclose and emphasize the significance of the DOH noise regulations with respect to the abutting residential areas. With respect to mixed zoning districts, the DOH regulations specifies that the primary land use designation shall be used to determine the applicable zoning district class and the maximum permissible sound level. However, zoning district class B includes commercial, business, multi-family dwellings, and apartments with the corresponding maximum permissible sound level listed in Figure 1.

6.3 FHWA Traffic Noise Mitigation

Vehicular traffic noise from Farrington Highway, Fort Weaver Road, and the H-1 Freeway may significantly impact the proposed development unless noise mitigation is considered.

6.3.1 Mitigation Through Setbacks or Buffer Zones

According to the FHWA's Highway Traffic Noise Analysis and Abatement Policy and Guidance [Reference 15], "the FHWA encourages State and local governments to practice compatible land use planning and control in the vicinity of highways. Local governments should use their power to regulate land development in such a way that noise-sensitive

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land uses are either prohibited from being located adjacent to a highway, or that the developments are planned, designed, and constructed in such a way that noise impacts are minimized." Although the FHWA criteria is not a regulatory requirement for this project, as it has no authority to enforce land use, its noise limit criteria is recommended by the FHWA to be used as a guideline for consideration of land use and the impact of traffic noise. The following setback distances are recommended to minimize traffic noise impact and are based on calculated traffic noise levels and compliance with the FHWA's maximum exterior L_{eq} noise limit of 67 dBA for homes, parks, and schools and 72 dBA for commercial areas.

Fort Weaver Road

Parks constructed adjacent to Fort Weaver Road should be at least 70 feet from the edge of pavement so as not to exceed the FHWA's maximum exterior noise limit. The use of parking lots as noise buffer zones is recommended.

Farrington Highway

Residences and schools constructed on parcels that border Farrington Highway should be at least 80 feet from the edge of pavement so as not to exceed the FHWA's maximum exterior L_{eq} noise limit of 67 dBA. Any homes within 80 feet of Farrington Highway will require noise mitigation, as discussed in Section 6.3.2, to meet the criteria.

H-1 Freeway

Vehicular traffic noise from the H-1 Freeway will significantly impact the proposed development. The calculated traffic noise levels show that residences and schools constructed on parcels within 120 feet from the H-1 Freeway will exceed the FHWA's maximum exterior L_{eq} noise limit, even with some form of traffic noise mitigation. To limit the noise impact on the project, the 120 foot buffer zone is best suited for structures that are less sensitive to noise, such as commercial and light industrial uses. The layout of these buildings should be carefully designed to block or shield adjacent residential buildings from freeway noise. Commercial areas constructed within 120 feet from the H-1 Freeway will require noise mitigation to meet the FHWA criteria.

6.3.2 Additional Noise Mitigation Options

A comprehensive traffic noise and barrier analysis using roadway layout data and the FHWA Traffic Noise Model Software was not performed. The guidelines listed below are general in nature and should be applied where residential housing, schools, parks, and commercial areas are constructed within the setback limits listed above and noise mitigation

becomes necessary. The following are effective noise mitigation measures.

- Construct barrier walls and/or earth berms along roadways.
- Air-condition buildings instead of relying on natural ventilation.
- Acoustically soften interior spaces by the addition of thick carpeting with a padding underlayment, an acoustical tile ceiling, louvered closet doors, etc.
- Use exterior wall constructions which exhibit high noise reductions.

Typical exterior-to-interior noise reductions for naturally ventilated homes, i.e., with open windows, are approximately 9 dB. Adding absorption to interior spaces, (acoustically softening), can further reduce the noise levels 1 to 5 dB, depending upon the absorption initially present, and the amount of absorption added to the space. Air-conditioned or mechanically ventilated homes will also typically exhibit higher exterior-to-interior noise reductions achieved by several types of building constructions. Estimating the noise reduction provided by a barrier, however, is more difficult to generalize. Factors such as distances to roadways and setbacks, intervening ground conditions, barrier construction, barrier height, roadway elevations, etc., will determine the noise reduction afforded by a traffic noise barrier. In general, a 5 to 10 dB reduction can be expected.

6.4 Mitigation of Aircraft Noise

The Ho'opili project site is well outside the L_{dn} 55 dBA noise contour. Therefore, noise mitigation to attenuate aircraft noise is not necessary.

6.5 Mitigation of Rail Transit Noise

The FTA's impact assessment report has identified appropriate "screening" distances, i.e. minimum setback distances, within which a transit project has little possibility of creating a noise impact. The screening distances for various fixed guideway systems and facilities are listed in Table 8.

If a transit system noise impact has been determined, noise mitigation may be required. The City and County of Honolulu is currently developing an Environmental Impact Statement for the proposed transit system. We assume that transit noise mitigation measures will be addressed in the EIS.

6.6 Board of Education Noise Mitigation

6.6.1 Proposed H-1/Kunia School Site

Exterior noise levels at the school site located adjacent to the H-1 Freeway and Fort Weaver/Kunia Road will exceed the BOE Policy 6700 noise limit

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of L_{10} = 65 dBA. The BOE policy requires that air conditioning be provided for this school in order to reduce the impact of traffic noise on the school.

Furthermore, the layout and construction of the school should be carefully designed such that exterior noise will not disturb learning activities and interfere with speech intelligibility. The following design parameters should be considered during the design phase of the school:

- To reduce traffic noise at the school site, an earthen berm or noise barrier walls should be included in the design of the new school.
- Noise buffer zones should be provided between the roadway and the noise sensitive school buildings. Parking lots should be located in this noise buffer zone.
- The exterior shell of the school should be constructed with materials such that interior noise levels are reduced to 50 dBA or less. Rooms facing the major roadways should not have operable windows and may require sound rated or double glazed windows.
- Arrange the rooms and buildings such that noise sensitive classrooms, libraries, lecture halls, offices, and all other rooms used for speech are buffered from traffic noise by rooms with noisier activities such as the gymnasium, cafeteria, shop, music.
- The school building should be used as a noise barrier to athletic fields or other school activities that take place outdoors.

6.6.2 Proposed Farrington School Site

Exterior noise levels at the school site located adjacent to Farrington Highway will exceed the BOE Policy 6700 noise limit of L_{10} = 65 dBA. The FHWA noise limit of 67 dBA will also be exceeded. In order to comply with the BOE Policy, one of the following options are necessary:

- As required by the BOE, provide air conditioning to the school facility. A substantial exterior shell construction may also be required to reduce interior noise levels to 50 dBA or less.
- Provide noise barrier walls along Farrington Highway to reduce the exterior noise levels at the school site.

6.6.3 Other School Sites

The three remaining school sites will not require noise mitigation.

REFERENCES

1. Chapter 46, *Community Noise Control*, Department of Health, State of Hawaii, Administrative Rules, Title 11, September 23, 1996.
2. *Department of Transportation, Federal Highway Administration Procedures for Abatement of Highway Traffic Noise*, Title 23, CFR, Chapter 1, Subchapter J, Part 772, 38 FR 15953, June 19, 1973; Revised at 47 FR 29654, July 8, 1982.
3. *Federal Highway Administration's Traffic Noise Model*, FHWA-RD-77-108; U.S. Department of Transportation, December 1978.
4. *Noise Analysis and Abatement Policy*, Department of Transportation, Highways Division, State of Hawaii, June 1977.
5. *Toward a National Strategy for Noise Control*, U.S. Environmental Protection Agency, April 1977.
6. *Department of Housing and Urban Development Environmental Criteria and Standards*, Title 24, CFR, Part 51, 44 FR 40860, July 12, 1979; Amended by 49 FR 880, January 6, 1984.
7. *FAA Regulations on Airport Noise Compatibility Planning Programs*, Code of Federal Regulations, Title 14, Chapter 1, Subchapter 1, Part 150; Issued by 49 FR 49269, December 18, 1984; corrected by 50 FR 5063, February 6, 1985; amended by 53 FR 8723, March 16, 1988; corrected by 53 FR 9726, March 24, 1988.
8. *Honolulu International Airport Master Plan Update and Noise Compatibility Program*, State of Hawaii Department of Transportation, Airports Division, Vol. 2, December 1989.
9. *Transit Noise and Vibration Impact Assessment*, Office of Planning, Federal Transit Administration, April 1995.
10. *Policies and Standards for School Facilities Design*, Board of Education, Policy 6700, Appendix A, Acoustical and Environmental Control, March 1995.
11. *Kalaeloa Airport Master Plan*, State of Hawaii Department of Transportation, Airports Division, November 1998.
12. *Federal Highway Administration's Traffic Noise Model Look-up Tables Software*, Ver. 2.5; U.S. Department of Transportation, December 17, 2004.
13. *Traffic Impact Analysis Report - Ho'opili*, Wilbur Smith Associates, December, 2007.
14. Honolulu High Capacity Transit Corridor Project, www.honolulutransit.org.
15. *Highway Traffic Noise Analysis and Abatement Policy and Guidance*, US Department of Transportation Federal Highway Administration, June 1995.

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TABLE 1:
FAR Part 150 Recommendations for Land Use Compatibility in Yearly Day-Night Average Sound Levels

TYPE OF LAND USE	Yearly Day-Night Average Sound Level (L_{dn})					
	< 65	65-70	70-75	75-80	80-85	> 85
RESIDENTIAL:						
Residential (except mobile homes & transient lodgings)	Y	N(1)	N(1)	N	N	N
Mobile home parks	Y	N	N	N	N	N
Transient lodgings	Y	N(1)	N(1)	N(1)	N	N
PUBLIC USE:						
Schools	Y	N(1)	N(1)	N	N	N
Hospitals and nursing homes	Y	25	30	N	N	N
Churches, auditoriums, and concert halls	Y	25	30	N	N	N
Government services	Y	Y	25	30	N	N
Transportation	Y	Y	Y(2)	Y(3)	Y(4)	Y(4)
Parking	Y	Y	Y(2)	Y(3)	Y(4)	N
COMMERCIAL USE:						
Offices, business and professional	Y	Y	25	30	N	N
Wholesale/Retail:(bldg. Mater., hardware, & farm equip.)	Y	Y	Y(2)	Y(3)	Y(4)	N
Retail trade – general	Y	Y	25	30	N	N
Utilities	Y	Y	Y(2)	Y(3)	Y(4)	N
Communication	Y	Y	25	30	N	N
MANUFACTURING AND PRODUCTION:						
Manufacturing, general	Y	Y	Y(2)	Y(3)	Y(4)	N
Photographic and optical	Y	Y	25	30	N	N
Agriculture (except livestock) and forestry	Y	Y(6)	Y(7)	Y(8)	Y(8)	Y(8)
Livestock farming and breeding	Y	Y(6)	Y(7)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL USE:						
Outdoor sports arenas and spectator sports	Y	Y(5)	Y(5)	N	N	N
Outdoor music shells, amphitheaters	Y	N	N	N	N	N
Nature exhibits and zoos	Y	Y	N	N	N	N
Amusements, parks, resorts and camps	Y	Y	Y	N	N	N
Golf courses, riding stables and water recreation	Y	Y	25	30	N	N

Note: Numbers in parentheses refer to the following notes.

(1) Where the community determines that residential or school uses must be allowed, measures to achieve outdoor-to-indoor Noise Level Reduction (NLR) of at least 25 dB and 30 dB should be incorporated into building codes and be considered in individual approvals. Normal residential construction can be expected to provide a NLR of 20 dB, thus, the reduction requirements are often stated as 5, 10, or 15 dB over standard construction and normally assume mechanical ventilation and closed windows year round. However, the use of NLR criteria will not eliminate outdoor noise problems.

(2) Measures to achieve NLR 25 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(3) Measures to achieve NLR 30 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(4) Measures to achieve NLR 35 must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(5) Land use compatible provided special sound reinforcement systems are installed.

(6) Residential buildings require a NLR of 25.

(7) Residential buildings require a NLR of 30.

(8) Residential buildings are not permitted.

Abbreviations:

Y(Yes) = Land Use and related structures compatible w/o restrictions.

N(No) = Land Use and related structures are not compatible and should be prohibited.

NLR = Noise Level Reduction (outdoor-to-indoor) to be achieved through incorporation of noise attenuation into the design and construction of the structure.

25, 30, or 35 = Land use and related structures general compatible; measures to achieve NLR of 25, 30, or 35 dB must be incorporated into design and construction of structures.

Regulatory Note.

The designations contained in this table do not constitute a Federal determination that any use of land covered by the program is acceptable or unacceptable under Federal, State, or local law. The responsibility for determining the acceptable and permissible land uses and the relationship between specific properties and specific noise contours rests with the local authorities. FAA determinations under Part 150 are not intended to substitute federally determined land uses for those determined to be appropriate by local authorities in response to locally determined needs and values in achieving noise compatible land uses.

Source: FAR Part 150, Appedix A, Table 1. "Land Use Compatibility with Yearly Day-Night Average Sound Levels."

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TABLE 2:
State Department of Transportation Airports Division Recommendations for Local Land Use Compatibility in Yearly Day-Night Average Sound Levels (Ldn)

TYPE OF LAND USE	Yearly Day-Night Average Sound Level (L_{dn})					
	< 60	60-65	65-70	70-75	75-80	80-85
RESIDENTIAL:						
Low density residential, resorts, & hotels (w/ outdoor fac)	Y(a)	N(b)	N	N	N	N
Low density apartment w/ moderate outdoor use	Y	N(b)	N	N	N	N
High density apartment with limited outdoor use	Y	N(b)	N(b)	N	N	N
Transient lodgings (w/limited outdoor use)	Y	N(b)	N(b)	N	N	N
PUBLIC USE:						
Schools, day care centers, libraries, and churches	Y	N(c)	N(c)	N(c)	N	N
Hospitals, nursing homes, clinics, and health facilities	Y	Y(d)	Y(d)	Y(d)	N	N
Indoor auditoriums, and concert halls	Y(c)	Y(c)	N	N	N	N
Government services and offices serving the public	Y	Y	Y(d)	Y(d)	N	N
Transportation and parking	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
COMMERCIAL USE:						
Offices - government, business and professional	Y	Y	Y(d)	Y(d)	N	N
Wholesale/Retail: bldg. Mater., hardware, & heavy equip	Y	Y	Y(d)	Y(d)	Y(d)	Y(d)
Airport businesses - car rental, ticketing, lei stands, etc	Y	Y	Y(d)	Y(d)	N	N
Retail trade, restaurants, shp. Centers, financial inst., etc	Y	Y	Y(d)	Y(d)	N	N
Power plants, sweage treatment plants, & base yards	Y	Y	Y(d)	Y(d)	Y(d)	N
Studios w/o outdoor sets, broadcasting & Production fac	Y(c)	Y(c)	N	N	N	N
MANUFACTURING AND PRODUCTION:						
Manufacturing, general	Y	Y	Y(d)	Y(d)	Y(d)	N
Photographic and optical	Y	Y	Y(d)	Y(d)	N	N
Agriculture (except livestock) and forestry	Y	Y(e)	Y(e)	Y(e)	Y(e)	Y(e)
Livestock farming and breeding	Y	Y(e)	Y(e)	N	N	N
Mining and fishing, resource production and extraction	Y	Y	Y	Y	Y	Y
RECREATIONAL USE:						
Outdoor sports arenas and spectator sports	Y	Y(f)	Y(f)	N	N	N
Outdoor music shells, amphitheaters	Y(f)	N	N	N	N	N
Nature exhibits and zoos, neighborhood parks	Y	Y	Y	N	N	N
Amusements, beach parks, active playgrounds, etc	Y	Y	Y	Y	N	N
Public golf courses, riding stables, cemeteries, gardens, etc	Y	Y	N	N	N	N
Professional/resort sports facil., media event facil., etc	Y(f)	N	N	N	N	N
Extensive natural wildlife and recreation areas	Y(f)	N	N	N	N	N

Note: Letters in parentheses refer to the following notes.

(a) A noise level of 60 L_{dn} does not eliminate all risks of adverse noise impacts from aircraft noise. However, the 60 L_{dn} planning level has been selected by the State Airports Division as an appropriate compromise between the minimal risk of level of 55 L_{dn} and the significant risk level of 65 L_{dn}.

(b) Where the community determines that these uses should be allowed, Noise Level Reduction (NLR) measures to achieve interior levels of 45 L_{dn} or less should be incorporated into building codes and be considered in individual approvals. Normal local construction employing natural ventilation can be expected to provide an average NLR of approximately 9 dB. Total closure plus air conditioning may be required to provide additional outdoor-to-indoor NLR, but will not eliminate outdoor noise problems.

(c) Because the L_{dn} noise descriptor system represents a 24-hour average of individual aircraft noise events, each of which can be unique in respect to amplitude, duration, and tonal content, the NLR requirements should be evaluated for the specific land use, interior acoustical requirements, and properties of the aircraft noise events. NLR requirements should not be based solely upon the exterior L_{dn} exposure level.

(d) Measures to achieve required NLR must be incorporated into the design and construction of portions of these buildings where the public is received, office areas, noise sensitive areas, or where the normal noise level is low.

(e) Residential buildings require NLR. Residential buildings should not be located where exterior noise is greater than 65 L_{dn}.

(f) Impact of amplitude, duration, frequency, and tonal content of aircraft noise events should be evaluated.

Abbreviations:
Y(Yes) = Land Use and related structures compatible without restrictions.
N(No) = Land Use and related structures are not compatible and should be prohibited.

Source: Airports Division, Department of Transportation, State of Hawaii

TABLE 3:
Long Term Noise Measurement Results

	AM L_{eq}	PM L_{eq}	L_{dn} (Calculated)
L1	63 - 72 dBA	59 - 72 dBA	74 dBA
L2	48 - 58 dBA	44 - 59 dBA	59 dBA
L3	40 - 60 dBA	37 - 50 dBA	53 dBA
L4	39 - 55 dBA	33 - 45 dBA	48 dBA

TABLE 4:
Vehicular Traffic Noise Analysis Constraints

Noise Prediction Location	A	B	C	D	E	F	G
Roadway	Old Fort Weaver	Fort Weaver	Farrington	H-1	B Street	East-West	Kunia
Distance to EOP+ (existing) ft.	25	85	90	120	N/A	N/A	N/A
Distance to EOP (future) ft.	25	70*	80*	120	25	25	40
Total Lanes (existing)	2	4	2	6	N/A	N/A	N/A
Total Lanes (2030)	2	6	4	6	2	2	4
Speed Limit (existing) mph	25	45	35	60	N/A	N/A	N/A
Speed Limit (2030) mph	30	40	40	60	30	40	40

Notes:
+ EOP - Edge-of-Pavement
* Future widening of the roadway will result in a reduced distance between the roadway and the prediction location.

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TABLE 5:
Predicted Traffic Noise Levels With and Without the Project and Resulting Increases Due to the Project at Locations A, B, C, and D[*]

Noise levels shown in the table are based on peak-hour traffic volumes, and are expressed in A-weighted decibels (dBA).

Row ID	Traffic Analysis Conditions	Location A[*]		Location B[*]		Location C[*]		Location D[*]	
		AM	PM	AM	PM	AM	PM	AM	PM
A	Existing (Calculated)	58.6	62.7	66.0	66.3	61.6	59.8	76.8	75.5
B	Future Without Project (2030)	57.3	59.7	65.0	65.3	61.6	61.8	79.1	77.7
C	Future With Project Scenario A (w Transit) (2030)	65.1	63.0	65.3	66.3	66.1	66.1	79.6	78.3
D	Future With Project Scenario B (wo Transit) (2030)	64.1	62.5	65.4	66.3	67.1	66.5	79.6	78.3
B-A	Future Increase Without Project (2030)	-1.3	-3.0	-1.0	-1.0	0.0	2.0	2.3	2.2
C-A	Future Increase With Project Scenario A (2030)	6.5	0.3	-0.7	0.0	4.5	6.3	2.8	2.8
D-A	Future Increase With Project Scenario B (2030)	5.5	-0.2	-0.6	0.0	5.5	6.7	2.8	2.8
C-B	**Future Increase Due to Project Scenario A (2030)**	7.8	3.3	0.3	1.0	4.5	4.3	0.5	0.6
D-B	**Future Increase Due to Project Scenario B (2030)**	6.8	2.8	0.4	1.0	5.5	4.7	0.5	0.6
D-C	**Effect of Transit on Project**	-1.0	-0.5	0.1	0.0	1.0	0.4	0.0	0.0

Notes:
[*] The noise level calculations were based on the traffic study provided by the Traffic Consultant [Reference 12].
- Location A - 25 feet east of Old Fort Weaver Road edge-of-pavement
- Location B - 85 feet and 70 feet east of Fort Weaver Road edge-of-pavement for the existing and future conditions, respectively
- Location C -90 feet and 80 feet south of Farrington Highway edge-of-pavement for the existing and future conditions, respectively
- Location D - 120 feet south of H-1 Freeway edge-of-pavement

TABLE 6:
Predicted Traffic Noise Levels With the Project and Resulting Increases Due to the Project at Locations E, F, and G[*]

Noise levels shown in the table are based on peak-hour traffic volumes, and are expressed in A-weighted decibels (dBA).

Row ID	Traffic Analysis Conditions	Location E[*]		Location F[*]		Location G[*]	
		AM	PM	AM	PM	AM	PM
A	Existing (Measured)[†]	55.3	50.4	53.5	48.2	N/A	N/A
B	Future With Project Scenario A (w Transit) (2030)	64.9	64.6	64.3	64.8	62.3	65.8
C	Future With Project Scenario B (wo Transit) (2030)	65.4	65.4	64.5	65.5	64.0	66.2
B-A	**Future Increase Due to Project Scenario A (2030)**	9.6	14.2	10.8	16.6	N/A	N/A
C-A	**Future Increase Due to Project Scenario B (2030)**	10.1	15.0	11.0	17.3	N/A	N/A
C-B	**Effect of Transit on Project**	0.5	0.8	0.2	0.7	1.7	0.4

Notes:
[*] The noise level calculations were based on the traffic study provided by the Traffic Consultant [Reference 12].
[†] The existing noise levels at Locations E and F are based on the long-term noise measurements conducted at Locations L3 and L4.
- Location E - 25 feet west of the proposed Street B edge-of-pavement
- Location F - 25 feet west of the proposed East-West Road edge-of-pavement
- Location G - 40 feet west of Kunia Road edge-of-pavement

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TABLE 7:
Federal Transit Administration Transit System Source Reference Sound Exposure Level (SEL)

Source/Type		Reference Conditions	Reference SEL* (dBA)
Commuter Rail, At-Grade	Locomotives	Diesel-electric, 3000 hp, throttle 5	92
		Electric	90
	Cars	Ballast, welded rail	82
Rail Transit		At-grade, ballast, welded rail	82
AGT	Steel Wheel	Aerial, concrete, welded rail	80
	Rubber Tire	Aerial, concrete guideway	78
Monorail		Aerial, straddle beam	82
Maglev		Aerial, open guideway	72
Automobiles and Vans		Normal roadway surface conditions	73
City Buses		Normal roadway surface conditions	84
Commuter Buses		Normal roadway surface conditions	88
Rail System	Yards and Shops	20 train movements in peak activity hour	118
	Layover Tracks (commuter rail)	One train with diesel locomotive idling for one hour	116
Bus System	Storage Yard	100 buses accessing facility in peak activity hour	111
	Operating Facility	100 buses accessing facility, 30buses serviced and cleaned in peak activity hour	114
	Transit Center	20 buses in peak activity hour	101
Parking Garage		1000 cars in peak activity hour	92
Park and Ride Lot		12 buses, 1000 cars in peak activity hour	101

Note: Measured 50 feet from centerline of guideway/roadway for mobile sources at 50 mph; 50 feet from center of noise-generating activity for stationary sources..

Source: Chapter 5: General Noise Assessment, Table 5-1, 5-3, 5-5. *Transit Noise and Vibration Impact Assessment*, Office of Planning, Federal Transit Administration, April 1995.

TABLE 8:
Federal Transit Administration Screening Distances for Noise Assessments

Type of Project		Screening Distance* (ft)	
		Unobstructed	Intervening Buildings
Fixed Guideway Systems:			
Commuter Rail Mainline		750	375
Commuter Rail Station		450	225
Rail Transit Guideway		700	350
Rail Transit Station		200	100
Access Roads		100	50
Low-and Intermediate-Capacity Transit	Steel Wheel	200	100
	Rubber Tire	125	75
	Monorail	300	150
Yards and Shops		2000	1000
Parking Facilities		150	75
Access Roads		100	50
Ancillary Facilities			
Ventilation Shafts		200	100
Power Substations		250	125

Note: Measured from centerline of guideway/roadway for mobile sources; from center of noise-generating activity for stationary sources.

Source: Chapter 4: Noise Screening Procedure, Table 4-1. *Transit Noise and Vibration Impact Assessment*, Office of Planning, Federal Transit Administration, April 1995.

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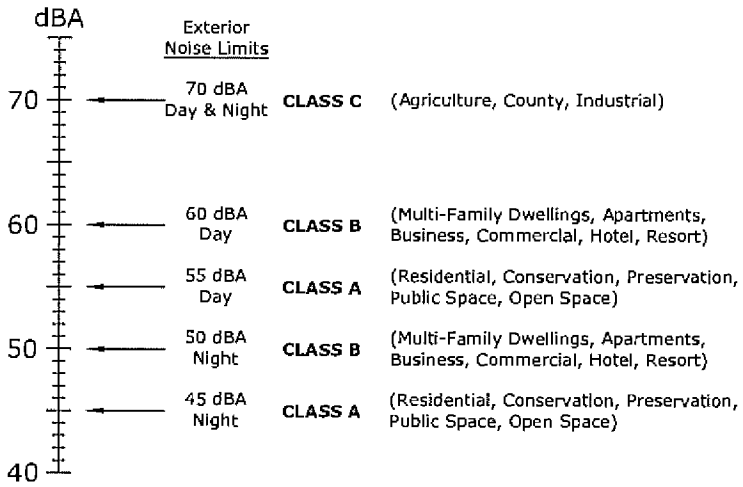
Zoning District	Day Hours (7 AM to 10 PM)	Night Hours (10 PM to 7 AM)
CLASS A Residential, Conservation, Preservation, Public Space, Open Space	55 dBA (Exterior)	45 dBA (Exterior)
CLASS B Multi-Family Dwellings, Apartments, Business, Commercial, Hotel, Resort	60 dBA (Exterior)	50 dBA (Exterior)
CLASS C Agriculture, Country, Industrial	70 dBA (Exterior)	70 dBA (Exterior)



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Hawaii Maximum Permissible Sound Levels for Various Zoning Districts

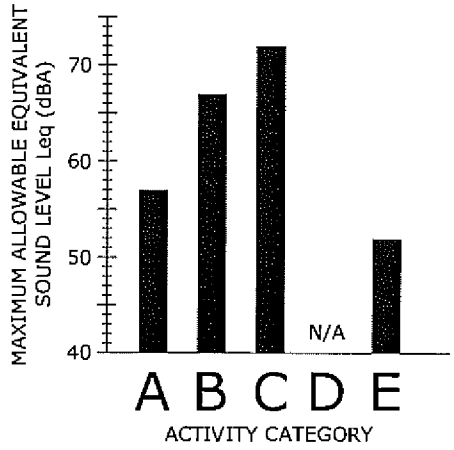
Ho'opili

Not to Scale

Date: February 2008 | Project No.: 06-34 | Drawn By: TRB

Figure No 1

ACTIVITY CATEGORY	ACTIVITY CATEGORY DESCRIPTION	MAXIMUM EQUIVALENT SOUND LEVEL $L_{eq(h)}$
A	LANDS ON WHICH SERENITY AND QUIET ARE OF EXTRAORDINARY SIGNIFICANCE AND SERVE AN IMPORTANT PUBLIC NEED AND WHERE THE PRESERVATION OF THOSE QUALITIES IS ESSENTIAL IF THE AREA IS TO CONTINUE TO SERVE ITS INTENDED PURPOSE.	57 dBA (EXTERIOR)
B	PICNIC AREAS, RECREATION AREAS, PLAYGROUNDS, ACTIVE SPORT AREAS, PARKS, RESIDENCES, MOTELS, HOTELS, SCHOOLS, CHURCHES, LIBRARIES, AND HOSPITALS.	67 dBA (EXTERIOR)
C	DEVELOPED LANDS, PROPERTIES, OR ACTIVITIES NOT INCLUDED IN ACTIVITY CATEGORIES A OR B ABOVE.	72 dBA (EXTERIOR)
D	UNDEVELOPED LAND	N/A
E	RESIDENCES, MOTELS, HOTELS, PUBLIC MEETING ROOMS, SCHOOLS, CHURCHES, LIBRARIES, HOSPITALS, AND AUDITORIUMS.	52 dBA (INTERIOR)



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Federal Highways Administration Recommended Equivalent Hourly Sound Levels Based on Land Use

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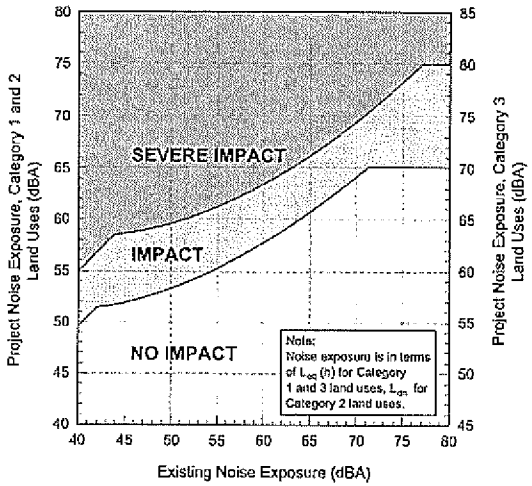
Figure No 2

AR00027770

LAND USE CATEGORY	LAND USE CATEGORY DESCRIPTION	NOISE METRIC (dBA)
1	TRACTS OF LAND WHERE QUIET IS AN ESSENTIAL ELEMENT IN THEIR INTENDED PURPOSE. THIS CATEGORY INCLUDES LANDS SET ASIDE FOR SERENITY AND QUIET, AND SUCH LAND USES AS OUTDOOR AMPHITHEATERS AND CONCERT PAVILIONS, AS WELL AS NATIONAL HISTORIC LANDMARKS WITH SIGNIFICANT OUTDOOR USE.	OUTDOOR Leq(h)
2	RESIDENCES AND BUILDINGS WHERE PEOPLE NORMALLY SLEEP. THIS CATEGORY INCLUDES HOMES, HOSPITALS AND HOTELS WHERE A NIGHTTIME SENSITIVITY TO NOISE IS ASSUMED TO BE OF UTMOST IMPORTANCE.	OUTDOOR Ldn
3	INSTITUTIONAL LAND USES WITH PRIMARILY DAYTIME AND EVENING USE. THIS CATEGORY INCLUDES SCHOOLS, LIBRARIES, AND CHURCHES WHERE IT IS IMPORTANT TO AVOID INTERFERENCE WITH SUCH ACTIVITIES AS SPEECH, MEDITATION, AND CONCENTRATION ON READING MATERIAL. BUILDINGS WITH INTERIOR SPACES WHERE QUIET IS IMPORTANT, SUCH AS MEDICAL OFFICES, CONFERENCE ROOMS, RECORDING STUDIOS AND CONCERT HALLS FALL INTO THIS CATEGORY. PLACES FOR MEDITATION OR STUDY ASSOCIATED WITH CEMETERIES, MONUMENTS, MUSEUMS. CERTAIN HISTORICAL SITES, PARKS, AND RECREATIONAL FACILITIES ARE ALSO INCLUDED.	OUTDOOR Leq(h)



Federal Transit Administration Noise Impact Criteria for Transit Projects

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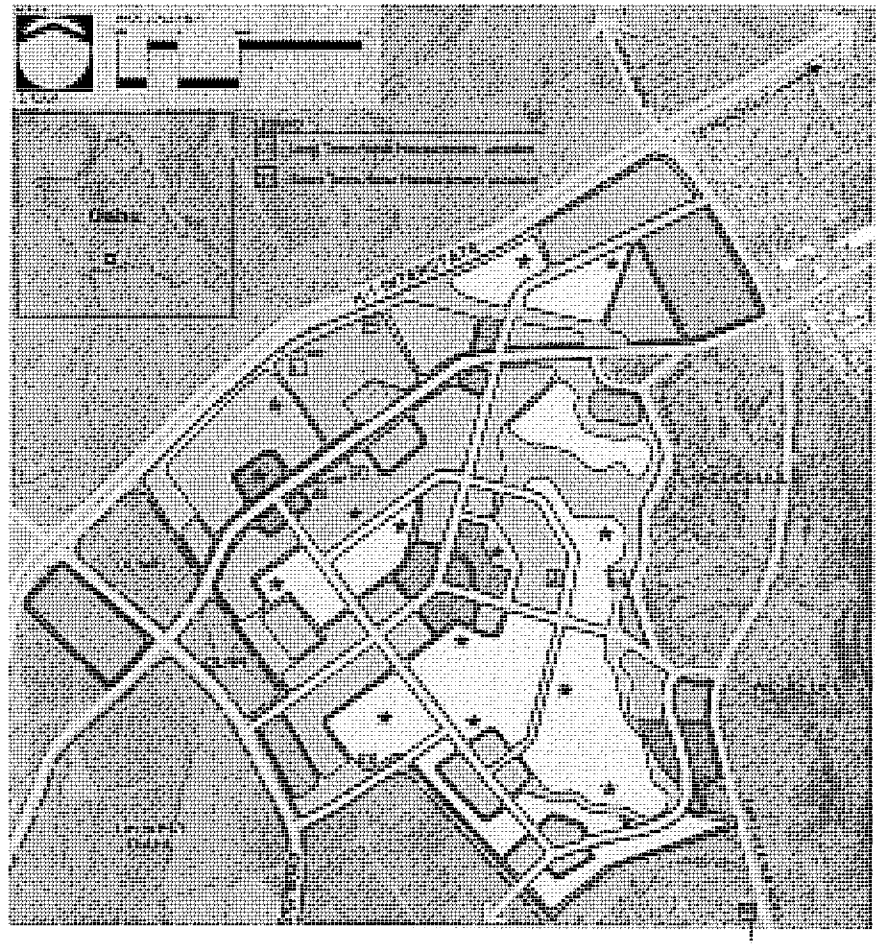
Date	Project No.	Drawn By
February 2008	06-34	DFD

Figure No 3



Project Site and Noise Measurement Locations

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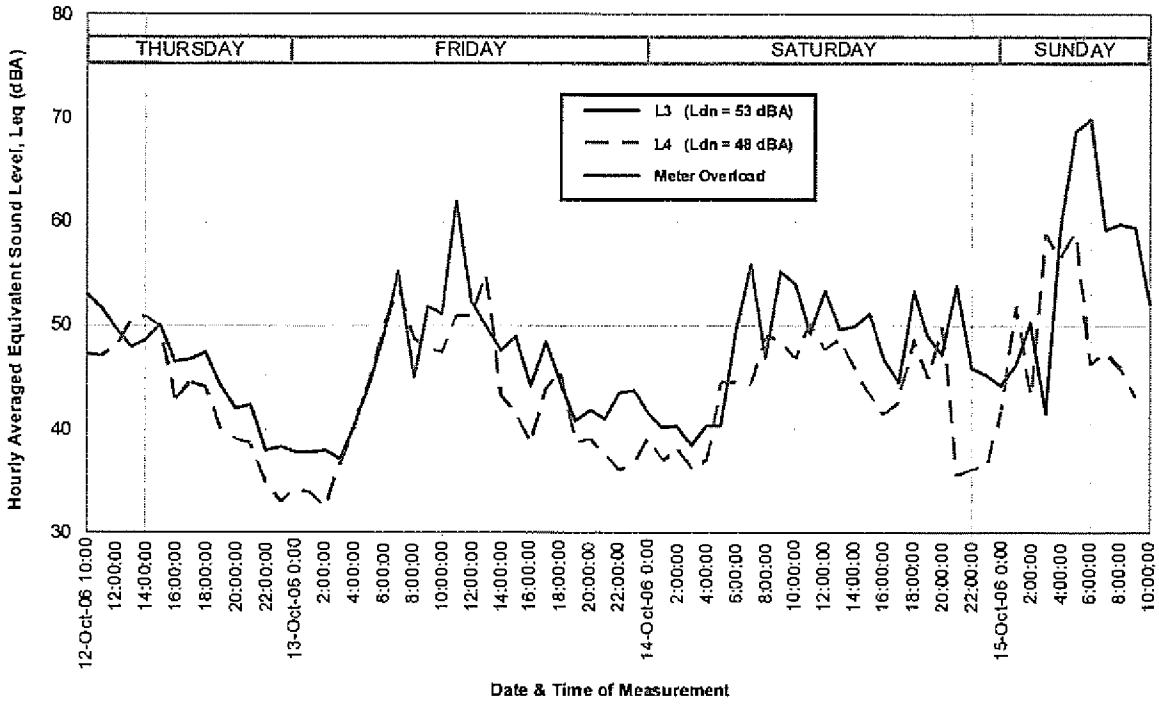
Date	Project No.	Drawn By
February 2008	06-34	DFD

Figure No 4

AR00027771



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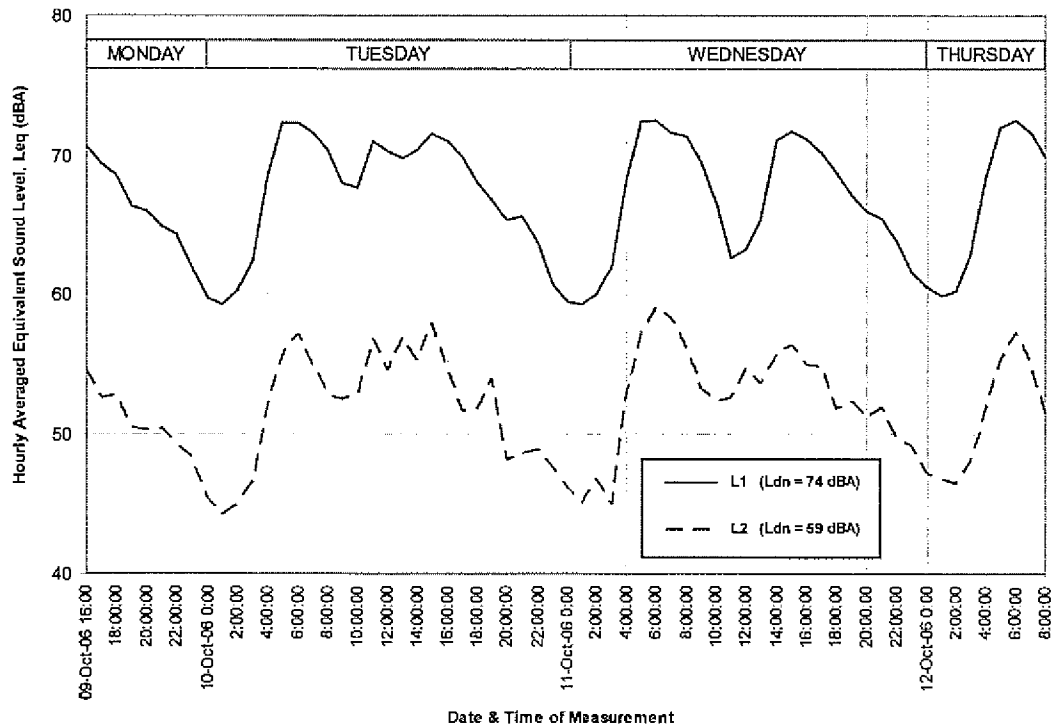
Graph of Long Term Noise Measurements (L3 and L4)

Ho'opili

Not to Scale

Date	Project No.	Drawn By
February 2006	06-34	DFD

Figure No 6



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Graph of Long Term Noise Measurements (L1 and L2)

Ho'opili

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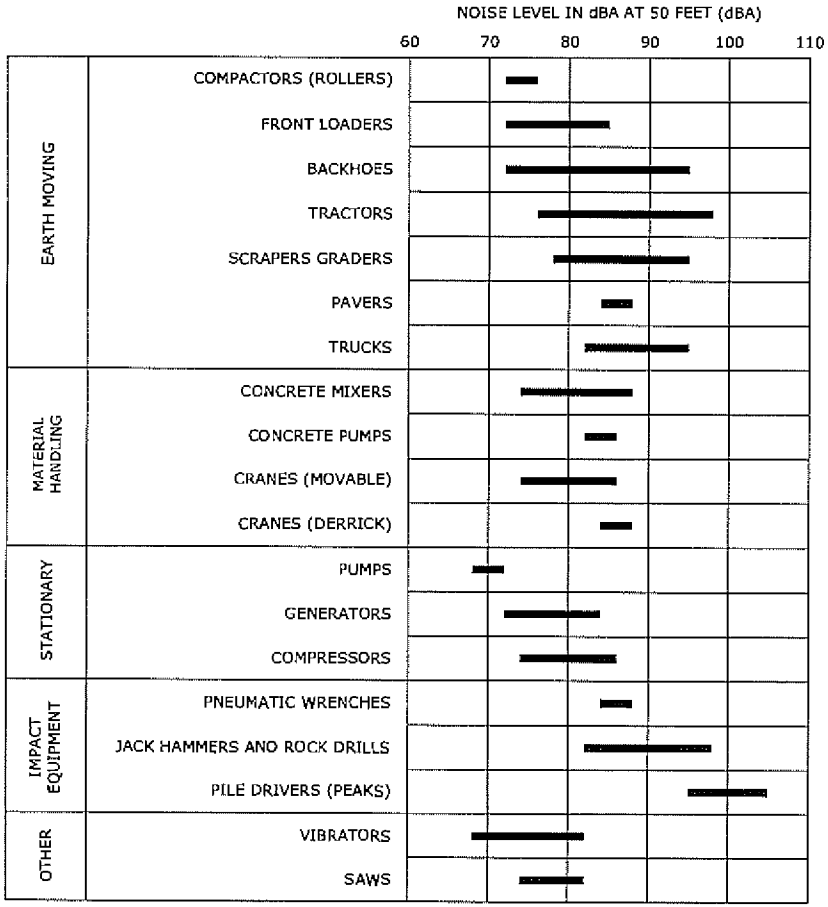
Date	Project No.	Drawn By
February 2006	06-34	DFD

Figure No 5



NOTE: BASED ON LIMITED AVAILABLE DATA SAMPLES

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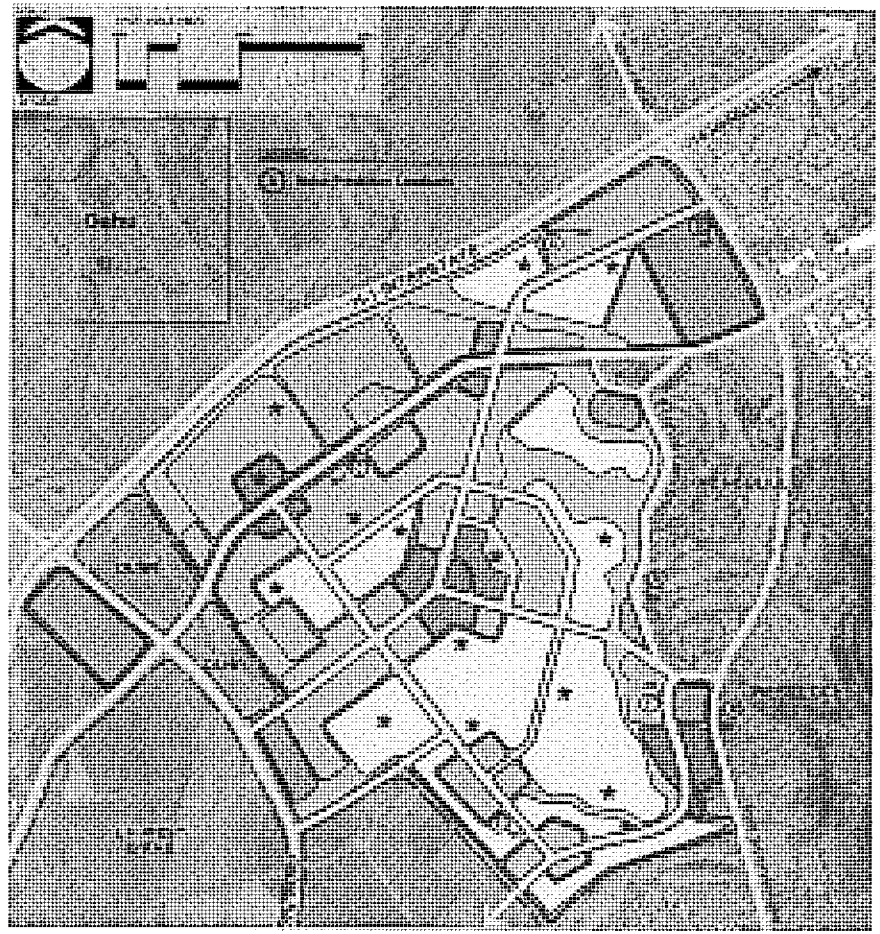
Typical Sound Levels from Construction Equipment

Ho'opili

Not to Scale

Date: February 2008 | Project No.: 06-34 | Drawn By: TRB

Figure No 7



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Noise Prediction Locations

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Figure No 8

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APPENDIX A

Acoustic Terminology

Acoustic Terminology

Sound Pressure Level

Sound, or noise, is the term given to variations in air pressure that are capable of being detected by the human ear. Small fluctuations in atmospheric pressure (sound pressure) constitute the physical property measured with a sound pressure level meter. Because the human ear can detect variations in atmospheric pressure over such a large range of magnitudes, sound pressure is expressed on a logarithmic scale in units called decibels (dB). Noise is defined as "unwanted" sound.

Technically, sound pressure level (SPL) is defined as:

$$SPL = 20 \log (P/P_{ref}) \text{ dB}$$

where P is the sound pressure fluctuation (above or below atmospheric pressure) and P_{ref} is the reference pressure, 20 μPa, which is approximately the lowest sound pressure that can be detected by the human ear. For example:

If P = 20 μPa, then SPL = 0 dB
If P = 200 μPa, then SPL = 20 dB
If P = 2000 μPa, then SPL = 40 dB

The sound pressure level that results from a combination of noise sources is not the arithmetic sum of the individual sound sources, but rather the logarithmic sum. For example, two sound levels of 50 dB produce a combined sound level of 53 dB, not 100 dB. Two sound levels of 40 and 50 dB produce a combined level of 50.4 dB.

Human sensitivity to changes in sound pressure level is highly individualized. Sensitivity to sound depends on frequency content, time of occurrence, duration, and psychological factors such as emotions and expectations. However, in general, a change of 1 or 2 dB in the level of sound is difficult for most people to detect. A 3 dB change is commonly taken as the smallest perceptible change and a 6 dB change corresponds to a noticeable change in loudness. A 10 dB increase or decrease in sound level corresponds to an approximate doubling or halving of loudness, respectively.

A-Weighted Sound Level

Studies have shown conclusively that at equal sound pressure levels, people are generally more sensitive to certain higher frequency sounds (such as made by speech, horns, and whistles) than most lower frequency sounds (such as made by motors and engines)[1] at the same level. To address this preferential response to frequency, the A-weighted scale was developed. The A-weighted scale adjusts the sound level in each frequency band in much the same manner that the

[1] D.W. Robinson and R.S. Dadson, "A Re-Determination of the Equal-Loudness Relations for Pure Tones," *British Journal of Applied Physics*, vol. 7, pp. 166 - 181, 1956. (Adopted by the International Standards Organization as Recommendation R-226.

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human auditory system does. Thus the A-weighted sound level (read as "dBA") becomes a single number that defines the level of a sound and has some correlation with the sensitivity of the human ear to that sound. Different sounds with the same A-weighted sound level are perceived as being equally loud. The A-weighted noise level is commonly used today in environmental noise analysis and in noise regulations. Typical values of the A-weighted sound level of various noise sources are shown in Figure A-1.

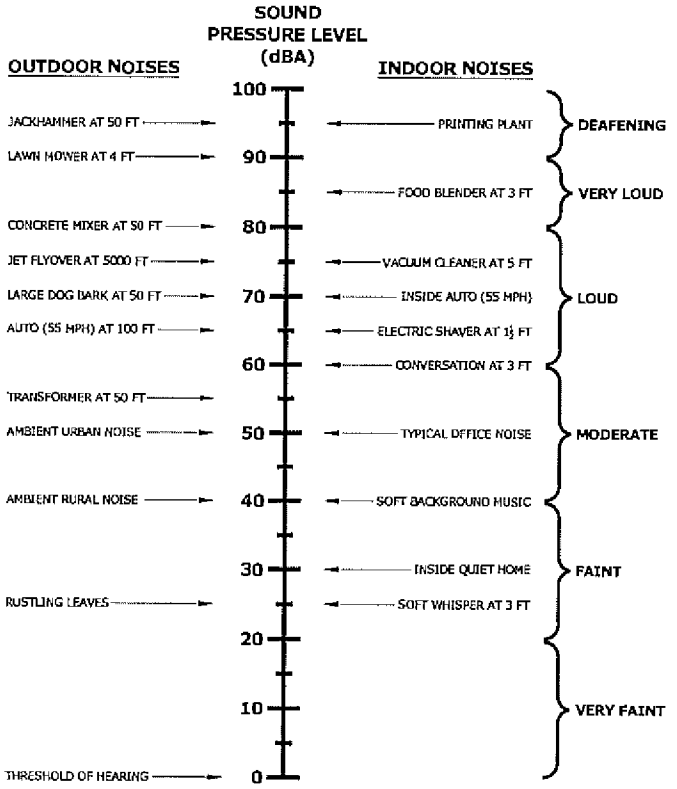

Figure A-1. Common Outdoor/Indoor Sound Levels

Equivalent Sound Level

The Equivalent Sound Level (L_{eq}) is a type of average which represents the steady level that, integrated over a time period, would produce the same energy as the actual signal. The actual *instantaneous* noise levels typically fluctuate above and below the measured L_{eq} during the measurement period. The A-weighted L_{eq} is a common index for measuring environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

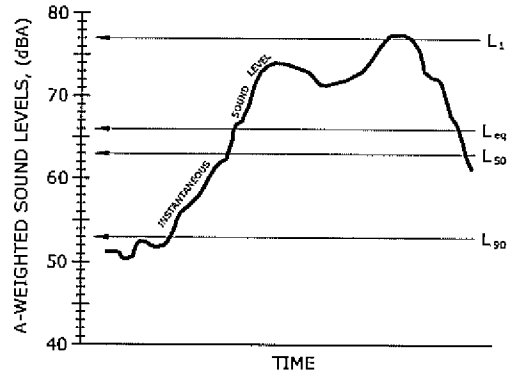

Figure A-2. Example Graph of Equivalent and Statistical Sound Levels

Statistical Sound Level

The sound levels of long-term noise producing activities such as traffic movement, aircraft operations, etc., can vary considerably with time. In order to obtain a single number rating of such a noise source, a statistically-based method of expressing sound or noise levels has been developed. It is known as the Exceedence Level, L_n. The L_n represents the sound level that is exceeded for n% of the measurement time period. For example, L_{10} = 60 dBA indicates that for the duration of the measurement period, the sound level exceeded 60 dBA 10% of the time. Typically, in noise regulations and standards, the specified time period is one hour. Commonly used Exceedence Levels include L_{01}, L_{10}, L_{50}, and L_{90}, which are widely used to assess community and environmental noise. A graphical description of the equivalent sound level is shown in Figure A-2.

Day-Night Equivalent Sound Level

The Day-Night Equivalent Sound Level, L_{dn}, is the Equivalent Sound Level, L_{eq}, measured over a 24-hour period. However, a 10 dB penalty is added to the noise levels recorded between 10 p.m. and 7 a.m. to account for people's higher sensitivity to noise at night when the background noise level is typically lower. The L_{dn} is a commonly used noise descriptor in assessing land use compatibility, and is widely used by federal and local agencies and standards organizations.

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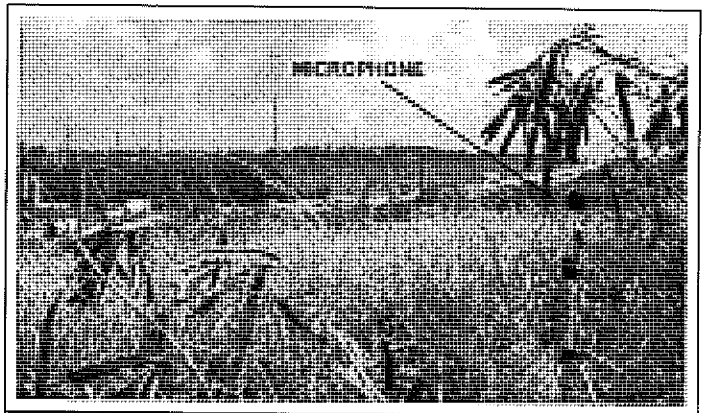
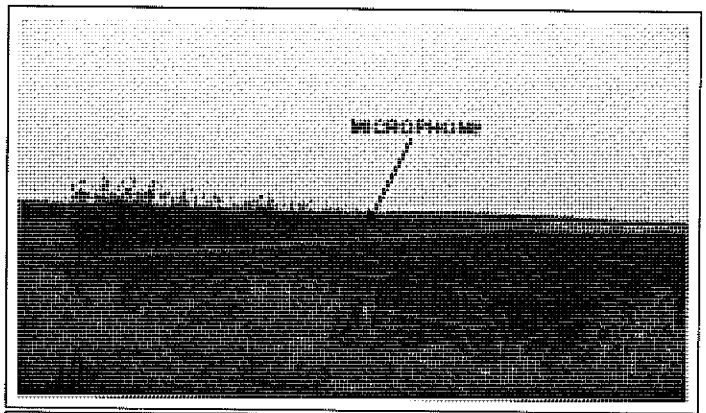
APPENDIX B

Photographs at Project Site



Location L1
Located 200 feet south of the H-1 Freeway



Location L2
Located 150 feet south of Farrington Highway

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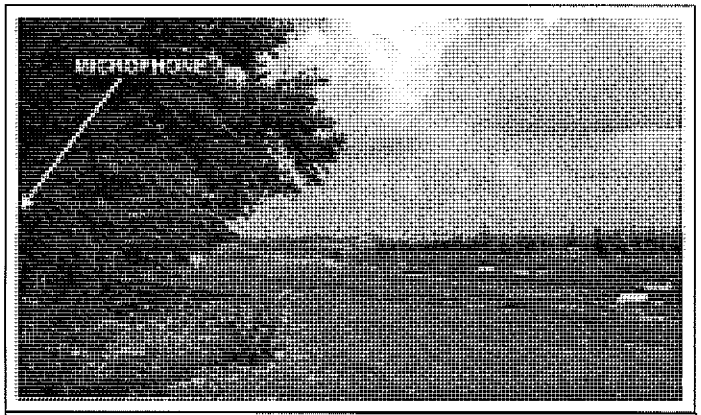
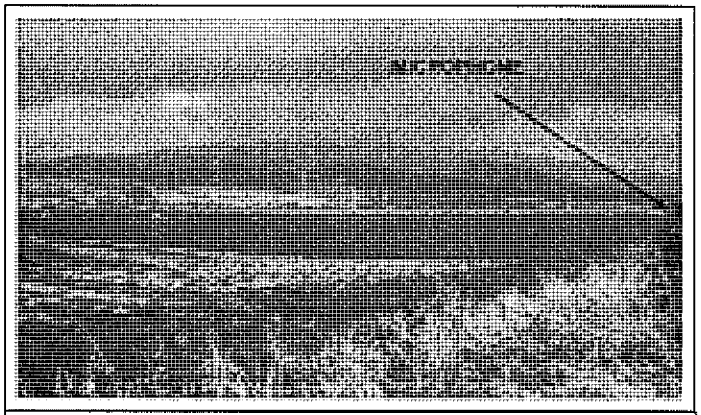


Location L3
Located at the southeastern edge of Ho'opili project site



Location L4
Located at the southwestern edge of Ho'opili project site nearby the future North-South Road

AR00027777

APPENDIX H
Air Quality Study

AIR QUALITY STUDY

FOR THE PROPOSED

HO'OPILI PROJECT

EWA, OAHU, HAWAII

Prepared for:

D.R. Horton – Schuler Division

February 2008

B.D. NEAL & ASSOCIATES

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1.0 SUMMARY

D.R. Horton-Schuler Division is proposing to develop the Ho'opili Project on approximately 1,555 acres of land at Ewa, Oahu. The proposed project will include approximately 11,750 dwelling units, 2.8 million square feet of retail/office space, and 0.9 million square feet of industrial floor area. Development of the project is expected to be completed and fully occupied by 2030. This study examines the potential short- and long-term air quality impacts that could occur as a result of construction and use of the proposed facilities and suggests mitigative measures to reduce any potential air quality impacts where possible and appropriate.

Both federal and state standards have been established to maintain ambient air quality. At the present time, seven parameters are regulated including: particulate matter, sulfur dioxide, hydrogen sulfide, nitrogen dioxide, carbon monoxide, ozone and lead. Hawaii air quality standards are comparable to the national standards except those for nitrogen dioxide and carbon monoxide which are more stringent than the national standards.

Regional and local climate together with the amount and type of human activity generally dictate the air quality of a given location. The climate of the Ewa area is very much affected by its leeward and coastal situation. Winds are predominantly trade winds from the east northeast except for occasional periods when kona storms may generate strong winds from the south or when the trade winds are weak and landbreeze-seabreeze circulations may develop. Wind speeds typically vary between about 5 and 15 miles per hour providing relatively good ventilation much of the time. Temperatures in the leeward Oahu area are generally very moderate with average daily temperatures ranging from about 65°F to 84°F.

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The extreme minimum temperature recorded at the nearby (former) Ewa Plantation is 47°F, while the extreme maximum temperature is 93°F. This area of Oahu is one of the drier locations in the state with rainfall often highly variable from one year to the next. Monthly rainfall has been measured to vary from as little as a trace to as much as 15 inches. Average annual rainfall amounts to about 21 inches with summer months being the driest.

The present air quality of the project area appears to be reasonably good based on nearby air quality monitoring data. Air quality data from the nearest monitoring stations operated by the Hawaii Department of Health suggest that all national air quality standards are currently being met, although occasional exceedances of the more stringent state standards for carbon monoxide may occur near congested roadway intersections.

If the proposed project is given the necessary approvals to proceed, it may be inevitable that some short- and/or long-term impacts on air quality will occur either directly or indirectly as a consequence of project construction and use. Short-term impacts from fugitive dust will likely occur during the project construction phase. To a lesser extent, exhaust emissions from stationary and mobile construction equipment, from the disruption of traffic, and from workers' vehicles may also affect air quality during the period of construction. State air pollution control regulations require that there be no visible fugitive dust emissions at the property line. Hence, an effective dust control plan must be implemented to ensure compliance with state regulations. Fugitive dust emissions can be controlled to a large extent by watering of active work areas, using wind screens, keeping adjacent paved roads clean, and by covering of open-bodied trucks. Other dust control measures could include limiting the area that can be disturbed at any given time and/or mulching or chemically

stabilizing inactive areas that have been worked. Paving and landscaping of project areas early in the construction schedule will also reduce dust emissions. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program. Exhaust emissions can be mitigated by moving construction equipment and workers to and from the project site during off-peak traffic hours.

After construction, motor vehicles coming to and from the proposed development could potentially result in a long-term increase in air pollution emissions in the project area. To assess the impact of emissions from these vehicles, an air quality modeling study was undertaken to estimate current ambient concentrations of carbon monoxide at roadway intersections in the project vicinity and to predict future levels both with and without the proposed project. During worst-case conditions, model results indicated that present 1-hour and 8-hour carbon monoxide concentrations in the project area are within the national ambient air quality standards, but they may occasionally exceed the more stringent state standards at some locations. In the year 2030 without the project, carbon monoxide concentrations were predicted to decrease (improve) in the project area despite the increase in traffic volumes that is expected. This is primarily due to the assumed retirement of older motor vehicles that emit more air pollution. With the project in the year 2030 and assuming that the roadway improvements recommended in the project traffic study are implemented, carbon monoxide concentrations were estimated to increase substantially at many locations in the project area. With the transit corridor alternative, the increase would be smaller at many of the locations studied. However, with or without the transit corridor, worst-case concentrations with the project should

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remain within both national and state standards through the year 2030.

Options available to mitigate long-term, traffic-related air pollution are generally to further improve roadways, to reduce traffic or to reduce individual vehicular emissions. Based on the air quality modeling results, worst case carbon monoxide concentrations in the future with the project should be lower (better) than the existing levels and within the national and state standards. Thus, implementing mitigation measures for traffic-related air quality impacts is probably unnecessary and unwarranted.

Depending on the demand levels, long-term impacts on air quality are also possible due to indirect emissions associated with a development's electrical power and solid waste disposal requirements. Quantitative estimates of these potential impacts were not made, but based on the estimated demand levels and emission rates involved, any impacts will likely be negligible.

2.0 INTRODUCTION

D.R. Horton-Schuler Division is proposing to develop the Ho'opili Project on approximately 1,555 acres of vacant lands in Ewa on the island of Oahu (see Figure 1 for project location). The project site is located adjacent to and south of the H-1 Freeway and west of Fort Weaver Road. The development will include approximately 11,750 dwelling units, 2.8 million square feet of retail/office space, and 0.9 million square feet of industrial building floor area. Construction of the project is expected to commence during 2009, and full development and occupancy is planned by 2030.

The purpose of this study is to describe existing air quality in the project area and to assess the potential short- and long-term direct and indirect air quality impacts that could result from construction and use of the proposed facilities as planned. Measures to mitigate impacts by the project are suggested where possible and appropriate.

3.0 AMBIENT AIR QUALITY STANDARDS

Ambient concentrations of air pollution are regulated by both national and state ambient air quality standards (AAQS). National AAQS are specified in Section 40, Part 50 of the Code of Federal Regulations (CFR), while State of Hawaii AAQS are defined in Chapter 11-59 of the Hawaii Administrative Rules. Table 1 summarizes both the national and the state AAQS that are specified in the cited documents. As indicated in the table, national and state AAQS have been established for particulate matter, sulfur dioxide, nitrogen dioxide, carbon monoxide, ozone and lead. The state has also set a standard for hydrogen sulfide. National AAQS are stated in terms of both primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect the public health with an "adequate margin of safety". National secondary standards, on the other hand, define levels of air quality necessary to protect the public welfare from "any known or anticipated adverse effects of a pollutant". Secondary public welfare impacts may include such effects as decreased visibility, diminished comfort levels, or other potential injury to the natural or man-made environment, e.g., soiling of materials, damage to vegetation or other economic damage. In contrast to the national AAQS, Hawaii State AAQS are given in terms of a single standard that is designed "to protect public health and welfare and to prevent the significant deterioration of air quality".

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Each of the regulated air pollutants has the potential to create or exacerbate some form of adverse health effect or to produce environmental degradation when present in sufficiently high concentration for prolonged periods of time. The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects. In the case of the short-term (i.e., 1- to 24-hour) AAQS, both national and state standards allow a specified number of exceedances each year.

The Hawaii AAQS are in some cases considerably more stringent than the comparable national AAQS. In particular, the Hawaii 1-hour AAQS for carbon monoxide is four times more stringent than the comparable national limit. The U.S. Environmental Protection Agency (EPA) is currently working on a plan to phase out the national 1-hour ozone standard in favor of the new (and more stringent) 8-hour standard.

The Hawaii AAQS for sulfur dioxide were relaxed in 1986 to make the state standards essentially the same as the national limits. In 1993, the state also revised its particulate standards to follow those set by the federal government. During 1997, the federal government again revised its standards for particulate, but the new standards were challenged in federal court. A Supreme Court ruling was issued during February 2001, and as a result, the new standards for particulate were implemented during 2005. To date, the Hawaii Department of Health has not updated the state particulate standards. In September 2001, the state

vacated the state 1-hour standard for ozone and an 8-hour standard was adopted.

4.0 REGIONAL AND LOCAL CLIMATOLOGY

Regional and local climatology significantly affects the air quality of a given location. Wind, temperature, atmospheric turbulence, mixing height and rainfall all influence air quality. Although the climate of Hawaii is relatively moderate throughout most of the state, significant differences in these parameters may occur from one location to another. Most differences in regional and local climates within the state are caused by the mountainous topography.

Hawaii lies well within the belt of northeasterly trade winds generated by the semi-permanent Pacific high pressure cell to the north and east. On the island of Oahu, the Koolau and Waianae Mountain Ranges are oriented almost perpendicular to the trade winds, which accounts for much of the variation in the local climatology of the island. The site of the proposed project is located on the Ewa Plain, which is generally leeward of the Koolau Range at an elevation of about 50 ft.

Wind frequency data for Honolulu International Airport (HIA), which is located about 7 miles to the southeast of the project site, are given in Table 2. These data can be expected to be only semi-representative of the project area due to the differences in exposure and terrain effects. Wind frequency for HIA show that the annual prevailing wind direction for this area of Oahu is east northeast. On an annual basis, 34.7 percent of the time the wind is from this direction, and more than 70 percent of the time the wind is in the northeast quadrant. Winds from the south are

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infrequent occurring only a few days during the year and mostly in winter in association with kona storms. Wind speeds average about 10 knots (12 mph) and mostly vary between about 5 and 15 knots (6 and 17 mph).

Air pollution emissions from motor vehicles, the formation of photochemical smog and smoke plume rise all depend in part on air temperature. Colder temperatures tend to result in higher emissions of contaminants from automobiles but lower concentrations of photochemical smog and ground-level concentrations of air pollution from elevated plumes. In Hawaii, the annual and daily variation of temperature depend to a large degree on elevation above sea level, distance inland and exposure to the trade winds. Average temperatures at locations near sea level generally are warmer than those at higher elevations. Areas exposed to the trade winds tend to have the least temperature variation, while inland and leeward areas often have the most. The project's inland, higher-elevation location results in a relatively moderate temperature profile compared to other coastal locations around Oahu and the state. Based on more than 50 years of data collected at the former Ewa Plantation a few miles away, average annual daily minimum and maximum temperatures in the Ewa Plain area are 65°F and 84°F, respectively [1]. The extreme minimum temperature on record is 47°F, and the extreme maximum is 93°F at this location. Temperatures at the project site can be expected to be a few degrees cooler due to the higher elevation.

Small scale, random motions in the atmosphere (turbulence) cause air pollutants to be dispersed as a function of distance or time from the point of emission. Turbulence is caused by both mechanical and thermal forces in the atmosphere. It is oftentimes measured and described in terms of Pasquill-Gifford stability class. Stability class 1 is the most turbulent and class 6 the

least. Thus, air pollution dissipates the best during stability class 1 conditions and the worst when stability class 6 prevails. In the project area, stability class 5 or 6 is generally the highest stability class that occurs, developing during clear, calm nighttime or early morning hours when temperature inversions form due to radiation cooling and mountain drainage flows. Stability classes 1 through 4 occur during the daytime, depending mainly on the amount of cloud cover and incoming solar radiation and the strength of the trade winds.

Mixing height is defined as the height above the surface through which relatively vigorous vertical mixing occurs. Low mixing heights can result in high ground-level air pollution concentrations because contaminants emitted from or near the surface can become trapped within the mixing layer. In Hawaii, minimum mixing heights tend to be high because of mechanical mixing caused by the trade winds and because of the temperature moderating effect of the surrounding ocean. Low mixing heights may sometimes occur, however, at inland locations and even at times along coastal areas early in the morning following a clear, cool, windless night. Coastal areas also may experience low mixing levels during sea breeze conditions when cooler ocean air rushes in over warmer land. Mixing heights in Hawaii typically are above 3000 feet (1000 meters).

Rainfall can have a beneficial affect on the air quality of an area in that it helps to suppress fugitive dust emissions, and it also may "washout" gaseous contaminants that are water soluble. Rainfall in Hawaii is highly variable depending on elevation and on location with respect to the trade wind. The Ewa Plain is one of the driest areas on Oahu due to its leeward and near sea level location. Average annual rainfall amounts to about 21 inches but may vary from about 10 inches during a dry year to more than 40

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inches during a wet year [1]. Most of the rainfall usually occurs during the winter months. Monthly rainfall may vary from as little as a trace to as much as 15 inches or more.

5.0 PRESENT AIR QUALITY

Present air quality in the project area is mostly affected by air pollutants from motor vehicles, industrial sources, agricultural operations and to a lesser extent by natural sources. Table 3 presents an air pollutant emission summary for the island of Oahu for calendar year 1993. The emission rates shown in the table pertain to manmade emissions only, i.e., emissions from natural sources are not included. As suggested in the table, much of the particulate emissions on Oahu originate from area sources, such as the mineral products industry and agriculture. Sulfur oxides are emitted almost exclusively by point sources, such as power plants and refineries. Nitrogen oxides emissions emanate predominantly from industrial point sources, although area sources (mostly motor vehicle traffic) also contribute a significant share. The majority of carbon monoxide emissions occur from area sources (motor vehicle traffic), while hydrocarbons are emitted mainly from point sources. Based on previous emission inventories that have been reported for Oahu, emissions of particulate and nitrogen oxides may have increased during the past several years, while emissions of sulfur oxides, carbon monoxide and hydrocarbons probably have declined.

The H-1 Freeway, which passes through the project area to the north, is a major arterial roadway that presently carries moderate to heavy levels of vehicle traffic during peak traffic hours. Emissions from motor vehicles using this roadway, primarily nitrogen oxides and carbon monoxide, will tend to be carried away from the project site by the prevailing winds.

Several sources of industrial air pollution are located in the Campbell Industrial Park, which is located at Barbers Point about 6 miles to the southwest of the project site. Industries currently operating there include the Chevron and BHP refineries, H-Power, Kalaeloa Partners, Applied Energy Services, Hawaiian Cement and others. Hawaiian Electric Company's Waiau Generating Station is located a few miles to the south at Pearl City. These industries emit large amounts of sulfur dioxide, nitrogen oxides, particulate matter, carbon monoxide and other air pollutants. Prevailing winds from the east or northeast will carry these emissions away from the project site most of the time.

Until recently, air pollution in the project area originating from agricultural sources could mainly be attributed to sugar cane operations in the Ewa area and to pineapple cultivation in the central Oahu area. Emissions from both the sugar mill and the canefield operations in the area have now been eliminated with the closure of the Oahu Sugar Company, and much of the former sugarcane lands are currently being used as pastureland or for diversified agriculture. Pineapple cultivation has been significantly reduced. Thus, air pollution from agricultural sources in the project area has been substantially reduced during the past several years.

Natural sources of air pollution emissions that also could affect the project area but cannot be quantified very accurately include the ocean (sea spray), plants (aero-allergens), wind-blown dust, and perhaps distant volcanoes on the island of Hawaii.

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The State Department of Health operates a network of air quality monitoring stations at various locations on Oahu. Each station, however, typically does not monitor the full complement of air quality parameters. Table 4 shows annual summaries of air quality measurements that were made nearest to the project area for several of the regulated air pollutants for the period 2001 through 2005. These are the most recent data that are currently available.

During the 2001-2005 period, sulfur dioxide was monitored by the State Department of Health at an air quality station located at Kapolei, which is about 2 miles southwest of the project site. Concentrations monitored were consistently low compared to the standards. Annual second-highest 3-hour concentrations (which are most relevant to the air quality standards) ranged from 12 to 28 $\mu g/m^3$, while the annual second-highest 24-hour concentrations ranged from 6 to 9 $\mu g/m^3$. Annual average concentrations were only about 1 to 2 $\mu g/m^3$. There were no exceedances of the state/national 3-hour or 24-hour AAQS for sulfur dioxide during the 5-year period.

Particulate matter less than 10 microns in diameter (PM-10) is measured at Pearl City, about 5 miles to the east of the project site. Annual second-highest 24-hour PM-10 concentrations ranged from 27 to 100 $\mu g/m^3$ between 2001 and 2005. Average annual concentrations ranged from 15 to 16 $\mu g/m^3$. One exceedance each of the 24-hour standard was reported in 2001 and 2005. These exceedances were related to fireworks activity on New Years Day.

Carbon monoxide measurements were also made at the Kapolei monitoring station. The annual second-highest 1-hour concentrations ranged from 1.6 to 2.0 mg/m^3. The annual second-highest 8-hour concentrations ranged from 0.8 to 1.8 mg/m^3. No exceedances of the state or national 1-hour or 8-hour AAQS were reported.

Nitrogen dioxide is also monitored by the Department of Health at the Kapolei monitoring station. Annual average concentrations of this pollutant ranged from 8 to 9 $\mu g/m^3$, safely inside the state and national AAQS.

The nearest available ozone measurements were obtained at Sand Island (about 11 miles southeast of the project area). The second-highest 8-hour concentrations for the period 2002 through 2005 ranged between 77 and 108 $\mu g/m^3$, which is well inside the state and federal standards. The 8-hour standard for ozone did not exist prior to 2002. Prior to 2002, the now obsolete state 1-hour standard was typically exceeded several times each year.

Although not shown in the table, the nearest and most recent measurements of ambient lead concentrations that have been reported were made at the downtown Honolulu monitoring station between 1996 and 1997. Average quarterly concentrations were near or below the detection limit, and no exceedances of the state AAQS were recorded. Monitoring for this parameter was discontinued during 1997.

Based on the data and discussion presented above, it appears likely that the State of Hawaii AAQS for sulfur dioxide, nitrogen dioxide, ozone and lead are currently being met at the project site. Concentrations of particulate matter normally comply with the standards except possibly during holiday fireworks activity. While carbon monoxide measurements at the Kapolei monitoring

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station suggest that concentrations are within the state and national standards, local "hot spots" may exist near traffic-congested intersections. The potential for this within the project area is examined later in this report.

6.0 SHORT-TERM IMPACTS OF PROJECT

Short-term direct and indirect impacts on air quality could potentially occur due to project construction. For a project of this nature, there are two potential types of air pollution emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust from vehicle movement and soil excavation; and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by lane closures of adjacent roadways.

Fugitive dust emissions may arise from the grading and dirt-moving activities associated with site clearing and preparation work. The emission rate for fugitive dust emissions from construction activities is difficult to estimate accurately. This is because of its elusive nature of emission and because the potential for its generation varies greatly depending upon the type of soil at the construction site, the amount and type of dirt-disturbing activity taking place, the moisture content of exposed soil in work areas, and the wind speed. The EPA [2] has provided a rough estimate for uncontrolled fugitive dust emissions from construction activity of 1.2 tons per acre per month under conditions of "medium" activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50. Uncontrolled

fugitive dust emissions at the project site would likely be somewhere near that level, depending on the amount of rainfall that occurs. In any case, State of Hawaii Air Pollution Control Regulations [3] prohibit visible emissions of fugitive dust from construction activities at the property line. Thus, an effective dust control plan for the project construction phase is essential.

Adequate fugitive dust control can usually be accomplished by the establishment of a frequent watering program to keep bare-dirt surfaces in construction areas from becoming significant sources of dust. In dust-prone or dust-sensitive areas, other control measures such as limiting the area that can be disturbed at any given time, applying chemical soil stabilizers, mulching and/or using wind screens may be necessary. Control regulations further stipulate that open-bodied trucks be covered at all times when in motion if they are transporting materials that could be blown away. Haul trucks tracking dirt onto paved streets from unpaved areas is often a significant source of dust in construction areas. Some means to alleviate this problem, such as road cleaning or tire washing, may be appropriate. Paving of parking areas and/or establishment of landscaping as early in the construction schedule as possible can also lower the potential for fugitive dust emissions. Monitoring dust at the project property line could be considered to quantify and document the effectiveness of dust control measures.

On-site mobile and stationary construction equipment also will emit air pollutants from engine exhausts. The largest of this equipment is usually diesel-powered. Nitrogen oxides emissions from diesel engines can be relatively high compared to gasoline-powered equipment, but the standard for nitrogen dioxide is set on an annual basis and is not likely to be violated by short-term construction equipment emissions. Carbon monoxide emissions from

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diesel engines, on the other hand, are low and should be relatively insignificant compared to vehicular emissions on nearby roadways.

Project construction activities will also likely obstruct the normal flow of traffic at times to such an extent that overall vehicular emissions in the project area will temporarily increase. The only means to alleviate this problem will be to attempt to keep roadways open during peak traffic hours and to move heavy construction equipment and workers to and from construction areas during periods of low traffic volume. Thus, most potential short-term air quality impacts from project construction can be mitigated.

7.0 LONG-TERM IMPACTS OF PROJECT

7.1 Roadway Traffic

After construction is completed, use of the proposed facilities will result in increased motor vehicle traffic in the project area, potentially causing long-term impacts on ambient air quality. Motor vehicles with gasoline-powered engines are significant sources of carbon monoxide. They also emit nitrogen oxides and other contaminates.

Federal air pollution control regulations require that new motor vehicles be equipped with emission control devices that reduce emissions significantly compared to a few years ago. In 1990, the President signed into law the Clean Air Act Amendments. This legislation requires further emission reductions, which have been phased in since 1994. More recently, additional restrictions were signed into law during the Clinton administration, which will

begin to take effect during the next decade. The added restrictions on emissions from new motor vehicles will lower average emissions each year as more and more older vehicles leave the state's roadways. It is estimated that carbon monoxide emissions, for example, will go down by an average of about 30 to 40 percent per vehicle during the next 10 years due to the replacement of older vehicles with newer models.

To evaluate the potential long-term indirect ambient air quality impact of increased roadway traffic associated with a project such as this, computerized emission and atmospheric dispersion models can be used to estimate ambient carbon monoxide concentrations along roadways leading to and from the project. Carbon monoxide is selected for modeling because it is both the most stable and the most abundant of the pollutants generated by motor vehicles. Furthermore, carbon monoxide air pollution is generally considered to be a microscale problem that can be addressed locally to some extent, whereas nitrogen oxides air pollution most often is a regional issue that cannot be addressed by a single new development.

For this project, four scenarios were selected for the carbon monoxide modeling study: (1) year 2007 with present conditions, (2) year 2030 without the project, (3) year 2030 with the project and with the transit corridor alternative, and (4) year 2030 with the project but without the transit corridor. To begin the modeling study of the four scenarios, critical receptor areas in the vicinity of the project were identified for analysis. Generally speaking, roadway intersections are the primary concern because of traffic congestion and because of the increase in vehicular emissions associated with traffic queuing. For this study, several of the key intersections identified in the traffic study were also selected for air quality analysis. These included

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the following intersections:

- Farrington Highway at Fort Weaver Road northbound ramps
- Farrington Highway at Leoku Street
- Fort Weaver Road at Old Fort Weaver Road
- Fort Weaver Road at Renton Road
- Farrington Highway at Fort Barrette Road
- North-South Road at H-1 eastbound ramps
- North-South Road at Farrington Highway
- North-South Road at Kapolei Parkway

The traffic impact report for the project [4] describes the projected future traffic conditions and laneage configurations of these intersections in detail. In performing the air quality impact analysis, it was assumed that all recommended traffic mitigation measures would be implemented.

The main objective of the modeling study was to estimate maximum 1-hour average carbon monoxide concentrations for each of the four scenarios studied. To evaluate the significance of the estimated concentrations, a comparison of the predicted values for each scenario can be made. Comparison of the estimated values to the national and state AAQS was also used to provide another measure of significance.

Maximum carbon monoxide concentrations typically coincide with peak traffic periods. The traffic impact assessment report evaluated morning and afternoon peak traffic periods. These same periods were evaluated in the air quality impact assessment.

The EPA computer model MOBILE6 [5] was used to calculate vehicular carbon monoxide emissions for each year studied. One of the key inputs to MOBILE6 is vehicle mix. Unless very detailed information is available, national average values are typically assumed, which is what was used for the present study. Based on national average vehicle mix figures, the present vehicle mix in the project area was estimated to be 39.5% light-duty gasoline-powered automobiles, 47.6% light-duty gasoline-powered trucks and vans, 3.6% heavy-duty gasoline-powered vehicles, 0.2% light-duty diesel-powered vehicles, 8.5% heavy-duty diesel-powered trucks and buses, and 0.6% motorcycles. For the future scenarios studied, the vehicle mix was estimated to change somewhat with fewer light-duty gasoline-powered automobiles and more light-duty gasoline-powered trucks and vans.

Ambient temperatures of 59 and 68 degrees F were used for morning and afternoon peak-hour emission computations, respectively. These are conservative assumptions since morning/afternoon ambient temperatures will generally be warmer than this, and emission estimates given by MOBILE6 generally have an inverse relationship to the ambient temperature.

After computing vehicular carbon monoxide emissions through the use of MOBILE6, these data were then input to an atmospheric dispersion model. EPA air quality modeling guidelines [6] currently recommend that the computer model CAL3QHC [7] be used to assess carbon monoxide concentrations at roadway intersections, or in areas where its use has previously been established, CALINE4 [8] may be used. Until a few years ago, CALINE4 was used extensively in Hawaii to assess air quality impacts at roadway intersections. In December 1997, the California Department of Transportation recommended that the intersection mode of CALINE4 no longer be used because it was

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thought the model has become outdated. Studies have shown that CALINE4 may tend to over-predict maximum concentrations in some situations. Therefore, CAL3QHC was used for the subject analysis.

CAL3QHC was developed for the U.S. EPA to simulate vehicular movement, vehicle queuing and atmospheric dispersion of vehicular emissions near roadway intersections. It is designed to predict 1-hour average pollutant concentrations near roadway intersections based on input traffic and emission data, roadway/receptor geometry and meteorological conditions.

Although CAL3QHC is intended primarily for use in assessing atmospheric dispersion near signalized roadway intersections, it can also be used to evaluate unsignalized intersections. This is accomplished by manually estimating queue lengths and then applying the same techniques used by the model for signalized intersections.

Input peak-hour traffic data were obtained from the traffic study cited previously. This included vehicle approach volumes, saturation capacity estimates, intersection laneage and signal timings. All emission factors that were input to CAL3QHC for free-flow traffic on roadways were obtained from MOBILE6 based on assumed free-flow vehicle speeds corresponding to the posted speed limits.

Model roadways were set up to reflect roadway geometry, physical dimensions and operating characteristics. Concentrations predicted by air quality models generally are not considered valid within the roadway-mixing zone. The roadway-mixing zone is

usually taken to include 3 meters on either side of the traveled portion of the roadway and the turbulent area within 10 meters of a cross street. Model receptor sites were thus located at the edges of the mixing zones near all intersections that were studied for all scenarios. This implies that pedestrian sidewalks either already exist or are assumed to exist in the future. All receptor heights were placed at 1.8 meters above ground to simulate levels within the normal human breathing zone.

Input meteorological conditions for this study were defined to provide "worst-case" results. One of the key meteorological inputs is atmospheric stability category. For these analyses, atmospheric stability category 6 was assumed for the morning cases, while atmospheric stability category 4 was assumed for the afternoon cases. These are the most conservative stability categories that are generally used for estimating worst-case pollutant dispersion within suburban areas for these periods. A surface roughness length of 100 cm and a mixing height of 1000 meters were used in all cases. Worst-case wind conditions were defined as a wind speed of 1 meter per second with a wind direction resulting in the highest predicted concentration. Concentration estimates were calculated at wind directions of every 5 degrees.

Existing background concentrations of carbon monoxide in the project vicinity are believed to be at relatively low levels. Thus, background contributions of carbon monoxide from sources or roadways not directly considered in the analysis were accounted for by adding a background concentration of 1.0 ppm to all predicted concentrations for 2007. Although increased traffic is expected to occur within the project area during the next several years with or without the project, background carbon monoxide concentrations may not change significantly since individual

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emissions from motor vehicles are forecast to decrease with time. Hence, a background value of 1.0 ppm was assumed to persist for the future scenarios studied.

Predicted Worst-Case 1-Hour Concentrations

Table 5 summarizes the final results of the modeling study in the form of the estimated worst-case 1-hour morning and afternoon ambient carbon monoxide concentrations. These results can be compared directly to the state and the national AAQS. Estimated worst-case carbon monoxide concentrations are presented in the table for each of the four study scenarios: year 2007 with existing traffic, year 2030 without the project, year 2030 with the project and with the transit corridor alternative, and year 2030 with the project but without the transit corridor. The locations of these estimated worst-case 1-hour concentrations all occurred at or very near the indicated intersections.

As indicated in the table, the highest estimated 1-hour concentration within the project vicinity for the present (2007) case was 12.1 mg/m^3. This was projected to occur during the morning peak traffic hour near the intersection of Fort Weaver Road and Renton Road. Concentrations at other locations and times studied ranged downward from 11.0 mg/m^3 during the morning at intersection of Fort Weaver Road and Old Fort Weaver Road to 4.6 mg/m^3 during the afternoon at Farrington Highway and the Fort Weaver Road northbound ramps. All predicted worst-case 1-hour concentrations for the 2007 scenario were within the national AAQS of 40 mg/m^3, but concentrations exceeded the more stringent state standard of 10 mg/m^3 at two locations in the project area (Fort Weaver Road at Renton Road and Fort Weaver Road at Old Fort Weaver Road).

In the year 2030 without the proposed project, the highest worst-case 1-hour concentration was predicted to occur during the morning at the intersection of Farrington Highway and Fort Barrette Road. A value of 7.7 mg/m^3 was predicted to occur at this location and time. Peak-hour worst-case values at the other locations and times studied for the 2030 without project scenario ranged between 3.2 and 7.4 mg/m^3. Compared to the existing case, concentrations decreased despite the higher traffic volumes, reflecting the reduced emissions from more effective vehicular emission controls. All projected worst-case concentrations for this scenario remained within both the state and the national standards.

In the year 2030 with the proposed project and with the transit corridor alternative, the predicted highest worst-case 1-hour concentration occurred during the morning at the intersection of the North-South Road and Farrington Highway with a value of 8.2 mg/m^3. Other concentrations for this scenario ranged between 4.6 and 7.8 mg/m^3. With the project and with the transit corridor (and assuming the recommended roadway improvements), carbon monoxide concentrations were predicted to increase substantially at several of the intersections studied compared to the without project scenario. At some locations, such as Farrington Highway at Fort Barrette Road, concentrations would remain about the same or decrease slightly. However, even with the predicted increase in concentrations at several of the study intersections, all locations were predicted to remain within the state and the national standards.

In the year 2030 with the project but without the transit corridor, concentrations would remain about the same or increase somewhat compared to the alternative with the project and with the transit corridor. Worst-case 1-hour concentrations in the project

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area were predicted to range between 4.6 and 8.9 mg/m^3 for this alternative. Although concentrations would be somewhat higher in this alternative, the values would comply with the state and the national standards.

Predicted Worst-Case 8-Hour Concentrations

Worst-case 8-hour carbon monoxide concentrations were estimated by multiplying the worst-case 1-hour values by a persistence factor of 0.5. This accounts for two factors: (1) traffic volumes averaged over eight hours are lower than peak 1-hour values, and (2) meteorological conditions are more variable (and hence more favorable for dispersion) over an 8-hour period than they are for a single hour. Based on monitoring data, 1-hour to 8-hour persistence factors for most locations generally vary from 0.4 to 0.8 with 0.6 being the most typical. One study based on modeling [9] concluded that 1-hour to 8-hour persistence factors could typically be expected to range from 0.4 to 0.5. EPA guidelines [10] recommend using a value of 0.7 unless a locally derived persistence factor is available. Recent monitoring data for locations on Oahu reported by the Department of Health [11] suggest that this factor may range between about 0.2 and 0.6 depending on location and traffic variability. Considering the location of the project and the traffic pattern for the area, a 1-hour to 8-hour persistence factor of 0.5 will likely yield reasonable estimates of worst-case 8-hour concentrations.

The resulting estimated worst-case 8-hour concentrations are indicated in Table 6. For the 2007 scenario, the estimated worst-case 8-hour carbon monoxide concentrations for the five locations studied ranged from 3.1 mg/m^3 at Farrington Highway and Fort Weaver Road northbound ramps to 6.0 mg/m^3 at the intersection of Fort Weaver Road and Renton Road. The estimated worst-case

concentrations for the existing case were within the national limit of 10 mg/m^3 but exceeded the state standard of 5 mg/m^3 at three of the five intersections studied.

For the year 2030 without project scenario, worst-case concentrations ranged between 2.0 and 3.7 mg/m^3, with the highest concentration occurring at Fort Weaver Road and Renton Road. All predicted concentrations were within both the national and the state standards.

For the 2030 with-project scenario and with the transit corridor alternative, worst-case concentrations increased at all locations studied except at Fort Weaver Road and Renton Road where a moderate decrease was predicted. The analysis assumes all traffic mitigation measures recommended in the project traffic study would be implemented. The worst-case concentrations ranged from 2.8 to 4.1 mg/m^3. All predicted 8-hour concentrations for this scenario were within both the national and the state AAQS.

With the project in the year 2030 and without the transit corridor, worst-case concentrations at intersections in the project area would likely increase slightly at most locations with concentrations ranging from 2.8 to 4.4 mg/m^3. However, all predicted 8-hour concentrations remained within both the national and the state AAQS.

Conservativeness of Estimates

The results of this study reflect several assumptions that were made concerning both traffic movement and worst-case meteorological conditions. One such assumption concerning worst-

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case meteorological conditions is that a wind speed of 1 meter per second with a steady direction for 1 hour will occur. A steady wind of 1 meter per second blowing from a single direction for an hour is extremely unlikely and may occur only once a year or less. With wind speeds of 2 meters per second, for example, computed carbon monoxide concentrations would be only about half the values given above. The 8-hour estimates are also conservative in that it is unlikely that anyone would occupy the assumed receptor sites (within 3 m of the roadways) for a period of 8 hours.

7.2 Electrical Demand

The proposed project also will cause indirect air pollution emissions from power generating facilities as a consequence of electrical power usage. The peak electrical demand of the project when fully developed is expected to reach about 140 megawatts [12]. Assuming the average demand is approximately one-half the peak demand, the annual electrical demand of the project will reach approximately 612 million kilowatt-hours. Electrical power for the project will most probably be provided mainly by oil-fired generating facilities located on Oahu, but some of the project power could also come from sources burning other fuels, such as H-Power and the AES coal-fired power plant at Campbell Industrial Park. In order to meet the electrical power needs of the proposed project, power generating facilities will be required to burn more fuel and hence more air pollution will be emitted at these facilities. Given in Table 7 are estimates of the indirect air pollution emissions that would result from the project electrical demand assuming all power is provided by burning more fuel oil at Oahu's power plants. These values can be compared to the island-wide emission estimates for 1993 given in Table 3. The estimated indirect emissions from project electrical demand amount to less than 1 percent of the present air pollution emissions occurring on Oahu. If power is

supplied instead or in part by coal or solid waste burning facilities, emissions will likely be higher than the values given in Table 7.

7.3 Solid Waste Disposal

Solid waste generated by the proposed development when fully completed and occupied is not expected to exceed about 60 tons per day [13]. Most project refuse will likely be hauled away and burned at the H-Power facility at Campbell Industrial Park to generate electricity. Burning of the waste to generate electricity will result in emissions of particulate, carbon monoxide and other contaminants, but these will be offset to some extent by reducing the amount of fuel oil that would be required to generate electricity for the project. Table 8 gives emission estimates assuming all project solid waste is burned at H-Power. These values can be compared to the island-wide emission estimates for 1993 given in Table 3. The estimated potential indirect emissions from project solid waste disposal demand amount to less than 0.1 percent of the present air pollution emissions occurring on Oahu.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The major potential short-term air quality impact of the project will occur from the emission of fugitive dust during construction. Uncontrolled fugitive dust emissions from construction activities are estimated to amount to about 1.2 tons per acre per month, depending on rainfall. To control dust, active work areas and any temporary unpaved work roads should be watered at least twice daily on days without rainfall. Use of wind screens and/or limiting the area that is disturbed at any given time will also help to contain fugitive dust emissions. Wind erosion of inactive

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areas of the site that have been disturbed could be controlled by mulching or by the use of chemical soil stabilizers. Dirt-hauling trucks should be covered when traveling on roadways to prevent windage. A routine road cleaning and/or tire washing program will also help to reduce fugitive dust emissions that may occur as a result of trucks tracking dirt onto paved roadways in the project area. Paving of parking areas and establishment of landscaping early in the construction schedule will also help to control dust. Monitoring dust at the project boundary during the period of construction could be considered as a means to evaluate the effectiveness of the project dust control program and to adjust the program if necessary.

During construction phases, emissions from engine exhausts (primarily consisting of carbon monoxide and nitrogen oxides) will also occur both from on-site construction equipment and from vehicles used by construction workers and from trucks traveling to and from the project. Increased vehicular emissions due to disruption of traffic by construction equipment and/or commuting construction workers can be alleviated by moving equipment and personnel to the site during off-peak traffic hours.

After construction of the proposed project is completed and it is fully occupied and assuming the transit corridor alternative is implemented, carbon monoxide concentrations in the project area will likely increase substantially at several locations in the project area compared to the without-project case. This assumes that the roadway improvements recommended in the project traffic study are implemented. Without the transit corridor but with the recommended project traffic mitigation measures, worst-case concentrations would increase slightly at several locations in the project area compared to without the transit corridor. However, with or without the transit corridor, worst-case

concentrations should remain within both the state and the national ambient air quality standards.

Aside from further improving roadways, air pollution impacts from motor vehicle emissions could conceivably be mitigated by reducing traffic volumes through the promotion of bus service and car pooling and/or by adjusting local school and business hours to begin and end during off-peak times. However, this mitigation measure is generally considered only partially successful. Reduction of emissions from individual vehicles would have to be achieved through the promulgation of county, state or federal air pollution control regulations. For example, Hawaii currently does not require annual inspections of motor vehicle air pollution control equipment. At the present time, there is no indication that the state is contemplating adopting such rules.

Another potential mitigation measure would be to provide added buffer zones between walkways and roadways in areas where space is available. Technically, however, the public would have to somehow be excluded from the buffer zones. The predicted worst-case concentrations in this report are based on a separation distance of 3 m (10 ft) between walkways and roadways. Doubling this distance to about 6 m (20 ft) would in many cases reduce maximum concentrations by about 10 to 15 percent.

While carbon monoxide concentrations in the project area will likely increase with the project, the worst-case concentration levels should be lower than the existing levels and within both the state and national ambient air quality standards. Thus, implementing any air quality mitigation measures for long-term traffic-related impacts is probably unnecessary and unwarranted.

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Any long-term impacts on air quality due to indirect emissions from supplying the project with electricity and from the disposal of waste materials generated by the project will likely be negligible based on the magnitudes of the estimated emissions compared to the current island-wide emissions.

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Figure 1 - Project Location

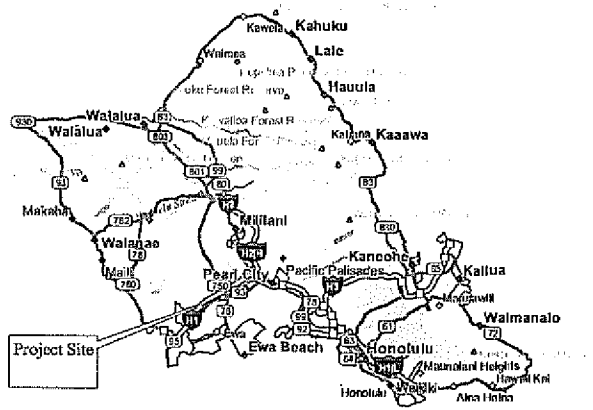

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Table 1

SUMMARY OF STATE OF HAWAII AND NATIONAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Units	Averaging Time	Maximum Allowable Concentration		
			National Primary	National Secondary	State of Hawaii
Particulate Matter (<10 microns)	µg/m³	Annual	50[a]	50[a]	50
		24 Hours	150[b]	150[b]	150[c]
Particulate Matter (<2.5 microns)	µg/m³	Annual	15[a]	15[a]	-
		24 Hours	65[d]	65[d]	-
Sulfur Dioxide	µg/m³	Annual	80	-	80
		24 Hours	365[c]	-	365[c]
		3 Hours	-	1300[c]	1300[c]
Nitrogen Dioxide	µg/m³	Annual	100	100	70
Carbon Monoxide	mg/m³	8 Hours	10[c]	-	5[c]
		1 Hour	40[c]	-	10[c]
Ozone	µg/m³	8 Hours	157[e]	157[e]	157[e]
		1 Hour	235[f]	235[f]	-
Lead	µg/m³	Calendar Quarter	1.5	1.5	1.5
Hydrogen Sulfide	µg/m³	1 Hour	-	-	35[c]

[a] Three-year average of annual arithmetic mean.

[b] 99th percentile value averaged over three years.

[c] Not to be exceeded more than once per year.

[d] 98th percentile value averaged over three years.

[e] Three-year average of fourth-highest daily 8-hour maximum.

[f] Standard is attained when the expected number of exceedances is less than or equal to 1.

Table 2

ANNUAL WIND FREQUENCY FOR HONOLULU INTERNATIONAL AIRPORT (%)

Wind Direction	Wind Speed (knots)									Total
	0-3	4-6	7-10	11-16	17-21	22-27	28-33	34-40	>40	
N	0.5	2.5	1.3	0.5	0.0	0.0	0.0	0.0	0.0	4.8
NNE	0.3	1.2	1.6	1.5	0.2	0.0	0.0	0.0	0.0	4.7
NE	0.3	2.1	6.1	11.0	3.2	0.3	0.0	0.0	0.0	23.0
ENE	0.2	2.5	10.9	16.6	4.1	0.3	0.0	0.0	0.0	34.7
E	0.1	1.0	2.5	2.8	0.5	0.0	0.0	0.0	0.0	7.0
ESE	0.0	0.3	0.4	0.3	0.0	0.0	0.0	0.0	0.0	1.1
SE	0.0	0.3	0.8	1.0	0.1	0.0	0.0	0.0	0.0	2.2
SSE	0.1	0.4	1.2	0.7	0.1	0.0	0.0	0.0	0.0	2.4
S	0.1	0.5	1.4	0.6	0.1	0.0	0.0	0.0	0.0	2.7
SSW	0.0	0.3	0.8	0.3	0.0	0.0	0.0	0.0	0.0	1.5
SW	0.0	0.2	0.8	0.4	0.0	0.0	0.0	0.0	0.0	1.5
WSW	0.0	0.3	0.5	0.4	0.0	0.0	0.0	0.0	0.0	1.2
W	0.1	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	1.1
WNW	0.2	1.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	2.0
NW	0.4	2.3	0.8	0.1	0.0	0.0	0.0	0.0	0.0	3.8
NNW	0.5	2.3	0.8	0.2	0.0	0.0	0.0	0.0	0.0	3.8
Calm	2.5									2.5
Total	5.4	18.3	30.6	36.5	8.5	0.7	0.0	0.0	0.0	100.0

Source: Climatography of the United States No. 90 (1965-1974), Airport Climatological Summary, Honolulu International Airport, Honolulu, Hawaii, U.S. Department of Commerce, National Climatic Center, Asheville, NC, August 1978.

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Table 3

AIR POLLUTION EMISSIONS INVENTORY FOR
ISLAND OF OAHU, 1993

Air Pollutant	Point Sources (tons/year)	Area Sources (tons/year)	Total (tons/year)
Particulate	25,891	49,374	75,265
Sulfur Oxides	39,230	nil	39,230
Nitrogen Oxides	92,436	31,141	123,577
Carbon Monoxide	28,757	121,802	150,559
Hydrocarbons	4,160	421	4,581

Source: Final Report, "Review, Revise and Update of the Hawaii Emissions Inventory Systems for the State of Hawaii", prepared for Hawaii Department of Health by J.L. Shoemaker & Associates, Inc., 1996

Table 4

ANNUAL SUMMARIES OF AIR QUALITY MEASUREMENTS FOR
MONITORING STATIONS NEAREST HO'OPILI PROJECT

Parameter / Location	2001	2002	2003	2004	2005
Sulfur Dioxide / Kapolei					
3-Hour Averaging Period:					
No. of Samples	2511	2420	2461	2504	2396
Highest Concentration ($\mu g/m^3$)	24	47	26	17	64
2nd Highest Concentration ($\mu g/m^3$)	15	19	19	12	28
No. of State AAQS Exceedances	0	0	0	0	0
24-Hour Averaging Period:					
No. of Samples	359	344	352	355	333
Highest Concentration ($\mu g/m^3$)	7	9	9	7	21
2nd Highest Concentration ($\mu g/m^3$)	6	7	9	6	9
No. of State AAQS Exceedances	0	0	0	0	0
Annual Average Concentration ($\mu g/m^3$)	2	2	1	1	2
Particulate (PM-10) / Pearl City					
24-Hour Averaging Period:					
No. of Samples	354	243	329	335	336
Highest Concentration ($\mu g/m^3$)	167	66	30	32	195
2nd Highest Concentration ($\mu g/m^3$)	100	63	27	31	99
No. of State AAQS Exceedances	1	0	0	0	1
Annual Average Concentration ($\mu g/m^3$)	15	15	15	15	16
Carbon Monoxide / Kapolei					
1-Hour Averaging Period:					
No. of Samples	8577	8354	8559	8507	8556
Highest Concentration (mg/m^3)	2.3	2.2	2.2	2.4	1.7
2nd Highest Concentration (mg/m^3)	1.9	2.0	1.6	1.7	1.6
No. of State AAQS Exceedances	0	0	0	0	0
8-Hour Averaging Period:					
No. of Samples	1073	1044	n/a	n/a	8551
Highest Concentration (mg/m^3)	1.6	1.8	0.8	1.0	1.0
2nd Highest Concentration (mg/m^3)	1.3	1.8	0.8	1.0	1.0
No. of State AAQS Exceedances	0	0	0	0	0
Nitrogen Dioxide / Kapolei					
Annual Average Concentration ($\mu g/m^3$)	8	9	9	9	9
Ozone / Sand Island					
8-Hour Averaging Period:					
No. of Samples	-	8549	8641	8474	8670
Highest Concentration (mg/m^3)	-	89	79	110	92
2nd Highest Concentration (mg/m^3)	-	88	77	108	92
No. of State AAQS Exceedances	-	0	0	0	0

Source: State of Hawaii Department of Health, "Annual Summaries, Hawaii Air Quality Data, 2001 - 2005"

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Table 6

ESTIMATED WORST-CASE 8-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR HO'OPILI PROJECT
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario			
	2007/Present	2030/Without Project	2030/With Project[a]	2030/With Project[b]
Farrington Highway at Fort Weaver Rd NB Ramps	3.1	2.0	2.9	3.3
Farrington Highway at Leoku Street	3.7	2.4	2.8	2.8
Fort Weaver Road at Old Fort Weaver Road	5.5	2.7	3.9	4.2
Fort Weaver Road at Renton Road	6.0	3.7	3.2	3.2
Farrington Highway at Fort Barrette Road	5.0	3.4	3.8	3.9
North-South Road at H-1 EB Ramps	-	3.0	3.7	3.8
North-South Road at Farrington Highway	-	3.0	4.1	4.4
North-South Road at Kapolei Parkway	-	3.0	3.6	3.4

[a]Assumes transit corridor and mitigation recommended in traffic study
[b]Assumes mitigation recommended in traffic study (but without transit corridor)

Table 5

ESTIMATED WORST-CASE 1-HOUR CARBON MONOXIDE CONCENTRATIONS
ALONG ROADWAYS NEAR HO'OPILI PROJECT
(milligrams per cubic meter)

Roadway Intersection	Year/Scenario							
	2007/Present		2030/Without Project		2030/With Project[a]		2030/With Project[b]	
	AM	PM	AM	PM	AM	PM	AM	PM
Farrington Highway at Fort Weaver Rd NB Ramps	6.2	4.6	3.9	3.8	5.8	5.0	6.6	5.1
Farrington Highway at Leoku Street	7.4	6.9	4.8	4.7	5.6	5.5	5.6	5.5
Fort Weaver Road at Old Fort Weaver Road	11.0	6.3	5.4	5.1	7.8	6.2	8.3	6.3
Fort Weaver Road at Renton Road	12.1	7.8	7.4	5.1	6.3	5.4	6.4	5.3
Farrington Highway at Fort Barrette Road	10.0	7.2	7.7	5.2	7.6	5.4	7.8	5.4
North-South Road at H-1 EB Ramps	-	-	6.1	3.2	7.4	4.6	7.6	4.6
North-South Road at Farrington Highway	-	-	5.9	4.8	8.2	5.9	8.9	6.9
North-South Road at Kapolei Parkway	-	-	5.9	4.6	7.2	6.0	6.8	6.0

[a]Assumes transit corridor and mitigation recommended in traffic study
[b]Assumes mitigation recommended in traffic study (but without transit corridor)

Table 7

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM HO'OPILI PROJECT ELECTRICAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	17
Sulfur Dioxide	210
Carbon Monoxide	17
Volatile Organics	1
Nitrogen Oxides	87

[a]Based on U.S. EPA emission factors for utility boilers [2]. Assumes electrical demand of 612 million kilowatt-hrs per year and low-sulfur oil used to generate power.

Table 8

ESTIMATED INDIRECT AIR POLLUTION EMISSIONS FROM HO'OPILI PROJECT SOLID WASTE DISPOSAL DEMAND[a]

Air Pollutant	Emission Rate (tons/year)
Particulate	1
Sulfur Dioxide	5
Carbon Monoxide	21
Nitrogen Oxides	55
Lead	<1

[a]Assumes solid waste disposal demand of 60 tons per day and that solid waste is burned in a refuse-derived fuel-fired power plant equipped with spray dryer and fabric filter. Emission rates based on U.S. EPA emission factors for refuse-derived fuel-fired combustors [2].

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APPENDIX I
Social Impact Assessment

July 9, 2008
2006.33.8500 / 08P-248

VIA ELECTRONIC MAIL and U.S. MAIL
vshigekuni@pbrhawaii.com

Mr. Vincent Shigekuni, Vice President
PBR Hawaii & Associates, Inc.
ASB Tower, Suite 650
1001 Bishop Street
Honolulu, Hawaii 96813

Dear Mr. Shigekuni:

Social Impact Assessment (November 2007)

Per comments received from the Leeward – Central Community Roundtable (aka Leeward – Central Community Forum) during the public review period of the Ho'opili Draft Environmental Impact Assessment, we concur that the fourth paragraph of Section 4.4, *Community Development on the Ewa Plain* of the Social Impact Assessment (November 2007) could be clarified with the sentence underlined below.

> Ho'opili will contribute to the growth of the urban community life in 'Ewa by providing new job locations, recreational areas, and schools as well as housing. It is designed as a community in which many residents will not need to drive to Honolulu often. Its transportation planning will work to address the region's serious traffic congestion problems. It will help to link existing and new communities, serving its neighbors as well as its residents.

Should you have any questions, please do not hesitate to contact me.

Sincerely,

BELT COLLINS HAWAII LTD.

John Kirkpatrick
Senior Socio-Economic Analyst

JK:lf

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Singapore

SOCIAL IMPACT ASSESSMENT

HO'OPILI
'EWA, O'AHU, HAWAI'I

Prepared for

D.R. Horton – Schuler Division
PBR Hawaii

Prepared by

Belt Collins

Belt Collins Hawaii Ltd.

November 2007

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ACRONYMS AND ABBREVIATIONS

CDPs	Census Designated Places
DHHL	Department of Hawaiian Homelands
EIS	Environmental Impact Statement
HCDA	Hawai'i Community Development Authority
msl	mean sea level
NAS	Naval Air Station
TMK	Tax Map Key
UHWO	University of Hawai'i, West O'ahu

CHAPTER ONE
INTRODUCTION

1.1 PROPOSED ACTION

The Ho'opili project site consists of approximately 1,555 acres of land on the 'Ewa Plain, in the 'Ewa Development Plan area, City and County of Honolulu. The land has long been owned by the Estate of James Campbell but was acquired by D.R. Horton - Schuler Division in 2006. Figure 1 shows the project location. The site is *makai* (seaward) of the H-1 Freeway, and extends along Farrington Highway and old Fort Weaver Road. To the west, between the site and the Villages of Kapolei, lies an area that the State plans to develop. The State acreage will include the University of Hawai'i, West O'ahu (UHWO) campus, Department of Hawaiian Home Lands (DHHL) housing areas, and other facilities supporting the UHWO development.

The D.R. Horton - Schuler Division project will include about 11,750 residential units, as well as commercial and industrial uses, parks, schools, public facilities, roads, and open space. Figure 1 shows the project's conceptual plan, and acreages to be devoted to major land uses. Table 1 specifies the proposed housing unit count and square footage for commercial and industrial uses.

The Ho'opili project is intended to respond to the continuing strong demand for affordable housing on O'ahu. It has been designed to encourage urban community life, with residents relying far less on their automobiles than residents of more conventional residential subdivisions in the region.

Schuler Homes, Inc., now a division of D.R. Horton, proposed reclassification of some 793 acres of land owned by the Campbell Estate and the State of Hawai'i in 1996. That petition was withdrawn. The current proposed action incorporates planning concepts derived in part from "Transit-Oriented Development," "New Urbanism," and "Smart Growth" initiatives, and have not yet been implemented in O'ahu communities.

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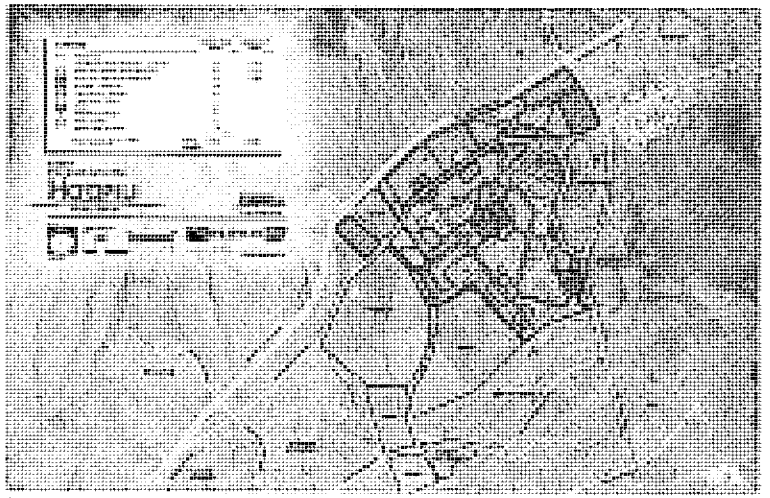
Figure 1: Project Concept Plan



SOURCE: PBR Hawaii, 2006.

Table 1: Major Land Uses

	Homes	Space	
Residential			
Low-Medium Density Residential/Live-Work (Combined R5 & AMX2)	5,100		
Mixed Use/Medium Density Residential	5,200		
Mixed Use/High Density Residential	1,450		
Total	11,750		
Retail		2,240,000	sq. ft.
Office		720,000	sq. ft.
Industrial		800,000	sq. ft.

SOURCE: PBR Hawaii, 2007.

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Purpose and Scope of This Study

This study is written for review by stakeholders, public agencies, and decision-makers. It will appear as part of the Environmental Impact Statement (EIS) on the proposed Ho'opili development.

The report deals with the social impacts of the project. It takes into account both existing conditions and likely future trends. It deals both with direct impacts and the cumulative impact of the project and other likely developments. The report is organized in four sections:

1. This introduction;
2. An account of the socio-economic context of the project;
3. A discussion of community issues and concerns; and
4. An analysis of social impacts, followed by discussion of mitigation measures and processes, to the extent that these are justified.

1.2 Study Area

The project is planned as a major mixed-use project, responding to a lack of housing for residents of many income levels throughout O'ahu, and the need to further realize the vision of a secondary urban center. It is widely recognized that the island forms a single real estate market, so the potential impact area is islandwide. The most general study area for this report is the City and County of Honolulu, i.e., the island of O'ahu.

Impacts can also be anticipated for the region. The project site lies at the northeastern corner of the 'Ewa Development Plan area. Its area of potential influence is larger, inasmuch as it is close to the town of Waipahu. On a broader scale, it is sometimes argued that residential growth in any part of the 'Ewa region affects traffic on the H-1 Freeway to and from Honolulu, and hence can affect the entire Leeward region (including Central O'ahu and, arguably, Wai'anae and the North Shore).

The application of particular impacts to particular areas will be specified in the course of the analysis. (Figure 2 shows the Development Plan areas.)

The name "'Ewa" is used in overlapping ways in Hawai'i. The 'Ewa Plain, between Waipahu and Kalaeloa, makes up about half of the 'Ewa Development Plan area. The Development Plan Area includes two Neighborhood Board areas, which elect separate advisory boards. After the Makakilo/Kapolei/Honokai Hale Neighborhood Board was created for western 'Ewa, the existing board, serving the communities along Fort Weaver Road, retained the name "'Ewa Neighborhood Board." (In Figure 3, Ho'opili is shown as in the 'Ewa Neighborhood Board area.) The State's 'Ewa Judicial

District, however, is much larger and includes most of Central O'ahu. No further reference is made here to the judicial district.

Because 'Ewa has been an area of rapid growth, it is difficult to compare the population of smaller communities over time. Census tract boundaries have shifted from count to count. Demographic data for Census Designated Places (CDPs) are useful to characterize parts of the region, but important sites, such as Kapolei, were not identified as CDPs by the year 2000. (Figure 1 shows the location of 'Ewa CDPs.)

The term "East Kapolei" has also been used in several ways. In the mid-1990s, Schuler Homes (now a division of D.R. Horton) proposed development of approximately 793 acres within the site designated in this study as Ho'opili (Helber, Hastert & Fee, Planners 1996). The State of Hawai'i has also termed its development area, where the UHWO and DHHL subdivisions are being planned, as "East Kapolei" (PBR Hawaii, 1998). The City and County of Honolulu Department of Planning and Permitting has identified a "subarea" of the 'Ewa Development Plan area as "Kapolei East," including the Ho'opili project site, adjacent DHHL lands, and the UHWO site between Ho'opili and the Villages of Kapolei.

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Figure 2: Development Plan Areas

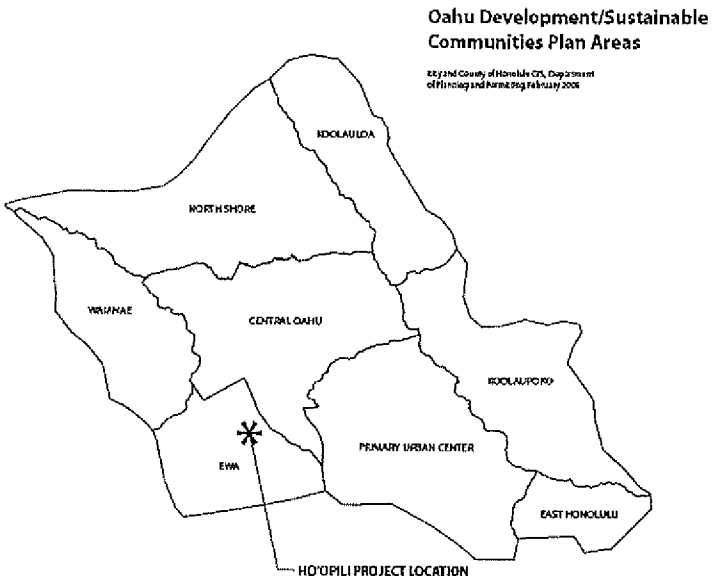
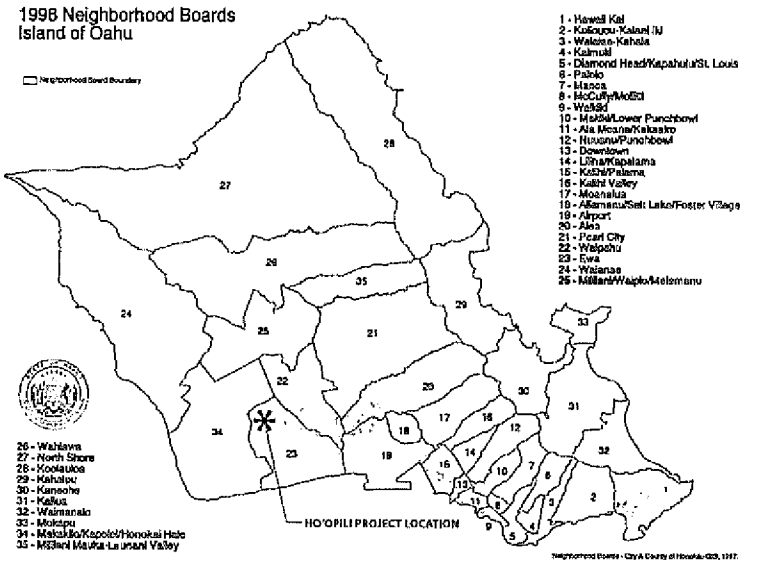


Figure 3: Neighborhood Board Areas



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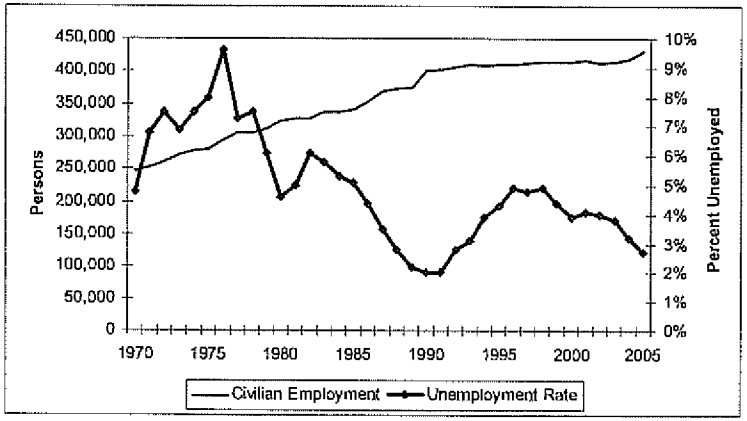
CHAPTER TWO
SOCIAL AND ECONOMIC CONTEXT

2.1 ISLAND AND REGIONAL ECONOMY

O'ahu is the economic and demographic center of Hawai'i. As such, it has seen steady economic growth over recent decades. It gained in population at the expense of other counties immediately after World War II. More recently, economic and population growth have picked up in the Neighbor Islands.

The 1990s were a difficult economic period for Hawai'i. Job growth slowed and housing starts and prices declined. O'ahu was not affected as much as other areas, as the low unemployment rates shown in Figure 4 indicate. O'ahu and Hawai'i have emerged with much lower unemployment rates than for the nation as a whole.

Figure 4: Island Economic Trends, 1970 through 2005



SOURCE: Historical and current statistics; State Department of Labor and Industrial Relations available through http://www.hiwi.org.

The island economy depended on a mix of tourism, military activity, construction, and plantation agriculture at the beginning of the 1970s. Since then, military activity declined but remained an important factor in the local economy. Plantation agriculture declined throughout the period. For the region surrounding Ho'opili, this development has been important.

- The O'ahu Sugar Company had used much of the 'Ewa Plain for sugar cultivation. As it closed operations (by 1995), land became available for urban development.
- With the closing of the plantation, many families in Waipahu and the 'Ewa Villages lost a major source of income. Many older workers retired. Others have retrained for other jobs.
- With the land and water released from sugar cultivation, 'Ewa has become a truck farming area, with Aloun Farms operating in the project site, emerging as the island's leading producer of vegetables.

The Kapolei area was designated as O'ahu's "Second City" decades ago. James Campbell Industrial Park was created as the island's leading heavy industrial area. The urban center was slower to develop. Commercial areas began to be built in the 1990s, and construction of residential areas began. Residential and retail growth has boomed since 2000. The major landowner in the region, Campbell Estate,[1] reports nearly 25,000 jobs in the 'Ewa Development Plan area, and expects that number to grow to about 65,000 by 2025 (http://www.kapolei.org). The industrial park has seen significant recent growth, including construction of a new *Honolulu Advertiser* printing plant. The resort area of Ko 'Olina now includes a hotel, a timeshare resort, and high-end vacation homes and condos. Kapolei itself has office buildings with State, City, and Bank of Hawai'i workers, as well as extensive retail areas.

In 2000, the workforce in the 'Ewa Development Plan Area was modest. Naval Air Station (NAS) Barbers Point had recently closed. The civilian job count in the Development Plan area (the combined 'Ewa and Makakilo/Kapolei/Honokai Hale Neighborhood Board areas) totaled about 15,000. The largest industry cluster, in terms of the number of local jobs, was education and health services, as shown in Table 2. About four-fifths of the jobs were on the western side of the 'Ewa Development Plan area. In Waipahu, which is closer to the Primary Urban Center, retail trade is the largest job sector.

[1] The Estate of James Campbell has been converted into successor firms including Aina Nui corporation and the James Campbell Company LLC.

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Table 2: Jobs on O'ahu and Selected Neighborhood Board Areas, 2000

	City and County of Honolulu	Ewa	Makakilo, Kapolei, Honokai Hale	Waipahu
Total Workers, 2000	393,245	3,010	11,560	11,165
Agriculture, forestry, mining	3,664	20	573	60
Construction	17,954	174	1,495	950
Manufacturing	12,671	59	1,160	453
Wholesale trade	11,460	20	684	944
Retail trade	43,506	265	834	2,378
Transportation, warehousing, utilities	22,476	109	718	509
Information	9,897	30	90	120
Finance, insurance, real estate	27,336	160	879	505
Professional, management, administrative services	34,416	179	749	574
Educational, health and social services	72,202	1,210	1,760	2,200
Entertainment, accommodations, food services	49,541	369	1,365	1,215
Other services (except public)	16,063	125	235	535
Public administration	34,905	165	810	419
Armed forces	36,927	135	194	0

SOURCE: US Census, Census Transportation Planning Package, organized by Census Tract by University of Wisconsin, Milwaukee; tracts combined to Neighborhood Board areas by Belt Collins (http://www.uwm.edu/Dept/ETI/drilldowns/index.html).

The island economy has grown steadily. Unemployment continues at very low rates (2.3% for the City and County of Honolulu, for the year 2006, according to the State Department of Labor and Industrial Relations, www.hiwi.org.) State tax revenues grew by 11% in FY2006, compared to FY2005 (Department of Taxation, 2006).

In 'Ewa, the expanding economy is visible in new store openings, construction in industrial areas, and investment by U.S. mainland real estate investors in industrial and commercial properties in the region.

2.2 Island and Regional Demographics

As a matter of policy, the Primary Urban Center, 'Ewa, and Central O'ahu have been identified as "development" areas, and the other Development Plan areas are termed "sustainable communities." New housing and population are to be channeled in the three development areas. 'Ewa has had the fastest growth, while the population has increased by larger numbers in Central O'ahu, as shown in Table 3.

Table 3: Historical Population Growth, O'ahu and Development Plan Areas

	1980	1990	2000	Average Annual Increase, 1980 - 2000
Primary Urban Center	417,240	432,023	419,338	0.0%
Ewa	35,523	42,931	68,718	3.4%
Central Oahu	101,685	130,526	148,186	1.9%
East Honolulu	43,213	45,654	46,735	0.4%
Koolaupoko	109,373	117,694	117,994	0.4%
Koolauloa	10,983	14,263	14,546	1.4%
North Shore	13,061	15,729	18,380	1.7%
Waianae	31,487	37,411	42,259	1.5%
Total Population	762,565	836,231	876,156	0.7%

SOURCE: Honolulu Department of Planning and Permitting, 2005.

In 2000, residential areas in the 'Ewa Development Plan Area were largely inhabited by young families. In the newer subdivisions, home ownership is much higher than for the island as a whole. However, military housing areas – Kalaeloa, which used to be NAS Barbers Point, and Iroquois Point – stand out as areas where housing is rented. Throughout these communities, vacation housing, for rent or sale, is rare. (However, it is becoming common in Ko 'Olina.)

Table 4: County and Local Demographics, 2000

	City and County of Honolulu	Ewa CDPs: Ewa Villages	Ewa Gentry	Ewa Beach	Iroquois Point	Barbers Point	Makakilo	Central Oahu CDPs (selected): Waipahu	Village Park	Wahiawa
Population										
Total	876,156	4,741	4,839	14,650	2,462	67	13,156	38,108	9,625	11,672
Age										
Under 5 years	58,849	347	512	1,052	392	14	1,128	2,271	699	756
5-17 years	151,909	971	899	3,221	703	20	2,685	5,485	2,227	2,302
18-64 years	549,681	2,770	3,319	9,789	1,365	33	8,343	19,111	5,190	7,852
65 years and over	117,737	653	209	1,568	2	-	800	5,243	509	762
Median age (years)	35.7	33.3	31.9	32.7	25.5	17.8	32.4	35.5	31.4	33.9
In households	96.5%	99.5%	100.0%	99.1%	100.0%	100.0%	99.8%	96.6%	99.0%	99.4%
In group quarters	3.5%	0.1%	0.0%	0.9%	0.0%	0.0%	0.2%	3.4%	0.1%	0.6%
Households										
Total	286,450	1,178	1,734	3,305	625	16	3,898	7,566	2,628	3,974
Family households	205,672	1,004	1,339	2,941	566	16	3,225	6,430	2,280	2,873
With own children under 18	91,022	466	770	1,251	564	14	1,350	2,740	1,308	1,535
With persons under 18	108,247	613	814	1,830	566	14	2,005	3,031	1,464	1,735
With persons 65 and over	80,464	477	21	1,099	2	-	589	3,181	392	545
Average household size	2.95	4.02	2.85	4.39	3.65	4.19	3.37	4.23	3.68	2.92
Housing units										
Total	315,968	1,274	1,843	3,315	1,635	127	4,119	8,033	2,778	4,110
Occupied	286,450	1,178	1,734	3,305	625	16	3,898	7,566	2,628	3,974
Owner	54.6%	81.0%	68.3%	68.9%	1.3%	0.0%	70.6%	53.1%	72.1%	64.3%
Renter	45.4%	19.0%	31.7%	31.1%	98.7%	100.0%	29.6%	46.6%	27.9%	35.7%
Vacant	29,518	96	109	210	360	111	221	467	148	136
Seasonal, recreational use	6,655	1	4	10	-	-	8	4	3	2
Seasonal, etc., as % of all units	2.2%	0.1%	0.2%	0.3%	0.0%	0.0%	0.2%	0.0%	0.1%	0.0%

NOTE: For more on the CDPs, see section 2.4.2.

SOURCE: US Census, compiled in community profiles, accessed through http://www.hawaii.gov/dbedt/census2k/profile-honolulu/index.html.

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While about 9% of the island workforce is in the military, the military share of most communities in the 'Ewa Development Plan Area was much smaller in 2000, except for Barbers Point and Iroquois Point, where the military formed the majority of the workforce. Agricultural workers were numerous in the 'Ewa Villages, but not elsewhere in the region.

Table 5: County and Local Workforce Distribution by Place of Residence, 2000

	City and County of Honolulu	Ewa CDPs						Central Oahu CDPs (selected)		
		Ewa Villages	*Ewa Gentry*	*Ewa Beach*	*Iroquois Point*	*Barbers Point*	*Makakilo*	*Waipahu*	*Village Park*	*Waipio*
Employment status										
Population 16 and over	691,915	3,538	3,750	10,885	1,440	42	9,523	25,349	7,051	8,099
In labor force	447,320	1,988	2,820	6,877	991	24	7,014	14,803	5,354	7,030
Civilian	408,638	1,982	2,555	6,718	359	2	6,698	14,446	5,095	6,442
Employed	65.4%	52.0%	65.5%	56.8%	20.9%	4.8%	68.7%	51.8%	68.3%	68.1%
Unemployed	3.7%	4.0%	2.4%	4.4%	4.2%	0.0%	3.6%	5.2%	3.6%	3.5%
Armed Forces	38,682	6	265	159	632	52	316	155	259	588
Industry										
Agriculture, forestry, mining	1.1%	39.0%	0.6%	0.6%	3.0%	0.0%	0.5%	1.9%	0.5%	0.0%
Construction	8.1%	7.2%	5.1%	5.6%	2.3%	0.0%	8.5%	8.6%	6.9%	5.3%
Manufacturing	3.6%	7.6%	6.0%	3.2%	2.7%	0.0%	4.3%	6.2%	3.3%	4.3%
Wholesale trade	3.4%	3.6%	1.1%	4.1%	0.0%	0.0%	2.8%	4.4%	4.4%	3.6%
Retail trade	12.1%	14.8%	10.3%	12.5%	16.6%	0.0%	13.7%	13.1%	16.6%	13.3%
Transportation, utilities	6.5%	6.2%	6.1%	6.0%	0.0%	0.0%	8.8%	5.6%	5.9%	6.0%
Information	2.7%	0.0%	2.5%	1.8%	0.0%	0.0%	2.8%	1.6%	2.2%	4.1%
Finance, insurance, real estate	7.5%	4.1%	5.0%	5.7%	8.3%	0.0%	8.8%	5.8%	6.6%	7.7%
Professional, management, waste services	9.8%	9.5%	6.5%	9.9%	7.9%	0.0%	9.1%	8.1%	9.4%	8.2%
Educational, health, social services	19.9%	16.7%	19.8%	17.6%	38.8%	0.0%	15.9%	18.4%	18.3%	18.0%
Accommodation, food, recreation services	13.6%	15.7%	15.5%	13.6%	1.7%	100.0%	8.4%	18.7%	12.2%	13.0%
Other services (except public)	4.5%	7.4%	4.8%	4.9%	0.0%	0.0%	3.2%	5.4%	2.5%	3.3%
Public administration	9.3%	8.7%	12.4%	8.3%	21.6%	0.0%	12.6%	5.7%	11.0%	13.0%

SOURCE: US Census, compiled in community profiles, accessed through http://www.hawaii.gov/dbedt/census2k/profile-honolulu/index.html.

2.3 ISLAND AND REGIONAL HOUSING DEMAND

Hawai'i is recognized as struggling with a housing crisis. It is marked by a surge in prices in recent years, followed by rental increases. New housing production goes far toward meeting demand for housing for sale, but little new rental housing is being built. At the same time, some older low-income rental projects can now convert to market rentals or condominiums, reducing the inventory within reach of low-income families.

In 2000, the local housing market was sluggish. In much of the 'Ewa Development Plan Area, the cost of home ownership was below the island average. Still, the share of homeowners paying a large share of income for housing was as high or higher than the average. Rents in 'Ewa communities varied greatly, with the old plantation community of 'Ewa Villages offering low rents for retired workers, and other communities having higher rents on average than islandwide. (The 'Ewa Development Plan Area inventory also includes a much larger share of single-family rentals than in most areas of O'ahu.)

Table 6: County and Local Housing Indicators, 2000

	City and County of Honolulu	Ewa CDPs						Central Oahu CDPs (selected)		
		Ewa Villages	*Ewa Gentry*	*Ewa Beach*	*Iroquois Point*	*Barbers Point*	*Makakilo*	*Waipahu*	*Village Park*	*Waipio*
Household income in 1999										
Less than $25,000	21.3%	22.4%	8.4%	18.5%	15.2%	0.0%	9.0%	25.6%	5.8%	8.8%
$25,000 to $49,999	26.5%	24.7%	25.8%	24.5%	44.5%	27.3%	22.8%	24.7%	25.5%	30.5%
$50,000 to $74,999	20.6%	29.2%	32.8%	25.5%	20.3%	40.9%	28.0%	20.5%	25.1%	25.0%
$75,000 to $99,999	13.4%	16.9%	20.4%	16.3%	15.5%	0.0%	20.2%	11.5%	24.5%	15.0%
$100,000 or more	18.1%	6.8%	12.7%	15.2%	4.4%	31.8%	20.0%	17.5%	19.8%	20.7%
Median household income	$51,914	$51,451	$61,462	$57,073	$44,200	$65,625	$67,257	$49,464	$70,302	$61,276
Poverty status (below poverty level)										
Individuals	83,937	403	131	1,430	45	-	663	4,478	491	471
Related children under 18	25,060	134	13	505	20	-	261	1,387	191	150
Persons 65 and over	8,614	97	-	98	-	-	31	722	8	56
Crowding (share of households)										
1.01 to 1.50 persons/room	7.9%	18.5%	9.4%	16.4%	4.8%	0.0%	9.3%	17.0%	15.6%	8.3%
1.51 or more	8.2%	18.4%	11.0%	11.6%	-	-	7.3%	15.6%	12.1%	4.8%
Housing costs										
Owners, with a mortgage	81,605	778	618	1,583	-	-	1,154	2,443	1,497	1,747
Median owner costs, with mortgage	$1,653	$1,300	$1,713	$1,617	$0	$0	$1,653	$1,622	$1,657	$1,689
Owner costs as share of income										
30 to 34.9%	7.5%	17.5%	12.3%	10.6%	0.0%	0.0%	12.5%	8.4%	18.5%	9.2%
35% or more	22.0%	24.9%	37.6	23.6%	0.0%	0.0%	26.4	22.0%	25.9%	23.6%
Rented units										
Median gross rent	$802	$244	$957	$931	$1,152	$1,542	$1,056	$654	$1,016	$901
Gross rent as share of income										
30 to 34.9%	7.5%	10.0%	14.6%	8.1%	1.3%	0.0%	9.0%	6.6%	17.1%	7.9%
35% or more	28.8%	13.4%	33.1%	33.3%	3.8%	17.5%	32.5	27.6%	31.8%	29.0%

SOURCE: US Census, compiled in community profiles, accessed through http://www.hawaii.gov/dbedt/census2k/profile-honolulu/index.html

On O'ahu, the housing market typically includes about twice as many single-family home sales as condominium sales each year. Single-family homes form an even larger share of the market in Tax Map Key (TMK) Zone 9, the region including 'Ewa and Central O'ahu, where most new housing construction occurs.

Hawai'i housing prices typically have a boom phase followed by a plateau or slow retreat, as Figure 7 illustrates. In the mid-1990s, new housing production continued strong well after housing prices reached the plateau. Developers had unsold inventory. As a result, they are now much less willing to expand supply in response to short-term demand, and housing production has not returned to former levels.[2]

[2] Figure 8 and subsequent tables based on the SMS study of historical residential real property sales depend on analysis of a large sample of fee-simple units, not the entire housing inventory. The volume shown hence is not the total volume of new housing sales on O'ahu (used in Figure 7). The volume of total sales in the longer-term analysis excludes leasehold sales and some sales that may simply be ownership transfers, rather than new market transactions.

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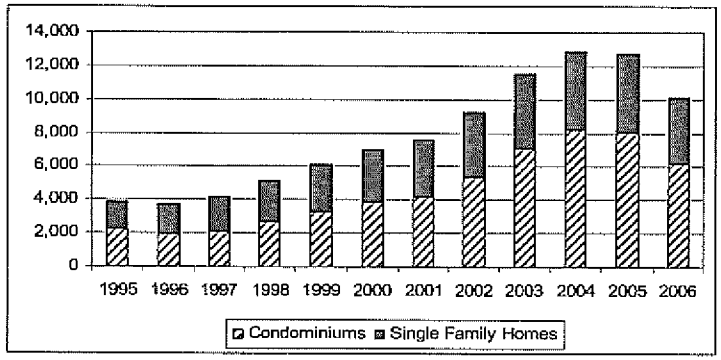
Housing prices respond to several factors, including mortgage rates, which affect the amount that families can borrow. While rates can go up or down, and buyers' resources can shrink or increase, construction costs have moved steadily upwards, limiting developers' ability to respond to changes in the market.[3]

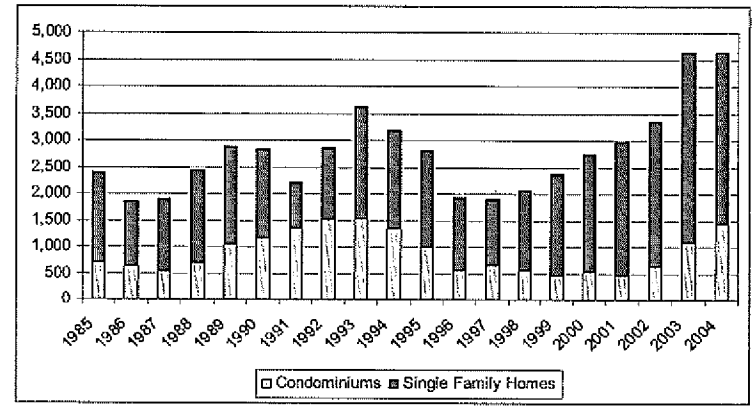
Figure 5: Volume of Residential Sales, O'ahu, 1995-2006



SOURCE: DBEDT (2007).

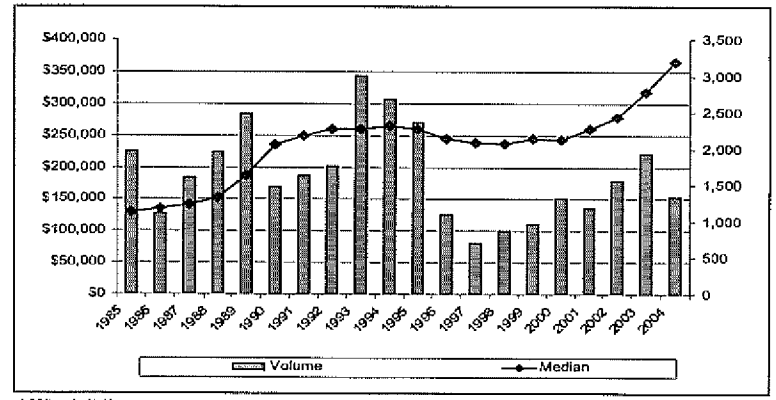
[3] The annual "affordable price" shown in Figure 8 is an estimate of the amount that a family with the median *income* could afford at prevailing interest rates in each year. It is not equivalent to the median price, i.e., the point at which half the units sold in the market are above, and half below.

Figure 6: Volume of Residential Sales, O'ahu Zone 9, 1985-2004



SOURCE: SMS (2005a).

Figure 7: Median Housing Prices and Volume of New Housing, O'ahu



SOURCE: SMS (2005a).

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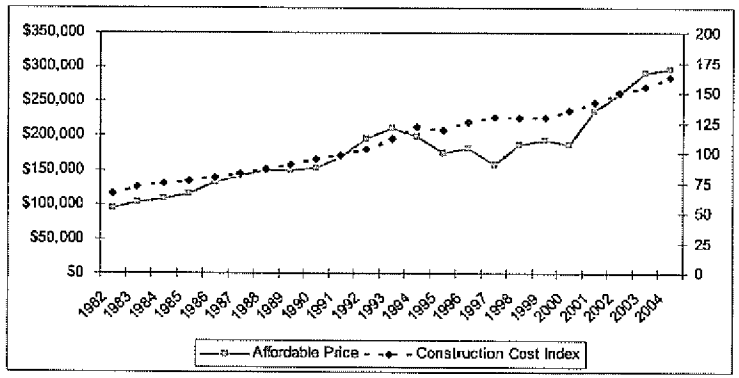
Figure 8: Affordable Housing Prices and Construction Cost Index, Honolulu

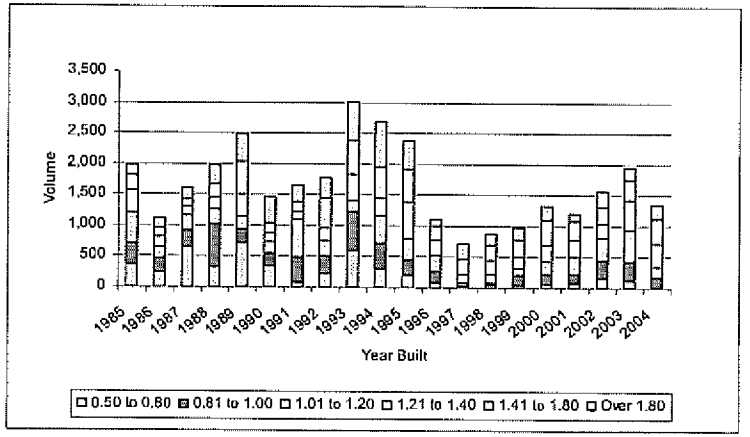


SOURCE: SMS (2005a).

When housing prices are converted to ratios of the annual affordable price, it is possible to compare the distribution of housing brought on the market from year to year. Figure 9 shows three major trends in new housing on O'ahu:

1. Nearly all new housing is being produced at prices that families with incomes higher than the median can afford. Units for sale at 80% of the affordable price have all but disappeared.
2. New housing is being produced for all sectors of the market above the 80% mark.
3. On O'ahu, the share of new units priced for families with 180% or more of the median income was highest in the early 1990s. More housing is produced for the 121% to 140% and the 141% to 180% segments.

Figure 9: Annual Distribution of New Housing by Affordability Level, O'ahu



NOTE: "Affordability level" is calculated in terms of what a household can afford to spend to pay for a mortgage on a home, in relation to the median household income for the County in a given year. The "0.50 to 0.80" entries refer to the number of units built that could be afforded by families earning 50% to 80% of the median income.

SOURCE: SMS (2005a).

SMS used this methodology to look at resales as well as new housing production, asking whether resales increased in value (expressed in terms of housing affordability). In an active market, older homes can be expected to decline in value compared to new units. In a tight market, older homes will likely increase in value, if new units are not being produced to meet demand. Figure 10 tracks resale values for four "cohorts" of homes that first sold (within the twenty-year time frame of the study) at different times. In the short term, resale values increase. Few resales of homes occur within a year or so, unless an opportunity for a short-term profit arises. Within two or three years, this factor disappears, and the slow decline in value to be expected in an active market follows.[4] (This analysis deals with value, not price. Over the twenty years studied, the price that families can afford has risen. Consequently, a home can resell for a much higher price, but lower value, than its initial sale price.)

[4] Markets on Kaua'i and Maui show increases in value characteristic of tight markets, unlike the long-term trends reported here for O'ahu. The analysis discussed here was conducted separately for various affordability levels, as well as for the total inventory of resales. The data showed the same trends for segments as for the total inventory.

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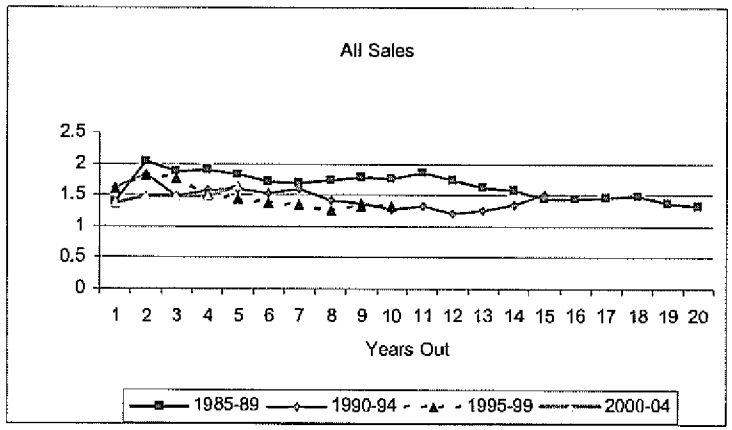
In 'Ewa and Central O'ahu (Zone 9), the long-term trend for the value of existing homes to decline over time has been stronger than for the island as a whole. However, recent sales show an increase in value over as much as five years, not just one or two. This suggests that current market conditions are tight in the area.

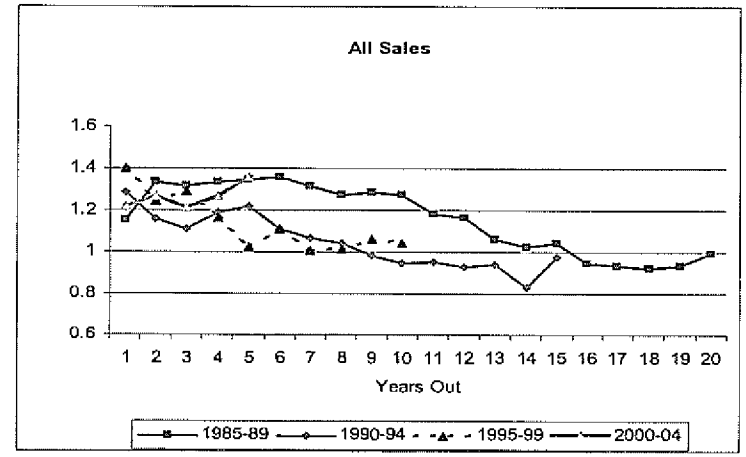
The average value of housing units sold in 'Ewa and Central O'ahu tends to be lower than for the island as a whole.

Figure 10: Resale Affordability, All Units, O'ahu, 1985-2004



SOURCE: SMS (2005a).

Figure 11: Resale Affordability, All Units, O'ahu Zone 9



SOURCE: SMS (2005a).

2.4 Development of 'Ewa Region

2.4.1 Geography and History

The two major land forms in the 'Ewa region are the 'Ewa Plain and Makakilo upland. The H-1 Freeway and Farrington Highway run along the boundary between the two land areas. The 'Ewa Plain is an elevated coral reef covered by alluvium. Elevations vary from about 50 feet above mean sea level (msl) near the southern boundary at Kalaeloa (formerly NAS Barbers Point), to 2,300 feet msl at Pu'u Manawahua, the highest peak in the 'Ewa region.

The climate is dry in 'Ewa. However, the land was arable in earlier times. There were once large terraced areas near West Loch referred to as 'Ewa taro lands. Hawaiians used pits in the coral for planting. Before contact with Europeans, settlement and agriculture on the plain were concentrated on the eastern, Pearl Harbor side.

Kamehameha III awarded the 'ahupua'a of Hono'uli'uli – including nearly all of the 'Ewa Development Plan area – to Chief Miriam Ke'ahikuni Kekau'onohi in 1848. She in turn leased it to ranchers. James Campbell bought Hono'uli'uli

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from a rancher in 1878. Campbell had the first artesian well drilled on his ranch in 1879, and subsequently developed well systems which allowed the cultivation of sugar cane in Hono'uli'uli. Campbell leased approximately 2,000 acres of land to Castle and Cooke in 1890 to grow sugar. A plantation settlement was established around the mill site on Renton Road and 'Ewa became a plantation community. 'Ewa's sugar and plantation communities flourished for decades.

After World War II, no new investment was made in the plantation villages. Castle and Cooke dissolved the Ewa Sugar Company in 1970 and sold its operations to AMFAC, thus merging 'Ewa Plantation with O'ahu Sugar Company. Cane cultivation continued but processing was done at O'ahu Sugar's Waipahu mill. O'ahu Sugar Company's lease with Campbell Estate, and sugar production in 'Ewa ended in 1995.

Harland Bartholomew and Associates prepared the first 'Ewa Master Plan in 1955 for Campbell Estate. The plan was revised in the early 1960s, and updated in 1974. By then, the concept of a self-contained city evolved. In 1986, Campbell Estate proposed a detailed implementation plan for a city center, bordered by Makakilo, Campbell Industrial Park, and NAS Barbers Point and renamed it Kapolei. The city center concept accorded with General Plan policies to develop a secondary urban center in west O'ahu.

The closure of O'ahu Sugar Company opened up land on both sides of the 'Ewa plain for redevelopment. Major developers on the east side were the City and County of Honolulu, the Gentry Companies, and HASEKO. On the western side, the State of Hawai'i housing development agency took the lead as master developer of the Villages of Kapolei, while the Campbell Estate developed its commercial and industrial lands. The Ko 'Olina resort area was planned and its key infrastructure was built by a consortium headed by Hawai'i developer Herbert Horita. When the economy slowed, the project stalled, and the Ko 'Olina lands were acquired by others. Recently, Aina Nui Corporation has petitioned for redesignation of "Kapolei West," land in Ko 'Olina on which the Ko 'Olina resort did not exercise options to develop. The City and County has withdrawn from the role of housing developer. The State's role is much reduced. The U.S. Navy had maintained NAS Barbers Point, housing areas at Iroquois Point and Pu'uloa, and ammunition storage areas in Pu'uloa. It has transferred limited rights to Iroquois Point to a private development partner. In 2002, the Hawai'i Community Development Authority was designated as responsible for redevelopment of Kalaeloa (Barbers Point). It recently completed a Master Plan for the site (2005).

2.4.2 Communities Surrounding the Ho'opili Project Area

This section provides brief accounts of the surrounding communities, with an emphasis on their role in the emerging Leeward O'ahu urban area. Existing

communities include Waipahu, Central O'ahu, a series of developments along Fort Weaver Road, and the residential areas to the west, reached from the H-1 Freeway via the current Makakilo/Kapolei interchange.

Most of the area in the eastern and western sections of the 'Ewa Plain is currently either in interim use as crop land or pasturage. Above the H-1 Freeway, Grace Pacific has one of the island's few major working quarries, reached by way of Farrington Highway.

2.4.2.1 Waipahu

The term "Waipahu" originally applied to a spring in the Waikele ahupua'a. The term was applied to land areas ('ili) surrounding the spring by the mid-nineteenth century (Nedbalek 1984), and later to the mill up the hill from the spring and to the town that spread around the mill.

Waipahu grew as a mill town. However, many residents took service and professional jobs in Pearl City and Honolulu by the 1980s. As sugar lands were taken out of agriculture, new residential and commercial development has surrounded the older town. Land at the mill site has been redeveloped and includes a Filipino Community Center, the Leeward headquarters of the YMCA, and an industrial park. The mill's smokestack remains as a landmark.

In 2000, the Waipahu CDP included more than 33,000 residents. The average household size, 4.23, is large, in part due to multifamily and multigenerational households.

2.4.2.2 West Loch

The first phase of this 491-acre City-sponsored project was completed in 1990 at the northern end of Fort Weaver Road. West Loch contains single and multifamily housing, a golf course, and parks. Some 60% of the homes were developed as "affordable" for families earning 120% of the median county income or less at the time of sale. This community is fully built out, with mature landscaping.

2.4.2.3 'Ewa Villages

The 'Ewa mill was built on Renton Road in the 1890s, and plantation villages were built nearby over the next decades. At one time there were eight villages, housing immigrant plantation workers from Portugal, Spain, Korea, Japan, and the Philippines. Some 1,200 housing units were built. Four of the newer villages – Renton, Tenney, Varona, and Fernandez – are still standing, while "C," Mill, Middle, and Lower Villages have been razed.

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Renton Village, built between 1913 and 1938, is the core of the villages. It included the mill, post office, school, and hospital. Churches built in the plantation era are still standing.

In 1990, this was an old plantation community. Almost half of the Village households received Social Security income, and one-third received retirement income. Since then, the Villages have been redeveloped through a mixture of renovation, infill development, and creation of new subdivisions. Still, 35% of households in the 'Ewa Villages CDP were mildly or severely crowded in 2000. The 2000 Census showed that nearly half the residents had moved into 'Ewa Villages after 1995.

The City's housing development efforts were reduced before 2000. First, the slow economy curtailed housing prices and sales of new units. Next, embezzlement by City officials responsible for moving residents and shops in the existing Villages was uncovered. In the City's reorganization in 1998, the Department of Housing and Community Development was dissolved, and the City is no longer active as a developer.

2.4.2.4 'Ewa by Gentry

The Gentry Companies have approvals for approximately 9,000 housing units, most of which have been built. Soda Creek, the first subdivision within the area, opened in 1988. By 2000, nearly 5,000 persons lived in 'Ewa by Gentry. Its elementary school, Holomua, opened in 1996, now has the largest K-6 enrollment in Hawai'i, with 1,444 students in 2007 (DOE Press Release, September 20, 2007, available at http://lilinote.k12.hi.us/STATE /COMM/DOEPRESS.NSF.)

2.4.2.5 'Ewa Beach

'Ewa Beach began as a weekend recreational area in the 1940s and eventually became a permanent residential community. It contained 3,426 housing units in 1990, and 3,315 is 2000 – the community has not grown while the nearby subdivisions have come into being. As in 'Ewa Villages, crowding is much more prevalent than islandwide or in the newer 'Ewa communities.

'Ewa Beach is home to 'Ilima Intermediate and Campbell High School. These served all of the 'Ewa Development Plan area until the corresponding Kapolei schools were opened in 1999 and 2000.

2.4.2.6 Ocean Pointe

Located at the southwestern end of Fort Weaver Road, Ocean Pointe has long been planned by HASEKO Hawaii. It has been developed to date as a

residential community, with 2,850 units built by mid-2004 (City and County of Honolulu, 2005), but it will also include a marina, as well as commercial and resort acreage. Ke'one'ula Elementary School opened its doors in January 2007.

2.4.2.7 Iroquois Point

Located east of 'Ewa Beach, the Iroquois Point and Pu'uloa housing areas long served the military population based at Pearl Harbor. Under the Ford Island redevelopment process, these areas are now leased to a private developer, which is renovating much of the housing stock and leasing units both to military and civilian tenants.

2.4.2.8 Kapolei

Kapolei is both the term used for much of the development area in 'Ewa and an urban center on the western side of the plain. Major components are:

- The City of Kapolei, with office buildings developed by the Estate of James Campbell and its successor firms, and by Bank of Hawaii, the State of Hawai'i, and the City and County of Honolulu.
- Extensive retail areas – shopping centers, a K-Mart, and a movieplex.
- The Villages of Kapolei, to the east of Fort Barrette Road, with 4,300 units planned. The first increments opened in 1990. As of mid-2005, more than two-thirds of the project had been built. The remaining increments are largely committed to development by DHHL for Native Hawaiians.
- Additional housing areas – Kapolei Knolls and the planned Mehana project – by D.R. Horton - Schuler Division.
- A senior housing village, Leihano, is being planned by Brookfield Homes and Kisco Senior Living.
- Public elementary, middle, and high schools, preschools, and a new non-sectarian private school.
- James Campbell Industrial Park and the Kapolei Business Park, with space for industrial, light industrial, and commercial development. The industrial park includes power plants and Hawai'i's two refineries, as well as a mix of other uses. Additional industrial space is being planned in the 345-acre Kapolei Harborside project.

Kalaeloa Harbor, located between Campbell Industrial Park and Ko 'Olina, is O'ahu's second deep-draft harbor. Previously named Barbers Point Harbor, it began development in 1990, and already handles more cargo than any Neighbor Island port. The harbor and the Industrial Park are included in Foreign Trade Zone No. 9.

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The City's transit plans call for a fixed guideway alignment serving the Kapolei area.

2.4.2.9 Makakilo

Makakilo opened for occupancy in 1962, with single and multifamily, mid-priced homes. Finance Realty was the major developer at Makakilo, which encompasses 1,202 acres located above Kapolei. Makakilo stands out as the most affluent of the 'Ewa CDPs.

Makakilo had 9,828 residents in 1990 and 13,156 in 2000. It continued to grow while the older communities in eastern 'Ewa did not.

2.4.2.10 Ko 'Olina

Ko 'Olina is a planned resort community at the southwest end of the 'Ewa region. It currently has a hotel, the first increments of a timeshare complex, and residential areas. While the oldest residential area, a townhouse project, serves residents, more recent subdivisions have attracted second-home buyers. A marina has been built and is in use.

2.4.2.11 Kalaeloa (NAS Barbers Point)

Barbers Point became a major Navy air facility during World War II. The base was listed for closure in the 1993 Base Realignment and Closure process. It closed in 1999, although the Navy retained much of the land at that time. Transfer of the land has stalled. Local government agencies have reconsidered their earlier proposals for development on the site. The former base includes an airport, now managed by the State Department of Transportation, the Coast Guard's Hawai'i airwing, the National Guard's Youth ChalleNGe program, housing for homeless veterans and families, and facilities retained by military agencies. Due in part to the cost of replacing infrastructure, redevelopment rather than simply reusing the existing facilities has been limited.

The 2000 Census data in this report reflects the closure. In 1990, the base had 2,200 residents and supported 1,600 civilian jobs. Since the closure, airport operations have been transferred to the State of Hawai'i, and the Hawai'i Community Development Authority (HCDA) has been charged with redevelopment. The Navy transferred some housing parcels to a private developer, and on-base housing is now available for civilian rentals. Transfer of much of the land area is stalled. Redevelopment will demand extensive work on infrastructure. HCDA has long-term plans for a mixed-use community on site.

2.4.3 Mobility

Two distinct sorts of mobility deserve note: movement of new households into the region and daily movement to and from work or school. Over the economic slowdown of the 1990s, residents of many communities in 'Ewa established themselves. However, jobs have not moved west as quickly as households, so long-distance commuting is common.

As of 2000, more than half the population in most 'Ewa communities had lived in the same house for five years or more. This figure is about the same as for the island as a whole (the exceptions are the two military areas, where most residents moved in the preceding year or two). However, the share of residents who had lived in the same house for a decade or more was well below the island average, except in 'Ewa Beach.

The CDP communities do not include some of the major development sites, and new residential development in 'Ewa has climbed since 2000.

Table 7: Geographic Mobility, 2000

	City and County of Honolulu	Ewa CDPs						Central Oahu CDPs (selected)		
		Ewa Villages	Ewa Gentry	Ewa Beach	Iroquois Point	Barbers Point	Makakilo	Waipahu	Village Park	Waipio
Geographic Mobility										
Where lived in 1995 --										
Population age 5 and over										
Same house in 1995	56.0%	56.7%	51.9%	54.5%	6.9%	4.5%	55.4%	58.6%	63.4%	60.3%
Different house, same county	26.1%	37.4%	32.1%	27.7%	4.5%	27.1%	32.5%	31.3%	26.5%	26.1%
Different county, same state	1.2%	0.0%	0.2%	1.2%	0.5%	0.0%	0.8%	1.1%	0.8%	1.2%
Different state	11.7%	0.0%	10.7%	4.0%	80.6%	52.0%	7.8%	2.3%	6.4%	8.7%
Elsewhere	4.7%	5.1%	5.1%	2.5%	7.5%	15.7%	3.1%	6.7%	2.9%	3.7%
When moved into unit --										
Householders										
1999 to March 2000	20.1%	20.9%	27.8%	15.3%	49.9%	82.4%	19.9%	17.0%	21.4%	22.6%
1995 to 1998	26.5%	32.4%	23.9%	18.0%	47.6%	17.6%	30.0%	22.6%	20.7%	23.2%
1990 to 1994	14.4%	0.4%	39.5%	14.0%	2.6%	0.0%	20.2%	12.7%	23.7%	17.5%
1980 to 1989	15.2%	19.5%	7.3%	18.5%	0.0%	0.0%	14.1%	14.9%	33.2%	28.4%
before 1980	23.8%	17.9%	1.6%	34.0%	0.0%	0.0%	16.1%	32.8%	1.1%	8.3%

SOURCE: US Census (www.census.gov).

Census data show the majority of 'Ewa workers as commuting to work in 2000. Use of public transportation was higher than the island average among workers from 'Ewa Villages, 'Ewa Beach, and Iroquois Point. Again, most workers with jobs in the leeward region commuted in their own cars.

Planning for the Second City envisaged residents as working near home, so that long-distance commuting could be minimized. A recent study suggests that no more than 29% of 'Ewa and Wai'anae Coast workers have jobs in their own home region. More residents work in Pearl City and Central O'ahu than in their home area.

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Table 8: Commuting Patterns by Place of Residence, 2000

	City and County of Honolulu	Ewa CDPs: Ewa Villages	Ewa Gentry	Ewa Beach	Iroquois Point	Barbers Point	Makakilo	Central Oahu CDPs (selected): Waipahu	Village Park	Waipio
Commuting to Work										
Drove alone	61.4%	61.2%	67.5%	62.8%	52.8%	78.2%	69.3%	57.7%	65.1%	70.8%
Carpooled	19.4%	19.6%	21.3%	20.5%	14.1%	20.8%	22.3%	21.1%	24.6%	21.0%
Public transportation	8.3%	15.3%	7.9%	11.2%	19.3%	0.0%	4.3%	15.0%	6.8%	5.1%
Mean travel time to work (minutes)	27.3	35.6	37	39.6	38.0	25.4	35.3	33.2	33.3	31.7

SOURCE: US Census (www.census.gov).

Table 9: Commuting Patterns, by Place of Work and Mode of Transport, 2000

	City and County of Honolulu	Ewa NB	Makakilo/Kapolei/ Honokai Hale NB	Waipahu NB
Total Workers, 2000	393,245	3,010	11,560	11,165
Drove Alone	61.4%	62.0%	75.4%	71.3%
Carpool	19.3%	17.0%	15.3%	16.4%
Mass Transit	8.1%	3.8%	3.1%	4.7%
Other	11.2%	17.2%	6.1%	7.6%

SOURCE: US Census, compiled by the City and County of Honolulu Department of Planning and Permitting. Available at http://honoluludpp.org/planning/demographics2/2000/NA/economic.pdf

Table 10: Inter-regional Commuting Patterns, 2005

Residential Areas (1)	Residents	Share of residents working in: Pearl City + Central	Downtown + Kaka'ako	E Honolulu + Waikiki	Windward Oahu	Rest of Oahu
Ewa / Wai'anae DP Areas	39,286	55.1%	13.0%	1.9%	0.8%	29.2%
Central Oahu / N. Shore / Pearl City	107,024	40.4%	16.1%	4.2%	2.0%	37.3%
Windward Oahu	52,219	19.1%	13.4%	0.6%	35.9%	30.0%
East Honolulu and Waikiki	59,464	18.9%	31.4%	30.8%	1.7%	17.4%
Rest of Primary Urban Center	108,630	33.2%	25.0%	7.6%	1.9%	32.3%

NOTE: Based on survey data, weighted to estimate population size. Residential and worksite areas are close to, but may not be precisely aligned with, the regions used to label them.
SOURCE: SMS Market Study, as reported in SMS 2005b.

2.4.4 Community Amenities and Facilities

To develop a new urban center, the City and State have relocated agencies to Kapolei. Residents are served by local police and fire stations, a satellite city hall office, and a public library.

Commercial development has proceeded quickly in Kapolei and along Fort Weaver Road. Kapolei has shopping centers, medical offices, and a movie theater. The Fort Weaver Road area has a medical center, a social service complex, and neighborhood malls. Neither has a regional mall, although Kapolei has "power centers" at K-Mart and Home Depot. The Waikele shopping center and outlet center, in Waipahu, is the nearest regional mall serving the area.

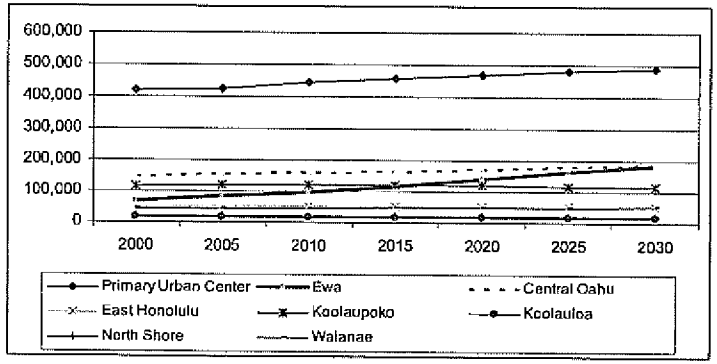
Kapolei has O'ahu's largest private recreation area, Hawaiian Waters Adventure Park. Community parks and golf courses are scattered throughout the 'Ewa region. Kalaeloa has extensive areas which have been designated for park development. However, funds for further development have not been programmed. The sand beaches are now accessible to the general public. Beaches at Ko 'Olina and 'Ewa Beach are also used by 'Ewa residents.

2.5 Emerging Trends

Population and job growth are expected to continue. The 'Ewa Development Plan area is expected to see a growth rate far higher than in any other area of O'ahu over the next twenty years. To accomplish that growth, more than 34,600 housing units would be needed in 'Ewa between 2000 and 2025.

For a detailed analysis of housing demand in relation to the proposed Ho'opili project, see the market study for Ho'opili (Mikiko Corporation, 2007).

Figure 12: Forecast Population Increase



SOURCE: Honolulu Department of Planning and Permitting. Available at http://honoluludpp.org/planning/demographics2/Projections/2030byDP.pdf

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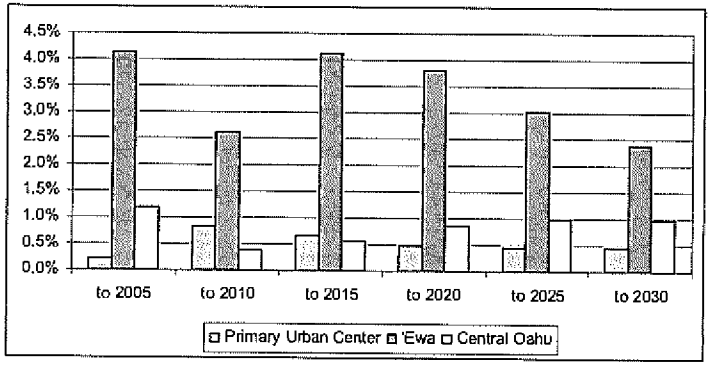
Figure 13: Annual Forecast Rate of Increase in Housing, 2000 to 2030, for Major Development Plan Areas



While Kapolei was planned as an urban center second to Honolulu, large facilities serving the larger region have tended to be located on its outskirts. Home Depot, for example, is located west of the urban center. More importantly, two projects being planned for the center of 'Ewa, the UHWO campus and a Ray and Joan Kroc Community Center, will be located east of the Villages of Kapolei on the new North-South Road. Commercial areas have also been proposed next to the campus and on DHHL land near the community center.

Chapter Three
Community Issues and Concerns

3.1 Sources

Major sources for understanding community viewpoints in Leeward O'ahu include Neighborhood Board discussions and public reactions to planning reported in City planning documents, EISs, and the newspapers. For the island as a whole, survey information is also available.

D.R. Horton – Schuler Division has convened a series of discussions with community stakeholders to help the developer shape the project to meet regional needs and avoid unwanted impacts. For this report, Belt Collins has reviewed minutes, attended meetings, and followed up with selected community stakeholders on issues raised in the meetings. Table 11 lists the members of the Ho'opili Community Task Force advisory group.

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Table 11: Ho'opili Community Task Force

HOOPILI COMMUNITY TASK FORCE	
Maureen Andrade	Village Park Community Association
Gary Bautista	'Ewa Neighborhood Board
Dick Beamer	"Honorary Mayor" of Ewa Beach
Scott Belford	HOSEFF Non-profit
John Condello	Hawaii Theological Institute
Kurt Fevella	'Ewa Neighborhood Board
Pearlyn Fukuba	Hawaii Community Development Authority, Kalaeloa
Frank Genadio	Makakilo resident
Kevin Gilbert	Hawaii Theological Institute
Michael Golojuch	Palehua Community Association
Carolyn Golojuch	Makakilo resident
Sharon Har	Kapolei resident
Teri Ikehara	West Loch Estates Board President
Coby Lynn	Ewa Beach Lions Club
Eileen Lynn	Ewa Beach resident
Tesha Malama	Ewa Beach resident
Richard Oshiro	Waipahu Neighborhood Board
Rodolpho Ramos	'Ewa Task Force
Frances Rivero	Ewa Beach Boys and Girls Club
Ross Rollrad	Rotary Club
Georgette Stevens	West Oahu Economic Development Association
Summer Thompson	Ewa Beach Boys and Girls Club
Keith Timson	Makakilo resident
Maeda Timson	Kapolei Neighborhood Board
Karen Wenke	'Ewa resident; small business owner
Chuck Wheatley	Guardian Angels, Waipahu
Lance Widner	Royal Kunia Community Association
Stephanie Widner	Royal Kunia resident
George Yakowenko	Waipahu Neighborhood Board
Annette Yamaguchi	Waipahu Business Association
Linda Young	Kapolei Neighborhood Board; Malanai Iki Assoc.

NOTE: List taken from Ho'opili Community Task Force Vision Statement. Members may have attended some, but not all, meetings. Several others, not listed, attended only one meeting.

Belt Collins also interviewed local stakeholders, complementing the process organized by the developer. Informants were asked to share ideas – both their own and those of others in the community. Affiliations are listed as an indicator of their experience and knowledge of the community. Neither informants nor community groups should be viewed as taking a position for or against the project because they are listed in the table.

Table 12: Informants Contacted for this Report

Patti Bates	Child & Family Service
Bob Campbell	West Loch Fairways Board of Directors
Donna Campbell	West Loch homeowner
Lincoln Chan	West Loch Fairways Board of Directors
Robert Creps	Grace Pacific Corporation
Yvonne Dembinski	West Loch Fairways Board of Directors
David Ellis	Kahi Mohala
Stanton Enomoto	Hawaii Community Development Authority, Kalaeloa; now with Office of Hawaiian Affairs
Larry Jefts	Sugarland Farms
Leonard Licino	Kahi Mohala
Laurie Murphy	West Loch Fairways Board of Directors
Mark Mitchell, MD	Kahi Mohala
Richard Oshiro	Waipahu Neighborhood Board
Diane L. Reece	Child & Family Service
Alec Sou	Aloun Farms
Chris Steele	Grace Pacific Corporation
Maeda Timson	Kapolei Neighborhood Board

NOTE: The persons listed were asked to provide information about concerns and views of the community, not to speak on behalf of their agencies or groups. Affiliations are listed to indicate the range of persons interviewed, not to claim that the organizations in question have taken any particular stance in relation to the Ho'opili project.

3.2 Issues and Concerns Voiced in Community Planning

The Department of Planning and Permitting reviewed Neighborhood Board minutes for 2000 through 2003 from the two 'Ewa Development Plan area boards and analyzed the frequency of concerns voiced in the meetings. The leading topics were:

- Transportation infrastructure: 43% of concerns;
- Public facilities (primarily schools, parks and parking): 29%;
- Development projects: 13%; and
- Environmental infrastructure (solid waste, water supply, sewerage): 10%.

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Residents expressed concerns with both regional circulation and inter-regional movement, i.e., mass transit. (The analysis was prepared for discussion with community stakeholders. It was accessed in December 2005 at http://honoluludpp.org/Planning/ewa/ewa5yr/StatusReportApril12.pdf.)

The Neighborhood Board minutes for 2004 and 2005 show continuing interest and concern about these themes. However, a shift of concern is apparent. Less time has been spent recently on plans for new roadways, and more on traffic flow on major streets, such as Makakilo Drive and Fort Weaver Road. Interest in ease of movement and connectivity is balanced by concern for pedestrian safety.

Major local development topics discussed included new roads, schools, the UHWO and DHHL projects in mid-'Ewa, a new electrical generating plant in Campbell Industrial Park, and plans to close Waimanalo Gulch landfill. Residents sought information about community benefits offered by Hawaiian Electric and by the city in connection with the electrical plant and landfill.

In a 2005 survey, residents of 'Ewa and Central O'ahu stood out as having longer average commuting times – 44 minutes – than residents of other O'ahu regions, and as seeing weekday traffic as "a lot worse" in the last year (57% of respondents).[1] Traffic emerged as the second "most important issues facing the State" in this poll, after education, for the first time in 2005. (The question was first asked for this poll in 1999.) This viewpoint was expressed even more strongly in a poll for the O'ahu Regional Transportation Plan (Ward Research, 2006). Some 94% of 'Ewa and Wai'anae respondents felt that traffic was a serious problem for their region.

All stakeholders expressing viewpoints at the community advisory group meetings for Ho'opili, and in interviews for this report, emphasized problems of traffic congestion and slow infrastructure development. Most mentioned their support for rail transit to help address the region's traffic problems, but added that it will not be sufficient to ease the region's traffic problems. Additional actions – movement of many jobs to Leeward O'ahu, a ferry system, and new bridges and roads between 'Ewa Beach and Honolulu – were cited as needed or worth further consideration to improve residents' quality of life.

In the O'ahu Regional Transportation Plan survey, 55% of 'Ewa/Wai'anae respondents said that they would use rail rapid transit regularly when it becomes available.

[1] The "People's Pulse" poll of January 2005 had a sample of 400 from O'ahu, 700 statewide. The "Ewa/Leeward" category reported here is distinguished from four other O'ahu areas (Honolulu, Windward, North Shore, Wai'anae) and presumably is equivalent to 'Ewa and Central O'ahu combined (accessed at http://www.prp-hawaii.com/prp/marketing/news.jsp, January 4, 2006).

'Ewa residents see the State and City as lagging far behind developers in providing for new residential areas. As a result, they would like to see developers insuring that needed infrastructure – roads, schools, parks – is in place early, not after a development is nearly built out. Some wanted the developers to pay for infrastructure, and then recoup others' share of the cost as other new developments are built.

3.3 Issues and Concerns with Regard to the Ho'opili Project

At the Ho'opili Community Task Force meetings, some local stakeholders said explicitly that the Ho'opili project had their support. They cited the project's ability to help to mitigate regional traffic problems and its contribution to regional land use planning as crucial (in the course of several meetings, they found that the project's commitment to transit, its bike trails, and its overall plan were a contribution to the region). Others recognized that the development was already within the planned urban area, but still wanted to hear how the project would help to alleviate traffic problems.

During group discussions of amenities in the project, considerable interest was expressed in features that could attract residents of the surrounding area. The park area located along Fort Weaver Road interested some as an amenity serving the Fort Weaver Road communities. The proposed town center was seen as attractive, especially if designed to allow farmers' markets or street fairs.

Interviewees included (a) a few of the stakeholders who had participated in the task force meetings and (b) persons knowledgeable about nearby institutions. Interviewees were asked about their general impressions and expectations of the project. They were then shown a preliminary map of land uses in the Ho'opili project area (Figure 2).

All stakeholders spoke about traffic and infrastructure issues. They stressed the impact of the project on the area's traffic congestion as a major issue. Some noted that, while state agencies were responsible for supplying highways and schools needed by residents, members of the regional community would be opposed to development if it worsens congestion. Respondents tended to discuss traffic as affecting the larger community, and schools as affecting future residents of Ho'opili.

Several stakeholders had heard that the developer was reserving space for a private school. They supported an increase in the number of private schools in the region. Participants in the community task force meetings favored this idea on several occasions.

A few stakeholders discussed the withdrawal of agricultural land due to urbanization of the property. They recognized that the process has long been

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anticipated. Community members expressed interest in seeing developers solve regional drainage problems, which have led to flooding in 'Ewa Villages in the past.

The idea of a walkable community was welcomed by some stakeholders, both as reducing dependence on automobiles and as encouraging a valued lifestyle. A few cautioned that it will be important to provide attractive streetscapes, with shade trees, to encourage walking.

Several stakeholders viewed Ho'opili as an extremely large development. In the community task force meetings, participants came to agree that the size of the project was understandable in relation to expected population growth on O'ahu. They also saw the project as being large enough to make up for the limitations of current development in the area. Still, when respondents were interviewed individually or in small groups, they were more likely to remark on the size of the project, the number of residents, and the potential traffic generated.

Some stakeholders with properties nearby expressed concern that young people from Ho'opili would add to traffic through their areas, not just along the main roads. They were concerned about both automobile and bicycle traffic.

Some stakeholders anticipated that the Ho'opili project would bring at least one more traffic light on Fort Weaver Road, and at least one on Farrington Highway. They saw this, along with population growth in the project, as adding to the major traffic problems experienced in the region.

Some informants were concerned that the project's residents would begin to experience parking and traffic problems on side streets as Ho'opili families mature, and have several cars in each household. They pointed to side streets in Makakilo as examples of roads that once seemed adequate but now are crowded.

One local resident pointed out that the proposed rail system would only be completed after the first generation of homebuyers in Ho'opili have lived there for at least a decade. As a result, children in those families would grow up in auto-dependent households, and would tend not to rely on bus and rail transportation. Later, perhaps, Ho'opili residents would come to prefer mass transit.

Chapter Four
Impacts and Mitigations

4.1 Introduction

This chapter deals with impacts of the Ho'opili project on social life. "Impacts" are distinguished from "issues," discussed in the last chapter. Impacts are, in the professional judgment of the analyst, likely consequences of project development, attributable at least in part to the development. "Issues" are identified as of concern to members of the community; they may point to impacts, but do not necessarily do so.

An impact makes a difference: if an issue is already felt to be a problem, and it will continue after development of a project, it is not an impact unless the project makes it happen more often or more severely. In this report, attention is paid to both beneficial and adverse impacts – in part because impacts viewed as beneficial to some may be seen as adverse to others. Where impacts appear to be adverse, ways to mitigate the impact are considered in Section 4.5.

As a major urban development, Ho'opili will affect its immediate neighbors, other communities on or near its major access roads, and the island as a whole.

Impacts may arise during planning, construction, or the operational lifetime of a project. Some impacts are likely to be transitory: construction impacts on traffic and nearby homes are limited by government regulations and usually only occur for a period of weeks or months. Others may increase over time, as the developed area becomes larger and community residents come to use facilities in the new project.

4.2 Affected Parties

Stakeholders who may be especially affected by the Ho'opili project fall into six groups:

- Future residents and businesses in the project: These are the most immediate beneficiaries of project development, and the persons most extensively affected.
- On-site agricultural operations and employees: Two firms hold the major leases on the property, and additional farmers are sub-lessees. The two firms are the largest suppliers of truck crops (locally grown fresh produce) on O'ahu, Sugarland Farms and Aloun Farms. As development proceeds, lands now leased short-term for agricultural

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use will be withdrawn, and the tenants will need to consolidate their operations and relocate them. The impact is discussed in detail in a separate report (Decision Analysts Hawaii Inc., 2007). The social impacts involve disruption of activities and, with higher production costs as agricultural operations move from the 'Ewa Plain, eventual increases in the cost of production, and hence the price of produce for consumers.[1]

Withdrawals will involve acreage larger than the land to be immediately developed. The tenants will need to provide buffers between agricultural and residential areas. While agricultural activities have constitutional protection in Hawai'i, the major agricultural operators seek to avoid confrontations with neighbors over dust, insecticides and the like. Accordingly, withdrawal of agricultural operations from the Ho'opili project land will be completed well before the project buildout (also, withdrawal of sites crucial in water distribution could affect all areas dependent on these for irrigation).

The two major tenants emphasized that land on the 'Ewa Plain is used in conjunction with other agricultural land to assure delivery of produce to Honolulu markets throughout the year. The 'Ewa lands have lower rainfall in winter months than fields at higher altitudes in Central O'ahu and, hence, are preferred for production in that period. Also, crop and variety choices depend on the specific characteristics of fields used. Relocation of agricultural operations will demand a careful review of varieties planted and cultivation techniques.

- Residents and operations on adjoining parcels: Properties adjoining or across the road from the project include two social service agencies (Child and Family Service and Kahi Mohala), older homes and small businesses along Old Fort Weaver Road, a Hawaiian Electric transformer substation, and lands to be developed by the DHHL. Much of the land on the *mauka* side of Farrington Highway is largely in agricultural use. Parts of 'Ewa Villages are directly south of Ho'opili, separated from it by part of that community's golf course.
- Residents of communities along Fort Weaver Road: This area has seen continuing growth since the early 1990s. Traffic congestion is a grave problem and concern. The communities were developed as plantation towns ('Ewa Villages, 'Ewa Beach), military housing areas (Iroquois Point and Pu'uloa), or residential subdivisions ('Ewa by Gentry, newer parts of 'Ewa Villages, West Loch, Ocean Pointe). None provides a center for activity or organization of the region as a whole.

[1] While agricultural operations will be disrupted by being moved off-site, this change has been long anticipated. The lands at the Ho'opili site were opened for truck farming only on limited-term leases, in the expectation of urban development in the near future.

- Operations on Farrington Highway: Currently, two commercial activities are located on Farrington Highway between the project site and Fort Barrette Road: the Gentry Pacific quarry and the Kapolei Golf Course. Both loaded and unloaded trucks use the highway to travel to and from the quarry. The golf course depends on the highway for access by golfers.
- Residents and other stakeholders of the larger Leeward area. Drivers from Wai'anae and Kapolei will take the H-1 Freeway past Ho'opili, and will form part of the customer and workforce base for the project. For Waipahu residents, Ho'opili will be a new development close to home.

In addition, all participants in the O'ahu housing market will be affected by the development of a new community at Ho'opili. The island economy, and construction workers in particular, will benefit from the jobs and income created throughout construction.

4.3 SOCIAL IMPACTS

Table 13 provides a listing of specific social impacts. The table organizes impacts by phase, and then describes them as actions leading to effects felt by particular groups with implications for social life. The key social impacts are in most cases due to the implications of and reactions to activities at Ho'opili, not the immediate effect. Over time, the development of Ho'opili will help to bring about a complex process of community development and integration on the 'Ewa Plain. That process will be discussed after attention is paid to more specific impacts.

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Table 13: Major Socio-Economic Impacts of Ho'opili Project *(continued)*

Phase	Action	Effect	Affected	Implications
Operations – approximately 2012 to 2062 (continued)				
			Region as a whole	Secondary urban center, both FWR and NSR corridors meet local needs
		Contributions to 'Ewa Traffic Impact Fund	SDOT, DTS, area residents	Help to improve roadways for 'Ewa
		Urbanization along Farrington Highway	Regional residents, businesses	Connectivity, UHWO to FWR, alternatives to Farrington Hwy; alternative access from FWR to the H-1 Freeway
	Roadways planned to allow connectivity	Increase routes available across 'Ewa	Regional residents	More choices for in-region trips; lessen impact of regional urbanization on traffic congestion
	Planning for transit, bus, bike use	Encourage alternatives to automobiles, ridership for public transit	Residents, workers in project, O'ahu	Lower impact of population growth on traffic congestion Set an example of a planned community that encourages alternative transportation
	Schools in project	Serve residents and nearby communities	Resident of project and nearby areas	New high school may link Ho'opili, Kunia, West Loch areas. Private school would expand educational choices, opportunity for regional residents.
	Proposed District Park site off FWR	Offer new park amenity	Resicents along FWR	Serve as a shared resource for FWR communities.

Notes: Abbreviations:
FWR: Fort Weaver Road
NSR: North-South Road

Table 13: Major Socio-Economic Impacts of Ho'opili Project

Phase	Action	Effect	Affected	Implications
Planning – approximately 2006 to 2009				
	Notification, meetings, and permit process	Collaborative planning	Agricultural tenants on-site	Given ample warning of eventual phased withdrawal, can plan for relocation of affected operations
			Other developers	Collaborate on plans, infrastructure
			Community	Raise concerns about impacts, explore way to mitigate impacts and create community amenities
Construction – approximately 2010 to 2030				
	Phased clearing of lands	Withdrawal of leased agricultural lands	Agricultural tenants	Consolidate operations and/or move
		Dust, noise	Adjacent properties	Irritants, controlled by State and County regulations
	Phased on-site construction	Truck and worker traffic	Adjacent properties; FWR communities	Dust, nose, truck traffic
	Road construction	Reduced road area	Other road users	Congestion; can be limited to off-peak hours
	Construction	Employment	Construction workers throughout O'ahu	Income, jobs in Leeward area.
Operations – approximately 2012 onwards				
	Housing development	Increase supply of new products	Island housing market	Housing provided in response to local demand; Increases to inventory tend to control price increases
	Mixed-use, mixed density planning	Distinctive community identity	Residents	Encourage loyalty to community; moving up over time; Facilitate bike, bus commutes; reduce car trips
	Planning for transit, bus, bicycles, pedestrian use	Less reliance on automobiles	Residents	Lead to improved health
	Urbanization of site	Further withdrawals	Agricultural tenants	Relocate, consolidate operations. Less dust and soil erosion.
		Loss of open space	Wai'anae, Kapolei	Change in view during part of commute on the H-1 Freeway; change on *makai* side of road - *mauka* still open.
		More population, traffic in 'Ewa	Area residents	Congestion on FWR, Farrington Highway, North-South Road
		New commercial, industrial space	Area residents	Jobs, shopping nearby, reduced need for commuting towards the Primary Urban Center.
		Medical park space	Area residents	Increased access to health providers
			Local industry	Complaints about noise, dirt, spills from residents

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4.3.1 Planning Phase

During planning and permitting, the developer has consulted with lessees currently on-site, with other developers, with members of the surrounding community, and with government agencies. For the agricultural tenants, the discussions deal with operations, long-term coordination, and planning. These meetings will eventually give notice of when fields will no longer be available for cultivation, and allow lessees to schedule future planting and harvests. Discussions with other developers and public agencies help in coordinating plans, notably in encouraging connectivity between future DHHL, UHWO, and D.R. Horton projects. These discussions have helped developers and local community leaders give input together on regional roadways and planning for O'ahu's future mass transit system.

The Ho'opili Community Task Force has offered ideas concerning development choices and ways in which the Ho'opili project can be integrated with the surrounding area. It provides a channel for the developer to share facts and viewpoints with the community. Topics have included regional transportation, public and private schooling for the region, employment, and public spaces in Ho'opili for gatherings and recreation. Participants have identified community concerns and criticism of development, and discussed ways in which Ho'opili can be designed to correct or mitigate problems and contribute to the larger regional community.

4.3.2 Construction Phase

Construction will bring physical irritants such as noise, dust, slow traffic on roadways around the project, which can be controlled through adherence to regulations established by the State Department of Health and the City and County of Honolulu, and directing construction traffic to off-peak hours. Impacts are most likely to affect Ho'opili residents, residents of the new UHWO and DHHL East Kapolei area, and perhaps golfers on the 'Ewa Villages course located directly *makai* of Ho'opili. For the agricultural tenants, construction will continue the phased withdrawal of lands from agricultural use.

For construction firms and workers, development at Ho'opili will bring income. With steady work at Ho'opili over many years, construction workers will be increasingly likely to live in Leeward O'ahu.

4.3.3 Operations Phase

The Ho'opili project will include approximately 11,750 homes. That number amounts to approximately 4.5 years' supply of new housing for O'ahu.[2] The project is located in an area in which new housing is expected to serve the needs of O'ahu's middle-income residents, rather than the mix of upper income residents and part-time residents found in established upscale neighborhoods.

New housing production increased through 2003; housing price increases continued through 2005. Figure 9 shows that the number and share of new units produced for middle-income families – 80% to 120% of the County median income – declined after 2003. Production for lower-income households disappeared.

When sales data from the Multiple Listings Service – i.e., resales of existing homes – are compared, it is clear that the distribution of units sold by price range has changed in two ways. Fewer units are sold at the lower price ranges, and the number of units sold in each price range tends to be about the same. Buyers who can pay higher prices are finding homes; families with limited resources have less choice or no opportunity to enter the 'for sale' housing market.

O'ahu needs housing for middle-income families. By developing new housing for the middle-income group, Ho'opili is responding to that need. Moreover, new housing construction will help to limit price increases for both new and resale housing.

The proposed housing will be in neighborhoods that integrate low- and medium-density or medium- and high-density residential areas. As a result, Ho'opili will include a range of income levels, and will likely include mixed-income neighborhoods. In this respect, it will resemble Hawai'i Kai and Mililani: planned communities that have become home to thousands of O'ahu residents who choose to move up within their community as they grow older, rather than move to other communities. However, Ho'opili will differ in several ways from existing subdivisions. It is being planned as part of a regional community. It is designed to encourage walking, bicycling, and use of public transport. Live/work units will be integrated into the development.

[2] The average number of new units built on O'ahu was 2,556 for the years 2000 through 2005 (DBEDT 2006). There is clearly demand for a larger number of units; the most recent Housing Policy Study estimates new demand for about 3,050 new units annually as of 2007, growing to about 4,280 units by 2024 (SMS 2003).

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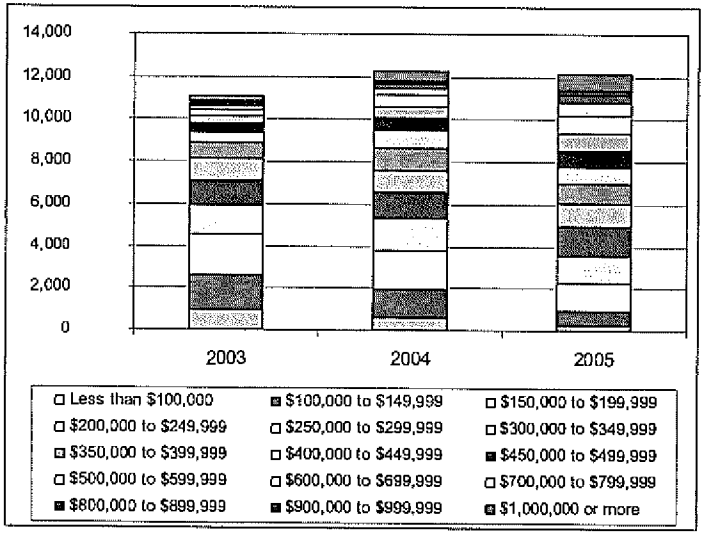
Figure 14: O'ahu Sales on Multiple Listings Service, by Price Range, 2003-2005



The presence of industrial and commercial areas will work to make Ho'opili a community, and not just a bedroom subdivision, for many residents. Some will be able to live and work within the community. Moreover, bus routes and bike paths connecting to every school in the project will encourage residents to live and work within the project with less dependence on their automobiles than in other developments. The project's design for alternative means of transportation will increase the number of young people who can reach their schools by bicycle – again, lowering automobile traffic.

Planning for Ho'opili will encourage community identity and encourage trips within, rather than outside, the development. The commercial core of the development will be a focus for socializing, shopping, and for special events.

Urbanization of the site will have mixed consequences. The first is continuing withdrawal of land from agriculture.[3] Agricultural tenants note that they will have to withdraw land to buffer new development from cultivation, as well as the land actually developed in early phases. Consequently, more land will be

[3] For discussion of the impacts of Ho'opili on agriculture, see Decision Analysts Hawaii, Inc. (2007).

withdrawn from agriculture during the early years of project development than will be urbanized. As noted earlier, the withdrawal will force agricultural tenants to move, and may increase operating costs. However, the land was slated for urban development even before truck crops and seed corn were planted on-site. Tenants had reason to know that cultivation was an interim use of the site.

From the H-1 Freeway, the major route used by residents of the Wai'anae Coast and the Kapolei area, the *mauka* view will remain open. *Makai*, drivers now see a berm, with occasional views of fields, succeeded by residential areas and the ocean in the distance. Development at Ho'opili (and the proposed elevated rail transit) will hence affect only part of the view plane from the highway. Project plans call for a landscape buffer along the H-1 Freeway right-of-way.

The visual impact of the project will be greater along Farrington Highway. Currently, there is little development along that roadway between Kapolei Golf Course and Fort Weaver Road. This will change with the development of the UHWO campus. Development of Ho'opili, along with the City-planned widening of Farrington Highway (and the proposed elevated rail transit), will extend the transformation of open space to urban areas. Also, Ho'opili will include destinations – notably commercial areas at the intersections of the highway with the North-South Road and Fort Weaver Road – encouraging travel along this roadway.

Urbanization will add to traffic on Fort Weaver Road and Farrington Highway through the project area.[4] On the other hand, development of the North-South Road and the H-1 Freeway access associated with the new roadway will help to limit congestion throughout the regional road system. New roads within the project will provide additional connectivity between Fort Weaver Road and the North-South Road and between the DHHL lands to the south of Ho'opili and Ho'opili itself.

Before Ho'opili is built, the new H-1 Freeway interchange will serve the North-South Road and Farrington Highway. This will be important for trucks to and from the Grace Pacific quarry and plant: they will travel to the new interchange, rather than along Farrington Highway past a major portion of the Ho'opili site. Accordingly, urbanization along Farrington Highway east of the new interchange will have little or no impact on this truck traffic.

Agricultural tenants and industrial managers expect that growth of residential areas will bring complaints about dust, litter, noise, and other irritants. As the

[4] For a detailed quantitative analysis of the project's impact on transportation and traffic congestion, see the Traffic Impact Analysis Report (Wilbur Smith Associates 2007). Traffic congestion is a social issue insofar as it affects the quality of life. As such, it is discussed in this report.

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area urbanizes, they will need to be increasingly sure that they do not intrude on residents' enjoyment of the area.

Eventually, rail transit could be built along North-South Road and Farrington Highway. Plans for Ho'opili have been drawn up with transit in mind, even though the exact route and placement of stations is still undecided. With transit, the project can further minimize dependence on automobiles by its residents.

The Ho'opili site fronts Old Fort Weaver Road. Properties on that road include older homes and a mental health facility. These have already been affected by development in the region, inasmuch as the daily afternoon rush hour commute fills this roadway as well as the major roads. With development of Ho'opili, the existing properties will be more visible to new neighbors. Development of commercial areas – both fronting Old Fort Weaver Road and along Farrington Highway just east of the northern end of Old Fort Weaver Road – will make commercial facilities more accessible to this neighborhood. However, project plans call for open space along much of Old Fort Weaver Road, limiting visual impacts.

A new road (referred to as the "proposed East-West Connector") will link Old Fort Weaver Road to the new North-South Road, through the Ho'opili project. While the project will add to traffic along the existing road, it will also provide an additional route that residents of Old Fort Weaver Road and the Fort Weaver Road corridor can use to travel from their homes to the west towards the city of Kapolei.

Ho'opili has been planned with the reduction of traffic impacts in mind. First, it includes transit-oriented development. Bus lines have been identified to encourage residents throughout the project to use rapid transit or to use buses or bicycles within the project area. Street sizes and connectivity will encourage pedestrian and bicycle movement. To the extent that automobile use declines (or Ho'opili attracts new residents who are less committed to automobile use than others), residents can expect to have more exercise, and be healthier than people in other subdivisions of Leeward O'ahu.

Schools in the project will serve residents of Ho'opili and nearby subdivisions. A high school will certainly attract residents from nearby areas – West Loch, UHWO, and the future DHHL areas, and possibly Royal Kunia. As a result, students from those areas may come to see Ho'opili as a focus for community life. If, as planned, a private school is built within the project, this will increase local families' educational choices, and possibly reduce one of the destinations for commuting outside of the region.

A proposed medical office park will complement the nearby hospital, making it easier for residents of the region to get access to health providers.

The project includes a canyon area below the elevation of most of Ho'opili. This can be developed as a passive park space easily accessible to residents of the Fort Weaver Road communities and available to anyone in the region.

Additional park spaces within Ho'opili will serve residents by providing play space and open areas near the homes. The regional demand for play areas will be met in part at the new Kroc Center on North-South Road and a proposed County District Park site along Fort Weaver Road. Eventually, additional fields may be developed (as initially proposed by the City and County of Honolulu) within Kalaeloa to the south.

4.4 Community Development on the 'Ewa Plain

Development of a "second city" on O'ahu has long been a policy of the State and City and County. The process began with planning for Kapolei and the growth of the James Campbell Industrial Park as the island's major industrial area. It continued with commercial and office development in Kapolei and several residential subdivisions in the Kapolei area and along Fort Weaver Road. With the rapid growth of those subdivisions, policy makers became concerned that 'Ewa would serve many of its residents as a bedroom suburb of Honolulu.

The second city is increasing understood as covering much of the 'Ewa Plain, with discrete land uses serving a regional community and with a system of roadways connecting different community areas and land uses. The new Kroc Center and UHWO campus, for example, will serve the region. They will be reached by routes now being built – the North-South Road and Kapolei Parkway – and new or widened roadways through Ho'opili, as well as bus and rail transit.

Mixed uses are increasingly being planned and built as well. Mehana in the City of Kapolei includes a mix of residential densities. Its first phase emphasizes live-work townhomes. Plans for the Kalaeloa Redevelopment District emphasize density, a new spine road, and mixed use development.

Ho'opili will contribute to the growth of urban community life in 'Ewa by providing new job locations, recreational areas, and schools as well as housing. Its transportation planning will work to address the region's serious traffic congestion problems. It will help to link existing and new communities, serving its neighbors as well as its residents.

Finally, further urbanization on the 'Ewa Plain could well have implications for community and political life on O'ahu. The region's political stance has been characterized in recent years by a sense of isolation. Local representatives have argued that their area receives O'ahu's unwanted land uses such as landfills and

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electrical plants, but little infrastructure that would improve quality of life for residents of the region. Support for this view can be found in studies that show county spending to be concentrated in older urban areas (Decision Analysts Hawaii, Inc. 1994). The obvious inference is that, with increasing population, areas of the island can expect to receive a larger share of government funding. As the 'Ewa Plain becomes urbanized, it will come to gain its fair share of funding for infrastructure and other services.

4.5 Mitigation of Adverse Impacts

The Ho'opili planning process has been characterized by extensive involvement with lessees and the surrounding community. That process has allowed for early identification of community concerns, leading to steps to mitigate or avoid anticipated impacts. As noted above, consultation with agricultural tenants is intended to lead to orderly consolidation of cultivated fields and to minimize the chance of conflict between agricultural operations and residents.

The developer plans to continue communications with local stakeholders such as the Neighborhood Boards, helping to alert the wider community to future opportunities for public input. After the current planning phase, it will be helpful to share information about upcoming construction activity and to invite regional participation in onsite events.

During construction, state and county regulations will limit noise and dust from construction activities. The project's builders will conform to those regulations and work with government agencies to co-ordinate work on or next to major roads, limiting the time in which drivers will be slowed down by construction zones.

Traffic impacts will be mitigated through several measures. First, the project's mixed use design is aimed to minimize traffic on the local roadways. The project is planned to be bicycle- and pedestrian-friendly, and transit-oriented. Next, Ho'opili will contribute to the 'Ewa Transportation Impact Fee program, supporting development of local roadways and easing impacts on the already-crowded arterials. Furthermore, the developer will implement the improvements identified in the Traffic Impact Analysis Report as needed to mitigate the impacts of the project on local roadways. Finally, the developer is investigating ways in which Transportation Demand Management activities can help to lower congestion during peak hours.

Chapter Five
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APPENDIX J
Market Assessment

MIKIKO
CORPORATION

MARKET ASSESSMENT FOR HO`OPILI

ISLAND OF OAHU

Prepared for:
D.R. Horton – Schuler Homes, LLC
dba D.R. Horton - Schuler Division

FINAL REPORT

March 2007

Market Assessment for Ho`opili

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MARKET ASSESSMENT FOR HO'OPILI

Report Text

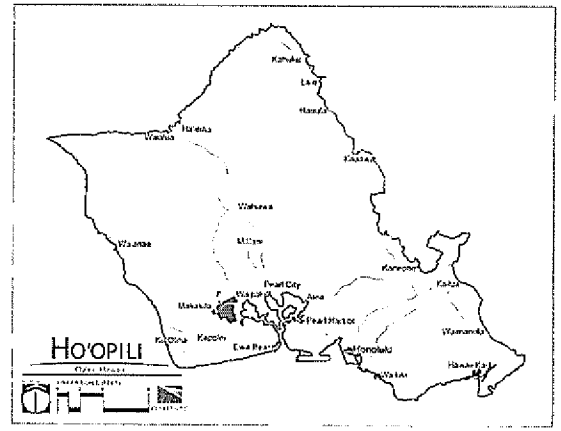
1 – Introduction and Executive Summary

Project Background (Exhibits 1-1 and 1-2)

D.R. Horton – Schuler Homes, LLC dba D.R. Horton – Schuler Division (DRH) owns approximately 1,555 acres in the Ewa District of Oahu. DRH proposes to develop these lands as an integrated, live-work community to be known as Ho'opili.

Ho'opili (the Project) occupies a prime development site due to its location within the Ewa Development Plan Area (DPA), which has long planned by the City and County of Honolulu (County) and the State of Hawaii (State) to accommodate the majority of future population growth for the island of Oahu. Within this district, Ho'opili is one of the most strategic urban expansion areas on the island:

- It stands at the "gateway" between the Ewa and the Central Oahu districts, fronting both H-1 and Fort Weaver Road.
- It is at approximately the center of population for the island.
- It is next to the planned University of Hawaii at West O'ahu (UHWO) campus and community, several residential and commercial areas planned by the State Department of Hawaiian Home Lands (DHHL), and the existing communities of Ewa Villages and West Loch.



Source: PBR Hawaii & Associates, Inc.

- It encompasses current alignments for the County's proposed mass transit system.

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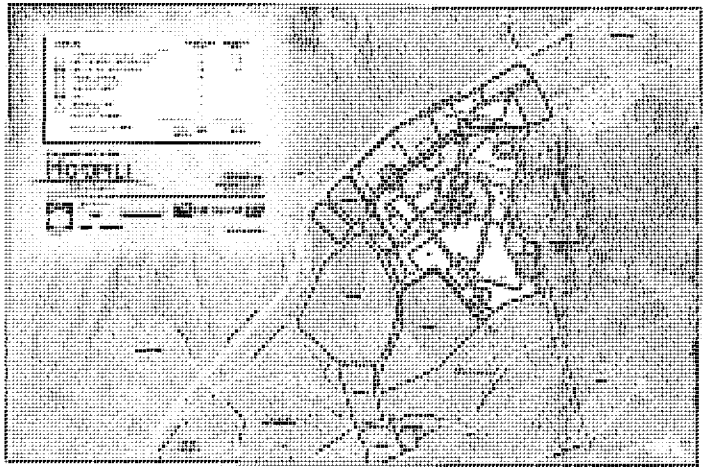
As envisioned, Ho`opili would encompass:

- **11,750 residential units.** Many of these would be developed in mixed-use structures combining retail and/or office uses. Up to 30% are expected to be developed as "affordable" units, in accordance with County guidelines.
- **2.96 million square feet of commercial retail or office spaces**, some within six Business/Commercial designated areas,[1] and some dispersed in residential mixed-use areas.
- **50 gross acres of business park or light industrial uses**, located between H-1 and Farrington Highway.
- Regional and neighborhood **parks, open spaces and a trail system.**
- Up to six sites for **schools or other public uses.**



Sources: PBR Hawaii, DRH, Van Meter Williams Pollack, Chardier Associates, Inc., 2006. See Exhibit 1-1 for copy at larger scale.

[1] One Business-Commercial site is located across the developing North-South Road from the rest of the community, separated by lands held by DLNR.

DRH estimates that the first real estate products at Ho`opili could be marketed as early as 2012. Further information on the resident, commercial and business park uses, which are the subject of this market study, are presented in Exhibit I-2.

Study Background

DRH has initiated a planning and entitlement process for Ho`opili, including an Environmental Impact Statement (EIS) that will be used in the State Land Use and County zoning processes. PBR Hawaii & Associates, Inc. (PBR Hawaii) is assisting DRH in this process and asked Mikiko Corporation (MC) to prepare market, economic and fiscal impact assessments for the Project, addressing the residential, commercial retail/office and industrial land uses noted above.

This report covers the market assessment. The economic and fiscal impacts of the Project are described in a separate report.

Mikiko Corporation Study Objective

MC's objective in this study was to describe the market support for development of the residential and commercial uses proposed at Ho`opili, in terms of:

a) Evidence of the demand for and competitive supply for the residential, commercial and light industrial/business park development elements, and

b) Assessment of likely market segments, supportable market shares and market absorption at Ho`opili; also, for residential units, assessment of supportable unit pricing.

These evaluations are based in part on information and planning parameters provided by PBR Hawaii and/or DRH.

The remaining sections of this chapter summarize the market conclusions. The rationale behind these conclusions, as well as documentation of the study methodology and supportive data, may be found in the subsequent chapters.

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General Community Outlook

Structural Changes

The projections developed herein largely judge that during Ho`opili's marketing timeframe (about 2012 to 2030), the Ewa DPA in general and Kapolei and East Kapolei in particular will approach their desired roles in a "Second City" for the State of Hawaii. An analogous though more advanced example of the roles played by the various areas of this urbanizing area may be drawn from Hawaii's "First City":

- **The City of Kapolei** would be the Ewa DPA's Central Business District (CBD),

- **East Kapolei** would be a nearby, and one day possibly adjacent, supplementary business district with lower densities and more residential uses, analogous to the Kapiolani or Kaka`ako districts, and

- **Ewa DPA** would be the entire area that is directly driven by the economic and civic leadership of the CBD and its supplementary business areas, analogous to the broader "City of Honolulu."

Approaching this desired outcome will require structural changes in the economy and culture of the area and will have far-reaching effects on the markets for housing, retail, office, business park and other land uses. This general outlook for Ewa assumes that some significant regional milestones are met during Ho`opili's marketing. These include establishment of:

- New centers of "primary jobs," those with sufficient income to sustain a household;
- Public policy support for new economies relevant to the area;
- More, high-quality elementary, middle and/or high schools;
- More options for entertainment, cultural, civic and spiritual endeavors;
- More high quality housing targeting a wide range of income and age groups;
- Neighborhoods of move-up housing; and
- More efficient transportation linkages within the area and to the rest of Oahu.

All of these precursors to change are in progress, and all are also reinforced by Ho`opili itself. Those already underway include:

- Plans for the new UHWO campus, with expanded programs and a surrounding town;
- The new State judiciary complex in Kapolei, with 650 direct and indirect jobs;
- Plans for other office buildings in Kapolei;
- Significant inventory of new business park areas under development in Kapolei;

- Growth of the private Island Pacific Academy college preparatory PK-12 school;
- Second home and golf-front developments recently entitled at Kapolei West;
- Development planning for the first regional shopping centers in Ewa;
- The promotion of knowledge- and innovation-based economies Statewide;
- Discussion of high technology or defense-related developments at Kalaeloa;
- Planned transit service linking Kapolei to Honolulu, and going through Ho`opili;
- Development of the North-South Road and Kapolei Parkway; and
- Improvements to Fort Barrette and Fort Weaver Roads.

New Urbanism

Considering the magnitude of demand for new housing and commercial facilities, yet with respect for Hawaii's precious island land, it is fortunate that Hawaii residents, like other people worldwide, are showing interest in more dense "urban village" living styles. Given the environmental burdens of population growth, this "New Urbanism" or "Smart Growth" movement not only reflects taste changes but a more sound approach to the use of natural resources. Chapter 3 offers a more complete discussion of these trends.

Ho`opili is in the path of urbanization, along a proposed transit route, and adjacent to existing and new centers of employment such as UHWO. These characteristics enhance "New Urbanist" planning, and support the mixed-use, higher-density developments proposed at Ho`opili.

Summary of Market Conclusions

The table below summarizes the projected market support for the land uses evaluated. These conclusions are explained in the sections and chapters that follow.

Projected Market Absorption at Ho`opili

	2012-2015	2016-2030	Total
Residential units	2,600	9,150	11,750
Commercial (square feet)	600,000	2,360,000	2,960,000
Business Park (net acres)	40	0	40

Source: Mikiko Corporation, 2007.

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Residential Market Assessment

Market Environment

Oahu has an acute shortage of housing suitable for primary residents, with an estimated pent-up demand for some 17,000 units as of the end of 2006. Additionally, based on growth projections in a study prepared for the State and county housing agencies, Oahu will need to house some 81,000 more households by 2030.[2]

About 55,100 potential future housing units are currently entitled at the State Land Use Commission (LUC) level.[3] Even assuming substantially accelerated housing development in the short-term, without further Urbanization of lands for residential use, Oahu's housing shortfall could gradually be pared down to some 10,000 units by about 2015, but it could then spiral to about 46,000 units by 2030.[4]

This conclusion is summarized as follows:

Supply and Demand for New Resident Housing Units on Oahu 2007 to 2030

Future Demand	Pent-up demand, end 2006	17,000
	Future need, 2007-2030	81,000
	Total need	98,000
Future Supply	Planned and entitled (55,000 less 5% vacancy)	52,000
Shortage	As of 2030	46,000

Source: Mikiko Corporation, 2007. Future supply estimate assumes full buildout of all lands currently designated Urban by the LUC, and proposed for residential development. See Exhibit 3-8 for further information.

[2] SMS, Inc., "Housing Policy Study, 2006: Hawaii Housing Model 2006," February 2007.

[3] In this report, "State-entitled" or "LUC-entitled" means lands carrying LUC "Urban" designation or those that are proposed for development but may be exempt from State regulatory control. Some of these would still require County zoning or other entitlement in order to proceed.

[4] Besides Ho'opili, other major developments for which State entitlement are sought include Koa Ridge and Waiawa by Castle & Cooke (up to 5,000 units) and Gentry Waiawa Phase 2 (up to 7,000 units.) Even if all three of these projects were entitled and developed to their full potential by 2030, Oahu could still be 22,250 housing units "short" (46,000 – 11,750 – 5,000 – 7,000).

Ho`opili Residential Market Assessment

Ho`opili's housing units are an important component of the Ewa regional plan as well as a solution for up to 25% of the island's currently unentitled housing needs through 2030.

- **Product mix** – The majority of Ho`opili's 11,750 residential units would be for-sale multifamily homes. The Project would also include single-family units for-sale and multifamily rental units. The exact mix of units by type will be determined during build-out, as market conditions and preferences materialize.

- **Development densities** – Ho`opili's single-family units would be developed at about 5 to 8 units per net acre while its multifamily units could range from low-rise townhouse units at 10 to 14 units per net acre, to mid-rise development at 30 to 50 units per net acre.

- **Target markets** – Up to 30% or 3,525 units is expected to be developed as affordable housing, in accordance with the County's affordable housing guidelines.

  Among the market for-sale units, the majority is expected to be purchased for use by owner-occupants. Some may be purchased as investments and rented out, again resulting in units for primary resident use.

- **Pricing (2006 dollars):**

  - **Market units:** Multifamily units are expected to find market support in the $350,000 to $650,000 range, while single-family units might be priced from about $500,000 to $750,000.

  - **Affordable units:** Pricing will be based on then-prevailing County rules and market conditions. For illustrative purposes, the County's 2006 price guidelines included:

    - For-sale units: $232,000 to $392,000 for families of four earning 80% to 120% of the County median income.

    - Rental units: $998 to $2,481 per month, for studio to 4-bedroom units and households earning 80% to 100% of the median County income.

- **Market share** – By the time of Ho`opili's marketing, there could be few other large residential developments with inventory. Hypothetically, if there were no further LUC entitlement of Oahu residential lands other than Ho`opili, the Project's fair market share in the 2016 to 2030 timetable would represent about 39% of developable inventory. However, three large residential projects in Central Oahu are

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preparing to petition the LUC at this time. Even if these projects were also entitled and marketed in a competitive time frame, Ho`opili's fair market share could still represent about 28% of Oahu's future market, as shown below.

Hypothetical Ho`opili Fair Market Share Under Two Entitlement Scenarios, 2016 to 2030

	Scenario 1: Add Ho`opili	Scenario 2: Add Ho`opili, Gentry-Waiawa, Waiawa-C&C & Koa Ridge	Notes
Entitled additional units, 2015 – 2030*	18,700	18,700	See Exhibit 3-7.
Ho`opili*	11,750	11,750	Maximum proposed.
Castle & Cooke-Waiawa and Koa Ridge plus Gentry Waiawa Ph 2*	0	12,000	Expected maximum residential entitlements to be sought.
Total potential inventory	**30,450**	**42,450**	Net of currently entitled but unplanned future developments.
Hypothetical Ho`opili Fair Market Share	**39%**	**28%**	**Percent of future Oahu market**

* Remaining developable inventory could vary, depending on amount of sales realized by 2015.
Source: Mikiko Corporation, 2007.

The above benchmarks are considered hypothetical since other development plans will inevitably emerge over the next decades. However, they are worthwhile benchmarks since Oahu is running out of large, developable tracts of land for new development.

In recent years, Oahu has absorbed around 2,000 developer units per year, with supply constraints. To begin to address pent-up and future demand, the island would have to produce around 3,900 units per year[5]. This assessment concludes that Ho`opili could achieve a 15% to 20% market share of the future island market, assuming there is sufficient other Oahu supply to approach the 3,900 units per year goal.

[5] 81,000 future + 17,000 pent-up demand satisfied over 25 years would require an average production of 3,920 units per year (98,000/25).

If future development represents only 2,000 units per year, closer to Oahu's historical levels and likely resulting in an increasing housing crisis, the Project's achieved market share could be expected to represent 30% to 35% of Oahu sales.

Projected Annual Residential Unit Sales Absorption at Ho`opili

	Scenario 1: At recent historical levels of Oahu production	Scenario 2: At demand-satisfying levels of Oahu production	Conclusion for Ho`opili
Assumed total Oahu developer sales	2,000	3,900	
Ho`opili market share	30% - 35%	15% - 20%	
Ho`opili average annual sales	**600 - 700**	**585 - 780**	**650**

Source: Mikiko Corporation, 2007.

Absorption – The above capture rates support the study conclusion that Ho`opili could sell about 650 units per year on a long-term average basis. Year-to-year sales would vary depending on production, unit mix, market and other factors.

The average sales could represent about 450 market units and 200 affordable units in any given year. The for-sale affordable housing is assumed to be absorbed more gradually because it would generally need to be developed as infrastructure and community facilities are supported by market unit sales.

This sales pace would lead to complete absorption of Ho`opili's residential inventory within 19 years, or by 2030.

This analysis assumes all units are built as for-sale housing. However, some may be developed as rentals, which would be expected to accelerate absorption.

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Illustrative Mix of Potential Residential Sales Absorption at Ho`opili

	Market units	Affordable for-sale units	Total for-sale housing
Potential total inventory	8,250	3,500	11,750
Average annual sales	450	200	650
Years on market	19	18	19
Start date	2012	2012	2012
End date	By 2030	By 2029	By 2030

Source: Mikiko Corporation, 2007.

Commercial Market Assessment

The commercial market assessment encompasses retail- and office-based developments, in recognition of the mixed-uses planned at Ho`opili as well as the typical crossover of office spaces within shopping centers and retail uses in office complexes. Specific types of commercial uses within each area of the Project will be determined in accordance with future market conditions and area-specific needs as each area is planned.

Retail Market Environment

Oahu's retail environment is considered undersupplied, with a year-end 2006 vacancy of 2.18%, the lowest in 15 years, according to Colliers Monroe Friedlander, Inc. (CMF.) Considering a Project Trade Area consisting of the Ewa, Central Oahu and Waianae DPAs, there were about 3.9 million retail square feet of gross leasable area (GLA) with an average vacancy of 2.5% in December 2006.

Another 3.9 million square feet of retail-based areas are planned and entitled within the Trade Area, mostly in Kapolei and East Kapolei. While these increases would be dramatic, given the large population increases anticipated in the region, its transition away from a bedroom community, and its under-retailed status today, the Trade Area could still be undersupplied throughout the projection period.

Office Market Environment

The Ewa DPA includes some 436,000 square feet of rentable building area (RBA) office space, mostly in Kapolei.[6] Central Oahu offers 194,000 square feet. The fact that Ewa's inventory is already twice Central Oahu's despite a population of about half of Central Oahu's demonstrates the widespread confidence in the area's potential as a future urban center.

Year-end 2006 office vacancies in "Leeward Oahu," which includes Ewa, Central Oahu and Waianae, were estimated at 6.4%, compared to 7.0% for the island as a whole, according to CMF. The Oahu rate was the lowest it has been since 1991, due to strong recent absorption.

Based on current plans, Ewa and Central Oahu's office-based areas could increase to 1.6 million square feet by 2015, and to 2.4 million by 2030. However, about a third of this potential future inventory is in Kalaeloa, where development plans are in considerable flux.

Ho`opili Commercial Market Assessment

- **Product overview** - Ho`opili is proposed for up to 2.96 million square feet of commercial uses on six Business/Commercial-designated and other mixed-use sites. Commercial areas would be developed for retail or office purposes, or in flexible capacities such as "live-work" units where portions of a unit could be used for residential or office purposes.

- **Sources of demand** – Ho`opili's primary retail Trade Area is considered to include the Ewa, Central Oahu and Waianae DPAs, while its office areas could draw from a larger community, including businesses that attract employees from throughout Oahu.

- **Market share** - If developed to the full proposed capacity, Ho`opili's commercial spaces could represent about 27% of the Ewa DPA's total 2030 inventory. It could also represent a venue for about two-thirds of the currently unplanned but future supportable commercial space in the DPA.

[6] The office market survey excludes government office buildings and office spaces that are ancillary to shopping centers. The Kapolei inventory noted above excludes the 215,000 square foot State Office Building, 96,000 square foot Kapolei Hale and 50,689 square foot Police headquarters.

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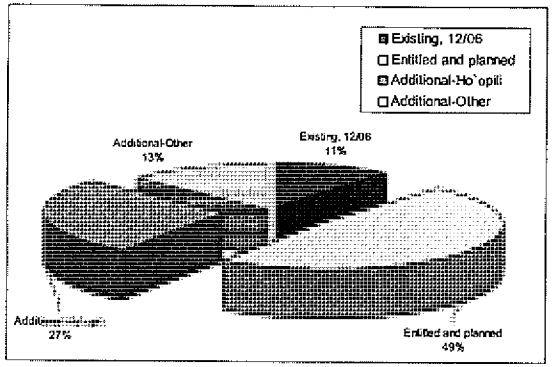
These market shares are considered achievable in light of the prime locations enjoyed by the site and the diverse commercial development types that are proposed for Ho`opili. Given that potential commercial developments on other entitled lands throughout Kapolei, East Kapolei, Ocean Pointe and Ewa Beach have already been accounted for, Ho`opili appears to be one of the only remaining areas within the DPA on which substantial commercial development could occur.

Ho`opili Commercial Development in Relation to Ewa DPA Marketplace, at Maximum Build-Out



Source: Exhibit 7-2 for sources and further information.

- **Absorption** - While some early commercial development will likely be a priority to anchor and serve the first increments of development at Ho`opili by 2015, the majority of the Project's commercial areas could be expected to be developed between 2016 and 2030.

Business Park/Industrial Market Assessment

Market Environment

Ewa offered some 1,560 acres of business park or industrial areas in 2006, all in Kapolei. Central Oahu included only about 320 acres. In terms of industrial building space, Ewa is considered undersupplied, with a 2.6% vacancy as of December 2006, according to CMF.

Kapolei's share of Oahu industrial building space inventory has ranged from 12% to 14%, but the area accounts for the vast majority of new space absorption on Oahu, some 70% to 90% since 2003. This reflects the strong market potential of the Kapolei region and the island's growing dependence on this area to serve its industrial and business park-related needs.

There are some 280 net acres entitled and planned for business park/industrial use in Ewa. However, the analysis concludes that about 280 more acres could be needed in the DPA by 2015, or 850 by 2030, over and above the planned inventory.[7] Not included in the planned count is the Kapolei Harborside Center, which is proposed for 345 acres (240 net saleable) and currently involved in hearings before the LUC. If Harborside is entitled, the region would still be expected to demand another 40 acres by 2015 (280 - 240) or 610 by 2030 (850 – 240).

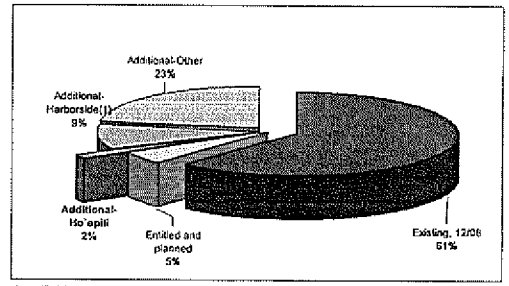
Ho`opili Business Park Market Assessment

- **Product overview** - Ho`opili would offer one prime business park site of 50 acres (40 net acres). Due to its location within a mixed-use residential community, the park is expected to cater to "clean" industries such as office headquarters campuses, research & development facilities, or service-retail uses.

- **Sources of demand** – As for other industrial/business park users in Kapolei, the trade area for businesses at this site would be expected to be super-regional, island-wide, Statewide or even out-of State. The analysis was prepared on the basis of Oahu-wide demand generators, with consideration for inter-regional movements of tenants.

- **Market share** – The 40-net acre site would represent only 2% of the future supportable areas in the region. Even if the Kapolei Harborside project receives LUC and other approvals to permit its development, there could remain substantial unmet demand for business park or industrial lands in the area, particularly in the 2015 to 2030 period.

Potential Ewa DPA Business Park/Industrial Inventory, 2030 (Ho`opili site as currently planned)



See Exhibit 8-7 for sources and further information.

[7] About 144 acres of the 280-net acre planned inventory are located in Kalaeloa, where the ultimate use and development timing is very uncertain as of this writing.

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- **Absorption** – Based on the Ewa net demand and the other developments proposed at Ho`opili, this site could be expected to find market support by 2015. However, its sale or lease could also be delayed in order to find the optimal user(s) for this key, high visibility position within Ho`opili.

- **Further development potential** - Given the strong regional market outlook, the outstanding location, access and visibility of Ho`opili, and the planned integration of a business park site into a mixed-use community with a range of housing opportunities, it is concluded that there could be market support for two or more times the current land allocation of 40 net acres at the Project. The additional areas would be expected to find market support between 2015 and 2030.

  Even at an expanded 80 net acres, business park development at Ho`opili would represent only 4% of future regional inventory in 2030, or 10% of net unplanned-for demand in the DPA.

- **Potential development concepts** – A business park at Ho`opili could be an iconographic source of high quality employment for the community. Example development types that might be considered include:

  - **Science and technology park** – This could be a complex catering to innovation- and knowledge-based enterprises. Its market could relate to the site's proximity to the proposed UHWO as well as its location on a future transit route and the modern infrastructure and planning of Ho`opili.

  - **Lifestyle/wellness campus** – Baby Boomers and younger generations have demonstrated significant expenditures at enterprises that cater to enhancing quality of life and appearance, and in prolonging one's healthy and productive years.

  - **General business park** – The site could also be developed as a more generic business park, offering land sales or space sales/leases to a variety of enterprises, including those related to the above concepts.

Report Conditions

This assessment is based on information provided by government agencies, developers, brokers, landowners, and other third party sources. While every attempt has been made to verify information via multiple sources, it is not always possible to do so. MC has noted any data that appears inconsistent, but cannot guarantee the accuracy of all information upon which its assessments are based.

MC has no responsibility to update this report or any of the underlying data for events and circumstances occurring after February 1, 2007, the date of substantial completion of primary data collection.

This report is for the planning purposes of DRH, PBR Hawaii and their consultants, as well as for public disclosure of the nature of the Project pursuant to seeking State and County land entitlements. It is not to be used for solicitation of investment or other third party purposes without prior written consent of the author.

This report does not offer an appraisal of the Subject, nor should it be construed as an opinion of value for the Project.

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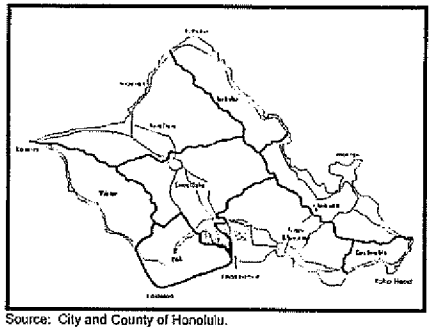
2. Economic and Demographic Trends

Geographic Areas of Analysis

City and County DPAs

Much of the economic and demographic data presented herein is organized by the City's DPAs. Ho`opili falls within the Ewa DPA, which extends from Iroquois Point on the western side of Pearl Harbor, up Fort Weaver Road and circles back to the Waianae coastline between Waimanalo Gulch and Nanakuli.

Oahu Development Plan Areas



Source: City and County of Honolulu.

Special attention is also given herein to the adjacent Central Oahu and Waianae DPAs because they represent supplementary markets for Ho`opili's commercial and community amenities.

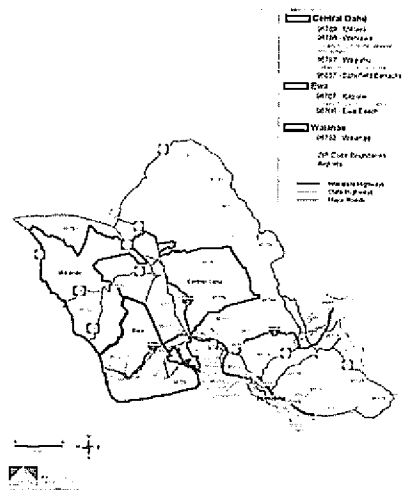
- **The Ewa DPA** encompasses the Subject as well as Makakilo, Kapolei (including the Villages of Kapolei, Kapolei City and East Kapolei), Ko Olina Resort, Ewa Villages, Ewa by Gentry, Ewa Beach, Iroquois Point, and several proposed or developing communities including Mehana, Maka'iwa Hills, and UH West Oahu.
- **The Central Oahu DPA** includes the communities of Waipahu, Village Park, Waipio, Wheeler Air Force Base, Schofield Barracks, Wahiawa, Kunia, Mililani and Mililani Mauka, Waikele, Waipio Acres and Waiawa. It stops short of Pearl City and Waimalu.
- **The Waianae DPA** includes the towns of Nanakuli, Ma`ili, Wai`anae and Makaha, as well as the Luafualei Military Reservation. It extends out to Ka`ena Point.

DPAs Approximated by Zip Code (Exhibit 2-1)

The City's DPAs often follow natural features that are not recognized as census divisions, so it is difficult to collect economic and demographic information within the DPAs per se. Thus, this report uses zip code areas as a proxy for the City's DPAs, and data presented as representative of a DPA may be drawn from the corresponding area approximated by zip code. By zip code, these areas differ from the "real" DPAs as follows:

- Ewa includes more land at its northern tip, but this area includes few homes.
- Central Oahu includes an extension to its northwest, between Routes 803 and 99. This area includes the military housing areas of Whitmore Village and Helemano.
- Waianae includes additional lands that wrap around and behind Schofield Barracks and mauka of Mokule'ia, but these appear to include little or no housing.

DPAs as Approximated by Zip Code



Source: Claritas 2006, see Exhibit 2-1 for copy at larger scale.

Overview of Demographic Trends

Projected Oahu Population (Exhibit 2-2)

Oahu recorded 876,156 residents at the U.S. Census in 2000. Four sources are considered in estimating how population has grown since then, and how it is likely to grow over the next two decades.

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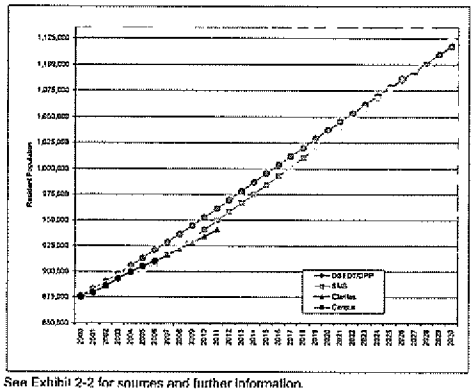
- In March 2007, the U.S. Census estimated Oahu's 2006 resident population at 909,863, or 0.5% higher than the 905,266 estimated for 2005.

- Claritas[1] provided this study with 2006 population estimates and a 5-year projection to 940,689 by 2011. Claritas' figures were prepared on the basis of the Census' 2005 estimate.

Resident Population – Island of Oahu



See Exhibit 2-2 for sources and further information.

- SMS[2] recently prepared a long-term outlook, with 1,125,688 residents projected for 2030 based on the "official parameter" growth rate of 0.9%. While SMS's shorter-term projections (for 2005 through 2011) are higher than those made by the Census and Claritas with the benefit of updated information, in the medium-term, they are lower than those prepared by DBEDT and DPP (see next bullet).

- The State of Hawaii, Department of Business, Economic Development and Tourism (DBEDT) also offers a long-term projection; the latest was prepared in August 2004. The City's Department of Planning and Permitting (DPP) has adopted DBEDT's projections. This series is higher than SMS's until 2025, after which the latter surpasses it. DBEDT/DPP's series anticipates 1,117,300 residents on Oahu by 2030.

[1] Claritas is a leading provider of geodemographic market research information to government and industry throughout the U.S. Claritas derives its information from the U.S. Bureau of the Census, State and local governmental planning and forecasting entities, its proprietary Business-Facts © database and other sources.

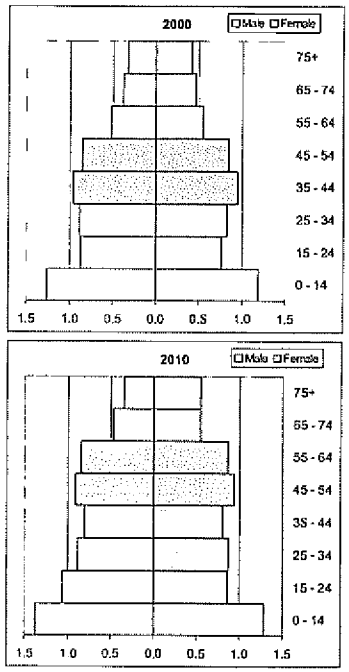
[2] SMS, Inc., "Housing Policy Study, 2006: Hawaii Housing Model 2006," February 2007. The study was prepared for a consortium including the Housing Officers and other Administrators of the City and County of Honolulu (as well as the other three Hawaii counties), and the State of Hawaii, Hawaii Housing Finance and Development Corporation, the Office of Hawaiian Affairs, and the Department of Hawaiian Home Lands.

Aging of the Population (Exhibit 2-3)

The changing age-composition of the population will have an enormous impact on home-buying and other consumer spending patterns in Hawaii as elsewhere in the nation. While long-term projected age-cohort data is not available by county or sub-areas, the U.S. Census does prepare decennial projections by state.

Viewed in an age pyramid, a most notable feature is the aging of the Baby Boomers, whose members were between the ages of 41 and 60 in 2006, will range from about 45 to 64 years old by 2010, 55 to 74 by 2020, and 65 to 84 by 2030.

Age Pyramids – State of Hawaii: 2000 and 2010



See Exhibit 2-3 for sources and further information.

- **2000 to 2010** - As the dominant consumers in the overall marketplace today and for years to come, Baby Boomers are fueling a move-up home-buying market consistent with their middle-aged, peak earnings-power status.

  Age groups showing the most population gains in the 2000 to 2010 period in Hawaii are all over 45:

  - 45 to 54: +14,000 persons
  - 55 to 64: +64,000 persons
  - 65 to 74: +16,000 persons
  - 75+: +15,000 persons

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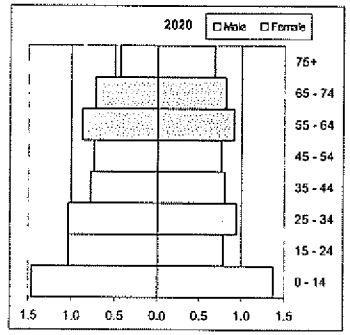
2010 to 2020 – In the subsequent decade, Baby Boomers will continue to exert strong influence in the housing market. This is expected to be reflected in rapidly growing demand for downsized, retirement and/or other specialized housing types reflecting their empty nester and retiree stages of life. Also notable in this decade will be strong growth in the entry and early-housing market, represented by persons aged 25 to 34.

Thus, age groups projected to show the most gains in this later period include both early and older homebuyers:

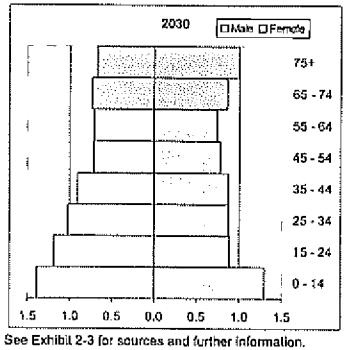
- 25 to 34: +22,000 persons
- 55 to 64: +8,000 persons
- 65 to 74: +52,000 persons
- 75+: +21,000 persons

Age Pyramid – State of Hawaii: 2020



See Exhibit 2-3 for sources and further information.

Age Pyramid – State of Hawaii: 2030



See Exhibit 2-3 for sources and further information.

2020 to 2030 – The last decade evaluated will be characterized by rapid growth of the elderly population, necessitating specialized and age-catering housing solutions.

The second most rapidly growing potential housing market during this period will consist of those aged 15 to 24, an age that usually encompasses household formation, often in rental housing.

The third rapidly growing group would be those aged 35 to 44, typically a home-buying or early trade-up housing market.

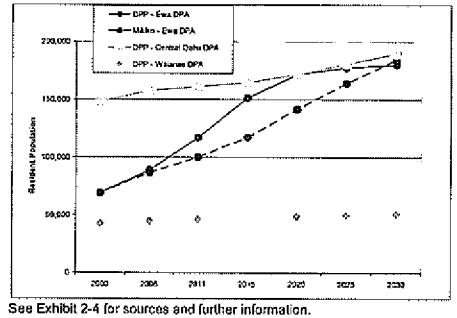
Cohorts expected to gain population statewide in this decade include:

- 15 to 24: + 27,000 persons
- 35 to 44: + 19,000 persons
- 65 to 74: + 6,000 persons
- 75+: +56,000 persons

Demographic Trends by Development Plan Area

Population by Area
(Exhibit 2-4)

Resident Population - Ewa, Central Oahu & Waianae



See Exhibit 2-4 for sources and further information.

DPP uses the State's projections to forecast population within its DPAs. DPP's most recent such forecast was prepared in 2006 and extends to 2030. These allocations of island population to DPAs are based in part on the City's development policies and plans. DPP anticipates relatively high rates of growth in Ewa over the projection period, as it becomes a "Second City." Ewa is eventually seen to house 17% of the island's population, more than doubling from some 86,000 persons in 2006 to 184,600 by 2030. The Ewa DPA is projected to approach Central Oahu in population by the end of the period.

MC reviewed DPP's Ewa projection in light of the existing inventory of unbuilt but State-entitled housing and found that even with dramatically smaller household sizes for new as compared to existing households and phased development of new projects, Ewa area population could grow more rapidly than projected by DPP initially, but could be constrained after 2025 by a lack of further developable housing inventory. In MC's analysis, population in the Ewa DPA is projected to grow 3.0% per annum over the next 24 years, finishing 2030 at about 180,200 persons. At 2025, this figure is closer than

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DBEDT/DPP's to those estimated by Campbell Estate and Decision Analysts[3] for the area. MC's projections may be conservative because:

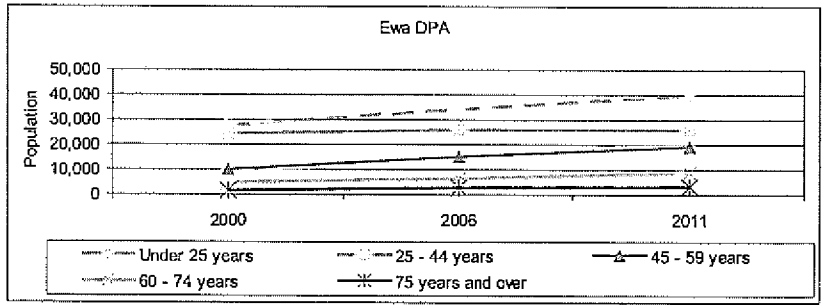
- We assume the new homes to be added will house fewer persons each than do existing homes, and
- We do not consider any impact from proposed developments that are not yet LUC-entitled, such as Ho'opili itself.

The conclusion of the entitled housing-based methodology is close to DPP's overall projection for the County in the long-run.

Population by Age Group (Exhibit 2-5)

The largest age groups in all three DPAs were those under 25, followed by the 25 to 44 and 45 to 59 age groups. Over the next five years, the greatest increases are anticipated within the under 25 and the 45 to 59 age groups, followed by the 60 to 74 age group. This reflects the Baby Boom generation moving into its 50s and 60s. In contrast, in this short-term view, Claritas projects that the 25 to 44 age group may decline in Central Oahu, and be static in Ewa and Waianae.

Population by Age Group – Ewa DPA



See Exhibit 2-5 for sources and further information.

[3] Decision Analysts Hawaii, Inc., projected Ewa regional population at 175,360 for 2025. "'Ewa Development, 2006 to 2025: Economic, Population and Fiscal Impacts," September 2005.

Ewa was estimated to have a median resident age of 32 in 2006, younger than the island-wide 37.7. This is attributed to Ewa's more numerous entry-level housing options. Central Oahu was also relatively young, at an estimated 2006 median age of 33.1, while Waianae was estimated at 29.3.

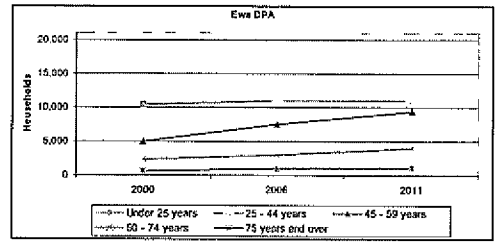
Number and Age of Households (Exhibits 2-6 and 2-7)

In 2006, Claritas estimated Oahu had about 300,900 households. Within this total, some 8% or 25,300 lived in Ewa[4], 16% or 48,000 lived in Central Oahu and 4% or 11,000 in Waianae. With the majority of entitled vacant lands on the island, Ewa's households are expected to gain against the County's over the next 5 years, to about 11% by 2011. This would represent 34,300 households at an average size of 3.4. This would represent new households at an average of 3.1 persons and already existing households at the 3.6 persons estimated by Claritas. Claritas sees household size declining in Central Oahu, to 3.3 by 2011, while remaining static in Waianae at 4.0.

Household heads are older than the population as a whole. The biggest group island-wide is currently householders ranging from 25 to 44.

However, the number of households headed by those aged 45 to 59 is increasing most rapidly. This group's size is anticipated to approach the 25 to 44 age group by 2011 in all three DPAs. The combination of population growth, aging and a trend towards smaller households could lead to 1,900 more households headed by persons aged 45 to 59, and 1,000 more by those aged 60 to 74 in Ewa over the next five years. Also over this period, the number of households headed by those aged 25 to 44 is expected to be static.

Households by Age of Head – Ewa DPA



See Exhibit 2-7 for sources and further information.

The 45 to 59 age group is considered a prime move-up housing market, while the 25 to 44 age group includes many first-time buyers.

[4] 2006 and 2011 Claritas figures for Ewa adjusted to be consistent with the area population projection presented previously.

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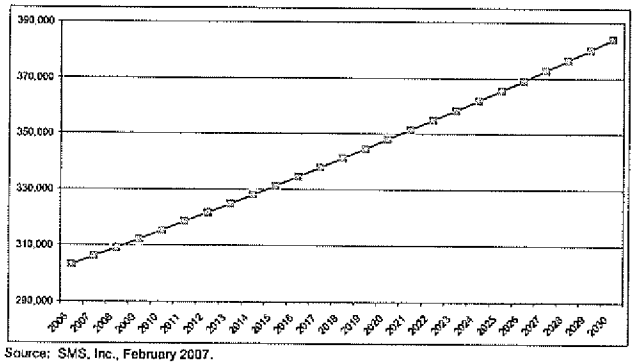
Long-term Projection of Households

SMS projected Oahu households to 2030, utilizing the projected population figures shown previously and assuming a gradual continuation of the trend towards smaller households. The series shows 303,149 households on Oahu in 2006, (at 2.99 persons per household) and 384,005 in 2030 (at 2.93 per household).

Projected Oahu Households



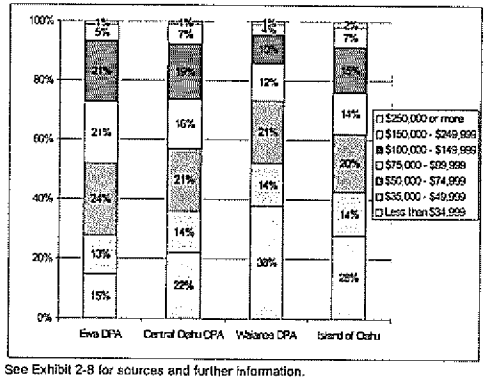
Source: SMS, Inc., February 2007.

Households by Income
(Exhibit 2-8)

Ewa and Central Oahu show a higher household income profile than the island as a whole, while Waianae shows a lower one. Claritas estimates the median 2006 household income is approximately $73,000 in Ewa, $66,700 in Central Oahu and $47,900 in Waianae, compared to $59,600 for the island of Oahu.

The Ewa DPA also shows relatively fewer households with incomes below $74,999

Households by Household Income, 2006



See Exhibit 2-8 for sources and further information.

(52%), and a greater share with incomes between $75,000 and $149,999 (42%) than the other regions evaluated. In comparison, an estimated 62% of Oahu's households earned less than $75,000 and only 29% $75,000 to $149,999 in 2006. Other areas of Oahu may have relatively more households in the highest income brackets; however, these represent a small number of households in absolute terms.

Further evidence of relatively high incomes in the Trade Area is found in an analysis of median household income by the state's top 30 zip codes in 2006[5], which found that:

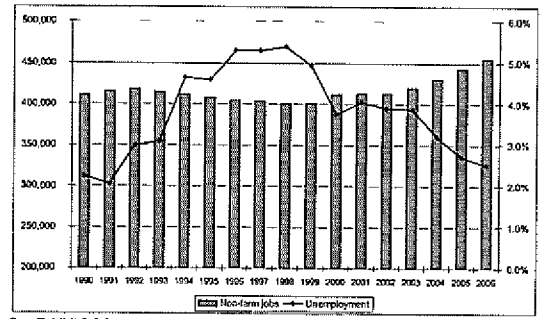
- **Mililani** (96789) showed the state's third highest median income, at $81,340;
- **Kapolei, Makakilo and Kalaeloa** (96707) had the sixth highest, at $77,902;
- **Ewa Beach** (96706) was seventh, at $74,396;
- **Waipahu** (96797) was ranked tenth, at $72,053.

For comparison, 96816 (Kahala, Waialae and Kaimuki) showed an estimated median household income of only $66,806. This made it only the thirteenth highest earning zip code area in the state in 2006, up from the fourteenth in 2005.

Employment Trends
(Exhibit 2-9)

Oahu Labor Force Trends

The State of Hawaii, Department of Labor and Industrial Relations (DLIR) reports Oahu unemployment averaging 2.5% in 2006, down from 2.7% in 2005[6]. This is also down from the island averages of 3.2% in 2004 and 3.8% to 4.1% between 2000 and 2003, and significantly down from the 4.3% to 4.9% range exhibited from 1995 to



See Exhibit 2-9 for sources and further information.

[5] Pacific Business News, December 22, 2006, 2007 Book of Lists: "Wealthiest Zip Codes, Ranked by 2006 Median Household Income." Data provided to Pacific Business News by ESRI.

[6] Not seasonally adjusted, for civilian labor force. Figures dated 12/4/2006.

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1999. Oahu's unemployment rates have been among the lowest in the nation in recent years.

Oahu has supported annual increases in the number of employed persons since 2002. In 2006, some 446,200 persons were employed out of a total civilian labor force of 457,700, according to the DLIR.

3. Residential Market Environment

Historical Supply Conditions

2005 Inventory

- **Oahu** had some 329,300 housing units in 2005, of which 300,557 or 91% were estimated to be occupied, according to the U.S. Census, American Community Survey (ACS)[1]. This estimate is within 1% of the Claritas estimate for Honolulu for 2005, which was at 333,000 total housing units.

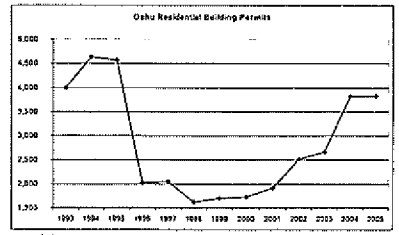
  Among occupied units, 57% were owner-occupied and 43% renter-occupied, according to the ACS. Among the 9% of units estimated to be vacant, the majority reflect non-resident housing uses, since the homeowner vacancy rate was estimated at less than 1% and the rental vacancy rate at 4%.

- **Ewa and Central Oahu** - While the ACS does not break out housing supply by area, according to Claritas, about 15% and 7% of the island's 2005 housing units were located in the Central Oahu and Ewa DPAs, respectively, representing about 50,900 in Central Oahu and 24,600 in Ewa.

  Both of these DPAs have substantially higher ownership rates than the County as a whole. In Central Oahu, some 61% of occupied units were estimated to be owner-occupied, while in Ewa some 72% were.

Residential Building Permits (Exhibit 3- 1)

Oahu residential permitting plunged from 1995 to 1996, as the effects of the collapsing real estate "bubble" of the late 1980s and early 1990s were finally realized. Permitting did not rise again materially until 2002.



See Exhibit 3-1 for sources and further information.

[1] Average figure for year, also referred to by State DBEDT as July 1 estimate. U.S. Census, "2005 American Community Survey," released October 2006. The ACS does not survey population living in institutions, college dormitories or other group quarters.

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In 2005, 3,821 new residential building permits were obtained on Oahu, according to the City and County. This compares to more than 4,500 per year in 1994 and 1995.

Data from the first three quarters of 2006 show a 30% decline in permitting activity from the same period in 2005. This represents the first decline in permitting activity since 1998, and reflects a lack of entitled land inventory held by developers, production difficulties related to labor and regulatory controls and a slowing business cycle.

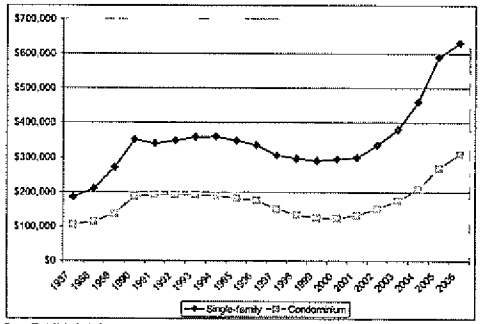
Market Trends

Oahu Home Resales (Exhibit 3-2)

Rapidly rising home prices in recent years reflect the relatively limited production of new housing, combined with strong labor market conditions and favorable financing conditions in recent years.

Sales recordations of existing homes during 2006 showed a median single-family price of $630,000 and a median condominium price of $310,000, according to the Honolulu Board of Realtors (HBOR).[2] These medians are 7% and 15% higher, respectively, than those recorded in 2005.

Oahu Resales – Median Prices



See Exhibit 3-2 for sources and further information.

In the first two months of 2007, prices are flattening or rising more slowly, while residential sales velocity has slowed since 2005. During 2005, 4,617 existing single-family homes were resold on Oahu, as were 7,990 condominium homes. These represent 1.8% fewer single-family and 1.3% more condominium sales than recorded in 2004. At 4,041 and 6,380 sales, respectively, 2006 showed a 14% decline in single-family and 20% decline in condominium sales compared to 2005. Previously, the number of homes resold on Oahu had shown nearly consistent annual increases since 1995.

Months inventory remaining, while still far below historical levels in the early- to mid-1990s, has been on an upswing since mid-2005, further defining a "landing" to the boom that endured over the prior six years. As of February 2007, the HBOR estimated there were 6.5 months worth of single-family inventory remaining on the island market, and 5.5 months of condominium inventory.

The short-term outlook is for slowing sales and stabilized or somewhat declining prices as the market makes adjustments to reflect the overly rapid rises of past years. However, longer-term, ongoing population growth, household formation and the still significant overhang of unhoused persons will continue to fuel demand for new housing.

Subject Area Resales (Exhibit 3-3)

Like the island as a whole, Central Oahu and Ewa neighborhood markets are recording fewer sales, while prices have continued to appreciate. During 2006 (with comparisons to 2005):

- Within the Ewa DPA:
  - Sales slowed 10% on the Ewa Plain[3], but increased 7% in Makakilo. Overall, the Ewa DPA declined 7%.
  - Prices have continued to rise. The Ewa Plain showed price increases averaging 8% for single-family and 18% for condominium products, for median prices of $528,000 single-family and $302,000 condominium.
  - In Makakilo, median prices increased 9% and 16% for single-family and condominium sales, respectively, reaching $600,000 for single-family homes and $320,000 for condominiums.
- Within Central Oahu:
  - Wahiawa, Mililani and Waipahu all generally showed fewer sales, averaging 9% fewer than in 2005. The only exception is Wahiawa condominiums, which show 5% more sales than the prior year.

[2] Honolulu Board of Realtors, "December 2006 Monthly Statistical Report," January 2007. The HBOR defines condominiums as duplexes, townhomes and other multifamily units having common areas.

[3] As defined by the HBOR, the Ewa Plain includes Kapolei, Ewa Beach and Ewa by Gentry.

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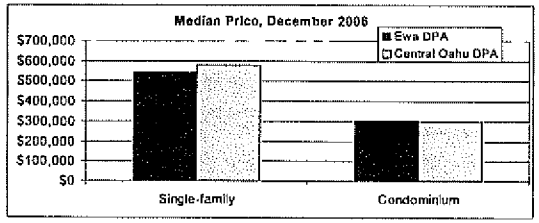
- Median prices rose across the board in these Central Oahu communities, ranging from 8% to 10% increases for single-family products and 14% to 39% increases for condominium products.

- Median single-family prices were highest in Mililani at $610,000, and lowest in Wahiawa at $462,000. Among condominium sales, the median price ranged from $188,000 in Wahiawa to $315,000 in Mililani. Wahiawa tends to have older housing stock than either Mililani or Waipahu.



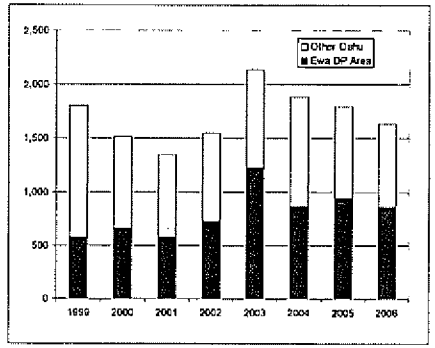
See Exhibit 3-2 for sources and further information.

Developer Unit Sales by Area (Exhibit 3-4)

Developer-built homes have also shown rising prices but absorption has been limited by production factors such as labor, permitting and the availability of entitled sites.

Oahu recorded an estimated 1,800 new home sales in 2005, but only 1,640 in 2006, according to The Harris Company. This is down from the peak production and absorption of 2,136 in 2003.[4] Of the total closings, 46% to 58% of units have been located in the Ewa DP area[5] over the past 5 years.

Oahu Developer Sales by Location



See Exhibit 3-4 for sources and further information.

[4] Note that developer unit sales are fewer than residential permits granted in any given year (Exhibit 3-1). The difference is due to permitted units not getting built, or being built as rental or other unit types not covered by the residential developer unit surveys.

Notably, there has been no long-term increase in new home production over the past eight years, despite population increases and very strong market activity. Production has generally stayed in the 1,500 to 2,000-unit level, subject to business cycles and other factors.

Also in recent years, single-family units have been losing market share to townhouse and high-rise home sales.

Ewa Developer Unit Sales by Type (Exhibit 3-4)

Considering only the Ewa area, developer sales have hovered between about 850 and 950 units per year in recent years, down from their peak of 1,230 units closed in 2003.

Historically, Ewa has provided an opportunity for smaller-unit, single-family living at relatively modest cost, given the trade-off of a longer commute to town. However, as Hawaii home prices have risen across the board, townhomes are assuming an increasing share of even Ewa area sales. In 2006 townhomes represented some 21% of area new sales, compared to an average 18% over the entire period. Additionally, the density of many single-family homes has increased to within the historical range of townhomes and a growing segment includes condominiumized elements such as driveways, courtyards, structural walls and the like. Thus the "single-family" homes being developed are increasingly likely to have characteristics previously associated with multifamily or townhome developments.

Housing Supply Outlook

Planned Communities in Ewa and Central Oahu (Exhibits 3-5 and 3-6)

MC reviewed planned residential development projects within the Ewa and Central Oahu DP areas. This survey targeted projects of 100 units or more for which LUC Urban designation was in place, and/or for which the landowner was be exempt from LUC governance.

- Ewa - Some 31,000 units of State-entitled future development were identified at 20 sites in Ewa. Of this total, about 65% could be fully absorbed by 2015.

  These figures do not include Ho'opili.

[5] Includes the Ewa, Kapolei and West Oahu (Ko Olina) areas, as defined by the Harris Company.

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- **Central Oahu** has only about 8,200 potential future units entitled currently, all of which could be developed and absorbed by 2020, and 90% by 2015.

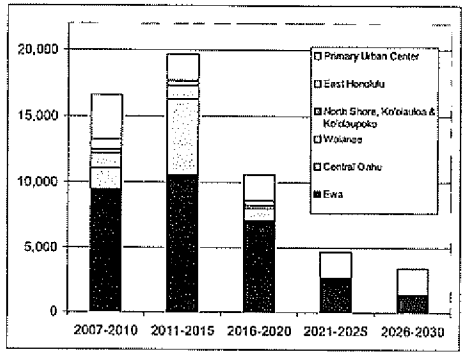
  Three planned Central Oahu developments, Castle & Cooke's Koa Ridge and Waiawa, and Gentry's Waiawa Phase 2 could conceivably add up to another 12,000 units. However, all three of these projects require LUC approval.

These potential inventories are considered generous since they consider current zoning or plan maximums and projected development schedules. Often projects get developed at less than their permitted or planned densities, and/or experience delays that push inventory further into the future.

Projected Oahu Housing Development (Exhibit 3-7)

Combining the data on Ewa and Central Oahu resident housing projects with information gathered on planned developments elsewhere on the island shows some 55,100 resident housing units with LUC approval at this time. This number is based on an estimated 31,000 units in Ewa, 8,200 in Central Oahu, 2,470 in Waianae, 1,230 in the North Shore, Ko'olauloa and Ko'olaupoko areas, 740 in East Honolulu and 9,370 in the Primary Urban Center (PUC.) The PUC figure includes an allowance of 2,000 units per 5-year period after 2010 for unforeseen redevelopment projects.

LUC-Entitled and Planned New Housing Unit Development on Oahu



See Exhibit 3-7 for sources and further information.

Considering information provided by developers and landowners and on historical absorption rates of similar products in the area, buildout of these entitled units could occur as shown above.

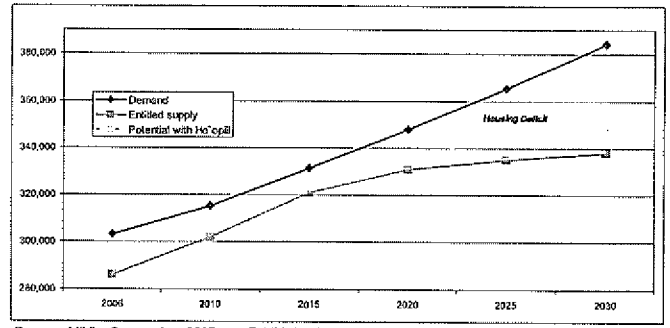
Summary of Island Demand and Supply Factors (Exhibit 3-8)

- **Current and Future Demand** - The SMS study previously cited projected that Oahu households will increase from about 303,149 in 2006, to 384,005 in 2030. These considerations suggest a need to provide housing for 81,000 new households over the next 24 years, or by 2030. In addition, existing pent-up demand as of the end of 2006 is estimated at 17,000 units.

- **Current Supply** – The current supply of housing is estimated using the ACS survey finding of 300,557 occupied housing units in 2005, less a 6% allowance for units held for nonresident use such as visitor or part-time resident use. This results in an estimated 283,000 occupied resident housing units (RHU) in mid-year 2005. Added to this figure are recorded new unit closings from July 2005 through December 2006. This results in an estimated 286,000 net available RHU by the end of 2006.

- **Future Supply** – Future supply estimates are based on the schedule of LUC-entitled potential future developments islandwide, representing some 55,100 units by 2030, as shown previously in Exhibit 3-7. From this figure a 5% vacancy allowance is deducted, resulting in some 52,000 units available for resident housing use. Note that these estimates are considered generous, as explained previously.

Oahu Resident Housing Unit Supply and Demand After Development of Currently LUC-Urban Lands



Source: Mikiko Corporation, 2007; see Exhibit 3-8 for further information.

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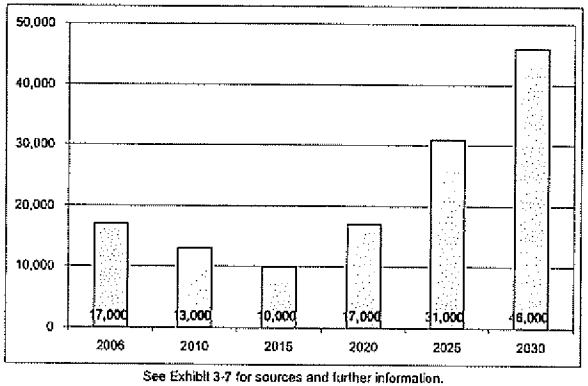
Taken together, the outlooks for demand and entitled supply projections indicate a substantial shortfall in currently permitted housing opportunities. In addition to the need to house up to 81,000 new households by 2030, there is a pre-existing estimated pent-up demand for about 17,000 housing units, yet only 52,000 net units LUC-enabled.[6]

Thus, it appears that aggressive housing production efforts in the near term could pare Oahu's shortage of primary resident housing units down to about 10,000 units by about 2015. However, without further State entitlement of major housing developments, the unmet need for housing could thereafter be expected to spiral up to some 46,000 homes by the year 2030.

Oahu Resident Housing Unit Deficit
After Development of Currently LUC Urban Lands



See Exhibit 3-7 for sources and further information.

[6] Based on 55,000 LUC-entitled units total, less a 5% vacancy allowance on those units.

4 – Ho`opili Residential Market Assessment

Future Housing Market Setting

Housing Demand (reference Exhibits 2-2 and 3-8)

DRH anticipates Ho`opili's first housing units could be available for occupancy in 2012. At that time, the housing market is expected to still be in deficit mode, with about 10,000 to 13,000 fewer units available for resident use than desired.

From 2012 to 2030, potential new household formation could be expected to generate demand for another 65,800 or so units.[1] This new demand is expected to be distributed between:

- **Downsizers** – Hawaii's 55 to 74 year-olds are expected to increase by about 60,000 between 2010 and 2020. This is the Baby Boom generation, and a larger share will be entering their mid-60s than their mid-50s by 2020, as shown previously in Exhibit 2-2.

  Many members of this generation can be expected to downsize their housing and to seek to live closer to community amenities as their children move out, they enter retirement and/or as they no longer care to maintain large properties. The leading end of this trend is already seen nationwide; in Hawaii, those trading single-family homes for multifamily living in a more urban setting are evidenced in Kaka'ako's new high rises.

  After 2020, the 55 to 64 age cohort could decline as more move into their 70s (see "senior markets," below.)

- **Entry level markets** – Hawaii's next most rapidly growing cohort between 2010 and 2020 is likely to be persons aged 25 to 34, the "Echo Boom" generation. This phase often includes household formation, and one's first rental or home purchase. Since affordability is key to this market and many do not yet have spouses or children, this market also tends to seek smaller units. This cohort is anticipated to increase by 22,000 persons statewide between 2010 and 2020.

[1] See Exhibit 3-8; represents 12,800 demanded 2012-2015 (3,200/year) plus 17,000 from 2016 to 2020, 18,000 from 2021 to 2025, and 18,000 from 2026 to 2030.

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- **First move-ups** – A strong move-up market could emerge after 2020, as the Echo Boom cohort ages into its mid 30s and early 40s. This age group is projected to increase by about 19,000 persons statewide between 2020 and 2030.

- **Retirement/senior markets** – The retiree/senior market will also show significant gains, with an additional 21,000 persons aged 75 or more anticipated statewide in 2020 compared to 2010, and another 56,000 between 2020 and 2030. Typically one or two persons per household, this market is also amenable to smaller units.

Altogether, satisfying the potential demand from Oahu's growing population after 2006, plus existing pent-up demand is projected to require that some 98,000 (81,000 + 17,000) more housing units be supplied over the next 24 years.

Within the island, the Ewa Plain has long been the preferred location for such future large-scale development, and a number of factors support this:

- **Land and infrastructure** – The Ewa DPA contains the majority of the island's remaining extensive, flat and less developed lands. State, County and private entities have already invested heavily in primary infrastructure for the area, including highways, major roads, harbor improvements and water and sewer systems.

- **Transit** – The County's proposed mass transit project, targeted to be operational by 2012, would link Kapolei to downtown Honolulu and eventually Waikiki and the University of Hawaii (UH) Manoa campus. The currently preferred route runs through Ho`opili, along Farrington Highway.

- **Jobs** – In addition to transportation solutions that enhance commuting out of the district, Kapolei is rapidly developing its own jobs base, which will reduce the need to out-commute. While historically the area has generated mostly secondary jobs, significant new primary job[2] creation is occurring, such as at:

  - **Judiciary** – The new State Court complex is projected to relocate 650 direct and indirect jobs to Kapolei.

  - **Island Pacific Academy** – This private school, opened in Kapolei in 2004 as a lower school, expanded enrollment and added middle and high school levels in 2006.

  - **UH West Oahu** – This major expansion is projected to generate 1,200 jobs at the new campus and support facilities.

[2] Meaning these jobs capable of providing the major financial support for a household.

  - **Business and industrial parks within the region** – Build-out of Kapolei Business Park and development of new parks such as the 54-acre Phase 2 of Kapolei Business Park, a 22-acre movie studio, and the 66-acre former Hawaii Raceway Park, as well as Kapolei Harborside Center (345 gross acres, now petitioning the LUC for a land use boundary amendment).

In summary, developments underway in Kapolei are projected to add 40,000 more jobs in the region by 2025, according to an earlier study[3].

Housing Supply (reference Exhibits 3-7 and 3-8)

Currently entitled projects are estimated to yield up to 52,000[4] of the required 98,000 housing units by 2030, if they are developed within the time frame and at currently planned or entitled use levels.

Despite these substantial developments and a greater than historical rate of new home production initially, the island could still anticipate a 46,000-unit shortage by 2030, the end of the projection period:

Supply and Demand for New Resident Housing Units on Oahu 2007 to 2030

Future Demand	Pent-up demand, end 2006	17,000
	Future need, 2007-2030	81,000
	Total need	98,000
Future Supply	Planned and entitled (55,000 less 5% vacancy)	52,000
Shortage	**As of 2030**	**46,000**

Source: Mikiko Corporation, 2007. Future supply estimate assumes full buildout of all lands currently designated Urban by the LUC, and proposed for residential development. See Exhibit 3-8 for further information.

Moreover, more than 65% of the entitled new development could be built out over the next 8 years, or by 2015. By 2020, within 8 years of Ho`opili's projected first marketing, all but 15% of the island's entitled inventory could have already been developed and absorbed.

[3] Decision Analysts Hawaii, Inc., "Ewa Development, 2006 to 2025: Economic, Population and Fiscal Impacts," 2005.

[4] This would represent up to 55,100 units delivered, less a 5% vacancy allowance.

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In conclusion, a stepped-up rate of housing production that appears possible over the next several years could help to pare down the current housing deficit through about 2015. However, thereafter, currently entitled projects would be unable to keep up with demand. Without further entitlement of significant lands for residential development, another, an even more drastic housing crisis than today's is anticipated to emerge between 2016 and 2030.

Supply Solutions/Currently Entitled Projects

During the majority of Ho`opili's marketing, most of the currently entitled projects are expected to be sold out. By 2016, only a few projects are anticipated to have significant remaining inventory. Even so, most of these could be fully absorbed by 2020:

- **In Ewa -**
  - Makaiwa Hills – Higher end, likely to substantially sell-out by 2020.
  - East Kapolei II and III – DHHL projects, to be restricted to persons of Native Hawaiian ancestry; expected to be completed by 2020.
  - UH West Oahu – Core is oriented to campus needs; surrounding potential developments projected to sell out before 2020.
  - Kalaeloa – Development types and schedules to be determined; much depends on U.S. Navy decisions yet to be made and emerging State policy.
- **In Central Oahu** - Waiawa Gentry Phase 1 could be nearing sell-out in the 2016 to 2020 period.

Outside of Ewa and Central Oahu, there is likely to be redevelopment within existing neighborhoods but there are limited lands available for new development and no major primary residential communities known to be in the planning phase.

This contrasts with today's market, where more than 12 developments of 500 or more remaining units are underway or in planning. By the time of Ho`opili's marketing, without further land use entitlement, there could be only the five projects noted above, and by 2020, only one or two. This is the source of the drastic housing shortage that could materialize after 2015, in the event that significant further inventory is not entitled.[5]

[5] In addition to Ho'opili, other large proposed developments that may seek LUC Urban reclassification include Castle & Cooke's Koa Ridge and Waiawa, and Gentry's Waiawa Phase 2. Together, these Central Oahu projects could offer up to 12,000 residential units, as currently configured.

New Urbanism

The development concept for Ho`opili is one that has been widely tested and refined as the principles of "New Urbanism" or "Smart Growth" are adopted in communities worldwide.[6] In contrast to the former suburban/commuter model of development, typical guidelines for New Urbanism include:

- Mixed land uses (residential, commercial, community);
- Compact building designs and higher densities;
- Walkable neighborhoods;
- A variety of transportation choices;
- Housing opportunities and choices for a range of household types and incomes; and
- A greater balance of jobs and housing within each community.

According to The Congress for New Urbanism (CNU), a leading promoter of such development, even if overall demand for new housing were to slow, cultural changes are resulting in a preference for living in dense, walkable neighborhoods, and thus the demand for homes in New Urbanist communities is expected to increase rapidly. This is being driven by several trends:

- Rapid increase in the number of households that are middle-aged or older, even though these same persons likely grew up in and raised their children in suburban, car-centered communities;
- Receptivity of the young adult "Echo Boomers" to urban lifestyles and New Urbanist values, as well as their general inability to afford living in the suburbs;
- Deteriorating driving experience on most US highways and roadways; and
- Workforce changes related to technology and outsourcing that encourage more people to work from home.

In Hawaii, recent high-rise development in the Kaka'ako area illustrates the acceptability of these concepts in our island setting. Over the past five years, Oahu residents have demonstrated strong interest in high density housing in Kaka'ako that is proximate to

[6] Although often dated to the late 1990s, the New Urbanism or Smart Growth movement is rooted in the ideas of Jane Jacobs, whose The Death and Life of Great American Cities was published in 1961.

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jobs (Waikiki, downtown and the corridor in between), entertainment, shopping, culture, multi-modal transportation and myriad recreational and natural resources.

Mehana, another DRH project, will be the first to directly implement these principles on the Ewa Plain. Mehana is expected to commence sales in mid-2007, and will offer 1,150 homes, most of which will be in mixed-use settings. Approximately 80% is planned as multifamily or attached housing. All of Mehana is within walking distance of the City of Kapolei and the site is traversed by the County's proposed transit route. To date, community reaction to Mehana has been very positive.

Also on the Ewa Plain, UHWO's college town area is planned to offer higher density developments dominated by multifamily housing, much of it in mixed-use settings.

Ho`opili's Proposal

Development Concept

Ho`opili is planned to respond to the trends and future community needs discussed above. It will serve a "graying" Kapolei and will make available opportunities for urban village living at more modest cost than now possible in Kaka'ako.

- It offers significant primary resident housing in an area that has long been planned for such expansion. Ho`opili's 11,750 units could represent a solution for up to about 25% of the island's currently unentitled housing needs through 2030.
- It offers a wide variety of housing types, not dominated by the high-end.
- It offers a highly accessible lifestyle that is not car-driven. This is enabled by its access to future transit service, its planned higher densities and mixed uses, and its planned trails and "walkable" streets. These transportation options further enhance the affordability of the community, as studies have shown that automobile costs represent up to 15% or more of the typical US household budget (and much more for lower income households.)
- It offers housing in conjunction with significant jobs, schools, parks and other community amenities. This in turn enhances Ho`opili's affordability as it reduces the need for a second or third automobile per household and also may represent significant timesavings.

Ho`opili Product Mix

The majority of Ho`opili's units are expected to be for-sale multifamily units. The development would also include single-family units for-sale and it may include multifamily rental units. The exact mix of units by type will be determined during the years of build-out, as market conditions and preferences materialize.

In terms of market orientation, up to 30% of Ho`opili's units are expected to be developed as affordable housing, in accordance with the County's affordable housing guidelines.

General densities, tied to the areas shown in the Land Use Map, are envisioned as follows:

- **Low- to medium-density** – 5,100 units total, including single-family homes at 5 to 8 units per acre and multifamily at 10 to 14 units per acre. Some multifamily development may be in residential-only buildings. Others would be located above lower or ground floor commercial uses and/or designed as "live-work" units that offer both a residence and a potential commercial area.
- **Medium-density** – 5,200 units total, all multifamily at 15 to 29 units per acre. These areas are planned as mixed-use, "live-work" units within low- to mid-rise buildings with neighborhood-serving commercial. They may include a senior housing or lifestyle component as well.
- **High-density** – 1,450 units total, developed in buildings at 30 to 50 units per acre, typically with neighborhood-serving commercial on the ground floor.

Affordable housing opportunities are planned within the medium and high-density areas.

Market Evaluation and Conclusions for Ho`opili

Anticipated Buyer Markets (Exhibit 4-1)

The proposed products respond to the market opportunities identified above as follows:

- **Entry-level markets** – Up to 30% units, those designated as affordable units, as well as many of the other higher density for-sale multifamily units are conceived to appeal to entry-level markets, typified by the rapidly increasing 25- to 34-year-old Echo Boom cohort in the 2010 to 2020 period.
- **Move-up markets** – Ho`opili's "traditional" or lower-density single-family housing, as well as some of its more amenitized multifamily offerings could appeal to move-up

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markets and growing families. The first level move-up market, typified by persons aged 35 to 44, is projected to grow particularly rapidly in the 2020 to 2030 period as the Echo Boomers mature.

- **Downsizers** – Ho`opili's higher density single-family units and all of its mixed-use multifamily units are seen to appeal to the Baby Boomer cohort that is looking to simplify its lifestyle, lessen homeowner commitments and enhance access to urban amenities.

- **Retirement/senior markets** – The medium density areas are seen to possibly include one or more senior housing developments, catering to the 75+ population, a rapidly increasing age classification. Some of the senior housing may also be part of the affordable housing inventory.

The great majority of Ho`opili homebuyers are anticipated to be purchasing for use as an owner-occupant. Based on surveys of 365 persons who signed sales contracts at eight DRH projects in 2004 and 2005, 95% expected to be an owner-occupant, while only 5% were purchasing primarily for an investment or for second home use.

Ho`opili's live-work units might encourage a higher share of investor buyers than seen in the marketplace recently. However, most of these buyers would be expected to put the units back into long-term rental, meaning it would still be in the primary residential market.

Ho`opili Residential Prices (Exhibits 4-2 and 4-3)

Pricing at other DRH projects frames the market orientation and production capabilities that the company could bring to Ho`opili. DRH's current projects in the region include build-out at various sites in Makakilo and of its masterplanned Sea Country community in Ma'ili. In addition, the company has been selling the last of its townhouse inventory in Hawaii Kai and single-family condominiums in Kahala. 2006 price indicators at these locations are presented in Exhibit 4-2 and summarized on the following page.

Market Unit Price Indicators and Conclusion
2006, except Mehana

	Multifamily units	Single-family units	Comparison to Ho`opili
Makakilo	$316,000 - $583,000 (12-14 u/ac)	$543,000 - $913,000 (5-6 u/ac)	Some have superior location and views
Sea Country, Ma'ili	None offered	$327,000 - $550,000 (5-8 u/ac)	Less desirable location
Hawaii Kai & Kahala	$557,000 - $725,000 (15 u/ac)	$650,000 - $1,400,000	Locations command premiums
Mehana (estimated, mid-2007)	$350,000 - $550,000 (17 u/ac)	No product priced yet	Most comparable plans and location
Ho`opili assessment (market units)	**$350,000 - $650,000 (10+ u/ac)**	**$500,000 - $750,000 (5-8 u/ac)**	**May be additional premiums**

Sources: DRH and Mikiko Corporation. See Exhibits 4-2 and 4-3 for further information.

In conclusion, Ho`opili's market units are expected to support prices ranging from (in 2006 dollars):

- $350,000 to $650,000 for its various multifamily products, to

- $500,000 to $750,000 for its single-family products.

Additional premiums may be realized in the future due to New Urbanist features of Ho`opili and it's many community amenities.

Affordable for-sale multifamily units would be priced in accordance with then-applicable County rules and guidelines. In 2006, such units would have been priced from $232,000 to $392,000 for a family of four earning 80% to 120% of the Honolulu median income.

Rental rates, assuming some affordable housing units are developed as rentals, would also be based on County rules then in effect. Currently, these would be expected to be

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targeted at persons earning below 80% and up to 100% of Honolulu's median income, or in some circumstances, to lower income groups. In 2006, conforming rents for this target market ranged from $998 to $2,481 for studio to 4-bedroom units, according to the County.

Residential Production Capacity

Over the past two years, DRH closed approximately 400 new units on Oahu each year, the majority in Makakilo. These deliveries have been constrained within each community by labor and supply factors, while the island-wide sales have been capped by the company's lack of other large sites ready for development. DRH's capacity has also been hampered because, without a large single project, it has had to disperse its Oahu production activities among three or more disparate locations (including Makakilo, Ma'ili, Kahala and Hawaii Kai.)

DRH's 2005 and 2006 sales were produced under a relatively high competition setting, and represent 21% to 22% of the island-wide market for new home sales in each of the years. Schuler's past market records demonstrate the company's ability to sustain much higher levels of production and sales, even before its capacity-increasing association with DRH in 2002. From 1992 to 1995, Schuler closed some 600 to 1,100 units annually on Oahu, with sales peaking in 1994 at 1,143 homes.

Ho'opili Absorption Conclusions

Given the highly limited supply of community development opportunities on Oahu in the 2012+ time frame, and even assuming entitlement of the large properties currently considering petitioning for development entitlements in Central Oahu, DRH's market share could be substantially higher than during the last two years. Since Ho'opili is the only large community in planning by DRH on Oahu (other than Mehana, which likely will be substantially sold out), this enlarged market share would largely accrue to Ho'opili. Ho'opili's anticipated market share also considers:

- It is a highly desirable location, far more proximate to future job and school centers than Makakilo or Ma'ili.

- As shown in the analyses in Chapter 1, without further entitlement of other residential developments, Ho'opili's hypothetical fair share in the 2016 to 2030 period could be about 39% of the island market. If Koa Ridge, and both of the Waiawa projects were also entitled and developed in the time frame, their additional 10,500 units could reduce the Project's fair market share to about 29% after 2015.

- The Project will offer a wide range of products, targeting many household types of a broad range of income levels. In comparison, the ridge developments at Makakilo (historically) and at Koa Ridge and Waiawa Phase 2 (if they are entitled in the future) will likely need to offer lower density and higher priced product.

As demonstrated previously in Exhibit 3-8, Oahu needs an annual average production of about 3,400 units through 2030 in order to meet future demand from household formation. In order to also pare down pent-up-demand, Oahu needs more than this.

The table on the next page shows two potential future housing scenarios with Ho'opili on the market. In both cases, the Project's assumed market share is substantially less than what its hypothetical fair share could be.

- **In the first case**, Oahu housing production would be near to recent historical levels, at an assumed 2,000 units per year. (In this scenario, the marketplace would likely continue to slide towards a greater housing crisis than is now being experienced.) This scenario could result from an inadequate supply of entitled and serviced lands, or other nonmarket barriers to production. Given the limited competitive product, Ho'opili's market share is expected to be substantially higher than has DRH's in recent years (21% to 22%), when there was a great deal of competition and the DRH's product was in less prime locations. This scenario suggests Ho'opili sales achieving a 30% to 35% market share, and averaging 600 to 700 closings per year.

- **The second scenario** assumes a more adequate supply of new housing on Oahu, though still not enough to also eliminate the backlog of pent-up demand. In this case, a hypothetical Oahu absorption of 3,900 units per year is assumed.

  This environment would be more competitive for DRH than Scenario 1, but still less than under current conditions. In this case the Project's market share is conservatively assumed to be 15% to 20% of the Oahu new home market, below the range of DRH's recent historical achievements, and less than its hypothetical fair share of about 30% in a similar situation. This would result in average annual Project sales of some 585 to 780 units as shown on the following page.

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Oahu and Ho`opili Annual Residential Unit Sales Absorption, 2012+

	Scenario 1: At recent historical levels of island production	Scenario 2: At demand-satisfying levels of island production	Conclusion for Ho`opili
Assumed total Oahu developer sales	2,000	3,900	
Ho`opili market share[7]	30% - 35%	15% - 20%	
Ho`opili average annual sales	**600 - 700**	**585 - 780**	**650**

Source: Mikiko Corporation, 2007.

Projected Ho`opili Residential Absorption

Considering the two scenarios, it is concluded that Ho`opili should be able to sell 650 units per year on a long-term average basis. Actual sales from year to year could span the range of outcomes projected (585 to 780 units per year), or show even greater fluctuation depending on market conditions and the types of units under development at any given time.

The 650 unit sales could represent 450 market units and 200 affordable units in an average year. The affordable housing sales absorption is assumed to occur more gradually because it would generally need to be developed as infrastructure and community facilities are supported by market housing unit sales.

[7] Compared to the Project's potential fair market share of 40% and 30%, respectively, under two similar scenarios (see Chapter 1.)

These rates would lead to complete absorption of the Project within 19 years, or by 2030.

Illustrative Mix of Potential Residential Sales Absorption at Ho`opili

	Market units	Affordable for-sale units	Total for-sale housing
Potential total inventory	8,250	3,500	11,750
Average annual sales	**450**	**200**	**650**
Years on market	19	18	19
Start date	2012	2012	2012
End date	**By 2030**	**By 2029**	**By 2030**

Source: Mikiko Corporation, 2007.

Alternatively, if some of the units were developed as rental products, the community could be expected to become fully occupied even earlier, given the historically high demand for and limited supply of quality rental products on Oahu.

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5 Retail Market Environment

Methodology

This chapter presents the estimated market support for additional commercial space in Ewa as derived from retail-based market indicators. While many retail shopping centers include substantial office space, and office buildings often include retail, office market conditions are considered more specifically in the next chapter[1].

The market assessment for retail areas compares retail supply to consumer demand, which consists of resident and daytime populations. Nationally, there was an average of 20.3 square feet of shopping center space per person in the U.S. in 2004, and 63% of all retail space was within shopping centers.[2] This is equivalent to 32 square feet total retail area per person.

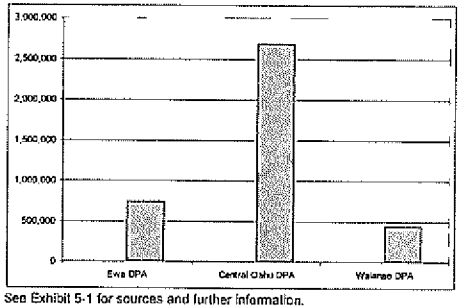
This is a useful benchmark, but Hawaii's retail market is unique in many respects. Thus, retail supply and population are also evaluated for the Ewa, Central Oahu and Waianae DPAs, which are considered the primary Trade Area, as well as for Hawaii Kai, which is considered a benchmark market.

Retail-Based Supply

Trade Area, 2006 (Exhibit 5-1)

The Trade Area had some 3.86 million square feet of retail space in December 2006. About 70% or 2.68 million square feet of this was located in Central Oahu. The Ewa DPA accounted for 19% of the region or some 737,000 square feet in place, while Waianae held the remaining 11%, with 439,000.

Existing Retail Gross Leasable Area
(square feet)



See Exhibit 5-1 for sources and further information.

[1] For purposes of this analysis, these relatively limited office areas within retail shopping centers are considered part of the "retail" market.

[2] National Research Bureau, Inc., "2004 NRB Shopping Center Census," 2005; Niemira, Michael P., "The U.S. Retail Space Market," Research Review, V.12, No. 2, 2005. Mr. Niemira is Vice President, Chief Economist and Director of Research for the International Council of Shopping Centers.

As of now, Ewa has no regional centers, but a 600,000 square foot center, the Kapolei Commons, is being planned.

Overall, Oahu's retail market is considered undersupplied, with a December 2006 vacancy rate of 2.2%, the lowest in 15 years, according to CMF. This is despite three strong years of net absorption, totaling about 650,000 square feet.[3] These trends are mirrored in West Oahu, which had an average 2.5% vacancy in December 2006. Central Oahu and Hawaii Kai's vacancies were even lower, at 0.6% each. Waianae showed the island's highest vacancy rate, at 14.5%.

Benchmark Area, 2006 (Exhibit 5-1)

As a planned community nearing buildout, with retail centers operating at or near capacity and a growing jobs base, Hawaii Kai is considered an indicator for the relationship of balanced retail supply to population levels in a suburban community.[4] Hawaii Kai has about 857,000 square feet of gross leasable areas (GLA), of which 247,000 are in the regional Hawaii Kai Towne Center, about 322,000 in Koko Marina Shopping Center, and 133,600 in Hawaii Kai Shopping Center.

Planned Development in the Trade Area (Exhibit 5-2)

Within Ewa, Kapolei is the focus of current commercial development interest. There are an estimated 3.3 million square feet of potential retail spaces underway or proposed on lands that are entitled[5] and planned for commercial development throughout the DPA. Of this, 75% or 2.5 million square feet are in Kapolei, including the East Kapolei area. Nearly 1.7 million square feet, more than twice Ewa's existing stock, could be added by 2011.

In contrast, the Central Oahu DPA has only about 540,00 square feet of identifiable and State-entitled retail projects in planning. The majority of this is at Gentry/A&B's Waiawa Phase I, which has been designated Urban, but much of which still requires zoning. However, Waiawa could produce more retail development than the 400,000 square feet estimated here for planning purposes. Over 100 acres of lands within this project were previously designated for commercial or industrial use and presumably will be developed in accordance with market demands.[6]

[3] Colliers Monroe Friedlander, Inc., "Retail Market Report: Oahu Year-End 2006," January 2007.

[4] Because Hawaii Kai is a suburban community, whereas Ewa is planned to be mostly urban, Hawaii Kai's ratios are considered possibly low indicators for Ewa.

[5] As for residential developments, this analysis considers only those proposals on lands designated Urban by the LUC.

[6] The other potential major retail project in Central Oahu would be at Castle & Cooke's proposed Koa Ridge development. These plans are still under review, but the project could designate significant lands to retail use if market conditions warrant. Koa Ridge is not included in the "entitled/planned" inventory because it still requires LUC redesignation, as well as County zoning, in order to proceed.

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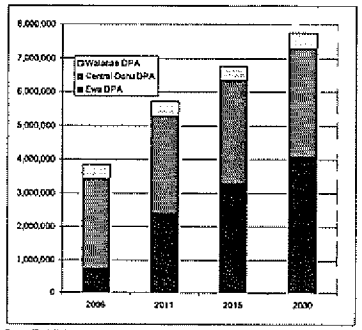
Specific projects and land areas from which these estimates were derived are presented in Appendix 4.

Future Trade Area Inventory (Exhibit 5-3)

Potential Future Retail Gross Leasable Area in Trade Area (square feet)



See Exhibit 5-3 for sources and further information.

Considering the planned and entitled projects identified, retail areas in the Trade Area could nearly double by 2030, to approximately 7.7 million square feet. Most of this new inventory would be added in Ewa, in alignment with the area's projected residential and population growth.

Retail-Based Demand

Area Resident Profiles (Exhibit 5-4)

With about 88,800 residents, the Ewa DPA has a little more than half the population of the Central Oahu DPA, and Waianae has about half of Ewa's. In total, the Trade Area is home to about 290,950 persons or 32% of the island's population in 2006. Relationships within the Trade Area will change significantly over the next five years, as Ewa population is projected to grow an average of 5.6% per year to 2011, compared to 0.4% in Central Oahu and 0.7% in Waianae.

The benchmark market Hawaii Kai housed about 29,000 persons in 2006 and could grow 0.9% per annum in coming years.

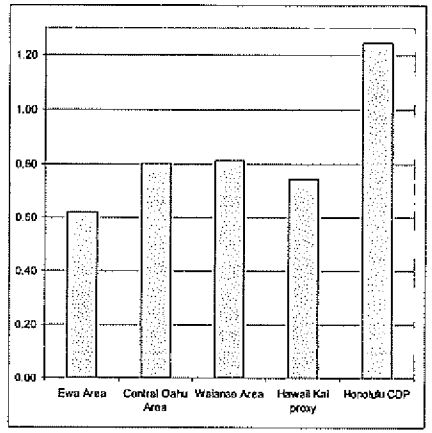
Incomes in the Ewa DPA compare favorably to Central Oahu and the island of Oahu as a whole, with a median $73,025 per household in 2006, or some $22,900 per person. This compares to medians of $66,667 in Central Oahu, $47,923 in Waianae, and $75,432 for the island as a whole.

Hawaii Kai shows a higher median household income than the Trade Area, at an estimated $97,091.

Daytime Population Ratios (Exhibit 5-5)

Daytime populations within the Trade Area and benchmark market are estimated based on 2000 ratios prepared by the US Census within Census Designated Places (CDPs)[7]. The Ewa DPA includes three CDPs, while Central Oahu has seven and Waianae has three. The ratios derived from this source are considered baseline figures for the current analysis, as explained below.

Ratio of Daytime Population to Residents



See Exhibit 5-5 for sources and further information.

Hawaii Kai is not a "Place" designated by the Census. Therefore, Kailua Town's population ratio was used as a proxy for Hawaii Kai's, since both are long-established bedroom communities to Honolulu, located about 30 minutes away, and both have shown recent increases in retail- and service-related employment.

On average, the Ewa CDPs show a daytime population of 62% of their resident population, suggesting significant out-commuting during the day.

Central Oahu reflects less out-commuting, as evidenced by a daytime ratio averaging 80% among its CDPs.

Waianae's CDPs also show a relatively high daytime population ratio, at 81%. However, this may be influenced by the relatively high unemployment rates in the district as much as by out-commuting.

Out-commuting for the Trade Area as a whole would be substantially lower than these figures reflect, because (1) there are persons who live and work in different Census Places but still within the Trade Area, and (2) the data are based on 2000 employment and residence patterns and, particularly in Ewa, significant job creation has occurred since then.

As a proxy for Hawaii Kai, Kailua CDP showed a 74% daytime to resident population ratio. Figures for the Honolulu CDP are also presented as an example of an urban area with net daytime in-commuting, and the ratio achievable within a much larger area.[8] The Honolulu

[7] US Census Bureau, Census 2000, PHC-T-40, "Estimated Daytime Population and Employment-Residence Ratios: 2000" Journey to Work and Migration Statistics Branch, 2005.

[8] The Census Bureau defines the Honolulu CDP to include Waikiki, the Primary Urban Center and East Honolulu. These data are not skewed by visitors, as they are not inventoried in the Census methodology.

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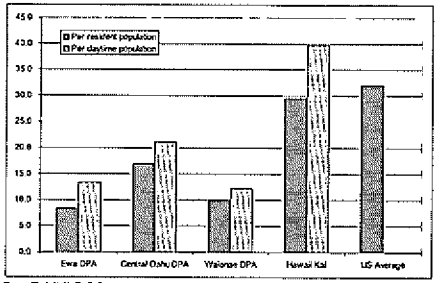
CDP is estimated to provide 54% more jobs than could be filled by its resident workers, and shows a daytime population ratio of 1.25.

Retail Supply in Relation to Population
(Exhibit 5-6)

Comparing retail GLA to resident population, the Ewa and Waianae DPAs appear significantly under-retailed currently, at only 8 to 10 square feet per resident. Central Oahu's resident ratio is more than twice Ewa's, at 17 square feet, while Hawaii Kai is considered a relatively balanced suburban market, at 30 square feet per resident. The latter is more consistent with the U.S. average of about 32 square feet per resident, as discussed previously.

Gross Leasable Square Feet Per Person



See Exhibit 5-6 for sources and further information.

In comparison to estimated daytime population, Ewa and Waianae again stand out as under-retailed, with a ratio just over one-third that shown as supportable in Hawaii Kai. Hawaii Kai is able to support these significantly higher space ratios despite virtually no vacancies.

Supportable Retail-Based Area in Ewa

Methodology (Exhibits 5-7 and 5-8)

Future support for additional retail-based areas in Ewa is expected to come primarily from the resident and daytime populations of the Trade Area. Within the Trade Area, the rapidly increasing resident populations of the Ewa DPA itself would anchor demand for new retail in the DPA. Additionally, the populations of the nearby Waianae and Central Oahu DPAs are expected to contribute an increasing share of their retail expenditures in Ewa, as Ewa becomes a regional hub for jobs, services, entertainment and shopping.

Therefore, the anticipated market support for additional retail space in Ewa is considered from these two perspectives:

- **Immediate market (Ewa DPA)** – Demand is projected by correlating the existing and planned/entitled retail areas in the Ewa DPA with its projected resident and daytime populations. These populations are estimated to support 30 square feet GLA per resident, and 36 square feet per daytime population. Both of these ratios apply to expenditures within the Ewa DPA and are benchmarked to within-community ratios derived from Hawaii Kai.

- **Nearby markets (Waianae and Central Oahu DPAs)** – Demand is projected by estimating expenditures these resident and daytime populations make within a regional market, and within this, Ewa capture rates are estimated. For these purposes, retail potential is estimated at 32 square feet GLA per resident population, and 40 square feet per daytime population. These ratios are marginally higher than those applied to Ewa, since they refer to potential expenditures throughout the Trade Area region, not just Ewa.

Key Assumptions (Exhibits 5-7 and 5-8)

Key assumptions to the projection methodology include the retail to population ratios, daytime to resident population ratios and Ewa's capture rate of retail expenditures made by those who live or work outside the DPA.

- **Retail to population ratios** (as presented above) -

  - Central Oahu today is a relatively large, diverse area with significant and diverse retail and service industries that provide a job base. However, it is not a major job center and still experiences significant out-commuting. Thus its resident and daytime retail to population ratios of 17 and 21 square feet, respectively, are very low indicators for the Trade Area, particularly in the future. Also, its vacancy rate of approximately 0.6% suggests it is under-retailed for its existing populations.

  - **Hawaii Kai** is smaller in terms of population, but is a nearly mature bedroom community, with a wide variety of retail, dining and service choices. It also offers facilities that serve a broader regional market. Thus, its ratios of 30 and 40 square feet per resident and daytime population are considered more representative of what the Trade Area could achieve in the future. However, given Hawaii Kai's bedroom community status and its low vacancy rates (0.6% in December 2006), it could also be a low benchmark for Ewa in the future. Additionally, since these figures are derived from space supported within Hawaii Kai only, they could under-represent the total market support if a larger area were considered.

  - The estimated **U.S. average** of 32 square feet per resident population helps to further establish the reasonableness of a resident ratio slightly higher than Hawaii Kai's 30.

- **Regional capture rate** - Ewa's share of expenditures made by nearby residents is expected to increase over time, from a nominal amount currently, to up to 15% (daytime

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population) or 20% (resident population) by 2030, as Kapolei and East Kapolei grow as centers of employment, shopping, entertainment and dining. It is particularly logical that Ho`opili capture a significant share of Central Oahu resident and daytime population expenditures, due to its location on the Central Oahu border. Residents are expected to be more flexible as to where they make their expenditures than are employees, who are an additional component of daytime population.

- **Daytime population ratios** - This assessment assumes daytime to resident population ratios approaching 0.95 throughout the Trade Area, compared to the average 0.75 within CDP ratios observed in 2000. This approximately 25% increase in the daytime population ratio over the 30 year period (from observations in 2000 to the end of the projection period in 2030) is considered possibly conservative due to:

  - The regional ratio is likely already substantially higher than the 0.75 figure assumed for 2006, since it reflects only those persons remaining within the Trade Area.
  - Some of this change is likely to have occurred already, since the ratios to which these increases are applied were based on 2000 data.
  - The Kapolei region is poised to move from a primarily bedroom community to one that is increasingly a "Second City," in accordance with public and community visions for the area.
  - The assessment would position the Trade Area of the future above the Hawaii Kai proxy of 0.74 and the 2000 Central Oahu figure of 0.80. Both of these areas are somewhat mature but are still bedroom communities.
  - At 0.88, the Trade Area would still be well below the Honolulu CDP figure of 1.25, which reflects a more representative land area, but one anchored by the State's major urban and jobs center.

Conclusions for Ewa

In comparing the two approaches, the daytime population methodology is considered more appropriate because it better reflects Ewa's expected emergence as a regional hub for employees, students, commuters and others who will represent primary support for its commercial markets. Compared to the resident population method, the daytime population method shows a more gradual build-up of additional supportable GLA, but a slightly higher level overall by the end of the projection period in 2030. The implications of the two methods as well as the conclusion for additional supportable retail-based areas in Ewa are summarized in the table on the following page.

Projected Supportable Additional Retail-Based Commercial Space in the Ewa DPA (square feet)

	2015	2030
Method 1: Resident population	1,900,000	2,800,000
Method 2: Daytime population	1,500,000	3,000,000
Conclusion (daytime method)	**1,500,000**	**3,000,000**

Note: Figures represent net additional development potential, beyond that for currently existing and proposed/State-entitled developments.

Source: Mikiko Corporation; see Exhibits 5-7 and 5-8 for further information.

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6 - Office Market Environment

Methodology

This chapter presents the estimated market support for additional commercial space in Ewa, as derived from office-based market indicators. Although office spaces are often included in retail shopping centers, this chapter focuses on the market for other office-based facilities: those developed as stand-alone office complexes (that may include some retail) as well as those that may be part of mixed-use developments.

Government office buildings are not considered, since their development and placement is more often a matter of policy and budget processes than market trends. Long-term demand for civilian office facilities is related to civilian job creation.

Waianae residents are as likely as Ewa or Central Oahu residents to find employment within office buildings in the Ewa DPA. However, at this time Waianae has very limited office facilities, so the area is not used as a supply or demand comparison. Rather, the analysis focuses on the Ewa and Central Oahu DPAs, with urban Honolulu and the island as a whole used as benchmarks to portray the types of structural changes that could take place in Ewa over time.

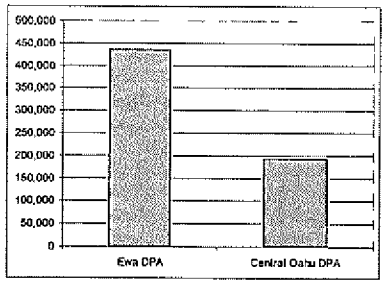
Office supply and demand is evaluated in terms of rentable building area (RBA), expressed in square feet.

Office-Based Supply

Area Inventory (Exhibit 6-1)

Ewa already has more RBA in office buildings than does the more populous Central Oahu DPA, reflecting the urban intent for Kapolei. As of December 2006, the Ewa DPA showed 436,00 square feet of private office space, compared to 194,000 in Central Oahu. The vast majority of Ewa's inventory is now in Kapolei.[1]

Existing Office RBA (square feet)



See Exhibit 6-1 for sources and further information.

[1] Not included in this Kapolei inventory because they are government facilities are 215,000 square feet at the State Office Building, 96,000 at the City's Kapolei Hale and 50,689 at its Police headquarters.

Although occupancy figures are not available for Ewa and Central Oahu separately, "Leeward Oahu," which includes both these areas as well as Waianae, showed a 6.4% office vacancy as of December 2006, according to CMF.

Benchmark Areas (Exhibit 6-1)

The island of Oahu had a total of 15.3 million RBA, of which 11.4 million or 74% was in urban Honolulu. For these purposes, urban Honolulu is defined as the Central Business District (CBD), Kapiolani and King Streets, and the Kaka'ako District, with the components as defined by CMF. Urban Honolulu would show considerably more office space if its government offices were included. Waikiki is not included in this definition of urban Honolulu.

The island's average vacancy rate was 7.0% in December 2006, while the CBD showed 6.7% and Kaka'ako, Kapiolani and King averaged 6.4%.

Planned and Entitled Development (Exhibit 6-2)

Ewa is poised for a nearly five-fold increase in office space, with about 2.2 million square feet of RBA planned and entitled as of December 2006. However, 725,000 square feet of this potential future inventory is located in Kalaeloa, where plans are in considerable flux as of this writing.

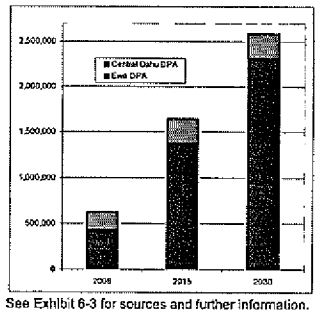
Central Oahu shows about 80,000 square feet in potential future office-based complexes, all within Gentry's Waiawa Phase 1, which is designated LUC Urban.

Specific projects and land areas from which these estimates were derived are presented in Appendix 5.

Future Area Inventory
(Exhibit 6-3)

Considering the planned and entitled projects identified, plus those already operating, Ewa and Central Oahu could have some 2.6 million RBA by 2030, if all projects are developed as currently planned and on the timetables projected. As for the planned retail inventories discussed in the last chapter, most of this new inventory would be added in Ewa, in alignment with the area's projected residential and employment growth.

Potential Future Office RBA in Ewa and Central Oahu (square feet)



See Exhibit 6-3 for sources and further information.

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Office-Based Demand

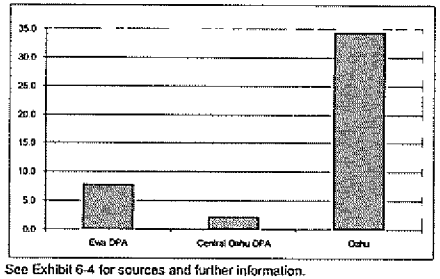
Employment Ratios (Exhibit 6-4)

The civilian labor force in the Ewa DPA currently represents 63% of its resident population. In Central Oahu, the ratio is 57% and in urban Honolulu as for the island as a whole, the ratio is 49%. Ewa's higher ratio reflects its relatively younger population, a higher share of whom are of labor force age. With the job and career opportunities envisioned in Ewa, it is likely to continue to attract a substantial workforce population, but its age profile will also "gray" as will the rest of Oahu's.

RBA Ratios (Exhibit 6-4)

Comparing existing office RBA to the number of civilian employees, the Ewa DPA shows more development than Central Oahu, but significantly less than Oahu as a whole and certainly than urban Honolulu. In 2006, Ewa's private office inventory was estimated at 8 square feet per person in the civilian labor force, compared to 2 in Central Oahu, 34 for the island, and 628 in urban Honolulu.

RBA Ratios Per Civilian Employed Persons



See Exhibit 6-4 for sources and further information.

The very high ratio in urban Honolulu (not depicted in the chart) is evidence of an office worker base that comes from throughout the island. It is anticipated that as it becomes a "Second City," Ewa will also be a magnet for office-based employment on the island, and that it will particularly provide opportunities for those who live in the West Oahu region, including Ewa.

Supportable Office-Based Area in Ewa

Key Assumptions (Exhibit 6-5)

Unlike for shopping, people are accustomed to commuting to their offices. Thus, while the population of the Ewa DPA itself will be a geographically immediate source of demand for future office development, the adjacent and more populous Central Oahu DPA is just as likely to be a source of office employees in Ewa. Central Oahu also appears to be under-supplied with respect to office space at the current time.

Considering just the Ewa and Central Oahu DPAs as demand generators, by 2030, Ewa could require up to 1.37 million square feet of office RBA beyond the potential future supplies that are already entitled and planned. This assessment is based on the following assumptions:

- **Sources of demand** - Only Ewa and Central Oahu employees are considered as a metric for future demand in Ewa. This is conservative since some future enterprises of the DPA could draw employees from throughout the island.

- **Share of population in civilian workforce** – While Ewa now shows 63% and Central Oahu 57%, the civilian employee ratios of both areas are expected to migrate towards the Honolulu and Oahu 2006 averages of 49% as their populations age. However, with the large amount of workforce housing planned in the region, Ewa is expected to continue to show a greater than island-average rate of civilian labor force participation.

- **Supportable RBA per civilian employee** – As the real estate and economic developments planned for the Ewa region take root, the area can expect to see structural changes in the nature of business and employment. Specifically, the Ewa DPA of the future is seen to have more professional and technical opportunities than today. These sectors tend to generate more office-based employment than others.

  Accordingly, the supportable RBA in the Ewa and Central Oahu DPAs is projected to increase to 10, 15 and then 25 square feet per civilian employed residents. This would be a significant change from the 2006 profiles of the areas, but is still a conservative assessment when compared to the 34-square foot average for the island as a whole or the 628 square feet per resident supported in urban Honolulu in 2006.

- **Ewa capture of regional market** – Ewa is projected to capture up to 55% of the combined DPA areas' office market opportunities. This reflects its fair market share (estimated at 50% based on 2030 residents) as well as Ewa's more urban nature relative to Central Oahu's.

Conclusions for Ewa (Exhibit 6-5)

Based on the analyses shown, the Ewa DPA is expected to support some 480,000 square feet of additional office-related building area by 2015, or up to 1.37 million additional RBA (including the 480,000) by 2030. These anticipated supportable areas are in addition to existing office buildings in the DPA, as well as office-based uses that are entitled and proposed for development in the interim.

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7 – Ho`opili Commercial Market Assessment

Overview

Ho`opili Proposal

DRH proposes to offer up to 2.96 million square feet of commercial area at Hoòpili, including both retail- and office-based uses. The majority would be located on six BusinessCommercial-designated sites. The balance would be distributed in mixed-use settings andór live-work units near to the village core. As for residential development, the first finished commercial building products are assumed to be available for use in about 2012.

Methodology

The commercial market assessment encompasses both retail- and office-based uses, in recognition of the mixed uses planned at Hoòpili as well as the typical crossover of office spaces within shopping centers and retail uses in office complexes. Thus, the types of commercial uses at the Project will likely be determined as each area is developed.

This chapter summaries the projected supportable additional commercial space for the Ewa DPA as derived from the retail-based and the office-based analyses of the two prior chapters. It also provides the market assessment for commercial uses at Hoòpili.

Ewa DPA Commercial Market

Projected Supportable Area (Exhibit 7-1)

Considering the analyses of retail- and office-based markets presented previously, the Ewa DPA could be expected to support 1.98 million square feet of commercial space in addition to that already in place and entitled and planned for development, by 2015. Over the ensuing 15 years, the DPA is expected to support another 2.39 million square feet of new development, for a cumulative total of about 4.37 million square feet over and above those areas already existing or proposed and entitled for development.

Projected Supportable Additional Commercial Areas in Ewa DPA (square feet)

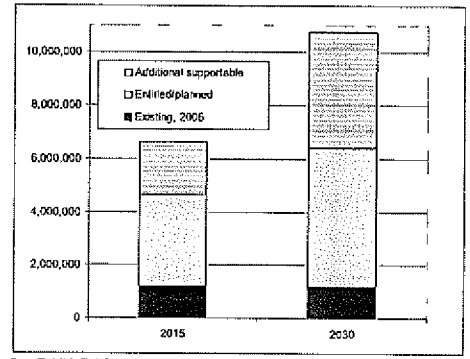
	2015	2030
Retail-based demand	1,500,000	3,000,000
Office-based demand	480,000	1,370,000
Total	1,980,000	4,370,000

Note: Represents net additional supportable development potential, beyond that for currently existing and proposed/State-entitled developments.

See Exhibits 5-8 and 6-5 for further information.

If added to the existing and proposedéntitled the retail and office areas, the net additional markets represent a potential total Ewa DPA commercial marketplace of up to 10.8 million square feet by 2030. This could include neighborhood, community and regional shopping centers, office buildings, "flex units" that could accommodate a proprietor's office as well as home, and retail spaces mixed into residential andór office structures.

Projected Supportable Commercial Areas in Ewa (square feet)



See Exhibit 7-1 for sources and further information.

Supportive Conditions are in Place

The strong commercial outlook for Ewa is based on an assumption that significant economic, workforce, and spending pattern changes take place within the DPA and its neighboring districts prior to or during Hoòpili's mark eting. Of great significance to commercial markets, these changes are expected to be accompanied by a decrease in out-commuting from Ewa, and its surrounding DPAs. These necessary precursors are consistent with the "Second City" vision for the area and include:

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- **New centers of "primary jobs,"** meaning jobs with sufficient income to be the primary support for households living in the area;
- **Public policy support for new economic enterprises** relevant to the area, including knowledge- and innovation-based initiatives;
- **More, high quality elementary, middle and high schools,** offering a wide variety of options, including quality public, charter or magnet, private/religious affiliated, and private/non-affiliated schools;
- **More options for entertainment, cultural and civic and spiritual endeavors,** such as performing arts centers, theaters, museums, shopping, social/business clubs, places of worship and libraries;
- **Renewed development** of high quality housing targeting a wide range of income and age groups;
- **Neighborhoods of move-up housing,** to which area households with rising income and home equity would be proud to relocate;and
- **More efficient transportation systems,** both within and to the region.

All of these precursors are in progress in Kapolei and/or East Kapolei, and all are being pursued within Hoòpili itself. Regional developments already underway that are advancing the Ewa DPA towards these desired outcomes include:

- The significant planned expansion of the UHWO campus and programs, and plans to develop a surrounding college town;
- The new State judiciary complex in Kapolei, with 650 direct and indirect jobs;
- Plans for other office buildings in Kapolei;
- Significant inventory of new business park areas under development in Kapolei;
- The State Administration's various "Innovation Initiatives," directed at transforming Hawaii's economy and preparing its citizens for jobs in the new sectors;
- Discussion of high technology or defense-related developments at Kalaeloa;
- The private Island Pacific Academy college preparatory PK-12 school in Kapolei, which opened in 2004 and is now expanding its middle- and high-school programs;
- Second home and golf-front developments recently entitled at Kapolei West;

- Development planning for the first regional shopping centers in Ewa, the Kapolei Commons and DHHL's project;
- Planned transit service linking Kapolei to Honolulu, and going through Hoòpili;
- Development of the North-South Road and Kapolei Parkway;and
- Improvements to Fort Barrette and Fort Weaver Roads.

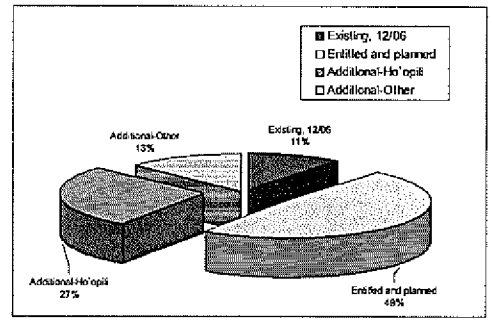
Assessment for Ho`opili

(Exhibit 7-2)

Hoòpili is proposed for up to 2.96 million square feet of commercial uses, including retail and office spaces.

If developed to the full proposed capacity, Hoòpili's commercial spaces could represent about 27% of the Ewa DPA's total future inventory. It could also represent a venue for about two-thirds of the currently unplanned but future supportable commercial space in the DPA.

Potential Ewa DPA Commercial Space Inventory: 2030



See Exhibit 7-2 for sources and further information.

These market shares are considered achievable in light of the prime locations enjoyed by the site and the diversity of commercial development types that are proposed for Hoòpili. Given that potential commercial developments on other entitled lands throughout Kapolei, East Kapolei, Ocean Pointe and Ewa Beach have already been accounted for, Hoòpili appears to be one of the only remaining areas within the DPA on which such development could occur.

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8 – Business Park Market Environment and Ho`opili Assessment

Overview

Ho`opili Proposal

As currently laid out, Ho`opili would offer 50 acres for a light industrial research or business park development. After allowing for circulation and infrastructure, a net of 40 acres of the site could be saleable. As discussed at the end of the chapter, however, this analysis concludes that up to two or more times this area could be supported at Ho`opili by future market demand.

Due to its location within a mixed use residential community, Ho`opili's business park is expected to cater to "clean" industries such as office headquarter campuses, research & development facilities, or service-retail uses. As such, the park is expected to have a relatively high floor area ratio (FAR). Ho`opili's site is preliminarily envisioned to show an FAR of 0.50 compared to a typical 0.40 at other built-up light industrial lands on Oahu and about 0.13 as observed for built properties in industrial parks in the Ewa region as a whole.

Methodology

Industrial areas can support business parks, manufacturing, research & development, wholesale, office and retail uses as well as light or heavy industry. They typically serve a super-regional or island-wide market. This analysis profiles current market trends within Ewa and Central Oahu, but the assessment for future demand is based on island-wide trends. This is appropriate because, as eastern Oahu and the island's urban core are redeveloped with higher density and higher value uses, more land-extensive industrial and business park facilities are increasingly being pushed to the western areas of the island.

Like office demand, long-term market demand for business park/industrial land is related to trends in civilian job creation. This analysis does not consider public facilities with industrial-related uses or industrial-designated lands such as at military bases, harbors, universities and airports.

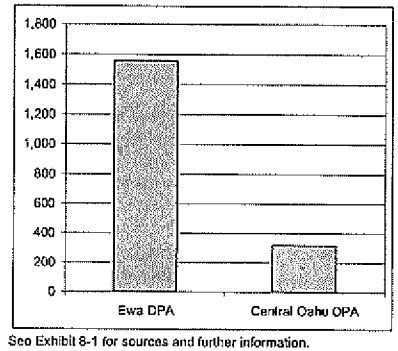
This analysis is prepared in terms of acres of land, although much of the available market data is for square feet within buildings developed on such lands.

Industrial and Business Park Supply

Area Inventory (Exhibit 8-1)

Ewa's entire business park/industrial inventory is currently in the Kapolei area, where some 1,560 acres were sold or in use as of December 2006. In comparison, Central Oahu includes about 320 acres, which are dispersed in a number of locations.

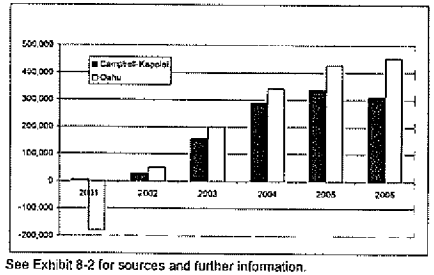
Existing Industrial Lands (in acres)



See Exhibit 8-1 for sources and further information.

Ewa showed a 2.6% vacancy as of December 2006, according to CMF, only slightly higher than Oahu's rate. This is a below-optimum level, one that inhibits the growth of businesses and increases their occupancy costs. As further evidence of the current inadequate supply of available properties, CMF reports that net asking rents for developed space have increased about 140% since 2002/03 in Kapolei,[1] and 23% for the island. Likewise, CMF estimates land appreciation since 2004 at 150% in Kapolei and 83% for Oahu as a whole.

Industrial Space Absorption (square feet)



See Exhibit 8-2 for sources and further information.

Market Trends for Industrial Space (Exhibit 8-2)

Oahu's current under-supplied market is in spite of four years of very strong industrial space absorption, particularly in Kapolei. Based on CMF's surveys of leaseable space in industrial buildings, Kapolei has been absorbing around 300,000 square feet in each of the past three years, peaking in 2005 at 335,500 square feet absorped. Since at least 2001,

[1] CMF describes this area as "Campbell-Kapolei."

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Oahu has shown consistent increases in absorption.

The Kapolei area now includes about 5.4 million square feet of leasable industrial building space, representing 14% of the island's built inventory of some 39 million square feet. While Kapolei's share of Oahu inventory has ranged from 12% to 14%, the area accounts for the vast majority of new space absorption, some 70% to 90% since 2003. This reflects the strong future market potential of the Kapolei region and Oahu's growing dependence on this area to serve its industrial- and business-related needs.

Although land area data is not available for the rest of Oahu, with its generally lower-costs and hence lower-density uses, the Kapolei region would represent an even greater share of both current inventory and abosrption if evaluated in terms of land acres rather than built square feet.

Planned Development and Future Inventory (Exhibit 8-3)

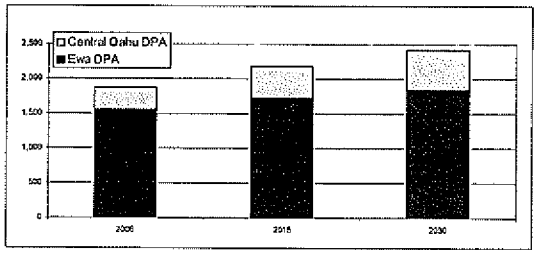
There are some 280 net acres of land entitled and planned for business park/industrial use in the Ewa DPA as of December 2006. However, some 144 acres of this potential future inventory are located in Kalaeloa (Navy plus HCDA-administered lands), and the ultimate use and development timing for these lands are very uncertain. Not included the 280-acre count is the Kapolei Harborside Center, which is proposed for 345 gross acres (240 net). Landowner Kapolei Property Development is now petitioning the LUC to entitle this project.

Another 260 net acres could be provided by 2030 in the Central Oahu DPA. These are largely within future phases of Mililani Tech Park and in Gentry's Waiawa Phase 1.

Specific projects from which these estimates were derived are presented in Appendix 6.

Considering these planned developments, plus areas already in use, Ewa and Central Oahu could have some 2,400 acres of private business or industrial park lands available by 2030, if all projects are developed as currently planned and on the timetables projected. The majority of this inventory would remain in the Ewa DPA.

Potential Future Industrial Land Inventory in Ewa and Central Oahu (acres)



See Exhibit 8-3 for sources and further information.

Industrial and Business Park Demand

Demand for future business park/industrial lands in Ewa can be expected to come from two sources:

1. **Employment-driven demand** - This is estimated based on projections of civilian employment and is driven by the future needs of businesses island-wide.

2. **Transition-driven demand** - Within Oahu, some existing industrial tenants and landowners can be expected to move to Ewa, as they are displaced from areas nearer to the urban core of Honolulu. Transition demand will also be driven by an increasing "pull" from Ewa with its critical mass of services, facilities and consumers, as well as its potentially lower costs and more modern infrastructure.

Employment-Driven Demand (Exhibit 8-4)

Oahu offered 88 square feet of industrial building area per civilian employed person in 2006. Considering the supply-constrained current marketplace, however, a more desirable ratio would be 90 square feet per employee, which would support an average 5% building vacancy compared to the current 2.3%. The ratio of building area to employees has been increasing, reflecting the strong State economy in recent years. Its rise also reflects as an evolving mix of industries on Oahu, particularly growth outside of tourism in areas such as research, high technology, film and media production and the like. As public policy and private efforts continue to encourage such economic transitions, one can expect to see the ratio of industrial space demand to employment continue to increase.

Compared to eight U.S. market areas reported on by Robert Charles Lesser & Co., LLC (RCL),[2] Honolulu's industrial space to employment ratio was the lowest. Comparison locales surveyed in 2004 include:

- Metro Las Vegas – 95 (with 7.6% vacancy);
- Metro Seattle – 111 (with 9.5% vacancy);
- San Diego County – 125 (with 7.6% vacancy);
- San Francisco Bay Area – 131 (with 0.0% vacancy);
- Metro Phoenix, Metro Denver and Los Angeles County – 143 to 236.

Based on just a 0.3% per annum increase in Oahu's ratio, to 97 square feet per employee by 2030, the island could be expected to demand up to 53.3 million square feet of industrial building area by 2030. This compares to the 39.1 million square feet existing as of December 2006, and implies need for another 14.2 million square feet over the next 24 years. The future inventory would represent only about a 1.2% per annum increase over the period, compared to a 0.9% projected annual increase in employed civilians.

[2] Robert Charles Lesser & Co., LLC, "Industrial Market Feasibility: 345-Acre Kapolei Harborside Center," Exhibit II-7, January 31, 2006, (prepared for Aina Nui Corporation). RCL cites Grubb and Ellis and Colliers as its sources.

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Assuming a FAR of 0.20 for the new areas[3], the projected demand for new building space implies need for another 1,627 net acres of land by 2030. This includes some 113 acres of estimated pent-up demand in 2006. The ratio used in this projection would position the Oahu of 2030 between Metro Las Vegas and Metro Seattle of 2004.

Given the 540 net acres identified as planned in Ewa and Central Oahu, plus another 115 documented at three other sites on Oahu, the island could require another 972 net acres of business park/industrial lands by 2030, beyond those already entitled and planned (1,627-540-115). This is the need component that can be associated with increases in the island's employment base.

Transition-Driven Demand (Exhibit 8-5)

In addition to demand related to a growing employment base, the Ewa district in particular will need to support business park/industrial land users moving from other areas of Oahu. Sources of this transition-based demand are two-fold:

- **Displacement** – Two large areas of current business park/industrial use near to Honolulu's urban core are already displacing tenants and can be expected to continue to do so. These include the Kaka'ako District, estimated by CMF to house some 2.88 million square feet of business park/industrial tenants (2.78 million estimated to be occupied), and the former Kapalama Military Reservation on Sand Island, with an estimated 1.25 million square feet. KMR's transition is expected to take about 5 years, while Kaka'ako's could persist over the next 15 years.

  Together, these two areas represent about 4.0 million square feet of space that will need to relocate within the island. By 2012, the projected start date for Ho'opili, some 100 acres worth of tenant space might have already relocated, including all of KMR and a portion of Kaka'ako. Tenants requiring up to another 73 acres (23 + 50) might still need to be relocated by 2021.[4]

- **Lease turnover** – Based on a common five-year space lease, in any given year approximately 20% of existing leases would come up for renewal and some 5% of those could be expected to relocate. Considering Oahu's current business park/industrial space inventory (outside of Kaka'ako and KMR), this would represent about 342,000 square feet of business park/industrial space seeking to relocate in any given year. While this source of demand will grow as the island inventory of space increases, for these purposes, only the 342,000 square foot figure is used.

[3] This compares to the 0.13 currently observed in business park/industrial areas in West Oahu, according to survey data provided by CMF.

[4] Expiring ground leases, area redevelopment and other factors will also displace tenants at other locations, including the Airport and Mapunapuna areas. These situations are not added to the demand calculations here because of the lack of complete information. The assessment of demand in Ewa would be higher if more such situations could be documented.

Within the study horizon, lease turnover could generate about 8.2 million square feet of relocations (3.1 million + 5.1 million), which could represent about 340 acres of land.

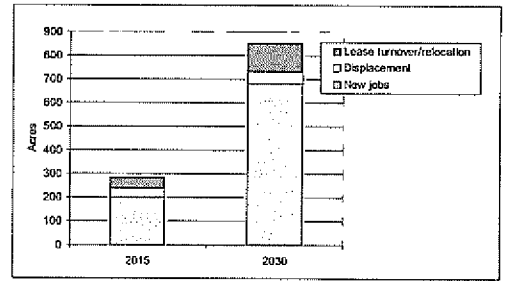
Business Park/Industrial Land Assessment

Ewa DPA (Exhibit 8-6)

The market potential for the Ewa DPA will be determined by its capture rates of the employment-driven and the transition-driven sectors of demand.

- **Employment-driven demand** – This demand originates primarily from new or expanding businesses that require new or more space. Because much of this demand could be attributable to new enterprises, it is considered more likely to be able to locate away from Oahu's existing centers of business and tourism near Honolulu and more likely to be attracted to the more modern infrastructure of the Kapolei region.

Potential Future Business Park/Industrial Land Requirements in the Ewa DPA by Demand Source



See Exhibit 8-6 for sources and further information.

A 70% capture rate is employed for this source, roughly equivalent to the Ewa DPA's fair share of anticipated new business park/industrial development on the island. Seventy percent is also within the Campbell-Kapolei area's share of new island industrial space absorption over the past four years, as presented in Exhibit 8-2.

This would result in about 199 more acres supportable in the DPA by 2015, or 680 cumulatively by 2030.

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- **Transition-driven demand** – Transition-driven demand is the relocation of existing tenancies rather than a net increase in island-wide demand. The Ewa DPA is likely to be an attractive area for many transitioning tenants, with its lower occupancy costs that permit more land-extensive operations, and its greater supply availability.

  On the other hand, the majority of the existing lease turnover tenancies and all of those examined for displacement (Kaka'ako and KMR) are already established near to the urban core, and likely have business and client relations there. Thus only 30% to 35% of the identified transitioning sources of demand are assumed to relocate to the Ewa DPA.

  Transition-driven demand could be expected to support some 82 new acres of business park/industrial or business park tenancy in Ewa by 2015, or 171 cumulatively by 2030.

- **Total demand** – In total, supportable new industrial/business park land in the Ewa DPA, beyond that already entitled and planned, could amount to some 280 acres by 2015, or 850 cumulatively by 2030.

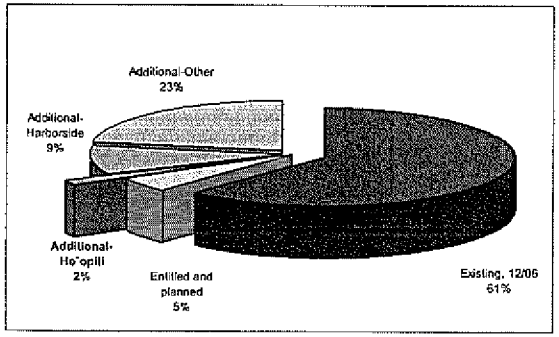
  Kapolei Harborside Center, a 240 net acre (345 gross acre) proposed development, is currently petitioning the LUC for Urbanization. Even if Harborside Center is approved, the region could still be expected to support at least 40 more net acres by 2015, or 610 cumulative by 2030 (850-240).

Assessment for Ho`opili (Exhibit 8-7)

The land use plan for Ho`opili includes a 50-acre (40 net acre) site for business park development.

This site would represent a solution for only 2% of the net unprovided-for demand in the region. Even if the Kapolei Harborside project receives LUC and other approvals to permit its development, there could remain substantial unmet demand for business park or industrial lands in the area, particularly in the 2015 to 2030 period.

Potential Supportable Ewa DPA Business Park/Industrial Inventory in 2030
(Hoopili land allocation as currently planned)



See Exhibit 8-7 for sources and further information.

Given the strong regional market conditions as well as Ho`opili's outstanding location, access and visibility, and the integration of its business park site into a mixed-use community with a range of housing opportunities, it is expected that the net 40-acre site proposed could be fully absorbed by 2015. In addition, it appears there could be market support for two or more times the current land allocation, with the additional area supportable between 2015 and 2030. At 80 net acres, the greater land allocation would still represent only 4% of 2030 regional supply or 10% of future demand currently not provided for by State entitlements and private development plans.

While even a 80 net acre site at Ho`opili would represent a small addition to the region's future inventory in 2030, it could enable an iconographic source of high quality employment for the community. Example development types that a Ho`opili business park could support include:

- **Science and Technology Park** – This opportunity could relate to the site's proximity to the proposed UH West Oahu as well as its location on a transit route and the modern infrastructure and planning of Ho`opili. Example enterprises or activities in such parks could include:

  - Wet lab-based research & development or production;
  - Social science or public health research;
  - Software or distance learning production;
  - Media/film/music school or production facility; and
  - Natural resource research and/or management.

- **Lifestyle/Wellness Center** – As Baby Boomers move into their 50s, 60s and beyond, there is amble evidence of interest in enterprises that cater to enhancing their quality of life or appearance, and in prolonging their healthy and productive years. Baby Boomers as well as younger generations have also demonstrated a willingness to expend significant funds on such endeavors. Example facilities within a lifestyle/wellness center include:

  - Health and wellness campus;
  - Fitness and rehabilitation institute;
  - Medical park;
  - Senior lifestyle and care facilities; and
  - Post-surgical retreat and recovery center.

- **General Business Park** – The site could also be developed as a more generic business park, offering land sales or space sales/leases to a variety of enterprises.

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Exhibit 1-1
Ho`opili Conceptual Land Use Plan

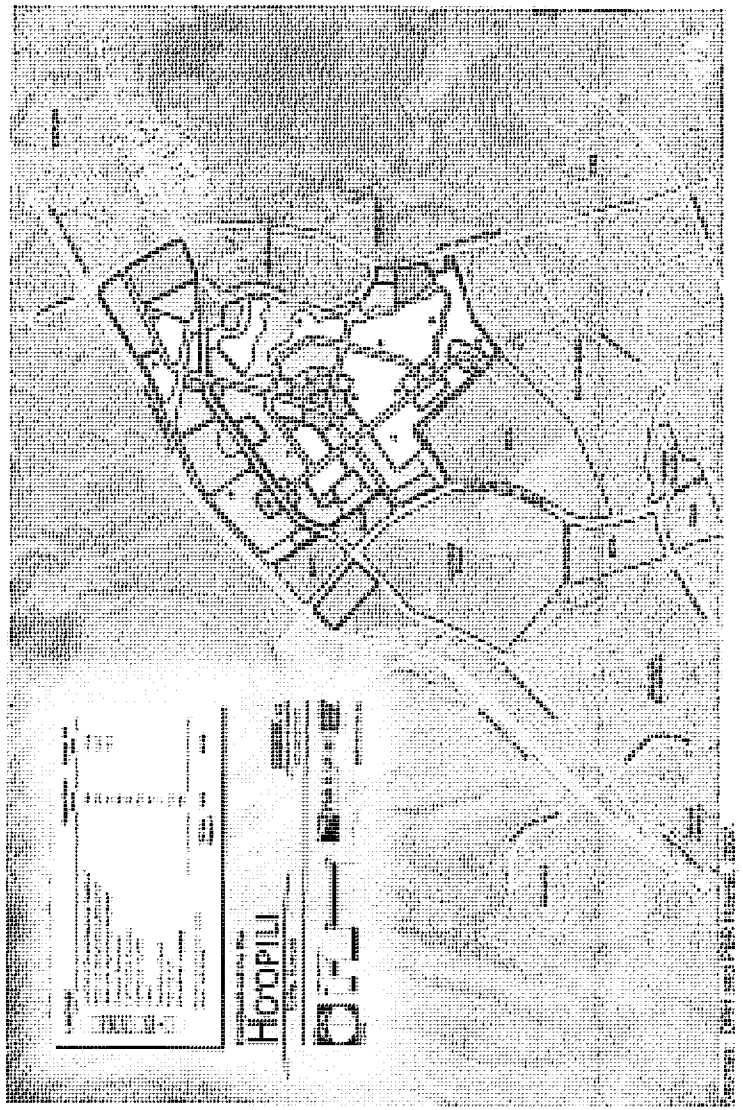

Exhibit 1-2
Overview of Ho`opili Development Plan

	Gross acres	Net acres[1]	Density range	Total	Comment
Residential:			*Units/net acre*	*Units*	
Low-Medium Density	535	400 - 475	5 -14	5,100	Single-family and mixed use (multifamily); includes office spaces within mixed-use areas.
Mixed Use/Medium Density	340	250 - 300	15 - 29	5,200	Mixed-use, including retail and office spaces (neighborhood-serving).
Mixed Use/High Density	50	40	30 - 50	1,450	Mixed-use, typically residential-over-retail, including retail and office spaces (neighborhood-serving).
Total	**925**	**690 - 815**		**11,750**	
			Floor area ratio	*Square feet*	
Commercial retail/office	**145**	**130**	**.23 - .50**	**2,960,000**	Figures include spaces within mixed-use residential areas; majority of retail space within two stand-alone sites serving regional markets.
Research and business park	**50**	**40**	**0.50**	**800,000**	Mauka of HECO sub-station, along Farrington.

Mixed use - combines residential with office and/or retail

[1] Excludes interior roadways and other non-saleable areas.

Sources: DRH and PBR Hawaii.

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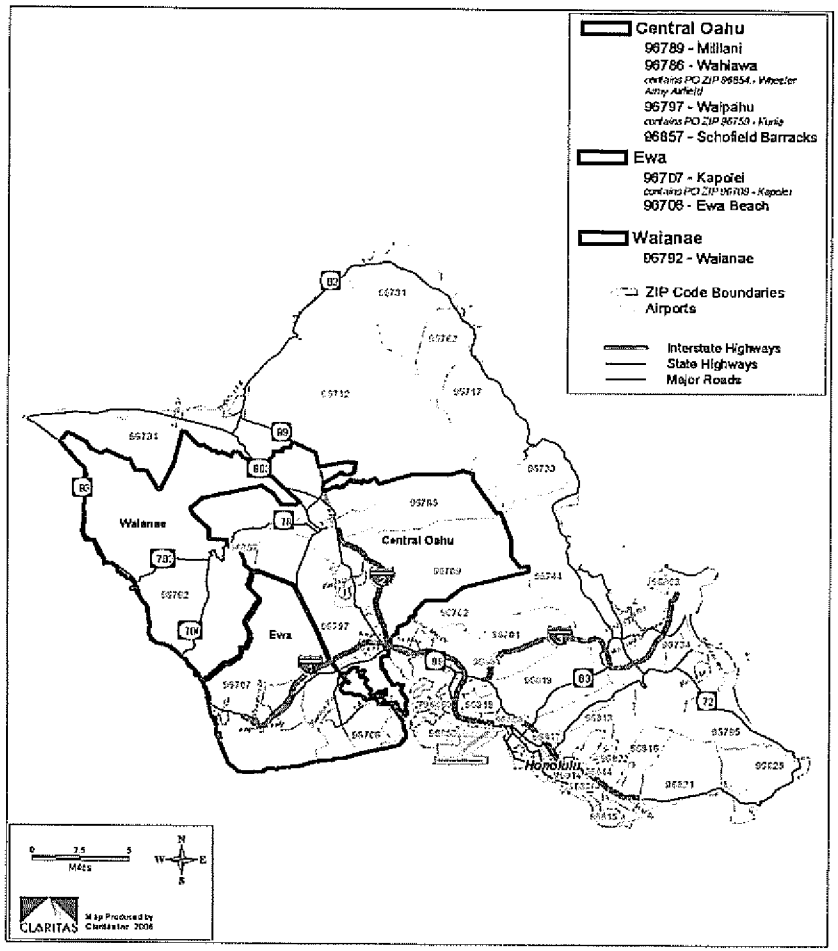
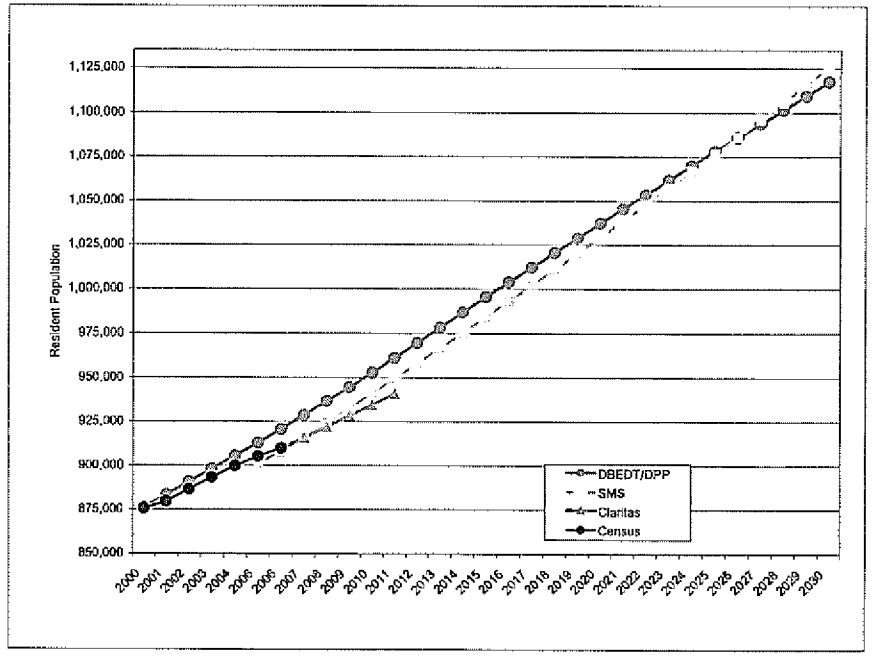
Exhibit 2-1
Trade Area Development Plan Areas as Approximated by Zip Code



Source: Claritas, Inc., 2006.

Exhibit 2-2
Resident Population - Island of Oahu
Comparison of Estimates and Projections
2000 to 2030

	Date prepared	2005	2006	2011	2015	2020	2025	2030
DBEDT/DPP[1]	*2004*	912,900	920,700	961,100	995,550	1,037,250	1,078,050	1,117,300
SMS[2]	2007	901,155	907,863	949,480	984,125	1,029,215	1,076,371	1,125,688
Claritas[3]	*2006*	--	909,408	940,689				
U.S. Census[4]	*2006*	905,266	909,863					



[1] State of Hawaii, Department of Business, Economic Development and Tourism, Research and Economic Analysis Division, "Population and Economic Projections for the State of Hawaii to 2030," (DBEDT 2030 Series), August 2004. Projections for 2005 and 5-year increments thereafter to 2030; figures interpolated in-between. City and County of Honolulu, Department of Planning and Permitting uses DBEDT's projections.

[2] SMS, Inc., "Housing Policy Study, 2006: Hawaii Housing Model 2006," February 2007. Population growth set to "official parameters" for Honolulu County of 0.9%.

[3] Claritas, Inc., October 23, 2006. Estimate for 2006; projection for 2011; figures interpolated in-between.

[4] U.S. Census Bureau, Population Division, Table 1: Annual Estimates of the Population for Counties of Hawaii (3/16/06). As of July 1.

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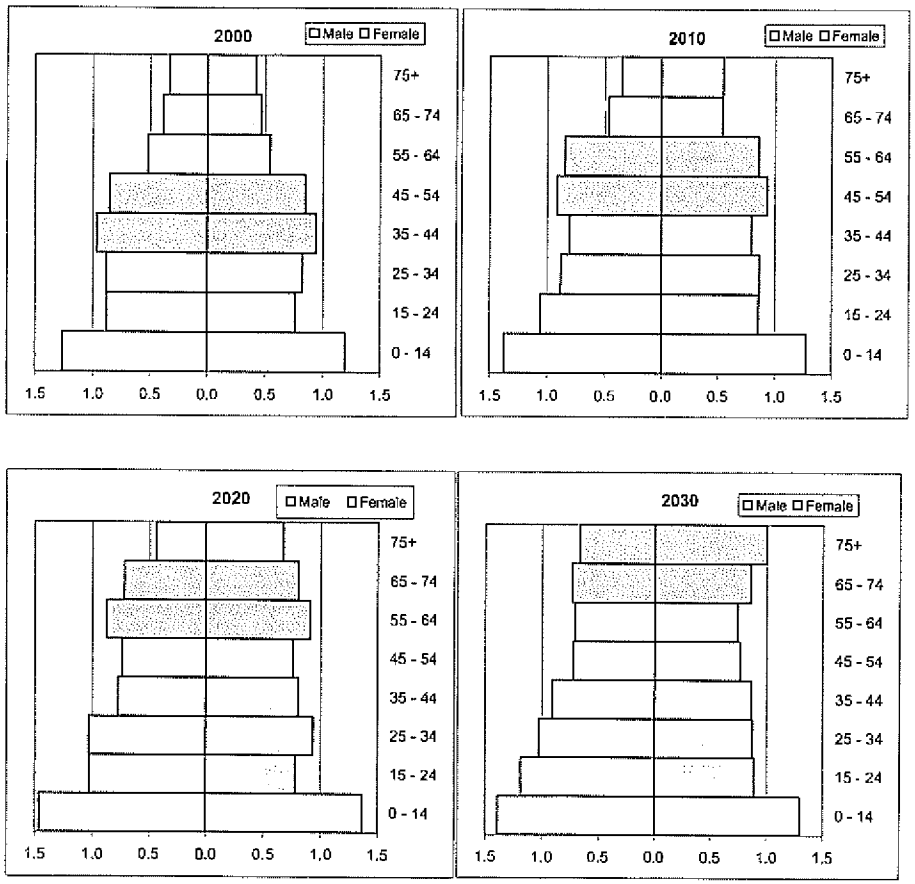
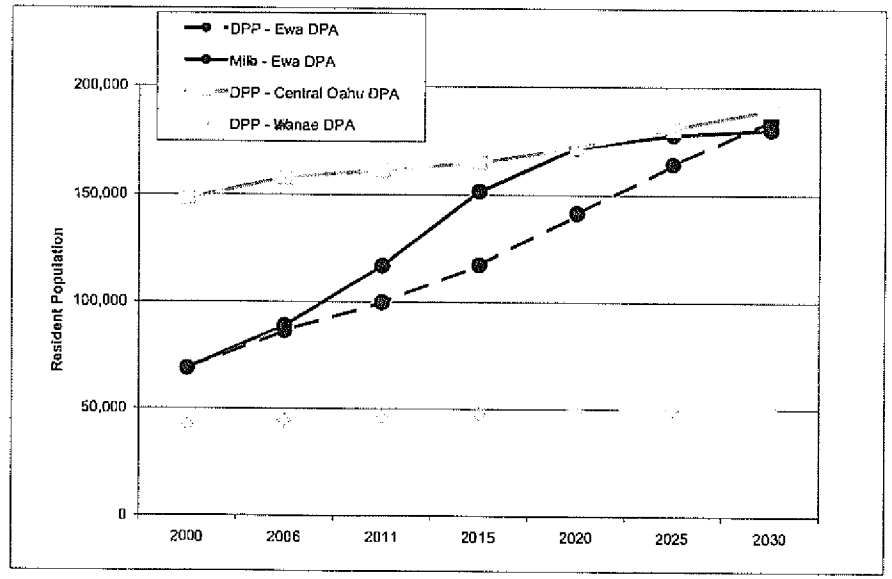
Exhibit 2-3
Projected Population by Age Group - State of Hawaii
2000 to 2030



Notes: Each unit on X-axis represents 100,000 persons. Highlighted bars include Baby Boom cohort.
Source: U.S. Census Bureau, Population Division, Interim State Population Projections (released 4/21/05), http://www.census.gov/population/www/projections/statepyramid.html.

Exhibit 2-4
Resident Population - Ewa, Central Oahu and Waianae
2000 to 2030

	2011	2015	2020	2025	2030	Average annual % increase, 2006-2030
DPP projections:						
Population:						
Ewa DPA	99,720	117,250	141,420	164,140	184,610	3.2%
Central Oahu DPA	161,250	164,960	172,100	180,690	189,600	0.8%
Waianae DPA	45,830	47,300	48,620	49,680	50,620	0.5%
Island of Oahu	961,080	995,550	1,037,250	1,078,050	1,117,300	0.8%
As a percentage of Oahu:						
Ewa DPA	10%	12%	14%	15%	17%	--
Central Oahu DPA	17%	17%	17%	17%	17%	--
Waianae DPA	5%	5%	5%	5%	5%	
Mikiko projection for Ewa DPA[1]:						
Population	116,800	151,600	171,900	177,800	180,200	3.0%
Percent of Oahu	12%	15%	17%	16%	16%	--



1 Mik Corporation projections are based on DPP's estimates for 2000 and 2005, with population thereafter based on anticipated development of UC-entitled housing in Ewa as shown in Exhibit 3-7 (adjusted 5% for vacancy) and an average household size of 3.1 (vs. historical area estimate of 3.5) in new housing units. Figures do not reflect impact of Hobpill or other unentitled, proposed developments. Other DPA projections not reviewed by Mik.

Source: City and County of Honolulu, Department of Planning and Permitting, February 16, 2006; Mik Corporation, 2007.

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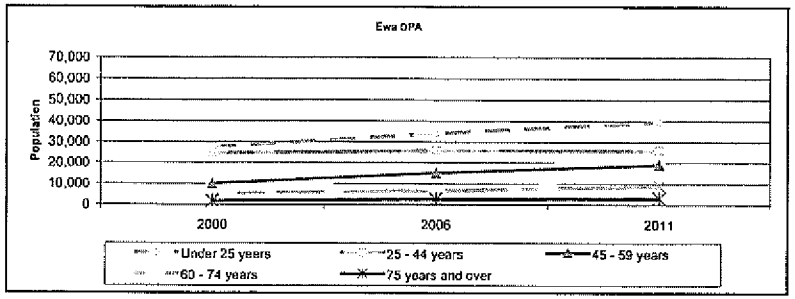
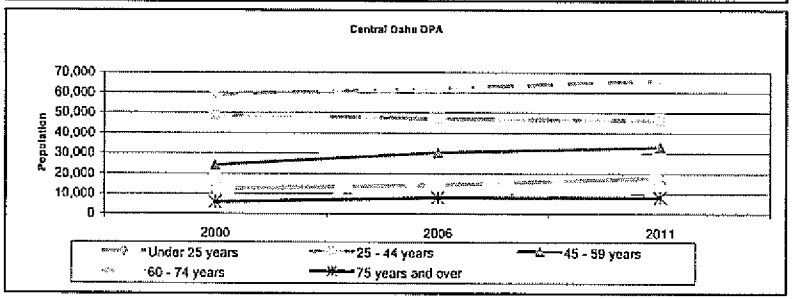
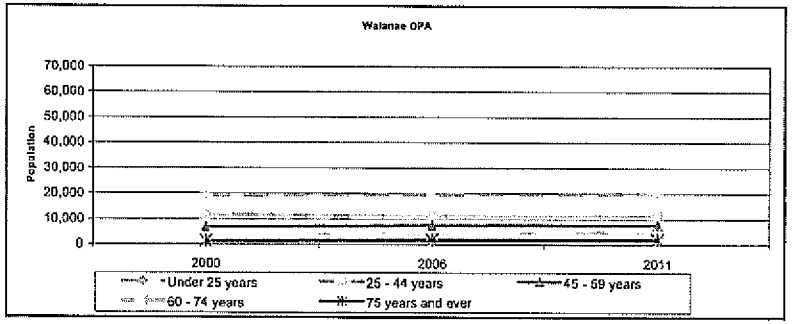
Exhibit 2-5
Population by Age Group - Ewa, Central Oahu and Waianae
2000 to 2011







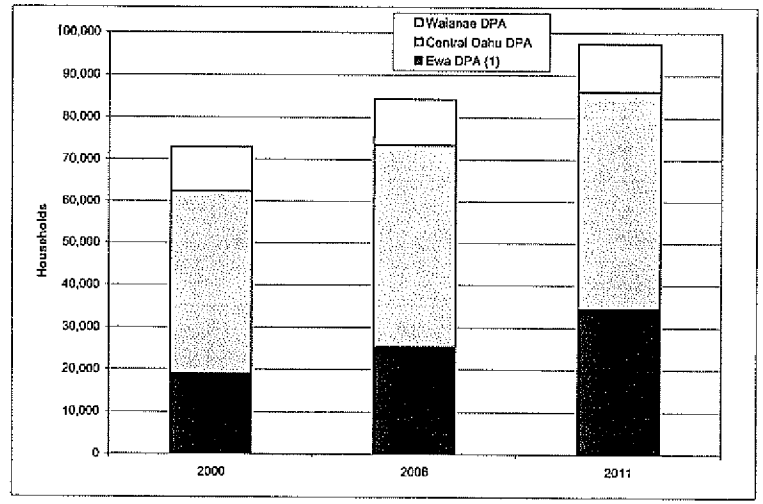
Median ages 2006: Ewa DPA - 32.0 Central Oahu - 33.1 Waianae DPA - 29.3 Oahu - 37.7

Note: DPAs (Development Plan Areas) are those defined by the City and County of Honolulu, but approximated for data generation purposes by zip code area. See Chapter 2 for further information.

Source: Claritas, Inc., October 23, 2006, October 24, 2006 and December 8, 2006.

Exhibit 2-6
Households - Ewa, Central Oahu and Waianae
2000 to 2011

	2000	2006	2011	Average annual % increase 2000 - 2006	Average annual % increase 2006 - 2011
Number of households:					
Ewa DPA[1]	18,942	25,371	34,344	5.0%	6.2%
Central Oahu DPA	43,384	47,981	51,811	1.7%	1.5%
Waianae DPA	10,535	10,960	11,365	0.7%	0.7%
Island of Oahu	286,450	300,924	313,409	1.0%	0.8%
Average household size:					
Ewa DPA[1]	3.6	3.5	3.4	-0.5%	-0.6%
Central Oahu DPA	3.5	3.4	3.3	-0.5%	-0.6%
Waianae DPA	4.0	4.0	4.0	0.0%	0.0%



1 Claritas figures for 2006 and 2011 adjusted by Mikiko Corporation to reflect anticipated population levels based on State LUC-entitled expected housing development, as shown in Exhibit 2-4. New households assumed to average 3.1 persons, while previously existing households assumed to average 3.5 in 2006.

Note: DPAs (Development Plan Areas) are those defined by the City and County of Honolulu, but approximated for data generation purposes by zip code area. See Chapter 2 for further information.

Source: Claritas, Inc., October 23, 2006, October 24, 2006 and December 8, 2006; Mikiko Corporation.

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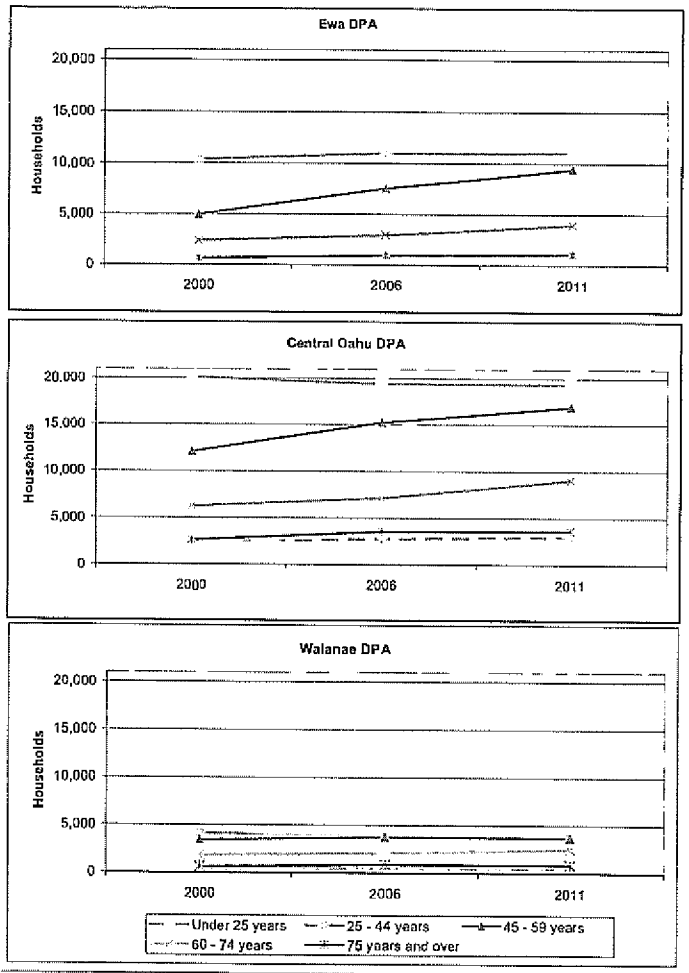
Exhibit 2-7
Households by Age of Head - Ewa, Central Oahu and Waianae
2000 to 2011

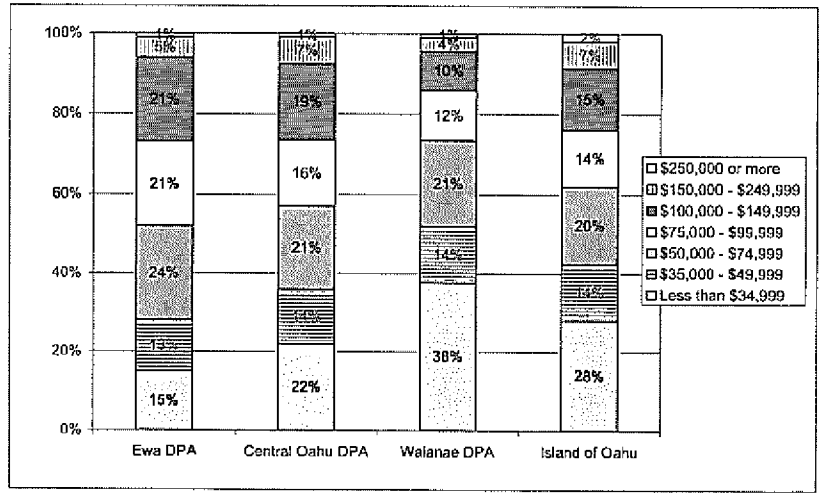


Note: DPAs (Development Plan Areas) are those defined by the City and County of Honolulu, but approximated for data generation purposes by zip code area. See Chapter 2 for further information.

Source: Claritas, Inc., October 23, 2006, October 24, 2006 and December 8, 2006.

Exhibit 2-8
Households by Household Income - Ewa, Central Oahu and Waianae
2006 Estimate

	Ewa DPA[1]	Central Oahu DPA	Waianae DPA	Island of Oahu
Median household income	$73,025	$66,667	$47,923	$59,606
Per capita income	$22,876	$23,493	$14,971	$25,565
Number of households, by income -				
Less than $34,999	3,806	10,563	4,127	84,338
$35,000 - $49,999	3,298	6,665	1,570	43,552
$50,000 - $74,999	6,089	10,143	2,353	58,744
$75,000 - $99,999	5,328	7,898	1,354	41,949
$100,000 - $149,999	5,328	9,060	1,068	46,369
$150,000 - $249,999	1,269	3,235	384	20,084
$250,000 or more	254	417	104	5,888
Total	25,371	47,981	10,960	300,924



Note: DPAs (Development Plan Areas) are those defined by the City and County of Honolulu, but approximated for data generation purposes by zip code area. See Chapter 2 for further information.

[1] Number of households in Ewa reflect Mikiko Corporation projections as shown in Exhibit 2-6, with distribution according to Claritas' projections.

Sources: Claritas, Inc., October 23, 2006, October 24, 2006 and December 8, 2006; Mikiko Corporation.

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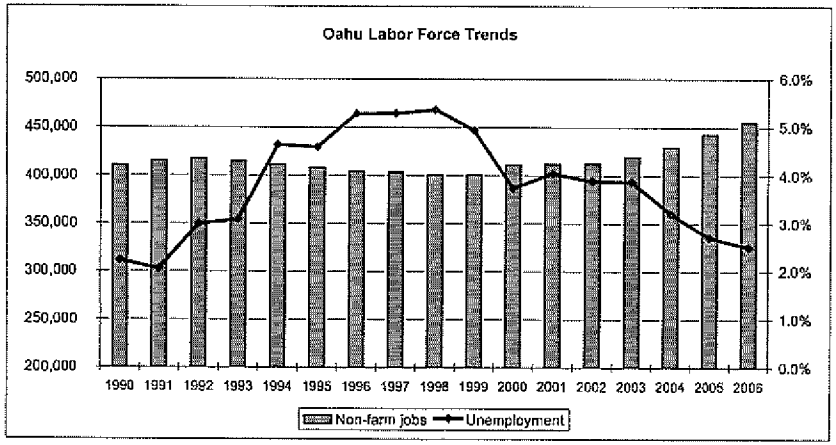
Exhibit 2-9
Labor Force Trends - Honolulu County
1990 to 2006

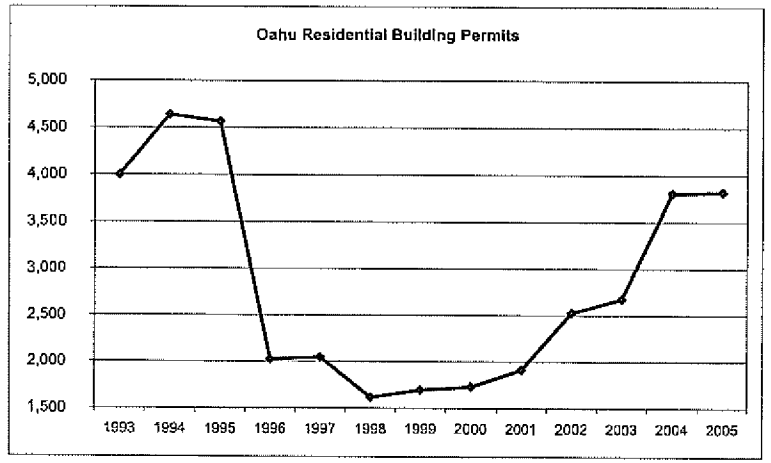
	Civilian labor force	Employed persons	Non-farm wage & salary jobs	Percent unemployment
1990	409,250	401,250	410,700	2.0%
1991	412,000	403,600	415,600	2.0%
1992	418,000	406,400	418,000	2.8%
1993	423,200	409,900	414,800	3.1%
1994	425,450	408,750	411,600	3.9%
1995	428,000	409,550	408,300	4.3%
1996	432,000	411,000	404,700	4.9%
1997	433,600	412,800	403,600	4.8%
1998	434,700	413,600	400,900	4.9%
1999	433,350	414,300	401,500	4.4%
2000	433,100	416,450	412,000	3.9%
2001	435,300	417,500	412,450	4.1%
2002	430,900	413,850	412,800	4.0%
2003	432,650	416,300	419,700	3.8%
2004	433,850	420,000	429,700	3.2%
2005	445,150	432,950	443,250	2.7%
2006	457,700	446,200	455,300	2.5%



Source: Hawaii State Department of Labor & Industrial Relations, 2007. Labor force estimates revised by DLIR with new methodology employed by U.S. Bureau of Labor Statistics, as of 2007. As referenced in: www.hiwi.org/admin/uploadedPublications/466_FHN.PD F.
Non-farm wage and salary job estimates provided by DLIR as referenced in:
http://www.hiwi.org/article.asp?ARTICLEID=15&PAGEID=94&SUBID=

Exhibit 3-1
Private Residential Building Permits - Island of Oahu
1993 to 2006

	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	Annual
1993	554	992	1,545	908	3,999
1994	613	1,385	1,261	1,380	4,639
1995	1,581	923	1,580	482	4,566
1996	532	260	885	347	2,024
1997	195	980	532	337	2,044
1998	423	334	497	361	1,615
1999	468	479	334	415	1,696
2000	352	469	382	527	1,730
2001	466	595	497	353	1,911
2002	296	553	807	867	2,523
2003	682	785	576	630	2,673
2004	1,509	940	620	742	3,811
2005	520	954	965	1,382	3,821
2006[1]	453	473	782	INA	INA



INA -Information not available.
[1] As of third qarter 2006.

Source: City &County of Honolulu Bilding Department, as referenced in
http://www.hawaii.gov/dbedt/info/economic/data_reports/qer/select-county-tables.xls.

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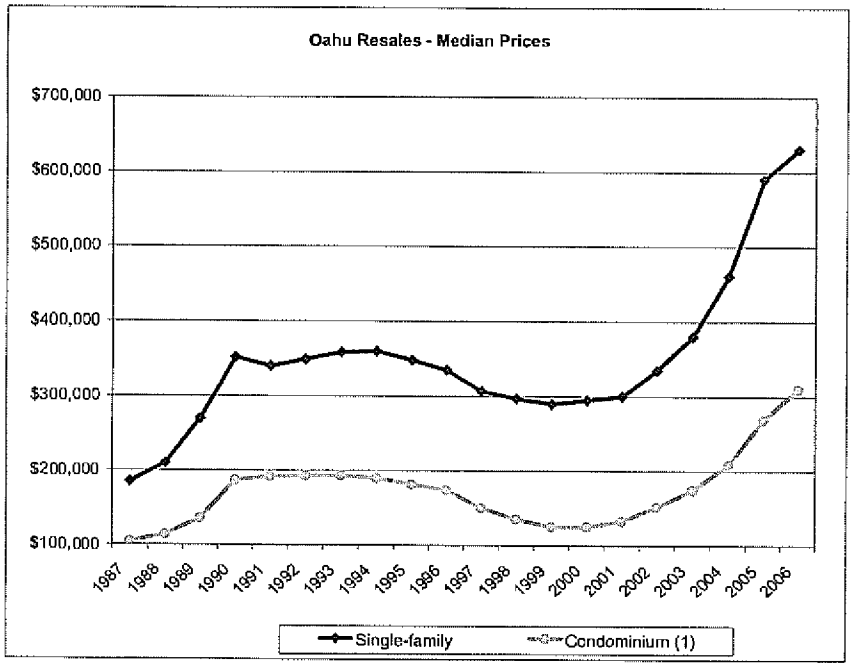
Exhibit 3-2
Median Home Sales Prices - Honolulu County
1987 to 2006

	Single-family	Condominium[1]
2000	$295,000	$125,000
2001	$299,900	$133,000
2002	$335,000	$152,000
2003	$380,000	$175,000
2004	$460,000	$208,500
2005	$590,000	$269,000
2006	$630,000	$310,000

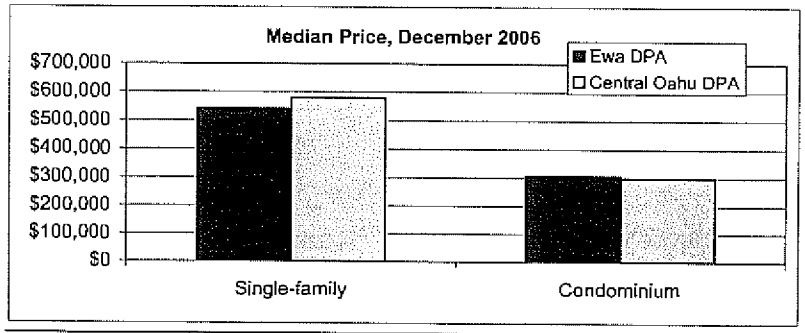


Note: Sales only; shows residential units that are entered in the Multiple Listing Service.
[1] Includes duplexes, townhomes and other multifamily units with common areas.

Source: Honolulu Bard of Baltors, Residential Sale Activity on Oahu,"monthly.

Exhibit 3-3
Residential Resales Indicators - Ewa and Central Oahu
As of December 2006

	Number of sales, Jan. - Dec. 2006			Median price, Dec. 2006	
	Single-family	Condominium	Total	Single-family	Condominium
Ewa DPA:					
Ewa Plain	692	500	1,192	$528,000	$302,000
Makakilo	179	191	370	$600,000	$320,000
Total	871	691	1,562	$543,000	$307,000
	Percent change since Jan. - Dec. 2005:			*Percent change since 12/05:*	
Ewa Plain	*-9%*	*-12%*	*-10%*	*8%*	*18%*
Makakilo	*20%*	*-3%*	*7%*	*9%*	*16%*
Total	*-5%*	*-9%*	*-7%*	*9%*	*18%*
Central Oahu DPA:					
Wahiawa	76	69	145	$462,000	$188,000
Mililani	348	524	872	$610,000	$315,000
Waipahu	355	410	765	$575,000	$298,000
Total	779	1,003	1,782	$580,000	$299,000
	Percent change since Jan. - Dec. 2005:			*Percent change since 12/05:*	
Wahiawa	*-21%*	*5%*	*-10%*	*10%*	*39%*
Mililani	*0%*	*-19%*	*-12%*	*8%*	*17%*
Waipahu	*-3%*	*-7%*	*-5%*	*10%*	*14%*
Total	*-4%*	*-13%*	*-9%*	*9%*	*16%*



Source: Honolulu Bard of Baltors, December 2006 Monthly Statistical Bport, Residential Bsale Activity on Oahu,"anuary 2007.

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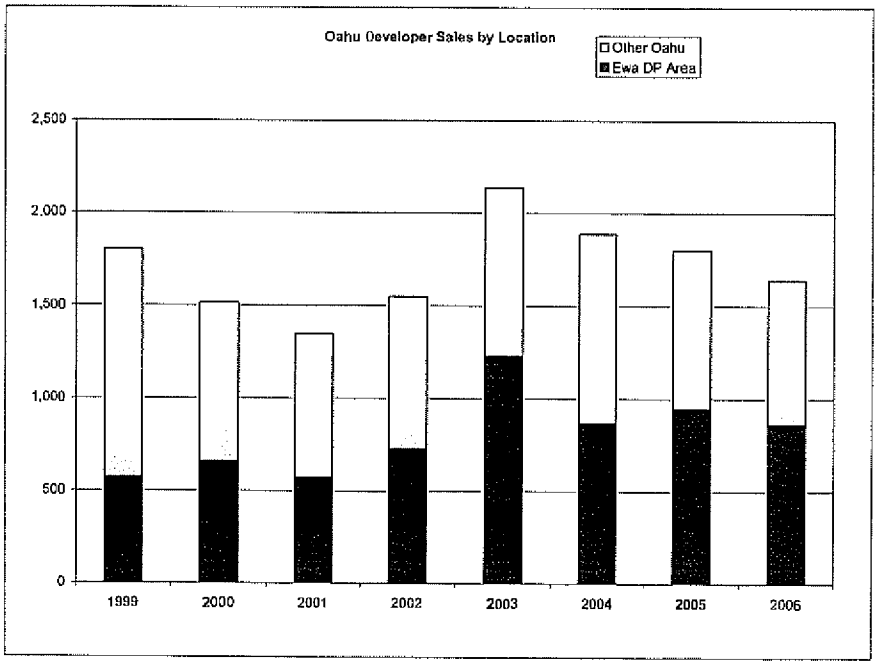
Exhibit 3-4
Developer Unit Sales - Island of Oahu and Ewa DPA
1999 to 2006

	1999	2000	2001	2002	2003	2004	2005	2006	Average annual
Island of Oahu:									
Single-family units	912	1,115	1,025	1,155	1,744	1,315	1,086	955	1,163
Townhouse units	290	195	268	381	371	547	531	358	368
High-rise condominium units	601	204	55	13	21	26	183	327	179
	1,803	1,514	1,348	1,549	2,136	1,888	1,800	1,640	1,710
Ewa DP area[2]:									
Single-family units	466	599	508	526	1,031	731	752	691	663
Townhouse units	108	62	66	204	199	136	195	170	143
High-rise condominium units	0	0	0	0	0	0	0	0	0
Total	574	661	574	730	1,230	867	947	861	805
As % of Island	*32%*	*44%*	*43%*	*47%*	*58%*	*46%*	*53%*	*53%*	*47%*



[1] Approximated by the Ewa, Kpolei and West Oahu (& Olina) areas, as defined by the Harris Company.

Source: The HARS Company. figures represent units reported by developers to have closed escrow and recorded.

Exhibit 3-5
Projected New Housing Supply - Ewa DPA
Planned Developments with State Land Use Entitlement or Exemption

as of December 2006

Project	Total planned units	2007 - 2010	2011 - 2015	2016 - 2020	2021 - 2025	2026 - 2030	Total, 2007-2030
Kapolei West	1,450	275	875	300	0	0	1,450
Makaiwa Hills I and II	4,100	650	1,625	1,625	200	0	4,100
City of Kapolei (Campbell)	1,000	650	350	0	0	0	1,000
Palailai Mauka (also "Kapolei Mauka")	750	225	525	0	0	0	750
Villages of Kapolei (remnants)	472	472	0	0	0	0	472
Wai Kalo'i ("Palehua East B")	300	300	0	0	0	0	300
Ewa Villages	57	0	57	0	0	0	57
Kahiwelo (por., Palehua East C & D)	475	285	190	0	0	0	475
Mehana (also "Kapolei Makai")	1,150	750	400	0	0	0	1,150
Ewa by Gentry and Gentry Ewa Makai	2,000	1,500	500	0	0	0	2,000
Ocean Pointe (prev. "Ewa Marina")	2,100	1,500	600	0	0	0	2,100
E A H	242	242	0	0	0	0	242
Ko Olina Resort & Marina	268	90	178	0	0	0	268
Franciscan Vistas Ewa	328	328	0	0	0	0	328
East Kapolei I	403	403	0	0	0	0	403
East Kapolei II & III	5,200	600	1,675	1,675	650	0	5,200
Kaupe'a (Villages of Kapolei, Village 6)	326	326	0	0	0	0	326
UH West Oahu project	4,041	400	1,875	1,766	0	0	4,041
Kalaeloa	6,290	400	1,500	1,500	1,500	1,390	6,290
Mokuola Vista	70	70	0	0	0	0	70
Total (rounded)	31,000	9,500	10,600	7,100	2,600	1,400	31,000
Percent of period		31%	34%	23%	8%	5%	100%

Source: Based on information presented in Appendix 2. Ko Olina units valued at 20% and Kapolei West units at 60% of respective total entitlements, to exclude nonresidential buyers.

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Exhibit 3-6
Projected New Housing Supply - Central Oahu DPA
Planned Developments with State Land Use Entitlement or Exemption
as of December 2006

Project	Total planned units	2007-2010	2011 - 2015	2016 - 2020	2021 - 2025	2026 - 2030	Total, 2007-2030
Mililani Mauka	440	440	0	0	0	0	440
Waipio Point	66	66	0	0	0	0	66
Walawa Gentry Phase 1	5,000	600	3,500	900	0	0	5,000
Kau'olu Properties	370	0	370	0	0	0	370
Royal Kunia II	2,000	200	1,800	0	0	0	2,000
Plantation Town Apartments	330	330	0	0	0	0	330
California Ave. Apartments	42	42	0	0	0	0	42
Total (rounded)	8,200	1,600	5,700	900	0	0	8,200
Percent of period		20%	70%	11%	0%	0%	100%

Source: Based on information presented in Appendix 2.

Exhibit 3-7
Projected New Housing Supply - Island of Oahu
Planned Developments with State Land Use Entitlement or Exemption
as of December 2006

Development Plan Area	2007 - 2010	2011 - 2015	2016 - 2020	2021 - 2025	2026 - 2030	Total, 2007-2030	Comment
Ewa	9,500	10,600	7,100	2,600	1,400	31,000	Excludes Subject Hoopili. Includes off-ocean sites at Ko Olina, with resident use valued at 20% of development potential.
Central Oahu	1,600	5,700	900	0	0	8,200	Excludes Koa Ridge and Waiawa (Castle & Cooke, c. 5,000 units) and Gentry Waiawa Phase 2 (c. 7,000 units), all of which reqire LUC approvals.
Waianae	1,110	990	370	0	0	2,470	Includes units by DHHL;Village Pokai Bay;Sea Country;selfhelp;maximum affordable condition at Makaha Valley; others.
North Shore, Ko'olauloa & Ko'olaupoko	310	430	370	120	0	1,230	Includes DHHL units in Waimanalo. Excludes resort units but includes maximum affordable condition at Turtle Bay Resort under existing Unilateral Agreement.
East Honolulu	740	0	0	0	0	740	Excludes buildout of custom lots and potential for some 200 units at Kamilonui (now designated Urban but under lease.)
Primary Urban Center	3,370	2,000	2,000	2,000	2,000	9,370	Majority high rise;inventories discounted for estimated share nonresident units (ranging from 0% on elderly/affordables, 20% in Kakaako and up to 60% at some Waikiki projects);also includes 400 military homes on Ford Island and on-going allowance of 2,000 units per 5-year period after 2011 for unforeseen future redevelopment projects.
Total (rounded)	16,600	19,700	10,700	4,700	3,400	55,100	
Percent of period	30%	36%	19%	9%	6%	100%	

Note: Targeting projects of 100 units or more. Excludes emergency shelters, dormitory beds and other group living qarters.

Sources: Interviews with developers, landowners and project principals;City and County of Honolulu, Department of Planning and Permitting, "Annual Report on the Status of Land Use on Oahu: Fiscal Year 2004," July 2005; interviews with developers and landowners;Hawaii Kai Neighborhood Board Meeting Minutes, January 2006;Honolulu Advertiser, "50,000 new homes planned for O'ahu," September 19, 2006;Ibid, "Special Report on Homeless on the Waianae Coast," October 20, 2006;Exhibits 35 and 36.

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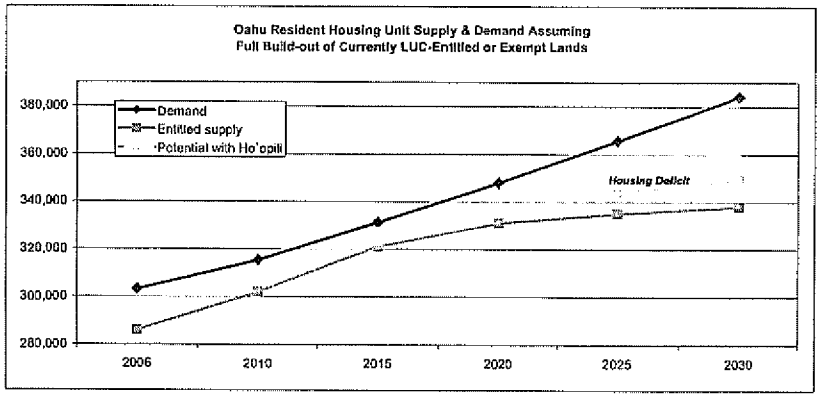
Exhibit 3-8
Projected Supply and Demand for Housing - Island of Oahu
2006 to 2030

	Reference	2006	2010	2015	2020	2025	2030	Total/ average, 2006-2030[1]
Demand (households):								
Number	SMS[1]	303,149	315,333	331,254	347,979	365,549	384,005	
Change since prior date -								
Total (rounded)		--	12,000	16,000	17,000	18,000	18,000	81,000
Average annual		--	3,000	3,200	3,400	3,600	3,600	3,380
Supply (resident housing units):								
Estimated occupied RHUs in 2005[2]	U.S. Census[2]	283,000						
New homes delivered, 2005-06	Harris[3]	2,800						
Entitled new developments, 2006-2025:								
Development since prior date	Exhibit 3-7	--	16,600	19,700	10,700	4,700	3,400	55,100
Less vacancy allowance (applied to new units)	5%	--	-530	-985	-535	-235	-170	-2,755
Net available RHUs (rounded)		286,000	302,000	321,000	331,000	335,000	338,000	52,000
Change since prior date -								
Total		--	16,000	19,000	10,000	4,000	3,000	52,000
Average annual		--	4,000	3,800	2,000	800	600	2,170
Resident housing unit surplus (deficit):								
At prior date shown		INA	(17,000)	(13,000)	(10,000)	(17,000)	(31,000)	
Net surplus (deficit) in RHU production since prior date		INA	4,000	3,000	(7,000)	(14,000)	(15,000)	
By end of year, column date		(17,000)	(13,000)	(10,000)	(17,000)	(31,000)	(46,000)	



INA = Information not available.

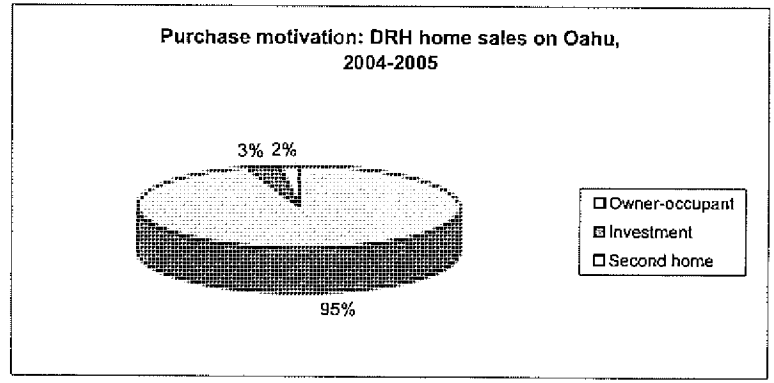
[1] SMS, Inc., "Housing Policy Study, 2006: Hawaii Housing Model 2006," February 2007. Population growth rate on interactive model set to "official parameters" for Honolulu County of 0.9% per annum.

[2] RHU = resident housing unit. Occupied housing units estimated by U.S. Census Bureau, 2005 American Community Survey (ACS, released October 2006) at 300,557. From this total, 6% are conservatively estimated to be used as second homes, vacation homes or for other nonresident uses. Note that a 2003 SMS study prepared for the State and Counties projected nonresident housing units on Oahu at 7.5% for 2000, while the ACS reflects the majority of the 9% of units found to be vacant were not RHUs..

[3] Developer ("new") unit sales since mid-2005 from The Harris Company, quarterly surveys of developer sales closings. Data is for 3Q05 through 4Q06 (six quarters), since the Census survey of supply refers to an "average" figure for 2005.

Exhibit 4-1
Comparison Project Buyer Motivations
Recent DRH Projects on Oahu
Sampled project sales through 2005

	Locations	Owner-occupant	Investment	Second home	Total
Townhomes	Hawaii Kai & Makiki				
Distribution		92%	6%	2%	100%
Sample size		115	7	3	125
Single-family condos:	Makiki &Ala'ili				
Distribution		98%	1%	1%	100%
Sample size		189	1	2	192
Traditional single-family:	Makiki &Kpolei				
Distribution		85%	10%	4%	100%
Sample size		41	5	2	48
Total					
Distribution		95%	3%	2%	100%
Sample size		345	13	7	365



Notes: Based on samples of persons who executed purchase contracts at eight DRH residential projects on Oahu in 2004 and 2005. Purchasers did not necessarily close the sale.

Source: DRH, December 2006.

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Exhibit 4-2
Comparison Project Pricing
Recent DRH Projects on Oahu

	Location	Unit Description	Units per acre	Market unit pricing (2006)	Comment
Townhomes:					
Moana Kai	Hawaii Kai	1,327 - 1,729 SF	15	$57,000 to $25,000	3-story buildings; behind Nanea
Kai Nani	Makakilo	1,010 - 1,766 SF	12 to 14	$30,000 to $83,000	
Ocean Ridge	Makakilo	1,424 - 1,529 SF	12	$16,000 to $79,000	Western end of Makakilo
Nanala	*Mehana, Kapolei*	*1,038 - 2,013 SF*	*17*	*$350,000 to $550,000*	*Preliminary pricing and plans; to be marketed 2007*
Pulewa		*1,182 - 1,562 (market units)*	*17*		
Single-family condos:					
Anuhea	Makakilo	1,291 - 1,808 SF	6	$43,000 to 820,000	Hillside
Holomoana	Maili (Sea Country)	1,119 - 1,270 SF	7	$27,000 to $26,000	3 to 4 units per courtyard
Kaimalino	Maili (Sea Country)	SFD and "duets"	8	$13,000 to $96,000	Duets share common walls at unit backs
Traditional single-family:					
Highpointe	Makakilo	1,359 - 2,757 SF	5	$99,000 to $13,000 (median $30,000)	Top of Makakilo; purchase lot & select home package
Wailana	Maili (Sea Country)	1,187 - 1,809 SF	5	$90,000 to $50,000	Ocean and valley views

Notes: SF - square feet; SFD - single-family detached
Source: DRH, anuary 2007.

Exhibit 4-3
Illustrative Potential Pricing of Residential Products at Ho`opili
In 2006 dollars

	Multifamily	Single-family	Comment
For-sale units (sales price):			
Market units	$50,000 - 650,000	$00,000 - $50,000	All single-family in Low-Medium Density areas; multifamily distributed throughout residential areas
"Affordable for-sale units"[1]	$32,000 - $92,000	Not offered	To be located in Medium- and High-Density mixed-use areas
"Affordable rental units" (monthly rent)[2]	$98 - 3,481	Not offered	For studio to 4-BR units targeted at 80% to 100% of median income households.

[1] Pricing and other terms to be determined in agreements to be made with the County. Figures shown provided by County DPP in February 2007, represent guidelines that were in effect as of March 2006, assuming a family of 4 earning 80% to 120% of median family income, putting 5% to 10% down. According to the U.S. Department of Housing &Urban Development, as of 2006, median family income in Honolulu was $1,300, meaning that the 80% to 120% of median income was approximately $7,000 to $6,000.

[2] As provided by the County DPP, guidelines in effect from February 2006 through February 2007.

Sources: City &County of Honolulu, Department of Housing and Community Development, "Adoption of Rules for the Terms of Unilateral Agreements Requiring Affordable Housing," 1994;Ibid, Department of Planning &Permitting, February 2007.

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Exhibit 5-1
Existing Retail Gross Leasable Area in Trade Area and Benchmark Market
In square feet, as of December 2006

	Trade Area				
	Ewa DPA	Central Oahu DPA	Waianae DPA	Total	Benchmark - Hawaii Kai
Existing inventory:					
Kapolei	524,807			524,807	
Ewa Beach	212,457			212,457	
Waipahu		1,986,007		1,986,007	
Mililani		694,764		694,764	
Waianae			439,112	439,112	
Hawaii Kai				0	857,392
Total, rounded	**737,000**	**2,681,000**	**439,000**	**3,857,000**	**857,000**
Vacancy indicators (12/06)[1]	2.1% "West Oahu"	0.6% "Central Oahu"	14.5% "Waianae"	2.5% Weighted average	0.6%
Largest properties (gross leasable area)	Kapolei Shopping Center (134,400)	Waiale Center (786,302)	Waianae Mall (208,000)	Waiale Center (786,302)	Ko Marina Shopping Center (322,261)
	Big Kart (122,848)	Pearl Highlands Center (410,325)	Makaha Marketplace (98,768)	Pearl Highlands Center (410,325)	Hawaii Kai Towne Center (247,000)

[1] Based on CMF reported vacancy for areas as defined by CMF. These vary somewhat from the DPAs but are the same for Hawaii Kai.

Sources: Colliers Monroe Friedlander, Inc. 2006 and 2007, custom reports;Ibid, "Oahu Retail Glde," in Hawaii Business, January 2007;Ibid, "Retail Market Report: Oahu Year End 2006," released January 24, 2007;Pacific Business News, 2006, "Book of Lists: 2007";www.kapolei.com;other Internet searches.

Exhibit 5-2
Planned and Entitled Retail Areas in Trade Area
Square feet of gross leasable area

Location	Estimated total[1]	Potential timing of deliveries 2007-2010	2011-2015	2016-2030
Ewa DPA:				
Kapolei, East Kapolei	2,494,155	1,391,155	720,000	383,000
Makaiwa	360,000	0	100,000	260,000
Ko Olina	20,000	0	20,000	0
Ewa Beach	255,000	255,000	0	0
Ocean Pointe	100,000	0	20,000	80,000
Kaeloa	116,000	0	31,000	85,000
Subtotal, rounded	**3,350,000**	**1,650,000**	**890,000**	**810,000**
Central Oahu DPA:				
Mililani Mauka	85,000	85,000	0	0
Waiawa Phase 1	400,000	70,000	170,000	160,000
Waipio Entry	25,189	25,189	0	0
Waipahu	34,000	34,000	0	0
Subtotal, rounded	**540,000**	**210,000**	**170,000**	**160,000**
Waianae DPA	**10,000**	**6,000**	**4,000**	**-**
Total, rounded	**3,900,000**	**1,866,000**	**1,064,000**	**970,000**

[1] See Appendix 4 for detailed listings. Based on State-entitled lands with development proposals in place; plans announced as of February 2007.

Note: Areas are net of those expected to primarily serve visitors, and of planned exclusive office or business parkuses (may include some office uses mixed with retail in shopping-center type settings.)

Sources: Interviews with developers, landowners and brokers;area site visits;Pacific Business News, Book of Lists 2007;Pacific Business News (weekly);Colliers Monroe Friedlander;developer websites; Honolulu Advertiser;Hawaii Community Development Authority;Internet searches.

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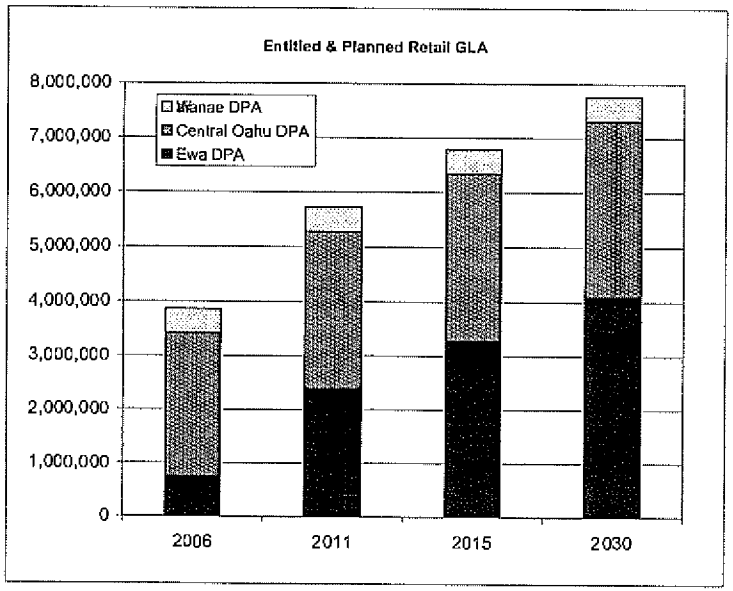
Exhibit 5-3
Potential Future Retail Areas in Trade Area
Existing and PlannedEntitled Developments as of February 2007

	Existing, 2006	Potential future 2011	2015	2030
Ewa DPA	737,000	2,387,000	3,277,000	4,087,000
Central Oahu DPA	2,681,000	2,891,000	3,061,000	3,221,000
Waianae DPA	439,000	445,000	449,000	449,000
Total	3,857,000	5,723,000	6,787,000	7,757,000



Source: Mikiko Corporation, based on Exhibits 5-1 and 5-2.

Exhibit 5-4
Area Resident Profiles
2006 estimates and 2011 projections

	Trade Area: Ewa DPA	Central Oahu DPA	Waianae DPA	Total	Benchmark - Hawaii Kai
Resident population[1]:					
2006 estimated	88,800	157,860	44,290	290,950	29,023
2011 projected	116,800	161,250	45,830	323,880	30,373
Compound annual % increase	5.6%	0.4%	0.7%	2.2%	0.9%
Income (2006):					
Median per household	$3,025	$6,667	$7,923	INA	$7,091
Est. per capita	$2,876	$3,493	$4,971	INA	$6,366

Note: DPAs (Development Plan Areas) are those defined by the City and County of Honolulu, but approximated for data generation purposes by ip code area. See Chapter 2 for further information. INA = Information not available.

[1] As shown in Exhibit 2-4;Ewa DPA population as adjusted by Mikiko Corporation.

Sources: Exhibits 2-4 and 2-8;Claritas Inc.: October 20, 2005 for benchmarkmarkt, with population updated based on projected 2005-2010 growth rates. Hawaii Kai 2006 median income supplied by ESRI.

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Exhibit 5-5
Daytime Population and Employment Residence Ratios by Census Designated Places
2000

	Residents, 2000	Employment residence ratio[1]	Daytime population[2]	Daytime pop/ residents
Trade Area:				
Ewa area CDPs -				
Ewa Beach CDP	14,650	0.35	10,627	0.73
Ewa Gentry CDP	4,939	0.06	2,477	0.50
Makakilo City CDP	13,156	0.09	7,243	0.55
Total/weighted av.	32,745	0.20	20,347	0.62
Central Oahu area CDPs -				
Mililani Town CDP	28,608	0.27	17,394	0.61
Schofield Barracks CDP	14,228	1.68	19,703	1.38
Wahiawa CDP	16,151	0.80	14,872	0.92
Village Park CDP	9,625	0.16	5,484	0.57
Waipahu CDP	33,108	0.55	27,397	0.83
Waipio CDP	11,672	0.37	7,547	0.65
Waipio Acres CDP	5,298	0.08	2,981	0.56
Total/weighted av.	118,690	0.58	95,378	0.80
Waianae area CDPs -				
Waianae CDP	10,506	0.68	9,264	0.88
Nanakuli CDP	10,814	0.28	8,355	0.77
Makaha CDP	7,753	0.34	6,031	0.78
Total/weighted av.	29,073	0.44	23,650	0.81
Benchmark markets:				
Hawaii Kai proxy[3]	INA	0.49	INA	0.74
Honolulu CDP[4]	371,657	1.54	462,962	1.25

INA -Information not available.

Note: All ratios shown are within the respective CDP. Ratios would be higher if reported on a regional basis.

[1] Workers working in the CDP divided by workers living the CDP.

[2] Residents plus in-commuters less out-commuters.

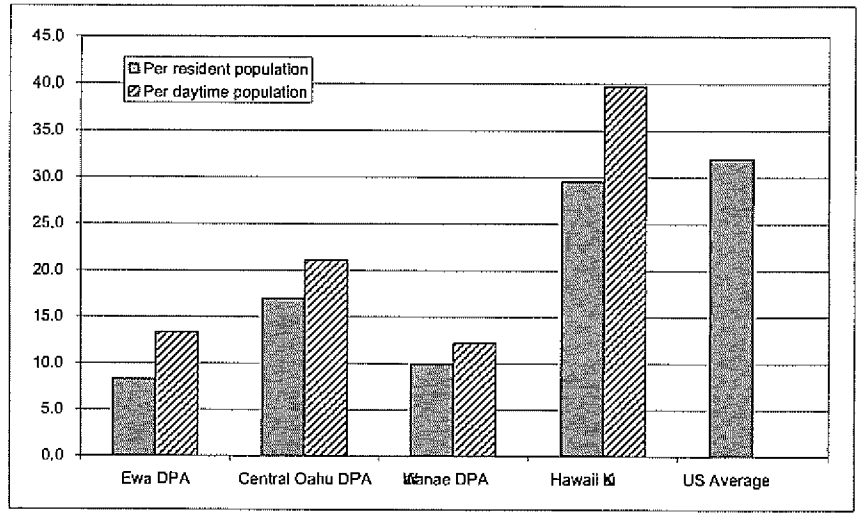
[3] The 2000 Census included Hawaii Kai within the Honolulu CDP, so Kailua CDP used as a proxy for Hawaii Kai ratios; actual population figures not relevant.

[4] Includes PUC and East Honolulu, encompassing Waikiki, Aina Haina, Hawaii Kai. The Census' daytime population calculations in this case do not consider visitors.

Source: US Census Bureau, Census 2000, PHC-T-40, "Estimated Daytime Population and Employment-Residence Ratios: 2000" dumey to Work and Migration Statistics Branch, 2005.

Exhibit 5-6
Existing Retail Areas in Relation to Consumer Population
As of 2006, except where noted

	Trade Area				Benchmark markets	
	Ewa DPA	Central Oahu DPA	Waianae DPA	Total	Hawaii Kai	2004 US average[1]
Estimated consumers:						
Resident population[2]	88,800	157,860	44,290	290,950	29,023	INA
Daytime ratio[3]	*0.62*	*0.80*	*0.81*	*0.75*	*0.74*	INA
Daytime population	55,200	126,900	36,000	218,100	21,568	INA
Existing retail GLA[4]	737,000	2,661,000	439,000	3,857,000	857,000	INA
Existing GLA ratios:						
Per resident population	8	17	10	13	30	32
Per daytime population	13	21	12	18	40	INA



Note: DPAs (Development Plan Areas) are those defined by the City and County of Honolulu, but approximated for data generation purposes by zip code area. See Chapter 2 for further information.

INA - Information not available.

[1] Based on shopping center per resident ratio of 20.3, as reported by National Research Bureau;figure adjusted by the estimated 37% U.S. retail space not located in shopping centers, as reported by the same source.

[2] Trade Area populations as shown in Exhibit 2-4;Ewa DPA according to Mik projections shown there.

[3] 2000 ratios, as shown in Exhibit 5-4

[4] Hawaii information as shown in Exhibit 5-1.

Sources: Claritas Inc., October 20, 2005;Colliers International, "Retail Market Report: Oahu Year End 2006", 2007;State of Ha wali, Department of Business Economic Development and Tourism;National Research Bureau, Inc., "2004 NRB Shopping Center Census," 2005;Niemira, Michael P., "The U.S. Retail Space Maret," Research Review, V12, No. 2, 2005.

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Exhibit 5-7
Projected Supportable Additional Retail-Based Commercial Areas in the Ewa DPA
Based on Resident Population Ratios
Gross leasable square feet, 2011 to 2030

	Basis/reference	2011	2015	2030	Av. annual change, 2011-2030
Immediate market (Ewa DPA)					
Resident population	Exhibit 2-4[1]	116,800	151,600	180,200	2.3%
Supportable GA in Ewa	30 sf/person [2]	3,500,000	4,500,000	5,400,000	2.3%
Less existing & planned	Exhibit 5-3	2,400,000	3,300,000	4,100,000	2.9%
Subtotal, supportable additional GA in Ewa		1,100,000	1,200,000	1,300,000	0.9%
Nearby markets (Central Oahu and Wanae DPAs)					
Resident population	Exhibit 2-4[1]	207,080	212,250	240,160	0.8%
Supportable GA in Trade Area	32 sf/person [2]	6,600,000	6,800,000	7,700,000	0.8%
New shares of region captured in Ewa DPA	Share of other Trade Area	5%	10%	20%	7.6%
Subtotal, supportable additional GA in Ewa		300,000	700,000	1,500,000	8.8%
Total additional market potential in Ewa DPA		1,400,000	1,900,000	2,800,000	

Note: DPAs (Development Plan Areas) as defined by the City and County of Honolulu. Differ slightly from those approximated by ip code area, as shown elsewhere in this report. See Chapter 2 for further information.

[1] Ewa DPA as assessed by Mikiko Corporation;others as projected by City & County of Honolulu, Department of Planning & Permitting. 2006.

[2] Derived from within Hawaii & and average U.S. ratios shown in Exhibit 5-6.

Exhibit 5-8
Projected Supportable Additional Retail-Based Commercial Areas in the Ewa DPA
Based on Daytime Population Ratios
Gross leasable square feet, 2011 to 2030

	Basis/reference	2011	2015	2030	Av. annual change, 2011-2030
Immediate market (Ewa DPA)					
Resident population	Exhibit 2-4[1]	116,800	151,600	180,200	2.3%
Daytime population -					
Ratio to resident pop	0.62 in 2000[2]	0.70	0.75	0.90	1.3%
Projected persons		81,760	113,700	162,180	3.7%
Supportable GA in Ewa	36 sf/person [3]	2,900,000	4,100,000	5,800,000	3.7%
Less existing & planned	Exhibit 5-3	2,400,000	3,300,000	4,100,000	2.9%
Subtotal, supportable additional GA in Ewa		500,000	800,000	1,700,000	6.7%
Nearby markets (Central Oahu and Wanae DPAs)					
Resident population	Exhibit 2-4[1]	207,080	212,250	240,160	0.8%
Daytime population -		161,250	164,950	180,690	0.6%
Ratio to resident pop	0.80 in 2000[2]	0.85	0.85	0.90	0.3%
Projected persons		176,018	180,413	216,144	1.1%
Supportable GA throughout Trade Area	40 sf/person [3]	7,000,000	7,200,000	8,600,000	1.1%
New shares of region captured in Ewa DPA	Share of other Trade Area	5%	10%	15%	6.0%
Subtotal, supportable additional GA in Ewa		400,000	700,000	1,300,000	6.4%
Total additional market potential in Ewa DPA		900,000	1,500,000	3,000,000	

Note: DPAs (Development Plan Areas) as defined by the City and County of Honolulu. Differ slightly from those approximated by ip code area, as shown elsewhere in this report. See Chapter 2 for further information.

[1] Ewa DPA as assessed by Mikiko Corporation;others as projected by City & County of Honolulu, Department of Planning & Permitting. 2006.

[2] Based on figures for Census Defined Places, not regions, in 2000, as shown in Exhibit 5-6. Hence these benchmark are considered below daytime ratios that would be effective for the larger regions considered here.

[3] Reference Hawaii & ratio shown in Exhibit 5-6.

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Exhibit 6-1
Existing Office Space in Ewa, Central Oahu and Benchmarks
Rentable building area, in square feet, as of December 2006

	Ewa DPA	Central Oahu DPA	Total	Benchmark markets: Island of Oahu	Benchmark markets: Urban Honolulu[1]
Existing inventory:					
Kapolei	422,118		422,118		
Ewa Beach	14,126		14,126		
Waipahu		84,999	84,999		
Mililani		108,804	108,804		
Waianae			0		
Central Business District					7,931,698
Kaka'ako/Kapiolani/ King					3,433,414
Total Oahu			0	15,336,904	
Total, rounded	**436,000**	**194,000**	**630,000**	**15,337,000**	**11,365,000**
Vacancy indicators (12/06)	INA	INA	6.4% "Leeward Oahu"	7.0% Island of Oahu average	6.7% and 6.4% CBD and Kaka'ako/ Kapiolani/King
Largest properties/areas (rentable building area)	Bank of Hawaii Building (208,406)	Lee Towne Center (52,557)	Bank of Hawaii Building (208,406)	Central Business District (7.9 million)	58 buildings, including Chinatown & Capitol district
	Campbell Square (136,868)	Castle & Cooke Building (34,241)	Campbell Square (136,868)	Kaka'ako/ Kapiolani/King (3.4 million)	

Notes: Excludes government-owned buildings and exclusively owner-occupied buildings. INA - information not available.

[1] Includes the Central Business District, Kapiolani and King Streets and Kaka'ako District, as defined by CMF. Excludes Waikiki.

Sources: Colliers Monroe Friedlander, Inc. 2006, custom reports; Ibid, "Honolulu Year-End 2006 Office Report Brief," released January 24, 2007; Internet searches.

Exhibit 6-2
Planned and Entitled Office Developments in Ewa and Central Oahu
Square feet of rentable building area

Location	Potential new development[1]: Total	2007-2015	2016-2030	Comments
Ewa DPA:				
Kapolei	1,285,000	785,000	500,000	Stand-alone and MUD buildings. Excludes Subject.
Makaiwa	90,000	0	90,000	Much in mixed-use development.
Makaeloa	725,000	150,000	350,000	Long-term development, assumed to extend beyond 2030.
Subtotal, rounded	**2,100,000**	**940,000**	**940,000**	
Central Oahu DPA:				
Waiawa	80,000	80,000	0	Zoning allows office, industrial or retail on many of these sites.
Subtotal, rounded	**80,000**	**80,000**	-	
Total, rounded	**2,180,000**	**1,020,000**	**940,000**	

[1] Excludes buildings proposed by government agencies. See Appendix 5 for detailed listings. Based on State LUC-entitled lands and plans known as of February 2007. Some proposed projects assumed to occur beyond the projection period, if at all.

Sources: Interviews with developers, landowners and brokers;area site visits;Pacific Business News, Book of Lists 2007; Pacific Business News (weekly);Colliers Monroe Friedlander Inc., 2006;developer websites;Honolulu Advertiser; Internet searches.

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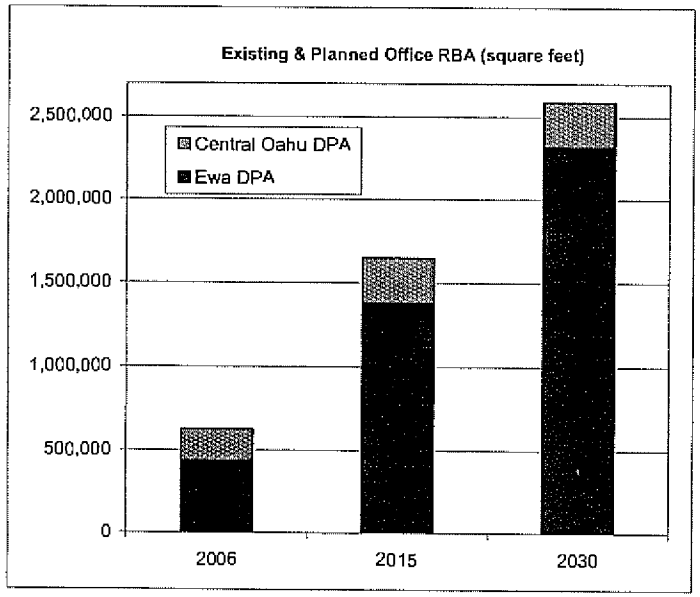
Exhibit 6-3
Potential Future Office Areas in Ewa and Central Oahu
Existing and PlannedEntitled Developments as of December 2006

	Existing, 2006	Potential future 2015	Potential future 2030
Ewa DPA	436,000	1,376,000	2,316,000
Central Oahu DPA	194,000	274,000	274,000
Total	630,000	1,650,000	2,590,000

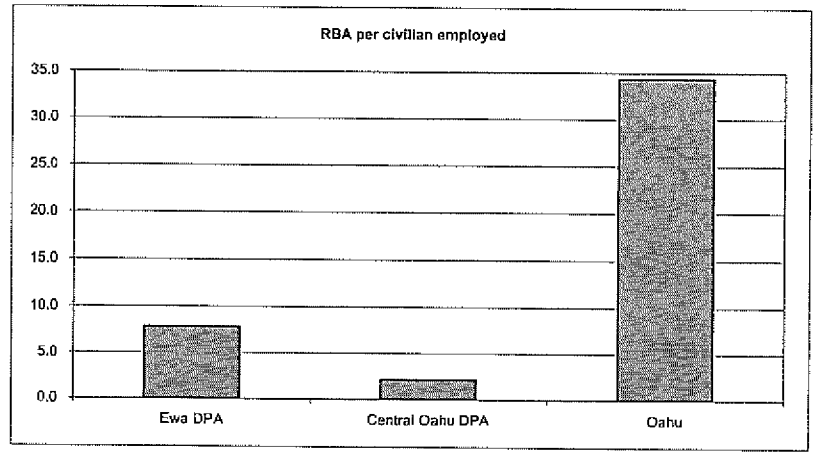


Note: Excludes government-owned buildings. RBA - rentable building area, in square feet.

Source: Mikiko Corporation, based on Exhibits 6-1 and 6-2.

Exhibit 6-4
Existing Office RBA in Relation to Employment
As of 2006, except where noted

	Ewa DPA	Central Oahu DPA	Total	Benchmark markets: Island of Oahu	Benchmark markets: Urban Honolulu[1]
Estimated consumers:					
Resident population[2]	88,800	157,860	246,660	909,408	37,100
% civilian employed[3]	63%	57%	59%	49%	49%
Civilian employed persons[4]	55,900	90,000	145,900	446,200	18,100
Existing office RBA[5]	436,000	194,000	630,000	15,337,000	11,365,000
Existing RBA ratio:					
Per civilian resident employee	8	2	4	34	628



Note: INA - Information not available; RBA - Rentable building area, in square feet.

[1] Includes the Central Business District, Kapiolani and King Streets and Kaka District, as defined by CMF. Associated population based on 2000 U.S. data for ip codes 96813 and 96814. Population updated to 2006 based on island growth rate in interim. Civilian employed persons estimated based on number in labor force in 2000, adjusted for 2006 island unemployment and 2000 to 2006 island growth rates.

[2] Ewa and Central Oahu populations as shown in Exhibit 2-4;Oahu total population as estimated by Claritas, 2006. See footnote 1 re Honolulu.

[3] 2005 estimates for Ewa and Central Oahu provided by Claritas, Inc., 2006;Island figure derived from DLIR estimate of civilian employed persons, as shown in Exhibit 2-9. See footnote 1 re Honolulu.

[4] Indicates civilians resident in area who are employed, but not necessarily in the area. See footnote 1 re Honolulu.

[5] As shown in Exhibit 6-1.

Sources: Claritas Inc., 2005 and 2006;American Factfinder, 2007;prior exhibits as cited.

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Exhibit 6-5
Projected Supportable Additional Office-Based Commercial Areas in the Ewa DPA
Private sector rentable building area, in square feet, 2011 to 2030

	Basis/reference	2011	2015	2030	Av. annual change, 2011-2030
Ewa and Central Oahu region:					
Resident population (Ewa and Central Oahu DPAs)	Exhibit 2-4[1]	278,050	316,550	369,800	1.5%
Number of civilian employees	55% of population	152,900	174,100	203,400	1.5%
Supportable RBA/employee[3]	In Ewa and Central Oahu	10	15	25	4.9%
Supportable RBA	In Ewa and Central Oahu	1,529,000	2,611,500	5,085,000	6.5%
Less existing & planned in Ewa and Central Oahu	Exhibit 6-3	1,220,000	1,650,000	2,590,000	4.0%
Supportable additional RBA in region[4]		309,000	961,500	2,495,000	11.6%
Ewa DPA conclusion:					
Share captured in Ewa DPA	Share of region	45%	50%	55%	1.1%
Total additional market potential in Ewa DPA		**140,000**	**480,000**	**1,370,000**	**12.8%**

Notes: Does not consider needs of government agencies, nor demand that could originate from employment provided to residents beyond the two DPAs evaluated.

[1] Ewa DPA as assessed by Mikiko Corporation; others as projected by City & County of Honolulu, Department of Planning & Permitting, 2006.

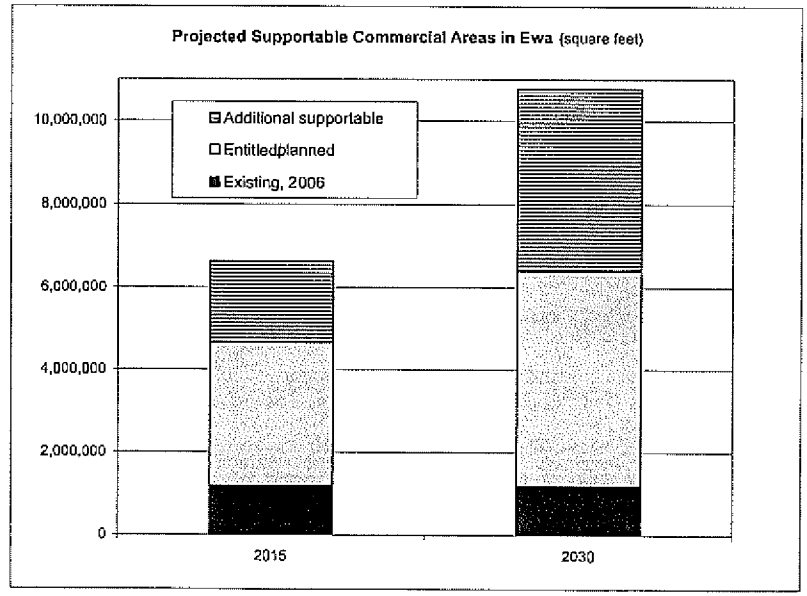
[2] As shown in Exhibit 6-1.

[3] Expected to approach Oahu ratio shown in Exhibit 6-4.

[4] As supported by Ewa and Central Oahu populations; other areas could also contribute to demand.

Exhibit 7-1
Ewa DPA Commercial Market Summary
Retail and office uses, in square feet, 2015 and 2030

	Basis/reference	2015	2030
Completed as of December 2006:			
Retail	*Exhibit 5-1*	737,000	737,000
Office	*Exhibit 6-1*	436,000	436,000
Subtotal		1,173,000	1,173,000
Entitled and planned:			
Retail	*Exhibit 5-2*	2,540,000	3,350,000
Office	*Exhibit 6-2*	940,000	1,880,000
Subtotal		3,480,000	5,230,000
Net additional supportable	*Exhibits 5-8 & 6-5*	**1,980,000**	**4,370,000**
Total		**6,600,000**	**10,800,000**



Source: Mikiko Corporation, 2007

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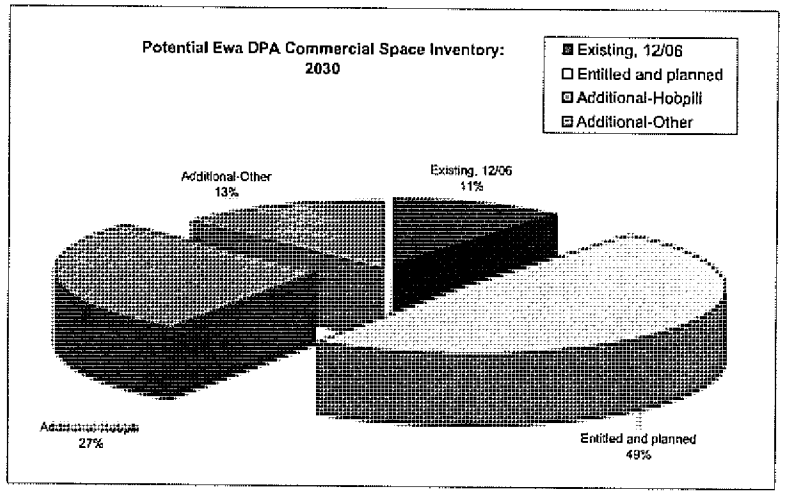
Exhibit 7-2
Commercial Market Assessment for Ho`opili
Retail and office uses, in square feet, 2015 and 2030

	Basis/reference	2015	2030
Ho`opili commercial market:			
Potential development phasing	*2,960,000 total proposed*	**600,000**	**2,960,000**
Share of total future Ewa DPA		**9%**	**27%**
Share of net additional Ewa DPA		**30%**	**68%**
Projected supportable in Ewa DPA:	*Exhibit 7-1*		
Existing, 12/06		1,173,000	1,173,000
Entitled and planned for 2007-2030		3,480,000	5,230,000
Net additional supportable		1,980,000	4,370,000
Total		6,600,000	10,800,000



Source: Mikiko Corporation, 2007

Exhibit 8-1
Developed Business Park/Industrial Lands in Ewa, Central Oahu and Benchmarks
Acres, as of December 2006

	Ewa DPA	Central Oahu DPA	Island of Oahu
Existing inventory:			
Kapolei	1,563		
Wahiawa		121	
Mililani		71	
Waipio		122	
Whiawa		4	
Total, rounded	1,560	320	INA[1]
Vacancy indicators (12/06)[2]	2.6% Kapolei Business Park/Campbell Industrial Park/Kalaeloa Industrial Park	3.6% Wahiawa, Mill Town Business Center	2.3% Island of Oahu average
		0.2% Gentry Business Park	Below 3% for last 5 years
Weighted average net asking rent psf (developed space, per month)[2]	$.03 - Campbell Industrial/Kapolei Business Park	$.19-Wahiawa/ Milltown $.67 - Gentry	$.12
% increase since 2002/2003	140%	INA	23%
Land appreciation (since 2004)	150% - Kapolei	INA	83%

Notes: INA - Information not available. Net of government-owned and operated facilities such as military bases, harbors, airports and universities.

[1] Data not available in land acres.

[2] Based on spaces in I-1 and I-2 zoned lands. Excludes IMX zoned lands, which can also permit retail development, as well as Ka'ab, where vacancies are estimated to be higher than this average.,

Sources: Colliers Monroe Friedlander, Inc. 2006, custom reports;Ibid, "Industrial Market Report: Honolulu Year-End 2006," January 24, 2007;Ibid, "Kapolei's Expanding Industrial Marketplace," December 2006 presentation.

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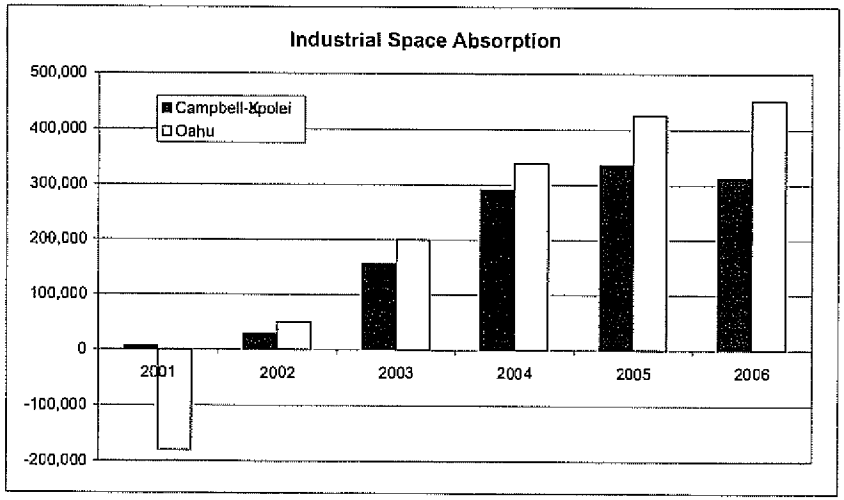
Exhibit 8-2
Business Park/Industrial Space Market Trends: Campbell-Kapolei and Oahu
Square feet in leasable buildings

	2001	2002	2003	2004	2005	2006
Campbell-Kapolei						
Vacancy	5.2%	5.2%	1.3%	0.3%	1.6%	4.6%
Absorption	6,400	28,900	156,300	290,900	335,500	312,200
Inventory	4,321,000	4,321,000	4,321,000	4,598,000	4,973,000	5,453,000
Island of Oahu						
Vacancy	4.4%	4.0%	2.7%	1.7%	1.8%	2.3%
Absorption	-180,800	50,300	199,400	339,700	425,300	452,000
Inventory	33,345,000	35,939,000	36,512,000	37,070,000	37,787,000	39,125,000
Campbell/Kapolei market share						
Absorption	NA	57%	78%	86%	79%	69%
Inventory	13%	12%	12%	12%	13%	14%

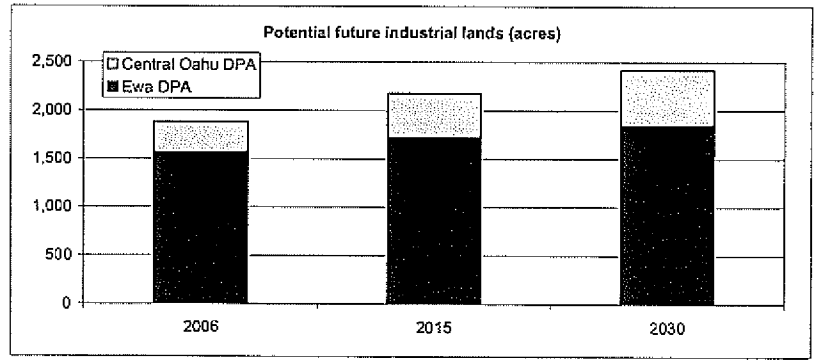


Notes: Net of owner-occupied or government-owned and operated facilities such as military bases, harbors and airports.

Sources: Colliers Monroe Friedlander, Inc. 2006, custom reports;ibid, "Industrial Market Report: Honolulu Mar-End 2006," anuary 24, 2007. Published CMF data adjusted to include CMF estimate of an additional 2.85 million square feet of inventory in Ka'eb. Vacancy rates shown do not reflect relatively higher rates reported in Ka'eb.

Exhibit 8-3
Planned and Entitled Business Park/Industrial Lands in Ewa and Central Oahu DPAs
Net acres; plans known as of December 2006

Location	Existing, 2006	Potential new development[1] 2015	2030	Total	Areas
Entitled potential supply (net acres since prior date):					
Ewa DPA		160	120	280	Kapolei, Kalaeloa, Kunia, Ewa Beach
Central Oahu DPA		140	120	260	Mililani, Waiawa
Total, rounded		300	240	540	
Potential future supply (existing and planned, cumulative):					
Ewa DPA	1,560	1,720	1,840		
Central Oahu DPA	320	460	580		
Total, rounded	1,880	2,180	2,420		



Note: Net acres represent salable or leasable areas, after allowance for major roads and other infrastructure. Planned inventory excludes government-owned and operated facilities such as military bases, harbors, airports and universities.

[1] See Appendix 6 for detailed listings. Based on plans known as of December 2006. Some proposed projects assumed to occur beyond the projection period, if at all. Future use of the Kalaeloa lands, representing some 200 acres of the proposed Ewa DPA inventory, is considered very preliminary but are included within the projection period to be conservative.

Sources: Interviews with project landowners, their consultants, planners, land managers, and brokers; Pacific Business News; company web sites; Enterprise Honolulu; Hawaii Community Development Authority, "Draft Kalaeloa Master Plan," 2005; Colliers Monroe Friedlander Inc., 2006.

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Exhibit 8-4
Projected Business Park/Industrial Land Requirements - Employment-Based Demand
Cumulative, Island of Oahu: 2015 and 2030

	Basis/notes	Benchmark - 2006	Projected 2015	Projected 2030	Average annual change, 2006-20230
Sources of demand:					
Resident population[1]	Exhibit 2-4	909,408	995,500	1,117,300	0.9%
Civilian employed persons[2]	49% of residents	446,200	488,400	548,200	0.9%
2006 market characteristics:[3]					
Building area (sq. ft.), 2006	Year-end, 2006	39,124,741			
Occupied building area, 2006	2.4% vacancy	38,196,000			
Net additional demand:					
Required building area for balanced market	5.0% vacancy	40,110,000	45,220,000	53,300,000	1.2%
Ratio for balanced market [4]	Bldg. sq. ft. per employee	90	93	97	0.3%
Additional sq. ft. required to achieve balance	Cumulative, vs. 2006	985,259	6,095,259	14,175,259	11.8%
Associated land area (cumulative net acres)	0.20 Floor Area Ratio (FAR)[5]	113 [6]	700	1,627	
Planned and entitled supply (cumulative net acres):					Percent mix, 2030
Ewa &Central Oahu	Exhibit 8-3		300	540	82%
Other - Hawaiian Cement	CMF, RCL		29	29	4%
Other - Manana Lands	CMF, RCL		15	15	2%
Other - Tesoro	CMF, RCL		71	71	11%
Total, cumulative			415	655	100%
Net additional requirements (cumulative acres)			285	972	

Notes: Net of government-owned and operated facilities such as military bases, harbors, airports and universities. FAR - Floor area ratio.

[1] 2006 figure from Claritas' estimate based on U.S. Census updates;2015 and 2025 figures based on State and County long-term projections as cited in Exhibit 2-2.

[2] 2006 ratio is based on DLIR's civilian labor force estimate, as shown in Exhibit 2-9. Projections assume ratio remains stable.

[3] CMF estimates Oahu space inventory at 39,244,741 square feet at 2.3% vacancy as of year-end 2006. However, per CMF, February 2007, these figures exclude approximately 2.88 million square feet in Ka'ab. Kalaeloa areas estimated at 3.5% vacancy based on CMF in RCL.

[4] RCL reports 2004 ratios (not adjusted for vacancy) at 80 in Honolulu, 95 Metro Las Vegas, 111 Seattle, and 125 San Diego County . Oahu's industrial building area required ratio is expected to increase as the economy transitions.

[5] According to data provided by CMF, 2006 industrial inventory in Wet Oahu, including Pearl City, Ewa, and Central Oahu, average s 0.13 FAR over 1,980 acres (11.4 million sf). Industrial uses in more urban areas would show higher FARs.

[6] Estimate of pent-up demand in 2006.

Sources: Colliers Monroe Friedlander, Inc, 2006, custom reports;Ibid, "Industrial Market Report: Honolulu Year-End 2006," January 24, 2007:Robert Charles Lesser &Co., LLC, "Industrial Market Feasibility: 345-Acre Kapolei Harborside Center," January 31, 2006;Claritas, 2007:State of Hawaii, Department of Labor &Industrial Relations, 2007.

Exhibit 8-5
Projected Business Park/Industrial Land Requirements - Transitioning Demand
Within Oahu: 2015 and 2030

	Occupied sq. ft.	Impacted area (sq. ft.)[1]	Loss over # years	Average annual replacement need (sq. ft.)	Duration Start	Duration End
Areas of displacement:						
Kapalama Military Reservation	1,250,000	1,250,000	5	250,000	2007	2011
Kaka'ako	2,780,000	2,780,000	15	185,000	2007	2021
Subtotal, in square feet	4,030,000	4,030,000		435,000		
Lease turnover:						
Oahu inventory (net of above), in square feet	34,160,000	342,000	On-going	342,000	On-going	

Total, replacement requirements (rounded):	Estimated total area impacted: Square feet	Acres[2]	Annual: Square feet	Acres[2]
Due to displacement -				
2007-2011	2,360,000	100	435,000	18
2012-2015	555,000	23	185,000	8
2016-2021	1,110,000	50	185,000	8
Due to turnover -				
2007-2015	3,078,000	130	342,000	14
2016-2030	5,130,000	210	342,000	14

Notes: Net of government-owned and operated facilities such as at military bases, harbors, airports and universities.

[1] Kapalama and Kaka'ako impacted areas based on occupied square feet. Oahu lease turnover assumes 5-year terms and 5% of those expiring seeking to move. Turnover estimate is conservative in that it does not account for an increasing Oahu inventory.

[2] Based on an average FAR of 0.55 which considers the higher than average existing densities of the areas to be relocated.

Sources: Colliers Monroe Friedlander, Inc. 2006, custom reports and subsequent discussions; Ibid, "Industrial Market Report: Honolulu Year-End 2006," January 24, 2007; Robert Charles Lesser & Co., LLC, "Industrial Market Feasibility: 345-Acre Kapolei Harborside Center," January 31, 2006; internet research.

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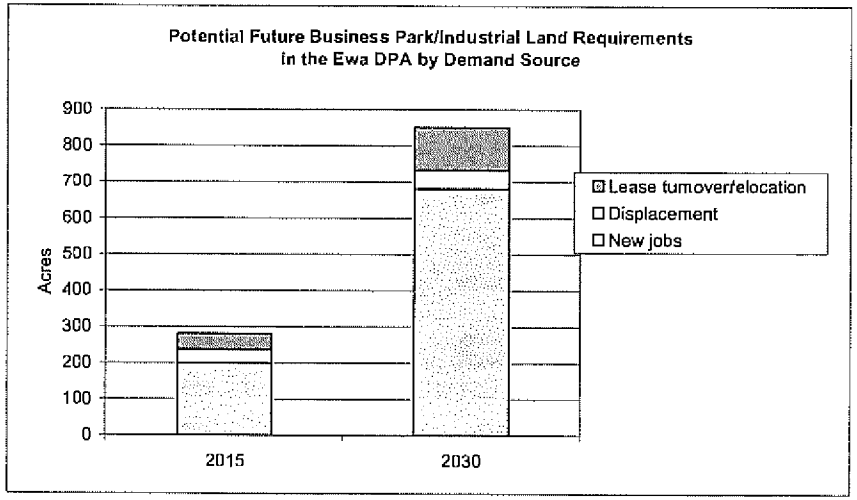
Exhibit 8-6
Business Park/Industrial Market Assessment for the Ewa DPA
Required additional land, cumulative acres, 2015 and 2030

	Basis/ reference	Potential Island-wide 2015	Potential Island-wide 2030	Ewa DPA Capture rate	Ewa DPA 2015	Ewa DPA 2030
Employment-driven demand	Exhibit 8-4	285	972	70%	199	680
Transition-driven demand:	Exhibit 8-5					
Due to displacement[1]	2007-2021	123	173	30%	37	52
Due to lease turnover[2]	2007-2030	130	340	35%	46	119
Subtotal		253	513		82	171
Total demand, rounded[3]		540	1,490		280	850



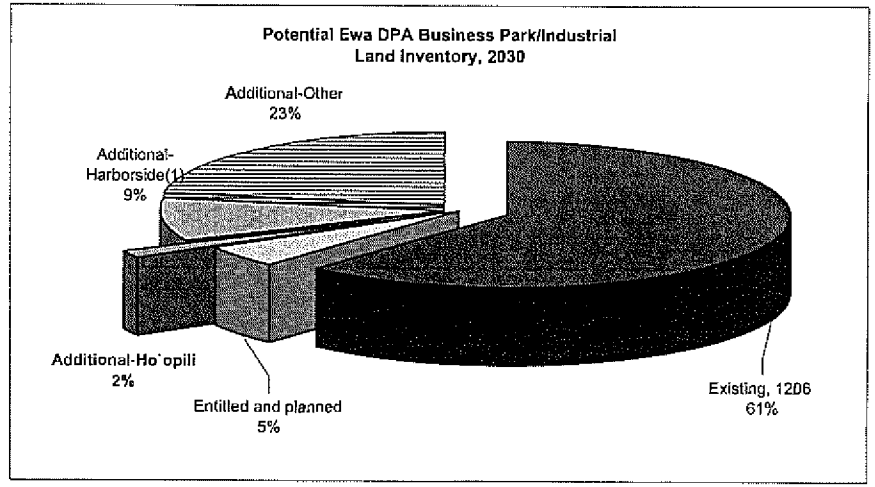
[1] Cumulative demand by 2015 based on 2007 to 2011 and 2012 and 2021 impacted areas;demand by 2030, based on 2015 total plus 2016 to 2021 impacted areas, as shown in Exhibit 8-5.

[2] Cumulative demand by 2015 based on 2007 to 2015 impacted areas;demand by 2030, based on 2015 total plus 2016 to 2030 impacted areas, as shown in Exhibit 8-5. Turnover estimate considered conservative in that it does not account for an increasing Oahu inventory.

[3] Beyond those already entitled. If entitled and aned, Kpolei Harborside Center could satisfy about 240 acres (net) of this demand after 2009.

Exhibit 8-7
Business Park/Industrial Market Assessment for Ho`opili
(Ho`opili Land Allocation as Currently Planned)
Cumulative net acres, by 2015 or 2025

	Basis/reference	2015	2030
Projected supportable in Ewa DPA:			
Existing, December 2006	Exhibit 8-1	1,560	1,560
Entitled and planned for 2007-2030	Exhibit 8-3	160	120
Net additional supportable in Ewa	Exhibit 8-6	280	850
Total, rounded		2,000	2,530
Ho`opili market:			
Proposed net acres		40	40
Share of total future Ewa DPA		2%	2%
Share of net additional Ewa RBA		14%	5%



[1] Kpolei Harborside Center, petitioning the State LUC for Urban designation as of March 2007. This market share would revert to "Additional-Other" if HC were not to receive necessary entitlements.

Source: Mik Corporation, 2007.

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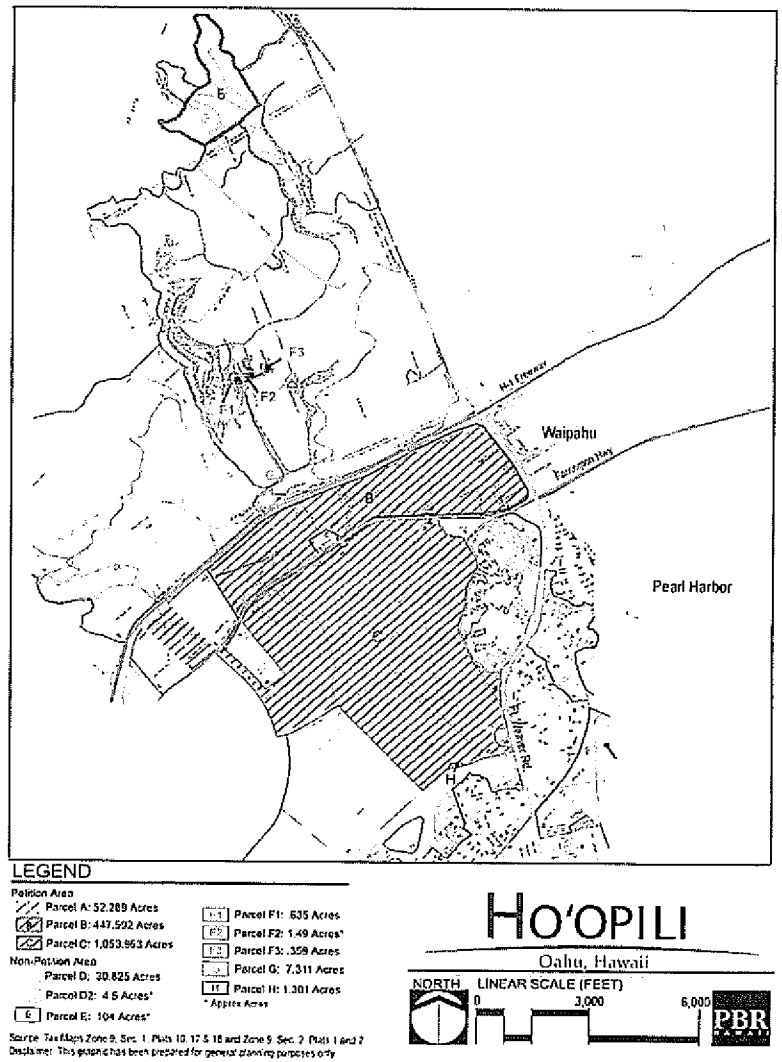
MARKET ASSESSMENT FOR HO`OPILI

Report Appendices

Appendix 1: Ho`opili Petition Area



Source: PBR Hawaii, 2007.

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Appendix 2: Planned Residential Development Projects in the Ewa Development Plan Area, Con't.

Projects with State Land Use Entitlement or Exemption, as of February 2007

Project	Developer or Owner	Number of units: Total	Built as of 1/07	Potential remaining	Estimated project timing/buildout	Residential product mix	Entitlement status	Comment
E A H	Hul Kauhale, Inc. (E A H)	242	0	242	2007 - 2010	192 apartment rentals 50 SF for-sale	Entitled	Ewa Villages Area "H", 123 acres. Rentals are tax credits targeted at <70% of MFY.
Ko Olina Resort & Marina	Ko Olina Development LLC (various entities) and Sekiguchi	2,500	1,164	1,340	2008 +	Condo: lower & low-rise	Entitled	A-1 and A-2 zoned sites only; excluding sites 44 and 47, being considered for nonresidential uses. Likely 70-80% out-of-state markets.
Franciscan Vistas Ewa	St. Francis Development Corp.	328	0	328	Available for sale/rent 2008	207 senior rentals 121 for-sale SF & TH	Entitled	Behind Ewa Villages Manager's home; 23 acres. Rentals are tax credits.
East Kapolei I	State of Hawaii (DHHL)	403	0	403	Grading start 2006; occupancy 2009+	All SF	SLUC Urban; not zoned but DHHL exempt	Average 5,000 s.f. lots, 97 acres. Contingent on DOT completion of N-S Road. Adjacent UHWO.
East Kapolei II & III	State of Hawaii (DHHL, HHFDC, DLNR)	5,200	0	5,200	Ground break 2008+; home completions 2009+	1,000 SF 1,200 MF	INA but DHHL exempt	Financing an issue to completion, as DHHL State funding expires in 2012. Includes 600 rental units to be developed by HHFDC.
Kaupe'a (Villages of Kapolei, Village 8)	State of Hawaii (DHHL)	326	0	326	Under construction 2006; occupancy 2007 - 2010	All SF homes	Entitled	Last of Villages of Kapolei, 53.3 acre site; minimum 5,000 s.f. lots.
UH West Oahu project	UH/West Oahu Campus Development LLP (Hunt ELP Ltd.)	4,041	0	4,041	2009 to 2020+	761 - student & faculty homes 355 - workforce /affordable units 2,560 - MF 365 - SF	500-acre site was Urbanized by HCDCH	MF includes 925 high density, 1,050 medium density and 585 in mixed use. About 300 of 500 acres are for college town. 100 for campus. Campus requires further State funding.
Kalaeloa	Various (State HCDA is master planner)	6,350	60	6,290	60-unit Onolau'ena reopened 2006; most rest 2015-2030	Med-high density TH and apartments	SLUC Urban; HCDA must zone & establish rules	3700 acre masterplanned area. More than half on Navy-brokered lands.
Mokuola Vista	INA	70	0	70	2007			Waipahu
	Total, rounded	41,500	9,400	32,100				

Note - Excludes Subject and c. 150 potential units at Palehua D-2, not yet Urban. Shows remaining units to be developed at each masterplanned project, targeting those of 100+ units each. Figures shown based on stated owner or developer plans within entitlement restrictions, wherever information is available.

INA - Information not available; DP - on City Development Plan Map; SF - Single-family; MF - Multifamily; TH - Townhouse (multifamily), SLUC - State Land Use Commission; DHHL - Department of Hawaiian Home Lands; DLNR - Department of Land & Natural Resources; HHFDC - Hawaii Housing Finance & Development Corporation; HCDA - Hawaii Community Development Authority; MFY - median family income for City and County of Honolulu; DEIS - Draft Environmental Impact Statement.

Sources: Interviews with project principals, developers, planners and brokers, and City and State officials; Honolulu Advertiser; Honolulu Star Bulletin; Pacific Business News; project websites.

Appendix 2: Planned Residential Development Projects in the Ewa Development Plan Area

Projects with State Land Use Entitlement or Exemption, as of February 2007

Project	Developer or Owner	Number of units: Total	Built as of 1/07	Potential remaining	Estimated project timing/buildout	Residential product mix	Entitlement status	Comment
Kapolei West	Aina Nui Corporation (Campbell Estate)	1,450	0	1,450	2009 - 2020	SF & TH	SLUC Urban as of 2006; not zoned	Entitled for 2,370 units but 38% estimated to be targeted at non-resident/second home buyers.
Makaiwa Hills I and II	Makaiwa Hills LLC (Campbell & Monarch Group)	4,100	0	4,100	2009 - 2025	Emphasis on SF; Affordable to luxury	SLUC Urban; not zoned	Includes limited neighborhood commercial. EIS in 2006. Across highway from Kapolei West.
City of Kapolei (Campbell)	Aina Nui Corporation (Campbell Estate)	1,000	0	1,000	2008 - 2015	Some age restricted	SLUC Urban; not zoned	Mauka of Mehana site by D.R. Horton/Schuler; count includes Leihano for-sale housing (Brookfield/Kisco).
Palailai Mauka (also "Kapolei Mauka")	Aina Nui Corporation (Campbell Estate)	750	0	750	2009-2015	THs for affordable to middle markets	SLUC Urban; not zoned	May address some of affordable requirements for Kapolei West.
Villages of Kapolei (remnants)	Castle & Cooke Homes Hawaii, Inc.	472	0	472	Estimated completions 2008 - 2010	228 for sale MF, 244 rental	Entitled	Tax credit (<60% MFY) & gap rentals (120-140% MFY); for-sale. Por. Villages 2, 5, 6 & 8.
Wai Kalo'i ("Palehua East B")	Castle & Cooke Homes Hawaii, Inc.	300	0	300	Estimated buildout 2008	SF detached, min. 5,000 s.f. lots	Entitled	At end of Makakilo Drive. Also "Makakilo Extension."
Ewa Villages	City and County of Honolulu	57	0	57	Indefinite	Vacant lots	Entitled	Held at Managing Director's Office; disposition uncertain.
Kahiwelo (por., Palehua East C & D)	D.R. Horton/Schuler Homes	475	0	475	2008 - 2012	SF homes	Entitled	Includes C-1, C-2, D-1 and portion of C-3 (the latter not part of Palehua East).
Mehana (also "Kapolei Makai")	D.R. Horton/Schuler Homes	1,150	0	1,150	2008 - 2015	SF, duplex, TH, condo	Entitled	30% affordable to households at 80% to 120% of median. Also "City of Kapolei - Schuler," and "Kapolei Parkway Residential"
Ewa by Gentry and Gentry Ewa Makai	Gentry Homes	8,350	6,350	2,000	Makai started 2005; buildout estimated by 2011-2014	SF condo, SF detached, MF	Entitled	Zoning on Makai obtained 4/2004.
Ocean Pointe (prev. "Ewa Marina")	HASEKO (Ewa), Inc.	3,900	1,800	2,100	On-going, started 1998	SF detached & TH	Entitled	Includes potential vacation units but excludes 950-unit hotel. 4,850 maximum units per Unilateral.

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Appendix 4: Entitled and Planned Retail Developments in the Ewa and Central Oahu Development Plan Areas

Projects with State LUC entitlement and plans, as of February 2007

Project Identification	Location	Developer	Site area (ac)	Estimated retail GLA (SF)	Potential new project delivery (square feet) 2007-2010	2011-2015	2016-2030	Comment
Ewa:								
Boat Parcel	Kapolei	Low Archibald (Newport Beach, CA)	14	88,000	88,000	0	0	To market 2-14 acre lots; not planned as shopping center; across Hawaiian Waters.
Kapolei Commons	Kapolei	MacNaughton /Kobayashi Groups	41	550,000	250,000	300,000	0	Initial 21 acres leased; 23-acre site at Kapolei West for 2nd phase under negotiation.
Costco	Kapolei	INA	13	160,000	160,000	0	0	Across from Home Depot.
Wal-Mart	Kapolei	Wal-Mart	25	148,000	148,000	0	0	Off of H-1 Makakilo Drive exit.
Leihano Senior Village	Kapolei	KISCO Senior Living/Brookfield Homes	INA	40,000	40,000	0	0	MUD in senior village.
Kapolei BMX Site	Kapolei	Brookfield Homes Hawaii	4	40,000	20,000	20,000	0	Currently being marketed for sale; part of Brookfield Transit Village MUD development.
Kapolei Center	Kapolei	MW Group	10	147,000	147,000	0	0	Former 12-acre site between K Mart & Home Depot; MW retaining 2 acres for self-storage.
Kapolei Promenade	Kapolei	INA	14	88,155	88,155	0	0	Balance of 335,155 GLA proposed as auto dealership.
City of Kapolei - other	Kapolei	Campbell	INA	333,000	50,000	100,000	183,000	Est. balance of zoned lands; includes Village Walk
Kapolei West	Kapolei	Aina Nui	21	125,000	0	70,000	55,000	15-acre transit site planned for MUD; 2 acre neighborhood retail site further west.
UH West Oahu Campus Village	East Kapolei	To be selected	46	175,000	50,000	80,000	45,000	Neighborhood; MUD
DHHL[1]	East Kapolei	De Barolo Development	67	600,000	350,000	150,000	100,000	Regional/other

Appendix 3: Planned Residential Development Projects in the Central Oahu Development Plan Area

Projects with State Land Use Entitlement or Exemption, as of February 2007

Project	Developer or Owner	Number of units: Total	Built as of 1/07	Potential remaining	Estimated project timing/buildout	Residential product mix	Entitlement status	Comment
Mililani Mauka	Castle & Cooke Homes Hawaii, Inc.	6,480	6,040	440	Projected sell-out by 2008	70% SF historically; c. 55% future	Entitled	All product levels, including affordables.
Waipio Point	Castle & Cooke Homes Hawaii, Inc.	66	0	66	Projected sell-out by 2007	All SF	Entitled	Near Waipahu High School; all released units reserved as of 2/24/06.
Waiawa Gentry Phase 1	Gentry Investments	5,000	0	5,000	Ground break 2006/07; unit sales estimated 2010-2020	Est. 40% attached; 60% detached	Entitled	4,500 to 6,000 units possible depending on density. Planned for multiple homebuilders. Phase 2 (c. 5,000 units) has DP recognition but is not Urban.
Kau'olu Properties	GSF (from State - HCDCH)	370	0	370	>2010	For-sale condos	SLUC Urban, seeking up-zoning	Waipahu. Targeted at households earning 140% or less of County median income. Now zoned R-5; preparing EA.
Royal Kunia II	Horita (161 acres); Robinson Trusts (50 acres)	2,000	0	2,000	Indefinite	SF and MF 600 affordable	SLUC - all; Zoning - Horita lands only	2,000 max based on off-site infra-structure, not entitlements. Horita repurchased at bankruptcy auction, 8/06.
Plantation Town Apartments	Plantation Town Apartments LLC	330	0	330	2008	2, 12-story towers, units, $139-298K	Needs height variance	Within HHFDC's Kau'olu community, Waipahu. Affordable housing.
California Ave. Apartments	INA	42	0	42	2007	Elderly rentals		Wahiawa
	Total, rounded	14,300	6,000	8,200				

Note - Excludes Kaa Ridge and Waiawa by Castle & Cooke (up to 5,500 units) and Gentry Waiawa Phase 2 (up to 5,000 units), both planned developments requiring SLUC approval. Exhibit shows net remaining units to be developed at each masterplanned project, targeting those at 100+ units each. Figures shown based on stated owner or developer plans within entitlement restrictions, wherever information is available.

INA - Information not available; DP - on City Development Plan Map; SF - Single-family; MF - Multifamily; TH - Townhouse (multifamily); SLUC - State Land Use Commission; HCDCH - Housing & Community Development Corporation of Hawaii; DHHL - Department of Hawaiian Home Lands; DLNR - Department of Land & Natural Resources; HHFDC - Hawaii Housing Finance & Development Corporation; HCDA - Hawaii Community Development Authority; MFY - median family income for City and County of Honolulu; DEIS - Draft Environmental Impact Statement.

Sources: Interviews with project principals, developers, planners and brokers, and City and State officials; Honolulu Advertiser; Honolulu Star Bulletin; Pacific Business News; project websites.

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Appendix 5: Planned and Entitled Office Developments in the Ewa and Central Oahu Development Plan Areas

As of February 2007

Project identification	Location	Developer/ Owner	RBA or building size (SF)	Potential new delivery (SF) 2007-2015	Potential new delivery (SF) 2016-2030	Project timing	Comments
Ewa:							
Kapolei Pacific Center	Kapolei	Avalon Development	335,000	335,000	0	2009	11-stories; includes up to 50,000 sq. ft. ground floor retail; across from library and regional park.
Kapolei City Center Office Complex	Kapolei	Kahl & Goveia	200,000	200,000	0	2009	Includes both medical and general office space
Goodwill Site	Kapolei	INA	200,000	200,000	0	2009	Planned for office development. Goodwill seeking proposals for ground lease.
City of Kapolei - other	Kapolei	Campbell	550,000	50,000	500,000	2008-2025	Estimated balance of City of Kapolei commercial-zoned lands, net of those committed to State or County.
Makaiwa Hills	Makaiwa	Aina Nui Corporation	90,000	0	90,000	2011+	Possibly additional office areas as future conditions warrant.
Kalaeloa	Kalaeloa	State/private partner(s)	725,000	150,000	350,000	2010 to 2030+	Includes about 56,000 RBA on Navy-brokered lands.
Central Oahu:							
Gentry Waiawa Phase 1	Waiawa	Gentry	80,000	80000	0	2010+	Not committed yet - could be interchanged with commercial, industrial uses.
Totals of available information, rounded:							
	Ewa		2,100,000	940,000	940,000		
	Central Oahu		80,000	80,000	-		
	Total Trade Area		2,180,000	1,020,000	940,000		

SF - square feet

Sources: Interviews with project developers, landowners, planners and brokers; area site visits; Pacific Business News, 2006, "Book of Lists 2007"; Pacific Business News (weekly); Colliers Monroe Friedlander; www.kapolei.com and other internet sites; Honolulu Advertiser; Hawaii Community Development Authority; Hawaii State Department of Business Economic Development & Tourism, Research and Economic Analysis Division, "Economic Impacts of the Proposed Kalaeloa Project," January 2007.

Appendix 4: Entitled and Planned Retail Developments in the Ewa and Central Oahu Development Plan Areas

Projects with State LUC entitlement and plans, as of February 2007

Project identification	Location	Developer	Site area (ac)	Estimated retail GLA (SF)	Potential new project delivery (square feet) 2007-2010	2011-2015	2016-2030	Comment
Makaiwa Hills	Makaiwa	Campbell	INA	360,000	0	100,000	260,000	Community center or MUD; balance of 450,000 assumed to be office
Ko Olina Junction	Ko Olina	Honu Group	INA	20,000	0	20,000	0	Balance of c. 60,000 expected to be primarily resort-oriented
Lauani Shopping Center	Ewa Beach	Bristol Group/Hamico (Art Howard)	20	255,000	255,000	0	0	Potential Target or other big box; on Ft. Weaver Rd.
Ocean Pointe	Ocean Pointe	Haseko	INA	100,000	0	20,000	80,000	Balance of 500,000 may include spa, other hotel-support
Kalaeloa	Kalaeloa	State/private partner(s)	INA	116,000	0	31,000	85,000	All commercial retail development on Navy brokered lands within Kalaeloa.
Central Oahu:								
Mililani Mauka Commercial B	Mililani Mauka	Castle & Cooke		85,000	85,000	0	0	INA
Gentry Waiawa	Waiawa	Gentry	18	100,000	30,000	70,000	0	Neighborhood, community, non-shopping center
Gentry Waiawa	Waiawa	Gentry	85	300,000	40,000	100,000	160,000	Commercial or industrial; unzoned
Laniakea Plaza	Waipio Gentry	INA	INA	25,189	25,189	0	0	
Plaza at Mill Town	Waipahu	Avalon	INA	34,000	34,000	0	0	2 acres of 15.3 acre site; balance zoned for industrial
Totals/average of available information, rounded:								
	Ewa			3,350,000	1,650,000	690,000	810,000	
	Central Oahu			540,000	210,000	170,000	160,000	
	Total			3,890,000	1,860,000	1,060,000	970,000	

INA = Information not available U/C = Under construction MUD = Mixed-use development, including residential and retail SC = Shopping center

[1] Assumes phasing of regional mall.

Sources: Interviews with project developers, landowners, planners and brokers; area site visits, Pacific Business News, 2006, "Book of Lists: 2007"; Pacific Business News (weekly); Colliers Monroe Friedlander, Inc.; developer websites; Honolulu Advertiser; Hawaii Community Development Authority; Hawaii State Department of Business Economic Development & Tourism, Research and Economic Analysis Division, "Economic Impacts of the Proposed Kalaeloa Project," January 2007.

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Appendix 6: Existing and Planned Business and Industrial Parks in Ewa and Central Oahu DPAs

As of February 2007

Project	Location	Year opened/ projected	Land area (gross acres) Total	In use or sold	Future supply[1]	Future net acres[2]	Potential new delivery (net acres) 2007-2015	2016-2030	Zoning	Comment
Central Oahu:										
Militani Technology Park	Militani	1989	101	71	30	23	20	3	Ph I - IMX-1	Ph I - 101 acres; Ph II - 135 acres but excluded because still Ag. Ph 1D infrastructure not complete.
Mill Town Business Center	Waipahu	1998	48	35	13	10	10	0	I-1	Includes Avalon's Sugar Mill Center (15-acres = 2 acres ground floor retail and 2 acres industrial, to market 2007).
Waipahu	Waipahu	INA	86	86	0	0	0	0	Most I-2; some B-2	Throughout town; c. 2.2 mil s.f. buildings.
Gentry Business Park	Waipio	1980	122	122	0	0	0	0	IMX-1, I-2	c. 1,523,000 s.f.
Wahiawa Industrial Center	Wahiawa	1990	4	4	0	0	0	0	I-2	Intensive industrial.
Gentry Waiawa Phase 1	Waiawa	2009+	175	0	175	131	90	41	B-2, IMX-1 & unzoned	Lands designated Commercial/Industrial on master plan - most could be developed as either.
Royal Kunia	Kunia	2012+	123	0	123	92	20	72	A-1	Requires zoning.
Subtotal, rounded			660	320	340	260	140	120		
Total, rounded			2,590	1,880	710	540	300	240		

[1] Estimated lands with State entitlement or exemption, and planned but not yet committed. Aina Nui's Kapolei Harborside Center (345 acres gross, 240 saleable) not included as it is currently before the LUC. Aina Nui projects 2009 to 2017 marketing period if entitled.

[2] Net acres estimated at 75% of gross acres, to allow for roads, infrastructure, etc.

INA - Information not available s.f. - square feet. FAR - Floor Area Ratio

Sources: Interviews with project landowners, their consultants, planners, land managers, and brokers; Pacific Business News; company web sites; Enterprise Honolulu; Hawaii Community Development Authority, "Draft Kalaeloa Master Plan," 2005; Colliers Monroe Friedlander Inc., 2006.

Appendix 6: Existing and Planned Business and Industrial Parks in Ewa and Central Oahu DPAs

As of February 2007

Project	Location	Year opened/ projected	Land area (gross acres) Total	In use or sold	Future supply[1]	Future net acres[2]	Potential new delivery (net acres) 2007-2015	2016-2030	Zoning	Comment
Ewa:										
Hawaii Raceway Park	Kapolei	2010	54	0	54	41	41	0	INA	To sell developed lots. Owner Irongate also developing Trump Towers in Waikiki.
James Campbell Industrial Park	Kapolei	1959	1,367	1,367	0	0	0	0	I-2	Heavy industry; vertical developments sold to HRPT.
Kapolei Business Park	Kapolei	1993	189	136	53	40	40	0	I-2, restricted	Phase 1 and 2 sold to Jupiter; 53 acres (19 lots) in phase 2, includes Kapolei Spectrum (condos) and Kapolei Industrial Court (also built.)
Kenai Industrial Park	Kapolei	1990	60	60	0	0	0	0	I-3	Sold out.
West Kalaeloa	Kapolei	2008+	100	0	100	75	75	0	I-2	Makai of Honolulu Advertiser site, adjacent to studio site. SHM Partners expect 2 mil s.f.
Kapolei Studios	Kapolei	2008+	23	0	23	17	17	6	I-2	Movie/production studios. SHM Partners; planning on State tax credits (Act 88).
Kalaeloa - Navy brokered & State administered properties	Kalaeloa	2010+	192	0	192	144	30	114	INA	Industrial, Light Industrial and Eco-Industrial lands, 10% in Navy-brokered lands; acreage estimated by CMF based on assumed FAR.
Subtotal, rounded			1,930	1,560	370	280	160	120		

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APPENDIX K

Economic & Fiscal Impact

MIKIKO
CORPORATION

ECONOMIC AND FISCAL IMPACT ASSESSMENT FOR HO`OPILI

ISLAND OF OAHU

Prepared for:
D.R. Horton – Schuler Homes, LLC
dba D.R. Horton – Schuler Division

FINAL REPORT

August 2007

AR00027897

Economic and Fiscal Impact Assessment for Ho`opili

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ECONOMIC AND FISCAL IMPACT ASSESSMENT FOR HO'OPILI

Report Text

AR00027898

1 – Introduction and Executive Summary

This chapter relates the study background, objectives, approach and principal conclusions of an economic and fiscal impact assessment prepared for the proposed Ho`opili development on Oahu. The following chapters offer a more detailed explanation of the findings and analyses on which these conclusions are based.

Project and Study Background

D.R. Horton – Schuler Homes, LLC dba D.R. Horton – Schuler Division (DRH), has initiated a planning and entitlement process to develop Ho`opili (also "the Project"). The mixed-use, master-planned community encompasses approximately 1,555 acres in the City and County of Honolulu's Ewa Development Plan Area (DPA). As proposed, Ho`opili would include up to 11,750 homes, a 50-acre (40 net acres) business park, and several areas of retail and/or office commercial development, totaling up to 2.96 million square feet of gross leasable area at buildout. It would also include one or more County-operated transit stations, up to six sites for schools or other public uses, regional and neighborhood parks, and other open spaces.

The Project is described further below, and in Mikiko Corporation (MC)'s prior report, "Market Assessment for Ho`opili," which is dated March 2007.

The planning firm PBR Hawaii & Associates, Inc. (PBR Hawaii) is preparing materials to support DRH's entitlement efforts for these lands.

Mikiko Corporation Study Objectives

PBR Hawaii engaged MC to prepare two reports:

1) **Market assessment** – An assessment of the market support for the residential, commercial and business park uses proposed at Ho`opili, including:

   - ☐ Evidence of demand and competitive supply
   - ☐ Assessment of appropriate markets, pricing, and supportable absorption

2) **Economic and fiscal impact assessment** – An assessment of the economic and fiscal impacts of the Project in terms of population, employment, personal income and State and County government operating expenditures.

The market report is the separate document cited above. This report uses the findings of the market report as input assumptions.

Economic and Fiscal Impact Approach

This economic and fiscal impact assessment is intended to assess the Project's effects within the State of Hawaii (State) and the City and County of Honolulu (County). Impacts that were evaluated include:

☒ Economic impacts:

- ☐ Part-time resident expenditures in Hawaii
- ☐ Development-related employment
- ☐ Operations-related employment
- ☐ Personal income deriving from development and operations

☒ Population impacts:

- ☐ Residential utilization patterns
- ☐ In-migrant population

☒ Fiscal impacts:

- ☐ Property tax and other County government revenues
- ☐ General excise tax, income and other State government revenues
- ☐ County and State government operating expenditures
- ☐ County and State net fiscal operating impacts

State and County revenues and expenses estimated herein are generally based on the structure of tax collections and services reported as of the fiscal year ending June 30, 2006[1]. The impacts estimated would differ if governmental taxing and spending policies were to be materially altered.

All dollar amounts in this report are stated in 2007 dollars, and year references are to calendar years, unless otherwise stated.

[1] Real property tax rates, however, have been updated to FY 2008 rates, since the County enacted significant changes to its tax structure in summer 2007.

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Executive Summary

Development Proposal

Over three decades ago, city planners set out to create a "second" city in West Oahu that would provide island residents an alternative to living and working in downtown Honolulu's existing urban core. This is documented in the County's Ewa Development Plan, which was adopted by the City Council in August 1997 and is periodically updated. The plan presents a vision for Ewa's future development and provides conceptual land use plans that serve as a policy guide for more detailed planning and for public and private sector investment decisions.

In the near future, Ewa should also become a major economic engine for the state. For the 2006 to 2025 period, planned development in the DPA is projected to generate some $620 million in annual payroll, and 40,000 new jobs in the area. Projections also forsee over 38,000 new workers employed in the area by 2025.[2]

This is the context in which Ho`opili was conceived. The new community is designed as one of the last pieces of the larger master plan for the area, delivering needed homes and jobs in this fast-growing region. Ho`opili is proposed as mixed-use project developed in a New Urbanist[3] style, a community where residences, employment opportunities and amenities are closely integrated and may be reached by foot, bike or transit, as well as by car. Like other New Urbanist developments, Ho`opili is intended as a community where one can "live, work and play."

Ho`opili will offer traditional single- and multifamily homes, as well as multifamily residences developed in mixed-use settings. These may be units developed on second or third floors above ground floor retail, as well as "live-work" units, which include spaces designed and permitted for commercial business operations. In general, housing at Ho`opili will be developed at higher average densities than Hawaii's planned communities have been historically. This should serve to enhance the affordability of its housing, to encourage non-automobile-based modes of travel, and to support the Project's commercial facilities.

In accordance with County policies, about 30% of Ho`opili's residential units would be priced to County standards for affordable housing. The table on the next page summarizes the key Project components that drive the economic and fiscal impact assessment presented herein.

[2] Decision Analysts Hawaii, Inc., September 2005, "Ewa Development, 2006 to 2025: Economic, Population and Fiscal Impacts."

[3] See market study, Chapter 4 for discussion on New Urbanism.

Ho`opili would also offer up to 2.96 million square feet of commercial areas, including retail and office uses. Some of this space would be located within six business/ commercial designated areas, and some dispersed in residential mixed-use areas. With its advantageous location at the "gateway" to Ewa, including the intersection of H-1 freeway and Fort Weaver Road, Ho`opili's commercial areas could serve broad regional markets as well as its own community needs.

Finally, the Project's 50-acre (40 net acres) business park is envisioned to seek establishments that serve national and international markets. This could include a science and technology center, a health-and-wellness-related facility or other professional or technical-focused enterprises.

This report does not consider the impacts of developing and operating the County's proposed transit station(s) at Ho`opili.

Overview of Proposed Developments at Ho`opili
2007 dollars

	Comment	By 2015	By 2030	Total
Homes:	*Overall mix:*			
Market units	*70%*	1,800	6,450	8,250
Affordable units[1]	*30%*	300	3,200	3,500
Total		2,100	9,650	11,750
Average home sales price:				
Market units		$480,000	$480,000	$480,000
Affordable units		$295,000	$295,000	$295,000
Weighted average		**$425,000**	**$425,000**	**$425,000**
Other developments:				
Business park	*Net acres*	20	20	40
Business park	*Same areas, but in building sq. ft.*	120,000	680,000	800,000
Commercial centers	*Gross leasable sq. ft.*	600,000	2,360,000	2,960,000
Total development costs	*Hard and soft costs (mils)*	**$1,076.6**	**$3,531.7**	**$4,608.3**

Note: Project also includes school and park sites, public facility sites, a bike path and open spaces.

1 Assumes 1:1 credit per County guidelines currently in effect. Actual credit could vary, changing the affordable unit count. See City & County of Honolulu, "Adoption of Rules for the Terms and Unilateral Agreements Requiring Affordable Housing," October 20, 1994.

Sources: Exhibits 1 and 5; DRH, 2007; Mikiko Corporation, "Market Assessment for Ho`opili," March 2007.

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As shown in the preceding table, development costs are estimated to total some $4.6 billion, including on- and off-site infrastructure, vertical construction, landscaping and soft costs such as professional services, administration of operating subsidiaries, marketing and the like.

Projected Impacts[4]

The Project would generate significant, on-going economic and fiscal benefits for residents of the islands, as well as for the County and State governments. Development of facilities would generate employment and consequent income and taxes. In addition, by attracting new part-time residents or retirees to Oahu and generating additional real estate sales activity, the Project is expected to support long-term impacts, including additional consumer expenditures, employment opportunities, personal income and government revenue enhancement.

Highlights of the Project impacts are summarized in the table on the next page.

- **Development employment** - Throughout its development, Ho'opili could support some 2,300 to 3,300 full-time equivalent (FTE) development-related jobs through its direct, indirect and induced impacts. These jobs are expected to be associated with annual personal earnings[5] of some $131 to $178 million per year, or $53,000 to $56,000 per job.

- **Operational employment** - By its completion in about 2030, the Project could also be expected to have generated about 7,000 permanent, ongoing FTE jobs, through its direct, indirect and induced impacts. About 1,550 of these jobs could be new to the County and State. They could be expected to include professional, technical and managerial positions at the proposed business park, sales and marketing positions supported by resales and releasing of property at the Project after its initial occupancy, and myriad other positions generated throughout the economy, as supported by the activity generated by such new expenditures. Altogether, these net new operations-related positions could be expected to generate personal earnings for Hawaii residents of about $109 million per year.

[4] See following chapter for study methodology and definitions of key terminology, such as "direct," "indirect" and "induced" impacts.

[5] Earnings are defined as wage, salary and proprietary income, plus director's fees and employer contributions to health insurance, less employee contributions to social insurance. "Earnings" are typically less than salaries.

Summary of Projected Economic and Fiscal Impacts

2007 dollars, in millions

	Comment	By 2015	By 2030
FTE employment[1]:	*Direct, indirect and induced*		
Development-related	*Average annual in preceding period*	2,340	3,340
Operations-related	*Annual, on-going*		
Total generated by Project	*On-site and directly supported*	1,836	7,043
Net new jobs	*New to County or State*	740	1,550
Total personal earnings[2]:	*Direct, indirect and induced*		
Development-related	*Average annual in preceding period*	$130.7	$178.3
Operations-related	*Annual, on-going, on net new jobs only*	$65.2	$109.2
Average earnings per FTE job	*Direct, indirect and induced*		
Development-related	*Average annual in preceding period*	$56,000	$53,000
Operations-related	*On net new jobs only*	$88,000	$70,000
In-migrant resident population:	*Average daily employees, dependents, and part-time residents*		
To the County		550	2,170
To the State	*Subset of County in-migrants*	260	1,020
Net additional government operating revenues[3]:	*Operating revenues less operating expenditures*		
For the County		$7.8	$27.5
For the State		$14.4	$19.9
Revenue/expenditure ratio[3]:	*For government operations*		
For the County		9.8	8.5
For the State		9.4	3.8

1. FTE = Full-time equivalent, defined as 40 hours per week or 2,080 hours per year.
2. Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance.
3. Does not consider impact and permit fees paid to County and State governments. These are projected to amount to approximately $194 million and $25 million, respectively, over the life of the Project, in 2007 dollars. They include sewer, water, transportation, schools, and other fees and permits. Figures also exclude impacts of transit facilities.

Sources: ORH, 2007; Mikiko Corporation, "Market Assessment for Ho'opili," March 2007.

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- **Population movements** - It can be assumed that the jobs created by Ho'opili, particularly its professional, technical and managerial career opportunities, will create incentives for some neighbor islanders or former Hawaii residents to move to Oahu. These and other indirect factors can be expected to result in up to 2,170 persons living on Oahu who might not otherwise have lived on the island (in-migration to the County.) Within this total, some 1,020 persons could be those who had previously lived out-of-State.

- **Net County fiscal impacts** - The Project could be expected to contribute some $27.5 million in net additional County revenues at its completion. By 2030 and beyond, new County government revenues are estimated to represent 8.5 times the new County government operating expenditures required to support the additional population expected to be attracted to Oahu by the Project.

- **Net State fiscal impacts** - For the State, net additional operating revenues derived from the Project are estimated at $19.9 million per year by 2030 and beyond. This represents a revenue/expenditure ratio of 3.8.

These public sector contributions do not consider the value of the school sites, public parks or various off-site infrastructural improvements to be contributed by DRH, nor do they consider the estimated $219 million in various impact and permit fees expected to be paid to the County and State governments during the development of the Project. These additional contributions would greatly increase the net public benefits of Ho'opili.

Report Organization

The rest of the report is organized in three parts, as follows:

1) **Remainder of Report Text** - Explanation of the study analyses and conclusions, including:

   - Study Approach
   - Economic Impacts
   - In-Migrant Population
   - Fiscal Impacts

2) **Exhibits**- Detailed bases and findings on which the conclusions are based.

3) **Appendices** – Report conditions and further documentation of input assumptions.

2. Study Approach

Special Considerations

Special considerations for some of Ho'opili's facilities guide the analyses presented herein. These and other aspects of this study's analytical framework are set forth below:

- **Time frame** – This analysis extends from 2009 to 2030, a 22-year period that would encompass from preconstruction planning through Project build-out. Ground-breaking may be anticipated in 2010. All residential units, as well as commercial and industrial space are projected to be sold and/or occupied during this period, in accordance with findings of the market study.

- **Use and classification of residential units** – Although not considered a major market segment, Ho'opili's unique development style and mixed-uses could attract some buyers that would be seeking a part-time residence in the community. This group is distinguished from primary resident buyers or renters because their economic and fiscal impacts are distinct.

  - Homes occupied by full-time residents are referred to herein as "primary resident homes" and are assumed to be occupied by persons who would be living elsewhere on Oahu even if the Project were not developed.

  - Homes occupied by part-time residents may be referred to herein as "non-resident homes" and/or "non-resident/second homes," and are assumed to be occupied by persons who will stay at the unit for significant portions of the year, but whose primary place of residence is or was formerly somewhere other than Oahu. This latter group also includes persons who retire to Ho'opili from somewhere off-island, even if their Ho'opili home becomes their principal place of residence.

- **Commercial facilities** - The proposed commercial facilities are expected to attract spending from:

  - Unit buyers at Ho'opili who reside on-site full- or part-time,
  - Oahu residents not living at Ho'opili, and
  - Oahu visitors not staying at Ho'opili.

  It is likely that Oahu residents and visitors not staying at Ho'opili would have spent an equivalent amount on dining out and/or personal services whether or not the Project's commercial facilities were developed. Thus, given the competitive retail market on Oahu, the planned complexes could lead to a geographic reallocation of

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spending within the region, but would not in themselves be expected to increase expenditures made in the County or State.

On the other hand, commercial facilities would contribute to the Project's ability to attract residential buyers to Ho`opili.

In other words, Ho`opili's commercial facilities will employ workers, pay taxes and generate other economic and fiscal benefits. These are considered directly generated impacts and most of these jobs would be located on-site. However, the net benefits of the Project's commercial facilities are best measured in terms of the part-time residents Ho`opili attracts, and the spending, taxes and other benefits these persons will generate throughout the County and State.

- **Other uses/considerations not modeled** – Other than development costs for the parks and infrastructure affiliated with the school site, this assessment does not consider the economic and fiscal impacts of development that would be of a public or civic nature. Thus, building or other facilities on the school sites or parks, the proposed transit station(s) and other public facilities are not considered. Neither is the value of the lands to be contributed to governmental agencies considered.

  With respect to the proposed transit station(s), it is assumed that they might be developed elsewhere in the Ewa district, if at all, whether or not Ho`opili proceeds. Thus the development costs and many other impacts of introducing mass transit in the region, although likely profound, are not considered to be a function of the development of Ho`opili per se.

- **Entitlement spending not considered** – DRH's currently on-going entitlement process for Ho`opili is already generating economic and fiscal benefits by employing professionals and supporting various vendors around the State. However, since such benefits are not dependent on the outcome of the entitlement process, they are not enumerated in this analysis.

- Other –This study does not compare the proposed developments to prior master plan(s) for the property nor to other developments that could be hypothesized given the lands' existing entitlements.

Definition of Terminology

Within this report, the following definitions apply:

- **Direct impacts** - Those economic, population or other impacts attributable to persons or activities that are a direct result of the proposed development. For instance, direct employment impacts might include those involved in building the proposed facilities, such as construction workers, and those who would later work at them in their operations.

Many, but not all of direct impacts can be expected to occur on-site. For instance, a portion of the construction budget is for architects and engineers. While such persons' employment might be temporarily dependent on the contracts generated by Ho`opili, they may do the majority of their work from offices in Honolulu or elsewhere. Likewise, administrative and managerial staff located off-site would support construction professionals working on-site.

- **Indirect impacts** - Indirect impacts occur when the businesses or persons who are directly affected make expenditures for additional supplies or services. For instance, some of the additional retail spending by those newly attracted to Hawaii by Ho`opili could be spent on eating out. These elevated dining out expenditures could indirectly increase demand for produce, seafood and meats from Hawaii farms, fishermen and/or ranching enterprises. Ho`opili would thus have indirectly supported new business opportunities for area providers of such goods and services.

- **Induced impacts** - Induced impacts occur throughout the community when those persons or companies that have benefited from the direct or indirect impacts of the Project spend their associated earnings on consumer goods and services. For instance, a construction worker may spend her earned wages to buy a new pair of shoes, or to pay for her child's day care. The farmer who sells produce to a restaurant at Ho`opili may use some of his profit to take his family out to the movies. The businesses and individuals impacted by such re-spending are said to enjoy induced economic impacts from the Project.

- **Total impacts** - Total impacts are defined as the sum of direct, indirect and induced impacts for any given variable.

- **Resident population** - Resident population refers to all those persons who habitually reside in a given area, whether or not they may have temporarily traveled away.

- **Full-time equivalent** - Although some direct, indirect and induced employment opportunities generated by Ho`opili can be expected to be part-time, this study measures employment opportunities in full-time equivalent (FTE) units. For purposes of this study, one full-time equivalent position is defined as 2,080 hours of employment (including paid vacation and sick leave) per year. This is equivalent to 40 hours per week, and may also be referred to as a "person-year" of employment. Two half-time jobs would be considered to together represent one FTE job.

  Residents may also be referred to as FTE. In this case, one FTE resident would represent 365 days of presence in the community. As an illustration, this could also represent four part-time residents each staying three months.

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Project Parameters

Assumptions regarding the scale, nature and timing of the Project are made in order to assess its impacts. This assessment is based on findings of the market study, and on timelines and development programs provided by DRH, PBR and others as noted.

Development Program (Exhibit 2-1)

Ho'opili is proposed to be developed with up to 11,750 residential units, 2.96 million square feet of commercial (retail and office) space, and 40 net acres (50 gross acres) of business park. The business park lands could be expected to accommodate up to 800,000 square feet of rentable building areas at completion.

Among the residential units, about 30% or some 3,500 would be developed as affordable housing, in accordance with County guidelines. If these units were developed for sale (as opposed to rentals), they could expect to be marketed for about $295,000 on average, based on County guidelines in effect in February 2007. Affordable units might be produced at a rate of about 200 per year, on average.

The average market-priced unit could be expected to be sold at $480,000, with an average of 450 units selling each year. These assumptions are explained in the market study.

Including the above land uses plus school and park sites, roads, pathways and other open spaces planned, the Project encompasses some 1,555 acres. The school and/or "public facilities" sites and several of the park sites are intended for contribution to State and County governments.

Assuming entitlements are obtained on a timely basis, the landowner believes construction of infrastructure could begin in 2010, and the first units could be available for occupancy in 2012. The Project as a whole is anticipated to be fully sold out and/or leased by 2030. As noted previously, however, this analysis begins in 2009, in order to capture the impacts of pre-construction but post-discretionary permit planning, design and related professional services.

Utilization Patterns (Exhibit 3-2)

County guidelines are expected to restrict the use of affordable housing units to primary residents. Market units are also likely to be mostly used as primary residences. Many would be purchased by households intending to live in them themselves, while some others may be purchased by investors who would subsequently rent them out. This would again result in a unit available for primary resident use.

Based on historical estimates for Oahu, about 7% of homes could be expected to be purchased by persons who customarily live or previously lived off-island, on a neighbor

island or out-of-State. These would include those who intend to live in their new unit on a part-time basis, as well as those who intend to move to Oahu to reside in the unit full-time, such as a retiree who relocates from off-island.

Primary resident market units at Ho'opili are assumed to be occupied 95% of the time, at 3.2 persons per household for market units, and 3.4 per household for the affordable units. These are based on the estimated 3.5 persons per household now resident in the Ewa DPA, and the projected 3.4 per household by 2011[6]. The current estimate and near-term projection are discounted further during the projection period to reflect ongoing anticipated declines in average household size.

The nonresident/second home units are assumed to be occupied an average of 50% of the year, by an average of 2.3 persons per unit, based on surveys of brokers and residents in other second home communities on Oahu. These assumptions support an average daily Project population of some 35,290 persons, assuming its full build-out and sales absorption by 2030.

[6] Claritas, Inc., 2006.

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3. Economic Impacts

Ho'opili may be expected to impact the State and County economies by (a) attracting part-time residents who would make new expenditures,[7] (b) generating development activity, which supports expenditures for goods and services, and (c) creating and supporting jobs and business enterprises in its ongoing operations. The new jobs would in turn generate additional personal earnings in the County and throughout the State.

Part-Time Resident Expenditures (Exhibit 3-1)

Expenditures by part-time residents attracted to Oahu by the Project will contribute to Ho'opili's economic benefits. Direct expenditures made in Hawaii by the part-time residents themselves are projected to amount to about $2.4 million by 2015, or $11.1 million per year by the Project's stabilization in 2030. Including the indirect and induced impacts of these direct expenditures, the total contribution to the State economy by Ho'opili's part-time residents is expected to amount to about $4.1 million per year by 2015 and $19.0 million per year by 2030 and thereafter.

Project Costs

Coefficients and Multipliers (Exhibit 3-2)

The State of Hawaii, Department of Business Economic Development and Tourism (DBEDT) periodically evaluates the economic interdependencies of the various industries within the State, and their rates of job and personal earnings creation. The latest such study is dated June 2006 and entitled, "The 2002 State Input-Output Study for Hawaii." Exhibit 4 shows the information extracted from this report for use in the analysis of Ho'opili's development activity.

- **Final demand industry coefficients** show the relationship between input, or spending within any given industry category, and its resulting creation of jobs and earnings in other sectors of the State economy[8]. Such coefficients are used to estimate the direct effects of the construction and development activities planned for Ho'opili.

- **Industry multipliers** show the relationship between direct jobs or earnings and the indirect and induced jobs or earnings that they can be expected to subsequently support.

[7] Although not planned as a second home community, nearly all areas of Hawaii attract some part-time resident ownership. Ho'opili's relatively smaller, mixed-use units could additionally appeal to neighbor islanders who frequently do business in or travel to Oahu.

[8] Personal earnings are defined in the DBEDT study as wage and salary income plus proprietors' income, plus director's fees, plus employer contributions to health insurance, less personal contributions to social insurance (i.e., social security taxes). See pp. 23 to 24.

Development Costs (Exhibits 3-3 and 3-4)

Based on estimates provided by DRH and other sources as cited in the exhibits, Ho'opili's development costs will amount to some $4.6 billion in total, spent over the 22 years between 2009 and 2030. This budget is in 2007 dollars and includes:

- **Professional services** – planning, architectural, engineering, landscape design, development management, legal, and similar services. Note that those services related to the effort to entitle Ho'opili's lands are not included in this estimate, since they are not contingent on the entitlement.

- **Construction** – including on- and off-site infrastructure, land subdivision and site preparation, all facility development (except for public facilities), and retail, office and business park tenant improvements.

- **Other** – including administrative overhead, subsidiary operations, marketing, public relations, off-site community contributions and other "soft" costs incurred during the Project's development.

Because the latest DBEDT coefficients are calibrated to 2002 dollars, the development budgets are also re-estimated in 2002 dollars, as also shown in Exhibit 3-3.

Exhibit 3-4 restates the 2007 figures but on an average annual basis within each period considered, rather than as a total for each period. Over the projection period, the Project could be expected to average $209.5 million per year in development expenditures in Hawaii. The rate of expenditures could be higher than this average between 2016 and 2030.

Employment and Earnings

Development Employment (Exhibit 3-5)

Over the life of its buildout, Ho'opili could directly generate some 27,400 person-years of development-related work. The majority of this work would occur on-site. However, some, such as the professional services and administrative positions, are likely to be located off-site, likely elsewhere on Oahu. This estimate includes wage, salaried and proprietary employment opportunities supported by Ho'opili's development.

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Considering also the indirect and induced employment opportunities that these direct impacts are likely to support, the total impacts of the Project's development could represent 66,600 FTE jobs by 2030.

The impacts are also considered on an average annual basis, in order to suggest the numbers of persons that could be employed in Ho'opili's development in an average year. Over the entire development period from 2006 to 2030, the Project is anticipated to support an average 1,240 direct FTE development-related jobs within the State. Total employment impacts, including direct, indirect and induced FTE jobs, could represent about 3,020 FTE positions in an average year. Average annual demand for development-related employees could be higher between 2016 and 2030.

Personal Earnings from Development (Exhibits 3-6 and 3-7)

Direct personal earnings associated with Hawaii-based positions could amount to some $1.84 billion over the Project's initial development. Considering the indirect and induced earnings, Hawaii workers could expect to enjoy some $3.59 billion in additional earnings over the Project's development.

On an annual basis, these total earnings represent an average of $163.1 million per year from 2009 to 2030, or up to $178.3 million per year between 2016 and 2030. The indirect and induced benefits could be expected to be supported throughout the State, with concentration on Oahu.

Comparing projected earnings to the employment figures shown previously, the FTE-wages, salaries, proprietary income and other earnings generated by the Project's overall development are estimated to average about $67,000 per direct FTE position, or $54,000 considering its total, more dispersed impacts.

Since most families include more than one jobholder, and many employees themselves hold more than one job, these position-specific salaries can be expected to be associated with higher average family incomes.[9] Thus, on average, those employed in positions directly supported by Ho'opili's development could be expected to have family incomes averaging $121,000, while those associated with all jobs created through the Project's direct, indirect or induced effects could be expected to have family incomes averaging $97,000. These would represent 165% and 132% of the median family income for Honolulu County, which was estimated at $73,500 in 2007.[10]

[9] Ratio derived from average annual wage in Honolulu County, as reported by the State Department of Labor & Industrial Relations and the median family income as reported for Honolulu MSA by the U.S. Department of Housing & Urban Development. See Exhibit 3-7 for further information.

[10] U.S. Department of Housing & Urban Development, HUD USER, July 2007.

Operational Employment (Exhibits 3-8 and 3-9)

In addition to its development-related positions, Ho'opili would create numerous long-term permanent jobs in its operations. Operational employment may be considered in two ways:

- **Employment directly generated** (Exhibit 3-8) – Ho'opili is expected to be directly associated with over 7,000 permanent positions in its operations. Most of these jobs would be on-site, such as employees of Ho'opili's business park, and its retail and office facilities, including those working at their own live-work units. Additionally, second home residents of Ho'opili will likely require assistance with property management, landscaping, cleaning and the like. Also, the development and marketing of Ho'opili will generate opportunities in real estate brokerage, management, sales and marketing. Some of these latter opportunities may be based at offices off-site. These estimates do not include employees of public facilities that may be developed on-site, such as at schools, parks or the like.

- **Net additional employment** (Exhibit 3-9) - It is likely that existing and future Oahu residents would spend an equivalent amount on dining out and/or personal services whether or not the Project's commercial facilities were developed. One impact of the Project's development may be a geographic reallocation of spending and hence jobs within the region. However, from a broader standpoint, many of the jobs to located at Ho'opili would not be net new jobs for Hawaii.

  On the other hand, to the extent that Ho'opili attracts new residents to the islands, those persons' spending can be considered new monies in the State economy, and that new spending will generate new employment opportunities that may be dispersed State-wide.

  In conclusion, Ho'opili's impacts on employment opportunities State-wide are estimated:

  - Via employment multipliers applied to estimated spending by new residents attracted by the Project;
  - Via employment multipliers applied to the projected volume of sales and leasing costs and commissions; and
  - As an estimated percent of the jobs at the business park that would be supported at businesses serving markets outside of Hawaii.

  Altogether, some 680 of the direct operational jobs to be generated by Ho'opili are considered likely to be net new jobs to the State. Indirect and induced effects could add another 870 permanent positions in Hawaii, for a total of some 1,550 net new permanent positions by the Project's stabilization in 2030.

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Personal Earnings from Operations (Exhibits 3-10 and 3-11)

Personal earnings are estimated for the net new operational jobs supported by Ho`opili. Direct wages and salaries paid to those employed in the Project's operations, plus proprietary earnings, director's fees and the like earned as a direct result of the Project's resident spending are expected to reach $40.9 million per year by Project stabilization in 2030. Including personal earnings associated with the indirect and induced positions, the Project could generate some $109.2 million per year in ongoing payroll within the State.

These figures do not include gratuities, bonuses or some of the employee benefits that would also be realized by many of the employees and proprietors benefiting from this economic growth.

Based on the multipliers derived from DBEDT's Input-Output Study, the direct employment and proprietary opportunities generated by Ho`opili could be expected to support average FTE earnings of about $70,000 at stabilization. This relatively high average reflects the caliber of earnings expected to be associated with the business park and with real estate brokerage.

As for development employment, these operational earnings per job would be associated with higher average family incomes. Using the same methodology explained previously, the families that include a person employed through direct, indirect or induced employment impacts of Ho`opili can be expected to have average incomes of about $126,000. This would put these Ho`opili-associated families in the 171st percentile with respect to the 2007 Oahu median family income

4. In-Migrant Population

Ho`opili is expected to lead to in-migration to the State and County as discussed below.

Ho`opili Residents (Exhibit 4-1)

Part-time/second home or retirement home buyers coming from off-island would have a direct impact on population. The majority of such in-migrants are anticipated to come from out-of State, but some could be newcomers to Oahu only, having moved from a neighbor island. Those moving could be attracted by a variety of factors, including the community lifestyle offered at Ho`opili, its job opportunities or those at the nearby UHWO.

By 2030, part-time/second home buyers or off-island retirees living at Ho`opili are estimated at 660 FTE persons. Some 430 of these persons are estimated to be in-migrants to the State, having moved from the US mainland or internationally. These persons, together with perhaps 230 FTE others that could have moved to Oahu from another island comprise the estimated total of 660 in-migrants to the County.

Employees and Dependents (Exhibit 4-1)

Some of those taking advantage of the construction and operational employment generated by the Project might move from other counties or states because of a job opportunity at Ho`opili. These might include young householders who grew up in Hawaii but had been working on the U.S. mainland due to the lack of attractive career and living environments in Hawaii, or neighbor islanders who seek employment and lifestyle opportunities such as envisioned at Ho`opili. Other household members might also accompany such in-migrating workers.

- **Development employees** - Hawaii's labor market is considered to have sufficient supply and the required skills to satisfy most of the Project's development labor needs. A nominal 3% of FTE specialty staffing needs is assumed to come from or be employed on the U.S. mainland. This could represent 30 or so of the development employees required in any given year. Such persons might be temporarily resident in the islands during periods of the Project's development.

  Those moving or commuting between islands during the Project's development could fill another 2%. Together with those from out-of-State, this would represent 5% of

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development employees being temporary in-migrants to the County, for a total of 50 of the FTE development positions per year.

- **Operational employees** – Some 93% of the Project's operational employee needs are anticipated to be satisfied from within the State's and 85% from within Oahu's labor pool. Conversely, this could mean that nearly 500 operational employees are ultimately attracted to Hawaii because of Ho`opili's operational employment opportunities, and another 500 or so are attracted from the neighbor islands. Together this would mean that total migration to Oahu from off-island (from out-of-State and within the State) would represent about 1,000 FTE persons.

- **Dependents** - In-migrant dependents are estimated at an average of 0.2 per FTE in-migrant construction worker, since the position on which the "move" is based would be temporary, and 1.0 per FTE in-migrant operational employee. Dependents are estimated at about 500 moving to the State plus another 500 moving to Oahu from within the State.

Total In-Migrant Impacts (Exhibit 4-1)

In total, by 2030, Ho`opili's employment creation is projected to have been associated with about 2,170 in-migrants to the County, of whom about 1,020 were also new to the State.

5. Fiscal Impacts

Ho`opili's fiscal impacts are estimated by comparing its anticipated impacts on government revenues to the government service costs associated with the additional population the Project could attract to the State and County.

Operating Revenues

Real Property Taxes (Exhibit 5-1)

For the County, the Project's most significant fiscal impact would be the higher real property taxes it would generate compared to those currently paid. Net new real property taxes are based on the County's Fiscal Year 2007-2008 (FY08) rates for land and building uses of the relevant land use classifications, as approved by the City Council in summer 2007.

Future assessed values will be based on the County assessors' estimates at a future time, and County standards of practice for establishing such values. For projection purposes, the following proxies are used:

- **Assessed values of the residential areas as improved** are based on the estimated average home sales price of $425,000, together with the total number of units projected to have been sold as of the two benchmark years of 2015 and 2030.

- **Assessed values of the unimproved residential areas** are based on comparison to FY07 tax assessed values per acre at other Urban-designated and Unimproved Residential use lands held by DRH at Mehana and Kahiwelo, and a pro-rata share of the Project's residential lands assumed to remain undeveloped at any given time.

- **Assessed values of the business park and commercial improvements** are estimated based on the estimated "hard" construction costs for the buildings, plus their tenant improvement costs, as presented previously.

- **Assessed values of the business park and commercial lands** are based on currently assessed values for an undeveloped industrial property held by DRH in East Kapolei and an unimproved commercial site held by DRH in Mehana, both in the Ewa DPA.

Based on these proxies, the Project is estimated to have a tax assessed value of $1.39 billion in 2015, and $6.29 billion by 2030, when it is assumed to be fully built-out.

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County Real Property Tax Revenues (Exhibit 5-1)

Considering the estimated assessments and the current County real property taxation structure, Ho'opili could support potential new real property taxes of up to $8.3 million by 2015 or $32.4 million per year by 2030 and thereafter.

Deductions from these figures include real property taxes currently paid for the subject lands, and an allowance for homeowners' exemptions.

On balance, Ho'opili is projected to supply the County with about $7.7 million in net additional real property tax revenues in 2015, or $29.1 million on an on-going annual basis after its completion in 2030.

Total County Government Operating Revenues (Exhibit 5-2)

In addition to real property taxes, the County obtains liquid fuel, utility franchise, motor vehicle weight, and other license and permit fees from residents and businesses. Based on Honolulu County revenues reported by City and County of Honolulu for FY06, these minor County taxes and fees amount to about $204 per resident, in 2007 dollars. Applying this revenue rate to the number of persons expected to move to the County because of Ho'opili yields an estimated $0.6 million in new County revenues by 2030.

Honolulu County also receives a 0.5% "surcharge" on all Gross Excise Tax (GET) collected by the State. Considering the development and operational activities of the Project that would be subject to GET, at completion Ho'opili could generate another approximately $1.5 million per year in new tax revenues for the County from this revenue source.

Added to the real property taxes discussed above, net new taxes earned by the County as a result of the Project's development and operations are estimated at $8.7 million in 2015 or $31.1 million per year by 2030 and thereafter.

These figures do not include some $194 million in impact and permit fees anticipated to be paid to the County during the development of the Project, nor the value of lands to be dedicated to County agencies such as for police, fire and transportation uses.

State Government Operating Revenues (Exhibits 5-3 and 5-4)

Additional operating revenues accruing to the State government are expected to derive principally from:

- GET applied to Ho'opili's development expenditures, brokers' commissions, the in-State spending by its part-time or retiree residents and employees who came from out of State, as well as
- Individual income taxes paid by the Project's employees, including both its development- and operations-related employees.

- Conveyance taxes on the initial developer sales of homes and developed commercial properties.
- Other sources evaluated include income taxes on new personal earnings generated by Ho'opili, and specific excise, licenses, fees, fines and other payments to the State made by those who move to Hawaii because of the Project.

Assumptions on which the above sources are estimated are shown in Exhibit 5-3.

Exhibit 5-4 applies these assumptions and shows net new operating revenues for the State at some $16.1 million in 2015, or $27.0 million per year by 2030 and thereafter.

These projected State tax revenues may be conservative in that they do not include:

- Potential income taxes from certain business operating incomes, including those that may be paid by the operating entity for Ho'opili,
- Personal income tax on gratuities, bonuses or other earnings by Project employees not accounted for herein,
- GET on any portion of Homeowners' Association fees that may be non-exempt,
- Conveyance taxes on commercial and business park space leasing,
- Conveyance taxes on the ongoing resales of residential and commercial or business park properties within the Project, and
- State surcharges on motor and tour vehicles that could be rented by the Project's residents.

The figures cited above also exclude some $25 million in school fees and a share of transportation fees that are expected to be paid to the State on behalf of Ho'opili over the years of its development. Neither do they include the value of lands to be dedicated to the State such as to the departments of Education and Transportation.

Operating Expenses

Per Capita Government Operating Expenditures (Exhibits 5-5 and 5-6)

Both State and County governments can be expected to incur additional operating expenses in supporting the in-migrants that are attracted by the Project. An analysis of the County's FY06 operating expenditures, net of Federal and State grants, suggests that the County spends some $1,291 per FTE resident per year, in 2007 dollars. These expenditures support functions ranging from public safety and highways to recreation, as well as County debt service and benefits for its employees.

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A similar analysis of State government operating expenditures, also based on data provided for FY06, suggests that the State spends about $4,912 per year to support government operations on behalf of each FTE resident.

Additional County Government Operating Expenditures (Exhibit 5-7)

The per capita budgets derived above are applied to the counts of those anticipated to in-migrate to the County because of employment or housing opportunities at the Project. This results in an estimated $0.9 million in additional County government operating expenditures in 2015, and $3.7 million per year by the time of project stabilization in 2030 and thereafter.

Additional State Government Operating Expenditures (Exhibit 5-8)

Employing an analogous methodology, the State could be expected to require up to $7.1 million more per year to support the net additional residents the Project could eventually attract, by 2030.

Net Fiscal Benefits (Exhibit 5-9)

Comparing the net new government operating revenues and expenditures discussed above yields the projected net fiscal benefits for the County and State governments.

- **County government** operating revenues attributable to Ho'opili are anticipated to exceed the additional operating expenses in both of the benchmark years evaluated. By Project stabilization, net additional operating revenues could represent some $27.5 million per year, for a revenue/expenditure ratio of 8.5.

- **The State government's** operating revenues are also anticipated to exceed the additional operating expenses throughout the Project's development and operating periods. The State's net additional revenues are projected to amount to $19.9 million per year by Project stabilization in 2030. New revenues to the State government could then represent some 3.8 times new State government operating expenditures.

Economic and Fiscal Impact Assessment for Ho`opili

Exhibits

AR00027910

Exhibit 2-1
Project Concept and Potential Development Timing
2009 to 2030

	Unit	Notes		2009-15	2016-30	Total
Highlights of period:				■ 2009-2011 infra-structure planning and develop-ment ■ First deliveries 2012	■ Ho'opili buildout and sales completion	
Development in period:						
Residential unit completions/sales -		*Av. price:*	*Av. sales/year*			
Market units (single & multifamily)	*Sold homes*	*$480,000*	*450*	1,800	6,450	8,250
Affordable units (multifamily)[1]	*Sold homes*	*$295,000*	*200*	300	3,200	3,500
Subtotal, residential units/weighted average price		*$423,000*	*650*	2,100	9,650	11,750
Business Park-developed land	*Net acres*	*Exhibit 8-7, Market study*		20	20	40
Business Park-buildings	*Built square feet*	*Assumes lag from land delivery*		120,000	680,000	800,000
Commercial Centers	*Gross leasable square feet*	*Exhibit 7-2, Market study*		600,000	2,360,000	2,960,000
Cumulative development by end of period:						
Residential unit completions/sales -						
Market units (single & multifamily)	*Sold homes*			1,800	8,250	
Affordable units (multifamily)	*Sold homes*			300	3,500	
Subtotal				2,100	11,750	
Business Park	*Net acres*			20	40	
Commercial Centers	*Gross leasable square feet*			600,000	2,960,000	

1 Assumes 1:1 credit per County guidelines currently in effect. Actual credits could vary, changing the affordable unit count. See City & County of Honolulu, "Adoption of Rules for the Terms of Unilateral Agreements Requiring Affordable Housing," October 20, 1994, page 2-2.

Sources: DRH, 2007; Mikiko Corporation, "Market Assessment for Ho'opili," March 2007.

Exhibit 2-2
Residential Utilization Patterns
2015 and 2030

	Basis/reference		2015	2030
Usage assumptions:				
Market units-primary residences	*93%*	*of sold market units*	1,674	7,673
Market units-2nd home/off-island buyer	*7%*	*of sold market units*	126	578
Affordable units (all primary homes)[1]	*100%*	*of sold affordable units*	300	3,500
Total			2,100	11,750
Unit occupancy assumptions:				
Market units-primary residences	*Allowance for vacancy/transitions*		*95%*	*95%*
Market units-2nd home/off-island buyer	*Share of time spent on-island*		*50%*	*50%*
Affordable units (all primary homes)	*Allowance for vacancy/transitions*		*95%*	*95%*
Utilization pattern:				
Average daily occupied units -	*Exhibit 2-1 + usage assumption*			
Market units-primary residences			1,590	7,289
Market units-2nd home/off-island buyer			63	289
Affordable units (all primary homes)			285	3,325
Subtotal			1,938	10,903
Average daily persons in residence[2] -				
Market units-primary residences	*3.2*	*persons per occupied unit*	5,089	23,324
Market units-2nd home/off-island	*2.3*	*persons per occupied unit*	145	664
Affordable units	*3.4*	*persons per occupied unit*	969	11,305
Subtotal, rounded			6,200	35,290

1 Assumes 1:1 credit per County guidelines currently in effect. Actual credits could vary, changing the affordable unit count. See City & County of Honolulu, "Adoption of Rules for the Terms of Unilateral Agreements Requiring Affordable Housing," October 20, 1994, page 2-2.

2 Primary resident occupancy based on Claritas, Inc., 2006 estimate of average 3.5 persons per household in Ewa District and projected 3.4 by 2011. Discounted further to reflect declining household sizes in future. Non-resident/second home estimate based on interviews with area realtors and property operators.

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Exhibit 3-1
Part-Time Resident Expenditures in Hawaii, Average Annual
2015 and 2030 (2007 dollars, in millions, except as noted)

	Basis/reference (not in millions)		2015	2030
Bases for direct expenditures:				
Average household income	*Part-time residents, pre-tax*	*$175,000*		
Percent of income spent on island[1]	*US Bureau of Labor Statistics*	*22%*		
Persons per household	*(See Exhibit 2-2):*	*2.3*		
Projections:				
Direct expenditures	*Expenditure per FTE person:*	*$16,700*	$2.4	$11.1
Indirect & Induced	*0.71 multiplier*[2]		$1.7	$7.9
Total			$4.1	$19.0

Note: Assumes new expenditures are attributable to part-time residents of residential units and their associated guests only, i.e., no additional retail spending on-island hypothesized for kamaaina's or other island visitors because they are assumed to spend elsewhere on the island even if the Project were not developed.

1 Based on spending patterns for consumer units averaging $115,629 income as shown in US Bureau of Labor Statistics, Table 2, "Income before taxes: Average annual expenditures and characteristics, Consumer Expenditure Survey, 2002." Excludes expenditures for mortgage interest and charges, rented dwellings, other lodging, natural gas, cash contributions, health & other insurance and pensions. Figures adjusted further to account for percent of time spent on island (see Exhibit 2-2, occupancy assumptions.)

2 Based on estimates by Dr. Xijun Tian, DBEDT (personal communication, 4/19/1999). Considers weighted average visitors to Hawaii and their expenditures as allocated to 113 industry categories as available in 1992 State Input-Output model by DBEDT.

Exhibit 3-2
Industry Coefficients and Multipliers for Development Activities

FINAL DEMAND INDUSTRY COEFFICIENTS[1]

	DBEDT industrial categories applied	Final demand coefficient per $1 million (2002$) project cost: Jobs[2]	FTE factor[3]	$ Earnings[4]
Professional services	*#45-Architectural and engineering services*	10.31	0.85	0.63
Construction:				
Residential units	*#13-SF housing construction*	7.37	0.94	0.34
Business park	*#14-Construction of other buildings*	8.41	0.94	0.44
Commercial facilities	*#14-Construction of other buildings*	8.41	0.94	0.44
Tenant improvements	*#14-Construction of other buildings*	8.41	0.94	0.44
Infrastructure	*#15-Heavy & civil engineering construction*	11.61	0.94	0.86
Other costs	*#42-Real estate, #44-Legal services, #40-Other finance and insurance*	8.55	0.85	0.52

DIRECT-EFFECT INDUSTRY MULTIPLIERS[5]

	DBEDT industrial categories applied	Indirect & induced multiplier per direct: FTE job	$ Earnings[4]
Professional services	*Same as above*	1.03	0.83
Construction:			
Residential units	*Same as above*	1.52	1.22
Business park	*Same as above*	1.42	1.05
Commercial facilities	*Same as above*	1.42	1.05
Tenant improvements	*Same as above*	1.42	1.05
Infrastructure	*Same as above*	1.40	0.87
Other	*Same as above*	0.97	1.17

1 For direct impacts of development expenditures. Type I total jobs and earnings direct impact coefficients, from Hawaii State Department of Business, Economic Development & Tourism, "The 2002 State Input-Output Study for Hawaii," June 2006 (revised from May 2006), Detailed Tables. Jobs coefficients are for 2012; earnings coefficients not provided for future years.

2 Input-Output Study estimates total wage, salaried and proprietary jobs, both full- and part-time (not full-time equivalent).

3 Adjustment factor applied in addition to the jobs coefficient to estimate full-time equivalent jobs at 40 hours per week. Factor derived from the 37.5 average weekly hours reported worked in the natural resources, mining and construction industries and 34.0 in financial activities industries for Honolulu MSA for 2006, as reported by Hawaii Department of Labor and Industrial Relations, at www.hawaii.gov/labor/ra, "Average Hourly Earnings," as accessed May 2007.

4 Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance.

5 For indirect and induced impacts of respective direct impacts. Indirect and induced factors derived from Type II Direct-Effect total job/total job and earnings/earnings multipliers as shown in DBEDT, Ibid, "Job multipliers for 2012-2012" and "2002 Detailed Output, Earnings and Tax Multipliers for Hawaii."

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Exhibit 3-3
Estimated Current Development Costs: Total for Each Period
2009 to 2030 (2007 and 2002 dollars, in millions unless stated)

In 2007 dollars[1]:	Basis/reference (tot in mils unless stated)	2009 2015	2016 2030	Total
Professional services	*$34 mil. total, of which 39% assumed expended by 2015*	$13.1	$20.4	$33.5
Construction -	*Net of contingencies; vertical and infrastructure*			
Residential units	*Average costs/unit: $161,500*	$338.1	$1,553.7	$1,891.8
Business park	*800,000 sq. ft at psf cost: $150*	$18.0	$102.0	$120.0
Commercial facilities	*2,960,000 sq. ft at psf cost: $200*	$120.0	$472.0	$592.0
Tenant improvements[2]	*$200 psf fensed*	$144.0	$608.0	$752.0
Infrastructure[3]	*$1,072 mil. total, of which 37% assumed expended by 2015*	$386.6	$685.4	$1,072.0
Subtotal		$1,016.7	$3,411.0	$4,427.8
Other	*$147 mil., distributed pro rata by number of years in period*	$46.8	$100.2	$147.0
Total, rounded		$1,076.6	$3,531.7	$4,608.3
In 2002 dollars:	*0.73 of 2007 values[4]*			
Professional services		$9.5	$14.8	$24.3
Construction -				
Residential units		$245.7	$1,128.8	$1,374.5
Business park		$13.1	$74.1	$87.2
Commercial facilities		$87.2	$342.9	$430.1
Tenant improvements		$104.6	$441.6	$546.4
Infrastructure		$280.2	$490.7	$770.8
Other		$34.0	$72.8	$106.8
Total, rounded		$782.2	$2,566.0	$3,348.2

Note. Figures exclude impacts of development of transit facilities.

1 Provided by DRH , May 2007.

2 Includes developer- and tenant-provided construction budgets. Recent Kapolei area examples for first generation buildouts include office space at $150-170 per square foot, retail at $150-$250 per square foot, industrial with 10% office $125, as provided by Colliers Monroe Friedlander, May 2007; high tech/laboratory spaces at $350-$1,000 per square foot; restaurants minimum $300 per square foot per SL Sofos & Co., Ltd.

3 Covers site preparation for residential and commercial pads, including sewer, water, electrical and drainage; also off-site utilities, roads, signalization, drainage; bicycle network; and preparation of school, public facility (fire/police stations) and parks site. Excludes vertical construction costs for schools, fire station and police station; park equipment to be donated; and contingencies representing 5-10% of each budget item.

4 First Hawaiian Bank, Research Department, records; Hawaii State Department of Business, Economic Development and Tourism (DBEDT), Research & Economic Analysis Division, Quarterly Statistical and Economic Reports, as reported by DBEDT for 2002 to 2006; UHERO, Honolulu construction cost index forecast for 2006 to 2007.

Exhibit 3-4
Estimated Current Development Costs: Average Annual
2009 to 2030 (2007 dollars, in millions)

Costs by type:	Basis/reference	2009 2015	2016 2030	Overall average
Professional services	*Exhibit 3-3, annualized*	$1.9	$1.4	$1.5
Construction -				
Residential units		$48.3	$103.6	$86.0
Business park		$2.6	$6.8	$5.5
Commercial facilities		$17.1	$31.5	$26.9
FF&E/Tenant improvements[1]		$20.6	$40.5	$34.2
Infrastructure[2]		$55.7	$45.0	$48.7
Other		$6.7	$6.7	$6.7
Total, rounded		$153.8	$235.4	$209.5

Note: Figures exclude impacts of transit facilities.

1 Includes developer- and tenant-provided construction budgets.

2 Covers site preparation for residential and commercial pads, including sewer, water, electrical and drainage; also off-site utilities, roads, signalization, drainage; bicycle network; and preparation of school, public facility (fire/police stations) and parks site. Excludes vertical construction costs for schools, fire station and police station; park equipment to be donated; and contingencies representing 5-10% of each budget item.

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Exhibit 3-5
Development Employment, FTE Jobs[1]
2009 to 2030 (Total in each period)

	Basis/reference	2009 2015	2016 2030	Total/ average
Total:				
Direct jobs -	*Exhibits 3-2 and 3-3*			
Professional services		83	130	213
Construction -				
Residential units		1,697	7,800	9,497
Business park		103	584	687
Commercial facilities		687	2,704	3,391
FF&E/Tenant improvements[2]		825	3,463	4,308
Infrastructure[3]		3,137	5,341	8,478
Other		247	529	776
Subtotal direct jobs (rounded)		6,800	20,600	27,400
Indirect and induced jobs[4]	*Exhibit 3-2*	9,591	29,597	39,188
Subtotal jobs (rounded)		16,400	50,200	66,600
Average annual:				
Direct jobs -				
Professional services		12	9	10
Construction[2,3]		921	1,327	1,198
Other		35	35	35
Subtotal direct jobs (rounded)		970	1,370	1,240
Indirect and induced jobs[4]		1,370	1,973	1,781
Subtotal jobs (rounded)		2,340	3,340	3,020

Note: Figures exclude impacts of transit facilities.

1 FTE = Full time equivalent, defined as 40 hours per week or 2,080 hours per year.

2 Includes employees supported by developer- and tenant-provided construction activities.

3 Covers site preparation for residential and commercial pads, including sewer, water, electrical and drainage; also off-site utilities, roads, signalization, drainage; bicycle network; and preparation of school, public facility (fire/police stations) and parks site. Excludes employment associated with vertical construction activities for schools, fire station and police station; park equipment; and contingencies.

4 Based on weighted average of Direct-Effect jobs multipliers for each job category, as shown on Exhibit 3-2.

Exhibit 3-6
Personal Earnings from Development - Total in Period
2009 to 2030 (2007 dollars, in millions)

	Basis/reference	2009 2015	2016 2030	Total
Direct earnings[1]:	*Exhibits 3-2 & 3-3*			
Professional services		$6.0	$9.4	$15.4
Construction -				
Residential units		$92.3	$424.2	$516.5
Business park		$6.4	$36.0	$42.4
Commercial facilities		$42.4	$166.8	$209.2
FF&E/Tenant improvements[2]		$50.9	$214.8	$265.7
Infrastructure[3]		$273.9	$466.4	$740.3
Other		$17.7	$37.9	$55.6
Subtotal, direct		$489.5	$1,355.4	$1,844.9
Indirect and induced earnings[4]		$425.3	$1,318.8	$1,744.1
Total earnings		$914.8	$2,674.2	$3,589.1

Note: Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance. Figures exclude impacts of transit facilities.

1 Based on industry coefficients and FTE factors as shown in Exhibit 3-2 and estimated construction costs in 2002 dollars, as shown in Exhibit 3-3. Figures inflated forward to estimated 2007 dollars based on Honolulu CPI-U Index from 2002 (first half) to second half 2006 dollars, at: 17.58% based on U.S. Department of Labor, Bureau of Labor Statistics, May 2007, at http://data.bls.gov.

2 Includes earnings supported by developer- and tenant-provided construction activities.

3 Covers site preparation for residential and commercial pads, including sewer, water, electrical and drainage; also off-site utilities, roads, signalization, drainage; bicycle network; and preparation of school, public facility (fire/police stations) and parks site. Excludes vertical construction costs for schools, fire station and police station; park equipment to be donated; and contingencies representing 5-10% of each budget item.

4 Weighted average of estimated direct earnings by industry as shown above, and Direct-Effect industry multipliers shown in Exhibit 3-2.

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Exhibit 3-7
Personal Earnings from Development - Average Annual
2009 to 2030 (2007 dollars, in millions except average earnings)

	Basis/reference	2009 2015	2016 2030	Average
Average annual in period:	*Exhibit 3-6, refers to all jobs*			
Direct earnings		$69.9	$90.4	$83.9
Indirect & induced earnings		$60.8	$87.9	$79.3
Total earnings		$130.7	$178.3	$163.1
Average per new FTE job:	*Exhibits 3-5 and 3-6, rounded*			
Direct jobs		$72,000	$68,000	$67,000
Indirect and induced jobs		$44,000	$45,000	$45,000
Average per job		$56,000	$53,000	$54,000
Estimated average family income[1]:	*1.8 times average wage*			
For direct job-holders		$130,000	$119,000	$121,000
For indirect and induced job-holders		$79,000	$81,000	$81,000
All Ho'opili-related job-holders		$101,000	$95,000	$97,000
Percent of median income[2]:	*$73,500 median family income, 2007*			
For direct job-holders		177%	162%	165%
For indirect and induced job-holders		107%	110%	110%
All Ho'opili-related job-holders		137%	129%	132%

Note: Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social insurance. Figures exclude impacts of transit facilities.

1 Ratio estimated from 2005 average annual wage in Honolulu County ($37,656), as provided by State of Hawaii, Department of Labor & Industrial Relations, and FY 2005 median family income in Honolulu MSA ($67,750), as provided by U.S. Department of Housing & Urban Development, HUD USER. Reflects multiple job-holders within each family as well as multiple job-holding by individuals.

2 U.S. Department of Housing & Urban Development, HUD USER, July 2007.

Exhibit 3-8
Direct Operational Employment Generated by the Project
FTE Jobs
2015 and 2030

	Basis/reference	2015	2030
On-site:			
Residential units -			
Second home properties	*7% of sold market units see Exhibit 2-2*	126	578
Supported jobs	*5 jobs per 100*	6	29
Commercial facilities -			
Business park	*550 square feet RBA per FTE job*	216	1,236
Commercial retail/office	*425 square feet GLA per FTE job*	1,412	5,553
Subtotal, on-site jobs, rounded		1,640	6,820
Other associated jobs:			
Residential and commercial brokerage	See Exhibit 3-9	196	223
Subtotal, other jobs, rounded		196	223
Total direct jobs associated with Project		1,836	7,043

Note: Figures exclude impacts of transit facilities. FTE = Full time equivalent, defined as 40 hours per week or 2,080 hours per year.

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Exhibit 3-9
Net Additional Operational Employment, FTE Jobs[1]
2015 and 2030 (2007 dollars, in millions)

	Basis/reference		2015	2030
Bases for projection:				
Av. annual spending by PT residents -	*Direct, indirect & induced, in state: Exhibit 3-1*		*$4.1*	*$19.0*
Av. annual residential selling costs -	*See Exhibit 3-1*			
Sell-out of developer inventory	*4.5%*	*of gross sales, preceding years*	*$10.0*	*$12.3*
Resales after 2015	*2.3%* *6.0%*	*Turnover per year*[2] *of gross sales, same av. price*	*$0.0*	*$0.5*
Av. annual commercial & industrial leasing expenses -				
Initial lease-up	*$25.9*	*mil total, listing & outside agents*	*$1.2*	*$1.4*
Releasing after 2015	*5.0%*	*Turnover per year*	*$0.0*	*$0.1*
Av. annual commercial & industrial selling costs -	*3.5%*	*of gross sales, preceding years*		
Sell-out of developer inventory	*9%*	*Cap, sales of stabilized centers*	*$2.7*	*$1.4*
Resales after 2015	*10%*	*Resold between 2016 and 2030*	*$0.0*	*$0.3*
Projected net additional jobs:				
Direct -				
Attributable to part-time residents[3]	*23.0*	*I$mil, net margin: 35%*	33	152
Real estate leasing & sales	*14.0*	*I$mil selling costs, new and resales*	195	223
Business park	*25%*	*assumed new jobs to Island; Exhibit 3-6*	55	309
Subtotal, direct jobs, rounded			280	680
Indirect and Induced -	*Multiplier and industry category applied*[4]*:*			
Attributable to part-time residents	*1.07*	*Average of select industries*	38	193
Real estate leasing & sales	*1.91*	*Real estate & rentals industries*	374	426
Business park	*0.91*	*Average of select industries*	50	252
Subtotal, indirect & induced jobs, rounded			460	870
Total net additional jobs			740	1,550

Note: Figures exclude impacts of transit facilities.

1 FTE = Full time equivalent, defined as 40 hours per week or 2,080 hours per year.

2 From 2016 on, resales activity assumed at 2.3% of completed and sold residential inventory shown in Exhibit 2-1. Resales factor based on 2004 Oahu sales activity of approximately 7,000 units per year vs. estimated 300,000 housing units (2.3%) and 2006 rate of 10,421 resales among approximately 340,000 total units (3.0%),: Honolulu Board of Realtors and American Community Survey. Commissions and other selling costs estimated at rate shown and average prices shown in Exhibit 2-1.

3 Category includes shopping center and office operational employment, since net additional employment is largely considered a function of induced new spending on-island, not leasable area to be developed at the Project. Also spending by existing island residents, such as at the commercial centers to be developed, is assumed to have occurred elsewhere on-island even if the Project were not developed.

Retail spending subject to reduction by 35% assumed retail trade margin prior to application of weighted average Type II jobs multiplier shown in Appendix 2.
This results in conservative estimates since OBEDT multipliers for many applicable industry categories such as services, agriculture, food processing & etc. are calculated assuming they will be applied to total expenditures rather than trade margin expenditures.

4 Based on Type II Direct-Effect Multipliers (less 1.0 each) as shown by industry groups in Appendix 2. Part-time residents based on all industries shown; business park multiplier based on information, health services, professional services, and business services industries.

Exhibit 3-10
Personal Earnings from Net New Operational Activity - Total Annual
2015 and 2030 (2007 dollars, in millions except where noted)

	Basis/reference (not in millions)		2015	2030
Direct earnings -	*Estimated average FTE salary or other basis*[1]*:*			
Attributable to part-time residents	*$41,434*	*Average Honolulu wage*	$1.4	$5.3
Av. annual commercial leasing -	Residential, commercial and industrial properties,			
Initial lease-up	Exhibit 3-9		$1.2	$1.4
Releasing after 2015			$0.0	$0.1
Real estate sales & marketing -	Residential, commercial and industrial properties,			
Sell out of developed inventory	Exhibit 3-9		$12.7	$13.7
On-going resales			$0.0	$0.8
Business park	*$60,200*	*average of select industries*	$3.3	$18.6
Subtotal, direct earnings			$18.6	$40.9
Indirect and Induced earnings -	*Multiplier and industry category*[2]*:*			
Attributable to part-time residents	*1.01*	*Average of select industries*	$1.4	$6.4
Real estate leasing and sales	*3.07*	*Real estate & rentals industries*	$42.9	$49.0
Business park	*0.70*	*Average of select industries*	$2.3	$13.0
Subtotal, indirect & induced			$46.6	$68.3
Total earnings			$65.2	$109.2

Note: Exhibit portrays on these earnings positions that would be new to the community; not on all employment associated with Ho'opili. Figures exclude impacts of transit facilities.

1 Exclusive of tips, bonuses, etc. Average Honolulu salary based on $37,556 reported for 2005 by Department of Labor and Industrial Relations, "2005 Employment and Payrolls in Hawai'i," with inflation to 2007 dollars based on Honolulu CPI-U. Considered conservative because it incorporates no adjustment to FTE work. Business park typical wage estimated as average for the following industrial classifications: Information, professional & technical services, management of companies & enterprises, health care & social assistance.

2 Based on Type II Direct-Effect Multipliers (less 1.0 each) as shown by industry groups in Appendix 2. Part-time residents based on all industries shown; business park multiplier based on information, health services, professional services, and business services industries.

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Exhibit 3-11
Personal Earnings from Net New Operational Activity - Average Per Job and Family
2015 and 2030 (2007 dollars)

	Basis/reference (not in millions)	2015	2030
Average earnings per new FTE job:	*Not in millions*		
Direct jobs		$67,000	$80,000
Indirect and induced jobs		$101,000	$79,000
Average per job		$88,000	$70,000
Estimated average family income[1]:	*1.8 times average wage*		
For direct job-holders		$121,000	$108,000
For indirect and induced job-holders		$182,000	$142,000
All Ho'opili-related job-holders		$158,000	$126,000
Percent of median income[2]:	*$73,500 median family income, 2007*		
For direct job-holders		165%	147%
For indirect and induced job-holders		248%	193%
All Ho'opili-related job-holders		215%	171%

Note: Exhibit portrays on those earnings on positions that would be new to the community; not on all employment associated with Ho'opili. Figures exclude impacts of transit facilities. Earnings defined to include wage, salary and proprietary incomes, plus directors' fees and employer contributions to health insurance, less employee contributions to social

1 Ratio estimated from 2005 average annual wage in Honolulu County ($37,656), as provided by State of Hawaii, Department of Labor & Industrial Relations, and FY 2005 median family income in Honolulu MSA ($67,750), as provided by U.S. Department of Housing & Urban Development, HUD USER. Reflects multiple job-holders within each family as well as multiple job-holding by individuals.

2 U.S. Department of Housing & Urban Development, HUD USER.

Exhibit 4-1
Average Daily In-Migrant Population
2015 and 2030

	Basis/reference	2015	2030
Ho`opili part-time residents:			
Average FTE persons in residence	*At 2nd home/off-island buyer units: Exhibit 2-2*	145	664
In-migrants to State (rounded)	*65% of FTE persons in residence*	90	430
In-migrants to Co. (rounded)[1]	*100% of FTE persons in residence*	140	660
Employees:			
In-migrants to the State[1] -	*(Subset of in-migrants to County)*		
Development employees	*3% of direct av. annual jobs (Ex. 3-5)*	0	29
Direct operational employees	*7% of jobs generated (Exhibit 3-6)*	129	493
Dependents[2]	*Ratio of in-migrant employees*	129	499
In-migrants to State (rounded)[3]		260	1,020
In-migrants to County[3] -	*(Includes in-migrants to State)*		
Development employees	*5% of direct av. annual jobs (Ex. 3-5)*	0	49
Operational employees	*15% of jobs generated (Exhibit 3-8)*	275	1,056
Dependents[2]	*Ratio of in-migrant employees*	275	1,066
In-migrants to County (rounded)[3]		550	2,170

Note: Figures exclude impacts of transit facilities.

1 Subset of County in-migrants. See footnote 3, below.

2 In-migrant dependents estimated to average 0.2 per in-migrant development employee, and 1.0 per in-migrant operational employee.

3 In-migrants to the County include all those moving to the State plus any that may move between islands due to job opportunities at the Project.

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Exhibit 5-1
Real Property Taxes Generated by Development
2015 and 2030 (2007 dollars, in millions except as noted)

	Basis/reference (not in millions)		2015	2030
Total assessed values[1]:				
Improved residential	*Based on number sold by average price (Ex. 2-1)*		$892.5	$4,993.8
Unimproved residential	*Estimated assessed value per acre:*	*$135,000*	$102.6	$0.0
Business park - land	*50 acres, @ per acre:*	*$165,000*	$8.3	$8.3
Business park - improvements	*Vert. cost (Ex. 3-3) + share of TI @*	*50%*	$90.0	$406.0
Commercial - land	*145 acres, @ per acre:*	*$630,000*	$91.4	$91.4
Commercial - improvements	*Vert. cost (Ex. 3-3) + share of TI @*	*50%*	$192.0	$776.0
Park & open space land[2]	*210 acres, @ per acre:*	*$50,000*	$10.5	$10.5
Total assessed values			$1,387.2	$6,285.9
Real property tax revenues:				
Potential new revenues -	*FY08 rates per $1,000 net taxable value*			
Improved residential	*$3.29*	*Improved Residential*	$2.9	$16.4
Unimproved residential	*$5.70*	*Unimproved Residential*	$0.6	$0.0
Business park - land	*$12.40*	*Industrial*	$0.1	$0.1
Business park - improvements	*$12.40*	*Industrial*	$1.1	$5.0
Commercial - land	*$12.40*	*Commercial*	$1.1	$1.1
Commercial - improvements	*$12.40*	*Commercial*	$2.4	$9.6
Parks & open spaces	*$5.70*	*Preservation*	$0.1	$0.1
Subtotal, potential tax revenues			$8.3	$32.4
Less deductions -				
RPT payments prior to Project	*FY07 real property taxes, per DRH*		$0.1	$0.1
Homeowners' exemption[3]	*$88,000 /unit, primary residences (Ex. 2-2)*		$0.6	$3.2
Subtotal deductions			$0.6	$3.3
Estimated net additional RPT			$7.7	$29.1

Note: Figures exclude impacts of transit facilities; public facility lands such as schools and roads presumed not taxed and dedicated.

1 Tax assessed values for unimproved lands based on other lands of same classification held by DRH at East Kapolei (other than Ho`opili), Mehana and Kahiwelo (Palehua). Undeveloped residential areas estimated pro rata based on number of units sold and total of: 925.0 acres, for a total land value of: $124.88 million. These lands include 330 acres that would be designated mixed-use and could be taxed at higher rates.

2 Based on estimated raw land values only; excludes value of grading, irrigating & grassing these lands.

3 Assumes 20% of households at $120,000 exemption, and 80% at $60,000 exemption. Note methodology may overstate exemptions/understate tax revenues: Claritas projects that by 2011, approximately 11% of Ewa DPA households will be headed by persons 65 or older (Claritas, Inc., 2006.)

Exhibit 5-2
Total Annual Revenues to County Government Attributable to Development & In-Migrant Population
2015 and 2030 (2007 dollars, in millions, except as noted)

	Basis/reference		2015	2030
Bases for projection:				
FTE in-migrants to County -	*Exhibit 4-1*			
Ho`opili part-time residents			*140*	*660*
Employees and their dependents			*550*	*2,170*
GET County surcharges	*Spending as shown in Exhibit 5-3*			
Estimated tax and other revenues:				
Net new property tax revenues	*Exhibit 5-1*		$7.7	$29.1
Taxes and other revenue sources from in-migrant residents[1]	*Other than real property taxes* *$204 per person*		$0.1	$0.6
General excise taxes, on -	*County GET surcharges only*			
Development	*0.5%*	*of professional service and construction costs*	$0.8	$1.2
Real estate sales and marketing	*0.5%*	*of costs*	$0.1	$0.1
Spending by Project PT residents	*0.5%*	*of spending*	$0.0	$0.1
Spending by In-migrants to State	*0.5%*	*of employee & dependent spending*	$0.0	$0.1
Total new County revenues			$8.7	$31.1

Note: Does not consider impact and permit fees paid to County. These projected to amount to approximately $194 million over the life of the Project, in 2007 dollars, including sewer, water system, water meter and other fees and permits, as well as a share of transportation impact fees. Figures also exclude impacts of transit facilities.

1 Includes fuel and motor vehicle weight taxes, licenses and permits and charges for services. Excludes forfeitures, fines and penalties, public utility franchise tax, transient accommodation taxes, public service company tax, sewer charges, bus transportation revenues, solid waste & other revenues. As stated in City and County of Honolulu, "The Executive Program and Budget: Fiscal Year 2008 - Volume 1 - Operating Program and Budget," 2007 (summary of resources by source.)

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Exhibit 5-3
Bases for Projecting State Government Revenues
2015 and 2030 (2007 dollars, in millions, except as noted)

	Basis/reference (in millions only where noted)		2015	2030
For GET calculations:				
Project development costs -	*Exhibit 3-4, average annual for preceding period*			
Professional services			$1.9	$1.4
Construction and other			$151.9	$234.1
Subtotal development cost			$153.8	$235.4
Real est. sales & marketing costs -	*Based on average activity in prior 5 years*			
Residential	*New and resold units, Exhibit 3-9*		$10.0	$12.8
Commercial & business park	*Leasing and selling costs, Exhibit 3-9*		$3.9	$3.2
Subtotal			$14.0	$15.9
Spending by part-time residents	*In-State spending: Exhibit 3-9*		$4.1	$19.0
In-migrant employees & dependents to State -				
Number persons	*Exhibit 4-1*		260	1,020
Estimated number households	*2.5 persons per household*		104	408
In-State spending[1]	*56% of hhd income, av. $79,000*		$4.8	$16.7
For individual income taxes:				
Net new personal income earned -	*Average annual in preceding period*			
Development employment	*Exhibit 3-7 (total personal earnings)*		$130.7	$178.3
Operational employment	*Exhibit 3-10 (total personal earnings)*		$65.2	$109.2
Av. personal earnings/FTE job -				
Development employment	*Exhibit 3-7 (total personal earnings)*	*Net in millions >>*	$56,000	$53,000
Operational employment	*Exhibit 3-10 (total personal earnings)*	*Net in millions >>*	$68,000	$70,000
For conveyance taxes[2]:				
On residential sales	*$480,000 av price (Ex. 2-1)*	*App. unit sales (Ex. 2-2)>>*	126	578
On commercial & industrial sales	*$1,315 mil total sales*	*% transacted (Ex. 2-1)>>*	19%	81%
For other State taxes:				
FTE in-migrants to State	*FTE part-time residents & primary residents: Exhibit 4-1*		350	1,450

Note: Does not consider impact fees paid to State. These projected to amount to approximately $25 million over the life of the Project, in 2007 dollars, including school fees and a share of transportation fees. Figures also exclude impacts of transit facilities.

1 U.S. Department of Labor, Bureau of Labor Statistics, "Consumer Spending Patterns in Honolulu: 2001-02", released April 30, 2004 at www.bls.gov/ro9/cashono.htm. Estimate uses study findings showing 77.8% of pre-tax income of household units was spent, of which 75.1% were on items likely subject to Hawaii Gross Excise Tax. Excludes spending on shelter (owned dwellings), cash contributions, personal insurance and pensions. Applied to estimated in-migrant households and average of personal earnings for 2015 and 2030 for operational employees, as shown. Excludes potential household income from other household members.

2 Conservative estimate in that conveyance taxes on commercial leasing are not considered nor conveyance taxes on resales. Conveyance taxes on residential sales applicable only to those that will not claim a homeowner's exemption.

Exhibit 5-4
Projected State Government Revenues
2015 and 2030 (2007 dollars, in millions, except as noted)

	Basis/reference (not in millions)	2015	2030
General excise taxes, on:	*County GET surcharges accounted for on prior exhibit*		
Development[1]	*4.0% of costs*	$4.0	$6.1
Real estate sales and marketing	*4.0% of costs*	$0.6	$0.6
Spending by Project PT residents	*4.0% of spending*	$0.2	$0.8
Spending by in-migrants to State	*4.0% of employee & dependent spending*	$0.2	$0.7
Individual income taxes[2]:			
Development employees	*5.01% effective tax rate on est. av. $53-$56K income*	$6.5	$8.9
Operational employees	*5.63% effective tax rate on est. av. $89K income (2015)* *5.34% effective tax rate on est. av. $70K income (2030)*	$3.7	$5.8
Conveyance taxes[3]:			
On residential sales	*0.15% of full consideration paid*	$0.1	$0.4
On commercial & industrial sales	*0.30% of full consideration paid*	$0.6	$3.2
Other taxes and revenues from in-migrants[4]	*$224 per person*	$0.1	$0.3
Total, additional revenues		$16.1	$27.9

Note: Does not consider impact fees paid to State. These projected to amount to approximately $25 million over the life of the Project, in 2007 dollars, including school fees, and a share of transportation fees. Figures also exclude impacts of transit facilities.

1 Based on 4% on 100% of professional services and 50% of construction costs, plus a wholesale construction materials tax of 0.5% against 40% of construction costs.

2 Based on 2006 Tax Table, Schedule II for married taxpayers filing joint returns and range of average personal earnings per job shown above. Adjusted Gross Incomes (AGI) assumed to be 15% less than total average earnings shown. Estimated tax impact likely to be conservative due to frequency of dual incomes and multiple job-holding among Hawaii households, which could push household incomes to higher tax brackets.

3 Conservative estimate in that conveyance taxes on commercial leasing are not considered nor conveyance taxes on resales. Conveyance taxes on residential sales applicable only to those that will not claim a homeowner's exemption.

4 Based on total FY 2006 State tax revenue receipts as reported by State of Hawaii, "Comprehensive Annual Financial Report for the Fiscal Year Ended June 30, 2006," statement of activities-general revenue taxes. Includes tobacco and liquor taxes, liquid fuel tax, and motor vehicle weight & registration tax. Excludes fines & forfeitures, licenses and other fees.

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Exhibit 5-5
City and County of Honolulu Operating Expenditures by Function, Net of Federal and State Sources
Per Capita in Fiscal Year July 1, 2005 to June 30, 2006

	Expenditures ($thousands)	Service population[1]	Expenditures (not in thousands) per: Resident	Visitor
Executive:				
General Government	$137,333	992,800	$138	$138
Public Safety	$288,511	992,800	$291	$291
Highways and Streets	$21,835	992,800	$22	$22
Sanitation[2]	$176,175	992,800	$177	$177
Human Services	$59,348	907,100	$65	
Culture-Recreation	$67,949	992,800	$68	$68
Utilities or Other Enterprises (Mass Transit)	$158,525	992,800	$160	$160
Debt Service	$202,335	992,800	$204	$204
Retirement System Contributions	$61,268	907,100	$68	$0
FICA and Pension Costs	$19,538	907,100	$22	$0
Health Benefits Contributions	$71,201	907,100	$78	$0
Miscellaneous	$19,225	992,800	$19	$19
Subtotal	$1,283,247		$1,313	$1,080
Legislative (Council operations)	$10,920	907,100	$12	$0
Less non-County operating resources:				
Federal Grants	-$75,094	992,800	-$76	-$76
State Grants	-$7,294	992,800	-$7	-$7
Subtotal, other sources	-$82,388		-$83	-$83
Total, in 2006 dollars	**$1,211,779**		**$1,242**	**$997**
Total, in 2007 dollars, based on increase of[3] 4.0%			**$1,291**	**$1,037**

1 Resident population of 907,100 as estimated by the U.S. Census Bureau, Population Division, March 20, 2007 (January 1 population estimated based on compound rate of growth between July 1, 2005 to July 1, 2006 estimates); plus average daily visitor population of 85,700 as published by Hawaii State Department of Business, Economic Development and Tourism, Research & Economic Analysis Division, for 2006.

2 Debt service on bonds for new sewer facilities included in Sanitation line item. Other City interest payments accounted for on the Debt Service line.

3 Based on 2007 vs. 2006 Honolulu CPI-U, 2007 as forecast by Hawaii State Department of Business, Economic Development and Tourism, February 21, 2007.

Source: City and County of Honolulu, "The Executive Program and Budget: Fiscal Year 2008, Volume 1 - Operating Program and Budget", 2007, pages A-5 and A-6.

Exhibit 5-6
State of Hawaii Primary Government Activity Expenses
Per Capita in Fiscal Year July 1, 2005 to June 30, 2006

	Operating expenditures ($thousands)	Service population[1]	Expenditures (not in thousands) per: Resident	Visitor
Governmental activities:				
General government	$455,008	1,464,300	$311	$311
Public safety	$336,362	1,464,300	$230	$230
Highways	$646,336	1,464,300	$441	$441
Conservation of natural resources	$76,490	1,464,300	$52	$52
Health	$690,255	1,464,300	$471	$471
Welfare	$1,709,526	1,279,400	$1,336	$0
Lower education	$2,151,691	1,279,400	$1,682	$0
Higher education	$678,338	1,279,400	$530	$0
Other education	$19,183	1,279,400	$15	$0
Culture and recreation	$58,121	1,464,300	$67	$67
Urban redevelopment and housing	$87,799	1,279,400	$69	$0
Economic development and assistance	$215,578	1,279,400	$168	$0
Interest expense	$172,673	1,464,300	$118	$118
Business-type activities:				
Airports	$292,086	1,464,300	$199	$199
Harbors	$61,408	1,464,300	$42	$42
Unemployment compensation	$105,786	1,279,400	$83	$0
Nonmajor proprietary fund	$2,587	1,464,300	$2	$2
Subtotal	$7,799,427		$5,817	$1,934
Less: intergovernmental revenues	($1,601,005)	1,464,300	($1,093)	($1,093)
Total, in 2006 dollars	$6,198,422		$4,723	$840
Total, in 2007 dollars, based on increase of[2]		4.0%	$4,912	$874

Note: General government includes legislative expenses; line items may also have debt service and employee benefit expenses within each. Excludes expenses of "Component Units" including the University of Hawaii, Housing and Community Development Corporation of Hawaii, Hawaii Health Systems Corporation and Hawaii Hurricane Relief Fund. The first three charge for services, and receive capital and operating grants and contributions.

1 Resident population of 1,279,400 as estimated by the U.S. Census Bureau, Population Division, March 20, 2007 (January 1 population estimated based on compound rate of growth between July 1, 2005 to July 1, 2006 estimates); plus average daily visitor population of 154,900 as published by Hawaii State Department of Business, Economic Development and Tourism, Research & Economic Analysis Division, for 2006.

2 Based on 2007 vs. 2006 Honolulu CPI-U, 2007 as forecast by Hawaii State Department of Business, Economic Development and Tourism, February 21, 2007.

Source: State of Hawaii, Department of Accounting and General Services, "State of Hawaii: Comprehensive Annual Financial Report For the Fiscal Year Ended June 30, 2006," 2007.

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Exhibit 5-7
Annual County Government Expenditures
Attributable to Population In-Migrating
2015 and 2030 (2007 dollars, in millions, except where noted)

	Basis/reference (not in millions)	2015	2030
Bases for County projection -			
FTE in-migrants to County	*Part-time residents, employees and dependents (Ex. 4-1)*	*690*	*2,830*
Annual expenditures -			
FTE in-migrants to County	*$1,291 per person, ref: Exhibit 5-5*	$0.9	$3.7
Subtotal new County expenditures		$0.9	$3.7

Note: Does not consider impact and permit fees paid to County. These projected to amount to approximately $18M million over the life of the Project, in 2007 dollars, including sewer, water system, water meter and other fees and permits, as well as a share of transportation impact fees. Figures also exclude impacts of transit facilities.

Exhibit 5-8
Annual State Government Expenditures
Attributable to Population In-migrating
2015 and 2030 (2007 dollars, in millions, except where noted)

	Basis/reference	2015	2030
Bases for State projection -			
FTE in-migrants to State	*Part-time residents, employees and dependents (Ex. 4-1)*	*350*	*1,450*
Annual expenditures -			
FTE in-migrants to State	*$4,912 per FTE person, ref. Exhibit 5-6*	$1.7	$7.1
Subtotal new State expenditures		$1.7	$7.1

Note: Does not consider impact fees paid to State. These projected to amount to approximately $25 million over the life of the Project, in 2007 dollars, including school fees and a share of transportation fees. Figures also exclude impacts of transit facilities.

AR00027921

Exhibit 5-9
County & State Government Revenue and Expenditure Comparison
2015 and 2030 (2007 dollars, in millions, except where noted)

	Basis/reference	2015	2030
City and County of Honolulu:			
New revenues	*Exhibit 5-2*	$6.7	$31.1
New expenditures	*Exhibit 5-7*	$0.9	$3.7
Net additional revenues		$7.8	$27.5
Revenue ÷ expenditure ratio[1]		9.8	8.5
State of Hawaii:			
New revenues[2]	*Exhibit 5-4*	$16.1	$27.0
New expenditures	*Exhibit 5-8*	$1.7	$7.1
Net additional revenues		$14.4	$19.9
Revenue ÷ expenditure ratio[1]		9.4	3.8

Note: Does not consider impact and permit fees paid to County and State governments. These are projected to amount to approximately $194 million and $25 million, respectively, over the life of the Project, in 2007 dollars. They include sewer, water, transportation and other fees and permits. Figures also exclude impacts of transit facilities.

1 New revenues divided by new expenditures. Calculated where denominator (additional expenses) exceeds zero.

2 Excludes potential income taxes from any operating entities and GET on ground lease rents.

ECONOMIC AND FISCAL IMPACT ASSESSMENT FOR HO'OPILI

Appendices

AR00027922

Appendix 1: Report Conditions

This assessment incorporates information provided by government agencies, developers, brokers, landowners, DRH, PBR Hawaii, and other sources as cited in the exhibits. While attempts have been made to verify information via multiple sources, it is not always possible to do so. MC cannot guarantee the accuracy of all information upon which its assessments may be based.

MC has no responsibility to update this report or any of the underlying data for events and circumstances occurring after May 15, 2007, the date of substantial completion of primary data collection.

This report is for the planning purposes of DRH, PBR Hawaii and their consultants, as well as for public disclosure of the nature of the Project pursuant to seeking State and County land entitlements. It is not intended to be used for solicitation of investment.

This report does not offer an appraisal of the Subject, nor should it be construed as an opinion of value for the Project.

Appendix 2: Derivation of Multipliers for Part-Time Resident Spending

	Type II final demand multipliers		Type II direct effect multipliers (for indirect & induced impacts)	
	Earnings	Job	Earnings	Job
Agriculture	0.66	36.6	1.77	1.44
Food processing	0.51	21.6	3.05	3.05
Other manufacturing	0.34	10.2	1.97	2.36
Transportation	0.57	17.7	2.26	2.55
Information	0.52	13.6	1.71	2.15
Utilities	0.33	8.2	2.38	4.17
Wholesale trade	0.55	17.1	1.76	1.96
Retail trade	0.57	24.4	1.69	1.51
Real estate & rentals	0.22	9.1	4.07	2.91
Professional services	0.81	23.3	1.69	1.97
Business services	0.83	30.9	1.69	1.62
Educational services	0.83	33.2	1.70	1.57
Health services	0.77	24.1	1.71	1.91
Arts & entertainment	0.77	37.4	1.59	1.38
Accommodations	0.63	20.0	1.80	2.06
Eating & drinking	0.60	30.5	1.99	1.54
Other services	0.69	30.7	1.80	1.54
Government	0.85	24.7	1.40	1.54
Average	**0.61**	**23.0**	**2.01**	**2.07**

Source: State of Hawaii, Department of Business, Economic Development and Tourism, "The 2002 State Input-Output Study for Hawaii," June 2006 (as revised from May 2006), Table 2.4.

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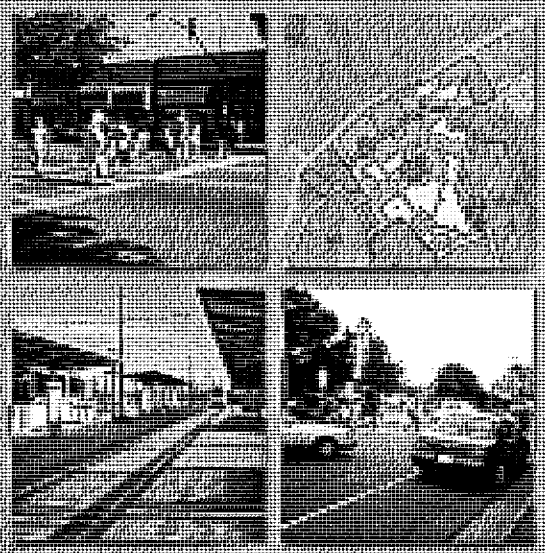
APPENDIX L
Traffic Impact Analysis Report

Traffic Impact Analysis Report (TIAR)
Ho'opili
Oahu, Hawaii



prepared for
D.R. Horton, Inc.
by Wilbur Smith Associates
February 2008

WilburSmith
ASSOCIATES

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EXECUTIVE SUMMARY

This document presents the results of the transportation impact analysis report (TIAR) prepared for the proposed Ho'opili Development (herein referred to as the "proposed Project"), a transit-oriented development in the 'Ewa District on the island of O'ahu, Hawaii. The purpose of this analysis is to identify the likely transportation impacts associated with the proposed development on the surrounding transportation system and to identify improvements to mitigate significant impacts. This TIAR solely reports on the impacts to intersections indentified herein, notably only those encompassed internally by the proposed project. As such, impacts found at intersections external to the project fall outside of the proposed project's jurisdiction and are not the responsibility of the project sponsor.

E.1 PROJECT DESCRIPTION

The proposed project involves development of a mixed-use community on approximately 1,555 acres in East Kapolei. The proposed plan for Ho'opili – which means "coming together" in Hawaiian – reflects the ideas, hopes and dreams of what the community wanted to see in this new development. The plan reflects the community's desire for vibrant and safe neighborhoods where people feel a sense of connection with one another, and with the rest of O'ahu.

The Conceptual Land Use Plan reflects the desire for a community that is "complete" with: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents. Implementation of the Plan will allow residents the ability to live, work, learn, play, and shop within Ho'opili without needing to use personal motor vehicles on regional roadways.

Ho'opili will be connected to the surrounding 'Ewa District (and neighboring Department of Hawaiian Home Lands (DHHL), the University of Hawaii at West Oahu (UHWO) and the Hawaii Community Development Authority (HCDA)) properties by a network of closely-spaced gridded streets and bicycle paths which allow a variety of circulation options for residents and visitors. Wider tree-lined boulevards will create a distinct axis running north-south and diagonally east-west across the site, but unlike a conventional subdivision of cul-de-sacs, there will many more streets, sized at a walking scale. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final setting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will be concentrated around the transit station(s).

The general land use allocation is described below:

Low-Medium Density Residential/Live-Work
Ranging from traditional single family detached homes on varying lot sizes to multifamily dwellings with a variety of live-work opportunities, there are approximately 535 gross acres (which includes secondary roads and mini-"neighborhood" parks) planned to accommodate approximately 5,100 residential units at densities of 5 to 14 units per acre. These areas would include mini-parks located as focal points and activity centers of the community.

Mixed-Use/Medium Density Residential
Planned to be oriented along future high-capacity transit and major roadway alignments, these medium density mixed use districts would include live-work residential units or residential uses over ground floor commercial and office uses. Within these districts that comprise approximately 340 acres (all of which will not be developed for housing because the acreage includes secondary roads, off-street parking and mini-"neighborhood" parks), there are approximately 5,200 dwelling units planned at densities of 15 to 29 units per acre along with retail and office use.

Mixed-Use/High Density Residential
Planned to be located near major transportation junctions, these higher density mixed use districts would include commercial, office space, and higher density live-work residential units or residential uses above ground floor businesses. Within these districts that comprise approximately 50 gross acres (which includes secondary roads, off-street parking and mini-"neighborhood" parks) would be approximately 40 net developable acres that would accommodate approximately 1,450 dwelling units planned at densities of 30 to 50 units per acre along with retail and office use.

Business / Commercial
To serve the neighborhoods and surrounding communities and to provide a variety of employment opportunities within Ho'opili, the business/commercial uses are located to be conveniently accessed from the major transportation corridors of the region. The approximately 145 gross acres illustrated (which includes secondary roads and off-street parking) are estimated to yield a net development area of approximately 130 acres that are projected to accommodate retail and office use. These areas would be significant employment generators for Ho'opili and the region.

Light Industrial / Business Mixed-Use
To meet regional demands and to provide for an additional employment center for Ho'opili, approximately 50 gross acres (which includes secondary roads and off-street parking) are planned to provide an area for larger light industrial type users and businesses. It is estimated that there would be a net development area of approximately 40 acres industrial mixed-use.

Open Spaces / Buffers
Integral to the connectivity of Hoÿopili to the surrounding neighborhoods, a variety of open space buffers and drainage detention areas are planned. Some of the key open space buffers include along the H-1 Freeway, Honouliuli Gulch and along Old Fort Weaver Road.

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Parks
Some of the key parks being planned include a district park along Fort Weaver Road and a "downtown" civic square to serve as the community gathering area.

Mini-Parks
Integral to the establishment and identity of neighborhoods, a variety of smaller parks of approximately one to two acres in size are planned. Properly planned and located, most residents will be within walking distance of one of these mini-parks.

Public Facilities
The proposed project could include as many as five or more public school sites. The Conceptual Land Use Plan shows the possible locations for five State Department of Education (DOE) school sites planned to be as accessible to the neighborhoods of Ho'opili as the community is developed; one high school, one middle school and three elementary schools. The plan can also accommodate a private school(s) as the need is determined. In addition, area is set aside along the western end of Farrington Highway fronting the Petition Area for either a fire station or a police substation. In total, approximately 100 acres are allocated to meet public facility needs.

There are several major transportation projects that have been long-planned for East Kapolei. The Ho'opili project has been planned assuming that the appropriate government agencies will secure the required rights-of-way from the landowner, these include the lands under: a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the segment of the proposed Honolulu High-Capacity Transit Corridor project through the Project Area.

The proposed project has been designed to reduce future residents' reliance on private motorized vehicles through the following measures:

- The project is the first new project designed to embrace high-capacity transit (elevated, fixed-guideway) corridor and station(s);
- The project is large enough to be designed and offer a full range of mixed land uses, including a wide range of places of live, work, shop, recreate and learn and will aspire to achieve a job-housing balance;
- The project is designed to maximize connectivity (transit, pedestrian, bicycle and vehicular) with surrounding streets and communities (including DHHL and UHWO),while minimizing cul-de-sacs and dead-end streets;
- The project will be designed to take advantage of the relatively flatness of the site and proximity to UHWO by designing streets and grade-separated multi-modal pathways for walking and bicycling; and
- The project will seek to implement other transportation management and transportation demand management strategies.

E.2 SCOPE OF ANALYSIS

The analysis for the Proposed Ho'opili Project focused on conditions with the City's proposed transit corridor project. However, an in depth analysis of conditions without the transit corridor was also conducted to identify additional traffic impact and improvement actions in the event that the proposed transit corridor does not extend to Ho'opili in 2030.

E.2.1 YEARS AND SCENARIOS

The transportation analysis was prepared according to the scope of work approved by the City and County of Honolulu, and the Hawaii Department of Transportation. For the analysis of the proposed Project, the following transportation scenarios were examined:

- Existing Conditions (2006)
- 2030 Baseline Conditions
- 2030 Baseline plus Project Conditions "With Transit Corridor"
- 2030 Baseline plus Project Conditions "Without Transit Corridor"

E.2.2 ANALYSIS LOCATIONS

The following intersections in the vicinity of the Proposed Project were analyzed for intersection Level of Service (LOS) during morning peak hour (one hour between 6:00 AM and 8:00 PM) and the evening peak hour (one hour between 3:00 PM and 5:00 PM):

- Kunia Rd / Kunia Loop
- Kunia Rd / H-1 WB On-Ramp
- Kunia Rd / H-1 EB Ramps
- Farrington Hwy / Fort Weaver Rd. SB Ramps
- Farrington Hwy/ Fort Weaver Rd. NB Ramps
- Farrington Hwy / Leokū St
- Fort Weaver Rd / Laulauni St
- Fort Weaver Rd / Old Fort Weaver Rd
- Fort Weaver Rd / Renton Rd
- Farrington Hwy / East Old Fort Weaver Rd
- Farrington Hwy / West Old Fort Weaver Rd
- Farrington Hwy / Fort Barrette Rd

As part of the future network, the following key intersections were also analyzed for this project:

- North South Road/ H-1 Westbound Ramps
- North South Road/ H-1 Eastbound Ramps
- North South Road/ Farrington Highway
- North South Road/ North University of Hawai'i Connector
- North South Road/ South University of Hawai'i Connector
- North South Road/ Kapolei Parkway

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- East-West Road/ Old Fort Weaver Road
- B Street/ 1st Avenue
- Farrington Highway/ B Street
- B Street/ 4th Avenue
- Parkway/ B Street
- B Street/5th Avenue
- East-West Road/ A Street
- 1st Avenue/ 2nd Avenue
- Farrington Highway/ Parkway/ 2nd Avenue
- Parkway/ 4th Avenue
- Parkway/ C Street
- C Street/ 5th Avenue
- 2nd Street/ D Street
- Kunia Road/ 2nd Avenue
- Kunia Road/ 3rd Avenue
- East-West Road/ B Street

Additionally, traffic impacts on freeways serving the vicinity of the development were also analyzed, these included:
- H-1 EB South of Makakilo Dr.
- H-1 EB West of Kunia Rd
- H-1 EB West of Paiwa St
- H-1 EB East of Kamehameha Hwy
- H-2 NB At Ka Uka Blvd.
- H-1 WB South of Makakilo Dr.
- H-1 WB West of Kunia Rd
- H-1 WB West of Paiwa St
- H-1 WB East of Kamehameha Hwy.
- H-2 SB At Ka Uka Blvd.

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Figure E.2
STUDY INTERSECTIONS

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E.2.3 THRESHOLDS OF SIGNIFICANCE

Neither the City and County of Honolulu nor the State of Hawai'i have guidelines for identifying the transportation impacts caused by a project. As such, WSA followed the guidelines provided in *Sections 5.1.1, 5.1.2, and 5.1.3* to identify the transportation impacts at the intersections, freeway segments, and ramp-freeway junctions.

E.2.3.1 Intersections

The thresholds of significance for the study intersections are as follows:

1. A project would cause a transportation impact at an intersection if it degrades the LOS of the intersection to LOS E or worse.
2. A project would cause a transportation impact at an intersection operating at LOS E or F if it degrades the volume-to-capacity ratio of the intersection by more than 10 percent.

E.2.3.2 Freeway Segments

The thresholds of significance for the freeway segments are as follows:

1. A project would cause a transportation impact at a freeway segment if it degrades the LOS of the freeway segment to LOS E or worse.

E.2.2.3 Ramp-Freeway Junctions

The thresholds of significance for the ramp-freeway junctions are as follows:

1. A project would cause a transportation impact at a ramp-freeway junction if it degrades the LOS of the ramp-freeway to LOS E or worse.

E.3 TRAVEL DEMAND FORECASTS

The process used to identify the demand and forecast the total number of trips that would be generated by the proposed Project, included a three step process:

1. Trip generation
2. Trip distribution
3. Trip assignment

In the first step, the amount of traffic entering and exiting the Project land uses is estimated on a daily and peak hour basis. In the second step, the directions that vehicles use to approach and depart the project site are estimated. In the final step, the trips are assigned to specific street segments and intersection turning movements.

As mentioned above, the methodologies used in the estimation of the project traffic included a multiple step process involving the following:

4. Categorizing project land uses into appropriate Institute of Transportation Engineers (ITE) Trip Generation Categories
5. Identifying trip generation rates and/or trip generation equations
6. Applying trip generation reductions
7. Calculating the Final Trip Generation

Under "With Transit Corridor Conditions" the proposed Project is estimated to generate 140,920 daily trips of which 7,069 would be morning peak hour trips and 12,077 would be evening peak hour trips.

Under "Without Transit Corridor Conditions", the proposed Project is estimated to generate 158,669 daily trips of which 9,172 would be morning peak hour trips and 13,776 would be evening peak hour trips.

E.4 PROPOSED IMPACTS AND ACTIONS WITH TRANSIT CORRIDOR

In general, under "With Transit Corridor" conditions, impacts would occur on the following roadways: Farrington Highway, Fort Weaver, North-South Road, and East-West Road, as well as at the following external intersections:

- Farrington Highway/ Fort Weaver Rd. Northbound Ramps
- Farrington Highway /Leokū Street
- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ East-West Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/Fort Barrette Road
- North-South Road/ H-1 Eastbound Ramps
- North-South Road/ Farrington Highway
- North-South Road/ Kapolei Parkway

Note that impacts at these locations are identified under Year 2030 conditions, and represent increases in cumulative traffic within the entire study area. Therefore, the contribution of traffic from the proposed Project to cumulative traffic increases must be recognized, and the assignment of traffic impacts must be proportionally allocated. One such method would be the implementation of a recurrent monitoring program to periodically measure traffic at specific locations. This would include the measurement of traffic associated both with the proposed Project (e.g., at key project access points/driveways), as well as along key transportation facilities.

The following locations are proposed for improvement under Scenario A: With Transit Corridor Conditions:

- Farrington Highway/Fort Weaver Road Northbound Ramps

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- Fort Weaver Road/Leokū Street
- Fort Weaver Road/Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/Fort Barrette Road
- North-South Road/H-1 Eastbound Ramps
- North-South Road/Farrington Highway
- North-South Road/Kapolei Parkway

Figure E.4 presents the proposed improvements at the above locations.

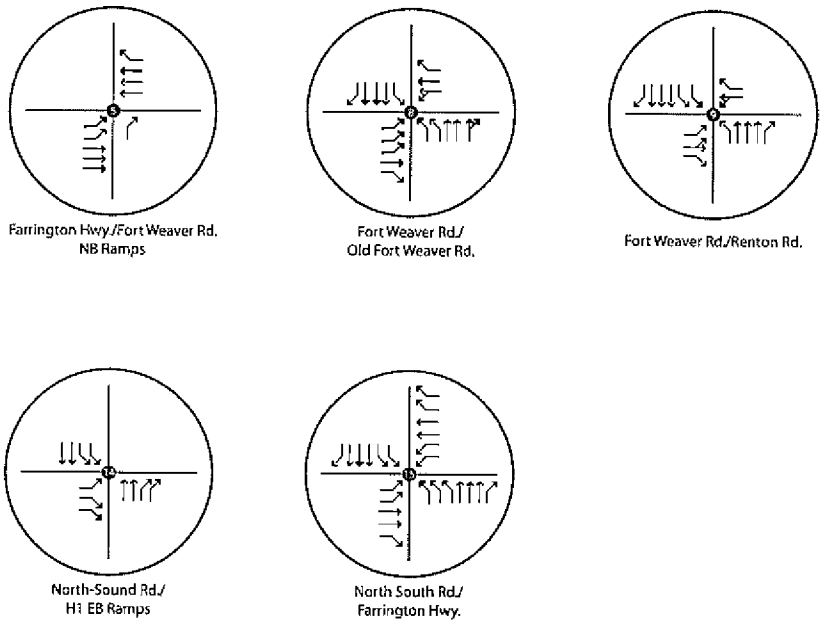

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Figure E.4
PROPOSED MITIGATION MEASURES
SCENARIO A: WITH TRANSIT CORRIDOR SCENARIO
160651/DEC 2007-12/10/07

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Proposed Intersection Improvements

Farrington Highway/Fort Weaver Road Northbound Ramps

1. Eastbound Approach: Construct one additional exclusive left-turn lane to provide dual left-turn lanes.
2. Westbound Approach: Convert existing shared through-right lane to through lane and construct a separate free right-turn lane.
3. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.

Fort Weaver Road/Leokū Street

The majority of the project-related traffic volumes would be added to the westbound through movements along Farrington Highway. Note that this section on Farrington Highway is planned to be widened to a six-lane roadway by Year 2030. To mitigate this impact, additional lanes would need to be constructed to accommodate through traffic, requiring acquisition of a new right-of-way. As such, it would not be feasible to add additional through lanes along Farrington Highway due to right-of-way constraints. However, implementation of the Transportation Demand Management (TDM) strategies discussed in *Section 6.3* could reduce the peak hour traffic volumes and Project impacts at this intersection.

Fort Weaver Road / Old Fort Weaver Road

1. Northbound Approach: Construct one additional exclusive left-turn lane to provide dual left turn lanes. Convert one of the existing through lanes to a shared through-right lane.
2. Eastbound Approach: Convert existing shared through-left turn lane to a through lane and construct 3 exclusive left turn lanes to allow a triple left-turn movement from Old Fort Weaver Road. Right-of-way acquisition may be required for the eastbound approach.
3. Signal Timing: For the eastbound and westbound directions, convert the signal timing from permitted to split phasing. In addition, provide free right-turns for eastbound and westbound movements.

Fort Weaver Road / Renton Road

1. Westbound Approach: Convert existing shared left-through-right lane to shared through-left lane and construct one exclusive right-turn lane.

Farrington Highway/Fort Barrette Road

1. Signal Timing: Change the cycle length from 210 seconds to 120 seconds. Also, convert the southeast and northwest right-turn phases from permitted to permitted plus overlap phases.
2. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.

North-South Road / H-1 Eastbound Ramps

1. Eastbound Approach: Construct one additional right-turn lane to provide dual right-turn lanes.

North-South Road / Farrington Highway

Two options were identified as part of the traffic analysis for this intersection. Option 1 is proposed as part of the Ho'opili TIAR while Option 2 is incorporated from the University of Hawai'i West O'ahu Traffic Study Report.

Option 1: Proposed as part of the Ho'opili TIAR

1. Southeast-bound Approach: Convert the shared through-right lane to an exclusive right-turn lane
2. Southwest-bound Approach: Construct one additional exclusive right-turn lane to provide dual right-turn lanes.
3. Northwest-bound Approach: Construct an additional left-turn lane to provide three exclusive left-turn lanes. This would also require widening Farrington Highway west of the intersection to provide three westbound departure lanes to receive the triple left-turn lane movement.

Option 2: Incorporated from the University of Hawai'i West O'ahu Traffic Study Report

As an alternative to the above mitigation measure, the mitigation measure proposed as part of the University of Hawai'i West O'ahu (UHWO) could also be implemented as a mitigation measure at this intersection. The UHWO Traffic Study Report suggests a potential configuration for grade separation to conduct the Farrington Highway through movement over the intersection. North-South Road would remain as an at-grade facility and all turning movements would occur at-grade at the intersection. By removing the Farrington Highway through movement from the intersection, more green time could be allocated to the other movements, to accommodate the projected traffic volumes.

North-South Road / Kapolei Parkway

1. Southbound Approach: Convert shared through-right lane to exclusive right-turn lane to provide three through lanes and one right-turn lane.
2. Northbound Approach: Convert shared through-right lane to exclusive right-turn lane to provide three through lanes and one right-turn lane.

The proposed improvements identified for the above intersections could be implemented in a number of ways, including 1) by programming an alternate signal timing plans that would be in operation during specified peak commute periods, or 2) restricting pedestrian crossings on one or more intersection approach in order to allow for unconstrained vehicle movement.

Transportation Demand Management

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Transportation Demand Management (TDM) strategies address traffic congestion by reducing the amount of vehicle miles traveled, thereby reducing overall travel demand. The aim of these strategies is focused on promoting travel alternatives such as increased transit usage, walking, and bicycling to help achieve this goal. The Leeward Oahu Transportation Management Association (LOTMA) currently provides TDM services in the vicinity of the proposed Project. It is anticipated that the proposed Project will continue to support the existing programs and services in place. It should be noted however that based on the proposed Project's trip generation during the AM and PM peak hours, the Project Sponsor may want to consider additional TDM strategies as a means of managing and improving travel demand. The following strategies are suggested for consideration:

- **Carsharing** – Project Sponsors could make carsharing available for residents of the Proposed development. Carsharing would provide residents access to a car on an "as needed" basis without incurring the fixed costs associated with owning and operating a personal automobile.

- **Carpool/Vanpool** – Developers and employers could promote carpool or vanpool programs for commuters who either live or work in the proposed Project and share the same schedule, through subsidizing the cost of vehicles and fuel costs.

- **Preferential HOV Parking** – Developers or employers could provide incentives for use of alternative modes of travel to the single occupancy vehicle by reserving close-in, secure, covered, or otherwise preferable parking spaces for high-occupancy vehicles.

- **Rent subsidies** – Developers of residential developments could offer tenants rent subsidies (reductions in rent) for the amount of money they would typically pay for a parking space included in the price of their rent.

- **Transit Subsidies** – Developers and employers could encourage the use of transit by offering a discounted monthly pass to its residents and employees.

- **Bicycle Parking and Shower Facilities** – Both businesses and developers can provide bicycle parking, storage, and shower facilities to promote and encourage the use of bicycles for work and home trips.

- **Staggered Class Schedules** – The University of Hawai'i and Department of Education (DOE) schools should consider following an alternative class schedules where courses begin at 9:00 AM so as to avoid the peak commute period (6:00AM to 8:00 AM).

E.5 PROPOSED IMPACTS AND ACTIONS WITHOUT TRANSIT CORRIDOR

The following presents a summary of the proposed impacts and actions that would occur as a result of the proposed Project in the event the City's transit corridor was not in place by Year 2030.

Under Scenario B: Without Transit Corridor, the following intersections would be impacted:

- Farrington Highway/ Fort Weaver Road Northbound Ramps
- Farrington Highway / Leokū Street
- Fort Weaver Road/ Laulaunui Street
- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/Fort Barrette Road
- North-South Road/ H-1 Eastbound Ramps
- North-South Road/ Farrington Highway
- North-South Road/ Kapolei Parkway

Of the 9 intersections identified above, 5 are found to be impacted under Scenario A: With Transit Corridor. While those impacts are discussed in detail under section E.4, the following three intersections are identified as having additional impacts under Scenario B and their corresponding improvement actions are also discussed:

- Farrington Highway/ North-South Road
- Fort Weaver Road/Laulaunui Street
- Farrington Highway/Fort Barrette Road

Note that impacts at these locations are identified under Year 2030 conditions, and represent increases in cumulative traffic within the entire study area. Therefore, the contribution of traffic from the proposed Project to cumulative traffic increases must be recognized, and the assignment of traffic impacts must be proportionally allocated. One such method would be the implementation of a recurrent monitoring program to periodically measure traffic at specific locations. This would include the measurement of traffic associated both with the proposed Project (e.g., at key project access points/driveways), as well as along key transportation facilities.

North-South Road/ Farrington Highway

Two options were identified as part of the traffic analysis for this intersection. Option 1 is proposed as part of the Ho'opili TIAR while Option 2 is incorporated from the University of Hawai'I West O'ahu Traffic Study Report.

Option 1: Proposed as part of the Ho'opili TIAR

1. Southwest-bound Approach: Construct one additional exclusive right-turn lane to provide dual right-turn lanes.
2. Southeast-bound Approach: Convert the existing permissive right-turn to a free right-turn.
3. Northeast-bound Approach: Convert the existing permissive right-turn to a dual free right-turn. Construct an additional right-turn lane.
4. Northwest-bound Approach: Construct an additional left-turn lane to provide triple left-turn lanes.

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5. Signal Timing: Change the cycle length from 150 seconds to 140 seconds.

Even with the proposed mitigations, the impact at this intersection is identified as significant but avoidable during the PM peak hour. As such, additional improvement actions may be required.

Option 2: Incorporated from the University of Hawai'i West O'ahu Traffic Study Report

As an alternative to the above mitigation measure, the mitigation measure proposed as part of the University of Hawai'i West O'ahu (UHWO) could also be implemented as a mitigation measure at this intersection. The UHWO Traffic Study Report suggests a potential configuration for grade separation to conduct the Farrington Highway through movement over the intersection. North-South Road would remain as an at-grade facility and all turning movements would occur at-grade at the intersection. By removing the Farrington Highway through movement from the intersection, more green time could be allocated to the other movements, to accommodate the projected traffic volumes.

Fort Weaver Road/Laulaunui Street

1. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.
2. Eastbound Approach: Construct an exclusive left-turn lane in addition to the shared through-left lane.

Farrington Highway/Fort Barrette Road

1. Signal Timing: Change the cycle length from 210 seconds to 120 seconds. Also, convert the southeast and northwest right-turn phases from permitted to permitted plus overlap phases.
2. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.

The proposed improvements identified for the above intersections could be implemented in a number of ways, including 1) by programming an alternate signal timing plans that would be in operation during specified peak commute periods, 2) restricting pedestrian crossings on one or more intersection approach in order to allow for unconstrained vehicle movement, or 3) by reducing travel lane widths to accommodate the recommended lane additions within existing (or future) intersection right-of-way.

Chapter 1
INTRODUCTION

The following document is a Transportation Impact Analysis Report (TIAR) which presents the existing transportation conditions and assesses the transportation impacts associated with the proposed Ho'opili Development Project (herein referred to as the "proposed Project") in the 'Ewa District on the Island of Oahu, Hawaii. The following transportation impacts were analyzed in the study:

- Traffic conditions
- Transit operations
- Parking conditions
- Pedestrian circulation
- Bicycle circulation

1.1 PROJECT DESCRIPTION

The proposed project involves development of a mixed-use community on approximately 1,555 acres in East Kapolei. The proposed plan for Ho'opili – which means "coming together" in Hawaiian – reflects the ideas, hopes and dreams of what the community wanted to see in this new community. The plan reflects the community's desire for vibrant and safe neighborhoods where people feel a sense of connection with one another, and with the rest of O'ahu.

The Conceptual Land Use Plan reflects the desire for a community that is "complete" with: affordable living options; employment centers; quality schools; shopping, gathering and recreational places; and parks and open space for residents. Implementation of the Plan will allow residents the ability to live, work, learn, play, and shop within Ho'opili without needing to use personal motor vehicles on regional roadways.

Ho'opili will be connected to the surrounding 'Ewa District (and neighboring Department of Hawaiian Home Lands (DHHL), the University of Hawaii at West Oahu (UHWO) and the Hawaii Community Development Authority (HCDA) properties by a network of closely-spaced gridded streets and bicycle paths which allow a variety of circulation options for residents and visitors. Wider tree-lined boulevards will create a distinct axis running north-south and diagonally east-west across the site, but unlike a conventional subdivision of cul-de-sacs, there will many more streets, sized at a walking scale. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the

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alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will be concentrated around the transit station(s).

The general land use allocation is described below:

Low-Medium Density Residential/Live-Work
Ranging from traditional single family detached homes on varying lot sizes to multifamily dwellings with a variety of live-work opportunities, there are approximately 535 gross acres (which includes secondary roads and mini-"neighborhood" parks) planned to accommodate approximately 5,100 residential units at densities of 5 to 14 units per acre. These areas would include mini-parks located as focal points and activity centers of the community.

Mixed-Use/Medium Density Residential
Planned to be oriented along future high-capacity transit and major roadway alignments, these medium density mixed use districts would include live-work residential units or residential uses over ground floor commercial and office uses. Within these districts that comprise approximately 340 acres (all of which will not be developed for housing because the acreage includes secondary roads, off-street parking and mini-"neighborhood" parks), there are approximately 5,200 dwelling units planned at densities of 15 to 29 units per acre along with retail and office use.

Mixed-Use/High Density Residential
Planned to be located near major transportation junctions, these higher density mixed use districts would include commercial, office space, and higher density live-work residential units or residential uses above ground floor businesses. Within these districts that comprise approximately 50 gross acres (which includes secondary roads, off-street parking and mini-"neighborhood" parks) would be approximately 40 net developable acres that would accommodate approximately 1,450 dwelling units planned at densities of 30 to 50 units per acre along with retail and office use.

Business / Commercial
To serve the neighborhoods and surrounding communities and to provide a variety of employment opportunities within Ho'opili, the business/commercial uses are located to be conveniently accessed from the major transportation corridors of the region. The approximately 145 gross acres illustrated (which includes secondary roads and off-street parking) are estimated to yield a net development area of approximately 130 acres that are projected to accommodate retail and office use. These areas would be significant employment generators for Ho'opili and the region.

Light Industrial / Business Mixed-Use
To meet regional demands and to provide for an additional employment center for Ho'opili, approximately 50 gross acres (which includes secondary roads and off-street parking) are planned to provide an area for larger light industrial type users and businesses. It is estimated that there would be a net development area of approximately 40 acres industrial mixed-use.

Open Spaces / Buffers
Integral to the connectivity of Ho'opili to the surrounding neighborhoods, a variety of open space buffers and drainage detention areas are planned. Some of the key open space buffers include along the H-1 Freeway, Honouliuli Gulch and along Old Fort Weaver Road.

Parks
Some of the key parks being planned include a district park along Fort Weaver Road and a "downtown" civic square to serve as the community gathering area.

Mini-Parks
Integral to the establishment and identity of neighborhoods, a variety of smaller parks of approximately one to two acres in size are planned. Properly planned and located, most residents will be within walking distance of one of these mini-parks.

Public Facilities
The proposed project could include as many as five or more public school sites. The Conceptual Land Use Plan shows the possible locations for five State Department of Education (DOE) school sites planned to be as accessible to the neighborhoods of Ho'opili as the community is developed; one high school, one middle school and three elementary schools. The plan can also accommodate a private school(s) as the need is determined. In addition, area is set aside along the western end of Farrington Highway fronting the Petition Area for either a fire station or a police substation. In total, approximately 100 acres are allocated to meet public facility needs.

Based on the above land use plan, the overall density is not anticipated to change. However, the distribution of density will change based upon the location of the proposed transit stations within Ho'opili. Additionally, internal traffic should be anticipated to change depending on the transit alignment and final station locations.

There are several major transportation projects that have been long-planned for East Kapolei. The Ho'opili project has been planned assuming that the appropriate government agencies will secure the required rights-of-way from the landowner, these include the lands under: a portion of North-South Road between Farrington Highway and Kapolei Parkway; a portion of the North-South Road and a new H-1 Freeway interchange; a portion of the intersection of North-South Road and Farrington Highway; the long-planned widening of Farrington Highway fronting Ho'opili; the proposed East-West Connector Road through the Petition Area; and the segment of the proposed Honolulu High-Capacity Transit Corridor project through the Project Area.

The proposed project has been designed to reduce future residents' reliance on private motorized vehicles through the following measures:

- the project is the first new project designed to embrace high-capacity transit (elevated, fixed-guideway) corridor and station(s);
- the project is large enough to be designed and offer a full range of mixed land uses, including a wide range of places of live, work, shop, recreate and learn and will aspire to achieve a job-housing balance;
- the project is designed to maximize connectivity (transit, pedestrian, bicycle and

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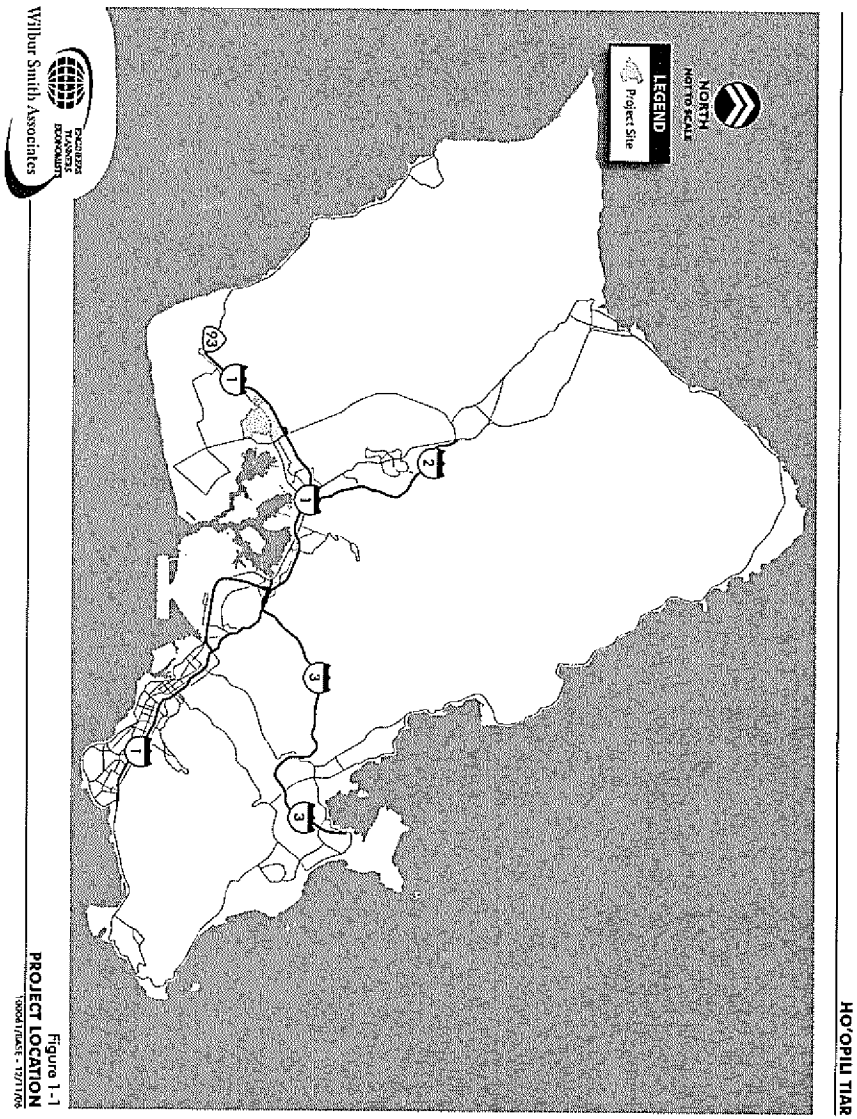
vehicular) with surrounding streets and communities (including DHHL and UHWO), while minimizing cul-de-sacs and dead-end streets;
- the project will be designed to take advantage of the relatively flatness of the site and proximity to UHWO by designing streets and grade-separated multi-modal pathways for walking and bicycling; and
- the project will seek to implement other transportation management and transportation demand management strategies.

1.2 STUDY SCOPE AND APPROACH

The transportation analysis was prepared according to the scope of work approved by the City and County of Honolulu, and the Hawaii Department of Transportation. For the analysis of the proposed Project, the following transportation scenarios were examined:

- Existing Conditions
- 2030 Baseline Conditions
- 2030 Baseline plus Project Conditions "With Transit Corridor"
- 2030 Baseline plus Project Conditions "Without Transit Corridor"



Wilbur Smith Associates

Figure 1-1
PROJECT LOCATION

HO'OPILI TIAR

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Figure 1-2
PROJECT STUDY AREA
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The purpose of this analysis is to identify the potential impacts of the proposed Project on the transportation system in the vicinity of the site that would be most directly impacted by the Project. As part of the existing traffic network, the following key intersections were analyzed for this project:

1. Kunia Road/ Kupuna Loop
2. H-1 Westbound Ramps/ Kunia Road
3. Fort Weaver Road/ H-1 Eastbound Ramps
4. Fort Weaver Road Southbound Ramps/ Farrington Freeway
5. Fort Weaver Northbound Ramps/ Farrington Freeway
6. Farrington Highway/ Leokū Street
7. Fort Weaver Road/ Laulaunui Street
8. Fort Weaver Road/ Old Fort Weaver Road
9. Fort Weaver Road/ Renton Road
10. Farrington Highway/ East Old Fort Weaver Road
11. Farrington Highway/ West Old Fort Weaver Road
12. Fort Barrette Road/ Farrington Highway

As part of the future traffic network, the following key intersections were also analyzed as part of this project:

13. North South Road/ H-1 Westbound Ramps
14. North South Road/ H-1 Eastbound Ramps
15. North South Road/ Farrington Highway
16. North South Road/ North University of Hawai'i Connector
17. North South Road/ South University of Hawai'i Connector
18. North South Road/ Kapolei Parkway
19. East-West Road/ Old Fort Weaver Road
20. B Street/ 1st Avenue
21. Farrington Highway/ B Street
22. B Street/ 4th Avenue
23. Parkway/ B Street
24. B Street/5th Avenue
25. East-West Road/ A Street
26. 1st Avenue/ 2nd Avenue
27. Farrington Highway/ Parkway/ 2nd Avenue
28. Parkway/ 4th Avenue
29. Parkway/ C Street
30. C Street/ 5th Avenue
31. 2nd Street/ D Street
32. Kunia Road/ 2nd Avenue
33. Kunia Road/ 3rd Avenue
34. East-West Road/ B Street

An evaluation of the traffic impacts on the freeways serving in the vicinity of the development area was also conducted. The following freeway mainline freeway segments were analyzed for this project:

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- Section 1: H-1 Freeway (south of Makakilo Drive)
- Section 2: H-1 Freeway (west of Kunia Road)
- Section 3: H-1 Freeway (west of Pāiwa Street)
- Section 4: H-1 Freeway (east of Kamehameha Highway)
- Section 5: H-2 Freeway (at Ka Uka Boulevard)

Traffic impact evaluation was also conducted for the ramps connecting to the freeways serving in the vicinity of the proposed Project. This analysis was conducted for the existing ramp connections from Fort Weaver Road/Kunia Road to H-1 Freeway. Ramp analyses were also conducted for the future ramp configurations connecting from Fort Weaver Road/Kunia Road to H-1 Freeway as well as the ramps connecting from North South Road to H-1 Freeway.

Some of the mitigation measures in this TIAR proposed additional laneage at the intersections analyzed. Land acquisition for additional right of way where land is owned of controlled by the Project is readily accommodated. Land acquisition at project extremities and remote locations/intersections, if necessary, may require assistance from City and State as part of the overall master planned roadway network.

The operations of the key intersections and freeway segments were evaluated during the weekday morning (AM) and evening (PM) peak traffic periods for the following scenarios:

Scenario 1: Existing Conditions includes the analysis of existing traffic volumes obtained from traffic counts.

Scenario 2: 2030 Baseline Conditions includes future transportation improvements including freeway, intersection, transit, and bicycle/pedestrian improvements that will be in place without the project by the year 2030. The future traffic volumes have been obtained from the Year 2030 Oahu Metropolitan Planning Organization (OMPO) Transportation Model.

Scenario 3: 2030 Baseline plus Project Conditions "With Transit Corridor" (Scenario A: With High-Capacity Transit Corridor) includes project conditions volumes plus traffic associated with the proposed project under the assumption that the Honolulu High-Capacity Transit Corridor would pass through the project site. The transit corridor's alignment would be fixed and run diagonally through Ho'opili using the University of Hawai'i's Road B. It would further turn down North-South Road in the median and stop in front of the Kroc Center in the North-South median. Two stops are currently proposed within Ho'opili for which the exact stop locations are still being determined. The project sponsor will be responsible for integrating the transit stops into the surrounding environment. It should be noted that depending on their locations, the bus stops may experience higher densities and be able to capture increased ridership as a result. Additionally, it is likely that a transit maintenance facility be located within Ho'opili. The details of this arrangement are discussed in the EIS report.

Scenario 4: 2030 Baseline plus Project Conditions "Without Transit Corridor" (Scenario B: Without High Capacity Transit Corridor) includes project conditions volumes plus traffic

associated with the proposed project under the assumption that the Honolulu High-Capacity Transit Corridor would not pass through the project site.

The remainder of the report is divided into six chapters. Chapter 2 describes Existing Conditions with regards to roadway facilities, transit services, pedestrian and bicycle facilities, and analysis methodologies. Intersection and Freeway operations under Background Conditions with traffic from approved but not yet constructed developments are discussed in Chapter 3. Chapter 3 provides a baseline from which to identify Project impacts.

Chapter 4 describes the methodology used to estimate the project traffic and the project's impact on the transportation system. Chapter 5 describes the future (Year 2030) transportation conditions including freeway, and intersection operations that will be a result of the construction of the East Kapolei Project. The results of the Project condition analysis as compared to the results of the 2030 Baseline Conditions (Chapter 3) analysis are used to identify significant project impacts. In Chapter 6, these significant impacts are identified, recommended improvements are proposed, and a phasing plan for improvement implementation is described. Chapter 6 also includes an assessment of site access, on-site circulation, transit services & pedestrian facilities and a review of the proposed roadway cross-sections for internal roadways and roadways adjacent to the project site. The study conclusions are presented in Chapter 7.

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Chapter 2
EXISTING CONDITIONS

This chapter provides a description of Existing Conditions in the vicinity of the proposed Project. Included in this chapter are descriptions of the existing roadway and transit networks, documentation of existing traffic, transit, pedestrian, and bicycle conditions.

2.1 EXISTING ROADWAY NETWORK

The project area includes several major roadways that serve regional trips within Central O'ahu, as well as provide access to the commercial and residential areas adjacent to the project area.

2.1.1 Regional Access

This section provides a discussion of the existing regional roadway network in the vicinity of the proposed Project site, including the location of the nearest access points.

H-1 Freeway (H-1) – H-1 extends east-west through Central Honolulu and the 'Ewa District to provide connections of the project area to areas outside of the 'Ewa District. East of the Waiawa interchange, it provides five travel lanes in each direction with one lane in each direction designated as a HOV lane for vehicles with two or more occupants, during the peak commute periods. Between the Waiawa and Kunia interchanges, the freeway provides four lanes in each direction. West of the Kunia interchange, the freeway has three travel lanes in each direction.

H-2 Freeway (H-2) – The H-2 Freeway extends north-south throughout Central O'ahu and connects at its interchange to the H-1 Freeway. The northern terminus is just south of Wahiawā at the junction with Kamehameha Highway and Wilikina Drive. It provides four lanes in each direction from the Waiawa interchange to Mililani, where it narrows to two lanes in each direction.

Farrington Highway – Farrington Highway extends east-west to accommodate traffic between its east terminus, at the interchange with Kamehameha Highway, and the Wai'anae coast of O'ahu. It is located generally parallel to and one-half to three quarters of a mile south of the H-1 Freeway within the study area. It provides four lanes in each direction from the Kamehameha interchange to Old Fort Weaver Road. It extends westward with one lane in each direction to the Villages of Kapolei where it widens to provide 2 lanes in each direction from Kapolei Golf Course Road into the City of Kapolei.

Kamehameha Highway (State Route 99) – Kamehameha Highway extends north-south to accommodate traffic between the north and south shores of O'ahu. It is located generally parallel to and one-half to one mile west of the H-2 Freeway within the study area. Kamehameha Highway has been widened to a four-lane highway, with separate left- and right-turn lanes at Waipahu Street, Lumiauau Street, Lumiaina Street, Waipio Uka Street, and Ka Uka Boulevard intersections, from the H-1 Freeway to Ka Uka Boulevard. Kamehameha Highway also has an

interchange with Farrington Highway where it continues to operate as a four lane freeway both east and west of the interchange.

2.1.2 Local Access

This section provides a discussion of the existing local roadway system in the vicinity of the proposed Project site, including the roadway designation, number of travel lanes, and traffic flow directions.

Fort Weaver Road – This north-south roadway connects the H-1 Freeway with the Farrington Highway and provides access to the Waipahu residential areas. North of Farrington Highway, Fort Weaver Road becomes Kunia Road. Fort Weaver Road functions as a six-lane expressway between the H-1 Freeway and Laulaunui Street which interchanges at H-1 and Farrington Highway. It is a four-lane principal arterial with a median divider and left turn lanes at cross streets from Farrington Highway to North Road. Makai of North Road, Farrington Highway functions as a two-lane minor arterial.

Fort Barrette Road – This north-south roadway connects the Kalaeloa Redevelopment Area to the Makakilo community and provides access to Farrington Highway and H-1 Freeway. It is a two-lane divided roadway from just makai of Farrington Highway to Franklin D. Roosevelt Avenue. It extends mauka of Farrington Highway as Makakilo Drive, a four-lane roadway with median divider.

Old Fort Weaver Road – Old Fort Weaver Road provides the Honouliuli community access to Farrington Highway and Fort Weaver Road. It is a two-lane roadway between Farrington Highway and Fort Weaver Road

Laulaunui Street is a four-lane east-west minor arterial roadway extending between Kaihuopala'ai Street and Laulaunui Lane. Laulauni Street also intersects with Fort Weaver Road.

Leokū Street is a two- to four-lane north-south minor roadway that extends from Waipahu Street to Leokāne Street and is parallel to Fort Weaver Road.

Kunia Road is an extension of Fort Weaver Road north from Farrington Highway and the H-1 Freeway interchange to provide access into Central O'ahu.

Kupuna Loop is a four lane looped arterial roadway with two lanes in each direction. It provides direct access to Kunia Road at both its origin and terminus.

Renton Road is a two- to four-lane east-west minor arterial roadway through the Renton Village area that connects Fort Weaver Road to the Kapolei Parkway and to Roosevelt Avenue.

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2.2 TRANSIT NETWORK

The City and County of Honolulu provides TheBus fixed-route service to the communities adjacent to and in the general vicinity of the proposed Project site, these routes include both suburban trunk routes and express routes. Figure 2-1 presents nearby bus routes. Table 2.1 presents the service frequencies for TheBus routes that service the proposed Project site. TheBus operates seven bus lines that directly serve the proposed Project and its immediate vicinity, they include:

- **Route A City Express** - Route A operates express service that connects Waipahu and Pearlridge with Downtown and the University of Hawai'i. Service is provided at approximately 15 minute intervals between 4:45 am and 10:00 PM on weekdays and 30 minute intervals between 5:00 AM and 8:30 PM on weekends.

- **Route 41 Kapolei Transit Center-** This route serves the Villages of Kapolei areas, including a portion of the Makakilo Drive-Fort Barrette Road. Service is provided approximately at one hour intervals from about 5:00 AM to 9:00 PM, seven days a week.

- **Route 42 'Ewa Beach-** Route 42 provides service along Farrington Highway in the City of Kapolei at half-hour intervals from approximately 6:00 AM to 1:30 AM for westbound travel seven days a week. Eastbound service runs from approximately 4:00 AM to 1:00 am also seven days a week.

- **Route 43 Waipahu Transit Center** – This route provides service along the H-1 Freeway and through the City of Waipahu, connecting Waipahu to downtown Honolulu. Service is provided seven days a week at half-hour intervals from 7:00 AM to 5:00 PM

- **Route 81 Waipahu Express (PM)/ Downtown Express (AM)** - This route provides express service at approximately 15 minute intervals from Waipahu to Downtown during the morning hours between 4:30 AM and 7:30 AM. Evening service frequency to Waipahu varies from 15 to 30 minute intervals and operates between 3:00 PM and 6:20 PM.

- **Route 91 Express Downtown (AM) / 'Ewa Beach Express (PM)** - Service is provided along the H-1 Freeway connecting the Downtown to 'Ewa Beach. Eastbound service on this route runs at 20 minute intervals from 4:30 AM to 7:00 AM, connecting 'Ewa Beach to the Downtown. Westbound service to 'Ewa Beach is provided the PM hours at 20 minute intervals beginning at 3:25 and concluding at 6:15 PM.

- **Route 102 Villages of Kapolei Express-** This route provides 3 morning Honolulu-bound trips and 3 afternoon return trips to the Villages of Kapolei during the peak commute periods. The route provides service along Fort Barrette Road and Farrington Highway in the Villages of Kapolei area.

In addition to TheBus express routes, the Leeward Oahu Transportation Management Association (LOTMA) also sponsors an express bus service along Fort Weaver Road to Honolulu with one morning and one afternoon trip.

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Table 2.1
Bus Service near the proposed Project

Route	From	To	Hours of Operation		Headway During Commute Periods			
					Weekday		Weekend	
			Weekday	Weekend/Holiday	AM	PM	AM	PM
A	Waipahu	University	4:22 AM – 10:02 PM	4:52 AM – 9:12 PM	15	15-20	15-30	30
A	University	Waipahu	5:18 AM – 8:48 PM	6:08 AM – 8:31 PM	10-15	10-15	15	30
41	Kapolei	'Ewa	5:00 AM – 9:15 PM	5:00 AM – 9:15 PM	30	30	60	60
41	'Ewa	Kapolei	5:03 AM – 9: 49 PM	5:33 AM – 9:49 PM	30	30	60	60
42	'Ewa	Waikīkī	4:20 AM – 12:54 AM	4:39 AM – 12:44 AM	30	30	20-30	20-30
42	Waikīkī	'Ewa	4:57 AM – 1:47 AM	5:59 AM – 1:29 AM	30	30	30	30
43	Honolulu	Waipahu	7:00 AM – 4:49 PM	7:03 AM – 5:03 PM	30	30	30	30
43	Waipahu	Honolulu	7:15 AM – 5:15 PM	7:15 AM – 5:15 PM	30	30	30	30
81	Waipahu	Honolulu	4:28 AM – 7:34 AM	4:40 AM – 7:00 AM	15-20	-	20	-
81	Honolulu	Waipahu	3:00 PM – 6:18 PM	-	-	20-30	-	-
91	'Ewa	Honolulu	4:30 AM – 7:10 AM	4:35 AM – 6:45 AM	20	-	20-45	-
91	Honolulu	'Ewa	3:25 PM – 6:15 PM	3:40 PM – 5:45 PM	-	20	-	20-30
102	Kapolei	Honolulu	5:30 AM – 6:10 AM	-	20	-	-	-
102	Honolulu	Kapolei	4:00 PM – 5:10 PM	-	-	20	-	-

Source: TheBus, January 2007

NOTES:
Headway is presented in minutes.

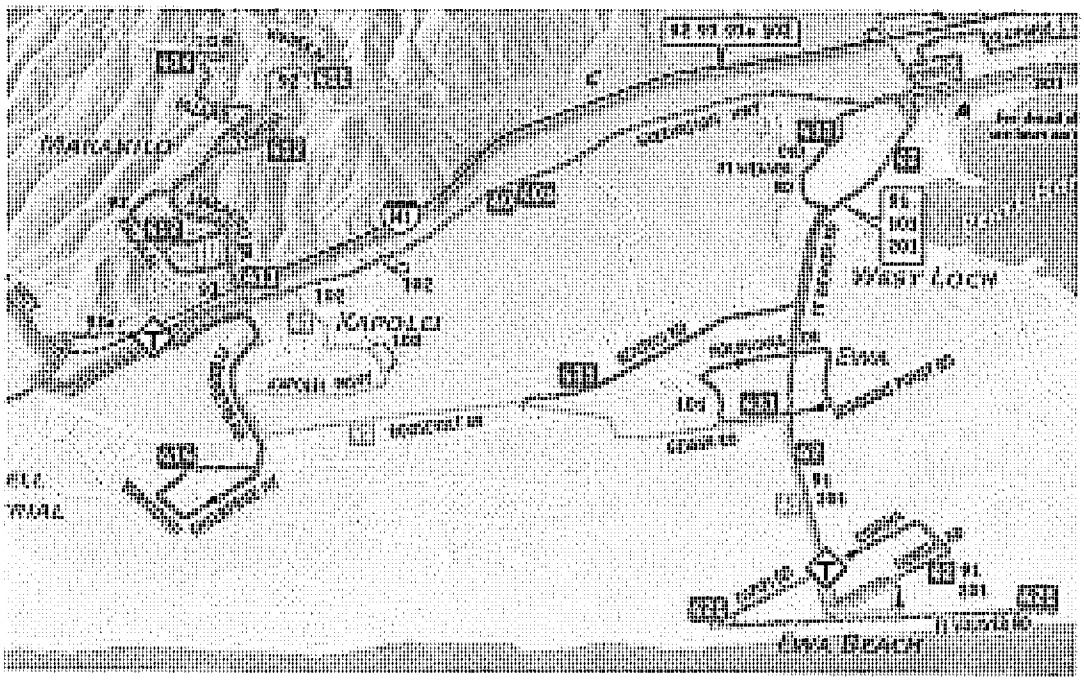

Figure 2-1
EXISTING TRANSIT NETWORK
100061/TRANSIT NETWORK - 01/05/07

AR00027943

2.3 PEDESTRIAN CONDITIONS

Within the vicinity of the proposed Project, sidewalk facilities are provided along both sides of Farrington Highway towards the east-west project limits beyond its intersection with Fort Weaver Road and along its intersection with Fort Barrette Road. Sidewalks are also provided along both sides of Renton Road, Laulaunui Road, Leokū Street, and along Makakilo Drive, as well as the westbound approach of Old Fort Weaver Road near the project area intersections. Crosswalks have also been provided along certain approaches to these intersections to support the sidewalks/bike trails.

2.4 BICYCLE CONDITIONS

A bicycle path is provided along both sides of Fort Weaver Road through the study area. Along the other major roadways, bicycles either use paved shoulder areas, wide outside lanes, or travel within the regular traffic lane.

2.5 TRANSPORTATION DEMAND MANAGEMENT

Since 1990, as Hawai'i's first transportation management organization, the Leeward Oahu Transportation Management Association (LOTMA) has worked to provide and promote alternative transportation options aimed at alleviating traffic congestion, air pollution, and fuel consumption. LOTMA presently sponsors a number of different programs to accommodate the increasing mobility needs of the West and Central Oahu region, including the following:

1. Carpooling and Vanpooling – In an effort to encourage new carpool and vanpool participation, LOTMA has partnered with Vanpool Hawai'i to provide financial start-up subsidies to new vanpool commuters who live in Leeward, Central and North Shore O'ahu.

2. Carpool Matchlist – LOTMA provides the opportunity for commuters living in Leeward, Central, and North Shore O'ahu to join a list of carpoolers which they can be paired with. As an incentive encouraging people to sign up and use this service, LOTMA enters each participant into a drawing for the opportunity to win a gas card valued at $25.00. In addition to the carpool list, LOTMA also provides information on larger carpooling databases offered by the O'ahu Department of Transportation as well as other international ridersharing websites.

3. LOTMA Commuter Express – Offers commuters morning and evening non-stop express service on the freeway express lanes between Central Oahu and Honolulu. Morning service begins at 6:05 AM from the Waipio Gentry Shopping Center and terminates at the Sheraton Waikīkī. Evening service from the Sheraton Waikīkī begins at 4:30 PM and terminates at 6:05 PM at the Miliani Mauka Park and Ride.

4. Emergency Ride Home Program (ERH) – The ERH program offers rides for unplanned personal emergencies including personal/family illness, family crisis, or in the event one's regularly scheduled carpool/vanpool is not available. Participation in the ERH is open to those living or working in Leeward, Central, or North Shore Oahu who carpool/vanpool, or ride the

LOTMA Commuter to work at least once a week. In addition, participants must commute to work by carpool/vanpool, or LOTMA Commuter Express on the day the ERH is needed.

5. LOTMA website – LOTMA regularly updates its website to provide users with the most current information about carpooling, vanpooling, the LOTMA Commuter Express, the Mililani Trolley, and TheBus. In addition, LOTMA also offers special program promotions via its website.

2.6 INTERSECTION OPERATING CONDITIONS

2.6.1 Methodology for Intersection Analysis

Operations of the study intersections were evaluated using Level of Service (LOS) calculations. LOS is a qualitative description of the performance of an intersection based on the average delay per vehicle. Intersection levels of service range from LOS A, which indicates free flow or excellent conditions with short delays, to LOS F, which indicates congested or overloaded conditions with extremely long delays.

Signalized Intersections
Levels of Service for signalized intersections were calculated using the *Highway Capacity Manual 2000* (HCM 2000) methodology. The LOS is based on the average delay (in seconds per vehicle) for the various movements within the intersection. A combined weighted average delay and LOS are presented for each of the signalized intersections. The average delay for signalized intersections was calculated using the Synchro analysis software and is correlated to the level of service designation as shown in Table 2.2.

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Table 2.2
Level of Service Criteria – Signalized Intersections

Level of Service	Description of Operations	Average Delay
A	Operations with very low delay occurring with favorable progression and/or short cycle length.	≤ 10.0
B	Operations with low delay occurring with good progression and/or short cycle lengths.	10.1 – 20.0
C	Operations with average delays resulting from fair progression and/or longer cycle lengths. Individual cycle failures begin to appear.	20.1 – 35.0
D	Operations with longer delays due to a combination of unfavorable progression, long cycle lengths, or high V/C ratios. Many vehicles stop and individual cycle failures are noticeable.	35.1 – 55.0
E	Operations with high delay values indicating poor progression, long cycle lengths, and high V/C ratios. Individual cycle failures are frequent occurrences. This is considered to be the limit of acceptable delay.	55.1 – 80.0
F	Operation with delays unacceptable to most drivers occurring due to over saturation, poor progression, or very long cycle lengths.	≥ 80.1

Source: Highway Capacity Manual, Transportation Research Board, 2000

NOTES:
Delay presented in seconds per vehicle.

Unsignalized Intersections

Unsignalized intersections were evaluated using the *Highway Capacity Manual 2000* methodology. The LOS rating is based on the weighted average control delay expressed in seconds per vehicle as illustrated in Table 2.3. Control delay includes initial deceleration delay, queue move-up time, stopped delay, and final acceleration. At two-way controlled intersections, LOS is calculated for each controlled movement, as opposed to the intersection as a whole. For all-way stop controlled locations, LOS is computed for the intersection as a whole.

Table 2.3
Level of Service Criteria – Unsignalized Intersections

Level of Service	Description of Operations	Average Delay
A	No Delay for stop-controlled approaches.	≤ 10.0
B	Operations with minor delays.	10.1 – 15.0
C	Operations with moderate delays.	15.1 – 25.0
D	Operations with some delays.	25.1 – 35.0
E	Operations with high delays, and long queues.	35.1 – 50.0
F	Operations with extreme congestion, with very high delays and long queues unacceptable to most drivers.	≥ 50.1

Source: Highway Capacity Manual, Transportation Research Board, 2000

NOTES:
Delay presented in seconds per vehicle.

2.6.2 Methodology for Freeway Analysis

Freeway segment operating conditions were evaluated using the *HCM* 2000 methodology. HCM methodology computes LOS for basic freeway segments using density as the measure of effectiveness. Based on the values of the input parameters (geometric data, volume, and base free-flow speed) flow rate and speed are determined. Adjustments are typically made to the base free-flow speed to account for lane width, number of lanes, interchange density, and lateral clearance. Using the flow rate and speed, density of the freeway segment is computed. Table 2.4 presents the LOS criteria for freeway segments using density as the performance measure.

Table 2.4
Level of Service Criteria – Basic Freeway Segments

Level of Service	Density
A	0.0 – 11.0
B	11.1 – 18.0
C	18.1 – 26.0
D	26.1 – 35.0
E	35.1 – 45.0
F	> 45.0

Source: Highway Capacity Manual, Transportation Research Board, 2000

NOTES:
DEC – Demand Exceeds Capacity.
Density is presented in passenger cars per hour per lane.

2.6.3 Methodology for Ramp-Freeway Junction Analysis

As in the case of intersections and freeway segments, *HCM 2000* methodology was applied to identify the operating conditions of the Ramp-Freeway junctions. Similar to freeway segments, HCM methodology computes LOS for ramp-freeway junctions using density as the measure of effectiveness. HCM methodology for ramp-freeway junctions computes demand flow rate after making adjustments to account for peak-hour factor, heavy vehicle factor, and driver population factor. Flow rates are computed immediately upstream of ramp influence area for both merging and diverging ramps. Determination of the LOS is then based on the comparison between the computed demand flow rate and the capacity of the ramp influence area. If the capacity if less than the flow rate then the ramp influence area operates at LOS F. For ramp-freeway junctions, lower densities indicate lower service levels and fewer or no delays; whereas, higher densities indicate higher service levels and long queues. Table 2.5 presents the LOS criteria for ramp-freeway junctions.

AR00027945

Table 2.5
Level of Service Criteria – Ramp-Freeway Junctions

Level of Service	Density	Minimum Speed
A	≤ 10.0	58
B	10.1 – 20.0	56
C	20.1 – 28.0	52
D	28.1 – 35.0	46
E	> 35	42
F	DEC	DEC

Source: Highway Capacity Manual, Transportation Research Board, 2000

NOTES:
DEC – Demand Exceeds Capacity.
Density is presented in passenger cars per hour per lane.
Speed is presented in miles per hour.

In the absence of established local criteria to describe the operating conditions of intersections, freeway segments, and ramp-freeway junctions, LOS D or better is typically considered to be acceptable for peak hours, while LOS E or worse are considered undesirable conditions. As such, this criterion was used to identify the operating conditions of intersections, freeway segments, and ramp-freeway junctions for this transportation study.

2.7 EXISTING TRAFFIC CONDITIONS

2.7.1 Existing Intersection Operating Conditions

Existing intersection operating conditions were evaluated for the morning peak hour (6:00 AM to 8:00 AM) and evening peak hour (3:00 PM to 5:00 PM) using *Synchro* software. It should be noted that Existing commute peak hour traffic volumes at key intersections were developed from manual intersection turning movement counts conducted by Wilbur Smith Associates in April 2006. The traffic movements were counted and recorded by traffic surveyors in 15 minute intervals during the peak commute periods. These counts were then analyzed to determine the peak one-hour traffic volumes at each intersection. The off- and on-ramp volumes at the intersection Kunia Road/ H-1 Westbound Ramps were obtained from the State of Hawaii, Department of Transportation's 24-Hour Traffic Count summaries.

A total of 12 intersections were analyzed under existing conditions of which nine are signalized, and three are Two-Way Stop-Controlled (TWSC) intersections. A field visit was conducted to verify the existing intersection lane configurations, intersection control devices, and signal cycle lengths. Figure 2-2 shows the existing geometric configurations at the study intersections and Figure 2-3 exhibits the AM and PM peak hour turning movement volumes at the 12 study intersections under existing conditions.

The existing lane configurations and peak hour turning movement volumes were used to calculate the levels of service for the 12 study intersections under existing peak hour conditions.

The results of the existing LOS analysis are presented in Table 2.6, and the calculation worksheets are included in Appendix A-1.

Under existing the AM peak hour conditions, seven of the 12 study intersections operate at LOS D or better (acceptable conditions), while the following five intersections operate at LOS E or F (unacceptable conditions):

- Kunia Road/ H-1 Westbound On-Ramp
- Fort Weaver Road/ Laulaunui Road
- Fort Weave Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/ Fort Barrette Road

Similar to AM peak hour conditions, under existing PM peak hour conditions, five study intersections operate at LOS E or F. The remaining seven intersections operate under acceptable conditions. The five intersections operating under unacceptable conditions are:

- Kunia Road/ H-1 Westbound On-Ramp
- Farrington Highway/ Leokū Street
- Fort Weaver Road/ Renton Road
- Farrington Highway/ East Old Fort Weaver Road
- Farrington Highway/ Fort Barrette Road

Figure 2-4 exhibits the LOS and delay values for all the turning movements of the study intersections under existing AM and PM peak hour conditions.

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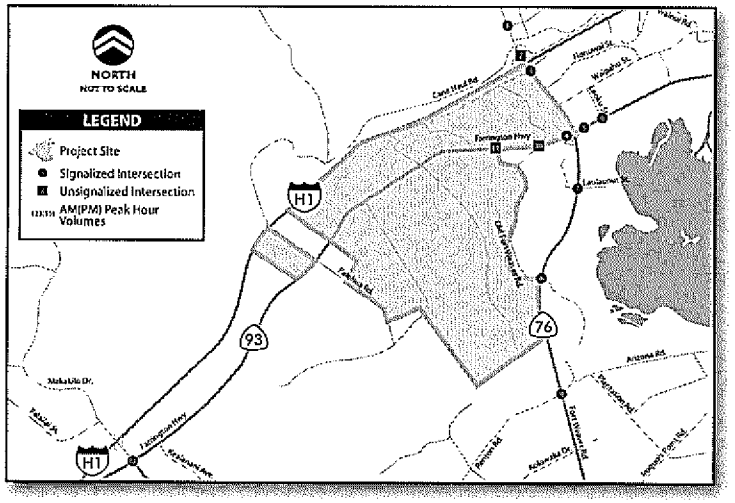


Figure 2-2
INTERSECTION GEOMETRIC CONFIGURATIONS - EXISTING CONDITIONS
100061/BASE - 12/19/06

Wilbur Smith Associates

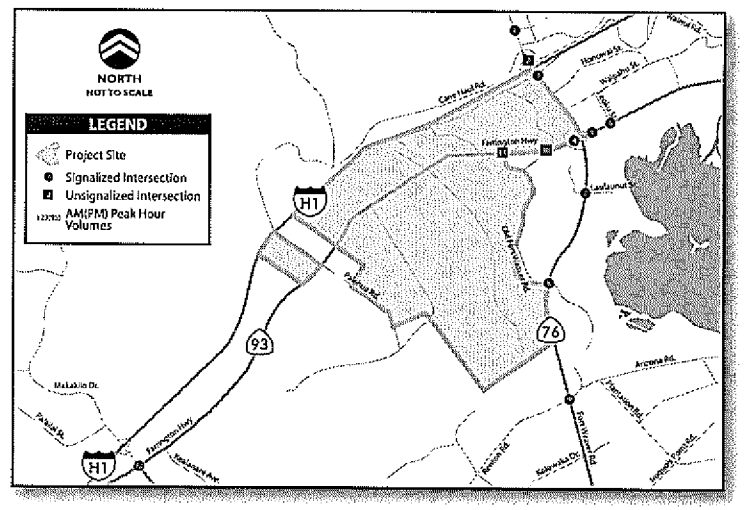


Figure 2-3
PEAK HOUR INTERSECTION VOLUMES - EXISTING CONDITIONS
100061/BASE - 12/19/06

Wilbur Smith Associates

AR00027947

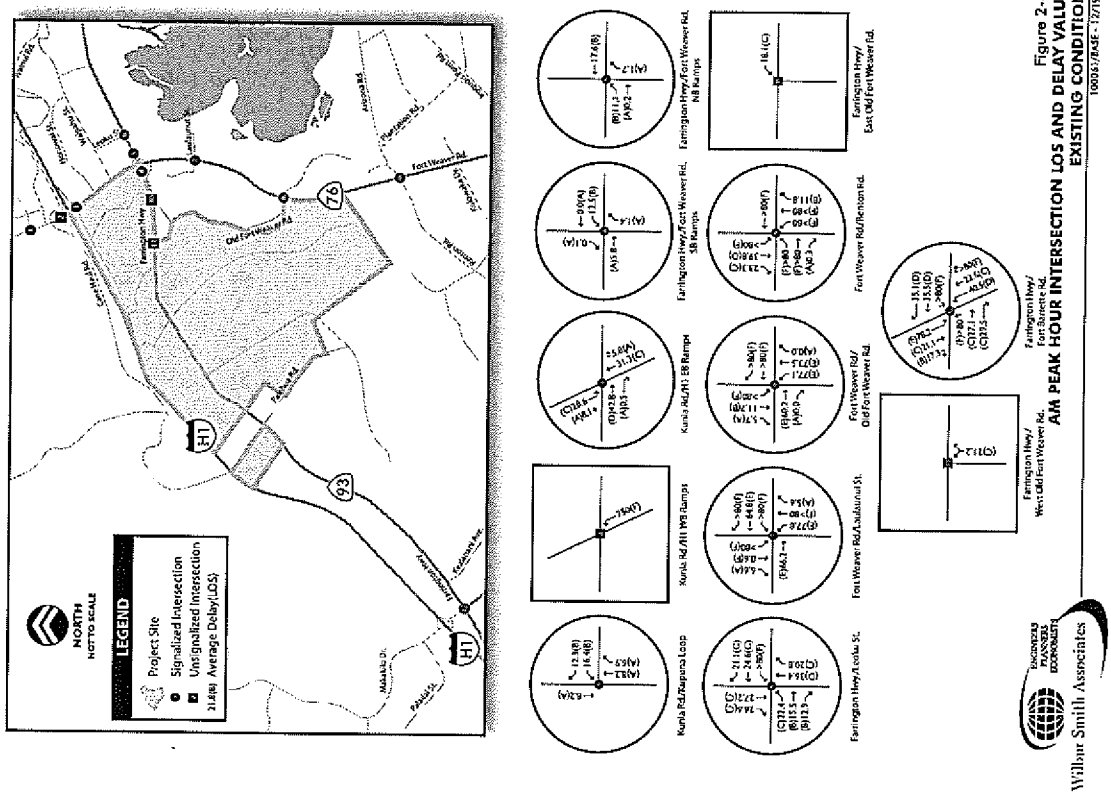


Figure 2-4A
AM PEAK HOUR INTERSECTION LOS AND DELAY VALUES
EXISTING CONDITIONS
10005/BASE - 12/19/06

Wilbur Smith Associates

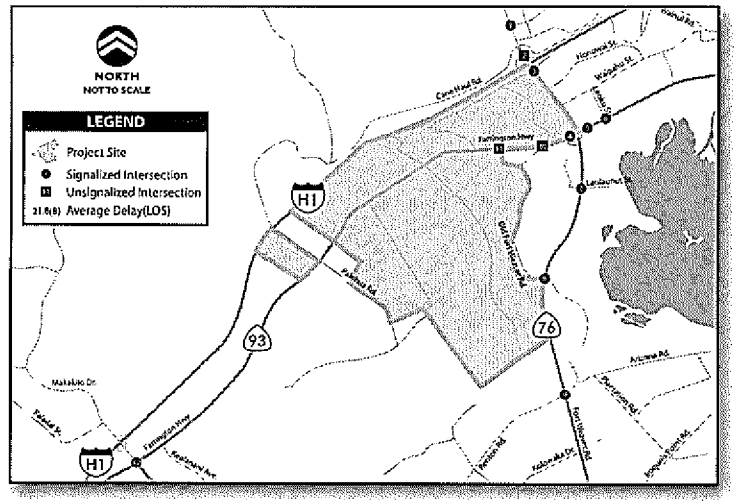
Table 2.6
Peak Hour Intersection Operations – Existing Conditions

#	Intersection	Control	AM			PM		
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS
1	Kunia Rd / Kunia Loop	Signal	10.0	0.54	A	8.8	0.62	A
2	Kunia Rd / H-1 WB On-Ramp	TWSC	723.3 (WB)	2.40 (WB)	F	>1000 (WB)	6.30 (WB)	F
3	Kunia Rd / H-1 EB Ramps	Signal	17.8	0.78	B	19.2	0.95	B
4	Farrington Hwy / Fort Weaver Rd. SB Ramps	Signal	4.0	0.55	A	2.4	0.59	A
5	Farrington Hwy / Fort Weaver Rd. NB Ramps	Signal	5.9	0.60	A	14.6	0.95	B
6	Farrington Hwy / Leokū St	Signal	21.9	0.61	C	108.1	1.18	F
7	Fort Weaver Rd / Laulaunui St	Signal	101.9	1.19	F	29.8	0.86	C
8	Fort Weaver Rd / Old Fort Weaver Rd	Signal	63.0	1.12	E	22.8	0.92	C
9	Fort Weaver Rd / Renton Rd	Signal	98.7	1.19	F	161.5	1.40	F
10	Farrington Hwy / East Old Fort Weaver Rd	TWSC	18.1 (SWB)	0.21 (SWB)	C	89.1 (SWB)	1.09 (SWB)	F
11	Farrington Hwy / West Old Fort Weaver Rd	TWSC	21.2 (NB)	0.18 (NB)	C	24.8 (NB)	0.15 (NB)	C
12	Farrington Hwy / Fort Barrette Rd	Signal	56.4	0.99	E	56.9	1.01	E

Source: Wilbur Smith Associates, 2007

NOTES:
AWSC – All-way Stop Control
TWSC – Two-way Stop Control
Signal – Traffic Signal
Delay presented in seconds per vehicle.
Delay and LOS presented for worst approach for two-way stop controlled intersections.
Bold type indicates unacceptable values.

AR00027948



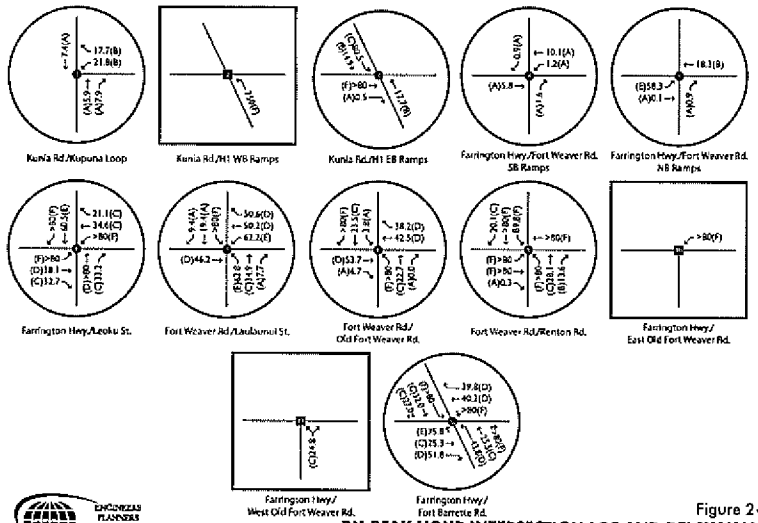


Figure 2-4B
PM PEAK HOUR INTERSECTION LOS AND DELAY VALUES
EXISTING CONDITIONS
100061/BASE - 12/19/06

Wilbur Smith Associates

2.7.2 Existing Freeway Segment Operating Conditions

Roadway and traffic control information was obtained through field reconnaissance by Wilbur Smith Associates (WSA) during April 2006. The roadway inventory included those items needed to estimate roadway capacities specifically, number and width of lanes, shoulder conditions, types of traffic controls, and traffic signal phasing and timing. Peak hour freeway segment volumes were obtained from the 24-Hour Traffic Count Station Summaries of the State of Hawaii, Department of Transportation.

The existing mainline freeway characteristics including number of lanes, volumes and posted speed limits were used to calculate the levels of service for each of the 10 existing freeway segments during each peak hour. The results of the existing freeway segment analysis using *Highway Capacity Software* (HCS), which is developed following the method described in the 2000 *Highway Capacity Manual* (HCM) are presented in Table 2.7 and the calculation worksheets are included in Appendix B-1.

Under AM peak hour conditions, 9 freeway segments operate under acceptable conditions (LOS D or better), while one (1) of the freeway segment, H-1 Eastbound (west of Pāiwa Street) operates under unacceptable conditions, LOS E.

Under PM peak hour conditions, eight of the 10 study freeway segments operate under acceptable conditions (LOS D or better), while the remaining two freeway segments H-1 Westbound (west of Pāiwa Street) and H-1 Westbound (east of Kamehameha Highway) operate under unacceptable conditions (LOS E or worse).

Figure 2-5 presents the existing freeway operating conditions.

Table 2.7
Peak Hour Freeway Segment Operations – Existing Conditions

#	Freeway	Segment	AM Peak Volume	AM Peak Density	AM Peak LOS	PM Peak Volume	PM Peak Density	PM Peak LOS
1	H-1 EB	S/O Makakilo Dr.	1582	10.6	A	1762	11.8	B
2	H-1 EB	W/O Kunia Rd.	3808	25.5	C	4077	27.3	D
3	H-1 EB	W/O Pāiwa St.	7067	35.7	E	4446	21.7	C
4	H-1 EB	E/O Kamehameha Hwy.	4468	28.4	D	2652	17.7	B
5	H-2 NB	At Ka Uka Blvd.	1777	11.9	B	3196	21.4	C
6	H-1 WB	S/O Makakilo Dr.	1482	9.9	A	2223	14.9	B
7	H-1 WB	W/O Kunia Rd.	3331	22.3	C	4079	25.1	C
8	H-1 WB	W/O Pāiwa St.	4366	21.3	C	7425	38.6	E
9	H-1 WB	E/O Kamehameha Hwy.	3069	20.5	C	5824	42.8	E
10	H-2 SB	At Ka Uka Blvd.	4078	27.3	D	2534	16.9	B

Source: Wilbur Smith Associates, 2007

NOTES:
Density is given in pc/mi/ln

AR00027949

2.7.3 Existing Ramp-Freeway Junction Operating Conditions

Similar to freeway segments, *HCS* software was used to analyze the ramp-freeway junctions. Table 2.8 exhibits the operating conditions of the existing ramp-freeway junctions; the calculation worksheets are included in Appendix C-1.

Under existing conditions, eastbound on-ramp at H-1/ Fort Weaver Road has three lanes. It should be noted that *HCS* software has a limitation in that it can only analyze up to a maximum of two lanes per ramp. Therefore, the LOS and density values of ramp-freeway junction H-1/ Fort Weaver Road (Eastbound On-Ramp) could not be determined.

Under existing AM peak hour conditions, four ramp-freeway junctions operate at LOS C or better (acceptable conditions).

Under PM peak hour conditions, two ramp-freeway junctions H-1/ Fort Weaver Road (Westbound Off-Ramp) and H-1/ Fort Weaver Road (Westbound Loop Off-Ramp) operate at LOS F. The remaining two ramp-freeway junctions operate under acceptable conditions.

Table 2.8
Ramp-Freeway Junction Operations – Existing Conditions

#	Location	Ramps	Peak Hour	Density	LOS
1	H-1/ Fort Weaver Road	WB Off-Ramp	AM Peak	31.1	D
2	H-1/ Fort Weaver Road	WB Loop Off-Ramp	AM Peak	20.1	C
3	H-1/ Fort Weaver Road	WB On-Ramp	AM Peak	20.7	C
4	H-1/ Fort Weaver Road	EB Off-Ramp	AM Peak	24.9	C
5	H-1/ Fort Weaver Road	EB On-Ramp	AM Peak	N.D.	N.D.
6	H-1/ Fort Weaver Road	WB Off-Ramp	PM Peak	DEC	**F**
7	H-1/ Fort Weaver Road	WB Loop Off-Ramp	PM Peak	DEC	**F**
8	H-1/ Fort Weaver Road	WB On-Ramp	PM Peak	25.1	C
9	H-1/ Fort Weaver Road	EB Off-Ramp	PM Peak	25.8	C
10	H-1/ Fort Weaver Road	EB On-Ramp	PM Peak	N.D.	N.D.

Source: Wilbur Smith Associates, 2007

NOTES:
DEC – Demand Exceeds Capacity
N.D. – Could not be determined
Density is presented in pc/mi/ln.
Bold type indicates LOS F.

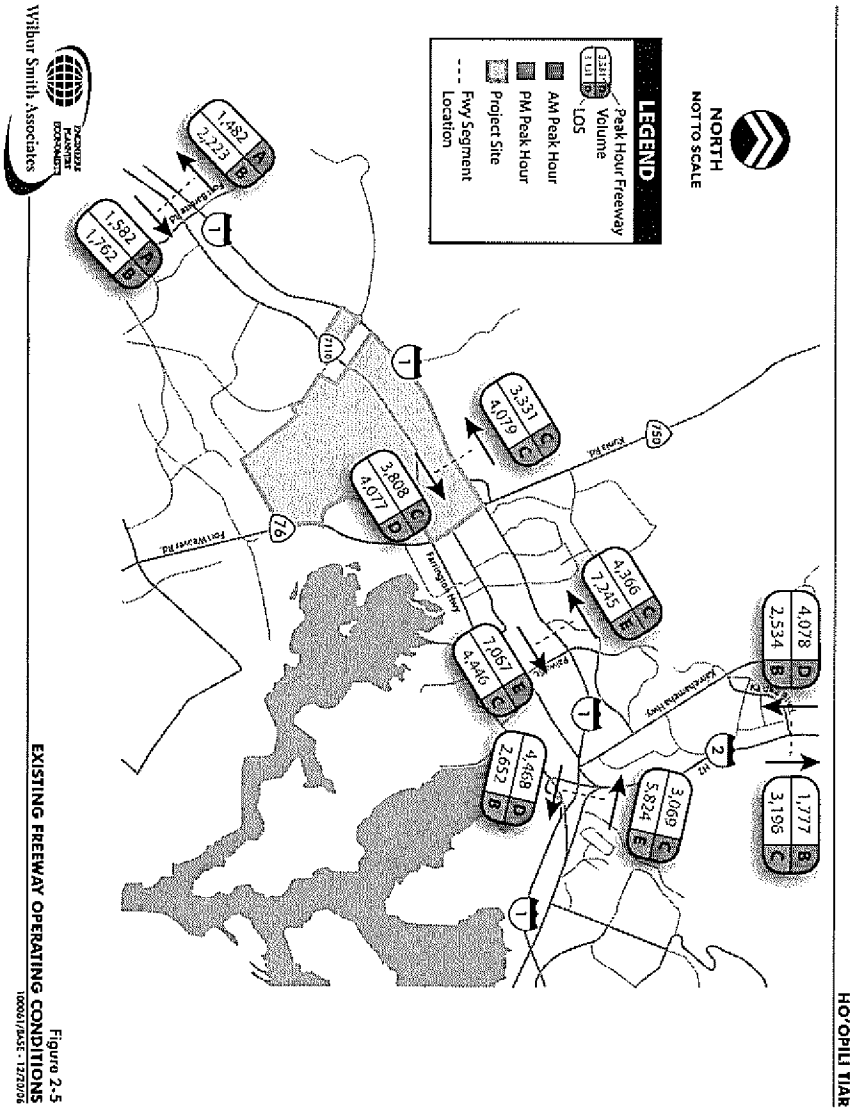


Figure 2-5
EXISTING FREEWAY OPERATING CONDITIONS
10000/BASE - 12/20/06

HO'OPILI TIAR

AR00027950

Chapter 3
2030 BASELINE CONDITIONS

This chapter discusses the methodology involved in the development of 2030 Baseline Conditions (without the proposed project) traffic volumes, and the operations of the study intersections. These conditions form the basis against which transportation impacts related to the proposed project will be identified.

Year 2030 represents the full buildout year of the Ho'opili Project, with all phases of the proposed project expected to be completed. As such, year 2030 has been selected as the future year of analysis to identify the operating conditions of the transportation network located in the vicinity of the proposed project under with and without Project conditions.

3.1 YEAR 2030 TRANSPORTATION SYSTEM IMPROVEMENTS

This section documents the planned transportation and circulation system improvements currently identified and approved by the Oahu Metropolitan Planning Organization (OMPO). The Oahu Regional Transportation Plan (ORTP) 2030 identifies a number of improvements to existing regional roadways and the construction of new facilities. In addition, some improvements are identified in the ongoing 'Ewa Connectivity study. The regional circulation improvements in the vicinity of the study area are located along the following corridors:

- H-1 Freeway
- Farrington Highway
- Fort Barrette Road
- Fort Weaver Road
- East-West Connector Road
- Kapolei Parkway
- Kunia Road
- Makakilo Drive
- North-South Road

Table 3.1 describes the planned and approved transportation improvement projects that are located in the vicinity of the study area. The corridors planned to be improved, the locations along the corridor, and the programmed improvements at those locations are summarized in Table 3.1.

3.2 STUDY AREA – 2030 BASELINE CONDITIONS

Due to the planned improvement of existing transportation network near the project site, the study area would include the new intersections located along North-South Road under 2030 Baseline Conditions. The following seven new intersections would be studied under Year 2030 Conditions in addition to the 12 study intersections analyzed under Existing Conditions:

- North-South Road/ H-1 Westbound Ramps
- North-South Road/ H-1 Eastbound Ramps
- North-South Road/ Farrington Highway
- North-South Road/ North University of Hawai'i Connector

- North-South Road/ South University of Hawai'i Connector
- North-South Road/ Kapolei Parkway
- East-West Road/ Old Fort Weaver Road

Figure 3-1 depicts the locations of the study intersections for 2030 Baseline Conditions, while Figures 3-2A and 3-2B presents the Year 2030 lane configurations of the study intersections.

The three unsignalized intersections -- Kunia Road/ H-1 Westbound On-Ramp, Farrington Highway/ East Old Fort Weaver Road, and Farrington Highway/ West Old Fort Weaver Road – were analyzed to assess whether installation of traffic signal controls would be appropriate under Year 2030 Conditions. The Peak Hour traffic signal analysis (MUTCD Warrant #3) for the unsignalized study intersections indicated that the forecast conditions at the intersection of Kunia Road with the H-1 Westbound On-Ramp would satisfy the signal warrant analysis. As such, for analysis purposes the intersection of Kunia Road/ H-1 Westbound On-Ramp has been considered as a signalized intersection under Year 2030 Conditions. Traffic signal warrant analysis sheets for Year 2030 Conditions are included in Appendix D-1.

Therefore, Year 2030 Conditions encompass 19 study intersections, of which 17 intersections are signalized and two are two-way stop-controlled intersections. The two unsignalized intersections are Farrington Highway/ East Old Fort Weaver Road and Farrington Highway/ West Old Fort Weaver Road.

The new interchange of the North-South Road with H-1 Freeway would be operational in year 2030. Therefore, under Year 2030 Conditions, the following four additional ramp-freeway junctions would be analyzed along with the five study ramp-freeway junctions studied under Existing Conditions:

- North-South Road/ H-1 (Eastbound On-Ramp)
- North-South Road/ H-1 (Eastbound Off-Ramp)
- North-South Road/ H-1 (Westbound On-Ramp)
- North-South Road/ H-1 (Westbound Off-Ramp)

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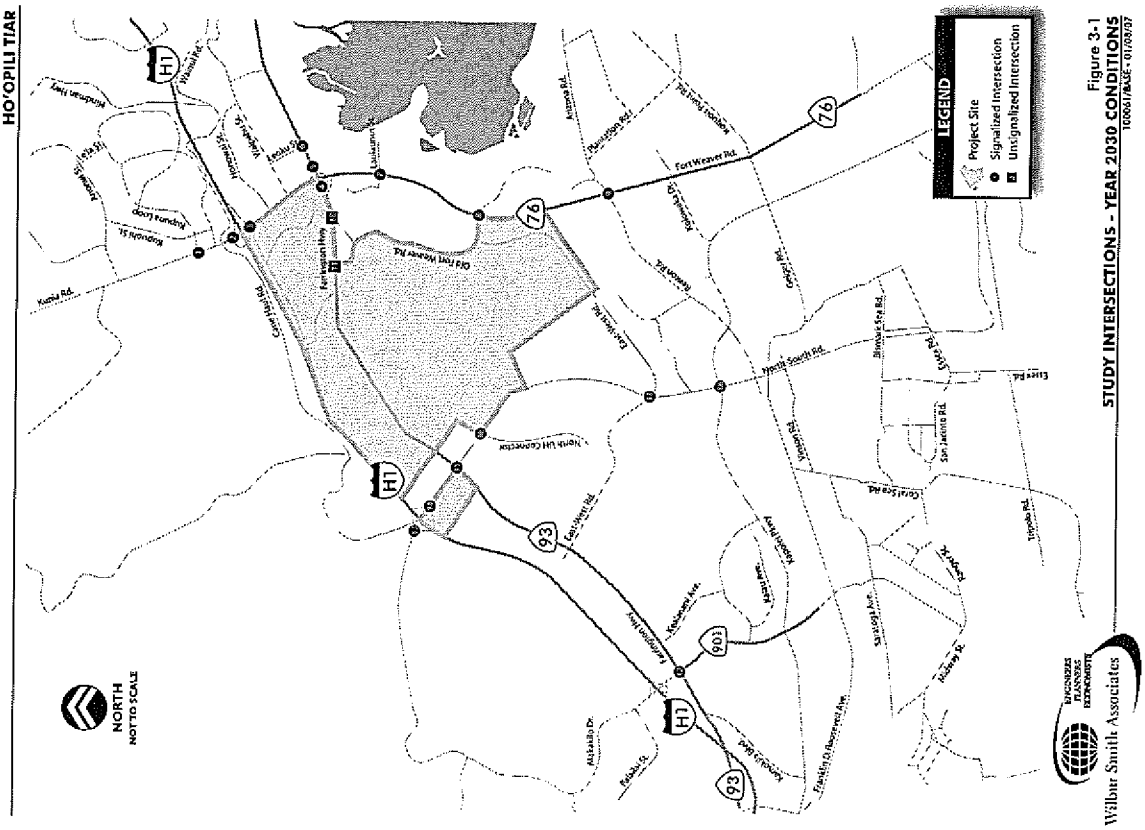

Figure 3-1
STUDY INTERSECTIONS - YEAR 2030 CONDITIONS
100661/BASE - 01/09/07

Table 3.1
Planned and Approved Transportation Network Improvement Projects

#	Roadway	Location	Proposed Improvement
1	H-1 Freeway	Ke'ehi Interchange – Kunia Interchange	Construct WB zipper lane for PM peak period
		City of Kapolei	Construct a new interchange between Pālailai and Makakilo Interchanges
		Makakilo Interchange	Construct a new EB off-ramp and a new WB on-ramp
		Waiawa Interchange – Makakilo Interchange	Construct 1 HOV lane in each direction
		Waiawa Interchange – Paiwa Interchange	Widen H-1 WB from 2 to 3 lanes in AM peak, from 4 to 5 lanes in PM peak
2	Farrington Hwy.	Kapolei Golf Course Rd. – W/O Fort Weaver Rd.	Widen from 2 to 4 lanes
		W/O Fort Weaver Rd. – Waiawa Interchange	Widen by 1 lane in each direction
3	Fort Barrette Rd.	Farrington Hwy. – Franklin D Roosevelt Ave.	Widen from 2 to 4 lanes
4	Fort Weaver Rd.	Farrington Hwy. – Geiger Rd.	Widen from 4 to 6 lanes
5	Kapolei Pkwy.	Kamokila Blvd. – Fort Barrette Rd.	Construct 6-lane parkway extension
		'Ewa Village Boundary – Renton Rd.	Construct 6-lane parkway extension
		Geiger Rd. – Papipi Rd.	Construct 4-lane parkway extension
		Ali'inui Dr. – Hanua St.	Construct 4-lane parkway extension
		Hānu'a St. – Kalaeloa Blvd.	Construct 6 lane parkway extension
6	Kunia Rd.	Anonui St. – Kupuna Loop	Widen from 2 to 4 lanes
		Kupuna Loop – Farrington Hwy.	Widen from 4 to 6 lanes
		Intersection Kunia Rd./ H-1 EB Ramps	Add 1 lane EB loop on-ramp
7	Makakilo Dr.	Makakilo Dr. – North South Rd.	Extend Makakilo Dr. south to H-1 Freeway as 4-lane roadway
8	North-South Rd.	Kapolei Pkwy. – Interstate Route H-1	Widen from 3 to 6 lines
		Kapolei Pkwy. – Franklin D Roosevelt Ave.	Construct 6-lane extension
9.	East-West Rd	North-South Road – Old Fort Weaver Rd	Construct new road

Source: Oahu Regional Transportation Plan 2030 & on-going EWA Roadway Connectivity Study

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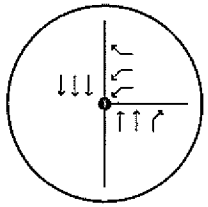
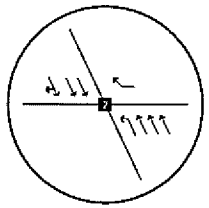

Kunia Rd./Kupuna Loop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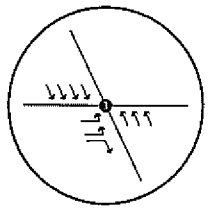
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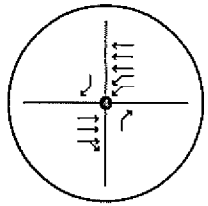
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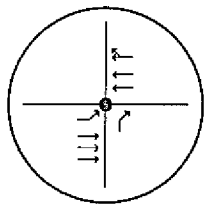
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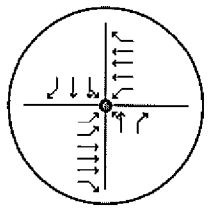
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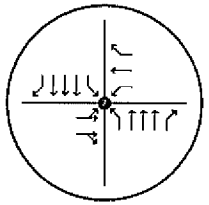
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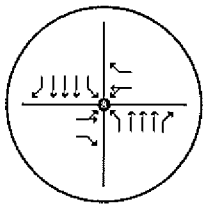
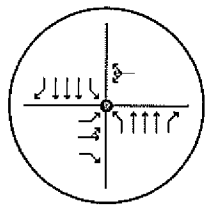

Fort Weaver Rd./ Old Fort Weaver Rd.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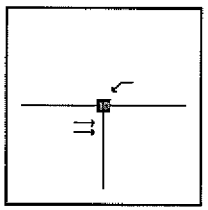
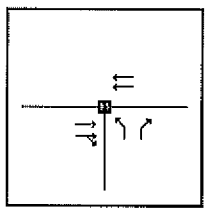

Farrington Hwy./ East Old Fort Weaver Rd.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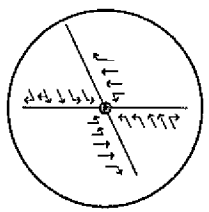
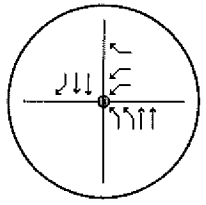

Farrington Hwy./ Fort Barrette Rd.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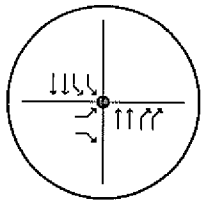
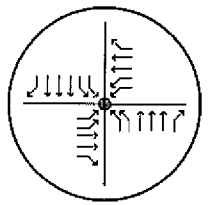
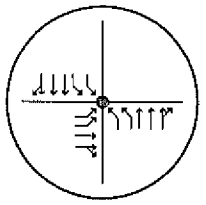
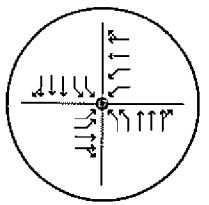
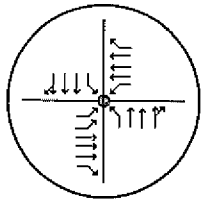
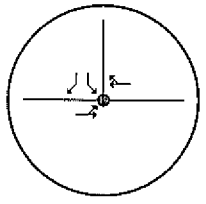

North-South Rd./ H1 EB Ramps


North-South Rd./ Farrington Hwy.


North-South Rd./ UH North Entrance


North-South Rd./ East-West Rd.


North-South Rd./ Kapolei Pkwy.


East-West Rd./ Old FOrt Weaver Rd.

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3.3 2030 BASELINE CONDITIONS TRAFFIC ESTIMATE

Traffic volumes under Year 2030 Conditions were estimated based on the forecasts provided by the Year 2030 Oahu Metropolitan Planning Organization (OMPO) Transportation Model. Appendix E-1 presents the land use assumptions contained in the OMPO Model. This approach results in a cumulative impaet assessment for future conditions and takes into account any anticipated developments expected by year 2030 near the project, plus the expected growth in housing and employment for the remainder of the region.

The OMPO Model study area is divided into 23 districts. The most recent version of the OMPO Model estimates future travel demand for the entire O'ahu region based on the UrbanSim modeling forecasts for year 2030.

Within the OMPO model, the entire study area covering the O'ahu region is divided into approximately 763 geographic areas, known as Transportation Analysis Zones (TAZs). For each TAZ, the model estimates the travel demand based on the population and employment assumptions, detennines the origin, destination, and mode of travel for each trip and assigns those trips to the transportation network. This model output was used to determine the traffic volumes at the study intersections and the freeway segments for year 2030.

Since the OMPO model was developed as a tool to forecast future traffic volumes on major regional traffic facilities and on major local streets, post-processing of the model output was conducted to identify future intersection turning movement volumes. The AM and PM peak hour roadway segment volumes for each of the approaches of the intersections under year 2030 conditions as predicted by the OMPO Transportation Model were utilized to calculate the turning movement volumes for year 2030. These Year 2030 intersection turning movement volumes were developed using 'Furness' process. The 'Furness' process used by WSA is in accordance with *NCHRP 255: Highway Traffic Data for Urbanized Area Project Planning & Design (Chapter 8)*. This process involves balancing the intersection volumes using an iterative process to compare them to the existing traffic distribution. The iterative process seeks to balance the total inbound and outbound volumes from each approach as projected by the transportation model.

Figures 3-3A, 3-3B, and 3-3C depict the Year 2030 peak hour intersection turning movement volumes as developed using the methodology described in the preceding paragraphs.

The traffic study conducted for the University of Hawai'i West Oahu campus indicates that several major roadways also considered part of the proposed project would be improved by 2009 and 2025. The following improvements would take place by year 2009: H-1 Freeway and Farrington Highway are assumed to be widened, and a new North-South Road, interchange at H-1 Freeway and connection to the completed Kapolei Parkway are anticipated. Based on the 2030 O'ahu Regional Transportation Plan (ORTP), the high-occupancy vehicle (HOV) lanes on H-1 Freeway are planned to be extended from Waiawa Interchange (H-1/H-2 Merge) to the Makakilo Interchange.

Note that both the State of Hawai'i Department of Transportation (HDOT) and the City and County of Honolulu were consulted on the potential timing of these projects. Road improvements anticipated by Year 2025 include the widening of Fort Barrette Road and Forth Weaver Road, additional roadways proposed by Ho'opili and East Kapolei I and the completion of the East-West Connector Road between Farrington Highway and Fort Weaver Road. As such, these improvements were assumed to be in place under Year 2030 conditions.

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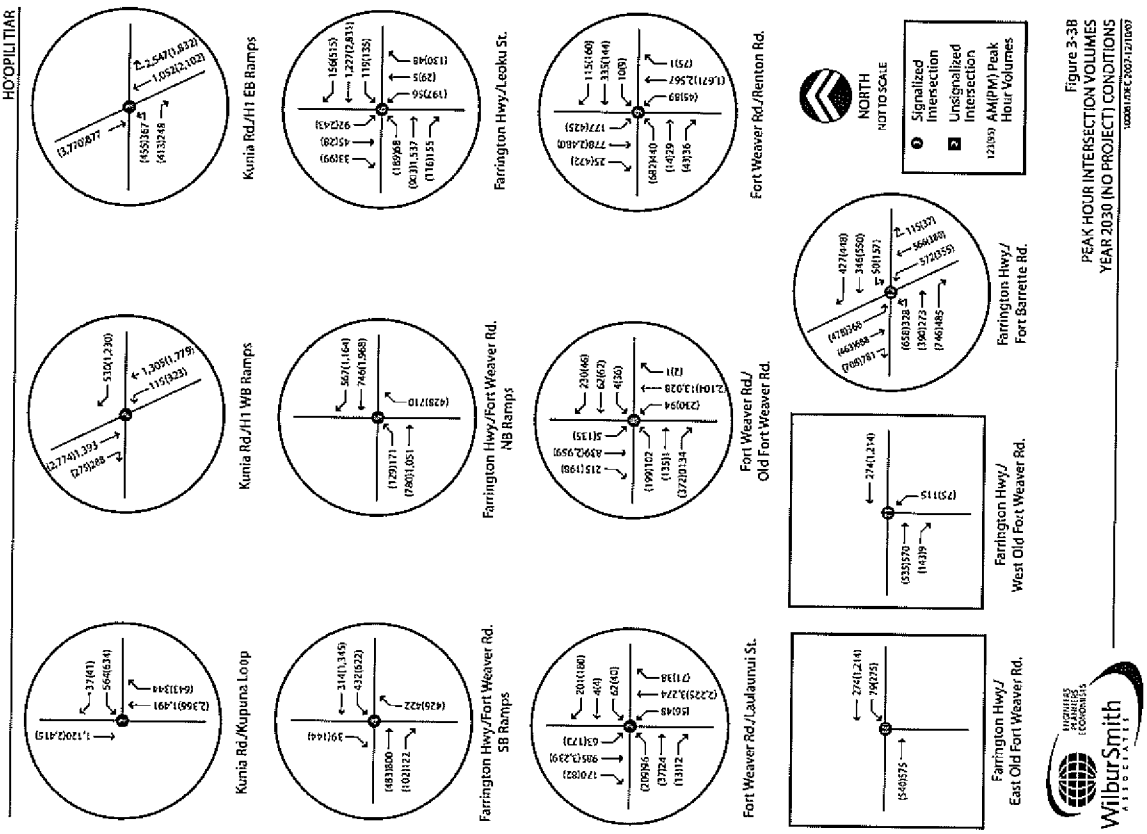

Figure 3-3B
PEAK HOUR INTERSECTION VOLUMES
YEAR 2030 (NO PROJECT) CONDITIONS

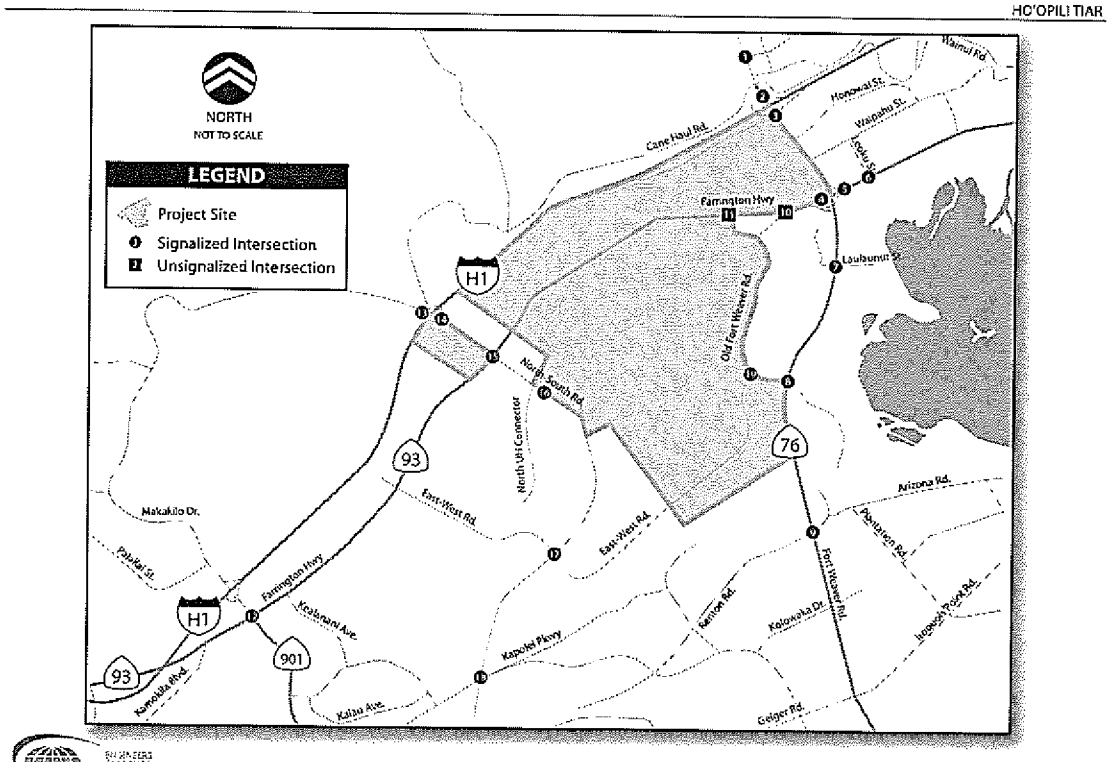

Figure 3-3A
PEAK HOUR INTERSECTION VOLUMES
YEAR 2030 (NO PROJECT) CONDITIONS

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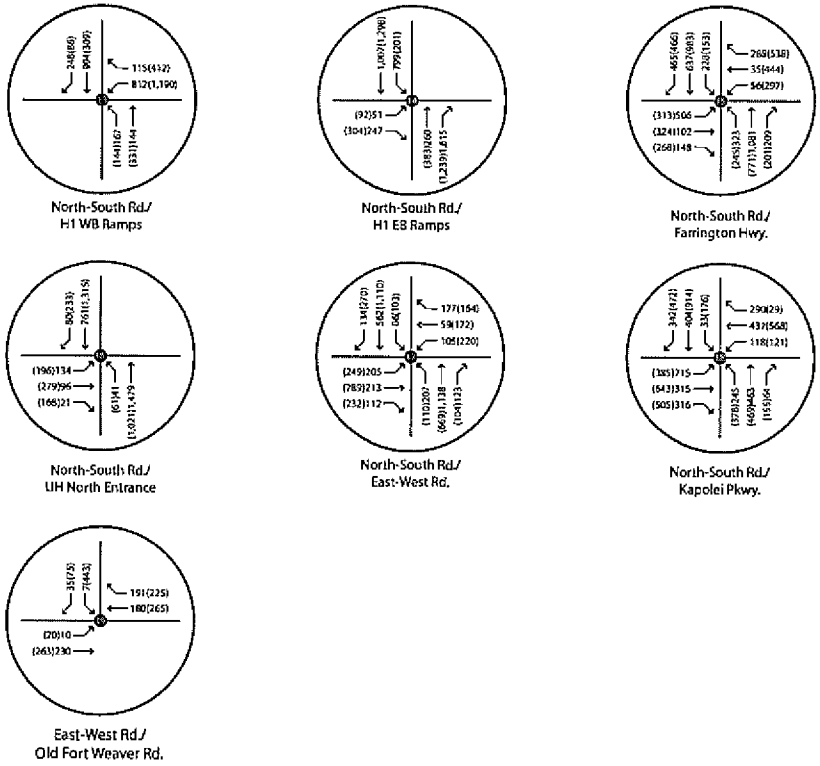

Figure 3-3C
PEAK HOUR INTERSECTION VOLUMES
YEAR 2030 (NO PROJECT) CONDITIONS
100061/DEC 2007-12/10/07

3.4 2030 BASELINE INTERSECTION OPERATING CONDITIONS

Using the volumes presented in Figure 3-3 and with the proposed improvement plans in Year 2030 as discussed in *Section 3.2*, the traffic conditions at the study intersections were calculated for the Year 2030 Baseline AM and PM peak hours. Table 3.2 presents the Year 2030 Baseline delays and LOS values of the study intersections, while the intersection analysis worksheets are included in Appendix A-2.

During the Year 2030 AM peak hour, 17 of the 19 study intersections would operate under acceptable conditions (LOS D or better). The two study intersections that would operate under unacceptable conditions (LOS E or worse) are:

- Fort Weaver Road/ Renton Road
- Farrington Highway/ Fort Barrette Road

During Year 2030 PM peak period, the study intersections would operate at LOS D or better with the exception of the following three intersections:

- Fort Weaver Road/ Renton Road
- Farrington Highway/ West Old Fort Weaver Road
- Farrington Highway/ Fort Barrette Road

The intersection at Farrington Highway/ West Old Fort Weaver Road would operate at LOS F, while the other two intersections would operate at LOS E.

Figures 3-4A1, 3-4A2, and 3-4A3; 3-4B1, 3-4B2, and 3-4BC exhibit the LOS and delay values for each of the turning movements at the study intersections during the AM and PM Peak Hour, respectively.

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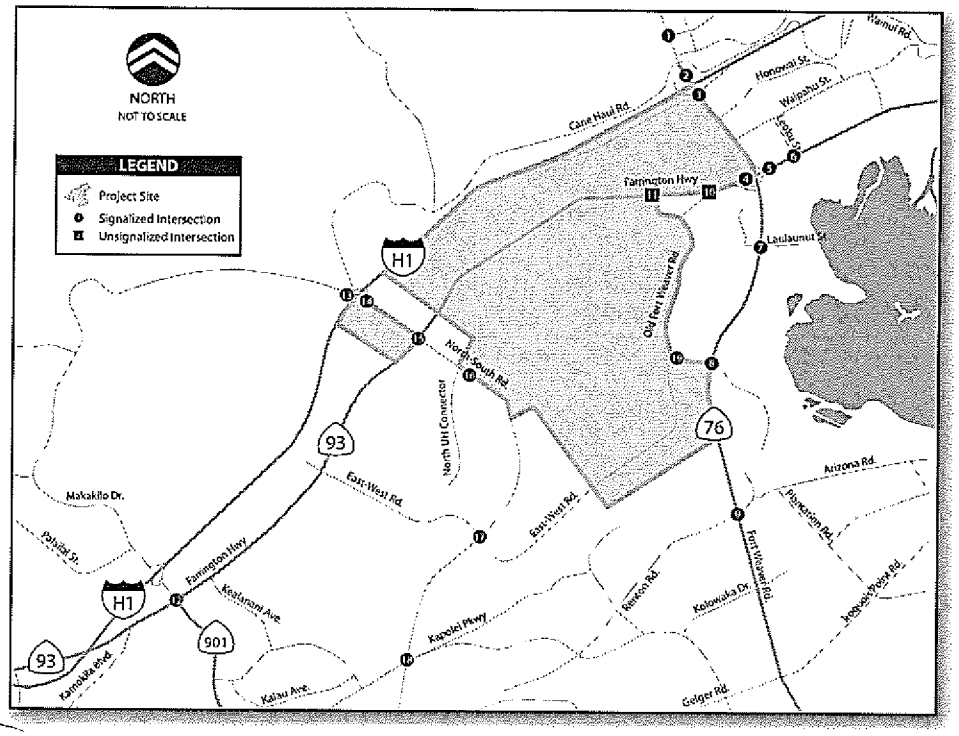

WilburSmith ASSOCIATES

Figure 3-4A1
AM PEAK HOUR LOS AND DELAY VALUES
YEAR 2030 (NO PROJECT) CONDITIONS

Table 3.2
Peak Hour Intersection Operations – Year 2030 Conditions

#	Intersection	Control	Year 2030					
			AM Peak			PM Peak		
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS
1	Kunia Rd./ Kunia Loop	Signal	12.8	0.70	B	17.1	0.90	B
2	Kunia Rd./ H-1 WB On-Ramp[A]	Signal	3.3	0.47	A	14.1	0.92	B
3	Kunia Rd./ H-1 EB Ramps	Signal	8.9	0.37	A	8.8	0.85	A
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	5.2	0.41	A	14.0	0.42	B
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	3.0	0.48	A	8.0	0.83	A
6	Farrington Hwy./ Leokū St.	Signal	18.0	0.63	B	47.7	0.88	D
7	Fort Weaver Rd./ Laulaunui St.	Signal	29.8	0.90	C	26.3	0.89	C
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	16.7	0.89	B	45.0	1.03	D
9	Fort Weaver Rd./ Renton Rd.	Signal	**78.1**	**1.08**	**E**	**63.4**	**1.03**	**E**
10	Farrington Hwy./ East Old Fort Weaver Rd.	TWSC	16.4 (WB)	0.21 (WB)	C	32.0 (WB)	0.71 (WB)	D
11	Farrington Hwy./ West Old Fort Weaver Rd.	TWSC	22.0 (NB)	0.37 (NB)	C	**55.4 (NB)**	**0.55 (NB)**	**F**
12	Farrington Hwy./ Fort Barrette Rd.	Signal	62.7	0.77	**E**	67.5	0.88	**E**
13	North-South Rd./ H-1 WB Ramps	Signal	32.4	0.68	C	25.6	0.59	C
14	North-South Rd./ H-1 EB Ramps	Signal	38.1	0.74	D	15.7	0.62	B
15	North-South Rd./ Farrington Hwy.	Signal	35.2	0.61	D	35.8	0.76	D
16	North-South Rd./ North UH Connector	Signal	7.3	0.39	A	13.5	0.47	B
17	North-South Rd./ East-West Road	Signal	27.0	0.63	C	28.6	0.62	C
18	North-South Rd./ Kapolei Pkwy.	Signal	34.8	0.75	C	54.2	0.88	D
19	East-West Rd./ Old Fort Weaver Rd.	Signal	22.3	0.24	C	20.6	0.62	C

Source: Wilbur Smith Associates, 2007

NOTES:
A - This location is stop-controlled under existing conditions, but is signalized after meeting the traffic signal warrants under year 2030 conditions.
TWSC – Two-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

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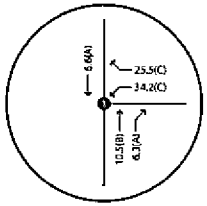
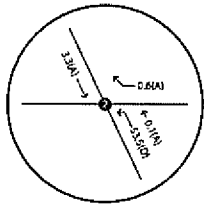
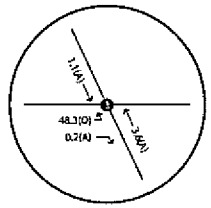


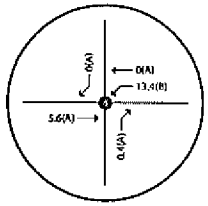
Kunia Rd./Kupuna Loop



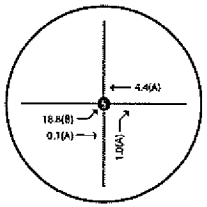
Kunia Rd./H1 WB Ramps



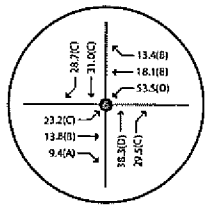
Kunia Rd./H1 EB Ramps



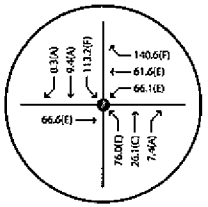
Farrington Hwy./Fort Weaver Rd. SB Ramps



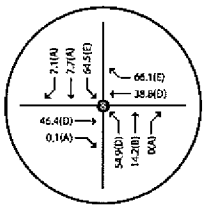
Farrington Hwy./Fort Weaver Rd. NB Ramps



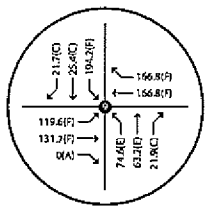
Farrington Hwy./Leoku St.



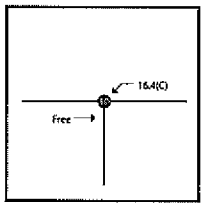
Fort Weaver Rd./Laulaunui St.



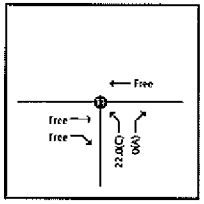
Fort Weaver Rd./ Old Fort Weaver Rd.



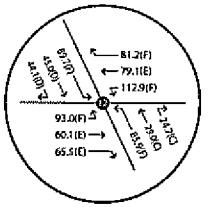
Fort Weaver Rd./Renton Rd.



Farrington Hwy./ East Old Fort Weaver Rd.



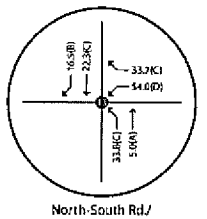
Farrington Hwy./ West Old Fort Weaver Rd.



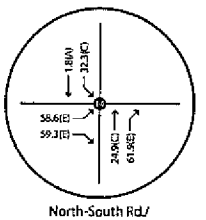
Farrington Hwy./ Fort Barrette Rd.

NOT TO SCALE

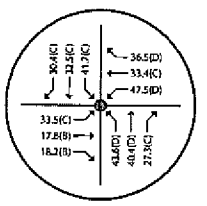
	Signalized Intersection
	Unsignalized Intersection
21.8(B)	Average Delay (LOS)



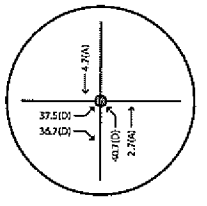
North-South Rd./ H1 WB Ramps



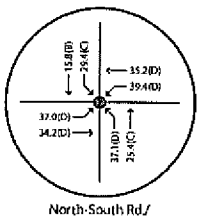
North-South Rd./ H1 EB Ramps



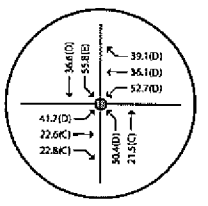
North-South Rd./ Farrington Hwy.



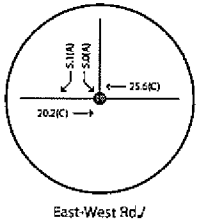
North-South Rd./ UH North Entrance



North-South Rd./ East-West Rd.



North-South Rd./ Kapolei Pkwy.



East-West Rd./ Old Fort Weaver Rd.

NOT TO SCALE

	Signalized Intersection
	Unsignalized Intersection
21.8(B)	Average Delay (LOS)

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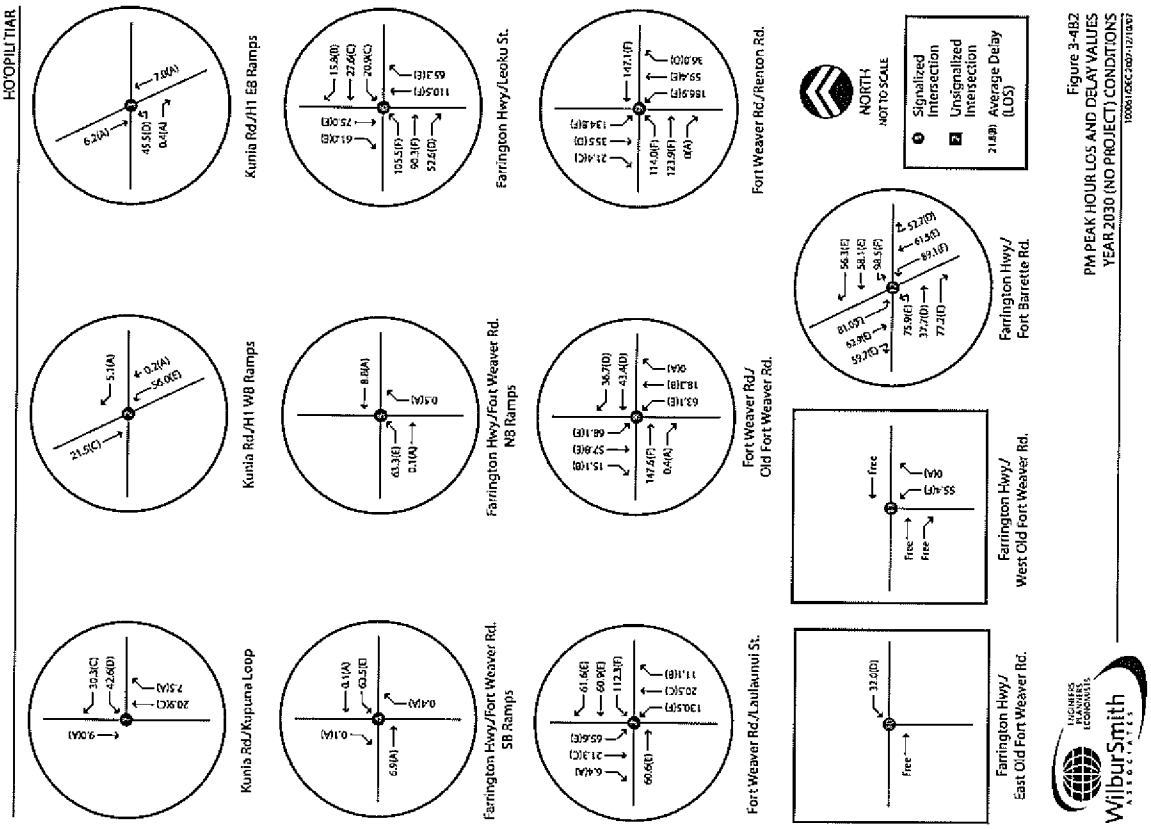

Figure 3-482
PM PEAK HOUR LOS AND DELAY VALUES
YEAR 2030 (NO PROJECT) CONDITIONS

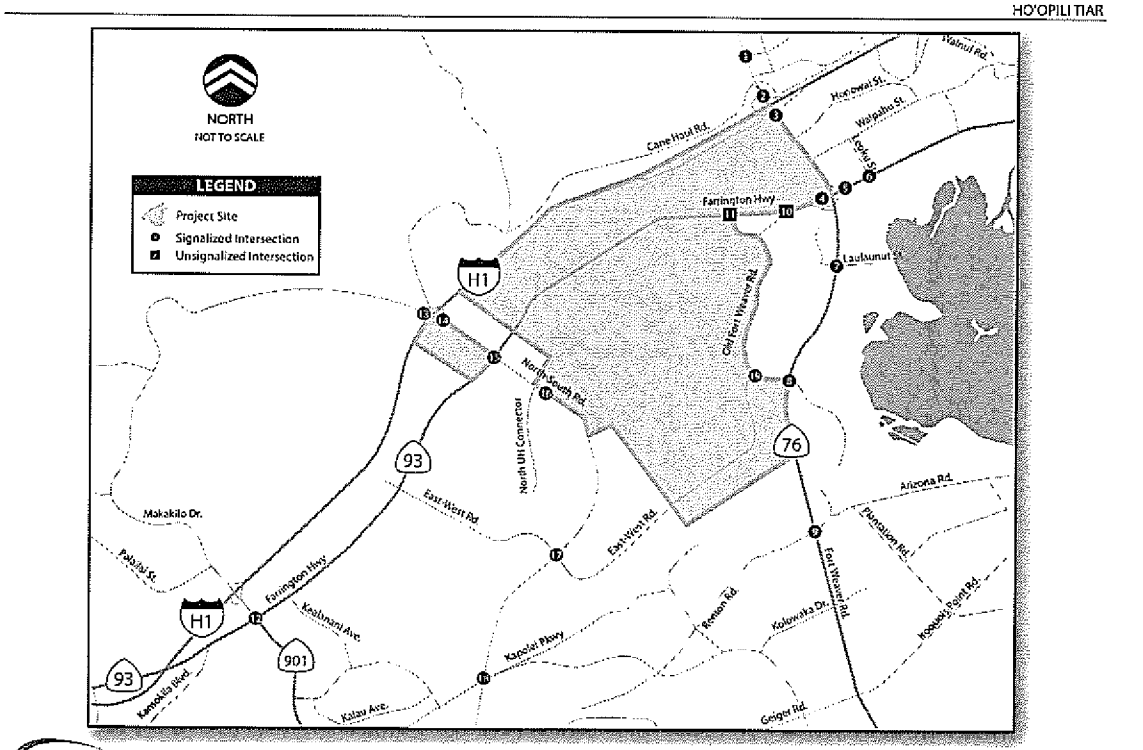

Figure 3-481
PM PEAK HOUR LOS AND DELAY VALUES
YEAR 2030 (NO PROJECT) CONDITIONS

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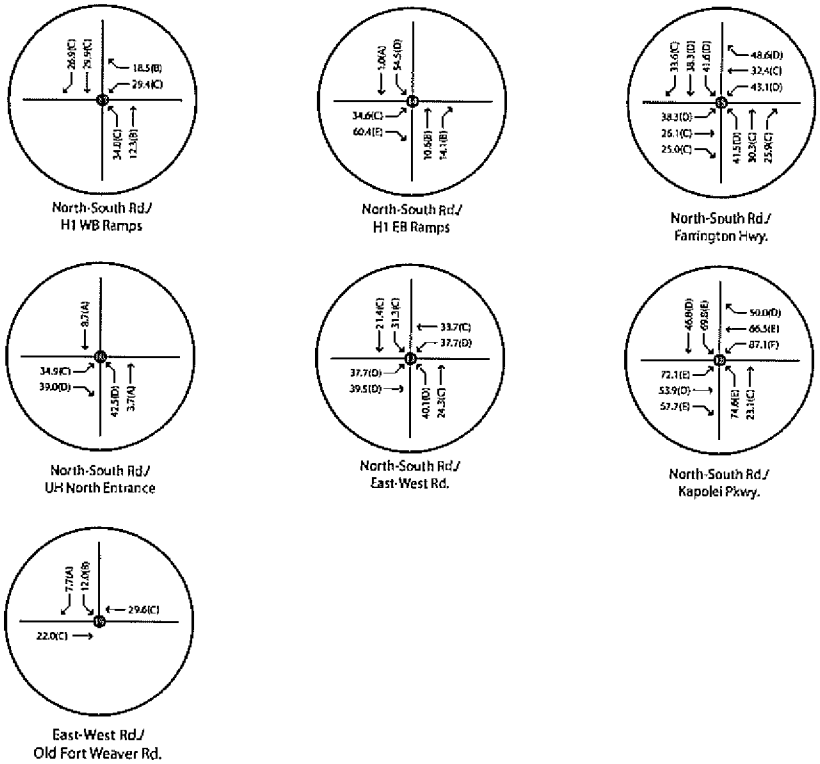

Figure 3-48
PM PEAK HOUR LOS AND DELAY VALUES
YEAR 2030 (NO PROJECT) CONDITIONS
100061/DEC 2007-12/10/07

3.5 FREEWAY SEGMENT OPERATING CONDITIONS

Table 3.3 presents the operating conditions of the study freeway segments for year 2030 AM and PM peak hours. During the Year 2030 AM peak hour, six of the 10 study freeway segments would operate under acceptable conditions (LOS D or better). Freeway segments that would operate under unacceptable conditions (LOS E or worse) are:

- H-1 Eastbound (south of Makakilo Drive) – LOS E
- H-1 Eastbound (west of Kunia Road) – LOS F
- H-1 Eastbound (west of Pāiwa Street) – LOS E
- H-1 Eastbound (east of Kamehameha Highway) – LOS E

Under Year 2030 PM peak hour conditions, the following four freeway segments would operate under unacceptable conditions:

- H-2 Northbound (at Ka Uka Boulevard) – LOS F
- H-1 Westbound (south of Makakilo Drive) – LOS F
- H-1 Westbound (west of Kunia Road) – LOS E
- H-1 Westbound (east of Kamehameha Highway) – LOS E

The other six freeway segments would operate at LOS D or better. Figure 3-5 exhibits the volumes and LOS values of the study freeway segments under Year 2030 Conditions.

Table 3.3
Peak Hour Freeway Segment Operations – Year 2030 Conditions

#	Freeway	Segment	AM Peak Volume	AM Peak Density[1]	AM Peak LOS	PM Peak Volume	PM Peak Density	PM Peak LOS
1	H-1 EB	S/O Makakilo Dr.	5434	37.8	E	4680	31.3	D
2	H-1 EB	W/O Kunia Rd.	8197	>45	F	5833	28.5	D
3	H-1 EB	W/O Pāiwa St.	9906	43.4	E	7137	27.2	D
4	H-1 EB	E/O Kamehameha Hwy.	7512	38.8	E	4249	28.4	D
5	H-2 NB	At Ka Uka Blvd.	3184	21.3	C	6220	>45	F
6	H-1 WB	S/O Makakilo Dr.	3259	21.8	C	6365	>45	F
7	H-1 WB	W/O Kunia Rd.	3735	18.3	C	7860	43.3	E
8	H-1 WB	W/O Pāiwa St.	4366	16.6	B	7931	25.2	C
9	H-1 WB	E/O Kamehameha Hwy.	3069	20.5	C	7766	42.2	E
10	H-2 SB	At Ka Uka Blvd.	6273	30.7	D	4616	22.5	C

Source: Wilbur Smith Associates, 2007

NOTES:
Density is given in pc/mi/ln.
Bold represents LOS E or F.
1 – Lower density does not necessarily indicate a lower LOS. This is because the LOS is calculated based upon a number of factors including: merge influence area, length of the acceleration lane, etc. See Appendix F for the HCM methodology used to calculate the LOS for Freeway Segments.

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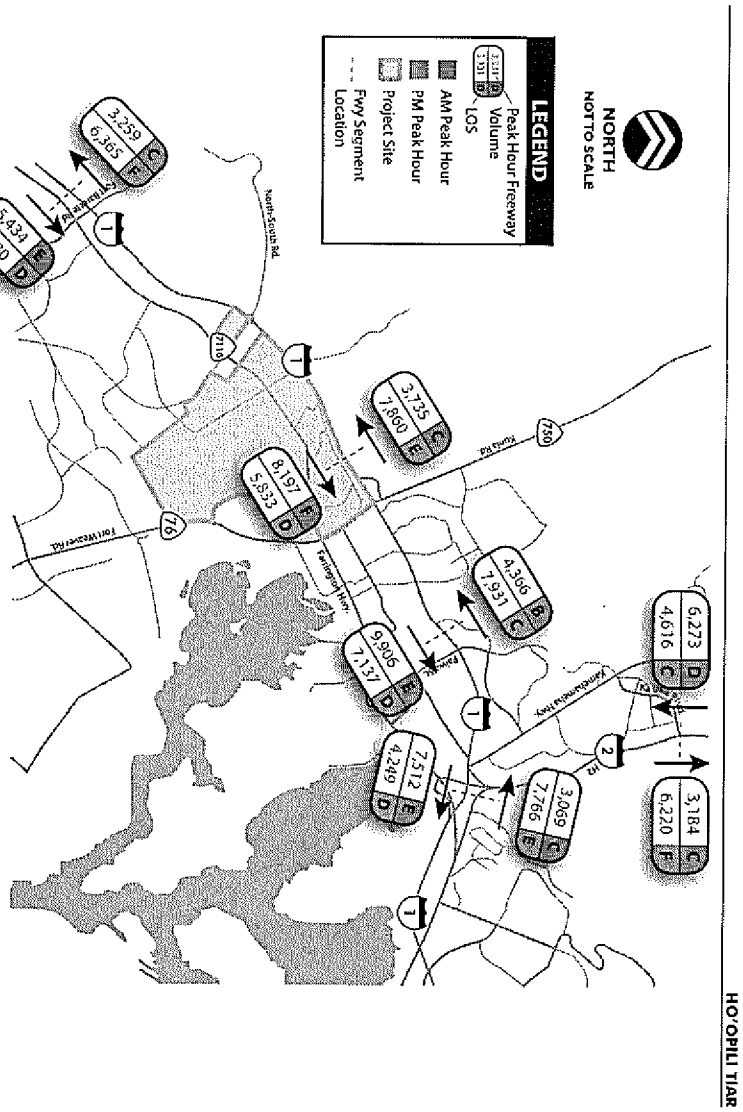
3.6 RAMP-FREEWAY JUNCTION OPERATING CONDITIONS

Table 3.4 presents the operating conditions of the ramp-freeway junctions under Year 2030 Conditions (Future Conditions). The calculation worksheets are included in Appendix C-2.

Under Year 2030 AM peak hour conditions, seven of the 10 study ramp-freeway junctions would operate at LOS D or better (acceptable conditions). The three ramp-freeway junctions that would operate under unacceptable conditions are:

- H-1/ Fort Weaver Road (Eastbound Off-Ramp)
- H-1/ Fort Weaver Road (Eastbound On-Ramp)
- H-1/ Fort Weaver Road (Eastbound Loop On-Ramp)

Similar to AM peak hour, during PM peak hour, seven of the 10 study ramp-freeway junctions would operate under acceptable conditions (LOS D or better). The remaining three that would operate under unacceptable conditions (LOS E or worse) are: H-1/ Fort Weaver Road (Westbound Off-Ramp), H-1/ Fort Weaver Road (Westbound Loop Off-Ramp), and H-1/ North-South Road (Westbound Off-Ramp).



HO'OPILI TIAR

Figure 3-5
YEAR 2030 (NO PROJECT) FREEWAY OPERATING CONDITIONS

Wilbur Smith Associates

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Table 3.4
Ramp-Freeway Junction Operations – Year 2030 Conditions

#	Location	Ramps	Peak Hour	Density	LOS
1	H-1/ Fort Weaver Road	WB Off-Ramp	AM Peak	16.0	B
2	H-1/ Fort Weaver Road	WB Loop Off-Ramp	AM Peak	1.3	A
3	H-1/ Fort Weaver Road	WB On-Ramp	AM Peak	15.0	B
4	H-1/ Fort Weaver Road	EB Off-Ramp	AM Peak	37.4	**E**
5	H-1/ Fort Weaver Road	EB On-Ramp	AM Peak	24.8	**F**
6	H-1/ Fort Weaver Road	EB Loop On-Ramp	AM Peak	26.3	**F**
7	H-1/ North-South Road	WB Off-Ramp	AM Peak	20.3	C
8	H-1/ North-South Road	WB On-Ramp	AM Peak	13.5	B
9	H-1/ North-South Road	EB Off-Ramp	AM Peak	25.0	C
10	H-1/ North-South Road	EB On-Ramp	AM Peak	28.8	D
11	H-1/ Fort Weaver Road	WB Off-Ramp	PM Peak	38.0	**F**
12	H-1/ Fort Weaver Road	WB Loop Off-Ramp	PM Peak	19.9	**F**
13	H-1/ Fort Weaver Road	WB On-Ramp	PM Peak	26.0	C
14	H-1/ Fort Weaver Road	EB Off-Ramp	PM Peak	28.8	D
15	H-1/ Fort Weaver Road	EB On-Ramp	PM Peak	18.3	B
16	H-1/ Fort Weaver Road	EB Loop On-Ramp	PM Peak	20.4	C
17	H-1/ North-South Road	WB Off-Ramp	PM Peak	41.1	**F**
18	H-1/ North-South Road	WB On-Ramp	PM Peak	27.7	C
19	H-1/ North-South Road	EB Off-Ramp	PM Peak	21.0	C
20	H-1/ North-South Road	EB On-Ramp	PM Peak	17.0	B

Source: Wilbur Smith Associates, 2007

NOTES:
DEC – Demand Exceeds Capacity
Density is presented in pc/mi/ln.
Bold type indicates LOS F.

Chapter 4
PROJECT TRAFFIC ESTIMATE

This chapter discusses the methodology and assumptions used to estimate the traffic characteristics of the proposed Project. The initial process involves the estimation of trips that would be generated by the proposed Project, and the distribution and assignment of these trips on the area roadways.

This chapter presents the generation distribution, and assignment (routing) of trips to/from the proposed project under the following two scenarios:

- **Scenario A: With Transit Corridor** – Under this scenario, it is assumed that the Honolulu High-Capacity Transit Corridor is constructed and would pass through the proposed Project site. The presence of transit corridor within the project site would affect the numbers of vehicle-trips generated by the proposed project land uses. The transit facility would attract an increased portion of the person-trips generated from the proposed Project; thus increasing the project-related transit trips and reducing the project-related vehicle trips. Thus a transit reduction factor was applied while developing the Project trip generation under this scenario;

  The proposed transit alignment would run diagonal in Ho'opili along the University of Hawai'i Road B, turn down North-South Road in the median, and stop at the Kroc Center in the North-South median. The median would follow the grasslined channel of the realigned Kaloi gultch. Two stops are proposed within Ho'opili, the exact locations of which are still being determined. It should be noted that increased ridership is likely to occur depending on the location of the stops, particularly based on the density of the area surrounding the stop.

- **Scenario B: Without Transit Corridor** – Under this scenario, it is assumed that the Honolulu High-Capacity Transit Corridor is either not constructed under the Year 2030 Conditions (Future Conditions) or is not passing through the proposed project site. In this scenario, no transit reduction factor was applied while developing the project trip generation.

The amount of traffic associated with a project is estimated using a three step process:

1. Trip generation
2. Trip distribution
3. Trip assignment

In the first step, the amount of traffic entering and exiting the Project land uses is estimated on a daily and peak hour basis. In the second step, the directions that vehicles use to approach and depart the project site are estimated. In the final step, the trips are assigned to specific street segments and intersection turning movements.

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4.1 PROJECT TRIP GENERATION

This section discusses the methodology involved in the estimation of the project traffic and provides an estimate of the total number of inbound and outbound trips generated by the project during weekday AM and PM peak hours. The methodologies involved in the estimation of project trips are discussed in the following sub-sections. The approach for estimating the project trip generation is as follows:

1. Categorize project land uses into appropriate Institute of Transportation Engineers (ITE) Trip Generation or San Diego Council of Governments (SANDAG) or URBEMIS Categories
2. Identify trip generation rates and/or trip generation equations
3. Apply trip generation reductions
4. Calculate Final Trip Generation

The trip generation model for the project includes adjustments for internal project trips, as well as reductions resulting from the mixed uses and transit oriented development components. Trip Generation rates are reported in Tables 4.1 and 4.2 for Scenario A: With Transit Corridor Scenario and Scenario B: Without Transit Corridor Scenario, respectively.

It should be noted that for those land uses where an equation is applied to calculate the project trip generation, the trip generation rate represents the calculated rate based on the results of the equation. For those uses when a trip generation rate is applied, the ITE based trip generation rate or the SANDAG based trip generation is reported

Using the information provided above, the proposed project under "With Transit Scenario Corridor" is estimated to generate 140,920 daily trips, 7,069 morning peak hour trips (3,183 inbound and 3,886 outbound), and 12,077 evening peak hour trips (6,122 inbound and 5,955 outbound).

Under "Without Transit Corridor Scenario", the proposed project is estimated to generate 158,669 daily trips, 9,172 morning peak hour trips (4,167 inbound and 4,996 outbound), and 13,776 evening peak hour trips (6,970 inbound and 6,806 outbound).

4.1.1 ITE Trip Generation

This calculation involved using Institute of Transportation Engineers (ITE) *Trip Generation, 7th Edition* handbook to evaluate the total traffic generated by the proposed project. The trip generation rates and equations provided in the *ITE Trip Generation, 7th Edition* handbook for the various land uses present in the proposed project were used to calculate the trips generated/attracted by each of the components of the project. For certain land uses, the ITE trip generation rates might not be appropriate to use in this study. The trip generation rates provided by San Diego Association of Governments (SANDAG)[1] were used for identifying the trip generation for the following land uses:

[1]San Diego Traffic Generators, April 2002, San Diego Association of Governments

- Specialty Retail Center
- Regional Park
- Multi-Purpose Recreational Facility

An appropriate ITE category was applied to each of the proposed land uses within the project site. The following section explains each trip generation rate applied for each land use.

Retail Uses: The specialty retail trip generation rate (SANDAG code: Specialty Retail/Strip Commercial) was applied to the retail sections within the Live-Work High Density and Live-Work Mixed Use areas. Specialty retail is described as small strip shopping centers and would be applicable to these developments as it is assumed there is no heavy commercial with the live-work high density and mixed-use areas. The retail developments within the business and commercial areas are assumed to be large shopping centers and ITE code 820 was used to identify the trip generation.

Residential Uses: The project description indicates that the residential uses on the site will contain medium to high-density residential units. These units could consist of condominiums, attached town homes, or small-lot single-family homes. Given the variety of possible housing types on this site, a general residential category (Land Use Code 230 – Residential Condos/Townhouses), was employed. The residential units for both the Live-Work High Density section and the Live-Work Mixed Use are assumed to be Residential Condominiums or Townhouses, which fall under ITE Trip Generation Code 230. The fitted curve equation that best fits this type of land use is an exponential equation that determines the number of trips generated based on the number of dwelling units. Since the equation is not linear the trip generation rate per dwelling unit varies depending on the number of units. In this case, as the number of dwelling units increase, the trip generation rate per unit decreases. This may be explained by carpooling with neighbors or an increase in internal social visits.

Office Uses: The office units for the Live-Work High Density section, the business and commercial areas and within the light industrial and business areas are assumed to be General Office Buildings, which fall under ITE Trip Generation Code 710.

Industrial Uses: The industrial units for the Light Industrial/Business section are assumed to be General Light Industries, which fall under ITE Trip Generation Code 110.

Park Uses: The park units for the Parks within the development include regional parks and multi-purpose recreational facilities, for which the park trip generation rate (SANDAG code: Parks) was applied.

School Uses: The school units for the Schools section include middle schools, high schools and elementary schools which fall under ITE Trip Generation Code 522, ITE Trip Generation Code 530, and ITE Trip Generation Code 520, respectively.

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4.1.2 External Trip Estimation

The estimated numbers of vehicle trips, as based on the ITE, San Diego, and URBEMIS trip rates, were adjusted as described in the following paragraphs to estimate the number of vehicle trips that would be made to/from areas outside the Project. These reflect both reductions in the number of vehicle trips (transit, TDM actions) and those trips that would be made within the Project area.

4.1.2.1 Transit Trip Reduction

The 2030 OMPO Travel Demand Forecasting Model (released August 11, 2006) was used to identify the travel mode splits of the trips generated by the proposed project. As per the OMPO model, the proposed project was contained within three Traffic Analysis Zones (TAZs), namely, TAZs 545, 550, and parts of TAZ 546. Based on the OMPO model results, 6.625 percent of the total daily trips generated by the project were attributed to daily transit trips. The total daily trips were then converted to peak hour trips based on the time-of-day factors (OMPO model documentation, December 17, 2002). This data indicated that 26 percent of the trips would occur during the AM peak period and 17.2 percent of the trips would occur during the PM peak period. Overall, this resulted in a peak hour factor of 14.3 percent for the AM peak hour and 10 percent for the PM peak hour.

This resulted in a reduction of 1,747 trips in the AM peak hour and 1,156 trips in the PM peak hour as a result of transit trips. In other words, there was a reduction of around 15% trips generated in the AM Peak hour and a reduction of around 6% trips in the PM peak hour based on the OMPO model results and the on-board survey data.

4.1.2.2 Pass-By Trip Reduction

The numbers of vehicle trips entering or exiting a retail development include both new vehicle trips and additional stops by vehicles that would be traveling through the development. These additional stops by traffic passing the site to use the retail and services uses are referred to as "pass-by trips." Pass-by trips are made as intermediate stops on the way from an origin to a primary trip destination without a route diversion. For example, trips associated with a gas station or a convenience stop near major highways make intermediate stops while traveling between other destinations. The ITE Trip Generation Handbook (*Trip Generation Handbook, An ITE Recommended Practice, Institute of Transportation Engineers, June 2004, Chapter 5 "Passby, Primary, and Diverted Linked Trips"*) provides a methodology and equations for estimating the proportion of the project-related vehicle trips that would be pass-by trips. This ITE methodology was used in this study and applied to appropriate land uses as show in Tables 4-1 and 4-2.

4.1.2.3 Transportation Demand Management (TDM) Reduction

The URBEMIS model (Version 9.2) was applied to determine trip reductions from the TDM program assumed to be in place as part of the proposed project. It should be noted that this model

has been adopted by California's Air Districts and funded by Caltrans to estimate trips for Smart Growth and Transit Oriented Development projects.

WSA assumed that the proposed project would adopt a TDM program composed of the following measures:

- Free transit passes,
- Employee Telecommuting Program with 1.5 percent participating an average of 1.6 days
- Secure bicycle parking (minimum of 1 space per 20 vehicles)
- Shower and changing facilities
- Guaranteed Ride Home
- Carsharing services
- Information provided on transportation alternatives
- Dedicated Employee Transportation Coordinator
- Vanpooling/Carpooling (preferential parking).

The reduced project trip generation is summarized in Tables 4-1 and 4-2.

4.1.2.4 Internal Trip Capture Reduction

Mixed-use trips (internal capture) refer to any project trips that start and end within a development. For example, a project consisting of both residences and office buildings will generate some mixed-use trips if any of the office workers live in the adjacent residences. The guidelines provided in the ITE Trip Generation Handbook (*Trip Generation Handbook, An ITE Recommended Practice, Institute of Transportation Engineers, June 2004, Chapter 7 "Multi-Use Development"*), together with the OMPO Travel Demand Model were used to estimate this trip reduction. The guidelines were also used to determine if it is appropriate to apply an internal capture factor.

The 2030 OMPO Travel Demand Model designated a certain percentage as internal trips, which originate and end in the project site without leaving the TAZ. The internal trip percentages as calculated from the OMPO model data for residential, office, and retail landuses are 8.4 percent, 7.1 percent, and 10.0 percent, respectively. This trip reduction was applied in the Project trip generation calculations as summarized in Tables 4.1 and 4.2.

Estimated External Project Vehicle Trips

Overall, the proposed Project would generate a total of 140,920 daily trips to or from areas external to the Project. During the weekday AM peak hour, the project is expected to generate 7,069 trips (3,183 inbound/3,886 outbound). During the PM peak hour, the proposed project would generate a total of 12,077 trips (6,122 inbound/5,955 outbound).

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4.1.5 Trip Generation Values

Tables 4.1 and 4.2 present the project trips generated during the weekday AM and PM peak periods for Scenario A: With Transit Corridor and Scenario B: Without Transit Corridor, respectively.

Table 4.3
External Trip Estimation - Scenario A: With Transit Corridor Scenario

Land Use	ITE Code	Size /a/	Unit	Average Trip Generation Rate /g/ Daily	Weekday AM	Weekday PM	Directional Split Weekday AM In	Weekday AM Out	Weekday PM In	Weekday PM Out	Trip Generation Daily	Weekday AM Peak Hour In	Weekday AM Peak Hour Out	Weekday AM Peak Hour Total	Weekday PM Peak Hour In	Weekday PM Peak Hour Out	Weekday PM Peak Hour Total
Single-Family Detached Housing /a/	210	5,100	DU	7.59	0.70	0.72	25%	75%	63%	37%	38,718	895	2,685	3,579	2,325	1,365	3,690
Live-Work High Density																	
Residential Condominium/Townhouse /b/	URBEMIS	5,200	DU	2.21	0.23	0.30	17%	83%	67%	33%	18,452	207	1,011	1,218	1,028	507	1,535
Specialty Retail Center /c/	URBEMIS	715,890	ksf	34.87	3% of Daily	9% of Daily	60%	40%	50%	50%	24,963	449	300	749	1,124	1,124	2,247
General Office Building	URBEMIS	393,890	ksf	8.48	1.41	1.32	88%	12%	17%	83%	3,834	494	67	562	88	432	520
Live-Work Mixed Use Commercial HD Residential																	
Residential Condominium/Townhouse /b/	URBEMIS	1,450	DU	2.21	0.30	0.37	17%	83%	67%	33%	6,232	75	364	439	361	178	539
Specialty Retail Center /c/	URBEMIS	121,710	ksf	34.87	3% of Daily	9% of Daily	60%	40%	50%	50%	4,314	77	52	129	194	194	388
Business Commercial																	
General Office Building	710	200,657	ksf	11.37	1.63	1.51	88%	12%	17%	83%	7,293	298	39	337	51	252	304
Shopping Centers /d/																	
Zone F2	820	371,621	ksf	45.12	3.05	4.21	61%	39%	48%	52%	14,511	192	123	315	650	704	1,353
Zone F3	820	554,634	ksf	40.60	0.94	4.07	61%	39%	48%	52%	15,465	204	130	335	693	751	1,444
Zone P1	820	211,333	ksf	52.26	1.16	4.85	61%	39%	48%	52%	11,045	150	96	245	492	533	1,026
Zone V2	820	72,998	ksf	75.92	1.78	6.97	61%	39%	48%	52%	5,535	79	51	130	244	264	509
Zone V3	820	100,582	ksf	67.77	1.56	6.25	61%	39%	48%	52%	6,817	96	61	157	302	327	628
Light Industrial / Business																	
General Light Industrial	110	800,000	ksf	7.34	1.07	1.23	83%	17%	21%	79%	5,874	789	145	935	206	775	981
General Office Building	710	125,453	ksf	12.66	1.79	1.75	88%	12%	17%	83%	1,589	198	27	225	37	182	219
Parks																	
Regional Park	SANDAG	33.000	acres	20.00	4% of Daily	8% of Daily	50%	50%	50%	50%	660	13	13	26	27	26	53
Multi-Purpose Recreation Facility	SANDAG	27.000	acres	90.00	2% of Daily	6% of Daily	50%	50%	50%	50%	2,430	25	24	49	73	73	146
Schools																	
Middle School	522	800	Students	1.62	0.41	0.15	55%	45%	52%	48%	972	135	111	246	47	45	92
High School	530	1,000	Students	1.73	0.41	0.31	69%	31%	32%	68%	1,729	281	126	407	99	210	309
Elementary School	520	210	Employees	18.88	7.30	3.41	54%	46%	45%	55%	3,965	828	705	1,533	322	393	715
Total											184,405	5,594	6,157	11,751	9,037	9,062	18,099
Transit Reduction /e/		6.6%									12,171	369	406	775	596	598	1,194
Internal Trip Reduction														15%			6%
Residential		8.4%									5,326	99	146	446	311	172	482
Light Industrial / Office Building		7.1%									964	120	20	140	23	117	141
Retail		10.0%									9,762	145	94	239	437	463	900
Other (Parks) /h/		80.0%									2,472	30	30	60	80	79	159
Schools /i/																	
Middle School		83%	Students/Staff								800	111	91	202	39	35	74
High School		82%	Students/Staff								1,424	231	104	335	82	173	255
Elementary School		82%	Students/Staff								3,265	682	581	1,263	265	324	589
Subtotal											23,816	1,418	1,181	2,679	1,142	1,363	2,505
Pass-by Trip Reduction /f/																	
Zone F2		27.0%							48%	52%	377				181	196	377
Zone F3		27.0%							48%	52%	390				187	203	390
Zone P1		31.4%							48%	52%	520				155	167	322
Zone V5		19.0%							48%	52%	245				118	127	245
Zone W1		27.4%							48%	52%	358				184	200	384
Subtotal											1,771	0	0	0	825	893	1,718
TDM Reduction /j/		3.0%									5,513	165	184	350	271	272	543
Total											140,910	3,183	3,806	7,046	6,227	5,855	12,081

Source: Wilbur Smith Associates, September 2008

NOTES

/a/ All residential low-medium density units are assumed to be single-family detached housing units.

/b/ All high density live-work residential units are assumed to be residential condominium/townhouse.

/c/ All retail uses located within the live-work areas are assumed to be Specialty Retail Centers. URBEMIS trip generation rates have been used for Specialty Retail Center. URBEMIS adjusts trip rates based on residential housing density and also includes adjustments based on pedestrian friendly projects, in which residential land uses are in close proximity to retail and employment land uses.

/d/ All retail uses located within the commercial areas are assumed to be Shopping Centers.

/e/ Transit reduction applied to take into account the trips reduced due to the *Honolulu High Capacity Transit Corridor*.

/f/ Pass-by trip reduction applied only to commercial trips (shopping centers). It was assumed that there would be no pass-by trips in the AM peak period hours (AM of AM).

/g/ Average trip generation rates are obtained as a mean of the total trip generation rates, calculated using *ITE Trip Generation Handbook*.

/h/ The 80 percent internal trip reduction for parks in the neighborhood is similar to the internal trip reduction for schools.

/i/ TDM reduction taken into account trip reduction due to TDM alternatives such as staggered work, work, telecommuting etc.

/j/ Internal trip reduction due to schools assumes walking, bicycling and drop-offs by private means for as the main modes of transportation used by students and staff.

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4.2 PROJECT TRIP DISTRIBUTION

This section provides a description of various travel patterns of the project trips from and to the project under Year 2030 Baseline Plus Project Conditions. The Year 2030 OMPO Transportation Model was used to identify the trip distribution of the project. Using the OMPO Model, a select link analysis was performed using the OMPO model to determine separate trip distribution percentages for each land use: office, retail, and residential. Each of these trip distributions present the percentage of vehicles traveling between the project site and each of the different areas surrounding the project site.

Table 4.3 summarizes the trip distribution patterns provided by the OMPO Model under the Year 2030 conditions; Figures 4-1 A, 4-1 B, 4-1 C exhibit the trip distribution patterns for residential, office, and retail land uses, respectively. These three figures present the trip distribution percentages only for the external vehicle trips.

4.3 PROJECT TRIP ASSIGNMENT

Trips generated solely by the proposed Ho'opili Development during the peak hour under Scenario A: With Transit Corridor are presented in Figures 4-2A, 4-2B, and 4-2C; while project trips generated during the peak hour under Scenario B: Without the Transit Corridor are presented in Figures 4-3A, 4-3B, and 4-3C.

Trips generated by the proposed Ho'opili Development are assigned to the roadway system based on the trip generation and trip distribution described in Section 4.1 and 4.2. The resulting intersection turning movement volumes under plus project conditions are discussed and presented in Chapter 5.

Table 4.2
External Trip Estimation - Scenario B: Without Transit Corridor Scenario

Land Use	ITE Code	Size /c/	Unit	Average Trip Generation Rate /g/ Daily	Weekday AM	Weekday PM	Directional Split Weekday AM In	Weekday AM Out	Weekday PM In	Weekday PM Out	Trip Generation Daily	Weekday AM Peak Hour In	Weekday AM Peak Hour Out	Weekday AM Peak Hour Total	Weekday PM Peak Hour In	Weekday PM Peak Hour Out	Weekday PM Peak Hour Total
Single-Family Detached Housing /a/	210	5,100	DU	7.59	0.70	0.72	25%	75%	63%	37%	38,718	895	2,685	3,579	2,325	1,365	3,690
Live-Work High Density																	
Residential Condominium/Townhouse /b/	URBEMS	5,200	DU	2.21	0.23	0.30	17%	83%	67%	33%	18,452	207	1,011	1,218	3,028	507	1,535
Specialty Retail Center /e/	URBEMS	715,890	ksf	34.87	3% of Daily	9% of Daily	60%	40%	50%	50%	24,963	449	300	749	1,124	1,124	2,248
General Office Building	URBEMS	393,890	ksf	8.48	1.43	1.32	88%	12%	17%	83%	3,834	494	67	562	89	432	520
Live-Work Mixed Use Commercial HD Residential																	
Residential Condominium/Townhouse /b/	URBEMS	1,450	DU	2.21	0.30	0.37	17%	83%	67%	33%	6,232	75	364	439	361	178	539
Specialty Retail Center /e/	URBEMS	123,710	ksf	34.87	3% of Daily	9% of Daily	60%	40%	50%	50%	4,314	77	52	129	194	194	388
Business Commercial																	
General Office Building	710	200,657	ksf	11.37	1.63	1.51	88%	13%	17%	83%	2,281	288	39	327	52	252	304
Shopping Centers /d/																	
Zone F2	820	321,621	ksf	45.12	0.98	4.21	61%	39%	48%	52%	14,511	192	123	315	650	784	1,433
Zone F3	820	354,634	ksf	43.60	0.94	3.95	61%	39%	48%	52%	15,462	204	130	334	692	751	1,444
Zone P1	820	211,335	ksf	52.26	1.16	4.85	61%	39%	48%	53%	11,045	150	96	245	492	533	1,025
Zone V1	820	92,995	ksf	25.82	1.78	6.97	61%	39%	48%	53%	5,535	79	51	130	244	264	508
Zone V3	820	100,592	ksf	67.77	1.56	6.25	61%	39%	48%	53%	6,817	96	61	157	302	327	629
Zone W1	820	339,230	ksf	44.29	0.96	4.13	61%	39%	48%	52%	15,023	199	127	326	673	729	1,402
Light Industrial / Business																	
General Light Industrial	110	800,600	ksf	3.34	1.07	1.23	83%	17%	21%	79%	5,824	709	145	855	206	775	981
General Office Building	710	125,453	ksf	17.66	1.79	1.75	88%	12%	17%	83%	1,589	198	27	225	37	182	219
Parks																	
Regional Parks	SANDAG	33.000	acres	20.00	4% of Daily	8% of Daily	50%	50%	50%	50%	660	13	13	26	27	26	53
Multi-Purpose Recreation Facility	SANDAG	27.000	acres	90.00	2% of Daily	6% of Daily	50%	50%	50%	50%	2,430	25	24	49	73	73	146
Schools																	
Middle School	522	600	Students	1.42	0.41	0.15	55%	45%	52%	48%	972	135	111	246	47	43	90
High School	530	1,000	Students	1.71	0.41	0.31	69%	31%	32%	68%	1,729	281	126	407	99	210	309
Elementary School	520	210	Employees	18.88	7.38	3.41	54%	46%	45%	55%	3,965	828	705	1,533	322	393	715
Total											184,405	5,091	6,257	11,348	9,832	9,062	18,894
Transit Reduction /e/		0.0%									/f	/f	/f	0%	/f	/f	0%
Internal Trip Reduction																	
Residential		8.4%									5,326	99	341	440	312	172	484
Light Industrial / Office Building		7.1%									964	120	20	140	27	117	144
Retail		10.0%									9,767	145	94	239	437	443	905
Other (Parks) /h/		80.0%									2,472	30	30	60	80	79	159
Schools /j/																	
Middle School		52%	Students/Staff								800	111	91	202	39	35	74
High School		17%	Students/Staff								1,424	231	104	335	82	173	255
Elementary School		32%	Students/Staff								3,265	682	481	1,163	265	324	589
Subtotal											24,018	1,418	1,161	2,579	1,242	1,343	2,685
Pass-by Trip Reduction /i/																	
Zone F2		27.0%							48%	52%	377				181	196	377
Zone F3		27.0%							48%	52%	590				187	203	390
Zone P1		27.0%							48%	52%	322				155	167	322
Zone V3		27.0%							48%	52%	245				118	127	245
Zone W1		27.0%							48%	52%	364				188	206	394
Subtotal											1,728	0	0	0	829	899	1,728
TDM Reduction /k/		0.0%									0	0	0	0	0	0	0
Total											158,660	3,673	4,996	8,769	6,998	6,866	13,864

Source: Wilbur Smith Associates, September 2007

NOTES

/a/ All residential low-medium density units are assumed to be single-family detached housing units.

/b/ All high density live-work residential units are assumed to be residential condominium/townhouse.

/c/ All retail units located within live-work zones are assumed to be Specialty Retail Centers. URBEMS trip generation rates have been used for Specialty Retail Center. URBEMS all unit trip rates based on residential housing density and also includes adjustments based on pedestrian friendly projects, in which residential and work trips that primarily interact and employ locate in the area.

/d/ All retail units located within the commercial zones are assumed to be Shopping Centers.

/e/ The trip reduction applied to take into account the trips reduced due to the *Honolulu High Capacity Transit Corridor*.

/f/ Transit trip reduction applied only to commercial trips (shopping centers). It is assumed that there would be no transit trips in the AM peak period from 6 to 9 AM.

/g/ Average trip generation rates are obtained as a result of the actual trip generation rates, calculated using *ITE Trip Generation Handbook*.

/h/ The 80 percent internal trip reduction for parks in the park is assumed to be the internal trip reduction for schools.

/i/ TDM reduction not an area or count trip reduction due to TDM's, rather is on such as staggered work week, telecommuting etc.

/j/ Internal trip reduction due to schools students walking, bicycling and shuttle/by private transit as the main modes of transportation used by students and staff.

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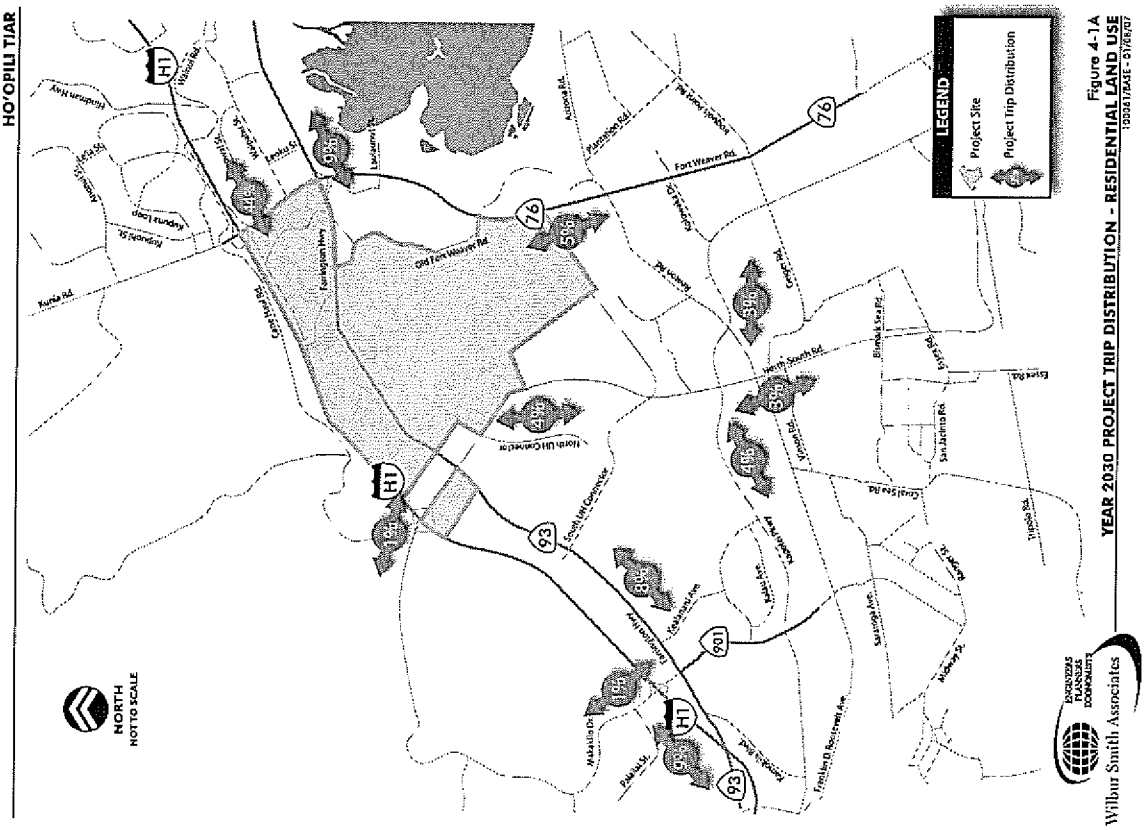

Figure 4-1A
YEAR 2030 PROJECT TRIP DISTRIBUTION - RESIDENTIAL LAND USE
109361/BASE - 01/08/07

Table 4.3
Project Trip Distribution

#	Roadway	Screenline Location	Landuse Residential	Office	Retail
1	Kunia Rd	N/O Kunia Loop	6.3%	3.9%	2.9%
2	Kunia Loop	E/O Kunia Rd	2.1%	3.5%	4.5%
3	Farrington Hwy	E/O Leoku St	8.5%	8.4%	9.1%
4	Laulaunui St	E/O Fort Weaver Rd	0.6%	0.9%	1.2%
5	Kawa Dr	E/O Fort Weaver Rd	0.7%	2.3%	4.6%
6	Renton Rd	E/O Fort Weaver Rd	0.4%	2.1%	4.1%
7	Fort Weaver Rd	S/O Renton Rd	3.7%	7.4%	9.0%
8	North-South Rd	N/O H-1	0.6%	2.4%	3.6%
9	N UHWO Connector	W/O North-South Rd	2.9%	3.2%	4.4%
10	S UHWO Connector	W/O North-South Rd	0.9%	1.1%	1.3%
11	Kapolei Parkway	W/O North South Rd	3.8%	4.4%	3.6%
12	North South Rd	S/O Kapolei Parkway	2.2%	1.1%	0.7%
13	Renton Rd	W/O Kapolei Parkway	0.0%	0.1%	0.1%
14	Kapolei Parkway	S/O Renton Rd	1.8%	3.8%	4.5%
15	Pahika	S/O Renton Rd	0.6%	0.6%	0.4%
16	Makakilo Dr	N/O H-1	0.7%	2.4%	2.6%
17	H-1	W/O Makakilo Dr	8.3%	8.7%	8.7%
18	Farrington Hwy	W/O Fort Barette Rd	3.1%	3.2%	2.6%
19	Fort Barette Rd	S/O Farrington Hwy	3.1%	3.3%	2.7%
20	H-1	E/O Kunia Rd	40.0%	29.3%	17.4%
21	Farrington Hwy	W/O North-South Rd	1.2%	1.0%	1.0%
22	Internal		8.4%	7.1%	10.0%
Total			**100.00%**	**100.00%**	**100.00%**

Source: Wilbur Smith Associates, 2007

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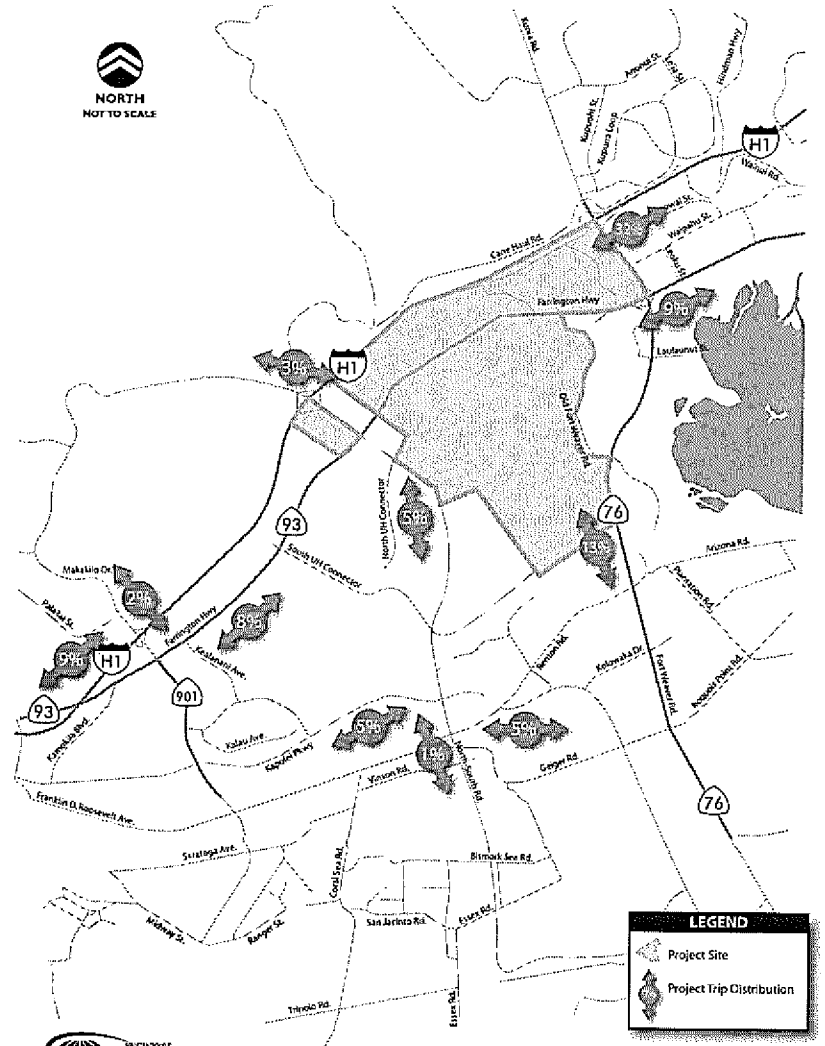

Figure 4-1B
YEAR 2030 PROJECT TRIP DISTRIBUTION - OFFICE LAND USE
100061/BASE - 01/08/07

Wilbur Smith Associates

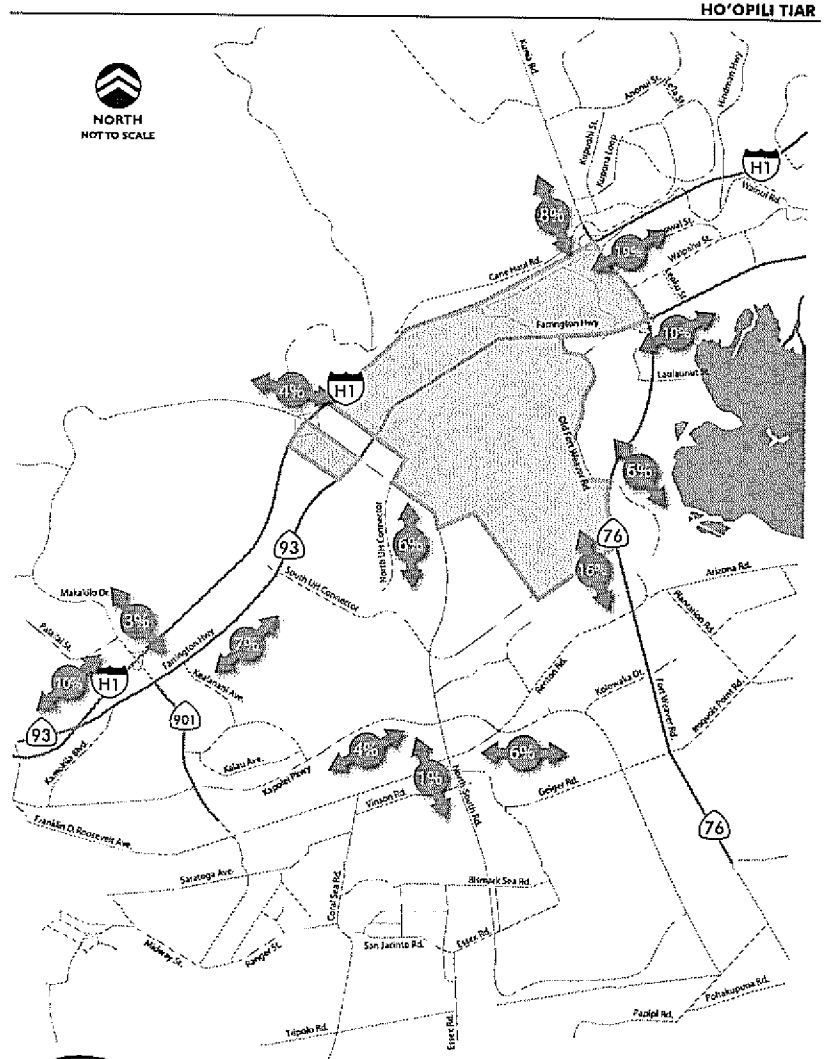

Figure 4-1C
YEAR 2030 PROJECT TRIP DISTRIBUTION - RETAIL LAND USE
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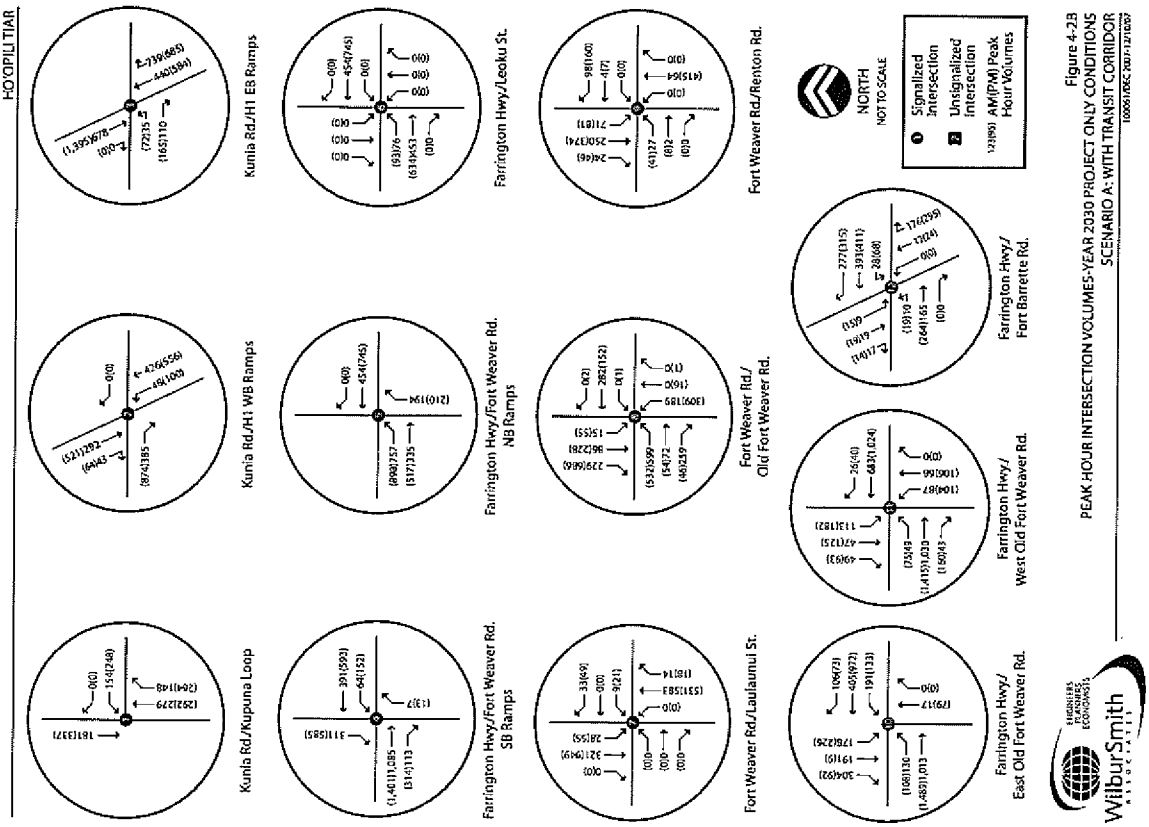

Figure 4-2B
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PROJECT ONLY CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

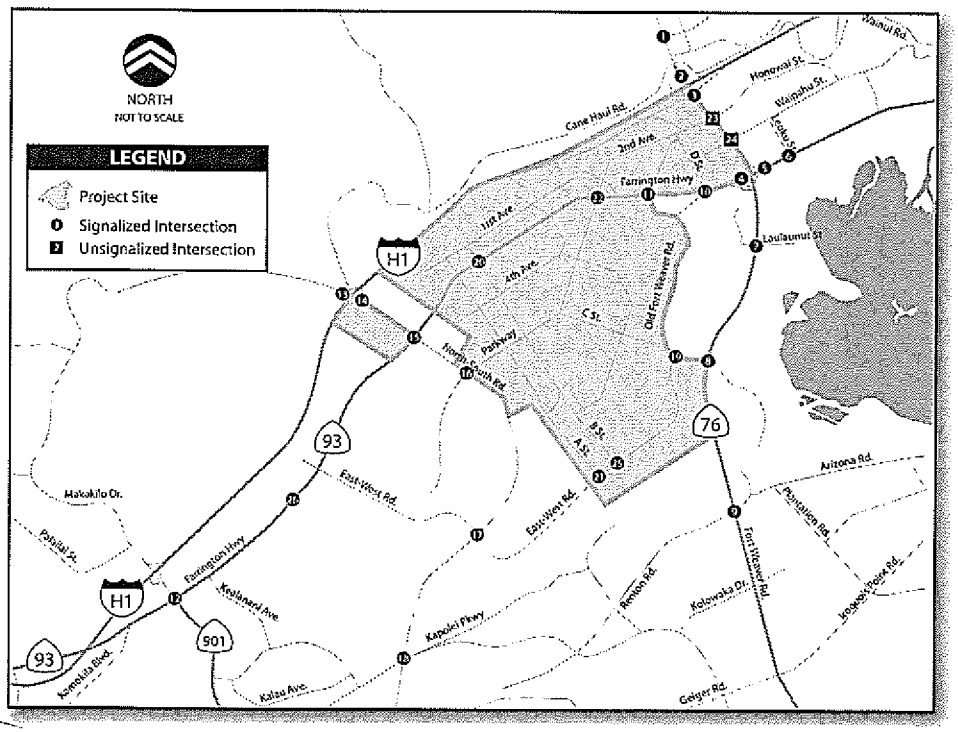

Figure 4-2A
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PROJECT ONLY CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

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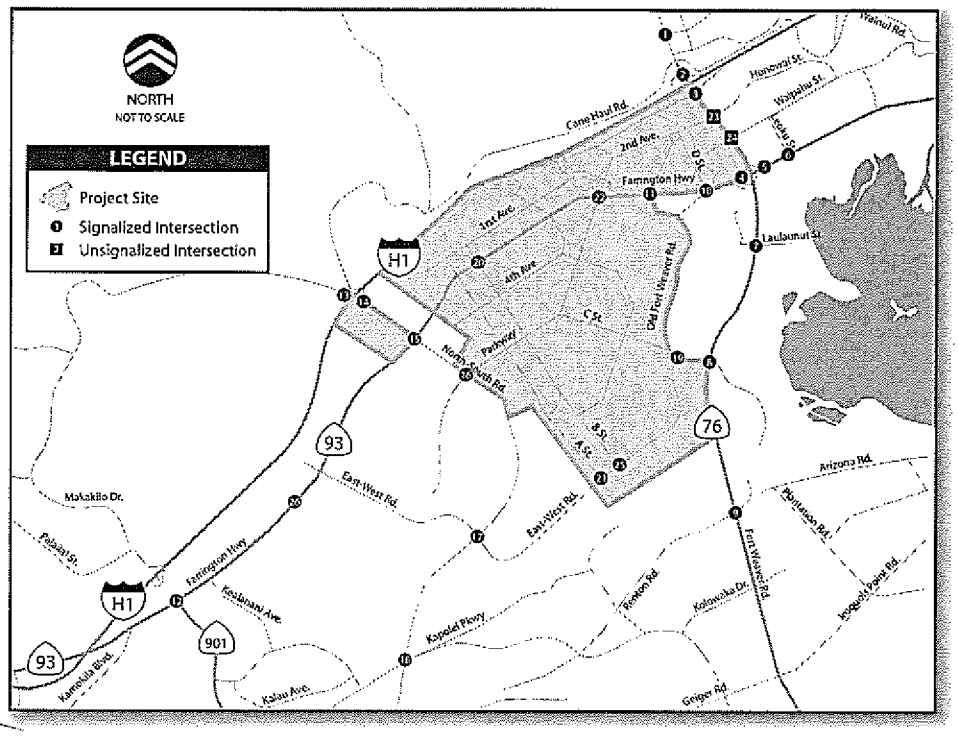

Figure 4-3A
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PROJECT ONLY CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

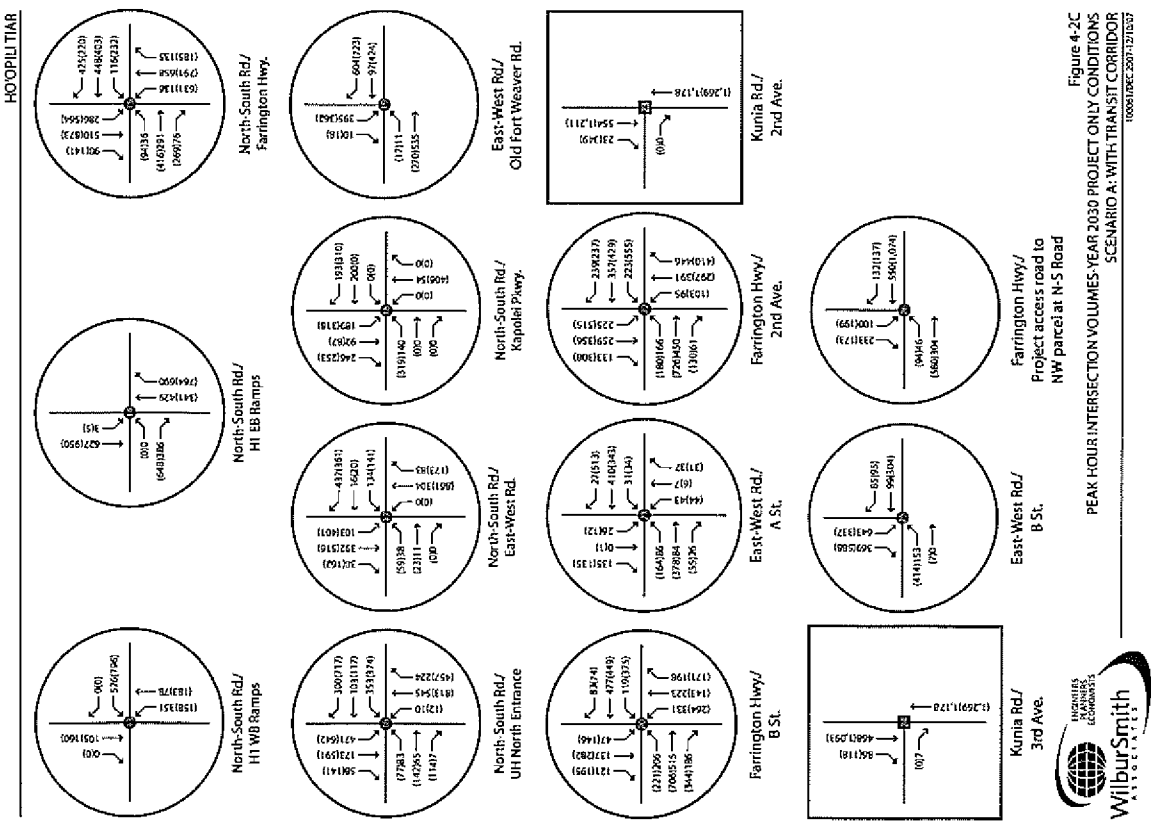

Figure 4-2C
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PROJECT ONLY CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

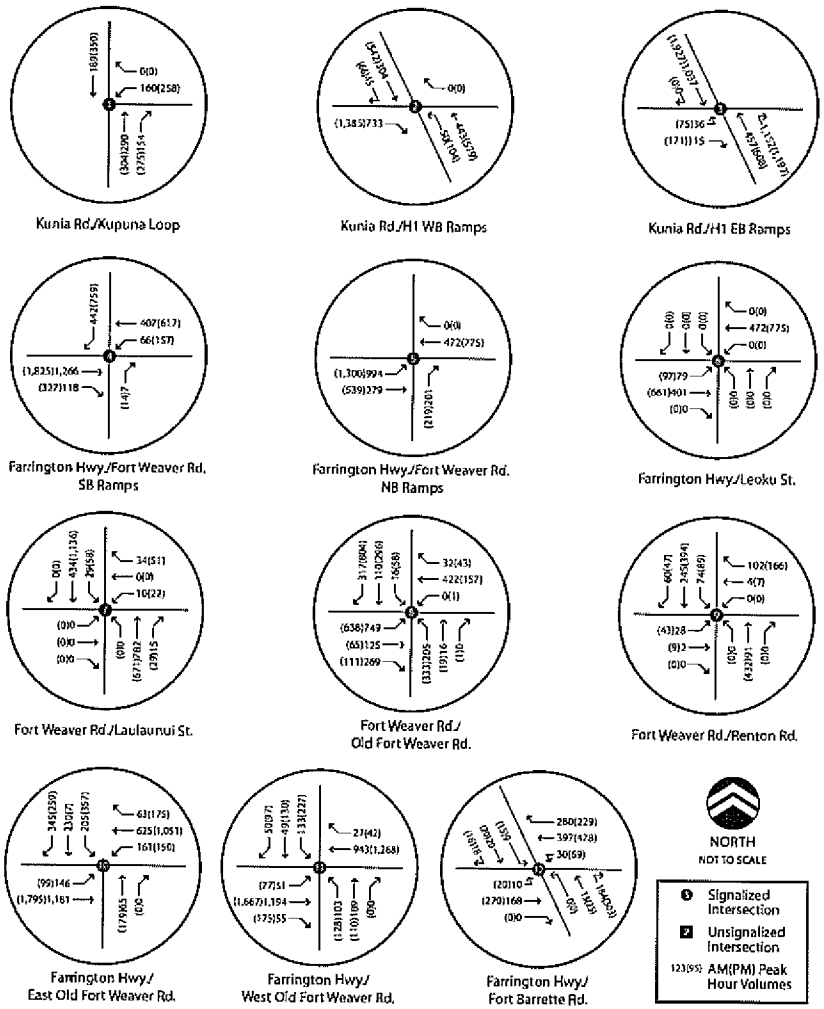

Figure 4-3B
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PLUS PROJECT ONLY CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

100061/DEC 2007-12/10/07

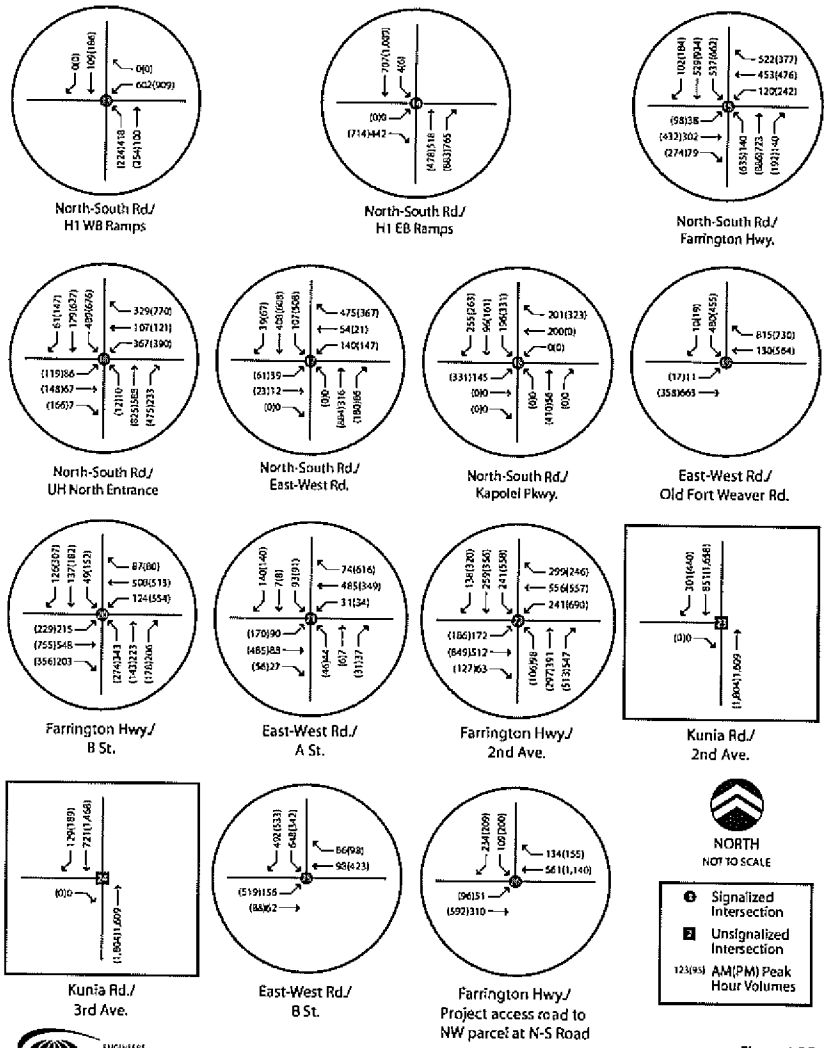

Figure 4-3C
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PROJECT ONLY CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

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Chapter 5
YEAR 2030 BASELINE PLUS PROJECT CONDITIONS

This chapter describes the Year 2030 transportation conditions including intersection, freeway, and freeway-ramp junction operations as a result of the construction of the proposed Project. Additionally, the transportation impacts associated with the proposed project were identified.

The operating conditions of the study intersections, freeway segments, and ramp-freeway junctions were studied under two scenarios as described in *Chapter 4:* "Without Transit Corridor Scenario A" and "With Transit Corridor Scenario B",. Levels of Service of the study intersections, freeway segments, and ramp-freeway junctions under Scenarios A and B were identified using the same methodologies as described in Chapter 2 for existing conditions.

5.1 THRESHOLDS OF SIGNIFICANCE

Neither the City and County of Honolulu nor the State of Hawai'i have guidelines for identifying the transportation impacts caused by a project. Therefore, WSA used the guidelines provided in *Sections 5.1.1, 5.1.2, and 5.1.3* to identify the transportation impacts at the intersections, freeway segments, and ramp-freeway junctions.

5.1.1 Intersections

The thresholds of significance for the intersections are as follows:

1. A project would cause a transportation impact at an intersection if it degrades the LOS of the intersection to LOS E or worse.
2. A project would cause a transportation impact at an intersection operating at LOS E or F if it degrades the volume-to-capacity ratio of the intersection by more than 10 percent.

5.1.2 Freeway Segments

The thresholds of significance for the freeway segments are as follows:

1. A project would cause a transportation impact at a freeway segment if it degrades the LOS of the freeway segment to LOS E or worse.

5.1.3 Ramp-Freeway Junctions

The thresholds of significance for the ramp-freeway junctions are as follows:

1. A project would cause a transportation impact at a ramp-freeway junction if it degrades the LOS of the ramp-freeway to LOS E or worse.

5.2 SCENARIO A: WITH TRANSIT CORRIDOR

5.2.1 Study Area – Scenario A

Figure 5-1 presents the proposed internal circulation within the project site. The names of the major streets have been assumed for analysis purposes. As part of the Ho'opili project, several new study intersections would be created between Project roadways and the major area roadways located adjacent to the project site. The new study intersections that are located within the project site and included in this analysis are:

- Farrington Highway/ B Street
- East-West Road/ A Street
- Farrington Highway/ Parkway/ 2nd Avenue
- Kunia Road/ 2nd Avenue
- Kunia Road/ 3rd Avenue
- East-West Road/ B Street
- Farrington Hwy/ Project Access Road to NW Parcel

Traffic signal warrant analysis has been performed on the new study intersections under Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario" (Scenario A) and all the intersections except the following two, which are both right-turn-in-only intersections, satisfied the MUTCD Warrant #3 for installation of a traffic signal:

- Kunia Road/ 2nd Avenue
- Kunia Road/ 3rd Avenue

For this analysis, the other 5 intersections of the major Project roadways with the major roadways were assumed to be signalized. The intersections Kunia Road/ 2nd Avenue as well as Kunia Road/ 3rd Avenue would only allow right turns from Kunia Road into the Project site and are assumed to be free-flow.

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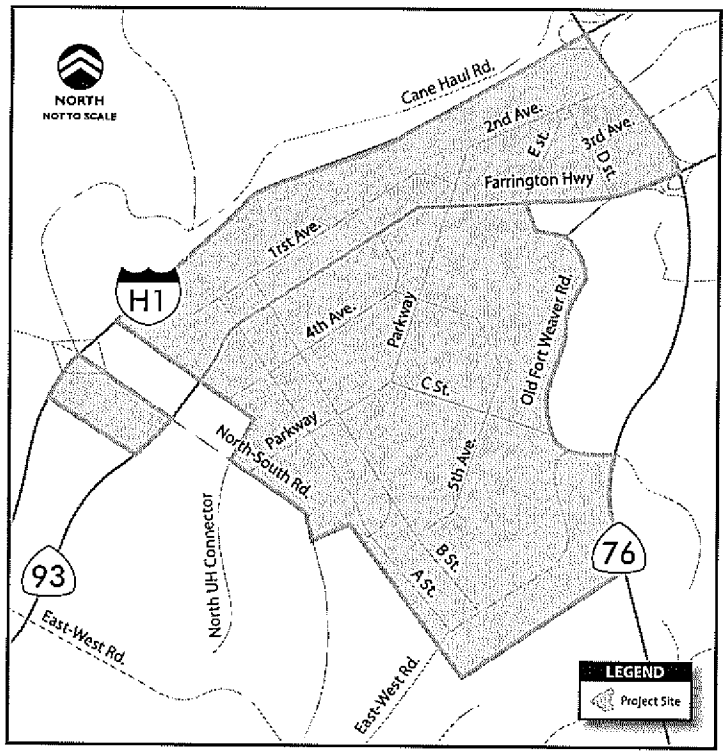

Figure 5-1
PROJECT INTERNAL CIRCULATION
160061/BASE - 01/09/07

To accommodate the increased traffic due to the Project, the proposed geometric layout of the following four study intersections are proposed for modification from the lanes used in the Year 2030 Baseline Conditions:

- Farrington Highway/ East Old Fort Weaver Road
- Farrington Highway/ West Old Fort Weaver Road
- North-South Road/ North University of Hawai'i Connector

Of the above three intersections, the two intersections Farrington Highway/ East Old Fort Weaver Road and Farrington Highway/ West Old Fort Weaver Road are unsignalized under Year 2030 Baseline Conditions. Traffic signal warrant analysis has been performed on both these intersections under Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario" and both the intersections have satisfied the criteria to allow consideration of signal installation. Therefore, for the purpose of this analysis, intersections Farrington Highway/ East Old Fort Weaver Road and Farrington Highway/ West Old Fort Weaver Road have been considered to be signalized under 'With Transit Corridor Scenario".

Additionally, to accommodate the increased traffic volumes along the roadways adjacent to the Project site, increased traffic lanes would be provided at the following three study intersections:

Farrington Highway/ East Old Fort Weaver Road

1. Install traffic signal.
2. Eastbound Approach: Construct one additional through lane and one exclusive left-turn lane.
3. Westbound Approach: Construct one additional shared through-right lane.
4. Southbound Approach: Construct one shared left-through-right lane and one exclusive left-turn lane.
5. Northbound Approach: Construct one additional shared left-through-right lane.

Farrington Highway/ West Old Fort Weaver Road

1. Install traffic signal.
2. Eastbound Approach: Convert existing exclusive right-turn lane to shared through-right lane, construct one exclusive left-turn lane.
3. Westbound Approach: Construct one additional shared through-right lane.
4. Southbound Approach: Construct one shared through-right lane and one exclusive left-turn lane
5. Northbound Approach: Convert existing exclusive left-turn lane to shared left-through-right lane.

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North-South Road/ North University of Hawaii Connector

1. Eastbound Approach: Convert existing exclusive right-turn lane to shared through-right lane.
2. Westbound Approach: Construct one through lane, two exclusive left-turn lanes, and two exclusive right-turn lanes.
3. Southbound Approach: Construct two additional exclusive left-turn lanes.
4. Northbound Approach: Construct one additional exclusive right-turn lane.

Figure 5-2 displays all the study intersections under Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario"; whereas, Figures 5-3A and 5-3B presents the proposed geometric configurations of the new study intersections and the three modified study intersections under Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario", as described above.

Figure 5-2
STUDY INTERSECTIONS
YEAR 2030 + PROJECT CONDITIONS

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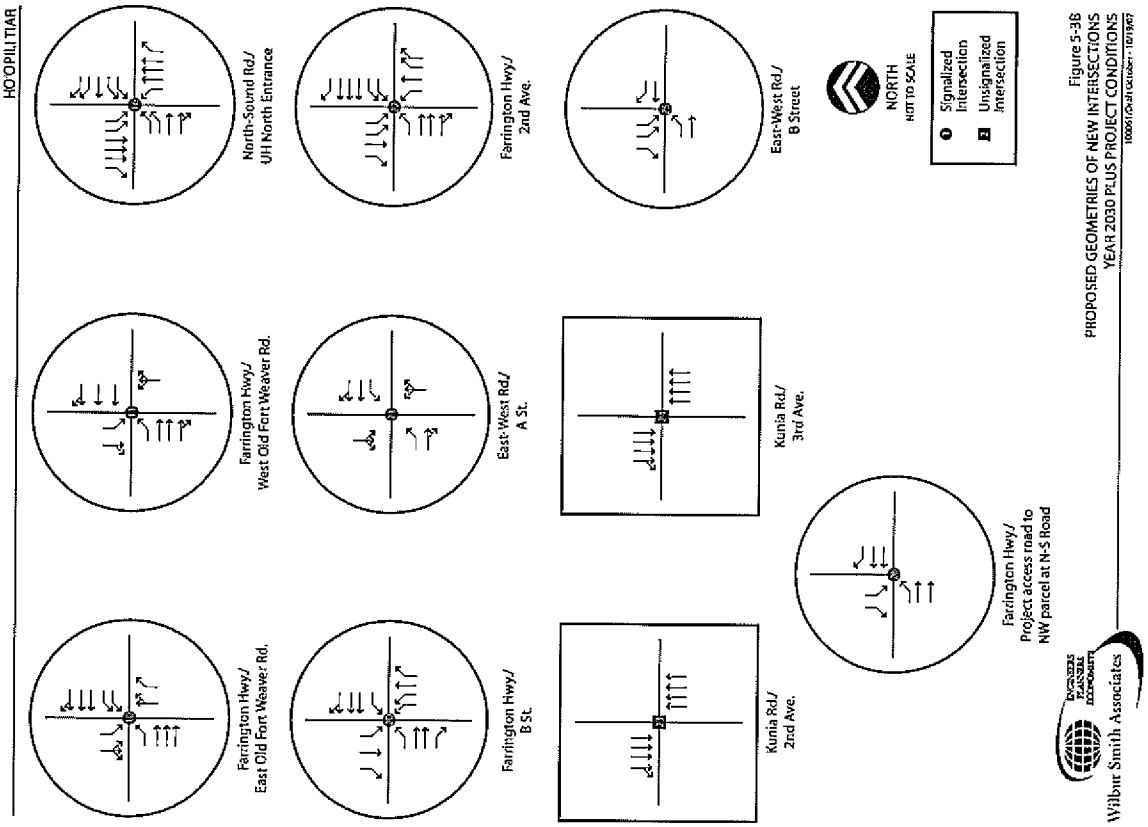

Figure 5-3B
PROPOSED GEOMETRIES OF NEW INTERSECTIONS
YEAR 2030 PLUS PROJECT CONDITIONS
100061/Draft October - 10/17/07

Wilbur Smith Associates

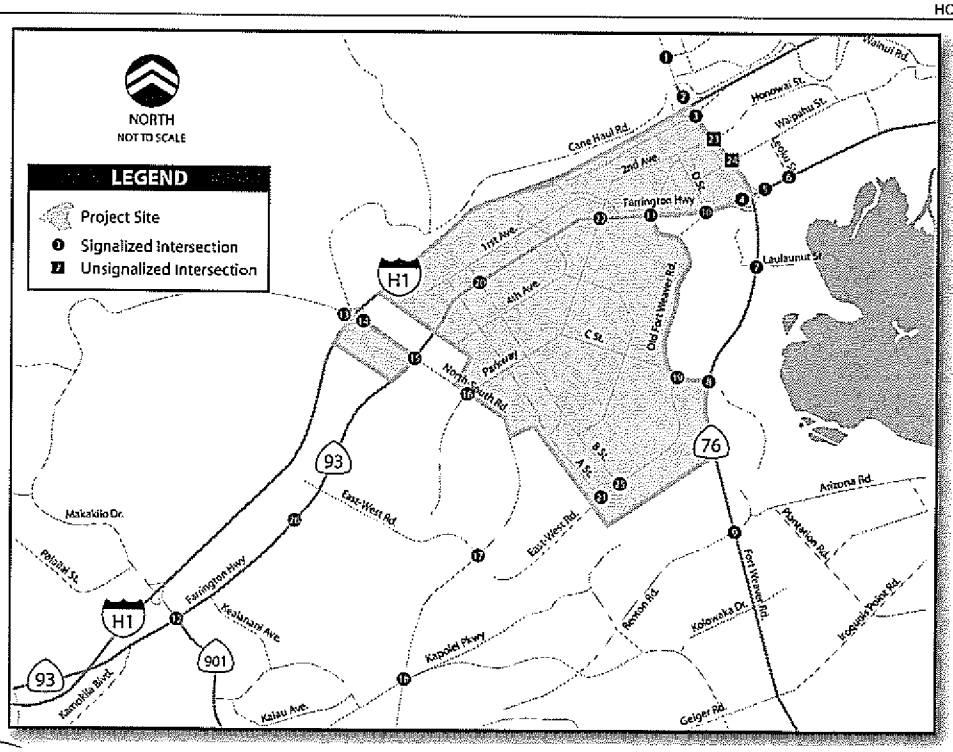

Figure 5-3A
PROPOSED GEOMETRIES OF NEW INTERSECTIONS
YEAR 2030 PLUS PROJECT CONDITIONS
100061/Draft October - 10/17/07

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5.2.2 Intersection Operating Conditions – Scenario A

Using the trip distribution pattern described in *Chapter 4*, the project trips generated under "With Transit Corridor Scenario" were distributed throughout the study area. The resulting turning movement volumes at the study intersections under Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario" are exhibited in Figures 5-4 A, 5-4 B, and 5-4 C.

The LOS of the study intersections, the study freeway segments, and the study freeway-ramp junctions were calculated using the same methodologies described in *Chapter 2*. The study intersection operations under Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario" are presented in Table 5.1. The LOS and delay values of the study intersections located outside the proposed Project site (external intersections) are exhibited in Tables 5.1 (a) and 5.2 (a) for AM and PM peak hour conditions respectively, while Tables 5.1 (b) and 5.2 (b) display the operations of the study intersections located within the proposed project site (internal intersections) under AM and PM peak hour conditions, respectively. Also identified in Tables 5.1 and 5.2 are the locations of transportation impacts under Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario".

During the AM peak hour, 22 of the 26 study intersections would operate under acceptable conditions (LOS D or better). The 4 intersections that would operate at LOS E or F are:

- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/ Fort Barrette Road
- North-South Road/ Farrington Highway

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Figure 5-4A
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

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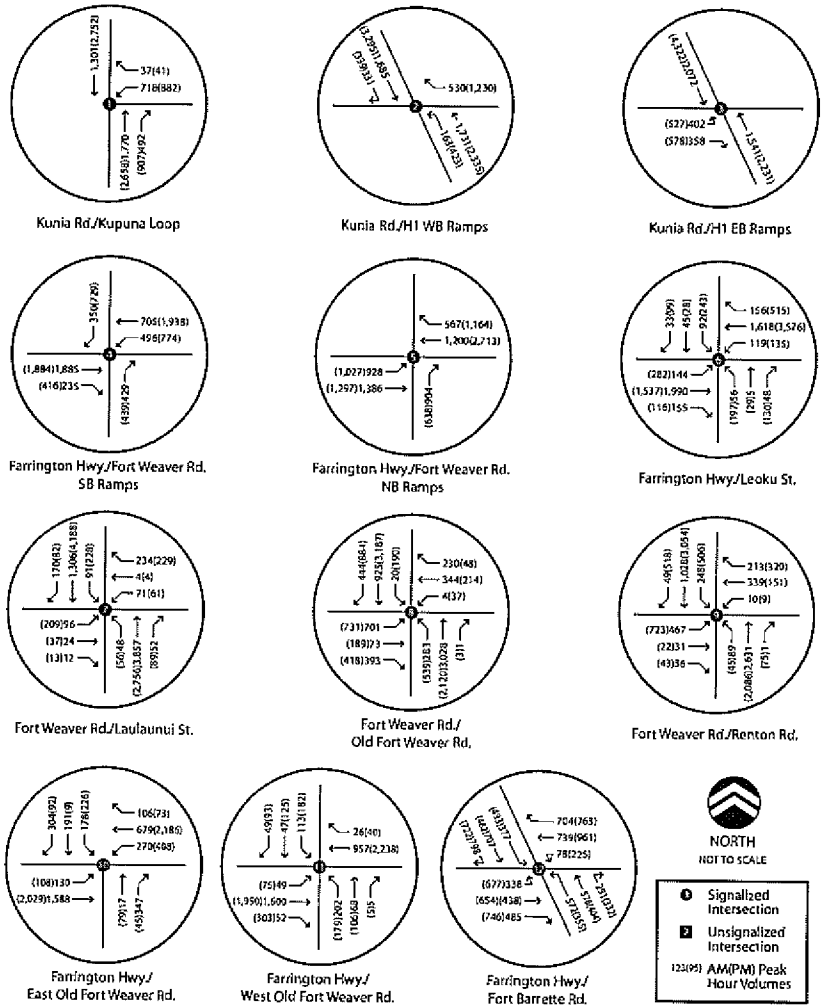

Figure 5-4B
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

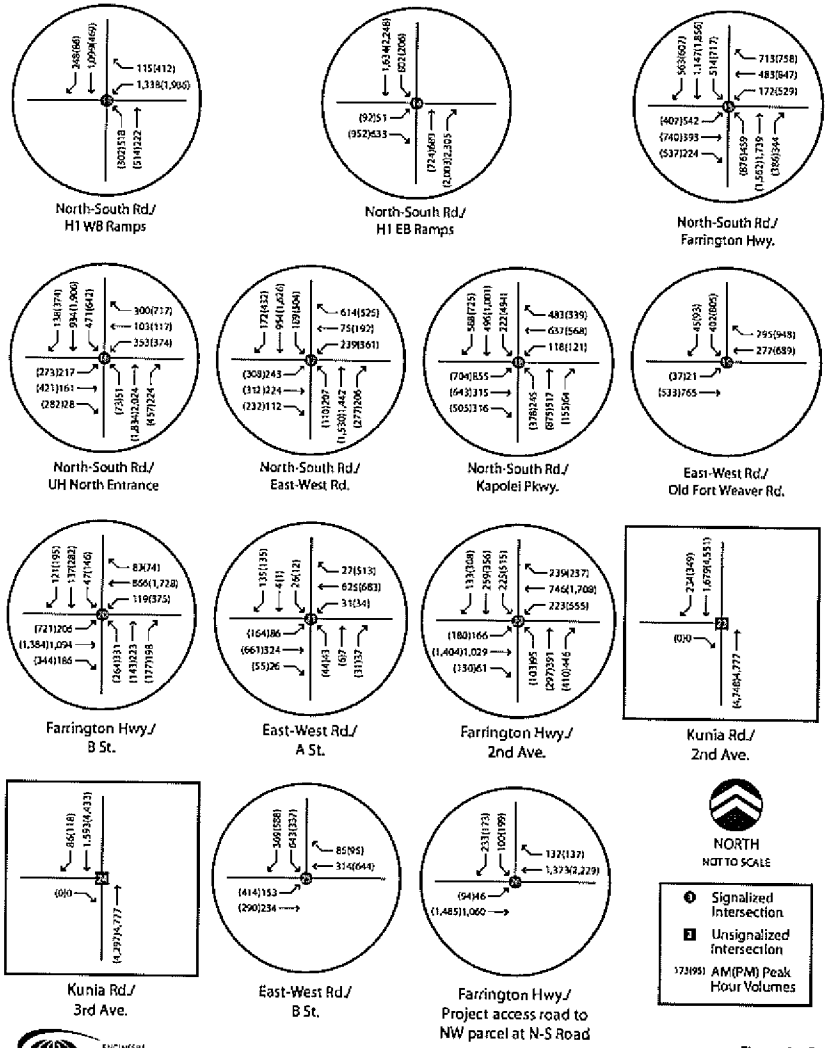

Figure 5-4C
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

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Table 5.1 (b)
AM Peak Hour Intersection Operations – Year 2030 Conditions Scenario A (Internal Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
20	Farrington Hwy./ B St.	Signal	-	-	-	30.2	0.69	C	N.A.
21	East-West Rd./ A St.	Signal	-	-	-	21.0	0.59	C	N.A.
22	Farrington Hwy./ Parkway/ 2nd Ave.	Signal	-	-	-	33.0	0.65	C	N.A.
23	Kunia Rd./ 2nd Ave.	OWSC	-	-	-	0.0 (NB)	0.76 (NB)	A	N.A.
24	Kunia Rd./ 3rd Ave.	OWSC	-	-	-	11.9 (EB)	0.01 (EB)	B	N.A.
25	East-West Rd./ B St.	Signal	-	-	-	27.3	0.82	C	N.A.
26	Farrington Hwy/Project Access Road to NW Parcel at N-S Road	Signal	-	-	-	17.8	0.65	B	N.A.

Source: Wilbur Smith Associates – 2007

NOTES:
OWSC – One-way Stop-Control
N.A. – Not Applicable
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Source: Wilbur Smith Associates – 2007

Table 5.1 (a)
AM Peak Hour Intersection Operations – Year 2030 Conditions Scenario A (External Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
1	Kunia Rd./ Kunia Loop	Signal	12.8	0.70	B	15.7	0.78	B	No
2	Kunia Rd./ H-1 WB On-Ramp[A]	TWSC	3.3	0.47	A	4.5	0.58	A	No
3	Kunia Rd./ H-1 EB Ramps	Signal	8.9	0.37	A	8.4	0.52	A	No
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	5.2	0.41	A	9.9	0.66	A	No
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	3.0	0.48	A	25.4	0.92	C	No
6	Farrington Hwy./ Leokü St.	Signal	18.0	0.63	B	19.2	0.73	B	No
7	Fort Weaver Rd./ Laulaunui St.	Signal	29.8	0.90	C	42.6	0.99	D	No
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	16.7	0.89	B	**176.6**	**1.69**	F	Yes
9	Fort Weaver Rd./ Reuton Rd.	Signal	**78.1**	**1.08**	E	**111.8**	**1.23**	F	Yes
10	Farrington Hwy./ East Old Fort Weaver Rd.[B]	TWSC	16.4 (WB)	0.21 (WB)	C	31.4	0.81	C	No
11	Farrington Hwy./ West Old Fort Weaver Rd.[B]	TWSC	22.0 (NB)	0.37 (NB)	C	17.2	0.62	B	No
12	Farrington Hwy./ Fort Barrette Rd.	Signal	**62.7**	0.77	E	**75.9**	**0.93**	E	Yes
13	North-South Rd./ H-1 WB Ramps	Signal	42.7	0.95	D	42.2	0.95	D	No
14	North-South Rd./ H-1 EB Ramps/	Signal	38.1	0.74	D	30.0	0.92	C	No
15	North-South Rd./ Farrington Hwy.	Signal	35.2	0.61	D	76.7	1.04	E	Yes
16	North-South Rd./ North UH Connector	Signal	7.3	0.39	A	38.6	0.87	D	No
17	North-South Rd./ East-West Rd.	Signal	27.0	0.63	C	37.0	0.79	D	No
18	North-South Rd./ Kapolei Pkwy.	Signal	34.8	0.75	C	43.1	0.86	D	No
19	East-West Rd./ Old Fort Weaver Rd.	Signal	22.3	0.24	C	14.3	0.61	B	No

NOTES:
A - This location is stop-controlled under existing conditions, but is signalized after meeting the traffic signal warrants under year 2030 conditions.
B - This location is stop-controlled under year 2030 conditions, but is signalized after meeting the traffic signal warrants under year 2030 plus project conditions.
TWSC – Two-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

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Table 5.2 (a)
PM Peak Hour Intersection Operations – Year 2030 Conditions Scenario A (External Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
1	Kunia Rd./ Kunia Loop	Signal	17.1	0.90	B	36.8	1.05	D	No
2	Kunia Rd./ H-1 WB On-Ramp[A]	TWSC	14.1	0.92	B	18.6	1.03	B	No
3	Kunia Rd./ H-1 EB Ramps	Signal	8.8	0.85	A	11.3	0.90	B	No
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	14.0	0.42	B	10.0	0.80	B	No
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	8.0	0.83	A	**134.2**	**1.41**	**F**	**Yes**
6	Farrington Hwy./ Leokū St.	Signal	47.4	0.88	D	**61.9**	**1.05**	**E**	**Yes**
7	Fort Weaver Rd./ Laulaunui St.	Signal	26.3	0.89	C	44.9	1.01	D	No
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	45.0	1.03	D	**289.5**	**2.01**	**F**	**Yes**
9	Fort Weaver Rd./ Renton Rd.	Signal	**63.4**	**1.03**	**E**	**125.3**	**1.25**	**F**	**Yes**
10	Farrington Hwy./ East Old Fort Weaver Rd.[B]	TWSC	32.0 (WB)	0.71 (WB)	D	20.6	0.75	C	No
11	Farrington Hwy./ West Old Fort Weaver Rd.[B]	TWSC	55.4 (NB)	0.55 (NB)	F	25.9	0.88	C	No
12	Farrington Hwy./ Fort Barrette Rd.	Signal	**67.5**	**0.88**	**E**	74.4	**0.91**	**E**	**Yes**
13	North-South Rd./ H-1 WB Ramps	Signal	25.6	0.59	C	38.2	0.86	D	No
14	North-South Rd./ H-1 EB Ramps	Signal	15.7	0.62	B	**87.5**	**1.30**	**F**	**Yes**
15	North-South Rd./ Farrington Hwy.	Signal	35.8	0.76	D	**136.3**	**1.28**	**F**	**Yes**
16	North-South Rd./ North UH Connector	Signal	13.5	0.47	B	49.0	0.92	D	No
17	North-South Rd./ East-West Rd.	Signal	34.3	0.76	C	43.1	0.87	D	No
18	North-South Rd./ Kapolei Pkwy.	Signal	54.2	0.88	D	**58.5**	**0.95**	**E**	**Yes**
19	East-West Rd./ Old Fort Weaver Rd.	Signal	20.6	0.62	C	62.6	0.56	E	Yes

Source: Wilbur Smith Associates – 2007

NOTES:
A - This location is stop-controlled under existing conditions, but is signalized after meeting the traffic signal warrants under year 2030 conditions.
B - This location is stop-controlled under year 2030 conditions, but is signalized after meeting the traffic signal warrants under year 2030 plus project conditions.
TWSC – Two-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Under Year 2030 Baseline plus Project "With Transit Corridor Scenario" PM peak hour conditions, 9 of the 26 study intersections would operate under unacceptable conditions (LOS E or worse). The other 17 study intersections would operate at acceptable conditions (LOS D or better). The study intersections operating at LOS E or F in the PM peak hour are:

- Farrington Highway/ Fort Weaver Road Northbound Ramps
- Farrington Highway/ Leokū Street
- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/ Fort Barrette Road
- North-South Road/ H-1 Eastbound Ramps
- North-South Road/ Farrington Highway
- North-South Road/ Kapolei Parkway
- East-West Road/ Old Fort Weaver Road

Of these, five intersections would operate at LOS E and five intersections would operate at LOS F.

The Farrington Highway intersection with Fort Barrette Road would operate at LOS E without or with the Project and is not significantly impacted by the Project.

Of the 4 intersections operating at LOS E or F conditions during the AM peak hour, all 4 would also operate unacceptably during the PM peak hour. Therefore under the "With Transit Corridor Scenario", the project traffic would result in transportation impacts at a total of 9 intersections during one or both peak hours.

Synchro calculation worksheets under Year 2025 Baseline plus Project conditions "With Transit Corridor Scenario" are included in Appendix A-3; Figure 5-5A1, 5-5A2, 5-5A3, 5-5B1, 5-5B2, and 5-5B3 present the LOS and delay values of all the turning movements at the study intersections under Year 2030 Baseline plus Project "With Transit Corridor Scenario" AM and PM peak hour conditions.

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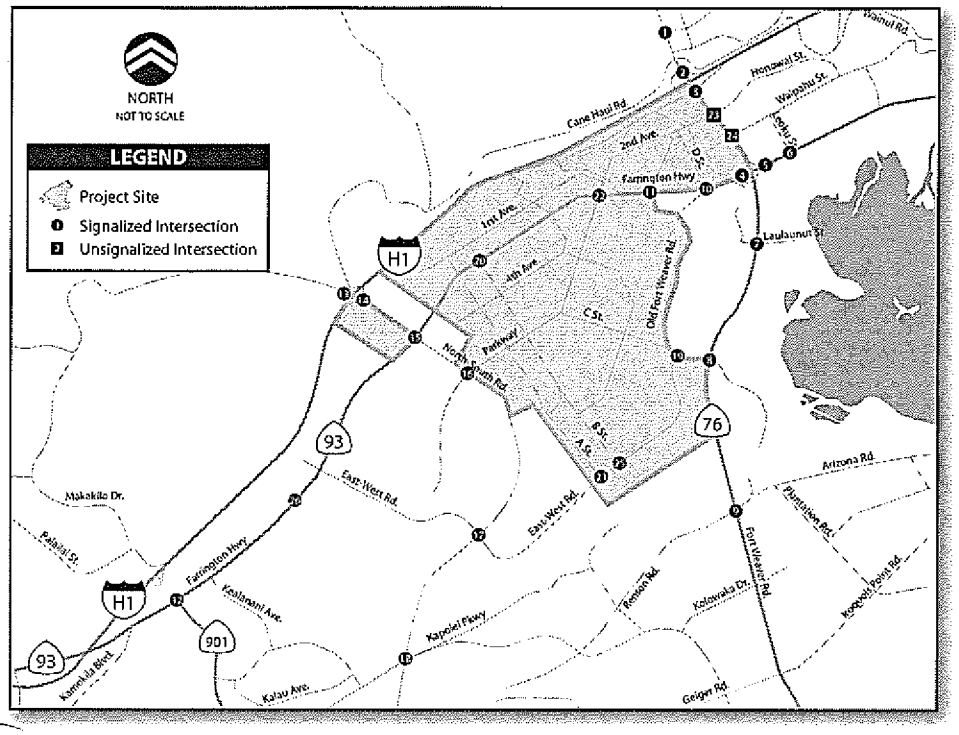

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Figure 5-5A1
AM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR
100661/Draft October - 10/17/07

Table 5.2 (b)
PM Peak Hour Intersection Operations – Year 2030 Conditions Scenario A (Internal Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
20	Farrington Hwy./ B St.	Signal	-	-	-	41.7	0.88	D	N.A.
21	East-West Rd./ A St.	Signal	-	-	-	17.5	0.61	B	N.A.
22	Farrington Hwy./ Parkway/ 2nd Ave.	Signal	-	-	-	**71.1**	**1.07**	E	N.A.
23	Kunia Rd./ 2nd Ave.	OWSC	-	-	-	0.0 (SB)	0.83 (SB)	A	N.A.
24	Kunia Rd./ 3rd Ave.	OWSC	-	-	-	0.0 (SB)	0.81 (SB)	A	N.A.
25	East-West Rd./ B St.	Signal	-	-	-	46.6	0.92	D	N.A.
26	Farrington Hwy/Project Access Road to NW Parcel at N-S Road	Signal	-	-	-	16.3	1.18	B	N.A.

Source: Wilbur Smith Associates – 2007

NOTES:
OWSC – All-way Stop-Control
N.A. – Not Applicable
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

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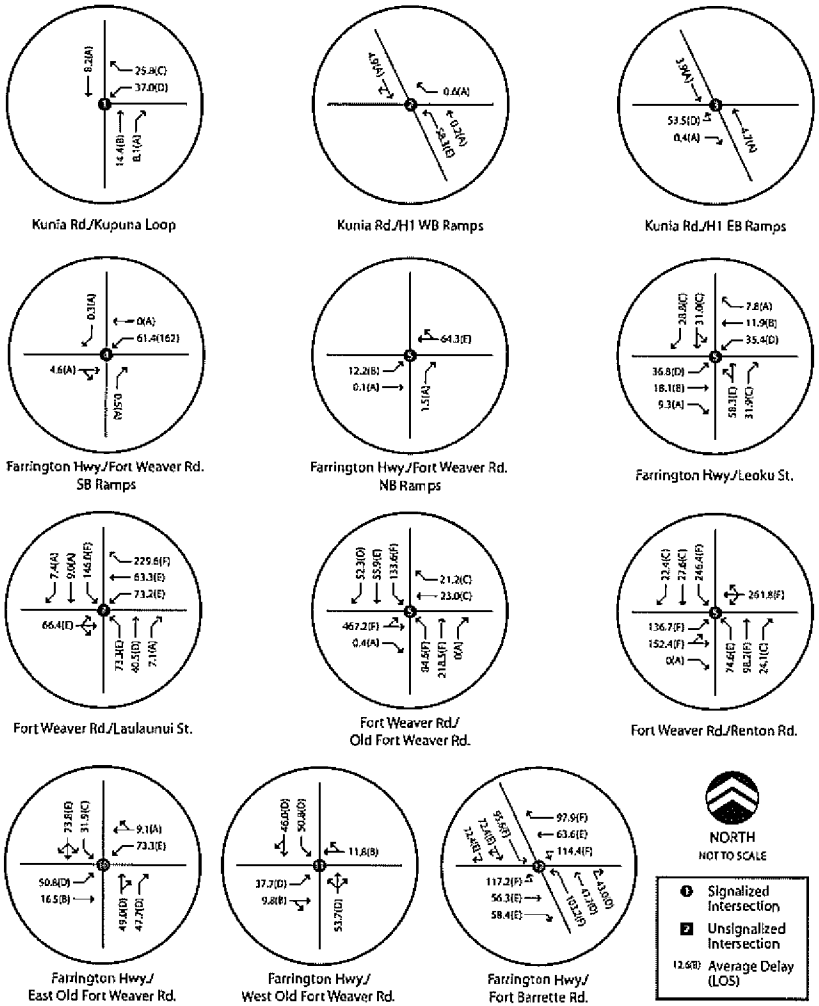

Figure 5-5A2
AM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

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100061/Draft October - 10/19/07

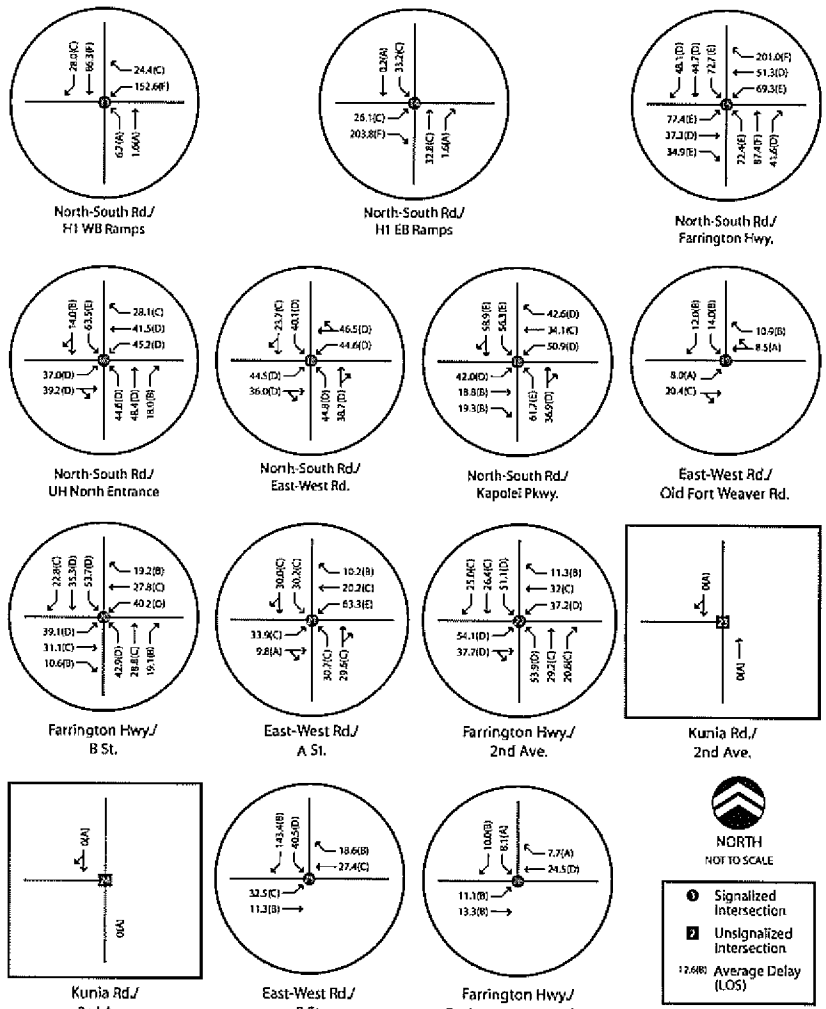

Figure 5-5A3
AM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

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100061/DEC 2007-12/10/07

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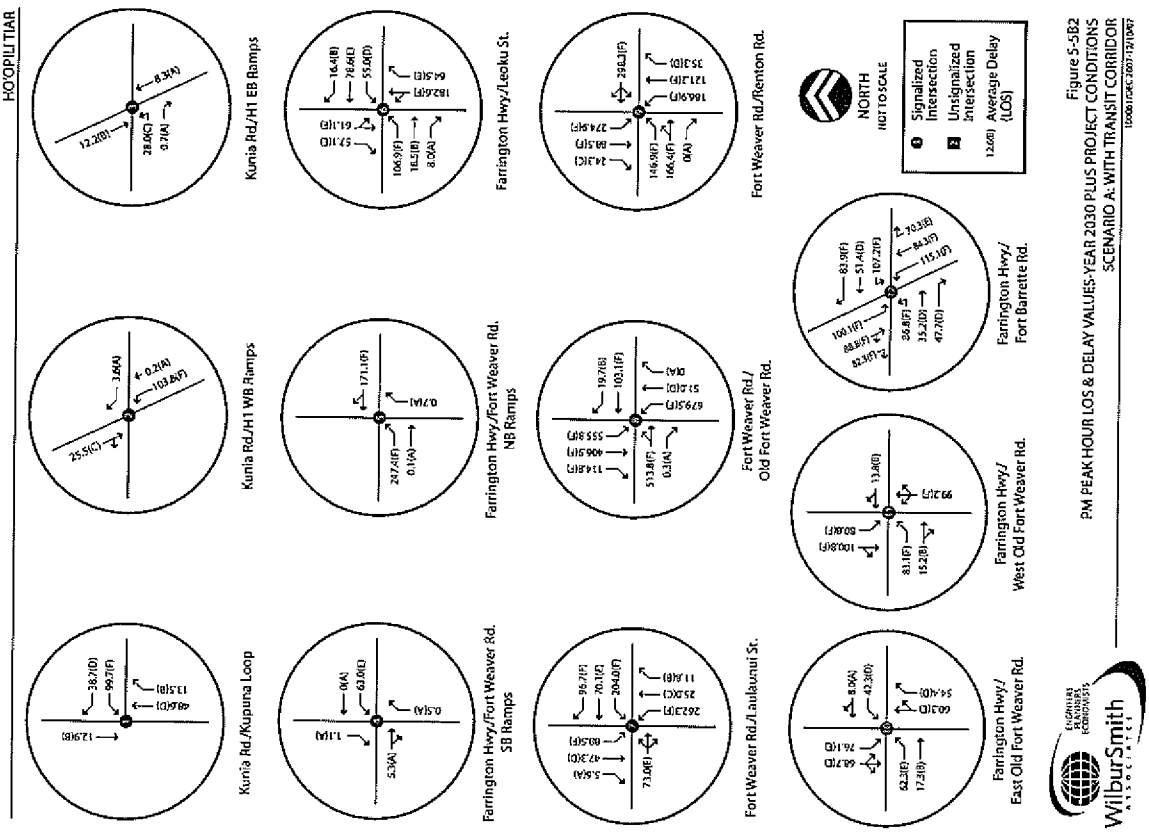

Figure 5-5B2
PM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR
100061/DEC 2007/12/1067

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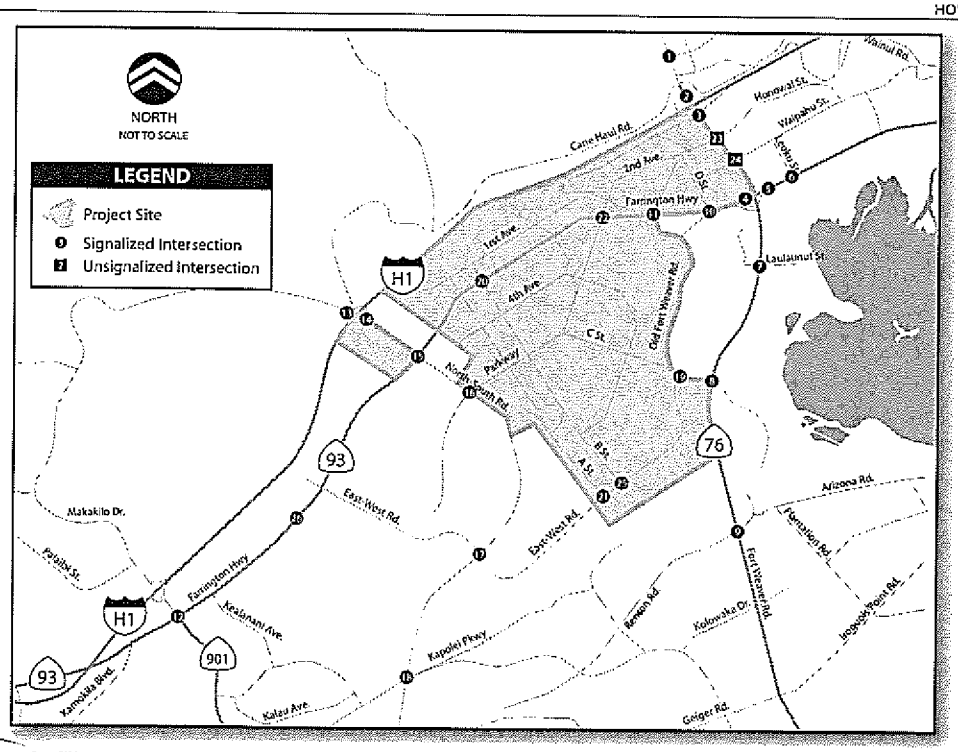

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Figure 5-5B1
PM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR
100061/Draft October - 10/17/07

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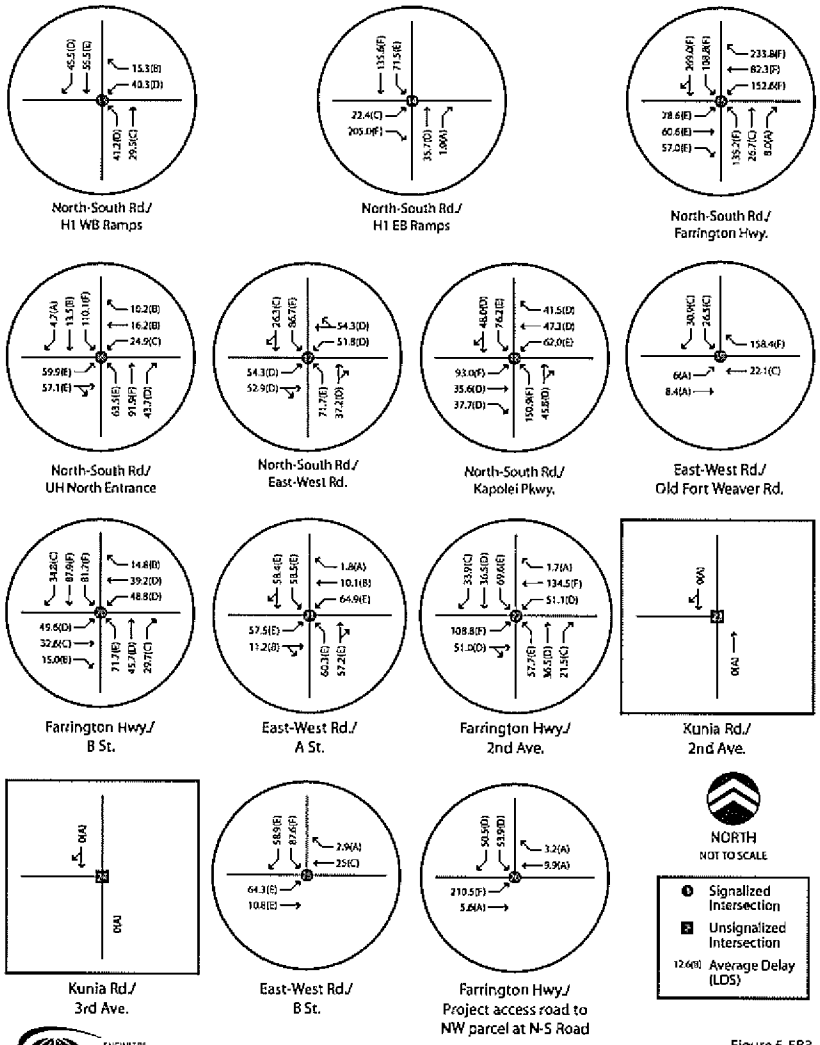

Figure 5-5B3
PM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

5.2.3 Freeway Operating Conditions – Scenario A

Figure 5-6 presents the freeway segment operations for Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario" and Table 5.3 compares the freeway segment operations under Year 2030 Baseline plus Project conditions with that for the baseline Year 2030 conditions.

For the morning peak period, four freeway segments would operate under unacceptable conditions (LOS E or worse), of which freeway segments H-1 Eastbound south of Makakilo Drive and H-1 Eastbound west of Kunia Road would operate at LOS E and LOS F, respectively under both Year 2030 Baseline and Year 2030 Baseline plus Project "With Transit Corridor Scenario" conditions. The other two freeway segments that would operate at LOS E or F in the Year 2030 plus Project scenario are H-1 Eastbound west of Pāiwa Street, and H-1 Eastbound east of Kamehameha Highway.

For the afternoon peak period, 7 of the 10 study freeway segments would operate under unacceptable conditions (LOS E or worse). Of the seven, two freeway segments operate at LOS F under both Year 2030 Baseline and Year 2030 Baseline plus Project conditions. The other five freeway segments operating under unacceptable conditions are H-1 Eastbound south of Makakilo Drive, H-1 Eastbound west of Pāiwa Street, H-1 Eastbound east of Kamehameha Highway, H-1 Westbound west of Kunia Road, and H-1 Westbound east of Kamehameha Highway.

Therefore, the proposed Project would result in potential cumulative impacts under "With Transit Corridor Scenario" at the following five freeway segments:

- H-1 Eastbound (south of Makakilo Drive)
- H-1 Eastbound (west of Pāiwa Street)
- H-1 Eastbound (east of Kamehameha Highway)
- H-1 Westbound (west of Kunia Road)
- H-1 Westbound (east of Kamehameha Highway)

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Table 5.3
Peak Hour Freeway Segment Operations – Year 2030 Conditions Scenario A

#	Freeway	Segment	Year 2030 Volume	Year 2030 Density	Year 2030 LOS	Year 2030 plus Project Volume	Year 2030 plus Project Density	Year 2030 plus Project LOS	Impact?
AM Peak									
1	H-1 EB	S/O Makakilo Dr.	5434	37.8	E	5892	43.9	E	No
2	H-1 EB	W/O Kunia Rd.	8197	>45	F	9143	>45	F	No
3	H-1 EB	W/O Pāiwa St.	9906	43.4	E	11906	>45	F	Yes
4	H-1 EB	E/O Kamehameha Hwy.	7512	38.8	E	8435	>45	F	Yes
5	H-2 NB	At Ka Uka Blvd.	3184	21.3	C	3597	24.1	C	No
6	H-1 WB	S/O Makakilo Dr.	3259	21.8	C	3756	25.1	C	No
7	H-1 WB	W/O Kunia Rd.	3735	18.3	C	4491	21.9	C	No
8	H-1 WB	W/O Pāiwa St.	4366	16.6	B	5858	22.3	C	No
9	H-1 WB	E/O Kamehameha Hwy.	3069	20.5	C	3757	25.1	C	No
10	H-2 SB	At Ka Uka Blvd.	6273	30.7	D	6581	32.5	D	No
PM Peak									
1	H-1 EB	S/O Makakilo Dr.	4680	31.3	D	5334	36.7	E	Yes
2	H-1 EB	W/O Kunia Rd.	5833	28.5	D	6891	34.5	D	No
3	H-1 EB	W/O Pāiwa St.	7137	27.2	D	9139	37.0	E	Yes
4	H-1 EB	E/O Kamehameha Hwy.	4249	28.4	D	5173	35.2	E	Yes
5	H-2 NB	At Ka Uka Blvd.	6220	>45	F	6663	>45	F	No
6	H-1 WB	S/O Makakilo Dr.	6365	>45	F	7022	>45	F	No
7	H-1 WB	W/O Kunia Rd.	7860	43.3	E	8875	>45	F	Yes
8	H-1 WB	W/O Pāiwa St.	7931	25.2	C	10131	32.9	D	No
9	H-1 WB	E/O Kamehameha Hwy.	7766	42.2	E	8781	>45	F	Yes
10	H-2 SB	At Ka Uka Blvd.	4616	22.5	C	5070	24.8	C	No

Source: Wilbur Smith Associates, 2007

NOTES:
Density is given in pc/mi/ln.
Bold represents LOS E or F.

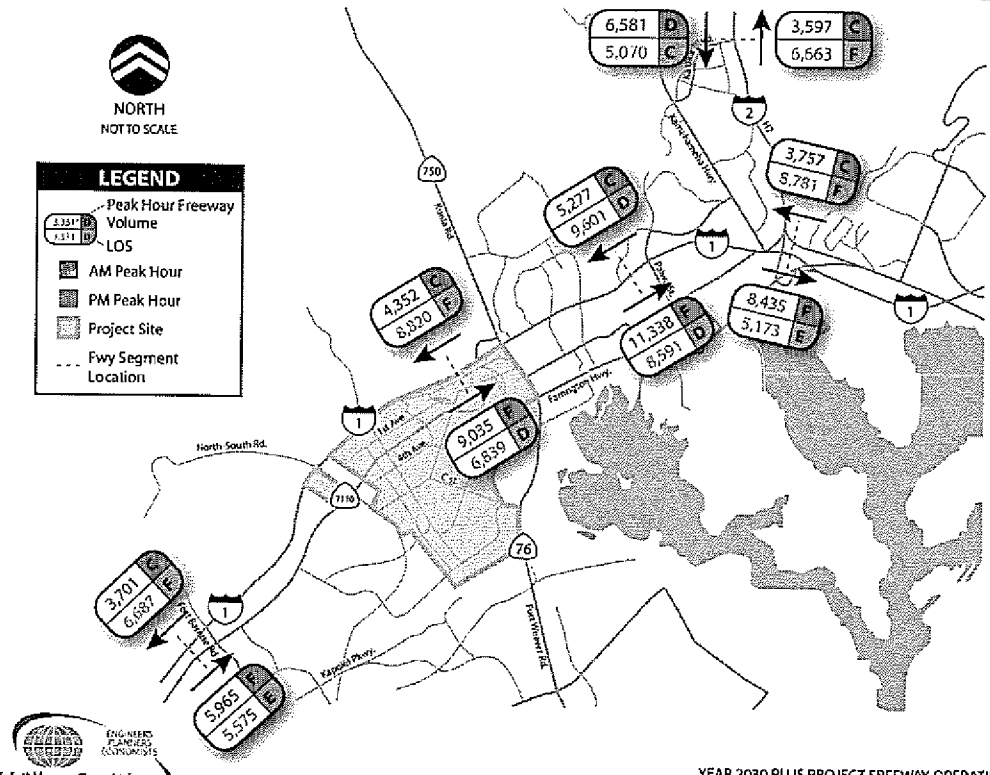

Figure 5-6
YEAR 2030 PLUS PROJECT FREEWAY OPERATING CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

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5.2.4 Freeway-Ramp Junction Operating Conditions – Scenario A

Table 5.4 presents the density and LOS values of the study ramp-freeway junctions under Year 2030 Baseline plus Project "With Transit Corridor Scenario". The North-South Road Interchange ramps were analyzed based on the planned initial diamond-type interchange configuration (Refer to Appendix E-2). Additionally, it should be noted that the analysis for the North-South Road Interchange was based on a ramp acceleration/deceleration lane length of 500 ft (in the absence of detailed information).

During Year 2030 plus Project "With Transit Corridor Scenario" AM peak hour, 7 of the 10 ramp-freeway junctions would operate under acceptable conditions (LOS D or better) with the Project. The four ramp-freeway junctions that would operate at LOS E or F conditions are: H-1/ Fort Weaver Road (Eastbound Off-Ramp), H-1/ Fort Weaver Road (Eastbound On-Ramp), and H-1/ North-South Road (Eastbound On-Ramp).

Similar to the AM peak hour, 7 of the 10 study ramp-freeway junctions would operate under acceptable conditions (LOS D or better) during the PM peak hour. The remaining three ramp-freeway junctions that would operate under unacceptable conditions (LOS E or F) are: H-1/ Fort Weaver Road (Westbound Loop Off-Ramp), H-1/ Fort Weaver Road (Eastbound On-Ramp), and H-1/ Fort Weaver Road (Westbound On-Ramp). Two of these ramp-freeway junctions would worsen to unacceptable levels with the addition of the Project traffic:

- H-1/ Fort Weaver Road (Eastbound On-Ramp)
- H-1/ North-South Road (Westbound On-Ramp)

In considering both peak hours, the Project would significantly affect conditions at a total of five ramp junctions:

- H-1/ Fort Weaver Road (Westbound Loop Off-Ramp)
- H-1/ Fort Weaver Road (Eastbound Off-Ramp)
- H-1/ Fort Weaver Road (Eastbound On-Ramp)
- H-1/ North-South Road (Westbound On-Ramp)
- H-1/ North-South Road (Eastbound On-Ramp)

Table 5.4
Peak Hour Ramp-Freeway Junction Operations – Year 2030 Conditions Scenario A

#	Location	Ramps	Peak Hour	2030 Baseline		2030 Scenario A	
				Density[1]	LOS	Density	LOS
1	H-1/ Fort Weaver Road	WB Off-Ramp	AM Peak	16.0	B	16.0	B
2	H-1/ Fort Weaver Road	WB Loop Off-Ramp	AM Peak	1.3	A	8.2	A
3	H-1/ Fort Weaver Road	WB On-Ramp	AM Peak	15.0	B	15.7	B
4	H-1/ Fort Weaver Road	EB Off-Ramp	AM Peak	37.4	**E**	38.9	**F**
5	H-1/ Fort Weaver Road	EB On-Ramp	AM Peak	24.8	**F**	36.1	**F**
6	H-1/ Fort Weaver Road	EB Loop On-Ramp	AM Peak	26.3	**F**	26.3	**F**
7	H-1/ North-South Road	WB Off-Ramp	AM Peak	20.3	C	26.3	C
8	H-1/ North-South Road	WB On-Ramp	AM Peak	13.5	B	16.9	B
9	H-1/ North-South Road	EB Off-Ramp	AM Peak	25.0	C	29.1	D
10	H-1/ North-South Road	EB On-Ramp	AM Peak	28.8	D	38.3	**F**
1	H-1/ Fort Weaver Road	WB Off-Ramp	PM Peak	38.0	**F**	38.0	**F**
2	H-1/ Fort Weaver Road	WB Loop Off-Ramp	PM Peak	19.9	**F**	30.7	**F**
3	H-1/ Fort Weaver Road	WB On-Ramp	PM Peak	26.0	C	26.3	C
4	H-1/ Fort Weaver Road	EB Off-Ramp	PM Peak	28.8	D	31.1	D
5	H-1/ Fort Weaver Road	EB On-Ramp	PM Peak	18.3	B	29.3	**F**
6	H-1/ Fort Weaver Road	EB Loop On-Ramp	PM Peak	20.4	C	20.4	C
7	H-1/ North-South Road	WB Off-Ramp	PM Peak	41.1	**F**	49.3	**F**
8	H-1/ North-South Road	WB On-Ramp	PM Peak	27.7	C	27.1	**F**
9	H-1/ North-South Road	EB Off-Ramp	PM Peak	21.0	C	27.3	C
10	H-1/ North-South Road	EB On-Ramp	PM Peak	17.0	B	25.8	C

Source: Wilbur Smith Associates, 2007

NOTES:
DEC – Demand Exceeds Capacity
Density is presented in pc/mi/ln.
Bold type indicates LOS F.

1 – Lower density does not necessarily indicate a lower LOS. This is because the LOS is calculated based upon a number of factors including: merge influence area, length of the acceleration lane, etc. See Appendix F for the HCM methodology used to calculate the LOS for Freeway Segments.

5.3 SCENARIO B: WITHOUT TRANSIT CORRIDOR

5.3.1 Project Study Area – Scenario B

Under Year 2025 Baseline plus Project conditions "Without Transit Corridor Scenario" (Scenario B), the study area and the proposed geometric configurations of 15 new study intersections as well as three modified study intersections would remain same as discussed in *Section 5.1.1* under Year 2025 Baseline plus Project conditions "With Transit Corridor Scenario" (Figures 5-2 and 5-3).

AR00027985

5.3.2 Intersection Operating Conditions – Scenario B

The intersection turning movement volumes under Year 2030 Baseline plus Project conditions "Without Transit Corridor Scenario" are exhibited in Figure 5-7 A, 5-7 B, and 5-7 C .

The intersection operations under Year 2030 Baseline plus Project conditions "Without Transit Corridor Scenario" are presented in Tables 5.5 and 5.6. The LOS and delay values of the study intersections located outside the proposed project site (external intersections) are exhibited in Table 5.5 (a) and 5.6 (a) for AM and PM peak hour conditions respectively, while Tables 5.5 (b) and 5.6 (b) display the operations of the study intersections located within the proposed project site (internal intersections) for AM and PM peak hour conditions.

During the AM peak period, the intersection operations under "Without Transit Corridor Scenario" are similar to that under "With Transit Scenario." Of the 26 study intersections, 20 would operate under acceptable conditions (LOS D or better) and the following six intersections would operate at LOS E or F:

- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/Fort Barrette Road
- North-South Road/ H-1 Westbound Ramps
- North-South Road/ Farrington Highway
- North-South Road/ Kapolei Parkway

During the PM peak period, the intersection operations under "Without Transit Corridor Scenario" marginally worsen compared to "With Transit Scenario." Of the 26 study intersections, 17 would operate under acceptable conditions (LOS D or better) and the following nine intersections would operate at LOS E or F:

- Farrington Hwy/ Fort Weaver Road Northbound Ramps
- Farrington Hwy/ Leokū Street
- Fort Weaver Road/ Laulaunui Street
- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/Fort Barrette Road
- North-South Road/ H-1 Eastbound Ramps
- North-South Road/ Farrington Highway
- North-South Road/ Kapolei Parkway

Figure 5-7A
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

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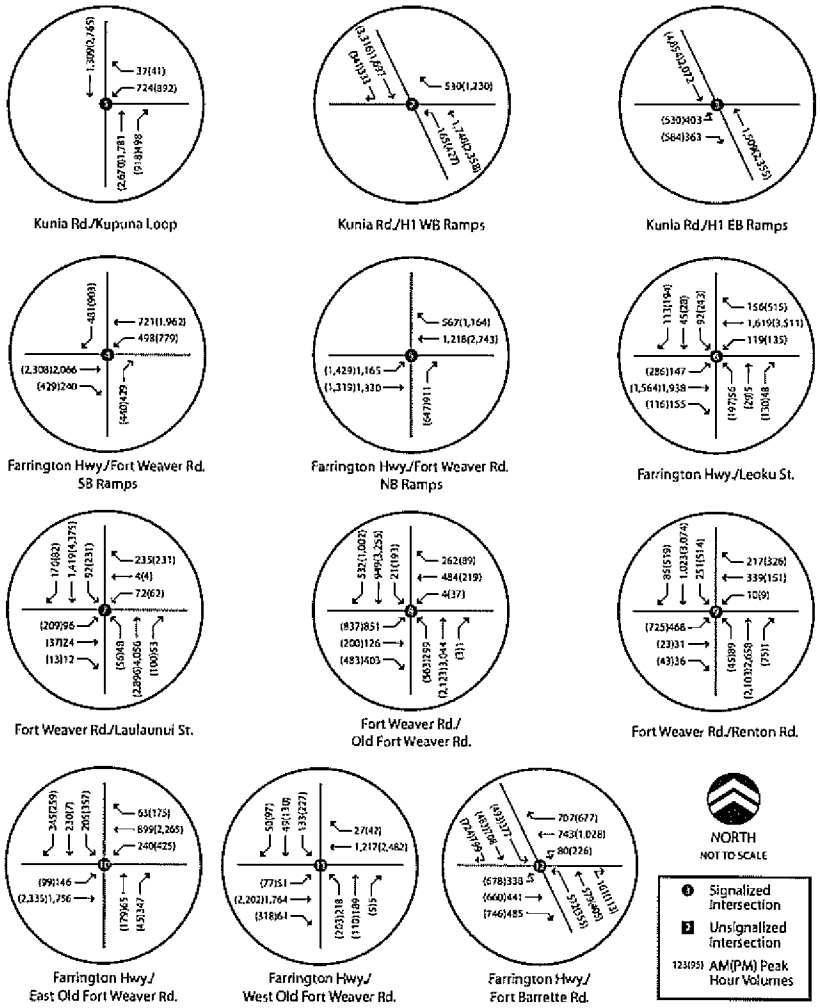

Figure 5-7B
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

100061/DEC 2007-12/10/07

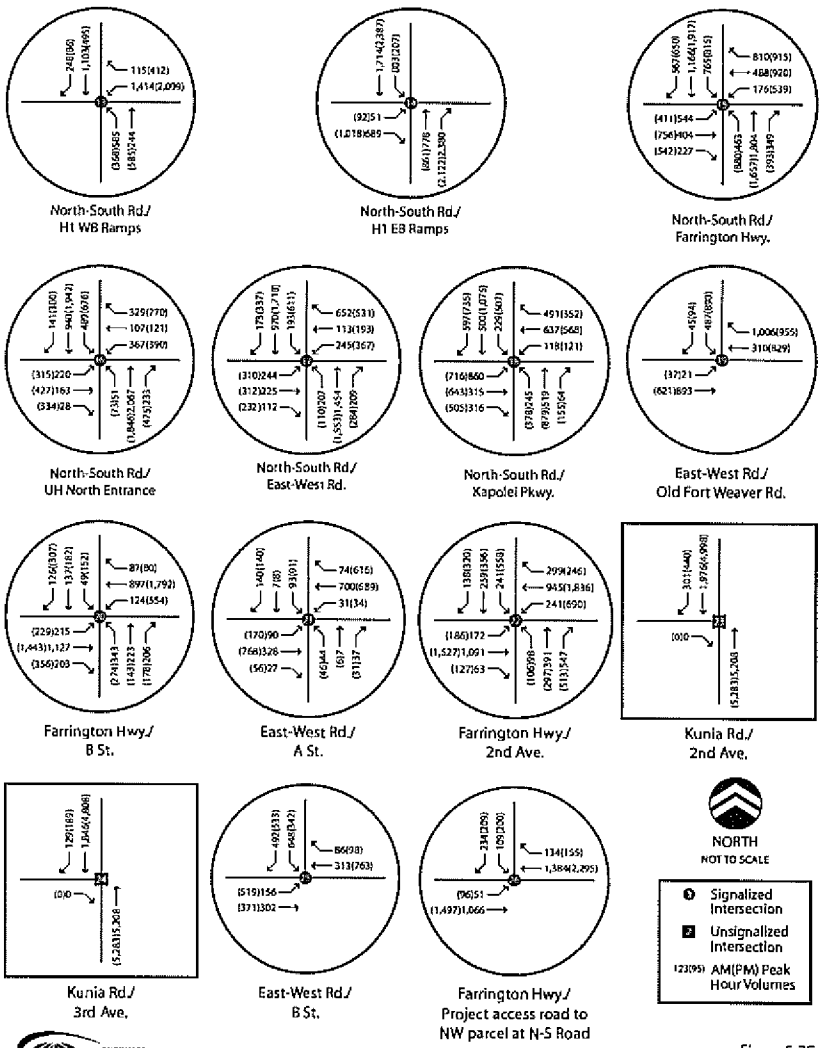

Figure 5-7C
PEAK HOUR INTERSECTION VOLUMES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

100061/DEC 2007-12/10/07

AR00027987

Table 5.5 (b)
AM Peak Hour Intersection Operations – Year 2030 Conditions Scenario B (Internal Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
20	Farrington Hwy./ B St.	Signal	-	-	-	30.6	0.71	C	N.A.
21	East-West Rd./ A St.	Signal	-	-	-	24.6	0.69	C	N.A.
22	Farrington Hwy./ Parkway/ 2nd Ave.	Signal	-	-	-	33.2	0.66	C	N.A.
23	Kunia Rd./ 2nd Ave.	OWSC	-	-	-	0.0 (NB)	0.83 (NB)	A	N.A.
24	Kunia Rd./ 3rd Ave.	OWSC	-	-	-	12.3 (EB)	0.02 (EB)	B	N.A.
25	East-West Rd./ B St.	Signal	-	-	-	23.9	0.84	C	N.A.
26	Farrington Hwy/Project Access Road to NW Parcel at N-S Road	Signal	-	-	-	18.3	0.66	B	N.A.

Source: Wilbur Smith Associates – 2007

NOTES:
AWSC – All-way Stop-Control
TWSC – Two-way Stop-Control
N.A. – Not Applicable
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Table 5.5 (a)
AM Peak Hour Intersection Operations – Year 2030 Conditions Scenario B (External Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
1	Kunia Rd./ Kunia Loop	Signal	12.8	0.70	B	17.9	0.85	B	No
2	Kunia Rd./ H-1 WB On-Ramp[A]	TWSC	3.3	0.47	A	4.5	0.59	A	No
3	Kunia Rd./ H-1 EB Ramps	Signal	8.9	0.37	A	8.4	0.52	A	No
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	5.2	0.41	A	10.3	0.71	B	No
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	3.0	0.48	A	38.4	1.07	D	No
6	Farrington Hwy./ Leokū St.	Signal	18.0	0.63	B	23.6	0.66	C	No
7	Fort Weaver Rd./ Laulaunui St.	Signal	29.8	0.90	C	53.9	1.03	D	No
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	16.7	0.89	B	**268.8**	**2.43**	F	Yes
9	Fort Weaver Rd./ Renton Rd.	Signal	**78.1**	**1.08**	E	**114.8**	**1.24**	F	Yes
10	Farrington Hwy./ East Old Fort Weaver Rd.[B]	TWSC	16.4 (WB)	0.21 (WB)	C	40.1	0.91	D	No
11	Farrington Hwy./ West Old Fort Weaver Rd.[B]	TWSC	22.0 (NB)	0.37 (NB)	C	24.8	0.77	C	No
12	Farrington Hwy./ Fort Barrette Rd.	Signal	**62.7**	**0.77**	E	**71.6**	**0.90**	E	Yes
13	North-South Rd./ H-1 WB Ramps	Signal	32.4	0.68	C	**99.4**	**1.00**	F	Yes
14	North-South Rd./ H-1 EB Ramps	Signal	38.1	0.74	D	37.3	0.98	D	No
15	North-South Rd./ Farrington Hwy.	Signal	35.2	0.61	D	**105.4**	**1.23**	F	Yes
16	North-South Rd./ North UH Connector	Signal	7.3	0.39	A	33.4	0.76	C	No
17	North-South Rd./ East-West Rd.	Signal	27.0	0.63	C	40.8	0.77	D	No
18	North-South Rd./ Kapolei Pkwy.	Signal	34.8	0.75	C	**62.7**	**0.92**	E	Yes
19	East-West Rd./ Old Fort Weaver Rd.	Signal	22.3	0.24	C	14.1	0.74	B	No

Source: Wilbur Smith Associates – 2007

NOTES:
A - This location is stop-controlled under existing conditions, but is signalized after meeting the traffic signal warrants under year 2030 conditions.
B - This location is stop-controlled under year 2030 conditions, but is signalized after meeting the traffic signal warrants under year 2030 plus project conditions.
TWSC – Two-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

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Table 5.6 (b)
PM Peak Hour Intersection Operations – Year 2030 Conditions Scenario B (Internal Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
20	Farrington Hwy./ B St.	Signal	-	-	-	38.4	0.87	D	N.A.
21	East-West Rd./ A St.	Signal	-	-	-	26.2	0.74	C	N.A.
22	Farrington Hwy./ Parkway/ 2nd Ave.	Signal	-	-	-	42.8	0.97	D	N.A.
23	Kunia Rd./ 2nd Ave.	OWSC	-	-	-	0.0 (SB)	0.91 (SB)	A	N.A.
24	Kunia Rd./ 3rd Ave.	OWSC	-	-	-	0 (SB)	0.12 (SB)	A	N.A.
25	East-West Rd./ B St.	Signal	-	-	-	60.8	1.01	E	N.A.
26	Farrington Hwy/Project Access Road to NW Parcel at N-S Road	Signal	-	-	-	17.0	1.21	B	N.A.

Source: Wilbur Smith Associates – 2007

NOTES:
AWSC – All-way Stop-Control
TWSC – Two-way Stop-Control
N.A. – Not Applicable
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

Table 5.6 (a)
PM Peak Hour Intersection Operations – Year 2030 Conditions Scenario B (External Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
1	Kunia Rd./ Kunia Loop	Signal	17.1	0.90	B	40.1	1.04	D	No
2	Kunia Rd./ H-1 WB On-Ramp[A]	TWSC	14.1	0.92	B	15.4	0.97	B	No
3	Kunia Rd./ H-1 EB Ramps	Signal	8.8	0.85	A	19.4	0.93	B	No
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	14.0	0.42	B	9.4	0.78	A	No
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	8.0	0.83	A	**221.0**	**1.65**	**F**	**Yes**
6	Farrington Hwy./ Leokū St.	Signal	47.4	0.88	D	**57.6**	**1.01**	**E**	**Yes**
7	Fort Weaver Rd./ Laulaunui St.	Signal	26.3	0.89	C	**56.3**	**1.05**	**E**	**Yes**
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	45.0	1.03	D	**322.9**	**2.17**	**F**	**Yes**
9	Fort Weaver Rd./ Renton Rd.	Signal	**63.4**	**1.03**	**E**	**130.6**	**1.30**	**F**	**Yes**
10	Farrington Hwy./ East Old Fort Weaver Rd.[B]	TWSC	32.0 (WB)	0.71 (WB)	D	40.9	0.91	D	No
11	Farrington Hwy./ West Old Fort Weaver Rd.[B]	TWSC	55.4 (NB)	0.55 (NB)	F	30.5	0.89	C	No
12	Farrington Hwy./ Fort Barrette Rd.	Signal	**67.5**	**0.88**	**E**	**67.0**	**0.86**	**E**	**Yes**
13	North-South Rd./ H-1 WB Ramps	Signal	25.6	0.59	C	54.0	0.94	D	No
14	North-South Rd./ H-1 EB Ramps	Signal	15.7	0.62	B	**105.4**	**1.39**	**F**	**Yes**
15	North-South Rd./ Farrington Hwy.	Signal	35.8	0.76	D	**117.1**	**1.27**	**F**	**Yes**
16	North-South Rd./ North UH Connector	Signal	13.5	0.47	B	50.3	0.94	D	No
17	North-South Rd./ East-West Rd.	Signal	34.3	0.76	C	45.9	0.85	D	No
18	North-South Rd./ Kapolei Pkwy.	Signal	54.2	0.88	D	**68.3**	**0.95**	**E**	**Yes**
19	East-West Rd./ Old Fort Weaver Rd.	Signal	20.6	0.62	C	13.6	0.72	B	No

Source: Wilbur Smith Associates – 2007

NOTES:
A - This location is stop-controlled under existing conditions, but is signalized after meeting the traffic signal warrants under year 2030 conditions.
B - This location is stop-controlled under year 2030 conditions, but is signalized after meeting the traffic signal warrants under year 2030 plus project conditions.
TWSC – Two-way Stop-Control
Signal – Traffic Signal
Delay represents average delay presented in seconds per vehicle.
Delay and LOS are presented for worst approach for two-way stop controlled intersections.
Bold type indicates LOS E or F.

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Overall, in considering both peak hours, under Year 2030 Baseline plus Project conditions "Without Transit Corridor Scenario", 10 of the 26 study intersections would operate under unacceptable conditions (LOS E or worse). The other 16 study intersections would operate under acceptable conditions (LOS D or better). The study intersections operating at LOS E or F are:

- Farrington Highway/ Fort Weaver Road Northbound Ramps
- Farrington Highway / Leokū Street
- Fort Weaver Road/ Laulaunui Street
- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/Fort Barrette Road
- North-South Road/ H-1 Eastbound Ramps
- North-South Road/ Farrington Highway
- North-South Road/ Kapolei Parkway

Intersections Farrington Highway/ Leokū Street, Fort Weaver Road/ Laulaunui Street, Farrington Highway/Fort Barrette Road, and North-South Road/ Kapolei Parkway would operate at LOS E, while the remaining 6 intersections would operate at LOS F.

Of the 10 intersections operating under unacceptable conditions during the PM peak hour, six intersections also operate unacceptably during the AM peak hour. Even though the Fort Weaver Road/ Old Fort Weaver Road intersection would operate at LOS F under both Year 2030 Baseline and Year 2030 Baseline plus Project "Without Transit Corridor Scenario" conditions, the difference in volume-to-capacity ratio is greater than 10 percent. Therefore under "Without Transit Corridor Scenario", the proposed Project would result in transportation impacts at all 10 intersections operating under unacceptable conditions during the PM peak period. A detailed description is presented in *Section 6.2.2*.

Synchro calculation worksheets under Year 2030 Baseline plus Project conditions "Without Transit Corridor Scenario" are included in Appendix A-4; whereas, Figures 5-8A1, 5-8A2, 5-8A3, 5-8B1, 5-8B2, and 5-8B3 present the LOS and delay values of all the turning movements at the study intersections under Year 2030 Baseline plus Project "Without Transit Corridor Scenario" AM and PM peak hour conditions.

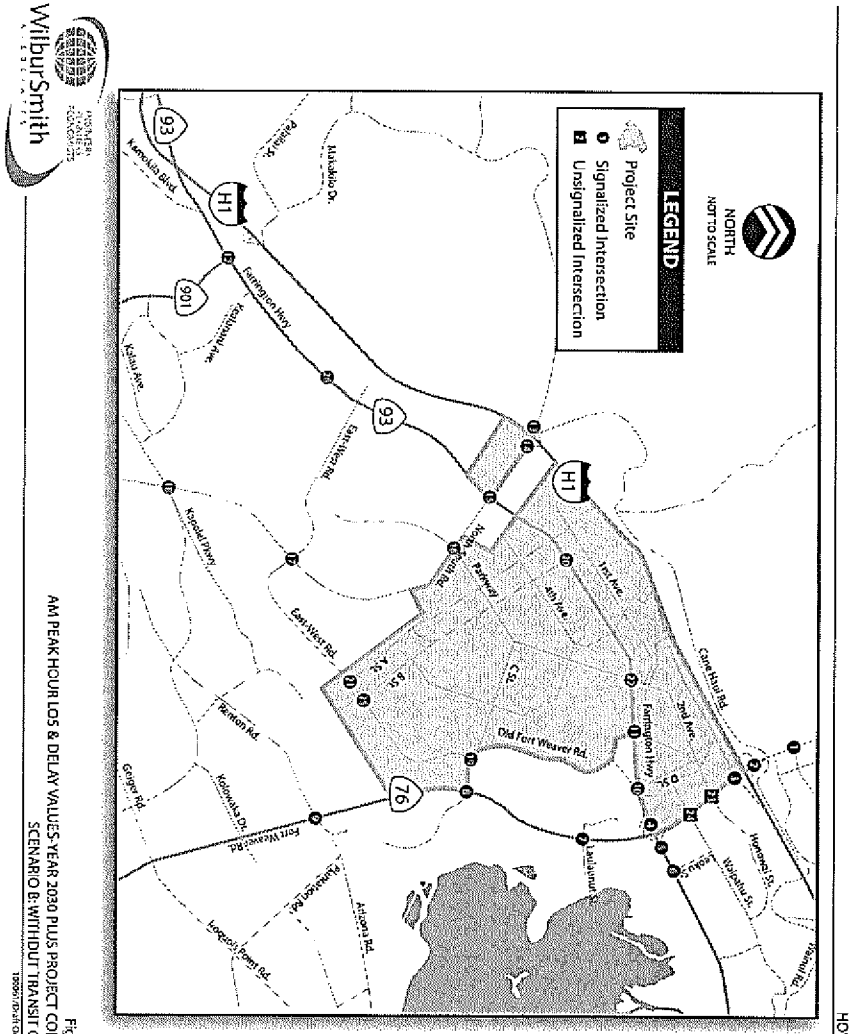

Figure 5-8A1
AM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

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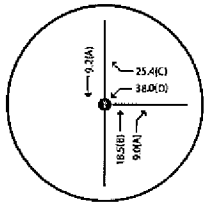
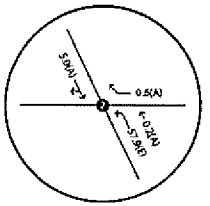
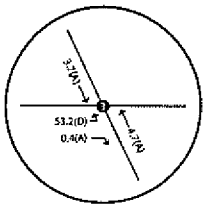


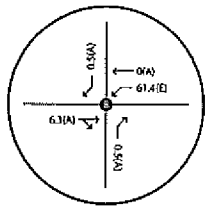
Kunia Rd./Kupuna Loop



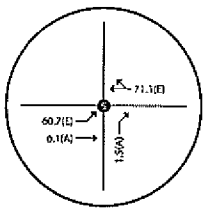
Kunia Rd./H1 WB Ramps



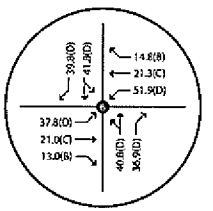
Kunia Rd./H1 EB Ramps



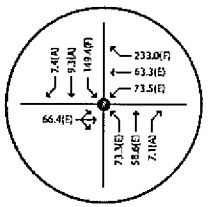
Farrington Hwy./Fort Weaver Rd. SB Ramps



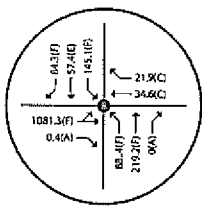
Farrington Hwy./Fort Weaver Rd. NB Ramps



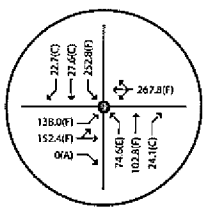
Farrington Hwy./Leoku St.



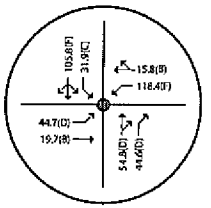
Fort Weaver Rd./Laulaunui St.



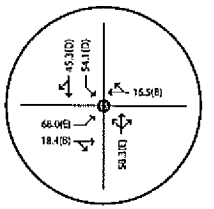
Fort Weaver Rd./ Old Fort Weaver Rd.



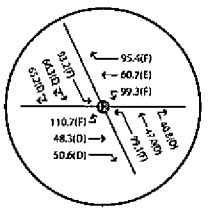
Fort Weaver Rd./Renton Rd.



Farrington Hwy./ East Old Fort Weaver Rd.



Farrington Hwy./ West Old Fort Weaver Rd.



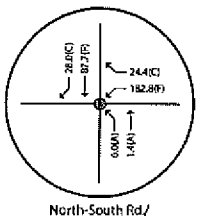
Farrington Hwy./ Fort Barrette Rd.

NORTH
NOT TO SCALE

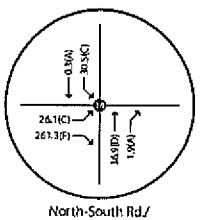
- Signalized Intersection
- Unsignalized Intersection
- 12.6(B) Average Delay (LOS)

Figure 5-8A2
AM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

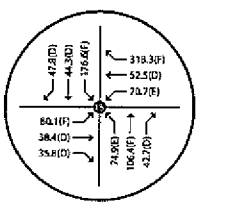
100061/DEC 2007-12/10/07



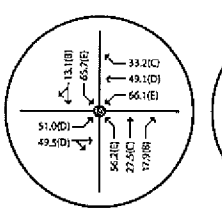
North-South Rd./ H1 WB Ramps



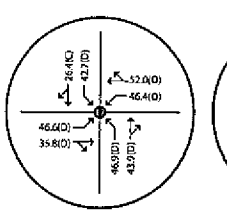
North-South Rd./ H1 EB Ramps



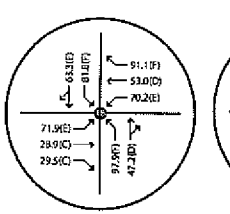
North-South Rd./ Farrington Hwy.



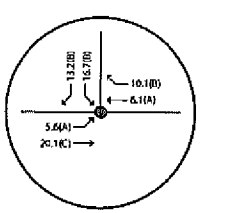
North-South Rd./ UH North Entrance



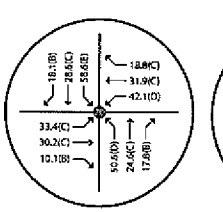
North-South Rd./ East-West Rd.



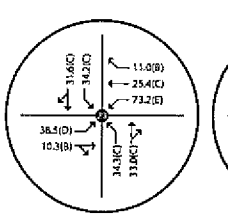
North-South Rd./ Kapolei Pkwy.



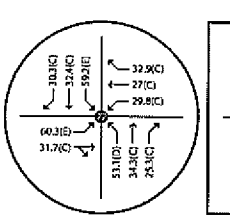
East-West Rd./ Old Fort Weaver Rd.



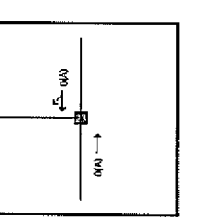
Farrington Hwy./ B St.



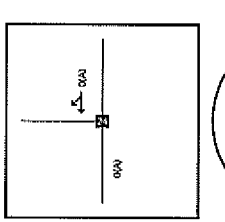
East-West Rd./ A St.



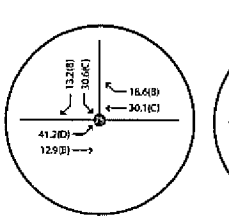
Farrington Hwy./ 2nd Ave.



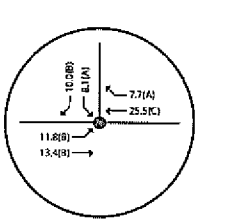
Kunia Rd./ 2nd Ave.



Kunia Rd./ 3rd Ave.



East-West Rd./ B St.



Farrington Hwy./ Project access road to NW parcel at N-S Road

NORTH
NOT TO SCALE

- Signalized Intersection
- Unsignalized Intersection
- 12.6(B) Average Delay (LOS)

Figure 5-8A3
AM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

100061/DEC 2007-12/10/07

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Figure 5-8B2
PM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

WilburSmith

Figure 5-8B1
PM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR
100061/Draft October - 10/17/07

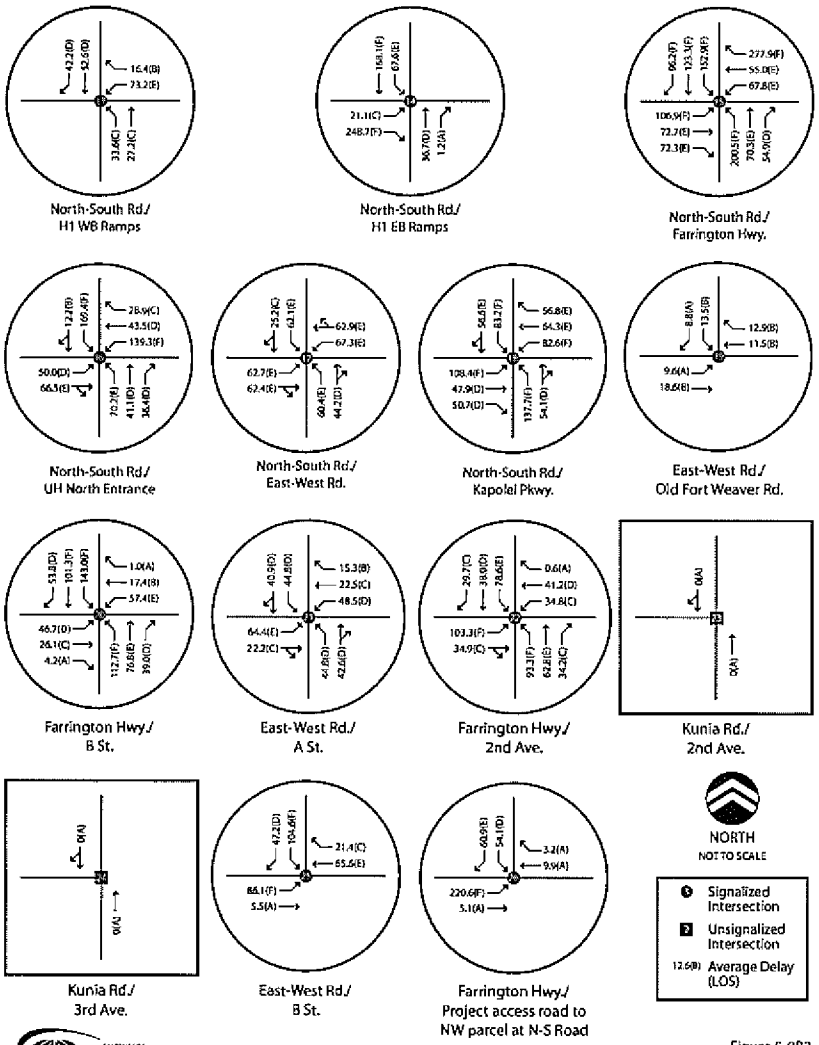

Figure 5-8B3
PM PEAK HOUR LOS & DELAY VALUES-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

100681/DEC2007-12/10/07

5.3.3 Freeway Operating Conditions - Scenario B

Figure 5-9 presents the freeway segment operations under Year 2030 Baseline plus Project conditions "Without Transit Corridor Scenario." Table 5.7 compares the freeway segment operations under Year 2030 Baseline plus Project conditions with that under Year 2030 Baseline conditions.

Similar to "With Transit Corridor Scenario, during the AM peak period, four freeway segments would operate under unacceptable conditions (LOS E or worse), of which freeway segments H-1 Eastbound (south of Makakilo Drive) and H-1 Eastbound (west of Kunia Road) would operate at LOS E and LOS F, respectively under both Year 2030 Baseline and Year 2030 Baseline plus Project "Without Transit Corridor Scenario" conditions. The other two freeway segments that would operate at LOS E or F under Year 2030 Baseline plus Project conditions are H-1 Eastbound (west of Pāiwa Street), and H-1 Eastbound (east of Kamehameha Highway).

During PM peak period, two of the 10 study freeway segments would operate under acceptable conditions (LOS D or better); all other eight freeway segments operate under unacceptable conditions (LOS E or worse). Of the eight segments, two freeway segments operate at LOS F under Year 2030 Baseline as well as Year 2030 Baseline plus Project conditions. The other six freeway segments operating under unacceptable conditions are H-1 Eastbound (south of Makakilo Drive), H-1 Eastbound (west of Kunia Road), H-1 Eastbound (west of Pāiwa Street), H-1 Eastbound (east of Kamehameha Highway), H-1 Westbound (west of Kunia Road), and H-1 Westbound (east of Kamehameha Highway). It should be noted that while the freeway segments H-2 Northbound/ At Ka Uka Boulevard and H-1 Westbound/ S/O Makakilo Drive operate at LOS F under 2030 plus Project conditions, no impact would result at these locations as they would already operate unsatisfactorily under 2030 Baseline conditions.

Therefore, the proposed Project would result in potential cumulative impacts under "Without Transit Corridor Scenario" at the following six freeway segments:

- H-1 Eastbound (south of Makakilo Drive)
- H-1 Eastbound (west of Kunia Road)
- H-1 Eastbound (west of Pāiwa Street)
- H-1 Eastbound (east of Kamehameha Highway)
- H-1 Westbound (west of Kunia Road)
- H-1 Westbound (east of Kamehameha Highway

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Table 5.7
Peak Hour Freeway Segment Operations – Year 2030 Conditions Scenario B

#	Freeway	Segment	Year 2030 Volume	Year 2030 Density	Year 2030 LOS	Year 2030 plus Project Volume	Year 2030 plus Project Density	Year 2030 plus Project LOS	Impact?
AM Peak									
1	H-1 EB	S/O Makakilo Dr.	5434	37.8	E	5928	44.5	E	No
2	H-1 EB	W/O Kunia Rd.	8197	>45	F	9217	>45	F	No
3	H-1 EB	W/O Pāiwa St.	9906	43.4	E	12062	>45	F	Yes
4	H-1 EB	E/O Kamehameha Hwy.	7512	38.8	E	8507	>45	F	Yes
5	H-2 NB	At Ka Uka Blvd.	3184	21.3	C	3629	24.3	C	No
6	H-1 WB	S/O Makakilo Dr.	3259	21.8	C	3794	25.4	C	No
7	H-1 WB	W/O Kunia Rd.	3735	18.3	C	4549	22.2	C	No
8	H-1 WB	W/O Pāiwa St.	4366	16.6	B	5974	22.8	C	No
9	H-1 WB	E/O Kamehameha Hwy.	3069	20.5	C	3811	25.5	C	No
10	H-2 SB	At Ka Uka Blvd.	6273	30.7	D	6605	32.6	D	No
PM Peak									
1	H-1 EB	S/O Makakilo Dr.	4680	31.3	D	5392	38.7	E	Yes
2	H-1 EB	W/O Kunia Rd.	5833	28.5	D	6985	35.1	E	Yes
3	H-1 EB	W/O Pāiwa St.	7137	27.2	D	9309	38.2	E	Yes
4	H-1 EB	E/O Kamehameha Hwy.	4249	28.4	D	5251	35.9	E	Yes
5	H-2 NB	At Ka Uka Blvd.	6220	>45	F	6668	>45	F	No
6	H-1 WB	S/O Makakilo Dr.	6365	>45	F	7080	>45	F	No
7	H-1 WB	W/O Kunia Rd.	7860	43.3	E	8964	>45	F	Yes
8	H-1 WB	W/O Pāiwa St.	7931	25.2	C	10317	33.7	D	No
9	H-1 WB	E/O Kamehameha Hwy.	7766	42.2	E	8867	>45	F	Yes
10	H-2 SB	At Ka Uka Blvd.	4616	22.5	C	5108	25.0	C	No

Source: Wilbur Smith Associates, 2007

NOTES:
Density is given in pc/mi/ln.
Bold represents LOS E or F.

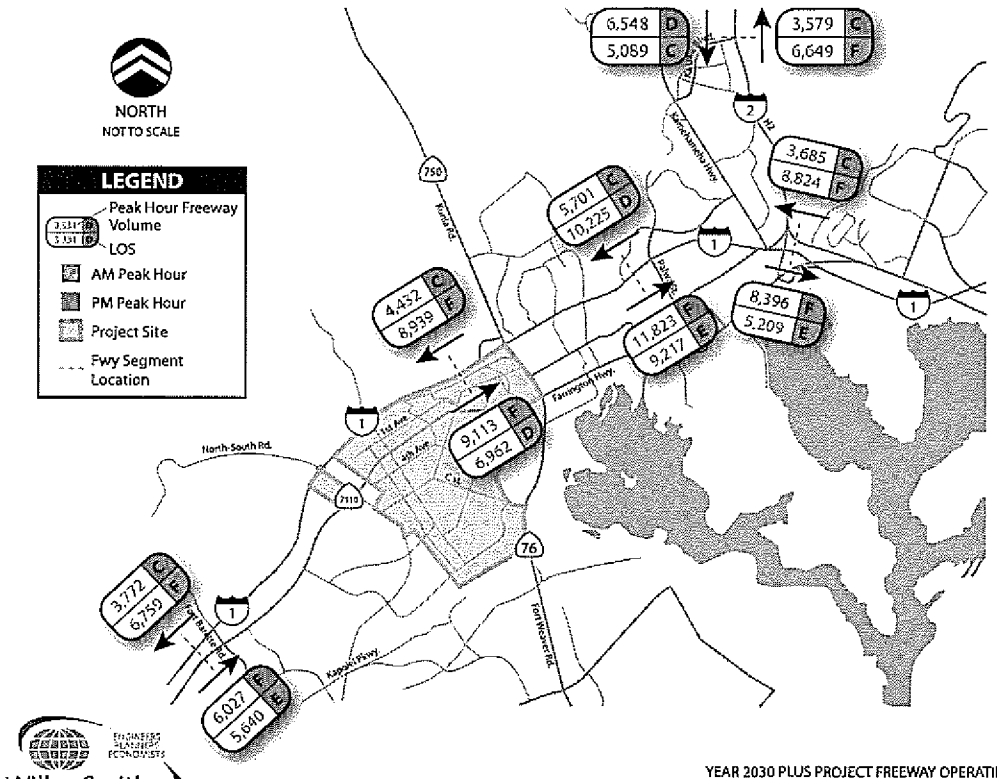

Figure 5-9
YEAR 2030 PLUS PROJECT FREEWAY OPERATING CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR
100061/DEC 2007-12/10/07

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5.3.4 Freeway-Ramp Junction Operating Conditions – Scenario B

Table 5.8 exhibits the density and LOS values of the study ramp-freeway junctions under Year 2030 Baseline plus Project "Without Transit Corridor Scenario". As previously mentioned, the analysis performed for the North-South Road Interchange was based on a ramp acceleration/deceleration lane length of 500 feet.

For the Year 2030 Baseline plus Project "Without Transit Corridor Scenario," eight of the 10 ramp-freeway junctions would operate under acceptable conditions during the AM peak hour. The two ramp-freeway junctions that would operate under unacceptable conditions are: H-1/ Fort Weaver Road (Eastbound On-Ramp), and H-1/ North-South Road (Eastbound On-Ramp).

During the PM peak hour, six of the 10 study ramp-freeway junctions would operate under acceptable conditions (LOS D or better). The remaining four ramp-freeway junctions that would operate under unacceptable conditions (LOS E or worse) are: H-1/ Fort Weaver Road (Westbound Loop Off-Ramp), H-1/ Fort Weaver Road (Westbound On-Ramp), H-1/ Fort Weaver Road (Eastbound On-Ramp), and H-1/ North-South Road (Westbound On-Ramp).

Therefore under Year 2030 Baseline plus Project "Without Transit Corridor Scenario" conditions, the proposed Project would cause transportation impacts at the following five ramp-freeway junctions:

- H-1/ Fort Weaver Road (Westbound Loop Off-Ramp)
- H-1/ Fort Weaver Road (Westbound On-Ramp)
- H-1/ Fort Weaver Road (Eastbound On-Ramp)
- H-1/ North-South Road (Westbound On-Ramp)
- H-1/ North-South Road (Eastbound On-Ramp)

Table 5.8
Peak Hour Ramp-Freeway Junction Operations – Year 2030 Conditions Scenario B

#	Location	Ramps	Peak Hour	2030 Baseline		2030 Scenario B	
				Density[1]	LOS	Density	LOS
1	H-1/ Fort Weaver Road	WB Off-Ramp	AM Peak	16.0	B	16.0	B
2	H-1/ Fort Weaver Road	WB Loop Off-Ramp	AM Peak	1.3	A	9.6	A
3	H-1/ Fort Weaver Road	WB On-Ramp	AM Peak	15.0	B	15.7	B
4	H-1/ Fort Weaver Road	EB Off-Ramp	AM Peak	37.4	**E**	39.0	**F**
5	H-1/ Fort Weaver Road	EB On-Ramp	AM Peak	24.8	**F**	37.7	**F**
6	H-1/ Fort Weaver Road	EB Loop On-Ramp	AM Peak	26.3	**F**	26.3	**F**
7	H-1/ North-South Road	WB Off-Ramp	AM Peak	20.3	C	26.9	C
8	H-1/ North-South Road	WB On-Ramp	AM Peak	13.5	B	17.2	B
9	H-1/ North-South Road	EB Off-Ramp	AM Peak	25.0	C	29.6	D
10	H-1/ North-South Road	EB On-Ramp	AM Peak	28.8	D	37.4	**F**
1	H-1/ Fort Weaver Road	WB Off-Ramp	PM Peak	38.0	**F**	38.0	**F**
2	H-1/ Fort Weaver Road	WB Loop Off-Ramp	PM Peak	19.9	**F**	33.0	**F**
3	H-1/ Fort Weaver Road	WB On-Ramp	PM Peak	26.0	C	26.3	**F**
4	H-1/ Fort Weaver Road	EB Off-Ramp	PM Peak	28.8	D	31.3	D
5	H-1/ Fort Weaver Road	EB On-Ramp	PM Peak	18.3	B	31.3	**F**
6	H-1/ Fort Weaver Road	EB Loop On-Ramp	PM Peak	20.4	C	20.4	C
7	H-1/ North-South Road	WB Off-Ramp	PM Peak	41.1	**F**	50.2	**F**
8	H-1/ North-South Road	WB On-Ramp	PM Peak	27.7	C	27.2	**F**
9	H-1/ North-South Road	EB Off-Ramp	PM Peak	21.0	C	27.9	C
10	H-1/ North-South Road	EB On-Ramp	PM Peak	17.0	B	26.7	C

Source: Wilbur Smith Associates, 2007

NOTES:
DEC – Demand Exceeds Capacity
Density is presented in pc/mi/ln.
Bold type indicates LOS F.
1 – Lower density does not necessarily indicate a lower LOS. This is because the LOS is calculated based upon a number of factors including: merge influence area, length of the acceleration lane, etc. See Appendix F for the HCM methodology used to calculate the LOS for Freeway Segments.

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Table 6.1 (a)
AM Peak Hour Intersection Operations – Year 2030 Conditions Scenario A with Mitigations (External Intersections)

#	Intersection	Control	Year 2030 plus Project			Mitigation Measures			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
1	Kunia Rd./ Kunia Loop	Signal	15.7	0.78	B	15.8	0.78	B	No
2	Kunia Rd./ H-1 WB On-Ramp[A]	TWSC	4.5	0.58	A	4.5	0.58	A	No
3	Kunia Rd./ H-1 EB Ramps	Signal	8.4	0.52	A	7.7	0.52	A	No
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	9.9	0.66	A	5.7	0.66	A	No
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	25.4	0.92	C	13.0	0.63	B	No
6	Farrington Hwy./ Leokū St.	Signal	19.2	0.73	B	19.3	0.72	B	No
7	Fort Weaver Rd./ Laulaunui St.	Signal	42.6	0.99	D	44.2	0.98	D	No
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	**176.6**	**1.69**	**F**	37.5	0.98	D	No
9	Fort Weaver Rd./ Renton Rd.	Signal	**111.8**	**1.23**	**F**	**59.2**	**1.01**	**E**	**Yes**
10	Farrington Hwy./ East Old Fort Weaver Rd.[B]	TWSC	31.4	0.81	C	37.1	0.81	D	No
11	Farrington Hwy./ West Old Fort Weaver Rd.[B]	TWSC	17.2	0.62	B	18.1	0.57	B	No
12	Farrington Hwy./ Fort Barrette Rd.	Signal	**75.9**	**0.93**	E	48.9	0.88	D	No
13	North-South Rd./ H-1 WB Ramps	Signal	42.7	0.95	D	42.2	0.95	D	No
14	North-South Rd./ H-1 EB Ramps	Signal	30.0	0.92	C	14.7	0.74	B	No
15	North-South Rd./ Farrington Hwy.	Signal	76.7	1.04	E	46.8	0.84	D	No
16	North-South Rd./ North UH Connector	Signal	38.6	0.87	D	38.7	0.87	D	No
17	North-South Rd./ East-West Rd.	Signal	37.0	0.79	D	35.1	0.74	D	No
18	North-South Rd./ Kapolei Pkwy.	Signal	43.1	0.86	D	36.1	0.76	D	No
19	East-West Rd./ Old Fort Weaver Rd.	Signal	14.3	0.61	B	20.5	0.59	C	No

Source: Wilbur Smith Associates

Chapter 6
PROJECT IMPACTS AND MITIGATION MEASURES

This chapter identifies potential transportation impacts on the roadway network due to travel demand generated by the proposed Project. Recommended improvements to the surrounding transportation system are proposed at the locations where significant impacts are identified. In addition, descriptions pertaining to project site access, on-site circulation, and transit services as well as pedestrian facilities that would be located within the project site are provided.

Some of the mitigation measures in this TIAR propose additional laneage at the intersections analyzed. Land acquisition and dedication for additional rights of way where land is owned or controlled by the Project is readily accommodated. Land acquisition outside the Project site, if necessary, may require assistance from City and State as part of the overall regional plan of roadway improvements. As such, in cases where there may be contention regarding land acquisition, the appropriate governmental bodies should actively seek to acquire said land or otherwise protect it for future use. Most of the off-site roadway improvements are the result of the cumulative traffic increases from both adjacent developments and from through traffic, therefore regional consideration should be taken into account when determining responsibility for implementation.

6.1 SCENARIO A: WITH TRANSIT CORRIDOR

6.1.1 Project Impacts - Year 2030 plus Project Conditions "Scenario A"

As indicated in *Section 5.2.2*, the proposed Project would cause transportation impacts at the following 9 study intersections under Year 2030 Baseline plus Project conditions "With Transit Corridor Scenario":

- Farrington Highway/Fort Weaver NB Ramps
- Farrington Highway/ Leokū St.
- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/ Fort Barrette Road
- North-South Road/H-1 EB Ramps
- North-South Rd./Farrington Highway
- North-South Rd. Kapolei Pkwy
- East-West Rd./Old Fort Weaver Rd.

Tables 6.1(a), 6.1(b), 6.2(a), and 6.2(b) present the AM and PM peak hour intersection operations for Year 2030 Scenario B with Mitigations Conditions. Descriptions of transportation impacts and the proposed improvements to mitigate them at each of the above identified intersections are discussed in *Section 6.1.2*.

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Table 6.2 (a)
PM Peak Hour Intersection Operations – Year 2030 Conditions Scenario A with Mitigations (External Intersections)

#	Intersection	Control	Year 2030 plus Project			Mitigation Measures			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
1	Kunia Rd./ Kunia Loop	Signal	36.8	1.05	D	37.5	1.05	D	No
2	Kunia Rd./ H-1 WB On-Ramp[A]	TWSC	18.6	1.03	B	22.9	1.03	C	No
3	Kunia Rd./ H-1 EB Ramps	Signal	11.3	0.90	B	8.2	0.90	A	No
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	10.0	0.80	B	10.0	0.80	A	No
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	134.2	1.41	F	34.7	1.10	C	No
6	Farrington Hwy./ Leokū St.	Signal	61.9	1.05	E	69.4	1.07	E	Yes
7	Fort Weaver Rd./ Laulaunui St.	Signal	44.9	1.01	D	46.1	1.02	D	No
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	289.5	2.01	F	62.8	1.10	E	Yes
9	Fort Weaver Rd./ Renton Rd.	Signal	125.3	1.25	F	60.4	0.99	E	Yes
10	Farrington Hwy./ East Old Fort Weaver Rd.[B]	TWSC	20.6	0.75	C	22.2	0.76	C	No
11	Farrington Hwy./ West Old Fort Weaver Rd.[B]	TWSC	25.9	0.88	C	20.5	0.82	C	No
12	Farrington Hwy./ Fort Barrette Rd.	Signal	74.4	0.91	E	53.0	0.93	D	No
13	North-South Rd./ H-1 WB Ramps	Signal	38.2	0.86	D	36.1	0.86	D	No
14	North-South Rd./ H-1 EB Ramps	Signal	87.5	1.30	F	42.7	1.08	D	No
15	North-South Rd./ Farrington Hwy.	Signal	136.3	1.28	F	53.9	0.98	D	No
16	North-South Rd./ North UH Connector	Signal	49.0	0.92	D	44.3	0.89	D	No
17	North-South Rd./ East-West Rd.	Signal	43.1	0.87	D	40.5	0.78	D	No
18	North-South Rd./ Kapolei Pkwy.	Signal	58.5	0.95	E	51.8	0.87	D	No
19	East-West Rd./ Old Fort Weaver Rd.	Signal	62.6	0.56	E	16.3	0.69	B	No

Source: Wilbur Smith Associates

Table 6.1 (b)
AM Peak Hour Intersection Operations – Year 2030 Conditions Scenario A with Mitigations (Internal Intersections)

#	Intersection	Control	Year 2030 plus Project			Mitigation Measures			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
20	Farrington Hwy./ B St.	Signal	30.2	0.69	C	30.3	0.66	C	No
21	East-West Rd./ A St.	Signal	21.0	0.59	C	20.4	0.59	C	No
22	Farrington Hwy./ Parkway/ 2nd Ave.	Signal	33.0	0.65	C	40.3	0.60	D	No
23	Kunia Rd./ 2nd Ave.	OWSC	0.0 (NB)	0.76 (NB)	A	0.0 (NB)	0.76 (NB)	A	No
24	Kunia Rd./ 3rd Ave.	OWSC	11.9 (EB)	0.01 (EB)	B	11.9 (EB)	0.01 (EB)	B	No
25	East-West Rd./ B St.	Signal	27.3	0.82	C	32.3	0.75	C	No
26	Farrington Hwy/Project Access Road to NW Parcel at N-S Road	Signal	17.8	0.65	B	15.2	0.55	B	No

Source: Wilbur Smith Associates

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6.1.2: Mitigation Measures - Year 2030 plus Project Conditions "Scenario A"

Improvements have been identified to mitigate impacts at the above intersections with these including 1) additional traffic lanes at intersections and/or changed usage of existing lanes; 2) by programming an alternate signal timing plans that would be in operation during specified peak commute periods; and 3) by restricting pedestrian crossings on one or more of the intersection approaches in order to allow unconstrained right-turn movement.

The application of contra-flow lanes should be considered for the existing and new major roadways in the region, particularly Fort Weaver Road and sections of Farrington Highway. Contra-flow lanes have not been proposed as Project mitigation because the forecast directional flows during the peak periods do not strongly favor such operations on these facilities. However, the potential for future contra-flow lanes should be accommodated within the design of the new and widened major roadways in the event that the actual future peak period directional volumes would result in efficient use of contra-flow lanes. Such contra-flow lanes could be open to general traffic use or could be limited to public transit and/or carpools in order to further encourage use of transportation alternatives to driving.

Several of the offsite intersection improvements may require additional right-of-way to accommodate the additional turn lane(s). Since the traffic problems at those locations would result from the cumulative traffic increases from other ongoing and new developments, the assistance of the City or State may be appropriate to facilitate the acquisition of rights-of-way needed for the improvement, or reservation and protection of rights-of-way that may be needed to implement these future improvements.

Impact 6.1.2A: Transportation Impact at Farrington Highway/ Fort Weaver Road Northbound Ramps under "With Transit Corridor Scenario"

For the Year 2030 Baseline scenario, the Farrington Highway intersection with the Fort Weaver Road northbound ramps would operate at LOS A conditions during AM and PM peak hours. For the Year 2030 Baseline plus Project "With Transit Corridor Scenario," conditions at the intersection would worsen to LOS D and LOS F during the AM and PM peak hours respectively. Since the proposed Project would worsen the operating conditions of this intersection to LOS F during the PM peak hour, roadway modifications are proposed to mitigate the transportation impact. The primary contributor of the forecast delays is the high eastbound left-turn volumes (928 vph in AM peak hour and 1027 vph in PM peak hour) and high westbound right-turn volumes (567 vph during AM peak hour and 1164 during PM peak hour).

Mitigation: The following mitigation measures are proposed:

1. Eastbound Approach: Construct one additional exclusive left-turn lane to provide dual left-turn lanes.
2. Westbound Approach: Convert existing shared through-right lane to through lane and construct a separate right-turn lane.

Table 6.2 (b)
PM Peak Hour Intersection Operations – Year 2030 Conditions Scenario A with Mitigations (Internal Intersections)

#	Intersection	Control	Year 2030 plus Project			Mitigation Measures			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
20	Farrington Hwy./ B St.	Signal	41.7	0.88	D	40.4	0.87	D	No
21	East-West Rd./ A St.	Signal	17.5	0.61	B	16.9	0.61	B	No
22	Farrington Hwy./ Parkway/ 2nd Ave.	Signal	71.1	1.07	E	48.3	0.98	D	No
23	Kunia Rd./ 2nd Ave.	OWSC	13.9 (SB)	0.03 (SB)	B	0.0 (SB)	0.83 (SB)	B	No
24	Kunia Rd./ 3rd Ave.	OWSC	13.8 (EB)	0.10 (EB)	B	0.0 (SB)	0.81 (EB)	A	No
25	East-West Rd./ B St.	Signal	46.6	0.92	D	59.4	0.92	E	Yes
26	Farrington Hwy/Project Access Road to NW Parcel at N-S Road	Signal	16.3	1.18	B	16.3	1.18	B	No.

Source: Wilbur Smith Associates

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3. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.

Impact after Mitigation: Less-than-significant level.

With the proposed mitigation measures, the operating conditions of the intersection Farrington Highway/ Fort Weaver Road Northbound Ramps would improve to LOS B and LOS C during the AM and PM peak hour conditions respectively.

Impact 6.1.2B: Transportation Impact at Farrington Highway/ Leokū Street under "With Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Farrington Highway/ Leokū Street would operate at operate at LOS B (volume-to-capacity ratio of 0.63) during the AM peak hour and deteriorate to LOS D (volume to capacity ratio 0.88) during the PM peak hour. Under Baseline Year 2030 plus project "With Transit Corridor Conditions", the intersection would continue to operate at LOS B during the AM (volume-to-capacity ratio of 0.73) but worsen to LOS E during the PM (volume to capacity ratio 1.05) peak periods. As such, a transportation impact would result.

Mitigation: The majority of the Project-related traffic volumes would be added to the westbound through movements along Farrington Highway. Note that this section on Farrington Highway is planned to be widened to a six-lane roadway by Year 2030. To mitigate this impact, additional lanes would need to be constructed to accommodate through traffic, requiring acquisition of a new right-of-way. As such, it would not be feasible to add additional through lanes along Farrington Highway due to right-of-way constraints. However, implementation of the Transportation Demand Management (TDM) strategies discussed in *Section 6.3* could reduce the peak hour traffic volumes and Project impacts at this intersection.

Impact after Mitigation: Significant and unavoidable.

Impact 6.1.2C: Transportation Impact nt Fort Weaver Road/ Old Fort Weaver Road under "With Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Fort Weaver Road/ Old Fort Weaver Road would operate at operate at LOS B (volume-to-capacity ratio of 0.89) during the AM peak hour and deteriorate to LOS D (volume to capacity ratio 1.03) during the PM peak hour. Under Baseline Year 2030 plus project "With Transit Corridor Conditions", the intersection would worsen to LOS F during the AM (volume-to-capacity ratio of 1.69) and PM (volume to capacity ratio 2.01) peak periods. As such, a transportation impact would result.

Mitigation: The following mitigation measures are proposed to improve the operating conditions at this intersection:

1. Northbound Approach: Construct one additional exclusive left-turn lane to provide dual left turn lanes. Convert one of the existing through lanes to a shared through-right lane.
2. Eastbound Approach: Convert existing shared through-left turn lane to a through lane and construct 3 exclusive left turn lanes to allow a triple left-turn movement from Old Fort Weaver Road. Right-of-way acquisition may be required for the eastbound approach.
3. Signal Timing: For the eastbound and westbound directions, convert the signal timing from permitted to split phasing. In addition, provide free right-turns for eastbound and westbound movements.

Impact After Mitigation: Less than significant impact during the AM peak hour. Significant and unavoidable impact for the PM peak hour.

With the proposed mitigation measures, the intersection would improve from LOS F to LOS D during the AM peak hour but operate at LOS E for the PM peak hour. The delays may encourage some of the forecast traffic to use alternative routes to/from the Project and other land uses along the Old Fort Weaver Road.

Impact 6.1.2D: Transportation Impact at Fort Weaver Road/ Renton Road under "With Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Fort Weaver Road/ Renton Road would operate at LOS E with a volume-to-capacity ratio of 1.08 during the AM peak hour and LOS E with a volume-to-capacity ratio of 1.03 during the PM peak hour. Under Year 2030 Baseline plus Project "With Transit Scenario" conditions, the intersection would worsen to LOS F during the AM (volume-to-capacity ratio of 1.23) and PM (volume-to-capacity ratio of 1.25) peak hours.

Mitigation: The following mitigation measures are proposed:

1. Westbound Approach: Convert existing shared left-through-right lane to shared through-left lane and construct one exclusive right-turn lane.

With the proposed mitigation measure, this intersection would operate at LOS E for both AM and PM peak hours. However, the additional lane would offset the estimated Project impacts and result in an improvement in average delays and volume-to-capacity ratios in both the AM and PM peak hours as compared to the Baseline conditions without the Project.

Impact after Mitigation: Less-than-significant level.

Impact 6.1.2E: Transportation Impact at Farrington Highway/ Fort Barrette Road under "With Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Farrington Highway/ Fort Barrette Road would operate at LOS E for both AM and PM peak hours. Under Year 2030 Baseline plus Project "With Transit Scenario" conditions, the intersection would continue to operate at LOS E

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for both AM and PM peak hours, but the volume-to-capacity ratio would worsen by more than 10 percent for the AM peak hour. Since the proposed Project would worsen the volume-to-capacity ratio for the AM peak hour by more than 10 percent, a transportation impact would result. High left-turn volumes from south-westbound Farrington Highway are primarily responsible for worsening the intersection operating conditions under Year 2030 Baseline plus Project "With Transit Corridor Scenario" conditions.

Mitigation: The following mitigation measure is proposed:

1. Signal Timing: Change the cycle length from 210 seconds to 120 seconds. Also, convert the southeast and northwest right-turn phases from permitted to permitted plus overlap phases.
2. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.

Impact after Mitigation: Less-than-significant level.

With the proposed mitigation measure, the operating conditions of this intersection would improve to LOS D for both AM and PM peak hours.

Impact 6.1.2F: Transportation Impact at North-South Road/ H-1 Eastbound Ramps under "With Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection North-South Road/ H-1 Eastbound Ramps would operate at LOS D during the AM peak hour and LOS B during the PM peak hour. Under Year 2030 Baseline plus Project "With Transit Scenario" conditions, the intersection would continue to operate at LOS D under AM peak hour conditions but would worsen to LOS F during the PM peak hour conditions. Since the proposed Project would worsen the operating conditions of this intersection to LOS F during PM peak hour conditions, a transportation impact would result.

Mitigation: The following mitigation measures are proposed:

1. Eastbound Approach: Construct one additional right-turn lane to provide dual right-turn lanes.

Impact after Mitigation: Less-than-significant level.

With the proposed mitigation measures, the operating conditions of this intersection would operate at LOS C during the AM peak hour but would improve the LOS from LOS F to LOS D during the PM peak hour.

Impact 6.1.2G: Transportation Impact at Farrington Highway/ North-South Road under "With Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Farrington Highway/ North-South Road would operate at LOS D during both the AM and PM peak hours. Under Year 2030 Baseline plus Project "With Transit Scenario" conditions, this intersection would operate at LOS E for the AM peak hour and LOS F for the PM peak hour. Since the proposed Project would worsen the operating conditions of this intersection from LOS D to LOS E for the AM peak hour and LOS F during the PM peak hour, a transportation impact would result.

Mitigation Option 1: Proposed as part of the Ho'opili TIAR

1. Southeast-bound Approach: Convert the shared through-right lane to an exclusive right-turn lane
2. Southwest-bound Approach: Construct one additional exclusive right-turn lane to provide dual right-turn lanes.
3. Northwest-bound Approach: Construct an additional left-turn lane to provide three exclusive left-turn lanes. This would also require widening Farrington Highway west of the intersection to provide three westbound departure lanes to receive the triple left-turn lane movement.

Impact after Mitigation: Less-than-significant level.

With the proposed mitigation measures, this intersection would operate at LOS D for both AM and PM peak hours.

Mitigation Option 2: Incorporated from the University of Hawai'i West O'ahu Traffic Study Report

As an alternative to the above mitigation measure, the mitigation measure proposed as part of the University of Hawai'i West O'ahu (UHWO) could also be implemented as a mitigation measure at this intersection. The UHWO Traffic Study Report suggests that a grade separation could be provided to improve future conditions. The potential configuration for grade separation would be to carry the Farrington Highway eastbound and westbound through movements over the intersection. The North-South Road through lanes would remain as an at-grade facility and all turning movements would occur at the at-grade intersection. By removing the Farrington Highway through movements from the intersection, more signal green time could be allocated to the other movements to better accommodate the projected traffic volumes.

Impact 6.1.2H: Transportation Impact at North-South Road/ Kapolei Parkway under "With Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, the North-South Road/Kapolei Parkway intersection would operate at LOS C during the AM peak hour and LOS D during the PM peak hour. Under Year 2030 Baseline plus project "With Transit Corridor Scenario, the intersection operates at LOS D for the AM peak hour and operates at LOS E during the PM peak hour. Since the intersection would operate at LOS level E, a transportation impact would result.

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Mitigation:

1. Southbound Approach: Convert shared through-right lane to exclusive right-turn lane to provide three through lanes and one right-turn lane.
2. Northbound Approach: Convert shared through-right lane to exclusive right-turn lane to provide three through lanes and one right-turn lane.

With this mitigation, the intersection would operate at LOS D during the AM and the PM peak periods.

Impact after Mitigation: Less-than-significant level.

Figures 6-1A and 6-1B exhibit the proposed intersection improvements under Year 2030 Baseline plus Project "With Transit Corridor Scenario".

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Figure 6-1A
PROPOSED INTERSECTION IMPROVEMENTS-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR

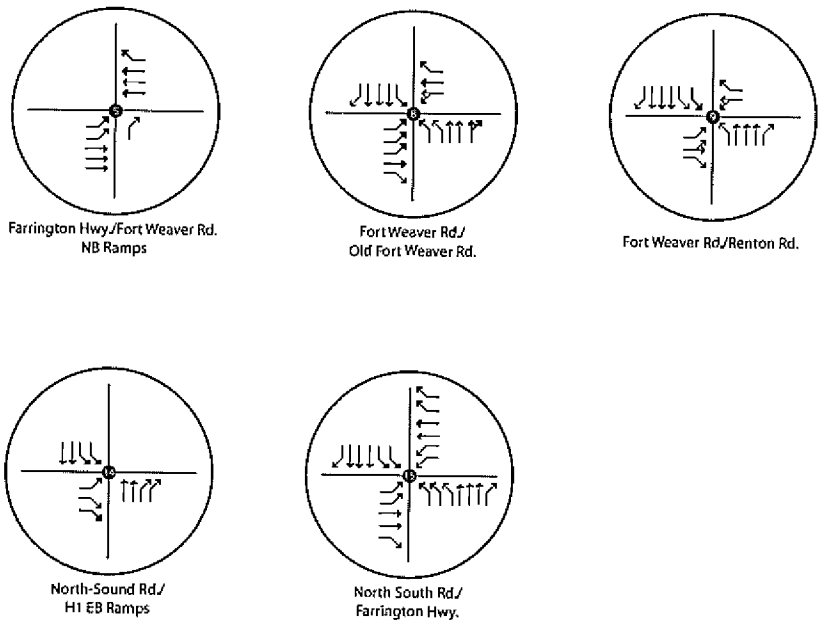

Figure 6-1B
PROPOSED INTERSECTION IMPROVEMENTS-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR SCENARIO

Wilbur Smith Associates

6.2 SCENARIO B: WITHOUT TRANSIT CORRIDOR

6.2.1 Project Impacts - Year 2030 plus Project Conditions "Scenario B"

As described in *Section 5.3.2*, the proposed Project would cause transportation impacts at the following 9 study intersections under Year 2030 Baseline plus Project conditions "Without Transit Corridor Scenario":

- Farrington Highway/ Fort Weaver Road Northbound Ramps
- Farrington Highway/ Leokū Street
- Fort Weaver Road/ Laulaunui Street
- Fort Weaver Road/ Old Fort Weaver Road
- Fort Weaver Road/ Renton Road
- Farrington Highway/ Fort Barrette Road
- North-South Road/ H-1 Eastbound Ramps
- North-South Road/ Farrington Highway
- North-South Road/ Kapolei Parkway

Descriptions of transportation impacts and the proposed improvements to mitigate them at each of the above identified intersections are discussed in *Section 6.2.2*. Tables 6.3(a), 6.3(b), 6.4(a), and 6.4(b) present the AM and PM peak hour intersection operations for Year 2030 Scenario B with Mitigations Conditions.

AR00028002

Table 6.3(b)
AM Peak Hour Intersection Operations – Year 2030 Conditions Scenario B with Mitigations (Internal Intersections)

#	Intersection	Control	Year 2030 plus Project			Mitigation Measures			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
20	Farrington Hwy./ B St.	Signal	30.6	0.71	C	31.0	0.70	C	No
21	East-West Rd./ A St.	Signal	24.6	0.69	C	24.4	0.72	C	No
22	Farrington Hwy./ Parkway/ 2nd Ave.	Signal	33.2	0.66	C	46.0	0.66	D	No
23	Kunia Rd./ 2nd Ave.	OWSC	0.0 (NB)	0.83 (NB)	A	0.0 (NB)	0.83 (NB)	A	No
24	Kunia Rd./ 3rd Ave.	OWSC	12.3 (EB)	0.02 (EB)	B	12.3 (EB)	0.02	B	No
25	East-West Rd./ B St.	Signal	23.9	0.84	C	28.6	0.71	C	No
26	Farrington Hwy/Project Access Road to NW Parcel at N-S Road	Signal	18.3	0.66	B	15.3	0.55	B	No

Source: Wilbur Smith Associates

Table 6.3 (a)
AM Peak Hour Intersection Operations – Year 2030 Conditions Scenario B with Mitigations (External Intersections)

#	Intersection	Control	Year 2030 plus Project			Mitigation Measures			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
1	Kunia Rd./ Kunia Loop	Signal	17.9	0.85	B	17.9	0.85	B	No
2	Kunia Rd./ H-1 WB On-Ramp[A]	TWSC	4.5	0.59	A	4.5	0.59	A	No
3	Kunia Rd./ H-1 EB Ramps	Signal	8.4	0.52	A	8.4	0.52	A	No
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	10.3	0.71	B	11.7	0.71	B	No
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	38.4	1.07	D	16.0	0.71	B	No
6	Farrington Hwy./ Leokū St.	Signal	23.6	0.66	C	19.3	0.66	B	No
7	Fort Weaver Rd./ Lanlaunui St.	Signal	53.9	1.03	D	52.0	1.02	D	No
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	268.8	2.43	F	97.2	1.14	F	Yes
9	Fort Weaver Rd./ Renton Rd.	Signal	114.8	1.24	F	60.5	0.98	E	No
10	Farrington Hwy./ East Old Fort Weaver Rd.[B]	TWSC	40.1	0.91	D	42.4	0.91	D	No
11	Farrington Hwy./ West Old Fort Weaver Rd.[B]	TWSC	24.8	0.77	C	20.5	0.65	C	No
12	Farrington Hwy./ Fort Barrette Rd.	Signal	71.6	0.90	E	52.0	0.97	D	No
13	North-South Rd./ H-1 WB Ramps	Signal	99.4	1.00	F	50.1	1.00	D	No
14	North-South Rd./ H-1 EB Ramps	Signal	37.3	0.98	D	14.6	0.80	B	No
15	North-South Rd./ Farrington Hwy.	Signal	105.4	1.23	F	46.5	0.98	D	No
16	North-South Rd./ North UH Connector	Signal	33.4	0.76	C	33.4	0.76	C	No
17	North-South Rd./ East-West Rd.	Signal	40.8	0.77	D	41.1	0.81	D	No
18	North-South Rd./ Kapolei Pkwy.	Signal	62.7	0.92	E	42.5	0.85	D	No
19	East-West Rd./ Old Fort Weaver Rd.	Signal	14.1	0.74	B	19.7	0.69	B	No

Source: Wilbur Smith Associates

AR00028003

Table 6.4(b)
PM Peak Hour Intersection Operations – Year 2030 Conditions Scenario B with Mitigations (Internal Intersections)

#	Intersection	Control	Year 2030			Year 2030 plus Project			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
20	Farrington Hwy./ B St.	Signal	38.4	0.87	D	45.4	0.91	D	No
21	East-West Rd./ A St.	Signal	26.2	0.74	C	32.1	0.69	C	No
22	Farrington Hwy./ Parkway/ 2nd Ave.	Signal	42.8	0.97	D	47.1	0.97	D	No
23	Kunia Rd./ 2nd Ave.	OWSC	0.0 (SB)	0.91 (SB)	A	0.0 (SB)	0.91 (SB)	A	No
24	Kunia Rd./ 3rd Ave.	OWSC	0.0 (SB)	0.12 (SB)	A	0.0 (SB)	0.88 (SB)	A	No
25	East-West Rd./ B St.	Signal	60.8	1.01	E	50.5	0.85	D	No
26	Farrington Hwy/Project Access Road to NW Parcel at N-S Road	Signal	17.0	1.21	B	17.0	12.1	B	No

Source: Wilbur Smith Associates

Table 6.4 (a)
PM Peak Hour Intersection Operations – Year 2030 Conditions Scenario B with Mitigations(External Intersections)

#	Intersection	Control	Year 2030 plus Project			Mitigation Measures			Impact?
			Delay	V/C Ratio	LOS	Delay	V/C Ratio	LOS	
1	Kunia Rd./ Kunia Loop	Signal	40.1	1.04	D	40.8	1.04	D	No
2	Kunia Rd./ H-1 WB On-Ramp^	TWSC	15.4	0.97	B	14.2	0.97	B	No
3	Kunia Rd./ H-1 EB Ramps	Signal	19.4	0.93	B	16.4	0.93	B	No
4	Farrington Hwy./ Fort Weaver Rd. SB Ramps	Signal	9.4	0.78	A	8.8	0.77	A	No
5	Farrington Hwy./ Fort Weaver Rd. NB Ramps	Signal	221.0	1.65	F	48.1	1.23	D	No
6	Farrington Hwy./ Leokū St.	Signal	57.6	1.01	E	66.5	1.03	E	Yes
7	Fort Weaver Rd./ Laulaunui St.	Signal	56.3	1.05	E	54.1	1.05	D	No
8	Fort Weaver Rd./ Old Fort Weaver Rd.	Signal	322.9	2.17	F	86.2	1.20	F	Yes
9	Fort Weaver Rd./ Renton Rd.	Signal	130.6	1.30	F	57.1	1.08	E	Yes
10	Farrington Hwy./ East Old Fort Weaver Rd.^	TWSC	40.9	0.91	D	37.3	0.89	D	No
11	Farrington Hwy./ West Old Fort Weaver Rd.^	TWSC	30.5	0.89	C	25.2	0.82	C	No
12	Farrington Hwy./ Fort Barrette Rd.	Signal	67.0	0.86	E	52.9	0.87	D	No
13	North-South Rd./ H-1 WB Ramps	Signal	54.0	0.94	D	54.1	0.94	D	No
14	North-South Rd./ H-1 EB Ramps	Signal	105.4	1.39	F	22.0	0.86	C	No
15	North-South Rd./ Farrington Hwy.	Signal	117.1	1.27	F	69.1	1.08	E	Yes
16	North-South Rd./ North UH Connector	Signal	50.3	0.94	D	51.4	0.94	D	No
17	North-South Rd./ East-West Rd.	Signal	45.9	0.85	D	44.7	0.91	D	No
18	North-South Rd./ Kapolei Pkwy.	Signal	68.3	0.95	E	48.8	0.87	D	No
19	East-West Rd./ Old Fort Weaver Rd.	Signal	13.6	0.72	B	32.8	0.64	C	No

Source: Wilbur Smith Associates

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6.2.2 Mitigation Measures - Year 2030 plus Project Conditions "Scenario B"

Impact 6.2.2A: Transportation Impact at Farrington Highway/ Fort Weaver Road Northbound Ramps under "Without Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Farrington Highway/ Fort Weaver Road Northbound Ramps would operate at LOS A during both AM and PM peak hours. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, the LOS of the intersection would worsen to LOS D during the AM peak hour and LOS F during both the PM peak hour. Since the proposed Project would worsen the operating conditions of this intersection to LOS F during the PM peak hour, a transportation impact would result. The primary contributor of the forecast delays is the high eastbound left-turn volumes (1165 vph in the AM peak hour and 1429 vph in the PM peak hour) and high westbound right-turn volumes (567 vph during AM peak hour and 1164 during PM peak hour).

Mitigation: The following mitigation measures are proposed:

1. Eastbound Approach: Construct one additional exclusive left-turn lane to provide dual left-turn lanes.
2. Westbound Approach: Convert existing shared through-right lane to through lane and construct a separate free right-turn lane.

Impact after Mitigation: Less-than-significant level.

With the proposed mitigations, the operating condition of this intersection would improve from LOS D to LOS B during the AM peak hour and from LOS F to LOS D during the PM peak hour.

Impact 6.2.2B: Transportation Impact at Farrington Highway/ Leokū Street under "Without Transit Corridor Scenario"

Under Year 2030 Baseline conditions, intersection Farrington Highway/ Leokū Street would operate at LOS B during the AM peak hour and LOS D during the PM peak hour. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, the LOS of the intersection would operate at LOS C during AM peak hour, but would worsen to LOS E during the PM peak hour. Since the associated trips from the proposed Project would worsen the LOS from LOS D to LOS E during the PM peak hour, this would result in a significant impact that this intersection. High volumes on the westbound approach to Farrington Highway is primarily responsible for the poor operating conditions at this intersection.

Mitigation: The majority of the project-related traffic volumes would be added to the eastbound and westbound through movements along Farrington Highway. To mitigate this impact, additional lanes would need to be constructed to accommodate through traffic, requiring acquisition of a new right-of-way. Note that this section of Farrington Highway is planned to be widened to a six-lane roadway by Year 2030. As such these actions would not be feasible.

However, the Transportation Demand Management (TDM) strategies discussed in *Section 6.3* are proposed to reduce the peak hour traffic volumes and Project impacts at this intersection.

Impact after Mitigation: Significant and unavoidable.

Impact 6.2.2C: Transportation Impact at Fort Weaver Road/ Laulauuui Street under "Without Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Fort Weaver Road/ Laulaunui Street would operate at LOS C for both AM and PM peak hours. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, the LOS of the intersection would worsen to LOS D for the AM peak hour and LOS E during the PM peak hour. Since the proposed Project would worsen the operating conditions of this intersection to LOS E during the PM peak hour, a transportation impact would result.

Mitigation:

1. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.
2. Eastbound Approach: Construct an exclusive left-turn lane in addition to the shared through-left lane.

Impact after Mitigation: Less-than-significant level.

With the proposed mitigation measures, the intersection would continue to operate at LOS D for the AM peak hour, but would improve operational conditions for the PM peak hour from LOS E to LOS D.

Impact 6.2.2D: Transportation Impact at Fort Weaver Road/ Old Fort Weaver Road under "Without Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Fort Weaver Road/ Old Fort Weaver Road would operate at LOS B during the AM peak hour and LOS D during the PM peak hour. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, the LOS of the intersection would worsen to LOS F under both AM and PM peak hours with volume-to-capacity ratios of 2.43 and 2.17 during AM and PM peak hours, respectively. Since the proposed project would worsen the LOS for both AM and PM peak hours, this will result in a significant impact at this intersection.

Mitigation: The proposed project would add the majority of traffic volumes to the northbound, southbound, and eastbound approaches at the intersection of Fort Weaver Road/ Old Fort Weaver Road. The following mitigation measures are proposed to improve the operating conditions of eastbound left-turning, northbound left-turning and southbound right-turning movements of this intersection:

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1. Northbound Approach: Construct one additional exclusive left-turn lane to provide dual left-turn lanes. Convert exclusive right-turn lane to shared through-right since there isn't sufficient traffic to warrant an exclusive right-turn lane.
2. Eastbound Approach: Convert existing shared through-left lane to a through lane and construct triple left-turn lanes. Right-of-way acquisition may be required for the eastbound approach.
3. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.

Impact after Mitigation: Significant and Unavoidable

Due to limited right of way in the westbound direction, additional capacity cannot be provided in this direction. With the proposed mitigation measures, the intersection would continue to operate at LOS F for both AM and PM peak hours. However, with the proposed mitigation measures, the volume-to-capacity ratio would improve from 2.43 for the AM peak hour to 1.14 and from 2.17 for the PM peak hour to 1.20. Some of the traffic forecast to use this intersection to access the Project and other land uses along Old Fort Weaver Road may have to use alternative routes.

Impact 6.2.2E: Transportation Impact at Fort Weaver Road/ Renton Road under "Without Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Fort Weaver Road/ Renton Road would operate at LOS E during both AM and PM peak hours. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, the operational conditions would worsen and the intersection would operate at LOS F for both AM and PM peak hours. Since the proposed Project would worsen LOS for both AM and PM peak hours to LOS F, a transportation impact would result.

Mitigation: The following mitigation measures are proposed:

1. Southbound Approach: Construct one additional exclusive left-turn lane to provide dual left-turn lanes.
2. Westbound Approach: Convert existing shared left-through-right lane to shared through-left lane and construct one exclusive right-turn lane.
3. Eastbound Approach: Due to limited right-of-way, additional capacity cannot be provided in this direction.

Impact after Mitigation: Significant and Unavoidable

With the proposed mitigation measures, this intersection would operate at LOS E for both AM and PM peak hours.

Impact 6.2.2F: Transportation Impact at Farrington Highway/ Fort Barrette Road under "Without Transit Corridor Scenario"

west direction to connect to North-South Road at the ninth vehicular access point from the south edge of the Proposed Project.

INTERNAL ROADWAYS

As previously stated, the proposed Project would include construction of numerous internal streets to accommodate on-site circulation. Included in this section are descriptions of the internal street network.

First Avenue is an east-west avenue connector street that runs from Second Avenue to A Street providing internal roadway connections from the fifth vehicular access point to the project site.

Second Avenue is an east-west avenue connector street that runs from Fort Weaver Road to Farrington Highway providing internal roadway connections between the first to the fifth vehicular access points.

Third Avenue is an east-west avenue connector street that runs from Fort Weaver Road to Second Avenue providing internal roadway connections between the second vehicular access point and Second Avenue via E and D streets.

Fourth Avenue is an east-west avenue connector street that runs between Parkway and C Street providing key internal connections to the core of the Proposed Project.

Fifth Avenue is a north-south avenue connector street that turns between Parkway and B Street providing internal roadway connections near the core of the Proposed Project.

A Street is a north-south street that runs between First Avenue and East-West Road.

B Street is a north-south street that runs between Farrington Highway and East-West Road providing internal roadway connections between the sixth vehicular access point and the Proposed Project.

C Street is an east-west street that runs between Fort Weaver Road and Parkway providing key internal roadway connections via the eighth vehicular access point, Old Fort Weaver Road, and East-West Road, to the Proposed Project.

D Street is a north-south street that runs between Second Avenue and Farrington Highway providing internal roadway connections via Third Street, E Street, Second Avenue, and Farrington Highway to the Proposed Project.

E Street is a north-south street that runs between Second Avenue and Farrington Highway providing internal roadway connections via Third Street, Farrington Highway to the Proposed Project.

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Under Year 2030 Baseline Conditions, intersection Farrington Highway/ Fort Barrette Road would operate at LOS E for both AM and PM peak hours. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, the LOS of the intersection would remain at LOS E during AM peak hour conditions, but the volume-to-capacity ratio would worsen from 0.77 to 0.90. For the PM peak hour, the LOS would worsen from LOS E to LOS F. Since the proposed Project would worsen the operating conditions of this intersection to LOS F during PM peak hour conditions, a transportation impact would result. High left-turn volumes from south-westbound Farrington Highway are primarily responsible for worsening the intersection operating conditions under Year 2030 Baseline plus Project "Without Transit Corridor Scenario" conditions.

Mitigation: The following mitigation measure is proposed:

1. Signal Timing: Change the cycle length from 210 seconds to 120 seconds. Also, convert the southeast and northwest right-turn phases from permitted to permitted plus overlap phases.
2. Signal Optimization: Optimization of intersection splits and cycle lengths along with the intersection offsets.

Impact after Mitigation: Less-than-significant level.

With the proposed mitigation measure, the operating condition of this intersection would improve from LOS F to LOS D for both AM and PM peak hours.

Impact 6.2.2G: Transportation Impact at North-South Road/ H-1 Eastbound Ramps under "Without Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection North-South Road/ H-1 Eastbound Ramps would operate at LOS D during the AM peak hour and LOS B during the PM peak hour. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, the intersection would continue to operate at LOS D for the AM peak hour but would worsen to LOS F during the PM peak hour. Since the proposed Project would worsen the operating conditions of this intersection to LOS F during the PM peak hour conditions, a transportation impact would result.

Mitigation: The following mitigation measures are proposed:

1. Southeast-bound Approach: Construct one additional through lane to provide three through lanes.
2. Eastbound Approach: Construct one additional right-turn lane to provide dual right-turn lanes.

Impact after Mitigation: Less-than-significant level.

With the proposed mitigation measures, the operating condition of this intersection would improve from LOS F to LOS C during the PM peak hour.

Impact 6.2.2H: Transportation Impact at Farrington Highway/ North-South Road under "Without Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection Farrington Highway/ North-South Road would operate at LOS D during both the AM and PM peak hours. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, this intersection would operate at LOS F with volume-to-capacity ratios of 1.23 and 1.27 during the AM and PM peak hours, respectively. Since the proposed Project would worsen the operating conditions of this intersection to LOS F during AM and PM peak hour conditions, a transportation impact would result.

Mitigation Option 1: Proposed as part of the Ho'opili TIAR

1. Southwest-bound Approach: Construct one additional exclusive right-turn lane to provide dual right-turn lanes.
2. Southeast-bound Approach: Convert the existing permissive right-turn to a free right-turn.
3. Northeast-bound Approach: Convert the existing permissive right-turn to a dual free right-turn. Construct an additional right-turn lane.
4. Northwest-bound Approach: Construct an additional left-turn lane to provide triple left-turn lanes.
5. Signal Timing: Change the cycle length from 150 seconds to 140 seconds.

Additionally, TDM strategies discussed in *Section 6.3* are proposed to reduce the peak hour intersection traffic volumes.

Impact after Mitigation: Less than significant for the AM peak hour but significant and unavoidable for the PM peak hour.

With the proposed mitigation measures, this intersection would operate at LOS D under AM peak hour conditions and LOS E during PM peak hour conditions, while the volume-to-capacity ratios would improve from 1.23 to 0.98 during the AM peak hours and from 1.27 to 1.08 during the PM peak hours, respectively. In addition, the intersection delays would improve from 105 to 47 seconds during the AM peak hour and from 117 to 69 seconds during the PM peak hour.

Mitigation Option 2: Incorporated from the University of Hawai'i West O'ahu Traffic Study Report

As an alternative to the above mitigation measure, the mitigation measure proposed as part of the University of Hawai'i West O'ahu (UHWO) could also be implemented as a mitigation measure at this intersection. The UHWO Traffic Study Report suggests a potential configuration for a grade separation to carry the Farrington Highway through movements over the intersection. North-South Road through lanes would remain as an at-grade facility and all turning movements would occur at-grade at the intersection. By removing the Farrington Highway through movements from the intersection, more green time could be allocated to the other movements to accommodate the projected traffic volumes.

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Impact 6.2.2I: Transportation Impact at North-South Road/ Kapolei Parkway under "Without Transit Corridor Scenario"

Under Year 2030 Baseline Conditions, intersection North-South Road/ Kapolei Parkway would operate at LOS C during the AM peak hour and LOS D during the PM peak hour. Under Year 2030 Baseline plus Project "Without Transit Scenario" conditions, the LOS of the intersection would be LOS E during both AM and PM peak hour conditions. Since the proposed Project would worsen the operating conditions of this intersection to LOS E during both AM and PM peak hour conditions, a transportation impact would result. High southbound left turn volumes (507 during PM peak hour and 229 during AM peak hour) and high southbound right turn volumes (735 vph during PM peak hour and 597 vph during AM peak hour) are the primary contributors to the intersection's poor operating conditions under Year 2030 Baseline plus Project "Without Transit Corridor Scenario" conditions.

Mitigation: The following mitigation measure is proposed:

1. Southbound Approach: Convert shared through-right lane to exclusive right-turn lane to provide three through lanes and one right-turn lane.

With the mitigation, the intersection would operate at LOS D during the AM and the PM peak periods.

Impact after Mitigation: Less-than-significant level.

Figures 6-2A and 6-2B exhibit the proposed intersection improvements under Year 2030 Baseline plus Project "Without Transit Corridor Scenario".

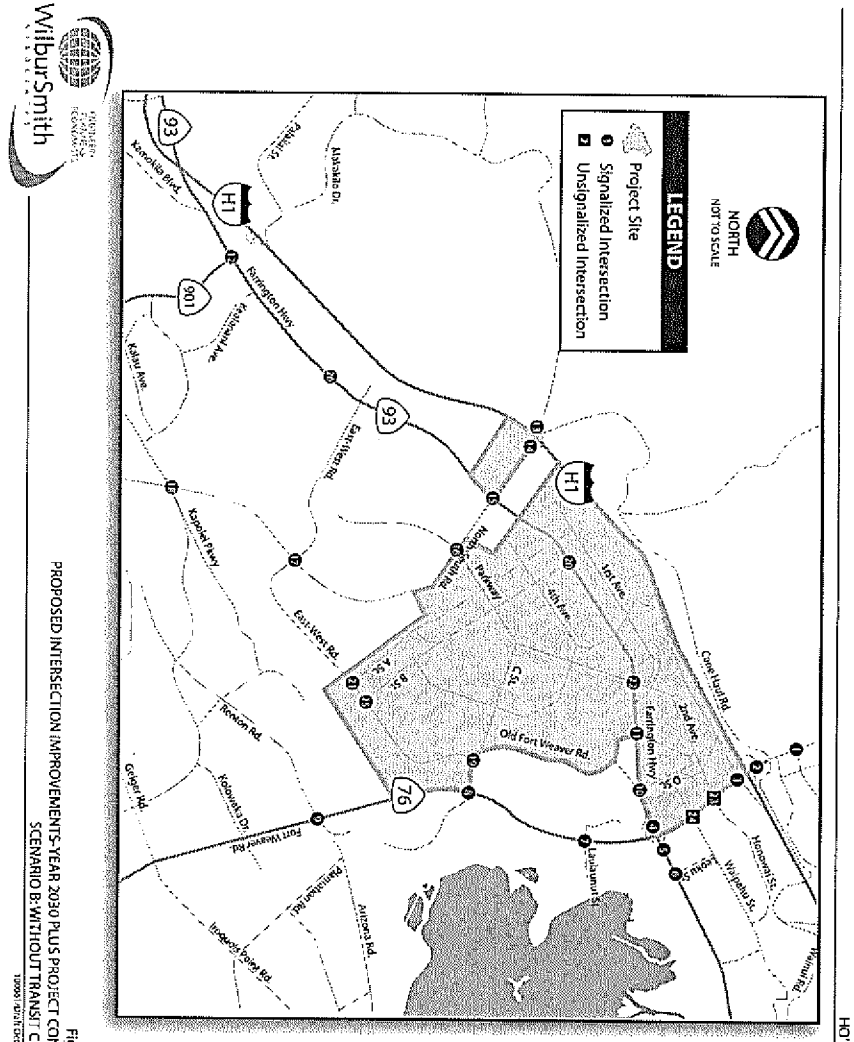

Figure 6-2A
PROPOSED INTERSECTION IMPROVEMENTS-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR

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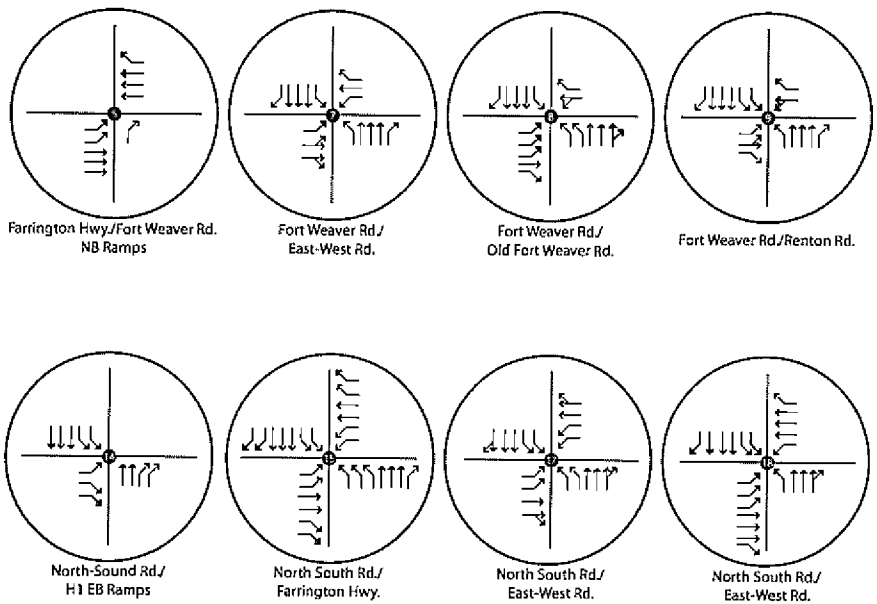

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Figure 6-2B
PROPOSED INTERSECTION IMPROVEMENTS-YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR SCENARIO
100061/DEC 2007-12/10/07

6.3 TRANSPORTATION DEMAND STRATEGIES

Transportation Demand Management (TDM) strategies address traffic congestion by reducing the amount of vehicle miles traveled, thereby reducing overall travel demand. The aim of these strategies is focused on promoting travel alternatives such as increased transit usage, walking, and bicycling to help achieve this goal. It should be noted that TDM strategies can be used in combination to create a comprehensive TDM Program that can affect a significant portion of total travel. Furthermore, TDM strategies can be tailored to achieve many objectives, specifically helping change travel behavior by correcting misperceptions regarding the true costs involved with driving and finding suitable alternatives. As previously noted, the Leeward Oahu Transportation Management Association (LOTMA) provides TDM services in the vicinity of the proposed Project. It is anticipated that the proposed Project will continue to support the existing programs and services in place. It should be noted however that based on the proposed Project's trip generation during the AM and PM peak hours, the Project Sponsor may want to consider additional TDM strategies as a means of managing and improving travel demand. The following strategies are suggested for consideration:

- **Carsharing** – Project Sponsors could make carsharing available for residents of the Proposed development. Carsharing would provide residents access to a car on an "as needed" basis without incurring the fixed costs associated with owning and operating a personal automobile. Users could pick up a car at a designated vehicle location (typically located throughout a given jurisdiction) and would be charged a standard fee for its usage. The rate would typically include gas, maintenance, and insurance.

- **Carpool/Vanpool** – Developers and employers could promote carpool or vanpool programs for commuters who either live or work in the proposed Project and share the same schedule, through subsidizing the cost of vehicles and fuel costs. The remaining costs would be divided among program participants who would pay a fee for mileage used.

- **Preferential HOV Parking** – Developers or employers could provide incentives for use of alternative modes of travel to the single occupancy vehicle by reserving close-in, secure, covered, or otherwise preferable parking spaces for high-occupancy vehicles. It should be noted that the carpool spaces should be those closest to the building entrance or elevator, however not closer than parking designated for use of the disabled.

- **Rent subsidies** – Developers of residential developments could offer tenants rent subsidies (reductions in rent) equivalent to the amount of money they would typically pay for a parking space included in the price of their rent if they forego the use of a parking space. For example, suppose each 1 bedroom unit is allocated one parking stall. Tenants who do not own or choose not to have a car would receive a reduction off their monthly rent equivalent to the value/cost of the parking stall.

- **Transit Subsidies** – Developers and employers could encourage the use of transit by offering a discounted monthly pass to its residents and employees.

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- **Bicycle Parking and Shower Facilities** – Both businesses and developers can provide bicycle parking, storage, and shower facilities to promote and encourage the use of bicycles for work and home trips. It is important to consider the provision of both short-term and long-term parking facilities. Notably, long term bicycle parking should be provided for residents or those who stay at the site for several hours and offer secure and weather protected places to store bicycles. In contrast, short-term parking should be provided for shoppers, customers, and other visitors who park for two hours or less, and be located in readily accessible places (e.g. within 50 feet of the entrance the cyclists use).

- **Staggered Class Schedules** – The University of Hawai'i and Department of Education (DOE) schools should consider following an alternative class schedules where courses begin at 9:00 AM so as to avoid the peak commute period (6:00AM to 8:00 AM).

6.4 SITE ACCESS AND ON-SITE CIRCULATION

The proposed Project would be primarily accessed along major defined roadways including, Farrington Highway, Fort Weaver Road, and North-South Road. Circulation within the proposed Project however would be made possible through a number of different access points. The vehicular circulation within the site includes ten new major internal streets and nine primary vehicular access locations. Note that a map of the Project site is included in Appendix E. The first access point is located at the intersection of Fort Weaver Road and Second Avenue, a new east-west internal road that would be constructed as part of the Proposed Project. A secondary vehicular access point is proposed at the junction of a new east-west internal street, named Third Avenue, with Fort Weaver Road. Third Avenue extends west connecting Fort Weaver Road to Second Avenue via two new north-south internal streets, E and D Streets. It should be noted that two vehicular access points at Fort Weaver Road would only allow southbound right turns into the Project.

A third vehicular access point would be located at the intersection of D Street, Farrington Highway, and Old Fort Weaver Road East. A fourth vehicular access point would be located immediately adjacent to the third, at the intersection of E Street, Farrington Highway, and Old Fort Weaver Road West. As Farrington Highway continues in the west direction, the fifth vehicular entrance will be located along Farrington Highway accessible from Second Avenue to the north (with connecting access to a new east-west internal street named First Avenue) and Parkway, a new north-south internal street to the south. A sixth access point is proposed at the intersection of Farrington Highway and a new north-south internal street named "B Street."

The proposed Project would also include additional vehicular access points from the west and south. A seventh access point would be located at the intersection of North-South Road and Parkway, providing access to/from the west side of the project site. It should be noted that Parkway runs east-west and would connect with yet another east-west internal street named C Street. C Street extends further east to connect with Old Fort Weaver Road and East-West Road where the eighth vehicular entrance/exit would be located. East-West Road continues in the

6.5 MULTI-MODAL TRANSPORTATION

As previously described, TheBus transit service is provided in the vicinity of the proposed Ho'Opili development. Given the size and nature of the proposed development the Project Sponsor should work closely with the City and County, and TheBus staff to identify possibilities for future expanded bus service in the vicinity of the Proposed Project. As part of this process, discussions between the Project Sponsor, the City and TheBus staff should include provision of bus stops and shelters and the identification of their appropriate placement such that they serve local schools, commercial, and recreational facilities in the area. In addition, the project should ensure that connecting pedestrian linkages are provided for future proposed bus stop locations. Proposed changes to should be carried out in accordance with existing American with Disabilities Act Accessibility Guidelines (ADAAG).

The City's planned guideway project will offer prime multi-modal transportation to the residents and visitors to Ho'opili. The Ho'opili land use plan effectively promotes and encourages the use of the guideway through its full range of mixed land uses, including a wide range of places of live, work, shop, recreate and learn and will aspire to achieve a job-housing balance. Furthermore, the project is designed to maximize connectivity (transit, pedestrian, bicycle and vehicular) with surrounding streets and communities (including DHHL and UHWO), while minimizing cul-de-sacs and dead-end streets. It is worth noting that the final selection of the transit station locations will also encourage higher levels of development intensity as well as density as they tend to concentrate around transit stations. As such, the guideway provides multiple opportunities to promote and advance multi-modal transportation within the Ho'opili development and its surrounding areas.

AR00028010

Chapter 7
CONCLUSION

To assess the transportation impacts associated with the construction of the proposed Ho'opili Development in O'ahu, Hawai'i, a Traffic Impact Analysis Report was conducted. The analysis evaluated the operations of twelve key intersections under Existing Conditions and thirty-four key intersections for Future 2030 Baseline Conditions, Future 2030 plus Project Conditions "With Transit Corridor Scenario", and Future 2030 plus Project Conditions "Without Transit Corridor Scenario" during the morning and evening peak hours.

The proposed Project includes approximately 2835 thousand square feet (ksf) of retail/office building floor area, 925 ksf of industrial building floor area, and approximately 11,750 dwelling units as per the Ho'opili Town master plan. The site is located in the 'Ewa District of O'ahu, within close proximity of the H-1 Freeway, Farrington Highway, and State Route 76 (Fort Weaver Road). The proposed Project "With Transit Scenario Corridor" Project is estimated to generate 140,920 daily trips, 7,069 morning peak hour trips (3,183 inbound and 3,886 outbound), and 12,077 evening peak hour trips (6,122 inbound and 5,955 outbound). The Proposed project "Without Transit Corridor Scenario" would generate 158,669 daily trips, 9,172 morning peak hour trips (4,176 inbound and 4,996 outbound), and 13,776 evening peak hour trips (6,970 inbound and 6,806 outbound).

Impacts of the proposed project on the study intersections were evaluated with level of service calculations. The results of the analysis indicate that the proposed Project would result in significant impacts to only one intersection under 2030 Baseline plus Project conditions "With Transit Corridor Scenario." In addition, the proposed Project would also result in significant impacts at two intersections under 2030 Baseline plus Project conditions "Without Transit Corridor Scenario."

Vehicular access to the proposed Project site would be made possible via multiple points. From the north, vehicles would approach the Project from the Kunia Road/ H-1 interchange and have access to the site at the intersections of Fort Weaver Road/ Second Avenue[1] and Fort Weaver Road/ Third Avenue[1]. Access in to the Project site from the south would be provided from the intersections of North-South Road/East-West Road and Fort Weaver Road/C Street. From the west vehicles would approach the proposed Project from the Farrington Highway/North-South Road intersection and gain access to the site at the intersection of Farrington Highway/B Street[1]. As vehicles travel from the east there are more opportunities to enter the Project site at the following access points along Farrington Highway; Farrington Highway/Second Avenue, Farrington Highway/West Old Fort Weaver Road, and Farrington Highway/East Old Fort Weaver Road.

[1] See Chapter 6 for description of the street. It should be noted that use of this street is only assumed as part of this study.

APPENDIX

AR00028011

APPENDIX A

INTERSECTION LOS ANALYSIS

AR00028012

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road

Existing AM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	0.97	1.00	0.95	1.00		0.95
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3433	1583	3539	1583		3539
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3433	1583	3539	1583		3539
Volume (vph)	613	21	829	340	0	843
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	666	23	901	370	0	916
RTOR Reduction (vph)	0	16	0	171	0	0
Lane Group Flow (vph)	666	7	901	199	0	916
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	15.5	15.5	27.2	27.2		27.2
Effective Green, g (s)	15.5	15.5	27.2	27.2		27.2
Actuated g/C Ratio	0.31	0.31	0.54	0.54		0.54
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	1050	484	1899	849		1899
v/s Ratio Prot	c0.19		0.25			c0.26
v/s Ratio Perm		0.00		0.13		
v/c Ratio	0.63	0.01	0.47	0.23		0.48
Uniform Delay, d1	15.2	12.3	7.3	6.2		7.3
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	1.3	0.0	0.9	0.6		0.9
Delay (s)	16.4	12.3	8.2	6.9		8.2
Level of Service	B	B	A	A		A
Approach Delay (s)	16.3		7.8			8.2
Approach LOS	B		A			A

Intersection Summary			
HCM Average Control Delay	10.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.54		
Actuated Cycle Length (s)	50.7	Sum of lost time (s)	8.0
Intersection Capacity Utilization	47.5%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road

Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	0	0	0	232	0	0	1259	197	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	0	252	0	0	1368	214	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)								1180				617
pX, platoon unblocked	0.94	0.94	0.94	0.94	0.94					0.94		
vC, conflicting volume	1602	1476	791	684	1583	0	0			1583		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1576	1442	714	600	1556	0	0			1556		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	100	100	0	100	100			100		
cM capacity (veh/h)	0	123	351	362	105	1084	1622			396		

Direction, Lane #	WB 1	SE 1	SE 2
Volume Total	252	912	670
Volume Left	0	0	0
Volume Right	0	0	214
cSH	105	1700	1700
Volume to Capacity	2.40	0.54	0.39
Queue Length 95th (ft)	564	0	0
Control Delay (s)	723.3	0.0	0.0
Lane LOS	F		
Approach Delay (s)	723.3	0.0	
Approach LOS	F		

Intersection Summary			
Average Delay	99.4		
Intersection Capacity Utilization	106.2%	ICU Level of Service	G
Analysis Period (min)	15		

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HCM Signalized Intersection Capacity Analysis
3: H-1 Off Ramp & Kunia Road

Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0				4.0	4.0			4.0	
Lane Util. Factor		1.00	1.00				0.97	0.91			0.95	
Frt		1.00	0.85				1.00	1.00			1.00	
Flt Protected		0.95	1.00				0.95	1.00			1.00	
Satd. Flow (prot)		1770	1583				3433	5085			3539	
Flt Permitted		0.95	1.00				0.95	1.00			1.00	
Satd. Flow (perm)		1770	1583				3433	5085			3539	
Volume (vph)	318	0	438	0	0	0	1097	1927	0	0	478	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	346	0	476	0	0	0	1192	2095	0	0	520	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	346	476	0	0	0	1192	2095	0	0	520	0
Turn Type	Split		Free				Prot					
Protected Phases	4	4					1	6			2	
Permitted Phases			Free									
Actuated Green, G (s)		17.0	74.0				28.9	49.0			16.1	
Effective Green, g (s)		17.0	74.0				28.9	49.0			16.1	
Actuated g/C Ratio		0.23	1.00				0.39	0.66			0.22	
Clearance Time (s)		4.0					4.0	4.0			4.0	
Vehicle Extension (s)		3.0					3.0	3.0			3.0	
Lane Grp Cap (vph)		407	1583				1341	3367			770	
v/s Ratio Prot		c0.20					c0.35	c0.41			0.15	
v/s Ratio Perm			0.30									
v/c Ratio		0.85	0.30				0.89	0.62			0.68	
Uniform Delay, d1		27.3	0.0				21.1	7.2			26.6	
Progression Factor		1.00	1.00				1.00	1.00			1.00	
Incremental Delay, d2		15.5	0.5				7.5	0.9			4.7	
Delay (s)		42.8	0.5				28.6	8.1			31.3	
Level of Service		D	A				C	A			C	
Approach Delay (s)		18.3			0.0			15.5			31.3	
Approach LOS		B			A			B			C	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	74.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp

Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.95		1.00	0.95				1.00			1.00
Frt		0.99		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		3521		1770	3539				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		3521		1770	3539				1611			1611
Volume (vph)	0	711	26	253	231	0	0	0	822	0	0	119
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	773	28	275	251	0	0	0	893	0	0	129
RTOR Reduction (vph)	0	3	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	798	0	275	251	0	0	0	893	0	0	129
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		37.8		14.2	60.0				60.0			60.0
Effective Green, g (s)		37.8		14.2	60.0				60.0			60.0
Actuated g/C Ratio		0.63		0.24	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		2218		419	3539				1611			1611
v/s Ratio Prot		0.23		0.16	0.07							
v/s Ratio Perm									c0.55			0.08
v/c Ratio		0.36		0.66	0.07				0.55			0.08
Uniform Delay, d1		5.3		20.7	0.0				0.0			0.0
Progression Factor		1.00		0.46	1.00				1.00			1.00
Incremental Delay, d2		0.5		3.1	0.0				1.4			0.1
Delay (s)		5.8		12.5	0.0				1.4			0.1
Level of Service		A		B	A				A			A
Approach Delay (s)		5.8			6.5			1.4			0.1	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	4.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	41.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps — Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0				4.0			
Lane Util. Factor	1.00	0.95			0.95				1.00			
Frt	1.00	1.00			0.96				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	3539			3397				1611			
Flt Permitted	0.95	1.00			1.00				1.00			
Satd. Flow (perm)	1770	3539			3397				1611			
Volume (vph)	444	1089	0	0	484	177	0	0	894	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	483	1184	0	0	526	192	0	0	972	0	0	0
RTOR Reduction (vph)	0	0	0	0	62	0	0	0	0	0	0	0
Lane Group Flow (vph)	483	1184	0	0	656	0	0	0	972	0	0	0
Turn Type	Prot								Free			
Protected Phases	5	2			6							
Permitted Phases									Free			
Actuated Green, G (s)	31.0	60.0			21.0				60.0			
Effective Green, g (s)	31.0	60.0			21.0				60.0			
Actuated g/C Ratio	0.52	1.00			0.35				1.00			
Clearance Time (s)	4.0	4.0			4.0							
Vehicle Extension (s)	3.0	3.0			3.0							
Lane Grp Cap (vph)	915	3539			1189				1611			
v/s Ratio Prot	0.27	0.33			0.19							
v/s Ratio Perm									c0.60			
v/c Ratio	0.53	0.33			0.55				0.60			
Uniform Delay, d1	9.6	0.0			15.7				0.0			
Progression Factor	1.10	1.00			1.00				1.00			
Incremental Delay, d2	0.5	0.2			1.8				1.7			
Delay (s)	11.1	0.2			17.6				1.7			
Level of Service	B	A			B				A			
Approach Delay (s)		3.4			17.6			1.7			0.0	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM Average Control Delay	5.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.60		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	50.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street — Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00		1.00	1.00		0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583		1792	1583		3433	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583		1792	1583		3433	1583
Volume (vph)	546	891	546	52	375	152	186	50	19	51	31	150
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	593	968	593	57	408	165	202	54	21	55	34	163
RTOR Reduction (vph)	0	0	342	0	0	133	0	0	11	0	0	148
Lane Group Flow (vph)	593	968	251	57	408	32	0	256	10	0	89	15
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	16.7	26.8	26.8	2.2	12.3	12.3		12.4	12.4		5.9	5.9
Effective Green, g (s)	16.7	26.8	26.8	2.2	12.3	12.3		12.4	12.4		5.9	5.9
Actuated g/C Ratio	0.26	0.42	0.42	0.03	0.19	0.19		0.20	0.20		0.09	0.09
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	906	1498	670	62	688	308		351	310		320	148
v/s Ratio Prot	c0.17	c0.27		0.03	0.12			c0.14			c0.03	
v/s Ratio Perm			0.16			0.02			0.01			0.01
v/c Ratio	0.65	0.65	0.37	0.92	0.59	0.10		0.73	0.03		0.28	0.10
Uniform Delay, d1	20.7	14.5	12.5	30.5	23.2	21.0		23.9	20.6		26.7	26.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	1.7	1.0	0.4	84.9	1.4	0.1		12.5	0.2		0.5	0.3
Delay (s)	22.4	15.5	12.9	115.3	24.6	21.1		36.4	20.8		27.2	26.6
Level of Service	C	B	B	F	C	C		D	C		C	C
Approach Delay (s)		16.7			31.9			35.2			26.8	
Approach LOS		B			C			D			C	

Intersection Summary			
HCM Average Control Delay	21.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	63.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	57.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
7: Laulaunul Street & Fort Weaver Road

Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		0.95		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.91	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3393		1770	1863	1583	1770	3539	1583	1770	5085	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3393		1770	1863	1583	1770	3539	1583	1770	5085	1583
Volume (vph)	67	20	4	99	5	198	47	2983	40	68	1435	200
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	73	22	4	108	5	215	51	3242	43	74	1560	217
RTOR Reduction (vph)	0	2	0	0	0	99	0	0	6	0	0	61
Lane Group Flow (vph)	0	97	0	108	5	116	51	3242	37	74	1560	156
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		9.5		8.0	8.0	8.0	7.0	105.0	105.0	5.9	103.9	103.9
Effective Green, g (s)		9.5		8.0	8.0	8.0	7.0	105.0	105.0	5.9	103.9	103.9
Actuated g/C Ratio		0.07		0.06	0.06	0.06	0.05	0.73	0.73	0.04	0.72	0.72
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		223		98	103	88	86	2573	1151	72	3659	1139
v/s Ratio Prot		c0.03		0.06	0.00		0.03	c0.92		c0.04	0.31	
v/s Ratio Perm						c0.07			0.02			0.10
v/c Ratio		0.44		1.10	0.05	1.32	0.59	1.26	0.03	1.03	0.43	0.14
Uniform Delay, d1		64.9		68.2	64.6	68.2	67.3	19.7	5.5	69.2	8.2	6.3
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1.4		121.1	0.2	202.2	10.5	120.3	0.1	114.0	0.4	0.3
Delay (s)		66.2		189.3	64.8	270.4	77.8	140.0	5.6	183.2	8.6	6.6
Level of Service		E		F	E	F	E	F	A	F	A	A
Approach Delay (s)		66.2			240.5			137.3			15.3	
Approach LOS		E			F			F			B	

Intersection Summary			
HCM Average Control Delay	101.9	HCM Level of Service	F
HCM Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	144.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	108.4%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Road & Fort Weaver Road

Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.98	1.00		0.97	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1817	1583		1800	1583	1770	3539	1583	1770	3539	1583
Flt Permitted		0.80	1.00		0.79	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1482	1583		1468	1583	1770	3539	1583	1770	3539	1583
Volume (vph)	3	3	52	114	49	210	98	2857	26	47	1485	6
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	3	3	57	124	53	228	107	3105	28	51	1614	7
RTOR Reduction (vph)	0	0	0	0	0	37	0	0	0	0	0	2
Lane Group Flow (vph)	0	6	57	0	177	191	107	3105	28	51	1614	5
Turn Type	Perm		Free	Perm		Perm	Prot		Free	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8			Free			6
Actuated Green, G (s)		16.0	150.0		16.0	16.0	13.4	118.0	150.0	4.0	108.6	108.6
Effective Green, g (s)		16.0	150.0		16.0	16.0	13.4	118.0	150.0	4.0	108.6	108.6
Actuated g/C Ratio		0.11	1.00		0.11	0.11	0.09	0.79	1.00	0.03	0.72	0.72
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		158	1583		157	169	158	2784	1583	47	2562	1146
v/s Ratio Prot							0.06	c0.88		c0.03	0.46	
v/s Ratio Perm		0.00	0.04		0.12	c0.12			0.02			0.00
v/c Ratio		0.04	0.04		1.13	1.13	0.68	1.12	0.02	1.09	0.63	0.00
Uniform Delay, d1		60.1	0.0		67.0	67.0	66.2	16.0	0.0	73.0	10.5	5.7
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		0.1	0.0		110.1	109.3	10.9	57.5	0.0	157.2	1.2	0.0
Delay (s)		60.2	0.0		177.1	176.3	77.1	73.5	0.0	230.2	11.7	5.7
Level of Service		E	A		F	F	E	E	A	F	B	A
Approach Delay (s)		5.8			176.6			73.0			18.3	
Approach LOS		A			F			E			B	

Intersection Summary			
HCM Average Control Delay	63.0	HCM Level of Service	E
HCM Volume to Capacity ratio	1.12		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	105.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

AR00028016

HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road

Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		0.99		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1681	1705	1583		1835		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1681	1705	1583		1835		1770	3539	1583	1770	3539	1583
Volume (vph)	565	82	278	1	31	4	356	2352	2	176	1277	248
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	614	89	302	1	34	4	387	2557	2	191	1388	270
RTOR Reduction (vph)	0	0	0	0	3	0	0	0	0	0	0	143
Lane Group Flow (vph)	342	361	302	0	36	0	387	2557	2	191	1388	127
Turn Type	Split		Free	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free						2			6
Actuated Green, G (s)	27.0	27.0	149.2		3.2		33.0	90.0	90.0	13.0	70.0	70.0
Effective Green, g (s)	27.0	27.0	149.2		3.2		33.0	90.0	90.0	13.0	70.0	70.0
Actuated g/C Ratio	0.18	0.18	1.00		0.02		0.22	0.60	0.60	0.09	0.47	0.47
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	304	309	1583		39		391	2135	955	154	1660	743
v/s Ratio Prot	0.20	c0.21			c0.02		0.22	c0.72		c0.11	0.39	
v/s Ratio Perm			0.19						0.00			0.08
v/c Ratio	1.12	1.17	0.19		0.92		0.99	1.20	0.00	1.24	0.84	0.17
Uniform Delay, d1	61.1	61.1	0.0		72.9		57.9	29.6	11.8	68.1	34.6	22.8
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	89.7	104.9	0.3		113.6		42.3	93.8	0.0	151.2	5.2	0.5
Delay (s)	150.8	166.0	0.3		186.5		100.2	123.4	11.8	219.3	39.8	23.3
Level of Service	F	F	A		F		F	F	B	F	D	C
Approach Delay (s)		111.0			186.5			120.3			55.9	
Approach LOS		F			F			F			E	

Intersection Summary			
HCM Average Control Delay	98.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.19		
Actuated Cycle Length (s)	149.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	109.2%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
10: Farrington Hwy & East Old Fort Weaver Road

Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	672	0	0	0	0	0	0	0	0	69	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	730	0	0	0	0	0	0	0	0	75	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					846							
pX, platoon unblocked												
vC, conflicting volume	0			730			768	730	730	730	730	0
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	0			730			768	730	730	730	730	0
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			100	100	100	100	79	100
cM capacity (veh/h)	1623			874			266	349	422	338	349	1085

Direction, Lane #	EB 1	SW 1
Volume Total	730	75
Volume Left	0	0
Volume Right	0	0
cSH	1700	349
Volume to Capacity	0.43	0.21
Queue Length 95th (ft)	0	20
Control Delay (s)	0.0	18.1
Lane LOS		C
Approach Delay (s)	0.0	18.1
Approach LOS		C

Intersection Summary			
Average Delay	1.7		
Intersection Capacity Utilization	56.8%	ICU Level of Service	B
Analysis Period (min)	15		

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HCM Unsignalized Intersection Capacity Analysis
11: Farrington Hwy & West Old Fort Weaver Road — Existing AM Peak

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	664	30	0	281	38	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	722	33	0	305	41	9
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			754		1043	738
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			754		1043	738
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		84	98
cM capacity (veh/h)			856		254	418

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	754	305	50
Volume Left	0	0	41
Volume Right	33	0	9
cSH	1700	1700	272
Volume to Capacity	0.44	0.18	0.18
Queue Length 95th (ft)	0	0	16
Control Delay (s)	0.0	0.0	21.2
Lane LOS			C
Approach Delay (s)	0.0	0.0	21.2
Approach LOS			C

Intersection Summary			
Average Delay	1.0		
Intersection Capacity Utilization	46.8%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
12: Farrington Hwy & Fort Barrette Road — Existing AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.91	0.91	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583	3433	3390	1441	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583	3433	3390	1441	3433	3539	1583
Volume (vph)	325	201	483	42	344	425	570	488	34	359	605	779
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	353	218	525	46	374	462	620	530	37	390	658	847
RTOR Reduction (vph)	0	0	339	0	0	317	0	0	23	0	0	172
Lane Group Flow (vph)	353	218	186	46	374	145	620	530	14	390	658	675
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases			4			8			6			2
Actuated Green, G (s)	9.0	22.7	22.7	2.4	16.1	16.1	16.0	34.8	34.8	14.3	33.1	33.1
Effective Green, g (s)	9.0	22.7	22.7	2.4	16.1	16.1	16.0	34.8	34.8	14.3	33.1	33.1
Actuated g/C Ratio	0.10	0.25	0.25	0.03	0.18	0.18	0.18	0.39	0.39	0.16	0.37	0.37
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	343	891	398	47	632	283	609	1308	556	544	1299	581
v/s Ratio Prot	c0.10	0.06		0.03	c0.11		c0.18	0.16		0.11	0.19	
v/s Ratio Perm			0.12			0.09			0.01			c0.43
v/c Ratio	1.03	0.24	0.47	0.98	0.59	0.51	1.02	0.41	0.03	0.72	0.51	1.16
Uniform Delay, d1	40.6	26.9	28.6	43.9	34.0	33.5	37.1	20.2	17.2	36.0	22.2	28.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	56.3	0.1	0.9	122.0	1.5	1.6	41.1	0.9	0.1	4.5	1.4	91.0
Delay (s)	96.9	27.1	29.5	165.9	35.5	35.1	78.2	21.1	17.3	40.5	23.6	119.5
Level of Service	F	C	C	F	D	D	E	C	B	D	C	F
Approach Delay (s)		50.7			42.1			50.8			70.0	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM Average Control Delay	56.4	HCM Level of Service	E
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	90.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	80.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

AR00028018

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road

Existing PM

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	0.97	1.00	0.95	1.00		0.95
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3433	1583	3539	1583		3539
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3433	1583	3539	1583		3539
Volume (vph)	415	12	1000	812	0	1314
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	451	13	1087	883	0	1428
RTOR Reduction (vph)	0	10	0	313	0	0
Lane Group Flow (vph)	451	3	1087	570	0	1428
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		6		2		
Actuated Green, G (s)	12.4	12.4	37.1	37.1		37.1
Effective Green, g (s)	12.4	12.4	37.1	37.1		37.1
Actuated g/C Ratio	0.22	0.22	0.65	0.65		0.65
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	740	341	2283	1021		2283
v/s Ratio Prot	c0.13		0.31			c0.40
v/s Ratio Perm		0.00		0.36		
v/c Ratio	0.61	0.01	0.48	0.56		0.63
Uniform Delay, d1	20.4	17.7	5.2	5.7		6.1
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	1.4	0.0	0.7	2.2		1.3
Delay (s)	21.8	17.7	5.9	7.9		7.4
Level of Service	C	B	A	A		A
Approach Delay (s)	21.7		6.8			7.4
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	8.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	57.5	Sum of lost time (s)	8.0
Intersection Capacity Utilization	54.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Sign Control		Stop			Stop			Free			Free	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	0	0	0	323	0	0	1454	275	0	0	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	0	0	351	0	0	1580	299	0	0	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type		None			None							
Median storage veh)												
Upstream signal (ft)								1180			617	
pX, platoon unblocked	0.75	0.75	0.75	0.75	0.75					0.75		
vC, conflicting volume	1905	1730	940	790	1879	0	0			1879		
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	1873	1638	577	377	1838	0	0			1838		
tC, single (s)	7.5	6.5	6.9	7.5	6.5	6.9	4.1			4.1		
tC, 2 stage (s)												
tF (s)	3.5	4.0	3.3	3.5	4.0	3.3	2.2			2.2		
p0 queue free %	0	100	100	100	0	100	100			100		
cM capacity (veh/h)	0	74	342	414	56	1084	1622			244		

Direction, Lane #	WB 1	SE 1	SE 2
Volume Total	351	1054	826
Volume Left	0	0	0
Volume Right	0	0	299
cSH	56	1700	1700
Volume to Capacity	6.30	0.62	0.49
Queue Length 95th (ft)	Err	0	0
Control Delay (s)	Err	0.0	0.0
Lane LOS	F		
Approach Delay (s)	Err	0.0	
Approach LOS	F		

Intersection Summary			
Average Delay	1573.9		
Intersection Capacity Utilization	162.7%	ICU Level of Service	H
Analysis Period (min)	15		

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HCM Signalized Intersection Capacity Analysis
3: H-1 Off Ramp & Kunia Road

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0				4.0	4.0			4.0	
Lane Util. Factor		1.00	1.00				0.97	0.91			0.95	
Frt		1.00	0.85				1.00	1.00			1.00	
Flt Protected		0.95	1.00				0.95	1.00			1.00	
Satd. Flow (prot)		1770	1583				3433	5085			3539	
Flt Permitted		0.95	1.00				0.95	1.00			1.00	
Satd. Flow (perm)		1770	1583				3433	5085			3539	
Volume (vph)	210	0	287	0	0	0	724	3387	0	0	770	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	228	0	312	0	0	0	787	3682	0	0	837	0
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	228	312	0	0	0	787	3682	0	0	837	0
Turn Type	Split		Free				Prot					
Protected Phases	4	4					1	6			2	
Permitted Phases			Free									
Actuated Green, G (s)		10.0	75.0				21.1	57.0			31.9	
Effective Green, g (s)		10.0	75.0				21.1	57.0			31.9	
Actuated g/C Ratio		0.13	1.00				0.28	0.76			0.43	
Clearance Time (s)		4.0					4.0	4.0			4.0	
Vehicle Extension (s)		3.0					3.0	3.0			3.0	
Lane Grp Cap (vph)		236	1583				966	3865			1505	
v/s Ratio Prot		c0.13					0.23	c0.72			0.24	
v/s Ratio Perm			0.20									
v/c Ratio		0.97	0.20				0.81	0.95			0.56	
Uniform Delay, d1		32.3	0.0				25.1	7.8			16.2	
Progression Factor		1.00	1.00				1.00	1.00			1.00	
Incremental Delay, d2		48.6	0.3				5.4	7.0			1.5	
Delay (s)		80.9	0.3				30.5	14.9			17.7	
Level of Service		F	A				C	B			B	
Approach Delay (s)		34.3			0.0			17.6			17.7	
Approach LOS		C			A			B			B	

Intersection Summary			
HCM Average Control Delay	19.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	75.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.95		1.00	0.95				1.00			1.00
Frt		0.99		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		3498		1770	3539				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		3498		1770	3539				1611			1611
Volume (vph)	0	273	23	442	952	0	0	0	870	0	0	652
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	297	25	480	1035	0	0	0	946	0	0	709
RTOR Reduction (vph)	0	11	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	311	0	480	1035	0	0	0	946	0	0	709
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		17.0		35.0	60.0				60.0			60.0
Effective Green, g (s)		17.0		35.0	60.0				60.0			60.0
Actuated g/C Ratio		0.28		0.58	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		991		1033	3539				1611			1611
v/s Ratio Prot		0.09		0.27	0.29							
v/s Ratio Perm									c0.59			0.44
v/c Ratio		0.31		0.46	0.29				0.59			0.44
Uniform Delay, d1		16.9		7.1	0.0				0.0			0.0
Progression Factor		1.00		0.15	1.00				1.00			1.00
Incremental Delay, d2		0.8		0.1	0.1				1.6			0.9
Delay (s)		17.7		1.2	0.1				1.6			0.9
Level of Service		B		A	A				A			A
Approach Delay (s)		17.7			0.4			1.6			0.9	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM Average Control Delay	2.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	39.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0				4.0			
Lane Util. Factor	1.00	0.95			0.95				1.00			
Frt	1.00	1.00			0.96				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	3539			3381				1611			
Flt Permitted	0.95	1.00			1.00				1.00			
Satd. Flow (perm)	1770	3539			3381				1611			
Volume (vph)	315	828	0	0	1394	592	0	0	666	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	342	900	0	0	1515	643	0	0	724	0	0	0
RTOR Reduction (vph)	0	0	0	0	38	0	0	0	0	0	0	0
Lane Group Flow (vph)	342	900	0	0	2120	0	0	0	724	0	0	0
Turn Type	Prot								Free			
Protected Phases	5	2			6							
Permitted Phases									Free			
Actuated Green, G (s)	12.0	60.0			40.0				60.0			
Effective Green, g (s)	12.0	60.0			40.0				60.0			
Actuated g/C Ratio	0.20	1.00			0.67				1.00			
Clearance Time (s)	4.0	4.0			4.0							
Vehicle Extension (s)	3.0	3.0			3.0							
Lane Grp Cap (vph)	354	3539			2254				1611			
v/s Ratio Prot	c0.19	0.25			c0.63							
v/s Ratio Perm									0.45			
v/c Ratio	0.97	0.25			0.94				0.45			
Uniform Delay, d1	23.8	0.0			8.9				0.0			
Progression Factor	0.96	1.00			1.00				1.00			
Incremental Delay, d2	35.3	0.1			9.4				0.9			
Delay (s)	58.3	0.1			18.3				0.9			
Level of Service	E	A			B				A			
Approach Delay (s)		16.2			18.3			0.9			0.0	
Approach LOS		B			B			A			A	

Intersection Summary			
HCM Average Control Delay	14.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	60.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00		1.00	1.00		0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583		1786	1583		3425	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583		1786	1583		3425	1583
Volume (vph)	532	645	317	85	1025	316	573	91	59	167	85	438
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	578	701	345	92	1114	343	623	99	64	182	92	476
RTOR Reduction (vph)	0	0	226	0	0	196	0	0	7	0	0	222
Lane Group Flow (vph)	578	701	119	92	1114	147	0	722	57	0	274	254
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	20.0	48.3	48.3	11.7	40.0	40.0		46.0	46.0		18.0	18.0
Effective Green, g (s)	20.0	48.3	48.3	11.7	40.0	40.0		46.0	46.0		18.0	18.0
Actuated g/C Ratio	0.14	0.34	0.34	0.08	0.29	0.29		0.33	0.33		0.13	0.13
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	490	1221	546	148	1011	452		587	520		440	204
v/s Ratio Prot	c0.17	0.20		0.05	c0.31			c0.40			0.08	
v/s Ratio Perm			0.08			0.09			0.04			c0.16
v/c Ratio	1.18	0.57	0.22	0.62	1.10	0.33		1.23	0.11		0.62	1.24
Uniform Delay, d1	60.0	37.4	32.5	62.0	50.0	39.4		47.0	32.7		57.8	61.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	100.3	0.7	0.2	7.9	60.4	0.4		117.9	0.4		2.7	144.1
Delay (s)	160.3	38.1	32.7	69.9	110.4	39.8		164.9	33.2		60.5	205.1
Level of Service	F	D	C	E	F	D		F	C		E	F
Approach Delay (s)		80.4			92.4			154.2			152.3	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM Average Control Delay	108.1	HCM Level of Service	F
HCM Volume to Capacity ratio	1.18		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	102.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		0.95		1.00	1.00	1.00	1.00	0.95	1.00	1.00	0.91	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3373		1770	1863	1583	1770	3539	1583	1770	5085	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3373		1770	1863	1583	1770	3539	1583	1770	5085	1583
Volume (vph)	159	22	9	36	10	141	123	2002	44	110	2323	184
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	173	24	10	39	11	153	134	2176	48	120	2525	200
RTOR Reduction (vph)	0	4	0	0	0	142	0	0	14	0	0	80
Lane Group Flow (vph)	0	203	0	39	11	11	134	2176	34	120	2525	120
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		11.6		4.0	4.0	4.0	10.5	66.0	66.0	8.0	63.5	63.5
Effective Green, g (s)		11.6		4.0	4.0	4.0	10.5	66.0	66.0	8.0	63.5	63.5
Actuated g/C Ratio		0.11		0.04	0.04	0.04	0.10	0.62	0.62	0.08	0.60	0.60
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		371		67	71	60	176	2212	989	134	3058	952
v/s Ratio Prot		c0.06		c0.02	0.01		c0.08	c0.61		0.07	0.50	
v/s Ratio Perm						0.01			0.02			0.08
v/c Ratio		0.87dl		0.58	0.15	0.18	0.76	0.98	0.03	0.90	0.83	0.13
Uniform Delay, d1		44.5		50.0	49.2	49.2	46.3	19.3	7.6	48.4	16.7	9.1
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1.7		12.2	1.0	1.4	17.5	15.7	0.1	47.3	2.7	0.3
Delay (s)		46.2		62.2	50.2	50.6	63.8	34.9	7.7	95.7	19.4	9.4
Level of Service		D		E	D	D	E	C	A	F	B	A
Approach Delay (s)		46.2			52.6			36.0			21.9	
Approach LOS		D			D			D			C	

Intersection Summary				
HCM Average Control Delay	29.6	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.86			
Actuated Cycle Length (s)	105.6	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	86.9%	ICU Level of Service	E	
Analysis Period (min)	15			

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Road & Fort Weaver Road

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.95	1.00	1.00	0.95	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		1.00	1.00		0.96	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1857	1583		1797	1583	1770	3539	1583	1770	3539	1583
Flt Permitted		0.98	1.00		0.47	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1833	1583		884	1583	1770	3539	1583	1770	3539	1583
Volume (vph)	10	167	1264	37	14	77	23	2082	36	92	2274	2
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	182	1374	40	15	84	25	2263	39	100	2472	2
RTOR Reduction (vph)	0	0	0	0	0	62	0	0	0	0	0	1
Lane Group Flow (vph)	0	193	1374	0	55	22	25	2263	39	100	2472	1
Turn Type	Perm		Free	Perm		Perm	Prot		Free	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8			Free			6
Actuated Green, G (s)		14.1	101.1		14.1	14.1	1.6	69.0	101.1	6.0	73.4	73.4
Effective Green, g (s)		14.1	101.1		14.1	14.1	1.6	69.0	101.1	6.0	73.4	73.4
Actuated g/C Ratio		0.14	1.00		0.14	0.14	0.02	0.68	1.00	0.06	0.73	0.73
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		256	1583		123	221	28	2415	1583	105	2569	1149
v/s Ratio Prot							0.01	0.64		0.06	c0.70	
v/s Ratio Perm		0.11	c0.87		0.06	0.01			0.02			0.00
v/c Ratio		0.75	0.87		0.45	0.10	0.89	0.94	0.02	0.95	0.96	0.00
Uniform Delay, d1		41.8	0.0		39.9	38.0	49.7	14.1	0.0	47.4	12.6	3.8
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		11.9	6.7		2.6	0.2	123.8	8.5	0.0	72.2	10.9	0.0
Delay (s)		53.7	6.7		42.5	38.2	173.4	22.7	0.0	119.6	23.5	3.8
Level of Service		D	A		D	D	F	C	A	F	C	A
Approach Delay (s)		12.5			39.9			23.9			27.2	
Approach LOS		B			D			C			C	

Intersection Summary				
HCM Average Control Delay	22.8	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.92			
Actuated Cycle Length (s)	101.1	Sum of lost time (s)	0.0	
Intersection Capacity Utilization	92.2%	ICU Level of Service	F	
Analysis Period (min)	15			

c Critical Lane Group

AR00028022

HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.95	0.95	1.00		1.00		1.00	0.95	1.00	1.00	0.95	1.00
Frt	1.00	1.00	0.85		0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1681	1689	1583		1805		1770	3539	1583	1770	3539	1583
Flt Permitted	0.95	0.95	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1681	1689	1583		1805		1770	3539	1583	1770	3539	1583
Volume (vph)	610	14	302	1	13	4	347	1587	113	172	2818	515
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	663	15	328	1	14	4	377	1725	123	187	3063	560
RTOR Reduction (vph)	0	0	0	0	4	0	0	0	9	0	0	139
Lane Group Flow (vph)	332	346	328	0	15	0	377	1725	114	187	3063	421
Turn Type	Split		Free	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free						2			6
Actuated Green, G (s)	24.0	24.0	148.4		2.3		21.0	87.7	87.7	18.4	85.1	85.1
Effective Green, g (s)	24.0	24.0	148.4		2.3		21.0	87.7	87.7	18.4	85.1	85.1
Actuated g/C Ratio	0.16	0.16	1.00		0.02		0.14	0.59	0.59	0.12	0.57	0.57
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	272	273	1583		28		250	2091	936	219	2029	908
v/s Ratio Prot	0.20	c0.20			0.01		c0.21	0.49		0.11	c0.87	
v/s Ratio Perm			c0.21						0.07			0.27
v/c Ratio	1.22	1.27	0.21		0.54		1.51	0.82	0.12	0.85	1.51	0.46
Uniform Delay, d1	62.2	62.2	0.0		72.5		63.7	24.2	13.4	63.7	31.5	18.4
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	127.7	146.1	0.3		18.4		248.3	3.9	0.3	26.1	231.9	1.7
Delay (s)	189.9	208.3	0.3		90.9		312.0	28.1	13.6	89.8	263.6	20.1
Level of Service	F	F	A		F		F	C	B	F	F	C
Approach Delay (s)		134.4			90.9			75.4			219.3	
Approach LOS		F			F			E			F	

Intersection Summary				
HCM Average Control Delay	161.5	HCM Level of Service	F	
HCM Volume to Capacity ratio	1.40			
Actuated Cycle Length (s)	148.4	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	131.1%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Unsignalized Intersection Capacity Analysis
10: Farrington Hwy & East Old Fort Weaver Road

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Sign Control		Free			Free			Stop			Stop	
Grade		0%			0%			0%			0%	
Volume (veh/h)	0	258	0	0	0	0	0	0	0	0	632	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	280	0	0	0	0	0	0	0	0	687	0
Pedestrians												
Lane Width (ft)												
Walking Speed (ft/s)												
Percent Blockage												
Right turn flare (veh)												
Median type								None			None	
Median storage veh)												
Upstream signal (ft)					846							
pX, platoon unblocked												
vC, conflicting volume	0			280			624	280	280	280	280	0
vC1, stage 1 conf vol												
vC2, stage 2 conf vol												
vCu, unblocked vol	0			280			624	280	280	280	280	0
tC, single (s)	4.1			4.1			7.1	6.5	6.2	7.1	6.5	6.2
tC, 2 stage (s)												
tF (s)	2.2			2.2			3.5	4.0	3.3	3.5	4.0	3.3
p0 queue free %	100			100			0	100	100	100	0	100
cM capacity (veh/h)	1623			1282			0	628	758	672	628	1085

Direction, Lane #	EB 1	SW 1
Volume Total	280	687
Volume Left	0	0
Volume Right	0	0
cSH	1700	628
Volume to Capacity	0.16	1.09
Queue Length 95th (ft)	0	504
Control Delay (s)	0.0	89.1
Lane LOS		F
Approach Delay (s)	0.0	89.1
Approach LOS		F

Intersection Summary			
Average Delay	63.2		
Intersection Capacity Utilization	71.4%	ICU Level of Service	C
Analysis Period (min)	15		

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HCM Unsignalized Intersection Capacity Analysis
11: Farrington Hwy & West Old Fort Weaver Road

Existing PM

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	250	27	0	972	21	8
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	272	29	0	1057	23	9
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			301		1343	286
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			301		1343	286
tC, single (s)			4.1		6.4	6.2
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		86	99
cM capacity (veh/h)			1260		168	753

Direction, Lane #	EB 1	WB 1	NB 1
Volume Total	301	1057	32
Volume Left	0	0	23
Volume Right	29	0	9
cSH	1700	1700	213
Volume to Capacity	0.18	0.62	0.15
Queue Length 95th (ft)	0	0	13
Control Delay (s)	0.0	0.0	24.8
Lane LOS			C
Approach Delay (s)	0.0	0.0	24.8
Approach LOS			C

Intersection Summary			
Average Delay	0.6		
Intersection Capacity Utilization	61.2%	ICU Level of Service	B
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
12: Farrington Hwy & Fort Barrette Road

Existing PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	1.00	0.95	1.00	0.97	0.91	0.91	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	1770	3539	1583	3433	3390	1441	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	1770	3539	1583	3433	3390	1441	3433	3539	1583
Volume (vph)	754	388	744	71	267	323	352	371	35	476	446	704
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	820	422	809	77	290	351	383	403	38	517	485	765
RTOR Reduction (vph)	0	0	332	0	0	244	0	0	28	0	0	171
Lane Group Flow (vph)	820	422	477	77	290	107	383	403	10	517	485	594
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	7	4		3	8		1	6		5	2	
Permitted Phases			4			8			6			2
Actuated Green, G (s)	23.0	32.6	32.6	5.0	14.6	14.6	11.0	26.0	26.0	19.0	34.0	34.0
Effective Green, g (s)	23.0	32.6	32.6	5.0	14.6	14.6	11.0	26.0	26.0	19.0	34.0	34.0
Actuated g/C Ratio	0.23	0.33	0.33	0.05	0.15	0.15	0.11	0.26	0.26	0.19	0.34	0.34
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	801	1170	523	90	524	234	383	894	380	662	1220	546
v/s Ratio Prot	c0.24	0.12		0.04	0.08		c0.11	0.12		0.15	0.14	
v/s Ratio Perm			c0.30			0.07			0.01			c0.38
v/c Ratio	1.02	0.36	0.91	0.86	0.55	0.46	1.00	0.45	0.03	0.78	0.40	1.09
Uniform Delay, d1	37.8	25.1	31.6	46.4	39.0	38.4	43.8	30.3	26.9	37.8	24.5	32.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	38.0	0.2	20.2	50.6	1.3	1.4	46.0	1.6	0.1	6.0	1.0	64.6
Delay (s)	75.8	25.3	51.8	97.1	40.2	39.8	89.8	32.0	27.0	43.8	25.5	96.9
Level of Service	E	C	D	F	D	D	F	C	C	D	C	F
Approach Delay (s)		55.9			46.1			58.6			61.7	
Approach LOS		E			D			E			E	

Intersection Summary					
HCM Average Control Delay	56.9	HCM Level of Service		E	
HCM Volume to Capacity ratio	1.01				
Actuated Cycle Length (s)	98.6	Sum of lost time (s)		12.0	
Intersection Capacity Utilization	74.4%	ICU Level of Service		D	
Analysis Period (min)	15				
c Critical Lane Group					

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APPENDIX A-2
YEAR 2030 CONDITIONS

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road

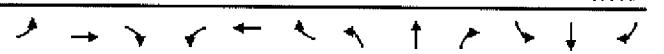
Year 2030 AM

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	0.97	1.00	0.95	1.00		0.91
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3433	1583	3539	1583		5085
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3433	1583	3539	1583		5085
Volume (vph)	564	37	1491	344	0	1120
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	613	40	1621	374	0	1217
RTOR Reduction (vph)	0	19	0	124	0	0
Lane Group Flow (vph)	613	21	1621	250	0	1217
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	21.0	21.0	58.2	58.2		58.2
Effective Green, g (s)	21.0	21.0	58.2	58.2		58.2
Actuated g/C Ratio	0.24	0.24	0.67	0.67		0.67
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	827	381	2362	1057		3394
v/s Ratio Prot	c0.18		c0.46			0.24
v/s Ratio Perm		0.01		0.16		
v/c Ratio	0.74	0.06	0.69	0.24		0.36
Uniform Delay, d1	30.6	25.5	8.9	5.7		6.3
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	3.6	0.1	1.6	0.5		0.3
Delay (s)	34.2	25.5	10.5	6.3		6.6
Level of Service	C	C	B	A		A
Approach Delay (s)	33.7		9.7			6.6
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	12.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	87.2	Sum of lost time (s)	8.0
Intersection Capacity Utilization	64.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road

Year 2030 AM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	0.91			0.91	
Frt						0.86	1.00	1.00			0.97	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5085			4955	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5085			4955	
Volume (vph)	0	0	0	0	0	530	115	1305	0	0	1393	288
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	576	125	1418	0	0	1514	313
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	16	0
Lane Group Flow (vph)	0	0	0	0	0	576	125	1418	0	0	1811	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						100.0	11.2	100.0			80.8	
Effective Green, g (s)						100.0	11.2	100.0			80.8	
Actuated g/C Ratio						1.00	0.11	1.00			0.81	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	198	5085			4004	
v/s Ratio Prot							c0.07	0.28			c0.37	
v/s Ratio Perm						0.36						
v/c Ratio						0.36	0.63	0.28			0.45	
Uniform Delay, d1						0.0	42.4	0.0			2.9	
Progression Factor						1.00	1.12	1.00			1.00	
Incremental Delay, d2						0.6	6.0	0.1			0.4	
Delay (s)						0.6	53.5	0.1			3.3	
Level of Service						A	D	A			A	
Approach Delay (s)	0.0			0.6				4.5			3.3	
Approach LOS	A			A				A			A	

Intersection Summary			
HCM Average Control Delay	3.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.47		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	46.4%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road

Year 2030 AM

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.86			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	1583	6408			5085
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	1583	6408			5085
Volume (vph)	367	248	877	0	0	1052
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	399	270	953	0	0	1143
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	399	270	953	0	0	1143
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	14.9	100.0	77.1			77.1
Effective Green, g (s)	14.9	100.0	77.1			77.1
Actuated g/C Ratio	0.15	1.00	0.77			0.77
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	512	1583	4941			3921
v/s Ratio Prot	c0.12		0.15			c0.22
v/s Ratio Perm		0.17				
v/c Ratio	0.78	0.17	0.19			0.29
Uniform Delay, d1	41.0	0.0	3.1			3.4
Progression Factor	1.00	1.00	0.34			1.00
Incremental Delay, d2	7.4	0.2	0.1			0.2
Delay (s)	48.3	0.2	1.1			3.6
Level of Service	D	A	A			A
Approach Delay (s)	28.9		1.1			3.6
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	8.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.37		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp

Year 2030 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.91		0.97	0.91				1.00			1.00
Frt		0.98		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		4984		3433	5085				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		4984		3433	5085				1611			1611
Volume (vph)	0	800	122	432	314	0	0	0	422	0	0	39
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	870	133	470	341	0	0	0	459	0	0	42
RTOR Reduction (vph)	0	39	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	964	0	470	341	0	0	0	459	0	0	42
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		21.7		10.3	40.0				40.0			40.0
Effective Green, g (s)		21.7		10.3	40.0				40.0			40.0
Actuated g/C Ratio		0.54		0.26	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		2704		884	5085				1611			1611
v/s Ratio Prot		c0.19		c0.14	0.07							
v/s Ratio Perm									0.28			0.03
v/c Ratio		0.36		0.53	0.07				0.28			0.03
Uniform Delay, d1		5.2		12.8	0.0				0.0			0.0
Progression Factor		1.00		1.00	1.00				1.00			1.00
Incremental Delay, d2		0.4		0.6	0.0				0.4			0.0
Delay (s)		5.6		13.4	0.0				0.4			0.0
Level of Service		A		B	A				A			A
Approach Delay (s)		5.6			7.8			0.4			0.0	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	5.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.41		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	37.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

AR00028027

HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps

Year 2030 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0				4.0			
Lane Util. Factor	1.00	0.91			0.91				1.00			
Frt	1.00	1.00			0.94				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	5085			4756				1611			
Flt Permitted	0.95	1.00			1.00				1.00			
Satd. Flow (perm)	1770	5085			4756				1611			
Volume (vph)	171	1051	0	0	746	567	0	0	710	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	186	1142	0	0	811	616	0	0	772	0	0	0
RTOR Reduction (vph)	0	0	0	0	203	0	0	0	0	0	0	0
Lane Group Flow (vph)	186	1142	0	0	1224	0	0	0	772	0	0	0
Turn Type	Prot								Free			
Protected Phases	5	2			6							
Permitted Phases									Free			
Actuated Green, G (s)	8.4	45.0			28.6				45.0			
Effective Green, g (s)	8.4	45.0			28.6				45.0			
Actuated g/C Ratio	0.19	1.00			0.64				1.00			
Clearance Time (s)	4.0	4.0			4.0							
Vehicle Extension (s)	3.0	3.0			3.0							
Lane Grp Cap (vph)	330	5085			3023				1611			
v/s Ratio Prot	0.11	0.22			0.26							
v/s Ratio Perm									c0.48			
v/c Ratio	0.56	0.22			0.40				0.48			
Uniform Delay, d1	16.6	0.0			4.0				0.0			
Progression Factor	1.00	1.00			1.00				1.00			
Incremental Delay, d2	2.2	0.1			0.4				1.0			
Delay (s)	18.8	0.1			4.4				1.0			
Level of Service	B	A			A				A			
Approach Delay (s)		2.7			4.4			1.0			0.0	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	3.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.48		
Actuated Cycle Length (s)	45.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	43.3%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street

Year 2030 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00		1.00	1.00		0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (prot)	3433	5085	1583	1770	5085	1583		1780	1583		3424	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (perm)	3433	5085	1583	1770	5085	1583		1780	1583		3424	1583
Volume (vph)	68	1537	155	119	1227	156	56	5	48	92	45	33
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	74	1671	168	129	1334	170	61	5	52	100	49	36
RTOR Reduction (vph)	0	0	84	0	0	103	0	0	47	0	0	33
Lane Group Flow (vph)	74	1671	84	129	1334	67	0	66	5	0	149	3
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	13.5	34.6	34.6	6.4	27.5	27.5		6.1	6.1		6.5	6.5
Effective Green, g (s)	13.5	34.6	34.6	6.4	27.5	27.5		6.1	6.1		6.5	6.5
Actuated g/C Ratio	0.19	0.50	0.50	0.09	0.40	0.40		0.09	0.09		0.09	0.09
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	666	2528	787	163	2009	625		156	139		320	148
v/s Ratio Prot	0.02	c0.33		c0.07	0.26			c0.04			c0.04	
v/s Ratio Perm			0.05			0.04			0.00			0.00
v/c Ratio	0.11	0.66	0.11	0.79	0.66	0.11		0.42	0.03		0.47	0.02
Uniform Delay, d1	23.1	13.1	9.3	30.9	17.3	13.3		30.1	29.1		29.9	28.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	0.1	0.7	0.1	22.5	0.8	0.1		8.2	0.4		1.1	0.1
Delay (s)	23.2	13.8	9.4	53.5	18.1	13.4		38.3	29.5		31.0	28.7
Level of Service	C	B	A	D	B	B		D	C		C	C
Approach Delay (s)		13.7			20.4			34.4			30.5	
Approach LOS		B			C			C			C	

Intersection Summary			
HCM Average Control Delay	18.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.63		
Actuated Cycle Length (s)	69.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	58.1%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road

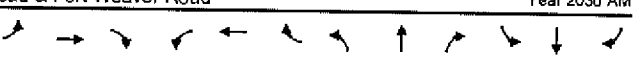
Year 2030 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3510		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3510		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	96	24	12	62	4	201	48	3274	38	63	985	170
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	104	26	13	67	4	218	52	3559	41	68	1071	185
RTOR Reduction (vph)	0	6	0	0	0	90	0	0	8	0	0	59
Lane Group Flow (vph)	0	137	0	67	4	128	52	3559	33	68	1071	126
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		11.0		12.0	12.0	12.0	7.5	100.0	100.0	6.8	99.3	99.3
Effective Green, g (s)		11.0		12.0	12.0	12.0	7.5	100.0	100.0	6.8	99.3	99.3
Actuated g/C Ratio		0.08		0.08	0.08	0.08	0.05	0.69	0.69	0.05	0.68	0.68
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		265		146	153	130	91	3794	1086	83	3768	1078
v/s Ratio Prot		c0.04		0.04	0.00		0.03	c0.64		c0.04	0.19	
v/s Ratio Perm						c0.08			0.02			0.08
v/c Ratio		0.52		0.46	0.03	0.99	0.57	0.94	0.03	0.82	0.28	0.12
Uniform Delay, d1		64.9		63.8	61.5	66.8	67.6	20.2	7.3	68.9	9.2	8.1
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1.7		2.3	0.1	73.8	8.4	5.9	0.1	44.3	0.2	0.2
Delay (s)		66.6		66.1	61.6	140.6	76.0	26.1	7.4	113.2	9.4	8.3
Level of Service		E		E	E	F	E	C	A	F	A	A
Approach Delay (s)		66.6			122.2			26.6			14.6	
Approach LOS		E			F			C			B	

Intersection Summary				
HCM Average Control Delay	29.8	HCM Level of Service		C
HCM Volume to Capacity ratio	0.90			
Actuated Cycle Length (s)	145.8	Sum of lost time (s)		16.0
Intersection Capacity Utilization	91.0%	ICU Level of Service		F
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Road & Fort Weaver Road

Year 2030 AM



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	0.91	1.00	1.00	0.91	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.95	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1775	1583		1858	1583	1770	5085	1583	1770	5085	1583
Flt Permitted		0.68	1.00		0.99	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1259	1583		1836	1583	1770	5085	1583	1770	5085	1583
Volume (vph)	102	1	134	4	62	230	94	3028	1	5	839	215
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	111	1	146	4	67	250	102	3291	1	5	912	234
RTOR Reduction (vph)	0	0	0	0	0	56	0	0	0	0	0	82
Lane Group Flow (vph)	0	112	146	0	71	194	102	3291	1	5	912	152
Turn Type	Perm		Free	Perm		Perm	Prot		Free	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8			Free			6
Actuated Green, G (s)		14.5	100.4		14.5	14.5	8.7	73.1	100.4	0.8	65.2	65.2
Effective Green, g (s)		14.5	100.4		14.5	14.5	8.7	73.1	100.4	0.8	65.2	65.2
Actuated g/C Ratio		0.14	1.00		0.14	0.14	0.09	0.73	1.00	0.01	0.65	0.65
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		182	1583		265	229	153	3702	1583	14	3302	1028
v/s Ratio Prot							c0.06	c0.65		0.00	0.18	
v/s Ratio Perm		0.09	0.09		0.04	c0.12			0.00			0.10
v/c Ratio		0.62	0.09		0.27	0.85	0.67	0.89	0.00	0.36	0.28	0.15
Uniform Delay, d1		40.3	0.0		38.2	41.9	44.4	10.5	0.0	49.5	7.5	6.8
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		6.1	0.1		0.5	24.2	10.5	3.6	0.0	14.9	0.2	0.3
Delay (s)		46.4	0.1		38.8	66.1	54.9	14.2	0.0	64.5	7.7	7.1
Level of Service		D	A		D	E	D	B	A	E	A	A
Approach Delay (s)		20.2			60.1			15.4			7.9	
Approach LOS		C			E			B			A	

Intersection Summary				
HCM Average Control Delay	16.7	HCM Level of Service		B
HCM Volume to Capacity ratio	0.89			
Actuated Cycle Length (s)	100.4	Sum of lost time (s)		12.0
Intersection Capacity Utilization	88.5%	ICU Level of Service		E
Analysis Period (min)	15			
c Critical Lane Group				

AR00028029

HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road

Year 2030 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00		1.00	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	0.85		0.97		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1766	1583		1798		1770	5532	1563	1770	5532	1583
Flt Permitted	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1766	1583		1798		1770	5532	1583	1770	5532	1583
Volume (vph)	440	29	36	10	335	115	89	2567	1	177	778	25
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	444	29	36	10	338	116	90	2593	1	179	786	25
RTOR Reduction (vph)	0	0	0	0	8	0	0	0	0	0	0	13
Lane Group Flow (vph)	231	242	36	0	456	0	90	2593	1	179	786	12
Turn Type	Split		Free	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free						2			6
Actuated Green, G (s)	20.0	20.0	150.0		32.0		12.3	69.0	69.0	13.0	69.7	69.7
Effective Green, g (s)	20.0	20.0	150.0		32.0		12.3	69.0	69.0	13.0	69.7	69.7
Actuated g/C Ratio	0.13	0.13	1.00		0.21		0.08	0.46	0.46	0.09	0.46	0.46
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	234	235	1583		384		145	2545	728	153	2571	736
v/s Ratio Prot	0.13	c0.14			c0.25		0.05	c0.47		c0.10	0.14	
v/s Ratio Perm			c0.02						0.00			0.01
v/c Ratio	0.99	1.03	0.02		1.19		0.62	1.02	0.00	1.17	0.31	0.02
Uniform Delay, d1	64.9	65.0	0.0		59.0		66.6	40.5	21.9	68.5	25.1	21.7
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	54.7	66.7	0.0		107.8		8.0	22.7	0.0	125.7	0.3	0.0
Delay (s)	119.6	131.7	0.0		166.8		74.6	63.2	21.9	194.2	25.4	21.7
Level of Service	F	F	A		F		E	E	C	F	C	C
Approach Delay (s)		116.9			166.6			63.6			55.8	
Approach LOS		F			F			E			E	

Intersection Summary				
HCM Average Control Delay	78.1	HCM Level of Service	E	
HCM Volume to Capacity ratio	1.08			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	110.9%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Unsignalized Intersection Capacity Analysis
10: Farrington Hwy & East Old Fort Weaver Road

Year 2030 AM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SWL	SWR
Lane Configurations										
Sign Control		Free			Free		Stop		Stop	
Grade		0%			0%		0%		0%	
Volume (veh/h)	0	570	0	0	0	0	0	0	79	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	620	0	0	0	0	0	0	86	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type							None		None	
Median storage veh)										
Upstream signal (ft)					942					
pX, platoon unblocked										
vC, conflicting volume	0			620			662	620	620	0
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	0			620			662	620	620	0
tC, single (s)	4.1			4.1			7.5	6.5	6.5	6.9
tC, 2 stage (s)										
tF (s)	2.2			2.2			3.5	4.0	4.0	3.3
p0 queue free %	100			100			100	100	79	100
cM capacity (veh/h)	1622			957			290	403	403	1064

Direction, Lane #	EB 1	EB 2	SW 1
Volume Total	310	310	86
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1700	403
Volume to Capacity	0.18	0.18	0.21
Queue Length 95th (ft)	0	0	20
Control Delay (s)	0.0	0.0	16.4
Lane LOS			C
Approach Delay (s)	0.0		16.4
Approach LOS			C

Intersection Summary			
Average Delay	2.0		
Intersection Capacity Utilization	43.9%	ICU Level of Service	A
Analysis Period (min)	15		

AR00028030

HCM Unsignalized Intersection Capacity Analysis
11: Farrington Hwy & West Old Fort Weaver Road — Year 2030 AM

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	570	9	0	274	115	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	620	10	0	298	125	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			629		773	315
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			629		773	315
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		63	100
cM capacity (veh/h)			949		335	681

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	413	216	149	149	125	0
Volume Left	0	0	0	0	125	0
Volume Right	0	10	0	0	0	0
cSH	1700	1700	1700	1700	335	1700
Volume to Capacity	0.24	0.13	0.09	0.09	0.37	0.00
Queue Length 95th (ft)	0	0	0	0	42	0
Control Delay (s)	0.0	0.0	0.0	0.0	22.0	0.0
Lane LOS					C	A
Approach Delay (s)	0.0		0.0		22.0	
Approach LOS					C	

Intersection Summary				
Average Delay	2.6			
Intersection Capacity Utilization	29.1%	ICU Level of Service		A
Analysis Period (min)	15			

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — Year 2030 AM

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	0.91	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3252	1441	3433	3539	1583	3433	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3252	1441	3433	3539	1583	3433	3539	1583	1770	3539	1583
Volume (vph)	368	688	781	572	566	115	328	273	485	50	348	427
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	400	748	849	622	615	125	357	297	527	54	376	464
RTOR Reduction (vph)	0	15	159	0	0	63	0	0	315	0	0	305
Lane Group Flow (vph)	400	1013	410	622	615	62	357	297	212	54	376	159
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	26.1	81.0	81.0	37.9	92.8	92.8	23.2	43.4	43.4	8.1	28.3	28.3
Effective Green, g (s)	26.1	81.0	81.0	37.9	92.8	92.8	23.2	43.4	43.4	8.1	28.3	28.3
Actuated g/C Ratio	0.14	0.43	0.43	0.20	0.50	0.50	0.12	0.23	0.23	0.04	0.15	0.15
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	481	1413	626	698	1762	788	427	824	369	77	537	240
v/s Ratio Prot	0.12	c0.31		c0.18	0.17		c0.10	0.08		0.03	c0.11	
v/s Ratio Perm			0.28			0.04			0.13			0.10
v/c Ratio	0.83	0.72	0.66	0.89	0.35	0.08	0.84	0.36	0.57	0.70	0.70	0.66
Uniform Delay, d1	78.0	43.3	41.7	72.2	28.4	24.5	79.7	59.9	63.3	88.0	75.0	74.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.7	1.8	2.5	13.6	0.5	0.2	13.3	0.3	2.2	25.0	4.1	6.7
Delay (s)	89.7	45.0	44.1	85.9	29.0	24.7	93.0	60.1	65.5	112.9	79.1	81.2
Level of Service	F	D	D	F	C	C	F	E	E	F	E	F
Approach Delay (s)		53.7			54.6			72.5			82.2	
Approach LOS		D			D			E			F	

Intersection Summary			
HCM Average Control Delay	62.7	HCM Level of Service	E
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	186.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	75.9%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road

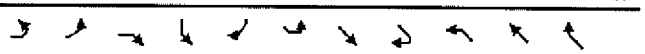
Year 2030 AM

Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97		1.00				0.95	1.00	0.97	0.95	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433		1583				3539	1583	3433	3539	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433		1583				3539	1583	3433	3539	
Volume (vph)	812	0	115	0	0	0	994	248	167	144	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	883	0	125	0	0	0	1080	270	182	157	0
RTOR Reduction (vph)	0	0	89	0	0	0	0	122	0	0	0
Lane Group Flow (vph)	883	0	36	0	0	0	1080	148	182	157	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	37.6		37.6				68.5	68.5	11.9	84.4	
Effective Green, g (s)	37.6		37.6				68.5	68.5	11.9	84.4	
Actuated g/C Ratio	0.29		0.29				0.53	0.53	0.09	0.65	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	993		458				1865	834	314	2298	
v/s Ratio Prot	c0.26		0.02				c0.31		c0.05	0.04	
v/s Ratio Perm								0.09			
v/c Ratio	0.89		0.08				0.58	0.18	0.58	0.07	
Uniform Delay, d1	44.2		33.6				20.9	16.0	56.7	8.4	
Progression Factor	1.00		1.00				1.00	1.00	0.55	0.59	
Incremental Delay, d2	9.8		0.1				1.3	0.5	2.6	0.1	
Delay (s)	54.0		33.7				22.3	16.5	33.8	5.0	
Level of Service	D		C				C	B	C	A	
Approach Delay (s)		51.5		0.0			21.1			20.4	
Approach LOS		D		A			C			C	

Intersection Summary			
HCM Average Control Delay	32.4	HCM Level of Service	C
HCM Volume to Capacity ratio	0.68		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road

Year 2030 AM



Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		1.00			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		1583			3433	3688			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		1583			3433	3688			3688	3135
Volume (vph)	51	0	247	0	0	799	1007	0	0	260	1615
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	0	249	0	0	807	1017	0	0	263	1631
RTOR Reduction (vph)	0	0	197	0	0	0	0	0	0	0	368
Lane Group Flow (vph)	52	0	52	0	0	807	1017	0	0	263	1263
Turn Type	Prot		custom			Prot					Perm
Protected Phases	4		4			1	6			2	
Permitted Phases											2
Actuated Green, G (s)	10.2		10.2			55.0	111.8			52.8	52.8
Effective Green, g (s)	10.2		10.2			55.0	111.8			52.8	52.8
Actuated g/C Ratio	0.08		0.08			0.42	0.86			0.41	0.41
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	139		124			1452	3172			1498	1273
v/s Ratio Prot	0.03		c0.03			c0.24	0.28			0.07	
v/s Ratio Perm											c0.40
v/c Ratio	0.37		0.42			0.56	0.32			0.18	0.99
Uniform Delay, d1	56.9		57.1			28.3	1.8			24.7	38.4
Progression Factor	1.00		1.00			1.13	0.90			1.00	1.00
Incremental Delay, d2	1.7		2.3			0.3	0.2			0.3	23.5
Delay (s)	58.6		59.3			32.3	1.8			24.9	61.9
Level of Service	E		E			C	A			C	E
Approach Delay (s)		59.2		0.0			15.3			56.8	
Approach LOS		E		A			B			E	

Intersection Summary			
HCM Average Control Delay	38.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	86.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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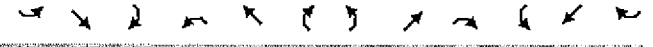
HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy — Year 2030 AM



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3539	1583
Volume (vph)	228	637	465	323	1081	209	506	102	148	56	35	288
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	248	692	505	351	1175	227	550	111	161	61	38	313
RTOR Reduction (vph)	0	0	382	0	0	167	0	0	96	0	0	244
Lane Group Flow (vph)	248	692	123	351	1175	60	550	111	65	61	38	69
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	12.1	23.6	23.6	14.1	25.6	25.6	26.0	39.0	39.0	3.9	16.9	16.9
Effective Green, g (s)	12.1	23.6	23.6	14.1	25.6	25.6	26.0	39.0	39.0	3.9	16.9	16.9
Actuated g/C Ratio	0.13	0.24	0.24	0.15	0.27	0.27	0.27	0.40	0.40	0.04	0.17	0.17
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	430	1242	387	501	1348	420	924	1429	639	139	619	277
v/s Ratio Prot	0.07	0.14		c0.10	c0.23		c0.16	0.03		0.02	0.01	
v/s Ratio Perm			0.08			0.04			0.04			c0.04
v/c Ratio	0.58	0.56	0.32	0.70	0.87	0.14	0.60	0.08	0.10	0.44	0.06	0.25
Uniform Delay, d1	39.8	31.9	29.9	39.2	33.9	27.1	30.7	17.7	17.9	45.3	33.2	34.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.9	0.5	0.5	4.4	6.5	0.2	2.8	0.1	0.3	2.2	0.2	2.1
Delay (s)	41.7	32.5	30.4	43.6	40.4	27.3	33.5	17.8	18.2	47.5	33.4	36.5
Level of Service	D	C	C	D	D	C	C	B	B	D	C	D
Approach Delay (s)		33.3			39.3			28.4			37.8	
Approach LOS		C			D			C			D	

Intersection Summary			
HCM Average Control Delay	35.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.61		
Actuated Cycle Length (s)	96.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connector — Year 2030 AM

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0				
Lane Util. Factor	0.97	0.91			0.91		0.97	0.95				
Frt	1.00	1.00			0.99		1.00	0.97				
Flt Protected	0.95	1.00			1.00		0.95	1.00				
Satd. Flow (prot)	3433	5085			5013		3433	3443				
Flt Permitted	0.95	1.00			1.00		0.95	1.00				
Satd. Flow (perm)	3433	5085			5013		3433	3443				
Volume (vph)	41	1479	0	0	761	80	134	96	21	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	45	1608	0	0	827	87	146	104	23	0	0	0
RTOR Reduction (vph)	0	0	0	0	6	0	0	21	0	0	0	0
Lane Group Flow (vph)	45	1608	0	0	908	0	146	106	0	0	0	0
Turn Type	Prot			Perm			Split					
Protected Phases	5	2			6		4	4				
Permitted Phases				6								
Actuated Green, G (s)	4.4	70.3			61.9		9.0	9.0				
Effective Green, g (s)	4.4	70.3			61.9		9.0	9.0				
Actuated g/C Ratio	0.05	0.81			0.71		0.10	0.10				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	173	4095			3554		354	355				
v/s Ratio Prot	0.01	c0.32			0.18		c0.04	0.03				
v/s Ratio Perm												
v/c Ratio	0.26	0.39			0.26		0.41	0.30				
Uniform Delay, d1	39.9	2.4			4.5		36.7	36.2				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	0.8	0.3			0.2		0.8	0.5				
Delay (s)	40.7	2.7			4.7		37.5	36.7				
Level of Service	D	A			A		D	D				
Approach Delay (s)		3.7			4.7			37.1			0.0	
Approach LOS		A			A			D			A	

Intersection Summary			
HCM Average Control Delay	7.3	HCM Level of Service	A
HCM Volume to Capacity ratio	0.39		
Actuated Cycle Length (s)	87.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	39.1%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

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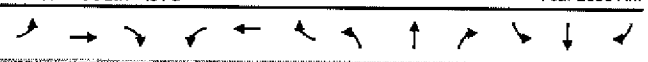
HCM Signalized Intersection Capacity Analysis
17: East-West Road & North-South Road

Year 2030 AM

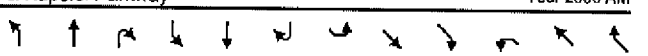


Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	0.95		0.97	0.95		0.97	0.91		0.97	0.91	
Frt	1.00	0.95		1.00	0.89		1.00	0.99		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	3356		3433	3141		3433	5011		3433	4938	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	3356		3433	3141		3433	5011		3433	4938	
Volume (vph)	205	213	112	105	59	177	207	1138	123	86	562	134
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	223	232	122	114	64	192	225	1237	134	93	611	146
RTOR Reduction (vph)	0	72	0	0	169	0	0	12	0	0	35	0
Lane Group Flow (vph)	223	282	0	114	87	0	225	1359	0	93	722	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	10.8	14.2		6.9	10.3		10.8	33.1		17.1	39.4	
Effective Green, g (s)	10.8	14.2		6.9	10.3		10.8	33.1		17.1	39.4	
Actuated g/C Ratio	0.12	0.16		0.08	0.12		0.12	0.38		0.20	0.45	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	425	546		271	371		425	1900		672	2229	
v/s Ratio Prot	c0.06	c0.08		0.03	0.03		c0.07	c0.27		0.03	c0.15	
v/s Ratio Perm												
v/c Ratio	0.52	0.52		0.42	0.23		0.53	0.72		0.14	0.32	
Uniform Delay, d1	35.8	33.4		38.3	34.9		35.9	23.1		29.0	15.4	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.2	0.8		1.1	0.3		1.2	2.3		0.4	0.4	
Delay (s)	37.0	34.2		39.4	35.2		37.1	25.4		29.4	15.8	
Level of Service	D	C		D	D		D	C		C	B	
Approach Delay (s)		35.3			36.5			27.1			17.3	
Approach LOS		D			D			C			B	

Intersection Summary				
HCM Average Control Delay	27.0	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.63			
Actuated Cycle Length (s)	87.3	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	54.6%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway

Year 2030 AM



Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.97	0.91	1.00	1.00	0.91	1.00
Frt	1.00	0.98		1.00	0.93		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	4992		1770	4735		3433	5085	1583	1770	5085	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	4992		1770	4735		3433	5085	1583	1770	5085	1583
Volume (vph)	245	463	64	33	404	342	715	315	316	118	437	290
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	266	503	70	36	439	372	777	342	343	128	475	315
RTOR Reduction (vph)	0	17	0	0	145	0	0	0	231	0	0	158
Lane Group Flow (vph)	266	556	0	36	666	0	777	342	112	128	475	157
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases									4			8
Actuated Green, G (s)	17.1	33.6		3.3	19.8		24.1	30.2	30.2	9.4	15.5	15.5
Effective Green, g (s)	17.1	33.6		3.3	19.8		24.1	30.2	30.2	9.4	15.5	15.5
Actuated g/C Ratio	0.18	0.36		0.04	0.21		0.26	0.33	0.33	0.10	0.17	0.17
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	327	1813		63	1014		894	1660	517	180	852	265
v/s Ratio Prot	c0.15	0.11		0.02	c0.14		c0.23	0.07		0.07	0.09	
v/s Ratio Perm									0.07			c0.10
v/c Ratio	0.81	0.31		0.57	0.66		0.87	0.21	0.22	0.71	0.56	0.59
Uniform Delay, d1	36.2	21.1		43.9	33.2		32.7	22.5	22.6	40.2	35.4	35.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.3	0.4		11.9	3.3		9.0	0.1	0.2	12.4	0.8	3.5
Delay (s)	50.4	21.5		55.8	36.6		41.7	22.6	22.8	52.7	36.1	39.1
Level of Service	D	C		E	D		D	C	C	D	D	D
Approach Delay (s)		30.7			37.4			32.8			39.5	
Approach LOS		C			D			C			D	

Intersection Summary				
HCM Average Control Delay	34.8	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.75			
Actuated Cycle Length (s)	92.5	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	71.2%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

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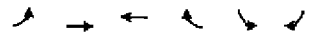

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00
Frt		1.00	0.93		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1859	1733		1770	1583
Flt Permitted		0.94	1.00		0.95	1.00
Satd. Flow (perm)		1760	1733		1770	1583
Volume (vph)	10	230	180	191	7	35
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	11	250	196	208	8	38
RTOR Reduction (vph)	0	0	63	0	0	15
Lane Group Flow (vph)	0	261	341	0	8	23
Turn Type	Perm					Perm
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)		16.5	16.5		36.3	36.3
Effective Green, g (s)		16.5	16.5		36.3	36.3
Actuated g/C Ratio		0.27	0.27		0.60	0.60
Clearance Time (s)		4.0	4.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		478	470		1057	945
v/s Ratio Prot			c0.20		0.00	
v/s Ratio Perm		0.15				c0.01
v/c Ratio		0.55	0.72		0.01	0.02
Uniform Delay, d1		18.9	20.1		5.0	5.0
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		1.3	5.5		0.0	0.0
Delay (s)		20.2	25.6		5.0	5.1
Level of Service		C	C		A	A
Approach Delay (s)		20.2	25.6		5.0	
Approach LOS		C	C		A	

Intersection Summary			
HCM Average Control Delay	22.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.24		
Actuated Cycle Length (s)	60.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	31.2%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road

Year 2030 PM

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	*0.99	1.00	*0.99	1.00		*0.99
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3504	1583	3688	1583		5532
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3504	1583	3688	1583		5532
Volume (vph)	634	41	2366	643	0	2415
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	640	41	2390	649	0	2439
RTOR Reduction (vph)	0	7	0	198	0	0
Lane Group Flow (vph)	640	34	2390	451	0	2439
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	22.0	22.0	68.1	68.1		68.1
Effective Green, g (s)	22.0	22.0	68.1	68.1		68.1
Actuated g/C Ratio	0.22	0.22	0.69	0.69		0.69
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	786	355	2560	1099		3840
v/s Ratio Prot	c0.18		c0.65			0.44
v/s Ratio Perm		0.02		0.28		
v/c Ratio	0.81	0.10	0.93	0.41		0.64
Uniform Delay, d1	36.1	30.2	13.0	6.4		8.2
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	6.5	0.1	7.8	1.1		0.8
Delay (s)	42.6	30.3	20.9	7.5		9.0
Level of Service	D	C	C	A		A
Approach Delay (s)	41.9		18.0			9.0
Approach LOS	D		B			A

Intersection Summary			
HCM Average Control Delay	17.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	98.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	90.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road

Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	0.91			0.91	
Frt						0.86	1.00	1.00			0.99	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5085			5016	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5085			5016	
Volume (vph)	0	0	0	0	0	1230	323	1779	0	0	2774	275
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	1337	351	1934	0	0	3015	299
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	11	0
Lane Group Flow (vph)	0	0	0	0	0	1337	351	1934	0	0	3303	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						100.0	22.8	100.0			69.2	
Effective Green, g (s)						100.0	22.8	100.0			69.2	
Actuated g/C Ratio						1.00	0.23	1.00			0.69	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	404	5085			3471	
v/s Ratio Prot							0.20	0.38			c0.66	
v/s Ratio Perm						c0.83						
v/c Ratio						0.83	0.87	0.38			0.95	
Uniform Delay, d1						0.0	37.2	0.0			13.9	
Progression Factor						1.00	1.08	1.00			1.00	
Incremental Delay, d2						5.1	15.8	0.2			7.6	
Delay (s)						5.1	55.0	0.2			21.5	
Level of Service						A	E	A			C	
Approach Delay (s)		0.0			5.1			8.8			21.5	
Approach LOS		A			A			A			C	

Intersection Summary			
HCM Average Control Delay	14.1	HCM Level of Service	B
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	84.3%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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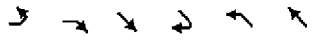
HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road

Year 2030 PM



Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.86			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	1583	6408			5085
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	1583	6408			5085
Volume (vph)	455	413	3770	0	0	2102
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	495	449	4098	0	0	2285
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	495	449	4098	0	0	2285
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	18.3	100.0	73.7			73.7
Effective Green, g (s)	18.3	100.0	73.7			73.7
Actuated g/C Ratio	0.18	1.00	0.74			0.74
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	628	1583	4723			3748
v/s Ratio Prot	c0.14		c0.64			0.45
v/s Ratio Perm		0.28				
v/c Ratio	0.79	0.28	0.87			0.61
Uniform Delay, d1	39.0	0.0	9.6			6.3
Progression Factor	1.00	1.00	0.42			1.00
Incremental Delay, d2	6.5	0.4	2.2			0.7
Delay (s)	45.5	0.4	6.2			7.0
Level of Service	D	A	A			A
Approach Delay (s)	24.1		6.2			7.0
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	6.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.3%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp

Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.91		0.97	0.91				1.00			1.00
Frt		0.97		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		4952		3433	5085				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		4952		3433	5085				1611			1611
Volume (vph)	0	483	102	622	1345	0	0	0	426	0	0	144
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	525	111	676	1462	0	0	0	463	0	0	157
RTOR Reduction (vph)	0	9	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	627	0	676	1462	0	0	0	463	0	0	157
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		90.7		31.3	130.0				130.0			130.0
Effective Green, g (s)		90.7		31.3	130.0				130.0			130.0
Actuated g/C Ratio		0.70		0.24	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		3455		827	5085				1611			1611
v/s Ratio Prot		0.13		c0.20	c0.29							
v/s Ratio Perm									0.29			0.10
v/c Ratio		0.18		0.82	0.29				0.29			0.10
Uniform Delay, d1		6.8		46.6	0.0				0.0			0.0
Progression Factor		1.00		1.29	1.00				1.00			1.00
Incremental Delay, d2		0.1		3.3	0.1				0.4			0.1
Delay (s)		6.9		63.5	0.1				0.4			0.1
Level of Service		A		E	A				A			A
Approach Delay (s)		6.9			20.1			0.4			0.1	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	14.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.42		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	36.0%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps

Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations		↑↑↑			↑↑↑				↱			
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0				4.0			
Lane Util. Factor	1.00	0.91			0.91				1.00			
Frt	1.00	1.00			0.94				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	5085			4802				1611			
Flt Permitted	0.95	1.00			1.00				1.00			
Satd. Flow (perm)	1770	5085			4802				1611			
Volume (vph)	129	780	0	0	1968	1164	0	0	428	0	0	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	140	848	0	0	2139	1265	0	0	465	0	0	0
RTOR Reduction (vph)	0	0	0	0	47	0	0	0	0	0	0	0
Lane Group Flow (vph)	140	848	0	0	3357	0	0	0	465	0	0	0
Turn Type	Prot								Free			
Protected Phases	5	2			6							
Permitted Phases									Free			
Actuated Green, G (s)	14.4	130.0			107.6				130.0			
Effective Green, g (s)	14.4	130.0			107.6				130.0			
Actuated g/C Ratio	0.11	1.00			0.83				1.00			
Clearance Time (s)	4.0	4.0			4.0							
Vehicle Extension (s)	3.0	3.0			3.0							
Lane Grp Cap (vph)	196	5085			3975				1611			
v/s Ratio Prot	c0.08	0.17			c0.70							
v/s Ratio Perm									0.29			
v/c Ratio	0.71	0.17			0.92dr				0.29			
Uniform Delay, d1	55.8	0.0			6.4				0.0			
Progression Factor	0.93	1.00			1.00				1.00			
Incremental Delay, d2	11.5	0.1			2.4				0.5			
Delay (s)	63.3	0.1			8.8				0.5			
Level of Service	E	A			A				A			
Approach Delay (s)		9.0			8.8			0.5			0.0	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	8.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.83		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	77.9%	ICU Level of Service	D
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street

Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations	↰↰	↑↑↑	↱	↰	↑↑↑	↱		↰	↱		↰↑	↱
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	1.00	*0.99	1.00		1.00	1.00		*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (prot)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (perm)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Volume (vph)	189	903	116	135	2831	515	197	29	130	243	28	99
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	191	912	117	136	2860	520	199	29	131	245	28	100
RTOR Reduction (vph)	0	0	98	0	0	167	0	0	42	0	0	87
Lane Group Flow (vph)	191	912	19	136	2860	353	0	228	89	0	273	13
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	9.0	24.7	24.7	73.3	89.0	89.0		20.0	20.0		15.0	15.0
Effective Green, g (s)	9.0	24.7	24.7	73.3	89.0	89.0		20.0	20.0		15.0	15.0
Actuated g/C Ratio	0.06	0.17	0.17	0.49	0.60	0.60		0.13	0.13		0.10	0.10
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	212	917	262	871	3304	946		240	212		355	159
v/s Ratio Prot	c0.05	c0.16		0.08	c0.52			c0.13			c0.08	
v/s Ratio Perm			0.01			0.22			0.06			0.01
v/c Ratio	0.90	0.99	0.07	0.16	0.87	0.37		0.95	0.42		1.38df	0.08
Uniform Delay, d1	69.6	62.1	52.5	20.8	25.0	15.5		64.0	59.2		65.3	60.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	35.9	28.2	0.1	0.1	2.6	0.2		46.5	6.1		9.6	0.2
Delay (s)	105.5	90.3	52.6	20.9	27.6	15.8		110.5	65.3		75.0	61.0
Level of Service	F	F	D	C	C	B		F	E		E	E
Approach Delay (s)		89.0			25.6			94.0			71.2	
Approach LOS		F			C			F			E	

Intersection Summary			
HCM Average Control Delay	47.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	149.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	90.2%	ICU Level of Service	E
Analysis Period (min)	15		

df Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

AR00028038

HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road

Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3519		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3519		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	209	37	13	40	4	180	56	2225	71	173	3239	82
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	227	40	14	43	4	196	61	2418	77	188	3521	89
RTOR Reduction (vph)	0	3	0	0	0	190	0	0	28	0	0	26
Lane Group Flow (vph)	0	278	0	43	4	6	61	2418	49	188	3521	63
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		14.4		4.0	4.0	4.0	5.0	76.0	76.0	18.0	89.0	89.0
Effective Green, g (s)		14.4		4.0	4.0	4.0	5.0	76.0	76.0	18.0	89.0	89.0
Actuated g/C Ratio		0.11		0.03	0.03	0.03	0.04	0.59	0.59	0.14	0.69	0.69
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		395		55	58	49	69	3274	937	248	3834	1097
v/s Ratio Prot		c0.08		c0.02	0.00		0.03	c0.44		0.11	c0.64	
v/s Ratio Perm						0.00			0.03			0.04
v/c Ratio		1.14dl		0.78	0.07	0.12	0.88	0.74	0.05	0.76	0.92	0.06
Uniform Delay, d1		54.9		61.8	60.4	60.5	61.4	19.0	11.0	53.1	16.6	6.3
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		5.6		50.5	0.5	1.1	69.1	1.5	0.1	12.4	4.7	0.1
Delay (s)		60.6		112.3	60.9	61.6	130.5	20.5	11.1	65.6	21.3	6.4
Level of Service		E		F	E	E	F	C	B	E	C	A
Approach Delay (s)		60.6			70.6			22.9			23.2	
Approach LOS		E			E			C			C	

Intersection Summary			
HCM Average Control Delay	26.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	128.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	94.2%	ICU Level of Service	F
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Road & Fort Weaver Road

Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.97	1.00		0.98	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1809	1583		1829	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.72	1.00		0.47	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		1339	1583		880	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	199	135	372	36	62	46	230	2104	2	135	2959	198
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	201	136	376	36	63	46	232	2125	2	136	2989	200
RTOR Reduction (vph)	0	0	0	0	0	36	0	0	0	0	0	96
Lane Group Flow (vph)	0	337	376	0	99	10	232	2125	2	136	2989	104
Turn Type	Perm		Free	Perm		Perm	Prot		Free	Prot		Perm
Protected Phases		4			6		5	2		1	6	
Permitted Phases	4		Free	8		8			Free			6
Actuated Green, G (s)		26.0	119.2		26.0	26.0	19.4	69.0	119.2	12.2	61.8	61.8
Effective Green, g (s)		26.0	119.2		26.0	26.0	19.4	69.0	119.2	12.2	61.8	61.8
Actuated g/C Ratio		0.22	1.00		0.22	0.22	0.16	0.58	1.00	0.10	0.52	0.52
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		292	1583		192	345	288	3202	1583	181	2868	821
v/s Ratio Prot							c0.13	0.38		0.08	c0.54	
v/s Ratio Perm		c0.25	0.24		0.11	0.01			0.00			0.07
v/c Ratio		1.15	0.24		0.52	0.03	0.81	0.66	0.00	0.75	1.04	0.13
Uniform Delay, d1		46.6	0.0		41.1	36.7	48.1	17.2	0.0	52.0	28.7	14.8
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		101.0	0.4		2.3	0.0	15.0	1.1	0.0	16.0	29.1	0.3
Delay (s)		147.6	0.4		43.4	36.7	63.1	18.3	0.0	68.1	57.8	15.1
Level of Service		F	A		D	D	E	B	A	E	E	B
Approach Delay (s)		70.0			41.3			22.7			55.7	
Approach LOS		E			D			C			E	

Intersection Summary			
HCM Average Control Delay	45.0	HCM Level of Service	D
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	119.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	106.6%	ICU Level of Service	G
Analysis Period (min)	15		

c Critical Lane Group

AR00028039

HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road

Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00		1.00	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	0.85		0.93		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1760	1583		1731		1770	5532	1583	1770	5532	1583
Flt Permitted	0.95	0.95	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1760	1583		1731		1770	5532	1583	1770	5532	1583
Volume (vph)	682	14	43	9	144	160	45	1671	75	425	2480	472
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	689	14	43	9	145	162	45	1688	76	429	2505	477
RTOR Reduction (vph)	0	0	0	0	25	0	0	0	9	0	0	229
Lane Group Flow (vph)	345	358	43	0	291	0	45	1688	67	429	2505	248
Turn Type	Split		Free	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free						2			6
Actuated Green, G (s)	29.0	29.0	150.0		23.0		4.0	49.0	49.0	33.0	78.0	78.0
Effective Green, g (s)	29.0	29.0	150.0		23.0		4.0	49.0	49.0	33.0	78.0	78.0
Actuated g/C Ratio	0.19	0.19	1.00		0.15		0.03	0.33	0.33	0.22	0.52	0.52
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	339	340	1583		265		47	1807	517	389	2877	823
v/s Ratio Prot	0.20	c0.20			c0.17		0.03	c0.31		c0.24	0.45	
v/s Ratio Perm			0.03						0.04			0.16
v/c Ratio	1.02	1.05	0.03		1.10		0.96	0.93	0.13	1.10	0.87	0.30
Uniform Delay, d1	60.5	60.5	0.0		63.5		72.9	48.9	35.5	58.5	31.6	20.5
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	53.5	63.4	0.0		83.6		114.0	10.4	0.5	76.3	3.9	0.9
Delay (s)	114.0	123.9	0.0		147.1		186.9	59.4	36.0	134.8	35.5	21.4
Level of Service	F	F	A		F		F	E	D	F	D	C
Approach Delay (s)		112.2			147.1			61.6			46.0	
Approach LOS		F			F			E			D	

Intersection Summary			
HCM Average Control Delay	63.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	106.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Unsignalized Intersection Capacity Analysis
10: Farrington Hwy & East Old Fort Weaver Road

Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBR	SWL	SWR
Lane Configurations										
Sign Control		Free			Free		Stop		Stop	
Grade		0%			0%		0%		0%	
Volume (veh/h)	0	540	0	0	0	0	0	0	275	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	587	0	0	0	0	0	0	299	0
Pedestrians										
Lane Width (ft)										
Walking Speed (ft/s)										
Percent Blockage										
Right turn flare (veh)										
Median type							None		None	
Median storage veh)										
Upstream signal (ft)					942					
pX, platoon unblocked										
vC, conflicting volume	0			587			736	587	587	0
vC1, stage 1 conf vol										
vC2, stage 2 conf vol										
vCu, unblocked vol	0			587			736	587	587	0
tC, single (s)	4.1			4.1			7.5	6.5	6.5	6.9
tC, 2 stage (s)										
tF (s)	2.2			2.2			3.5	4.0	4.0	3.3
p0 queue free %	100			100			100	100	29	100
cM capacity (veh/h)	1622			984			130	420	420	1084

Direction, Lane #	EB 1	EB 2	SW 1
Volume Total	293	293	299
Volume Left	0	0	0
Volume Right	0	0	0
cSH	1700	1700	420
Volume to Capacity	0.17	0.17	0.71
Queue Length 95th (ft)	0	0	136
Control Delay (s)	0.0	0.0	32.0
Lane LOS			D
Approach Delay (s)	0.0		32.0
Approach LOS			D

Intersection Summary			
Average Delay	10.8		
Intersection Capacity Utilization	36.8%	ICU Level of Service	A
Analysis Period (min)	15		

AR00028040

HCM Unsignalized Intersection Capacity Analysis
11: Farrington Hwy & West Old Fort Weaver Road — Year 2030 PM

Movement	EBT	EBR	WBL	WBT	NBL	NBR
Lane Configurations						
Sign Control	Free			Free	Stop	
Grade	0%			0%	0%	
Volume (veh/h)	535	143	0	1214	75	0
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	582	155	0	1320	82	0
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type					None	
Median storage veh)						
Upstream signal (ft)						
pX, platoon unblocked						
vC, conflicting volume			737		1319	368
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol			737		1319	368
tC, single (s)			4.1		6.8	6.9
tC, 2 stage (s)						
tF (s)			2.2		3.5	3.3
p0 queue free %			100		45	100
cM capacity (veh/h)			865		148	629

Direction, Lane #	EB 1	EB 2	WB 1	WB 2	NB 1	NB 2
Volume Total	388	349	660	660	82	0
Volume Left	0	0	0	0	82	0
Volume Right	0	155	0	0	0	0
cSH	1700	1700	1700	1700	148	1700
Volume to Capacity	0.23	0.21	0.39	0.39	0.55	0.00
Queue Length 95th (ft)	0	0	0	0	69	0
Control Delay (s)	0.0	0.0	0.0	0.0	55.4	0.0
Lane LOS					F	A
Approach Delay (s)	0.0		0.0		55.4	
Approach LOS					F	

Intersection Summary			
Average Delay	2.1		
Intersection Capacity Utilization	44.4%	ICU Level of Service	A
Analysis Period (min)	15		

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — Year 2030 PM

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	0.91	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3245	1441	3433	3539	1583	3433	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3245	1441	3433	3539	1583	3433	3539	1583	1770	3539	1583
Volume (vph)	478	463	708	355	380	37	658	390	746	157	550	448
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	520	503	770	386	413	40	715	424	811	171	598	487
RTOR Reduction (vph)	0	17	315	0	0	31	0	0	228	0	0	260
Lane Group Flow (vph)	520	687	254	386	413	9	715	424	583	171	598	227
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	31.2	48.1	48.1	23.1	40.0	40.0	41.4	67.8	67.8	20.5	46.9	46.9
Effective Green, g (s)	31.2	48.1	48.1	23.1	40.0	40.0	41.4	67.8	67.8	20.5	46.9	46.9
Actuated g/C Ratio	0.18	0.27	0.27	0.13	0.23	0.23	0.24	0.39	0.39	0.12	0.27	0.27
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	610	889	395	452	807	361	810	1367	612	207	946	423
v/s Ratio Prot	c0.15	c0.21		0.11	0.12		c0.21	0.12		0.10	0.17	
v/s Ratio Perm			0.18			0.01			c0.37			0.14
v/c Ratio	0.85	0.77	0.64	0.85	0.51	0.03	0.88	0.31	0.95	0.83	0.63	0.54
Uniform Delay, d1	69.9	58.7	56.1	74.6	59.2	52.6	64.7	37.5	52.3	75.8	56.7	55.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.1	4.2	3.6	14.5	2.3	0.1	11.2	0.1	24.9	22.8	1.4	1.3
Delay (s)	81.0	62.9	59.7	89.1	61.5	52.7	75.9	37.7	77.2	98.5	58.1	56.3
Level of Service	F	E	E	F	E	D	E	D	E	F	E	E
Approach Delay (s)		67.1			73.8			68.1			62.9	
Approach LOS		E			E			E			E	

Intersection Summary			
HCM Average Control Delay	67.5	HCM Level of Service	E
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	175.5	Sum of lost time (s)	12.0
Intersection Capacity Utilization	85.2%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road

Year 2030 PM

Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97		1.00				0.95	1.00	0.97	0.95	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433		1583				3539	1583	3433	3539	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433		1583				3539	1583	3433	3539	
Volume (vph)	1190	0	412	0	0	0	309	86	144	331	0
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	1293	0	448	0	0	0	336	93	157	360	0
RTOR Reduction (vph)	0	0	211	0	0	0	0	67	0	0	0
Lane Group Flow (vph)	1293	0	237	0	0	0	336	26	157	360	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	44.4		44.4				27.6	27.6	16.0	47.6	
Effective Green, g (s)	44.4		44.4				27.6	27.6	16.0	47.6	
Actuated g/C Ratio	0.44		0.44				0.28	0.28	0.16	0.48	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1524		703				977	437	549	1685	
v/s Ratio Prot	c0.38		0.15				c0.09		c0.05	0.10	
v/s Ratio Perm								0.02			
v/c Ratio	0.85		0.34				0.34	0.06	0.29	0.21	
Uniform Delay, d1	24.8		18.2				29.0	26.6	37.0	15.3	
Progression Factor	1.00		1.00				1.00	1.00	0.93	0.78	
Incremental Delay, d2	4.6		0.3				1.0	0.3	0.3	0.3	
Delay (s)	29.4		18.5				29.9	26.9	34.8	12.3	
Level of Service	C		B				C	C	C	B	
Approach Delay (s)		26.6		0.0			29.3			19.1	
Approach LOS		C		A			C			B	

Intersection Summary			
HCM Average Control Delay	25.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road

Year 2030 PM

Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		1.00			0.97	0.95			0.95	0.88
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		1583			3433	3539			3539	2787
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		1583			3433	3539			3539	2787
Volume (vph)	92	0	304	0	0	201	1298	0	0	383	1239
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	100	0	330	0	0	218	1411	0	0	416	1347
RTOR Reduction (vph)	0	0	59	0	0	0	0	0	0	0	532
Lane Group Flow (vph)	100	0	271	0	0	218	1411	0	0	416	815
Turn Type	Prot		custom			Prot					Perm
Protected Phases	4		4			1	6			2	
Permitted Phases											2
Actuated Green, G (s)	19.7		19.7			11.0	72.3			57.3	57.3
Effective Green, g (s)	19.7		19.7			11.0	72.3			57.3	57.3
Actuated g/C Ratio	0.20		0.20			0.11	0.72			0.57	0.57
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	3.0
Lane Grp Cap (vph)	349		312			378	2559			2028	1597
v/s Ratio Prot	0.06		c0.17			0.06	c0.40			0.12	
v/s Ratio Perm											0.29
v/c Ratio	0.29		0.87			0.58	0.55			0.21	0.51
Uniform Delay, d1	34.2		38.9			42.3	6.4			10.3	12.9
Progression Factor	1.00		1.00			1.26	0.06			1.00	1.00
Incremental Delay, d2	0.5		21.5			1.4	0.6			0.2	1.2
Delay (s)	34.8		60.4			54.5	1.0			10.6	14.1
Level of Service	C		E			D	A			B	B
Approach Delay (s)		54.4		0.0			8.1			13.2	
Approach LOS		D		A			A			B	

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.4%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy

Year 2030 PM

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	0.97	0.91	1.00	0.97	0.95	1.00	0.97	0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	5085	1583	3433	5085	1583	3433	3539	1583	3433	3539	1583
Volume (vph)	153	983	466	245	771	201	313	324	268	297	444	538
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	166	1068	507	266	838	218	340	352	291	323	483	585
RTOR Reduction (vph)	0	0	271	0	0	157	0	0	201	0	0	251
Lane Group Flow (vph)	166	1068	236	266	838	61	340	352	90	323	483	334
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	9.9	24.4	24.4	12.5	27.0	27.0	18.0	29.8	29.8	13.3	25.1	25.1
Effective Green, g (s)	9.9	24.4	24.4	12.5	27.0	27.0	18.0	29.8	29.8	13.3	25.1	25.1
Actuated g/C Ratio	0.10	0.25	0.25	0.13	0.28	0.28	0.19	0.31	0.31	0.14	0.26	0.26
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	354	1292	402	447	1430	445	644	1099	491	476	925	414
v/s Ratio Prot	0.05	c0.21		c0.08	c0.16		c0.10	0.10		c0.09	0.14	
v/s Ratio Perm			0.15			0.04			0.06			c0.21
v/c Ratio	0.47	0.83	0.59	0.60	0.59	0.14	0.53	0.32	0.18	0.68	0.52	0.81
Uniform Delay, d1	40.6	33.8	31.4	39.4	29.7	25.8	35.2	25.3	24.2	39.3	30.3	33.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.0	4.5	2.2	2.1	0.6	0.1	3.1	0.8	0.8	3.8	2.1	15.4
Delay (s)	41.6	38.3	33.6	41.5	30.3	25.9	38.3	26.1	25.0	43.1	32.4	48.6
Level of Service	D	D	C	D	C	C	D	C	C	D	C	D
Approach Delay (s)		37.2			31.8			30.0			41.7	
Approach LOS		D			C			C			D	

Intersection Summary				
HCM Average Control Delay	35.8	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.76			
Actuated Cycle Length (s)	96.0	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	67.1%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connector

Year 2030 PM

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0				
Lane Util. Factor	0.97	*0.99			*0.99		*0.99	0.95				
Frt	1.00	1.00			0.98		1.00	0.94				
Flt Protected	0.95	1.00			1.00		0.95	1.00				
Satd. Flow (prot)	3433	5532			5408		3504	3340				
Flt Permitted	0.95	1.00			1.00		0.95	1.00				
Satd. Flow (perm)	3433	5532			5408		3504	3340				
Volume (vph)	61	1021	0	0	1315	233	196	279	168	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	62	1031	0	0	1328	235	198	282	170	0	0	0
RTOR Reduction (vph)	0	0	0	0	19	0	0	98	0	0	0	0
Lane Group Flow (vph)	62	1031	0	0	1544	0	198	354	0	0	0	0
Turn Type	Prot		Perm	Perm			Split					
Protected Phases	5	2			6		4	4				
Permitted Phases			2	6								
Actuated Green, G (s)	5.9	70.0			60.1		15.4	15.4				
Effective Green, g (s)	5.9	70.0			60.1		15.4	15.4				
Actuated g/C Ratio	0.06	0.75			0.64		0.16	0.16				
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0				
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0				
Lane Grp Cap (vph)	217	4146			3480		578	551				
v/s Ratio Prot	0.02	c0.19			c0.29		0.06	c0.11				
v/s Ratio Perm												
v/c Ratio	0.29	0.25			0.44		0.34	0.64				
Uniform Delay, d1	41.7	3.6			8.3		34.5	36.4				
Progression Factor	1.00	1.00			1.00		1.00	1.00				
Incremental Delay, d2	0.7	0.1			0.4		0.4	2.6				
Delay (s)	42.5	3.7			8.7		34.9	39.0				
Level of Service	D	A			A		C	D				
Approach Delay (s)		5.9			8.7			37.7			0.0	
Approach LOS		A			A			D			A	

Intersection Summary				
HCM Average Control Delay	13.5	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.47			
Actuated Cycle Length (s)	93.4	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	50.4%	ICU Level of Service	A	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
17: East-West Rd & North-South Road

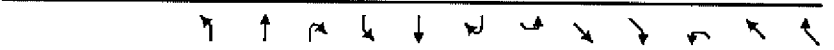
Year 2030 PM

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	0.95		0.97	0.95		0.97	0.91		0.97	0.91	
Frt	1.00	0.93		1.00	0.93		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	3303		3433	3280		3433	4983		3433	4936	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	3303		3433	3280		3433	4983		3433	4936	
Volume (vph)	249	289	232	220	172	164	110	689	104	103	1110	270
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	271	314	252	239	187	178	120	727	113	112	1207	293
RTOR Reduction (vph)	0	150	0	0	149	0	0	19	0	0	34	0
Lane Group Flow (vph)	271	416	0	239	216	0	120	821	0	112	1466	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	12.1	15.3		11.3	14.5		7.0	30.0		16.1	39.1	
Effective Green, g (s)	12.1	15.3		11.3	14.5		7.0	30.0		16.1	39.1	
Actuated g/C Ratio	0.14	0.17		0.13	0.16		0.08	0.34		0.18	0.44	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	468	570		437	536		271	1685		623	2176	
v/s Ratio Prot	c0.08	c0.13		0.07	0.07		c0.03	0.16		0.03	c0.30	
v/s Ratio Perm												
v/c Ratio	0.58	0.73		0.55	0.40		0.44	0.49		0.18	0.67	
Uniform Delay, d1	35.9	34.7		36.3	33.2		39.0	23.3		30.7	19.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.7	4.8		1.4	0.5		1.2	1.0		0.6	1.7	
Delay (s)	37.7	39.5		37.7	33.7		40.1	24.3		31.3	21.4	
Level of Service	D	D		D	C		D	C		C	C	
Approach Delay (s)		38.9			35.3			26.2			22.1	
Approach LOS		D			D			C			C	

Intersection Summary				
HCM Average Control Delay	28.6	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.62			
Actuated Cycle Length (s)	88.7	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	65.8%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway

Year 2030 PM



Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.97	0.91	1.00	1.00	0.91	1.00
Frt	1.00	0.96		1.00	0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	4896		1770	4825		3433	5085	1583	1770	5085	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	4896		1770	4825		3433	5085	1583	1770	5085	1583
Volume (vph)	378	469	155	176	914	472	385	643	505	121	568	29
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	411	510	168	191	993	513	418	699	549	132	617	32
RTOR Reduction (vph)	0	40	0	0	65	0	0	0	340	0	0	27
Lane Group Flow (vph)	411	638	0	191	1441	0	418	699	209	132	617	5
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases									4			8
Actuated Green, G (s)	34.0	62.2		19.0	47.2		19.0	25.9	25.9	12.3	19.2	19.2
Effective Green, g (s)	34.0	62.2		19.0	47.2		19.0	25.9	25.9	12.3	19.2	19.2
Actuated g/C Ratio	0.25	0.46		0.14	0.35		0.14	0.19	0.19	0.09	0.14	0.14
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	444	2249		248	1682		482	973	303	161	721	224
v/s Ratio Prot	c0.23	0.13		0.11	c0.30		c0.12	0.14		0.07	c0.12	
v/s Ratio Perm									0.13			0.00
v/c Ratio	0.93	0.28		0.77	0.86		0.87	0.72	0.69	0.82	0.86	0.02
Uniform Delay, d1	49.5	22.8		56.1	41.0		57.0	51.3	51.0	60.5	56.7	50.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	25.1	0.3		13.7	5.9		15.1	2.6	6.6	26.7	9.8	0.0
Delay (s)	74.6	23.1		69.8	46.8		72.1	53.9	57.7	87.1	66.5	50.0
Level of Service	E	C		E	D		E	D	E	F	E	D
Approach Delay (s)		42.5			49.4			59.7			69.3	
Approach LOS		D			D			E			E	

Intersection Summary				
HCM Average Control Delay	54.2	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.88			
Actuated Cycle Length (s)	135.4	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	84.5%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

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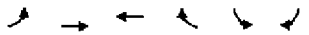

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00
Frt		1.00	0.94		1.00	0.85
Flt Protected		1.00	1.00		0.95	1.00
Satd. Flow (prot)		1856	1747		1770	1583
Flt Permitted		0.76	1.00		0.95	1.00
Satd. Flow (perm)		1424	1747		1770	1583
Volume (vph)	20	263	265	225	443	75
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	22	286	288	245	482	82
RTOR Reduction (vph)	0	0	44	0	0	37
Lane Group Flow (vph)	0	308	489	0	482	45
Turn Type	Perm					Perm
Protected Phases		4	8		6	
Permitted Phases	4					6
Actuated Green, G (s)		24.3	24.3		38.5	38.5
Effective Green, g (s)		24.3	24.3		38.5	38.5
Actuated g/C Ratio		0.34	0.34		0.54	0.54
Clearance Time (s)		4.0	4.0		4.0	4.0
Vehicle Extension (s)		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)		489	600		963	861
v/s Ratio Prot			c0.28		c0.27	
v/s Ratio Perm		0.22				0.03
v/c Ratio		0.63	0.81		0.50	0.05
Uniform Delay, d1		19.5	21.2		10.1	7.6
Progression Factor		1.00	1.00		1.00	1.00
Incremental Delay, d2		2.5	8.4		1.9	0.1
Delay (s)		22.0	29.6		12.0	7.7
Level of Service		C	C		B	A
Approach Delay (s)		22.0	29.6		11.4	
Approach LOS		C	C		B	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.62		
Actuated Cycle Length (s)	70.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	61.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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APPENDIX A-3
YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR SCENARIO

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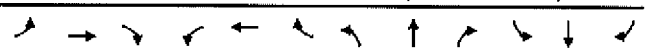
HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	0.97	1.00	0.95	1.00		0.91
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3433	1583	3539	1583		5085
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3433	1583	3539	1583		5085
Volume (vph)	718	37	1770	492	0	1301
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	725	37	1788	497	0	1314
RTOR Reduction (vph)	0	15	0	174	0	0
Lane Group Flow (vph)	725	22	1788	323	0	1314
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	25.1	25.1	61.2	61.2		61.2
Effective Green, g (s)	25.1	25.1	61.2	61.2		61.2
Actuated g/C Ratio	0.27	0.27	0.65	0.65		0.65
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	914	421	2297	1027		3300
v/s Ratio Prot	c0.21		c0.51			0.26
v/s Ratio Perm		0.01		0.20		
v/c Ratio	0.79	0.05	0.78	0.31		0.40
Uniform Delay, d1	32.2	25.8	11.7	7.3		7.8
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	4.8	0.1	2.7	0.8		0.4
Delay (s)	37.0	25.8	14.4	8.1		8.2
Level of Service	D	C	B	A		A
Approach Delay (s)	36.4		13.0			8.2
Approach LOS	D		B			A

Intersection Summary			
HCM Average Control Delay	15.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	94.3	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (with Transit Corridor) - AM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	0.91			0.91	
Frt						0.86	1.00	1.00			0.98	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5085			4960	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5085			4960	
Volume (vph)	0	0	0	0	0	530	163	1731	0	0	1685	331
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	576	177	1882	0	0	1832	360
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	15	0
Lane Group Flow (vph)	0	0	0	0	0	576	177	1882	0	0	2177	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						110.0	15.0	110.0			87.0	
Effective Green, g (s)						110.0	15.0	110.0			87.0	
Actuated g/C Ratio						1.00	0.14	1.00			0.79	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	241	5085			3923	
v/s Ratio Prot							c0.10	0.37			c0.44	
v/s Ratio Perm						0.36						
v/c Ratio						0.36	0.73	0.37			0.55	
Uniform Delay, d1						0.0	45.6	0.0			4.3	
Progression Factor						1.00	1.06	1.00			1.00	
Incremental Delay, d2						0.6	9.7	0.2			0.6	
Delay (s)						0.6	58.3	0.2			4.9	
Level of Service						A	E	A			A	
Approach Delay (s)		0.0			0.6			5.2			4.9	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	4.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	55.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.86			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	1583	6408			5085
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	1583	6408			5085
Volume (vph)	402	358	2072	0	0	1541
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	437	389	2252	0	0	1675
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	437	389	2252	0	0	1675
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	17.3	110.0	84.7			84.7
Effective Green, g (s)	17.3	110.0	84.7			84.7
Actuated g/C Ratio	0.16	1.00	0.77			0.77
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	540	1583	4934			3915
v/s Ratio Prot	c0.13		c0.35			0.33
v/s Ratio Perm		0.25				
v/c Ratio	0.81	0.25	0.46			0.43
Uniform Delay, d1	44.8	0.0	4.5			4.3
Progression Factor	1.00	1.00	0.80			1.00
Incremental Delay, d2	8.7	0.4	0.3			0.3
Delay (s)	53.5	0.4	3.9			4.7
Level of Service	D	A	A			A
Approach Delay (s)	28.5		3.9			4.7
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	8.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.91		0.97	0.91				1.00			1.00
Frt		0.98		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		5001		3433	5085				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		5001		3433	5085				1611			1611
Volume (vph)	0	1885	235	496	705	0	0	0	429	0	0	350
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	2049	255	539	766	0	0	0	466	0	0	380
RTOR Reduction (vph)	0	10	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2294	0	539	766	0	0	0	466	0	0	380
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		79.7		22.3	110.0				110.0			110.0
Effective Green, g (s)		79.7		22.3	110.0				110.0			110.0
Actuated g/C Ratio		0.72		0.20	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		3623		696	5085				1611			1611
v/s Ratio Prot		c0.46		c0.16	0.15							
v/s Ratio Perm									0.29			0.24
v/c Ratio		0.63		0.77	0.15				0.29			0.24
Uniform Delay, d1		7.7		41.5	0.0				0.0			0.0
Progression Factor		0.51		1.44	1.00				1.00			1.00
Incremental Delay, d2		0.6		1.8	0.0				0.5			0.3
Delay (s)		4.6		61.4	0.0				0.5			0.3
Level of Service		A		E	A				A			A
Approach Delay (s)		4.6			25.4			0.5			0.3	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	9.9	HCM Level of Service	A
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps

2030 + PRD (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0				4.0			
Lane Util. Factor	1.00	*0.99			*0.99				1.00			
Frt	1.00	1.00			0.95				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	5532			5266				1611			
Flt Permitted	0.95	1.00			1.00				1.00			
Satd. Flow (perm)	1770	5532			5266				1611			
Volume (vph)	928	1386	0	0	1200	567	0	0	904	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	937	1400	0	0	1212	573	0	0	913	0	0	0
RTOR Reduction (vph)	0	0	0	0	78	0	0	0	0	0	0	0
Lane Group Flow (vph)	937	1400	0	0	1707	0	0	0	913	0	0	0
Turn Type	Prot								Free			
Protected Phases	5	2			6							
Permitted Phases									Free			
Actuated Green, G (s)	67.0	110.0			35.0				110.0			
Effective Green, g (s)	67.0	110.0			35.0				110.0			
Actuated g/C Ratio	0.61	1.00			0.32				1.00			
Clearance Time (s)	4.0	4.0			4.0							
Vehicle Extension (s)	3.0	3.0			3.0							
Lane Grp Cap (vph)	1078	5532			1676				1611			
v/s Ratio Prot	c0.53	0.25			c0.32							
v/s Ratio Perm									0.57			
v/c Ratio	0.87	0.25			1.02				0.57			
Uniform Delay, d1	17.9	0.0			37.5				0.0			
Progression Factor	0.33	1.00			1.00				1.00			
Incremental Delay, d2	6.4	0.1			26.8				1.5			
Delay (s)	12.2	0.1			64.3				1.5			
Level of Service	B	A			E				A			
Approach Delay (s)		5.0			64.3			1.5			0.0	
Approach LOS		A			E			A			A	

Intersection Summary				
HCM Average Control Delay	25.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.92			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	93.9%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street

2030 + PRD (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00		1.00	1.00		0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (prot)	3433	5085	1583	1770	5085	1583		1780	1583		3424	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (perm)	3433	5085	1583	1770	5085	1583		1780	1583		3424	1583
Volume (vph)	144	1990	155	119	1601	156	56	5	48	92	45	113
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	157	2163	168	129	1740	170	61	5	52	100	49	123
RTOR Reduction (vph)	0	0	83	0	0	89	0	0	49	0	0	109
Lane Group Flow (vph)	157	2163	85	129	1740	81	0	66	3	0	149	14
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	9.4	36.5	36.5	7.0	34.1	34.1		4.0	4.0		8.4	8.4
Effective Green, g (s)	9.4	36.5	36.5	7.0	34.1	34.1		4.0	4.0		8.4	8.4
Actuated g/C Ratio	0.13	0.51	0.51	0.10	0.47	0.47		0.06	0.06		0.12	0.12
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	449	2581	804	172	2412	751		99	88		400	185
v/s Ratio Prot	0.05	c0.43		c0.07	0.34			c0.04			c0.04	
v/s Ratio Perm			0.05			0.05			0.00			0.01
v/c Ratio	0.35	0.84	0.11	0.75	0.72	0.11		0.67	0.03		0.37	0.08
Uniform Delay, d1	28.5	15.2	9.2	31.6	15.1	10.5		33.3	32.1		29.3	28.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	0.5	2.5	0.1	16.7	1.1	0.1		30.3	0.7		0.6	0.2
Delay (s)	28.9	17.7	9.3	48.3	16.2	10.5		63.6	32.8		29.9	28.5
Level of Service	C	B	A	D	B	B		E	C		C	C
Approach Delay (s)		17.8			17.8			50.0			29.3	
Approach LOS		B			B			D			C	

Intersection Summary				
HCM Average Control Delay	19.2	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.73			
Actuated Cycle Length (s)	71.9	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	56.8%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3510		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3510		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	96	24	12	71	4	234	48	3857	52	91	1306	170
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	97	24	12	72	4	236	48	3896	53	92	1319	172
RTOR Reduction (vph)	0	6	0	0	0	102	0	0	10	0	0	52
Lane Group Flow (vph)	0	127	0	72	4	134	48	3896	43	92	1319	120
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		10.6		10.0	10.0	10.0	7.4	101.0	101.0	7.9	101.5	101.5
Effective Green, g (s)		10.6		10.0	10.0	10.0	7.4	101.0	101.0	7.9	101.5	101.5
Actuated g/C Ratio		0.07		0.07	0.07	0.07	0.05	0.69	0.69	0.05	0.70	0.70
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		256		122	128	109	90	3840	1099	96	3859	1104
v/s Ratio Prot		c0.04		0.04	0.00		0.03	c0.70		c0.05	0.24	
v/s Ratio Perm						c0.08			0.03			0.08
v/c Ratio		0.50		0.59	0.03	1.23	0.53	1.01	0.04	0.96	0.34	0.11
Uniform Delay, d1		64.9		65.8	63.2	67.8	67.4	22.2	7.0	68.6	8.7	7.2
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1.5		7.4	0.1	161.9	6.0	18.3	0.1	77.4	0.2	0.2
Delay (s)		66.4		73.2	63.3	229.6	73.3	40.5	7.1	146.0	9.0	7.4
Level of Service		E		E	E	F	E	D	A	F	A	A
Approach Delay (s)		66.4			191.4			40.5			16.8	
Approach LOS		E			F			D			B	

Intersection Summary			
HCM Average Control Delay	42.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	145.5	Sum of lost time (s)	16.0
Intersection Capacity Utilization	104.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Rd & Fort Weaver Road — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1782	1583		1862	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.43	1.00		0.99	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		803	1583		1846	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	701	73	393	4	344	230	283	3028	1	20	925	444
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	708	74	397	4	347	232	286	3059	1	20	934	448
RTOR Reduction (vph)	0	0	0	0	0	37	0	0	0	0	0	286
Lane Group Flow (vph)	0	782	397	0	351	195	286	3059	1	20	934	162
Turn Type	Perm		Free	Perm		Perm	Prot		Free	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8			Free			6
Actuated Green, G (s)		75.0	149.2		75.0	75.0	27.1	59.8	149.2	2.4	35.1	35.1
Effective Green, g (s)		75.0	149.2		75.0	75.0	27.1	59.8	149.2	2.4	35.1	35.1
Actuated g/C Ratio		0.50	1.00		0.50	0.50	0.18	0.40	1.00	0.02	0.24	0.24
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		404	1583		928	796	321	2217	1583	28	1301	372
v/s Ratio Prot							c0.16	c0.55		0.01	0.17	
v/s Ratio Perm		c0.97	0.25		0.19	0.12			0.00			0.10
v/c Ratio		1.94	0.25		0.38	0.25	0.89	1.38	0.00	0.71	0.72	0.44
Uniform Delay, d1		37.1	0.0		22.8	21.0	59.6	44.7	0.0	73.1	52.5	48.6
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		430.1	0.4		0.3	0.2	25.0	173.8	0.0	60.5	3.4	3.7
Delay (s)		467.2	0.4		23.0	21.2	84.6	218.5	0.0	133.6	55.9	52.3
Level of Service		F	A		C	C	F	F	A	F	E	D
Approach Delay (s)		310.0			22.3			207.0			55.9	
Approach LOS		F			C			F			E	

Intersection Summary			
HCM Average Control Delay	176.6	HCM Level of Service	F
HCM Volume to Capacity ratio	1.69		
Actuated Cycle Length (s)	149.2	Sum of lost time (s)	12.0
Intersection Capacity Utilization	136.2%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road

2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00		1.00	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	0.85		0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1766	1583		1766		1770	5532	1583	1770	5532	1583
Flt Permitted	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1766	1583		1766		1770	5532	1583	1770	5532	1583
Volume (vph)	467	31	36	10	339	213	89	2631	1	248	1028	49
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	472	31	36	10	342	215	90	2658	1	251	1038	49
RTOR Reduction (vph)	0	0	0	0	15	0	0	0	0	0	0	27
Lane Group Flow (vph)	245	258	36	0	552	0	90	2658	1	251	1038	22
Turn Type	Split		Free	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free						2			6
Actuated Green, G (s)	20.0	20.0	150.0		33.0		12.3	65.0	65.0	16.0	68.7	68.7
Effective Green, g (s)	20.0	20.0	150.0		33.0		12.3	65.0	65.0	16.0	68.7	68.7
Actuated g/C Ratio	0.13	0.13	1.00		0.22		0.08	0.43	0.43	0.11	0.46	0.46
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	234	235	1583		389		145	2397	686	189	2534	725
v/s Ratio Prot	0.14	c0.15			c0.31		0.05	c0.48		c0.14	c0.19	
v/s Ratio Perm			0.02						0.00			0.01
v/c Ratio	1.05	1.10	0.02		1.42		0.62	1.11	0.00	1.33	0.41	0.03
Uniform Delay, d1	65.0	65.0	0.0		58.5		66.6	42.5	24.1	67.0	27.1	22.3
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	71.7	87.4	0.0		203.3		8.0	55.7	0.0	179.4	0.5	0.1
Delay (s)	136.7	152.4	0.0		261.8		74.6	98.2	24.1	246.4	27.6	22.4
Level of Service	F	F	A		F		E	F	C	F	C	C
Approach Delay (s)		135.1			261.8			97.4			68.5	
Approach LOS		F			F			F			E	

Intersection Summary				
HCM Average Control Delay	111.8	HCM Level of Service	F	
HCM Volume to Capacity ratio	1.23			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	123.0%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
10: Farrington Hwy & D Street

2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.91		0.97	0.91			0.95	0.95	0.95	0.95	
Frt	1.00	1.00		1.00	0.98			0.86	0.85	1.00	0.91	
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		3433	4982			1528	1504	1681	1607	
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085		3433	4982			1528	1504	1681	1607	
Volume (vph)	130	1588	0	270	679	106	0	17	347	178	191	304
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	131	1604	0	273	686	107	0	17	351	180	193	307
RTOR Reduction (vph)	0	0	0	0	16	0	0	161	162	0	52	0
Lane Group Flow (vph)	131	1604	0	273	777	0	0	31	14	180	448	0
Turn Type	Prot			Prot					Perm	Split		
Protected Phases	5	2		1	6			8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	12.9	45.0		9.0	41.1			8.5	8.5	31.5	31.5	
Effective Green, g (s)	12.9	45.0		9.0	41.1			8.5	8.5	31.5	31.5	
Actuated g/C Ratio	0.12	0.41		0.08	0.37			0.08	0.08	0.29	0.29	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	208	2080		281	1861			118	116	481	460	
v/s Ratio Prot	0.07	c0.32		c0.08	0.16			c0.02		0.11	c0.28	
v/s Ratio Perm									0.01			
v/c Ratio	0.63	0.77		0.97	0.42			0.26	0.12	0.37	0.97	
Uniform Delay, d1	46.3	28.1		50.4	25.6			47.8	47.3	31.4	38.8	
Progression Factor	0.99	0.50		0.55	0.33			1.00	1.00	1.00	1.00	
Incremental Delay, d2	4.9	2.4		45.4	0.7			1.2	0.5	0.5	34.9	
Delay (s)	50.8	16.5		73.3	9.1			49.0	47.7	31.9	73.8	
Level of Service	D	B		E	A			D	D	C	E	
Approach Delay (s)		19.1			25.5			48.4			62.7	
Approach LOS		B			C			D			E	

Intersection Summary				
HCM Average Control Delay	31.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.81			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	79.0%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

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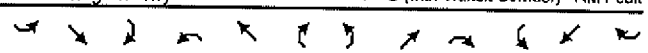
HCM Signalized Intersection Capacity Analysis
11: Farrington Hwy & E Street — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91			0.91			1.00		1.00	1.00	
Frt	1.00	1.00			1.00			1.00		1.00	0.92	
Flt Protected	0.95	1.00			1.00			0.96		0.95	1.00	
Satd. Flow (prot)	1770	5061			5065			1792		1770	1720	
Flt Permitted	0.95	1.00			1.00			0.96		0.95	1.00	
Satd. Flow (perm)	1770	5061			5065			1792		1770	1720	
Volume (vph)	49	1600	52	0	957	26	202	68	5	113	47	49
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	49	1616	53	0	967	26	204	69	5	114	47	49
RTOR Reduction (vph)	0	2	0	0	2	0	0	1	0	0	36	0
Lane Group Flow (vph)	49	1667	0	0	991	0	0	277	0	114	60	0
Turn Type	Prot						Split			Split		
Protected Phases	5	2			6		8	8		4	4	
Permitted Phases												
Actuated Green, G (s)	7.2	64.3			53.1			21.5		12.2	12.2	
Effective Green, g (s)	7.2	64.3			53.1			21.5		12.2	12.2	
Actuated g/C Ratio	0.07	0.58			0.48			0.20		0.11	0.11	
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	116	2958			2445			350		196	191	
v/s Ratio Prot	0.03	c0.33			0.20			c0.15		c0.06	0.04	
v/s Ratio Perm												
v/c Ratio	0.42	0.56			0.41			0.79		0.58	0.32	
Uniform Delay, d1	49.4	14.2			18.3			42.1		46.5	45.1	
Progression Factor	0.72	0.65			0.62			1.00		1.00	1.00	
Incremental Delay, d2	1.9	0.6			0.4			11.6		4.3	1.0	
Delay (s)	37.7	9.8			11.8			53.7		50.8	46.0	
Level of Service	D	A			B			D		D	D	
Approach Delay (s)		10.6			11.8			53.7			48.6	
Approach LOS		B			B			D			D	

Intersection Summary				
HCM Average Control Delay	17.2	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.62			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	60.5%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — 2030 + PRO (with Transit Corridor) - AM Peak



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	0.91	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3250	1441	3433	3539	1583	3433	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3250	1441	3433	3539	1583	3433	3539	1583	1770	3539	1583
Volume (vph)	377	707	798	572	578	159	338	438	485	78	739	704
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	381	714	806	578	584	161	341	442	490	79	746	711
RTOR Reduction (vph)	0	17	131	0	0	94	0	0	253	0	0	254
Lane Group Flow (vph)	381	970	402	578	584	67	341	442	237	79	746	457
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	26.7	66.7	66.7	35.9	75.9	75.9	21.4	68.4	68.4	13.6	60.6	60.6
Effective Green, g (s)	26.7	66.7	66.7	35.9	75.9	75.9	21.4	68.4	68.4	13.6	60.6	60.6
Actuated g/C Ratio	0.13	0.33	0.33	0.18	0.38	0.38	0.11	0.34	0.34	0.07	0.30	0.30
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	457	1081	479	614	1339	599	366	1207	540	120	1069	478
v/s Ratio Prot	0.11	c0.30		c0.17	0.17		c0.10	0.12		0.04	0.21	
v/s Ratio Perm			0.28			0.04			0.15			c0.29
v/c Ratio	0.83	0.90	0.84	0.94	0.44	0.11	0.93	0.37	0.44	0.66	0.70	0.96
Uniform Delay, d1	84.8	63.7	62.0	81.3	46.4	40.5	88.9	49.8	51.2	91.2	61.9	68.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.3	9.9	12.2	22.8	1.0	0.4	30.1	0.2	0.6	12.3	2.0	30.0
Delay (s)	97.1	73.5	74.2	104.1	47.5	40.8	119.0	50.0	51.8	103.5	63.9	98.6
Level of Service	F	E	E	F	D	D	F	D	D	F	E	F
Approach Delay (s)		78.5			71.4			69.2			82.0	
Approach LOS		E			E			E			F	

Intersection Summary				
HCM Average Control Delay	75.9	HCM Level of Service	E	
HCM Volume to Capacity ratio	0.93			
Actuated Cycle Length (s)	200.6	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	87.8%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99		1.00				*0.99	1.00	0.97	*0.99	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504		1583				3688	1583	3433	3688	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504		1583				3688	1583	3433	3688	
Volume (vph)	1338	0	115	0	0	0	1099	248	518	222	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1352	0	116	0	0	0	1110	251	523	224	0
RTOR Reduction (vph)	0	0	71	0	0	0	0	168	0	0	0
Lane Group Flow (vph)	1352	0	45	0	0	0	1110	83	523	224	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	39.0		39.0				33.0	33.0	16.0	53.0	
Effective Green, g (s)	39.0		39.0				33.0	33.0	16.0	53.0	
Actuated g/C Ratio	0.39		0.39				0.33	0.33	0.16	0.53	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1367		617				1217	522	549	1955	
v/s Ratio Prot	c0.39		0.03				c0.30		c0.15	0.06	
v/s Ratio Perm								0.05			
v/c Ratio	0.99		0.07				0.91	0.16	0.95	0.11	
Uniform Delay, d1	30.3		19.2				32.1	23.7	41.6	11.8	
Progression Factor	1.00		1.00				1.00	1.00	0.62	0.04	
Incremental Delay, d2	21.5		0.1				11.8	0.6	22.9	0.1	
Delay (s)	51.8		19.2				43.9	24.3	48.9	0.6	
Level of Service	D		B				D	C	D	A	
Approach Delay (s)		49.2		0.0			40.3			34.4	
Approach LOS		D		A			D			C	

Intersection Summary			
HCM Average Control Delay	42.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	91.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		1.00			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		1583			3433	3688			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		1583			3433	3688			3688	3135
Volume (vph)	51	0	633	0	0	802	1634	0	0	689	2305
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	0	639	0	0	810	1651	0	0	696	2328
RTOR Reduction (vph)	0	0	23	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	52	0	616	0	0	810	1651	0	0	696	2328
Turn Type	Prot		custom			Prot					Free
Protected Phases	4		4			1	6			2	
Permitted Phases											Free
Actuated Green, G (s)	29.0		29.0			30.4	63.0			28.6	100.0
Effective Green, g (s)	29.0		29.0			30.4	63.0			28.6	100.0
Actuated g/C Ratio	0.29		0.29			0.30	0.63			0.29	1.00
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	513		459			1044	2323			1055	3135
v/s Ratio Prot	0.03		c0.39			0.24	0.45			0.19	
v/s Ratio Perm											c0.74
v/c Ratio	0.10		1.34			0.78	0.71			0.66	0.74
Uniform Delay, d1	26.0		35.5			31.7	12.4			31.4	0.0
Progression Factor	1.00		1.00			1.15	0.90			1.00	1.00
Incremental Delay, d2	0.1		168.3			1.2	0.6			3.2	1.6
Delay (s)	26.1		203.8			37.7	11.7			34.7	1.6
Level of Service	C		F			D	B			C	A
Approach Delay (s)		190.4		0.0			20.3			9.2	
Approach LOS		F		A			C			A	

Intersection Summary			
HCM Average Control Delay	33.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	91.0%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	5532	1583	3504	5532	1583	3504	3688	1583	3504	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	5532	1583	3504	5532	1583	3504	3688	1583	3504	3688	1583
Volume (vph)	514	1147	563	459	1739	344	542	393	224	172	483	713
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	519	1159	569	464	1757	347	547	397	226	174	488	720
RTOR Reduction (vph)	0	0	224	0	0	154	0	0	150	0	0	227
Lane Group Flow (vph)	519	1159	345	464	1757	193	547	397	76	174	488	493
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	25.3	47.1	47.1	23.2	45.0	45.0	26.0	49.9	49.9	12.2	36.1	36.1
Effective Green, g (s)	25.3	47.1	47.1	23.2	45.0	45.0	26.0	49.9	49.9	12.2	36.1	36.1
Actuated g/C Ratio	0.17	0.32	0.32	0.16	0.30	0.30	0.18	0.34	0.34	0.08	0.24	0.24
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	597	1756	502	548	1677	480	614	1240	532	288	897	385
v/s Ratio Prot	c0.15	0.21		0.13	c0.32		c0.16	0.11		0.05	0.13	
v/s Ratio Perm			0.22			0.12			0.05			c0.31
v/c Ratio	0.87	0.66	0.69	0.85	1.05	0.40	0.89	0.32	0.14	0.60	0.54	1.28
Uniform Delay, d1	59.9	43.7	44.2	60.9	51.7	41.0	59.8	36.6	34.3	65.8	49.0	56.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.8	0.9	3.9	11.6	35.7	0.6	17.6	0.7	0.6	3.6	2.4	144.8
Delay (s)	72.7	44.7	48.1	72.4	87.4	41.6	77.4	37.3	34.9	69.3	51.3	201.0
Level of Service	E	D	D	E	F	D	E	D	C	E	D	F
Approach Delay (s)		52.0			78.5			55.6			131.6	
Approach LOS		D			E			E			F	

Intersection Summary			
HCM Average Control Delay	76.7	HCM Level of Service	E
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	148.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	103.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connector — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	0.86	0.86	0.97	0.91		0.97	0.95		0.97	1.00	0.88
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	4806	1362	3433	4987		3433	3461		3433	1863	2787
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	4806	1362	3433	4987		3433	3461		3433	1863	2787
Volume (vph)	51	2024	224	471	934	138	217	161	28	353	103	300
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	2044	226	476	943	139	219	163	28	357	104	303
RTOR Reduction (vph)	0	0	105	0	14	0	0	15	0	0	0	70
Lane Group Flow (vph)	52	2044	121	476	1068	0	219	176	0	357	104	233
Turn Type	Prot		Perm	Prot			Prot			Prot		pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2									8
Actuated Green, G (s)	4.4	39.8	39.8	14.0	49.4		14.0	11.2		13.1	10.3	24.3
Effective Green, g (s)	4.4	39.8	39.8	14.0	49.4		14.0	11.2		13.1	10.3	24.3
Actuated g/C Ratio	0.05	0.42	0.42	0.15	0.52		0.15	0.12		0.14	0.11	0.26
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	161	2033	576	511	2618		511	412		478	204	838
v/s Ratio Prot	0.02	c0.43		c0.14	0.21		0.06	0.05		c0.10	c0.06	0.04
v/s Ratio Perm			0.09									0.04
v/c Ratio	0.32	1.01	0.21	0.93	0.41		0.43	0.43		0.75	0.51	0.28
Uniform Delay, d1	43.4	27.2	17.2	39.6	13.5		36.4	36.5		36.9	39.5	27.9
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	1.2	21.3	0.8	23.9	0.5		0.6	0.7		6.3	2.0	0.2
Delay (s)	44.6	48.4	18.0	63.5	14.0		37.0	39.2		45.2	41.5	28.1
Level of Service	D	D	B	E	B		D	D		D	D	C
Approach Delay (s)		45.4			29.1			38.0			37.9	
Approach LOS		D			C			D			D	

Intersection Summary			
HCM Average Control Delay	38.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	94.1	Sum of lost time (s)	16.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
17: East-West Rd. & North-South Road

2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	0.97	0.95		0.97	0.95		0.97	0.91		0.97	0.91	
Frt	1.00	0.95		1.00	0.87		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3433	3362		3433	3066		3433	4990		3433	4969	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3433	3362		3433	3066		3433	4990		3433	4969	
Volume (vph)	243	224	112	239	75	614	207	1442	206	189	954	172
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	245	226	113	241	76	620	209	1457	208	191	964	174
RTOR Reduction (vph)	0	54	0	0	206	0	0	17	0	0	21	0
Lane Group Flow (vph)	245	285	0	241	490	0	209	1648	0	191	1117	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	12.4	20.5		12.2	20.3		11.2	37.2		16.1	42.1	
Effective Green, g (s)	12.4	20.5		12.2	20.3		11.2	37.2		16.1	42.1	
Actuated g/C Ratio	0.12	0.20		0.12	0.20		0.11	0.36		0.16	0.41	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	417	676		411	610		377	1820		542	2051	
v/s Ratio Prot	c0.07	0.08		0.07	c0.16		c0.06	c0.33		0.06	c0.22	
v/s Ratio Perm												
v/c Ratio	0.59	0.42		0.59	1.19dr		0.55	0.91		0.35	0.54	
Uniform Delay, d1	42.4	35.6		42.5	38.9		43.0	30.7		38.3	22.7	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.1	0.4		2.1	7.6		1.8	8.0		1.8	1.0	
Delay (s)	44.5	36.0		44.6	46.5		44.8	38.7		40.1	23.7	
Level of Service	D	D		D	D		D	D		D	C	
Approach Delay (s)		39.6			46.0			39.4			26.1	
Approach LOS		D			D			D			C	

Intersection Summary				
HCM Average Control Delay	37.0	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.79			
Actuated Cycle Length (s)	102.0	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	80.1%	ICU Level of Service	D	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway

2030 + PRO (with Transit Corridor) - AM Peak

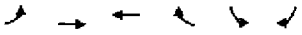
Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99		1.00	*0.99		*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.98		1.00	0.92		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5440		1770	5082		3504	5532	1583	1770	5532	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5440		1770	5082		3504	5532	1583	1770	5532	1583
Volume (vph)	245	517	64	222	496	588	855	315	316	118	637	483
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	247	522	65	224	501	594	864	318	319	119	643	488
RTOR Reduction (vph)	0	17	0	0	211	0	0	0	195	0	0	249
Lane Group Flow (vph)	247	570	0	224	884	0	864	318	124	119	643	239
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases									4			8
Actuated Green, G (s)	15.2	17.8		14.6	17.2		26.4	36.7	36.7	9.4	19.7	19.7
Effective Green, g (s)	15.2	17.8		14.6	17.2		26.4	36.7	36.7	9.4	19.7	19.7
Actuated g/C Ratio	0.16	0.19		0.15	0.18		0.28	0.39	0.39	0.10	0.21	0.21
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	285	1025		273	925		979	2148	615	176	1153	330
v/s Ratio Prot	c0.14	0.10		0.13	c0.17		c0.25	0.06		0.07	0.12	
v/s Ratio Perm									0.08			c0.15
v/c Ratio	0.87	0.56		0.82	1.19dr		0.88	0.15	0.20	0.68	0.56	0.73
Uniform Delay, d1	38.7	34.8		38.7	38.3		32.6	18.8	19.2	41.1	33.5	34.9
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.0	2.2		17.6	20.6		9.5	0.0	0.2	9.8	0.6	7.7
Delay (s)	61.7	36.9		56.3	58.9		42.0	18.8	19.3	50.9	34.1	42.6
Level of Service	E	D		E	E		D	B	B	D	C	D
Approach Delay (s)		44.3			58.5			32.3			39.0	
Approach LOS		D			E			C			D	

Intersection Summary				
HCM Average Control Delay	43.1	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.86			
Actuated Cycle Length (s)	94.5	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	86.4%	ICU Level of Service	E	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

AR00028055

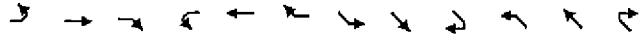
HCM Signalized Intersection Capacity Analysis
19: East-West Rd. & Old Fort Weaver Rd — 2030 + PRO (with Transit Corridor) - AM Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	3539	1583	3433	1583
Flt Permitted	0.58	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1080	1863	3539	1583	3433	1583
Volume (vph)	21	765	277	795	402	45
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	21	773	280	803	406	45
RTOR Reduction (vph)	0	0	0	407	0	28
Lane Group Flow (vph)	21	773	280	396	406	17
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Actuated Green, G (s)	29.8	29.8	29.8	29.8	22.7	22.7
Effective Green, g (s)	29.8	29.8	29.8	29.8	22.7	22.7
Actuated g/C Ratio	0.49	0.49	0.49	0.49	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	532	918	1743	780	1288	594
v/s Ratio Prot		c0.41	0.08		c0.12	
v/s Ratio Perm	0.02			0.25		0.01
v/c Ratio	0.04	0.84	0.16	0.51	0.32	0.03
Uniform Delay, d1	7.9	13.3	8.5	10.4	13.4	11.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	7.1	0.0	0.5	0.6	0.1
Delay (s)	8.0	20.4	8.5	10.9	14.0	12.0
Level of Service	A	C	A	B	B	B
Approach Delay (s)		20.1	10.3		13.8	
Approach LOS		C	B		B	

Intersection Summary				
HCM Average Control Delay	14.3	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.61			
Actuated Cycle Length (s)	60.5	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	59.2%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
20: Farrington Hwy & B Street — 2030 + PRO (with Transit Corridor) - AM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	1770	1863	1583	3433	1863	1583
Volume (vph)	206	1094	186	119	866	83	47	137	121	331	223	198
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	224	1189	202	129	941	90	51	149	132	360	242	215
RTOR Reduction (vph)	0	0	94	0	0	58	0	0	14	0	0	63
Lane Group Flow (vph)	224	1189	108	129	941	32	51	149	118	360	242	152
Turn Type	Prot		pm+ov	Prot		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6		7	4	5	3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	11.2	35.9	49.1	8.4	33.1	33.1	4.4	18.2	29.4	13.2	27.0	35.4
Effective Green, g (s)	11.2	35.9	49.1	8.4	33.1	33.1	4.4	18.2	29.4	13.2	27.0	35.4
Actuated g/C Ratio	0.12	0.39	0.54	0.09	0.36	0.36	0.05	0.20	0.32	0.14	0.29	0.39
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	419	1385	917	314	1277	571	85	370	577	494	549	680
v/s Ratio Prot	c0.07	c0.34	0.02	0.04	0.27		0.03	0.08	0.02	c0.10	c0.13	0.02
v/s Ratio Perm			0.05			0.02			0.05			0.08
v/c Ratio	0.53	0.86	0.12	0.41	0.74	0.06	0.60	0.40	0.20	0.73	0.44	0.22
Uniform Delay, d1	37.8	25.6	10.6	39.3	25.5	19.1	42.8	32.0	22.6	37.5	26.2	18.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	5.5	0.1	0.9	2.3	0.0	11.4	3.2	0.2	5.3	2.6	0.2
Delay (s)	39.1	31.1	10.6	40.2	27.8	19.2	54.1	35.3	22.8	42.9	28.8	19.1
Level of Service	D	C	B	D	C	B	D	D	C	D	C	B
Approach Delay (s)		29.6			28.5			33.2			32.4	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM Average Control Delay	30.2	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.69			
Actuated Cycle Length (s)	91.7	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	63.6%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028056

HCM Signalized Intersection Capacity Analysis
21: East-West Rd. & A Street — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.85		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1842		1770	1863	1583	1770	1591		1770	1630	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1842		1770	1863	1583	1770	1591		1770	1630	
Volume (vph)	86	324	26	31	625	27	26	4	135	43	7	37
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	93	352	28	34	679	29	28	4	147	47	8	40
RTOR Reduction (vph)	0	2	0	0	0	14	0	132	0	0	36	0
Lane Group Flow (vph)	93	378	0	34	679	15	28	19	0	47	12	0
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6						
Actuated Green, G (s)	7.3	39.6		2.1	34.4	34.4	7.5	7.5		7.6	7.6	
Effective Green, g (s)	7.3	39.6		2.1	34.4	34.4	7.5	7.5		7.6	7.6	
Actuated g/C Ratio	0.10	0.54		0.03	0.47	0.47	0.10	0.10		0.10	0.10	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	177	1002		51	880	748	182	164		185	170	
v/s Ratio Prot	c0.05	0.21		0.02	c0.36		c0.02	0.01		c0.03	0.01	
v/s Ratio Perm						0.01						
v/c Ratio	0.53	0.38		0.67	0.77	0.02	0.15	0.12		0.25	0.07	
Uniform Delay, d1	31.1	9.5		35.0	15.9	10.2	29.8	29.6		30.0	29.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.8	0.2		28.3	4.2	0.0	0.4	0.3		0.7	0.2	
Delay (s)	33.9	9.8		63.3	20.2	10.2	30.2	30.0		30.7	29.6	
Level of Service	C	A		E	C	B	C	C		C	C	
Approach Delay (s)		14.5			21.8			30.0			30.2	
Approach LOS		B			C			C			C	

Intersection Summary				
HCM Average Control Delay	21.0	HCM Level of Service		C
HCM Volume to Capacity ratio	0.59			
Actuated Cycle Length (s)	72.8	Sum of lost time (s)		16.0
Intersection Capacity Utilization	62.9%	ICU Level of Service		B
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
22: Farrington Hwy & 2nd Avenue — 2030 + PRO (with Transit Corridor) - AM Peak

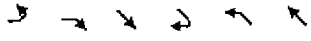
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		0.97	0.95	1.00	1.00	0.95	0.88	0.97	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5043		3433	3539	1583	1770	3539	2787	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5043		3433	3539	1583	1770	3539	2787	3433	3539	1583
Volume (vph)	166	1029	61	223	746	239	95	391	446	225	259	133
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	180	1118	66	242	811	260	103	425	485	245	282	145
RTOR Reduction (vph)	0	6	0	0	0	188	0	0	20	0	0	96
Lane Group Flow (vph)	180	1178	0	242	811	72	103	425	465	245	282	49
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		Perm
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases						6			8			4
Actuated Green, G (s)	15.7	34.0		12.0	30.3	30.3	10.5	36.0	48.0	12.0	37.5	37.5
Effective Green, g (s)	15.7	34.0		12.0	30.3	30.3	10.5	36.0	48.0	12.0	37.5	37.5
Actuated g/C Ratio	0.14	0.31		0.11	0.28	0.28	0.10	0.33	0.44	0.11	0.34	0.34
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	253	1559		375	975	436	169	1158	1317	375	1206	540
v/s Ratio Prot	0.10	c0.23		0.07	c0.23		c0.06	c0.12	0.04	c0.07	0.08	
v/s Ratio Perm						0.05			0.13			0.03
v/c Ratio	0.71	0.76		0.65	0.83	0.16	0.61	0.37	0.35	0.65	0.23	0.09
Uniform Delay, d1	45.0	34.3		47.0	37.5	30.2	47.8	28.3	20.7	47.0	26.0	24.7
Progression Factor	1.00	1.00		0.72	0.65	0.35	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	9.1	3.5		3.5	7.6	0.7	6.1	0.9	0.2	4.1	0.5	0.3
Delay (s)	54.1	37.7		37.2	32.0	11.3	53.9	29.2	20.8	51.1	26.4	25.0
Level of Service	D	D		D	C	B	D	C	C	D	C	C
Approach Delay (s)		39.9			28.9			27.7			35.1	
Approach LOS		D			C			C			D	

Intersection Summary				
HCM Average Control Delay	33.0	HCM Level of Service		C
HCM Volume to Capacity ratio	0.65			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)		16.0
Intersection Capacity Utilization	60.4%	ICU Level of Service		B
Analysis Period (min)	15			
c Critical Lane Group				

AR00028057

HCM Unsignalized Intersection Capacity Analysis
23: 2nd Avenue & Kunia Road

2030 + PRO (with Transit Corridor) - AM Peak



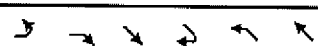
Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations			↑↑↑↱			↑↑↑↑
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	1679	234	0	4777
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	1825	254	0	5192
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			870			
pX, platoon unblocked						
vC, conflicting volume	3250	583			2079	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3250	583			2079	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	7	455			263	

Direction, Lane #	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	521	521	521	515	1298	1298	1298	1298
Volume Left	0	0	0	0	0	0	0	0
Volume Right	0	0	0	254	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.31	0.31	0.31	0.30	0.76	0.76	0.76	0.76
Queue Length 95th (ft)	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS								
Approach Delay (s)	0.0				0.0			
Approach LOS								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
24: 3rd Avenue & Kunia Road

2030 + PRO (with Transit Corridor) - AM Peak



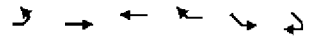
Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations		↱	↑↑↑↱			↑↑↑↑
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	7	1593	86	0	4777
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	8	1732	93	0	5192
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			1234			
pX, platoon unblocked						
vC, conflicting volume	3076	480			1825	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3076	480			1825	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			100	
cM capacity (veh/h)	9	532			331	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	8	495	495	495	341	1298	1298	1298	1298
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	8	0	0	0	93	0	0	0	0
cSH	532	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.01	0.29	0.29	0.29	0.20	0.76	0.76	0.76	0.76
Queue Length 95th (ft)	1	0	0	0	0	0	0	0	0
Control Delay (s)	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B								
Approach Delay (s)	11.9	0.0				0.0			
Approach LOS	B								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		

AR00028058

HCM Signalized Intersection Capacity Analysis
25: East-West Rd. & B Street — 2030 + PRO (with Transit Corridor) - AM Peak



Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Volume (vph)	153	234	314	85	643	369
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	166	254	341	92	699	401
RTOR Reduction (vph)	0	0	0	68	0	179
Lane Group Flow (vph)	166	254	341	24	699	222
Turn Type	Prot			Prot		Prot
Protected Phases	5	2	6	6	4	4
Permitted Phases						
Actuated Green, G (s)	9.5	30.4	16.9	16.9	27.6	27.6
Effective Green, g (s)	9.5	30.4	16.9	16.9	27.6	27.6
Actuated g/C Ratio	0.14	0.46	0.26	0.26	0.42	0.42
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	255	858	477	405	740	662
v/s Ratio Prot	c0.09	0.14	c0.18	0.01	c0.40	0.14
v/s Ratio Perm						
v/c Ratio	0.65	0.30	0.71	0.06	0.94	0.34
Uniform Delay, d1	26.7	11.1	22.4	18.5	18.5	13.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.8	0.2	5.0	0.1	22.0	1.4
Delay (s)	32.5	11.3	27.4	18.6	40.5	14.4
Level of Service	C	B	C	B	D	B
Approach Delay (s)		19.7	25.5		31.0	
Approach LOS		B	C		C	

Intersection Summary			
HCM Average Control Delay	27.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.82		
Actuated Cycle Length (s)	66.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
26: Farrington Hwy & — 2030 + PRO (with Transit Corridor) - AM Peak

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3688	3688	1583
Flt Permitted	0.95	1.00	0.25	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	466	3688	3688	1583
Volume (vph)	100	233	46	1060	1373	132
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	101	235	46	1071	1387	133
RTOR Reduction (vph)	0	5	0	0	0	80
Lane Group Flow (vph)	101	230	46	1071	1387	53
Turn Type		Perm	Perm			Perm
Protected Phases	6			4	8	
Permitted Phases		6	4			8
Actuated Green, G (s)	16.0	16.0	16.0	16.0	16.0	16.0
Effective Green, g (s)	16.0	16.0	16.0	16.0	16.0	16.0
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Grp Cap (vph)	708	633	186	1475	1475	633
v/s Ratio Prot	0.06			0.29	c0.38	
v/s Ratio Perm		c0.15	0.10			0.03
v/c Ratio	0.14	0.36	0.25	0.73	0.94	0.08
Uniform Delay, d1	7.6	8.4	8.0	10.1	11.5	7.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.4	1.6	3.2	3.2	13.0	0.3
Delay (s)	8.1	10.0	11.1	13.3	24.5	7.7
Level of Service	A	B	B	B	C	A
Approach Delay (s)	9.4			13.2	23.0	
Approach LOS	A			B	C	

Intersection Summary			
HCM Average Control Delay	17.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

AR00028059

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	*0.99	1.00	*0.99	1.00		*0.99
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3504	1583	3688	1583		5532
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3504	1583	3688	1583		5532
Volume (vph)	882	41	2658	907	0	2752
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	891	41	2685	916	0	2780
RTOR Reduction (vph)	0	4	0	206	0	0
Lane Group Flow (vph)	891	37	2685	710	0	2780
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	31.0	31.0	91.0	91.0		91.0
Effective Green, g (s)	31.0	31.0	91.0	91.0		91.0
Actuated g/C Ratio	0.24	0.24	0.70	0.70		0.70
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	836	377	2582	1108		3872
v/s Ratio Prot	c0.25		c0.73			0.50
v/s Ratio Perm		0.02		0.45		
v/c Ratio	1.07	0.10	1.04	0.64		0.72
Uniform Delay, d1	49.5	38.6	19.5	10.6		11.8
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	50.2	0.1	29.1	2.9		1.2
Delay (s)	99.7	38.7	48.6	13.5		12.9
Level of Service	F	D	D	B		B
Approach Delay (s)	97.0		39.7			12.9
Approach LOS	F		D			B

Intersection Summary			
HCM Average Control Delay	36.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	105.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	*0.99			*0.99	
Frt						0.86	1.00	1.00			0.99	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5532			5455	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5532			5455	
Volume (vph)	0	0	0	0	0	1230	423	2335	0	0	3295	339
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	0	0	0	0	1242	427	2359	0	0	3328	342
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	20	0
Lane Group Flow (vph)	0	0	0	0	0	1242	427	2359	0	0	3650	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						70.0	15.0	70.0			47.0	
Effective Green, g (s)						70.0	15.0	70.0			47.0	
Actuated g/C Ratio						1.00	0.21	1.00			0.67	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	379	5532			3663	
v/s Ratio Prot							c0.24	0.43			c0.67	
v/s Ratio Perm						0.77						
v/c Ratio						0.77	1.13	0.43			1.00	
Uniform Delay, d1						0.0	27.5	0.0			11.4	
Progression Factor						1.00	0.90	1.00			1.00	
Incremental Delay, d2						3.6	79.1	0.2			14.1	
Delay (s)						3.6	103.8	0.2			25.5	
Level of Service						A	F	A			C	
Approach Delay (s)	0.0			3.6				16.1			25.5	
Approach LOS	A			A				B			C	

Intersection Summary			
HCM Average Control Delay	18.6	HCM Level of Service	B
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

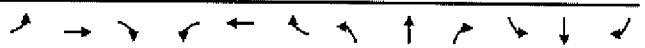
AR00028060

HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	*0.99	1.00	*0.99			*0.99
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3504	1583	7376			5532
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3504	1583	7376			5532
Volume (vph)	527	578	4322	0	0	2231
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	573	628	4698	0	0	2425
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	573	628	4698	0	0	2425
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	16.0	70.0	46.0			46.0
Effective Green, g (s)	16.0	70.0	46.0			46.0
Actuated g/C Ratio	0.23	1.00	0.66			0.66
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	801	1583	4847			3635
v/s Ratio Prot	c0.16		c0.64			0.44
v/s Ratio Perm		0.40				
v/c Ratio	0.72	0.40	0.97			0.67
Uniform Delay, d1	24.9	0.0	11.3			7.3
Progression Factor	1.00	1.00	0.49			1.00
Incremental Delay, d2	3.1	0.7	6.7			1.0
Delay (s)	28.0	0.7	12.2			8.3
Level of Service	C	A	B			A
Approach Delay (s)	13.7		12.2			8.3
Approach LOS	B		B			A

Intersection Summary			
HCM Average Control Delay	11.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	130.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp — 2030 + PRO (With Transit Corridor) - PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.91		0.97	0.91				1.00			1.00
Frt		0.97		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		4947		3433	5085				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		4947		3433	5085				1611			1611
Volume (vph)	0	1884	416	774	1938	0	0	0	439	0	0	729
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	2048	452	841	2107	0	0	0	477	0	0	792
RTOR Reduction (vph)	0	19	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2481	0	841	2107	0	0	0	477	0	0	792
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		81.8		40.2	130.0				130.0			130.0
Effective Green, g (s)		81.8		40.2	130.0				130.0			130.0
Actuated g/C Ratio		0.63		0.31	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		3113		1062	5085				1611			1611
v/s Ratio Prot		c0.50		c0.24	0.41							
v/s Ratio Perm									0.30			0.49
v/c Ratio		0.80		0.79	0.41				0.30			0.49
Uniform Delay, d1		17.9		41.1	0.0				0.0			0.0
Progression Factor		0.22		1.53	1.00				1.00			1.00
Incremental Delay, d2		1.4		0.4	0.0				0.5			1.1
Delay (s)		5.3		63.0	0.0				0.5			1.1
Level of Service		A		E	A				A			A
Approach Delay (s)		5.3			18.0			0.5			1.1	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM Average Control Delay	10.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

AR00028061

HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps

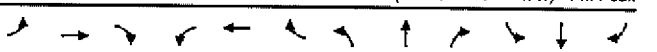
2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0				4.0			
Lane Util. Factor	1.00	*0.99			*0.99				1.00			
Frt	1.00	1.00			0.95				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	5532			5283				1611			
Flt Permitted	0.95	1.00			1.00				1.00			
Satd. Flow (perm)	1770	5532			5283				1611			
Volume (vph)	1027	1297	0	0	2713	1164	0	0	638	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1037	1310	0	0	2740	1176	0	0	644	0	0	0
RTOR Reduction (vph)	0	0	0	0	14	0	0	0	0	0	0	0
Lane Group Flow (vph)	1037	1310	0	0	3902	0	0	0	644	0	0	0
Turn Type	Prot								Free			
Protected Phases	5	2			6							
Permitted Phases									Free			
Actuated Green, G (s)	51.0	130.0			71.0				130.0			
Effective Green, g (s)	51.0	130.0			71.0				130.0			
Actuated g/C Ratio	0.39	1.00			0.55				1.00			
Clearance Time (s)	4.0	4.0			4.0							
Vehicle Extension (s)	3.0	3.0			3.0							
Lane Grp Cap (vph)	694	5532			2885				1611			
v/s Ratio Prot	c0.59	0.24			c0.74							
v/s Ratio Perm									0.40			
v/c Ratio	1.49	0.24			1.35				0.40			
Uniform Delay, d1	39.5	0.0			29.5				0.0			
Progression Factor	0.50	1.00			0.41				1.00			
Incremental Delay, d2	227.7	0.1			158.8				0.7			
Delay (s)	247.4	0.1			171.1				0.7			
Level of Service	F	A			F				A			
Approach Delay (s)		109.4			171.1			0.7			0.0	
Approach LOS		F			F			A			A	

Intersection Summary			
HCM Average Control Delay	134.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.41		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	142.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street

2030 + PRO (With Transit Corridor) - PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	1.00	*0.99	1.00		1.00	1.00		*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.95	1.00
Satd. Flow (prot)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (perm)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Volume (vph)	282	1537	116	135	3481	515	197	29	130	243	28	194
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	285	1553	117	136	3516	520	199	29	131	245	28	196
RTOR Reduction (vph)	0	0	56	0	0	158	0	0	47	0	0	106
Lane Group Flow (vph)	285	1553	61	136	3516	362	0	228	84	0	273	90
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	10.6	67.6	67.6	18.0	75.0	75.0		14.0	14.0		14.4	14.4
Effective Green, g (s)	10.6	67.6	67.6	18.0	75.0	75.0		14.0	14.0		14.4	14.4
Actuated g/C Ratio	0.08	0.52	0.52	0.14	0.58	0.58		0.11	0.11		0.11	0.11
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	286	2877	823	245	3192	913		192	170		391	175
v/s Ratio Prot	c0.08	0.28		0.08	c0.64			c0.13			c0.08	
v/s Ratio Perm			0.04			0.23			0.05			0.06
v/c Ratio	1.00	0.54	0.07	0.56	1.10	0.40		1.19	0.49		1.26dl	0.52
Uniform Delay, d1	59.7	20.8	15.6	52.3	27.5	15.1		58.0	54.7		55.7	54.5
Progression Factor	0.93	0.85	0.51	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	51.2	0.7	0.2	2.7	51.1	1.3		124.6	9.8		5.4	2.6
Delay (s)	106.9	18.5	8.0	55.0	78.6	16.4		182.6	64.5		61.1	57.1
Level of Service	F	B	A	D	E	B		F	E		E	E
Approach Delay (s)		30.8			70.1			139.5			59.4	
Approach LOS		C			E			F			E	

Intersection Summary			
HCM Average Control Delay	61.9	HCM Level of Service	E
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	105.4%	ICU Level of Service	G
Analysis Period (min)	15		
dl Defacto Left Lane. Recode with 1 though lane as a left lane.			
c Critical Lane Group			

AR00028062

HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road

2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3518		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3518		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	209	37	13	61	4	229	56	2756	89	228	4188	82
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	211	37	13	62	4	231	57	2784	90	230	4230	83
RTOR Reduction (vph)	0	3	0	0	0	196	0	0	25	0	0	18
Lane Group Flow (vph)	0	258	0	62	4	35	57	2784	65	230	4230	65
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		14.8		5.0	5.0	5.0	4.0	91.0	91.0	22.0	109.0	109.0
Effective Green, g (s)		14.8		5.0	5.0	5.0	4.0	91.0	91.0	22.0	109.0	109.0
Actuated g/C Ratio		0.10		0.03	0.03	0.03	0.03	0.61	0.61	0.15	0.73	0.73
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		350		59	63	53	48	3383	968	262	4052	1160
v/s Ratio Prot		c0.07		c0.04	0.00		c0.03	0.50		0.13	c0.76	
v/s Ratio Perm						0.02			0.04			0.04
v/c Ratio		1.19d		1.05	0.06	0.66	1.19	0.82	0.07	0.88	1.04	0.06
Uniform Delay, d1		65.1		71.9	69.6	71.1	72.4	22.6	11.7	62.1	19.9	5.6
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		7.9		132.1	0.4	25.7	189.9	2.4	0.1	26.4	27.4	0.1
Delay (s)		73.0		204.0	70.1	96.7	262.3	25.0	11.8	88.5	47.3	5.6
Level of Service		E		F	E	F	F	C	B	F	D	A
Approach Delay (s)		73.0			116.7			29.2			48.6	
Approach LOS		E			F			C			D	

Intersection Summary			
HCM Average Control Delay	44.9	HCM Level of Service	D
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	148.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	112.5%	ICU Level of Service	H
Analysis Period (min)	15		

d Defacto Left Lane. Recode with 1 though lane as a left lane.

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Rd & Fort Weaver Road

2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00		0.99	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1792	1583		1849	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.53	1.00		0.29	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		995	1583		537	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	731	189	418	37	214	48	539	2120	3	190	3187	884
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	738	191	422	37	216	48	544	2141	3	192	3219	893
RTOR Reduction (vph)	0	0	0	0	0	26	0	0	0	0	0	330
Lane Group Flow (vph)	0	929	422	0	253	22	544	2141	3	192	3219	563
Turn Type	Perm		Free	Perm		Perm	Prot		Free	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8			Free			6
Actuated Green, G (s)		59.0	130.0		59.0	59.0	17.0	52.0	130.0	7.0	42.0	42.0
Effective Green, g (s)		59.0	130.0		59.0	59.0	17.0	52.0	130.0	7.0	42.0	42.0
Actuated g/C Ratio		0.45	1.00		0.45	0.45	0.13	0.40	1.00	0.05	0.32	0.32
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		452	1583		244	718	231	2213	1583	95	1787	511
v/s Ratio Prot							c0.31	0.39		0.11	c0.58	
v/s Ratio Perm		c0.93	0.27		0.47	0.01			0.00			0.36
v/c Ratio		2.06	0.27		1.04	0.03	2.35	0.97	0.00	2.02	1.80	1.10
Uniform Delay, d1		35.5	0.0		35.5	19.7	56.5	38.2	0.0	61.5	44.0	44.0
Progression Factor		0.91	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		481.4	0.3		67.6	0.0	623.0	12.9	0.0	494.3	362.9	70.8
Delay (s)		513.6	0.3		103.1	19.7	679.5	51.0	0.0	555.8	406.9	114.8
Level of Service		F	A		F	B	F	D	A	F	F	F
Approach Delay (s)		353.3			89.8			178.2			352.9	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM Average Control Delay	289.5	HCM Level of Service	F
HCM Volume to Capacity ratio	2.01		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	168.5%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

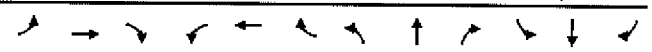
AR00028063

HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00		1.00	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	0.85		0.91		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1761	1583		1694		1770	5532	1583	1770	5532	1583
Flt Permitted	0.95	0.95	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1761	1583		1694		1770	5532	1583	1770	5532	1583
Volume (vph)	723	22	43	9	151	320	45	2086	75	506	3054	518
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	730	22	43	9	153	323	45	2107	76	511	3085	523
RTOR Reduction (vph)	0	0	0	0	48	0	0	0	8	0	0	205
Lane Group Flow (vph)	366	386	43	0	437	0	45	2107	68	511	3085	318
Turn Type	Split		Free	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free						2			6
Actuated Green, G (s)	28.0	28.0	150.0		26.0		4.0	50.0	50.0	30.0	76.0	76.0
Effective Green, g (s)	28.0	28.0	150.0		26.0		4.0	50.0	50.0	30.0	76.0	76.0
Actuated g/C Ratio	0.19	0.19	1.00		0.17		0.03	0.33	0.33	0.20	0.51	0.51
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	327	329	1583		294		47	1844	528	354	2803	802
v/s Ratio Prot	0.21	c0.22			c0.26		0.03	0.38		c0.29	c0.56	
v/s Ratio Perm			0.03						0.04			0.20
v/c Ratio	1.12	1.17	0.03		1.49		0.96	1.14	0.13	1.44	1.10	0.40
Uniform Delay, d1	61.0	61.0	0.0		62.0		72.9	50.0	34.8	60.0	37.0	22.8
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	85.9	105.4	0.0		236.3		114.0	71.2	0.5	214.9	51.5	1.5
Delay (s)	146.9	166.4	0.0		298.3		186.9	121.2	35.3	274.9	88.5	24.3
Level of Service	F	F	A		F		F	F	D	F	F	C
Approach Delay (s)		148.4			298.3			119.6			103.4	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM Average Control Delay	125.3	HCM Level of Service	F
HCM Volume to Capacity ratio	1.25		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	130.4%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
10: Farrington Hwy & D Street — 2030 + PRO (With Transit Corridor) - PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	*0.99		*0.99	*0.99			*0.99	*0.99	*0.99	*0.99	
Frt	1.00	1.00		1.00	1.00			1.00	0.85	1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	0.98	
Satd. Flow (prot)	1770	5532		3504	5506			1844	1567	1752	1660	
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	0.98	
Satd. Flow (perm)	1770	5532		3504	5506			1844	1567	1752	1660	
Volume (vph)	108	2029	0	408	2186	73	0	79	45	226	9	92
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	117	2205	0	443	2376	79	0	86	49	246	10	100
RTOR Reduction (vph)	0	0	0	0	3	0	0	0	45	0	33	0
Lane Group Flow (vph)	117	2205	0	443	2452	0	0	86	4	173	150	0
Turn Type	Prot			Prot					Perm	Split		
Protected Phases	5	2		1	6			8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	12.7	66.8		20.1	74.2			11.3	11.3	15.8	15.8	
Effective Green, g (s)	12.7	66.8		20.1	74.2			11.3	11.3	15.8	15.8	
Actuated g/C Ratio	0.10	0.51		0.15	0.57			0.09	0.09	0.12	0.12	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	173	2843		542	3143			160	136	213	202	
v/s Ratio Prot	0.07	c0.40		0.13	c0.45			c0.05		c0.10	0.09	
v/s Ratio Perm									0.00			
v/c Ratio	0.68	0.78		0.82	0.78			0.54	0.03	0.81	0.74	
Uniform Delay, d1	56.7	25.5		53.2	21.6			56.8	54.3	55.7	55.1	
Progression Factor	0.99	0.62		0.63	0.29			1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.5	1.4		8.6	1.8			3.4	0.1	20.5	13.6	
Delay (s)	62.3	17.3		42.3	8.0			60.3	54.4	76.1	68.7	
Level of Service	E	B		D	A			E	D	E	E	
Approach Delay (s)		19.5			13.3			58.2			72.3	
Approach LOS		B			B			E			E	

Intersection Summary			
HCM Average Control Delay	20.6	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

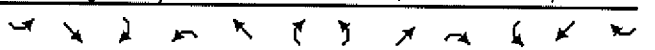
AR00028064

HCM Signalized Intersection Capacity Analysis
11: Farrington Hwy & E Street — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	*0.99			*0.99			1.00		1.00	1.00	
Frt	1.00	0.98			1.00			1.00		1.00	0.94	
Flt Protected	0.95	1.00			1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5421			5518			1803		1770	1744	
Flt Permitted	0.95	1.00			1.00			0.97		0.95	1.00	
Satd. Flow (perm)	1770	5421			5518			1803		1770	1744	
Volume (vph)	75	1950	303	0	2238	40	179	106	5	182	125	93
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	2120	329	0	2433	43	195	115	5	198	136	101
RTOR Reduction (vph)	0	18	0	0	1	0	0	1	0	0	21	0
Lane Group Flow (vph)	82	2431	0	0	2475	0	0	314	0	198	216	0
Turn Type	Prot						Split			Split		
Protected Phases	5	2			6		8	8		4	4	
Permitted Phases												
Actuated Green, G (s)	7.0	78.0			67.0			23.0		17.0	17.0	
Effective Green, g (s)	7.0	78.0			67.0			23.0		17.0	17.0	
Actuated g/C Ratio	0.05	0.60			0.52			0.18		0.13	0.13	
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	95	3253			2844			319		231	228	
v/s Ratio Prot	0.05	c0.45			c0.45			c0.17		0.11	c0.12	
v/s Ratio Perm												
v/c Ratio	0.86	0.75			0.87			0.98		0.86	0.95	
Uniform Delay, d1	61.0	18.9			27.7			53.3		55.3	56.1	
Progression Factor	0.86	0.76			0.41			1.00		1.00	1.00	
Incremental Delay, d2	30.4	0.8			2.4			45.9		25.5	44.7	
Delay (s)	83.1	15.2			13.8			99.2		80.8	100.8	
Level of Service	F	B			B			F		F	F	
Approach Delay (s)		17.4			13.8			99.2			91.7	
Approach LOS		B			B			F			F	

Intersection Summary			
HCM Average Control Delay	25.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.88		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.7%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — 2030 + PRO (With Transit Corridor) - PM Peak



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	*0.99	*0.99	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	3540	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	3540	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Volume (vph)	493	482	722	355	404	111	677	654	746	225	961	763
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	498	487	729	359	408	112	684	661	754	227	971	771
RTOR Reduction (vph)	0	19	309	0	0	94	0	0	217	0	0	189
Lane Group Flow (vph)	498	647	241	359	408	18	684	661	537	227	971	582
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	30.4	39.8	39.8	21.4	30.8	30.8	42.5	88.8	88.8	28.6	74.9	74.9
Effective Green, g (s)	30.4	39.8	39.8	21.4	30.8	30.8	42.5	88.8	88.8	28.6	74.9	74.9
Actuated g/C Ratio	0.16	0.20	0.20	0.11	0.16	0.16	0.22	0.46	0.46	0.15	0.38	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	547	724	320	385	584	251	765	1683	722	260	1419	609
v/s Ratio Prot	c0.14	c0.18		0.10	0.11		c0.20	0.18		0.13	0.26	
v/s Ratio Perm			0.15			0.01			0.34			c0.37
v/c Ratio	0.91	0.89	0.75	0.93	0.70	0.07	0.89	0.39	0.74	0.87	0.68	0.96
Uniform Delay, d1	80.8	75.3	72.8	85.9	77.5	69.7	73.9	35.0	43.5	81.2	50.0	58.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.3	13.4	9.6	29.2	6.8	0.5	12.9	0.2	4.1	25.9	1.4	25.7
Delay (s)	100.1	88.8	82.3	115.1	84.3	70.3	86.8	35.2	47.7	107.2	51.4	83.9
Level of Service	F	F	F	F	F	E	F	D	D	F	D	F
Approach Delay (s)		90.0			95.1			56.5			70.5	
Approach LOS		F			F			E			E	

Intersection Summary			
HCM Average Control Delay	74.4	HCM Level of Service	E
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	194.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	90.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99		1.00				*0.99	1.00	0.97	*0.99	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504		1583				3688	1583	3433	3688	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504		1583				3688	1583	3433	3688	
Volume (vph)	1986	0	412	0	0	0	469	86	302	514	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	2006	0	416	0	0	0	474	87	305	519	0
RTOR Reduction (vph)	0	0	63	0	0	0	0	70	0	0	0
Lane Group Flow (vph)	2006	0	353	0	0	0	474	17	305	519	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	82.8		82.8				28.1	28.1	17.1	49.2	
Effective Green, g (s)	82.8		82.8				28.1	28.1	17.1	49.2	
Actuated g/C Ratio	0.59		0.59				0.20	0.20	0.12	0.35	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	2072		936				740	318	419	1296	
v/s Ratio Prot	c0.57		0.22				c0.13		c0.09	0.14	
v/s Ratio Perm								0.01			
v/c Ratio	0.97		0.38				0.64	0.05	0.73	0.40	
Uniform Delay, d1	27.3		15.0				51.3	45.2	59.2	34.3	
Progression Factor	1.00		1.00				1.00	1.00	0.60	0.84	
Incremental Delay, d2	13.0		0.3				4.2	0.3	5.6	0.8	
Delay (s)	40.3		15.3				55.5	45.5	41.2	29.5	
Level of Service	D		B				E	D	D	C	
Approach Delay (s)		36.0		0.0			54.0			33.8	
Approach LOS		D		A			D			C	

Intersection Summary			
HCM Average Control Delay	38.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	107.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		1.00			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		1583			3433	3688			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		1583			3433	3688			3688	3135
Volume (vph)	92	0	952	0	0	206	2248	0	0	724	2003
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	93	0	962	0	0	208	2271	0	0	731	2023
RTOR Reduction (vph)	0	0	1	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	93	0	961	0	0	208	2271	0	0	731	2023
Turn Type	Prot		custom			Prot					Free
Protected Phases	4		4			1	6			2	
Permitted Phases											Free
Actuated Green, G (s)	63.0		63.0			12.7	69.0			52.3	140.0
Effective Green, g (s)	63.0		63.0			12.7	69.0			52.3	140.0
Actuated g/C Ratio	0.45		0.45			0.09	0.49			0.37	1.00
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	797		712			311	1818			1378	3135
v/s Ratio Prot	0.05		c0.61			0.06	c0.62			0.20	
v/s Ratio Perm											0.65
v/c Ratio	0.12		1.35			0.67	1.25			0.53	0.65
Uniform Delay, d1	22.3		36.5			61.6	35.5			34.3	0.0
Progression Factor	1.00		1.00			1.12	0.61			1.00	1.00
Incremental Delay, d2	0.1		166.5			2.2	114.1			1.5	1.0
Delay (s)	22.4		205.0			71.5	135.6			35.7	1.0
Level of Service	C		F			E	F			D	A
Approach Delay (s)		188.9		0.0			130.3			10.2	
Approach LOS		F		A			F			B	

Intersection Summary			
HCM Average Control Delay	87.5	HCM Level of Service	F
HCM Volume to Capacity ratio	1.30		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	107.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99		*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00
Frt	1.00	0.96		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	5328		3504	5532	1583	3504	3688	1583	3504	3688	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	5328		3504	5532	1583	3504	3688	1583	3504	3688	1583
Volume (vph)	717	1856	607	876	1562	386	407	740	537	529	847	758
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	724	1875	613	885	1578	390	411	747	542	534	856	766
RTOR Reduction (vph)	0	45	0	0	0	190	0	0	284	0	0	265
Lane Group Flow (vph)	724	2443	0	885	1578	200	411	747	258	534	856	501
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases						2			4			8
Actuated Green, G (s)	25.0	40.0		27.0	42.0	42.0	17.0	30.0	30.0	17.0	30.0	30.0
Effective Green, g (s)	25.0	40.0		27.0	42.0	42.0	17.0	30.0	30.0	17.0	30.0	30.0
Actuated g/C Ratio	0.19	0.31		0.21	0.32	0.32	0.13	0.23	0.23	0.13	0.23	0.23
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	674	1639		728	1787	511	458	851	365	458	851	365
v/s Ratio Prot	0.21	c0.46		c0.25	0.29		0.12	c0.20		0.15	0.23	
v/s Ratio Perm						0.13			0.16			c0.32
v/c Ratio	1.07	1.49		1.22	0.88	0.39	0.90	0.88	0.71	1.17	1.01	1.37
Uniform Delay, d1	52.5	45.0		51.5	41.7	34.1	55.6	48.2	46.0	56.5	50.0	50.0
Progression Factor	1.00	1.00		0.63	0.56	0.21	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	56.3	224.0		102.9	3.2	1.0	23.0	12.4	11.0	96.1	32.3	183.8
Delay (s)	108.8	269.0		135.2	26.7	8.0	78.6	60.6	57.0	152.6	82.3	233.8
Level of Service	F	F		F	C	A	E	E	E	F	F	F
Approach Delay (s)		232.9			57.8			63.8			153.5	
Approach LOS		F			E			E			F	

Intersection Summary			
HCM Average Control Delay	136.3	HCM Level of Service	F
HCM Volume to Capacity ratio	1.28		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	123.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connector — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	*0.99	0.86	*0.99	*0.99	1.00	*0.99	*0.99		*0.99	1.00	*0.99
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5532	1362	3504	5532	1583	3504	3466		3504	1863	3135
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5532	1362	3504	5532	1583	3504	3466		3504	1863	3135
Volume (vph)	73	1834	457	642	1906	374	273	421	262	374	117	717
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	74	1853	462	648	1925	378	276	425	265	378	118	724
RTOR Reduction (vph)	0	0	215	0	0	173	0	90	0	0	0	26
Lane Group Flow (vph)	74	1853	247	648	1925	205	276	620	0	378	118	698
Turn Type	Prot		Perm	Prot		pm+ov	Prot			Prot		pm+ov
Protected Phases	5	2		1	6	7	7	4		3	8	1
Permitted Phases			2			6						8
Actuated Green, G (s)	5.6	40.3	40.3	20.8	55.5	70.5	15.0	27.8		25.1	37.9	58.7
Effective Green, g (s)	5.6	40.3	40.3	20.8	55.5	70.5	15.0	27.8		25.1	37.9	58.7
Actuated g/C Ratio	0.04	0.31	0.31	0.16	0.43	0.54	0.12	0.21		0.19	0.29	0.45
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	148	1715	422	561	2362	858	404	741		677	543	1416
v/s Ratio Prot	0.02	c0.33		c0.18	0.35	0.03	0.08	c0.18		c0.11	0.06	0.08
v/s Ratio Perm			0.18			0.10						0.14
v/c Ratio	0.50	1.08	0.59	1.16	0.81	0.24	0.68	0.84		0.56	0.22	0.49
Uniform Delay, d1	60.8	44.9	37.8	54.6	32.7	15.6	55.2	48.9		47.4	34.8	25.2
Progression Factor	1.00	1.00	1.00	0.70	0.40	0.30	1.00	1.00		0.52	0.46	0.40
Incremental Delay, d2	2.6	47.1	5.9	71.9	0.3	0.0	4.7	8.2		0.3	0.1	0.1
Delay (s)	63.5	91.9	43.7	110.1	13.5	4.7	59.9	57.1		24.9	16.2	10.2
Level of Service	E	F	D	F	B	A	E	E		C	B	B
Approach Delay (s)		81.7			33.6			57.9			15.4	
Approach LOS		F			C			E			B	

Intersection Summary			
HCM Average Control Delay	49.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.92		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	101.8%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
17: East-West Rd & North-South Road — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	*0.99	0.95		0.97	*0.99		*0.99	*0.99		*0.99	*0.99	
Frt	1.00	0.94		1.00	0.89		1.00	0.98		1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3504	3313		3433	3283		3504	5405		3504	5358	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3504	3313		3433	3283		3504	5405		3504	5358	
Volume (vph)	308	312	232	361	192	525	110	1530	277	504	1626	432
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	311	315	234	365	194	530	111	1545	280	509	1642	436
RTOR Reduction (vph)	0	81	0	0	163	0	0	24	0	0	39	0
Lane Group Flow (vph)	311	468	0	365	561	0	111	1801	0	509	2039	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	14.4	20.6		17.2	23.4		5.0	45.1		17.0	57.1	
Effective Green, g (s)	14.4	20.6		17.2	23.4		5.0	45.1		17.0	57.1	
Actuated g/C Ratio	0.12	0.18		0.15	0.20		0.04	0.39		0.15	0.49	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	435	589		509	663		151	2103		514	2640	
v/s Ratio Prot	0.09	0.14		c0.11	c0.17		0.03	c0.33		c0.15	0.38	
v/s Ratio Perm												
v/c Ratio	0.71	0.79		0.72	1.11dr		0.74	0.86		0.99	0.77	
Uniform Delay, d1	48.8	45.6		47.0	44.5		54.8	32.4		49.4	24.1	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.5	7.3		4.8	9.8		16.9	4.7		37.4	2.3	
Delay (s)	54.3	52.9		51.8	54.3		71.7	37.2		86.7	26.3	
Level of Service	D	D		D	D		E	D		F	C	
Approach Delay (s)		53.4			53.5			39.2			38.2	
Approach LOS		D			D			D			D	

Intersection Summary			
HCM Average Control Delay	43.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	115.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	94.5%	ICU Level of Service	F
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway — 2030 + PRO (With Transit Corridor) - PM Peak

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99		1.00	*0.99		*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.98		1.00	0.94		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5407		1770	5184		3504	5532	1583	1770	5532	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5407		1770	5184		3504	5532	1583	1770	5532	1583
Volume (vph)	378	875	155	494	1001	725	704	643	505	121	568	339
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	382	884	157	499	1011	732	711	649	510	122	574	342
RTOR Reduction (vph)	0	26	0	0	118	0	0	0	297	0	0	292
Lane Group Flow (vph)	382	1015	0	499	1625	0	711	649	213	122	574	50
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases									4			8
Actuated Green, G (s)	20.0	25.0		31.0	36.0		21.0	26.5	26.5	10.4	15.9	15.9
Effective Green, g (s)	20.0	25.0		31.0	36.0		21.0	26.5	26.5	10.4	15.9	15.9
Actuated g/C Ratio	0.16	0.23		0.28	0.33		0.19	0.24	0.24	0.10	0.15	0.15
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	325	1241		504	1714		676	1346	385	169	808	231
v/s Ratio Prot	c0.22	0.19		c0.28	c0.31		c0.20	0.12		0.07	c0.10	
v/s Ratio Perm									0.13			0.03
v/c Ratio	1.18	0.82		0.99	1.15dr		1.05	0.48	0.55	0.72	0.71	0.22
Uniform Delay, d1	44.5	39.8		38.8	35.5		44.0	35.3	36.0	47.8	44.3	41.0
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	106.4	6.1		37.4	12.5		49.0	0.3	1.7	14.1	3.0	0.5
Delay (s)	150.9	45.8		76.2	48.0		93.0	35.6	37.7	62.0	47.3	41.5
Level of Service	F	D		E	D		F	D	D	E	D	D
Approach Delay (s)		74.0			54.3			58.0			47.1	
Approach LOS		E			D			E			D	

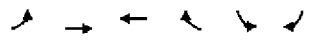
Intersection Summary			
HCM Average Control Delay	58.5	HCM Level of Service	E
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	108.9	Sum of lost time (s)	12.0
Intersection Capacity Utilization	100.9%	ICU Level of Service	G
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

AR00028068

HCM Signalized Intersection Capacity Analysis
19: East-West Rd & Old Fort Weaver Rd

2030 + PRO (With Transit Corridor) - PM Peak

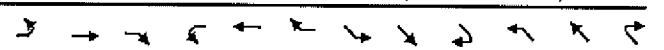


Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	3539	1583	3433	1583
Flt Permitted	0.29	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	546	1863	3539	1583	3433	1583
Volume (vph)	37	533	689	948	805	93
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	37	538	696	958	813	94
RTOR Reduction (vph)	0	0	0	0	0	48
Lane Group Flow (vph)	37	538	696	958	813	46
Turn Type	Perm			pm+ov		Perm
Protected Phases		4	8	6	5	
Permitted Phases	4			8		6
Actuated Green, G (s)	58.7	58.7	58.7	122.0	63.3	63.3
Effective Green, g (s)	58.7	58.7	58.7	122.0	63.3	63.3
Actuated g/C Ratio	0.45	0.45	0.45	0.94	0.49	0.49
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	247	841	1598	1583	1672	771
v/s Ratio Prot		0.29	0.20	c0.29	0.24	
v/s Ratio Perm	0.07			0.31		0.03
v/c Ratio	0.15	0.64	0.44	0.61	0.49	0.06
Uniform Delay, d1	21.0	27.5	24.3	0.6	22.4	17.6
Progression Factor	0.27	0.25	0.89	1.00	1.19	1.75
Incremental Delay, d2	0.2	1.3	0.0	0.1	0.4	0.1
Delay (s)	5.8	8.1	21.7	0.6	27.0	30.8
Level of Service	A	A	C	A	C	C
Approach Delay (s)		8.0	9.5		27.4	
Approach LOS		A	A		C	

Intersection Summary				
HCM Average Control Delay	14.4	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.61			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	0.0	
Intersection Capacity Utilization	68.7%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
20: Farrington Hwy & B Street

2030 + PRO (With Transit Corridor) - PM Peak



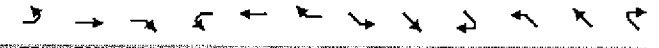
Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	*0.99	1.00	0.97	*0.99	1.00	1.00	1.00	1.00	*0.99	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3688	1583	3433	3688	1583	1770	1863	1583	3504	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3688	1583	3433	3688	1583	1770	1863	1583	3504	1863	1583
Volume (vph)	221	1384	344	375	1728	74	146	282	195	264	143	171
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	223	1398	347	379	1745	75	147	285	197	267	144	173
RTOR Reduction (vph)	0	0	46	0	0	27	0	0	5	0	0	23
Lane Group Flow (vph)	223	1398	301	379	1745	48	147	285	192	267	144	150
Turn Type	Prot		pm+ov	Prot		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6		7	4	5	3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	12.7	51.0	61.0	17.9	56.2	56.2	11.0	18.0	30.7	10.0	17.0	34.9
Effective Green, g (s)	12.7	51.0	61.0	17.9	56.2	56.2	11.0	18.0	30.7	10.0	17.0	34.9
Actuated g/C Ratio	0.11	0.45	0.54	0.16	0.50	0.50	0.10	0.16	0.27	0.09	0.15	0.31
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	386	1666	855	544	1836	788	172	297	430	310	281	545
v/s Ratio Prot	0.06	0.38	0.03	c0.11	c0.47		0.08	c0.15	0.05	c0.08	0.08	0.04
v/s Ratio Perm			0.16			0.03			0.07			0.05
v/c Ratio	0.58	0.84	0.35	0.70	0.95	0.06	0.85	0.96	0.45	0.86	0.51	0.28
Uniform Delay, d1	47.6	27.3	14.7	44.9	27.0	14.7	50.2	47.1	34.1	50.8	44.1	29.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.1	5.3	0.3	3.9	12.2	0.1	31.5	40.8	0.7	20.9	1.6	0.3
Delay (s)	49.6	32.6	15.0	48.8	39.2	14.8	81.7	87.9	34.8	71.7	45.7	29.7
Level of Service	D	C	B	D	D	B	F	F	C	E	D	C
Approach Delay (s)		31.4			40.0			69.8			52.9	
Approach LOS		C			D			E			D	

Intersection Summary				
HCM Average Control Delay	41.7	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.88			
Actuated Cycle Length (s)	112.9	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	89.8%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028069

HCM Signalized Intersection Capacity Analysis
21: East-West Rd & A Street

2030 + PRO (With Transit Corridor) - PM Peak

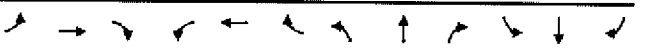


Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.85		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1841		1770	1863	1583	1770	1585		1770	1631	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1841		1770	1863	1583	1770	1585		1770	1631	
Volume (vph)	164	661	55	34	683	513	12	1	135	44	6	31
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	178	718	60	37	742	558	13	1	147	48	7	34
RTOR Reduction (vph)	0	2	0	0	0	174	0	138	0	0	32	0
Lane Group Flow (vph)	178	776	0	37	742	384	13	10	0	48	9	0
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6						
Actuated Green, G (s)	19.9	92.7		4.8	77.6	77.6	7.7	7.7		8.8	8.8	
Effective Green, g (s)	19.9	92.7		4.8	77.6	77.6	7.7	7.7		8.8	8.8	
Actuated g/C Ratio	0.15	0.71		0.04	0.60	0.60	0.06	0.06		0.07	0.07	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	271	1313		66	1112	945	105	94		120	110	
v/s Ratio Prot	c0.10	0.42		0.02	c0.40		c0.01	0.01		c0.03	0.01	
v/s Ratio Perm						0.24						
v/c Ratio	0.66	0.59		0.57	0.67	0.41	0.12	0.10		0.40	0.08	
Uniform Delay, d1	51.8	9.3		61.6	17.6	13.9	58.0	57.9		58.1	56.8	
Progression Factor	1.00	1.00		0.97	0.49	0.09	1.00	1.00		1.00	1.00	
Incremental Delay, d2	5.6	2.0		5.2	1.5	0.6	0.5	0.5		2.2	0.3	
Delay (s)	57.5	11.2		64.9	10.0	1.8	58.5	58.4		60.3	57.2	
Level of Service	E	B		E	B	A	E	E		E	E	
Approach Delay (s)		19.8			8.1			58.4			58.8	
Approach LOS		B			A			E			E	

Intersection Summary				
HCM Average Control Delay	17.5	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.61			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	70.1%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
22: Farrington Hwy & 2nd Avenue

2030 + PRO (With Transit Corridor) - PM Peak



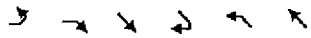
Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		0.97	0.95	1.00	1.00	0.95	0.88	0.97	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5021		3433	3539	1583	1770	3539	2787	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5021		3433	3539	1583	1770	3539	2787	3433	3539	1583
Volume (vph)	180	1404	130	555	1708	237	103	297	410	515	356	308
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	1526	141	603	1857	258	112	323	446	560	387	335
RTOR Reduction (vph)	0	8	0	0	0	81	0	0	6	0	0	181
Lane Group Flow (vph)	196	1659	0	603	1857	177	112	323	440	560	387	154
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		Perm
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases						6			8			4
Actuated Green, G (s)	15.0	46.0		23.0	54.0	54.0	11.0	23.0	46.0	22.0	34.0	34.0
Effective Green, g (s)	15.0	46.0		23.0	54.0	54.0	11.0	23.0	46.0	22.0	34.0	34.0
Actuated g/C Ratio	0.12	0.35		0.18	0.42	0.42	0.08	0.18	0.35	0.17	0.26	0.26
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	204	1777		607	1470	658	150	626	986	581	926	414
v/s Ratio Prot	0.11	c0.33		0.18	c0.52		c0.06	c0.09	0.08	c0.16	0.11	
v/s Ratio Perm						0.11			0.08			0.10
v/c Ratio	0.96	0.93		0.99	1.26	0.27	0.75	0.52	0.45	0.96	0.42	0.37
Uniform Delay, d1	57.2	40.5		53.4	36.0	25.0	58.1	48.5	32.2	53.6	39.8	39.3
Progression Factor	1.00	1.00		0.53	0.35	0.05	0.76	0.71	0.66	1.01	0.90	0.64
Incremental Delay, d2	51.6	10.5		22.7	121.0	0.4	13.8	2.2	0.2	15.5	0.5	1.0
Delay (s)	108.8	51.0		51.1	134.5	1.7	57.7	36.5	21.5	69.6	36.5	33.9
Level of Service	F	D		D	F	A	E	D	C	E	D	C
Approach Delay (s)		57.1			103.4			31.6			50.3	
Approach LOS		E			F			C			D	

Intersection Summary				
HCM Average Control Delay	71.1	HCM Level of Service	E	
HCM Volume to Capacity ratio	1.07			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	93.4%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028070

HCM Unsignalized Intersection Capacity Analysis
23: 2nd Avenue & Kunia Road

2030 + PRO (With Transit Corridor) - PM Peak



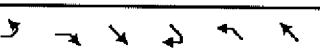
Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations			↑↑↑↱			↑↑↑↑
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	4551	349	0	4748
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	4947	379	0	5161
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			868			
pX, platoon unblocked	0.39	0.39			0.39	
vC, conflicting volume	6427	1426			5326	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	10281	0			7432	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	0	419			1	

Direction, Lane #	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	1413	1413	1413	1086	1290	1290	1290	1290
Volume Left	0	0	0	0	0	0	0	0
Volume Right	0	0	0	379	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.83	0.83	0.83	0.64	0.76	0.76	0.76	0.76
Queue Length 95th (ft)	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS								
Approach Delay (s)	0.0				0.0			
Approach LOS								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	75.1%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
24: 3rd Avenue & Kunia Road

2030 + PRO (With Transit Corridor) - PM Peak



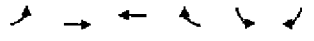
Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations			↑↑↑↱			↑↑↑↑
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	4433	118	0	4297
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	4818	128	0	4671
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			1232			
pX, platoon unblocked	0.42	0.42			0.42	
vC, conflicting volume	6050	1269			4947	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	8872	0			6250	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	0	456			2	

Direction, Lane #	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	1377	1377	1377	817	1168	1168	1168	1168
Volume Left	0	0	0	0	0	0	0	0
Volume Right	0	0	0	128	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.81	0.81	0.81	0.48	0.69	0.69	0.69	0.69
Queue Length 95th (ft)	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS								
Approach Delay (s)	0.0				0.0			
Approach LOS								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		

AR00028071

HCM Signalized Intersection Capacity Analysis
25: East-West Rd & B Street — 2030 + PRO (With Transit Corridor) - PM Peak

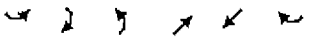


Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Volume (vph)	414	290	644	95	337	588
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	450	315	700	103	366	639
RTOR Reduction (vph)	0	0	0	44	0	398
Lane Group Flow (vph)	450	315	700	59	366	241
Turn Type	Prot			Prot		Prot
Protected Phases	5	2	6	6	4	4
Permitted Phases						
Actuated Green, G (s)	34.7	94.0	55.3	55.3	28.0	28.0
Effective Green, g (s)	34.7	94.0	55.3	55.3	28.0	28.0
Actuated g/C Ratio	0.27	0.72	0.43	0.43	0.22	0.22
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	472	1347	792	673	381	341
v/s Ratio Prot	c0.25	0.17	c0.38	0.04	c0.21	0.15
v/s Ratio Perm						
v/c Ratio	0.95	0.23	0.88	0.09	0.96	0.71
Uniform Delay, d1	46.9	6.0	34.4	22.3	50.5	47.2
Progression Factor	0.81	1.74	0.36	0.15	1.00	1.00
Incremental Delay, d2	26.4	0.3	13.0	0.2	37.2	11.7
Delay (s)	64.3	10.8	25.4	3.7	87.6	58.9
Level of Service	E	B	C	A	F	E
Approach Delay (s)		42.3	22.7		69.4	
Approach LOS		D	C		E	

Intersection Summary				
HCM Average Control Delay	46.7	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.92			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	85.5%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
26: Farrington Hwy & — 2030 + PRO (With Transit Corridor) - PM Peak



Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3688	3688	1583
Flt Permitted	0.95	1.00	0.05	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	98	3688	3688	1583
Volume (vph)	199	173	94	1485	2229	137
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	201	175	95	1500	2252	138
RTOR Reduction (vph)	0	16	0	0	0	33
Lane Group Flow (vph)	201	159	95	1500	2252	105
Turn Type		Perm	Perm			Perm
Protected Phases	6			4	8	
Permitted Phases		6	4			8
Actuated Green, G (s)	16.0	16.0	76.0	76.0	76.0	76.0
Effective Green, g (s)	16.0	16.0	76.0	76.0	76.0	76.0
Actuated g/C Ratio	0.16	0.16	0.76	0.76	0.76	0.76
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Grp Cap (vph)	283	253	74	2803	2803	1203
v/s Ratio Prot	c0.11			0.41	0.61	
v/s Ratio Perm		0.10	c0.97			0.07
v/c Ratio	0.71	0.63	1.28	0.54	0.80	0.09
Uniform Delay, d1	39.8	39.2	12.0	4.9	7.4	3.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.1	11.3	198.5	0.7	2.6	0.1
Delay (s)	53.9	50.5	210.5	5.6	9.9	3.2
Level of Service	D	D	F	A	A	A
Approach Delay (s)	52.3			17.8	9.6	
Approach LOS	D			B	A	

Intersection Summary				
HCM Average Control Delay	16.3	HCM Level of Service	B	
HCM Volume to Capacity ratio	1.18			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	87.8%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

AR00028072

APPENDIX A-4
YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR
SCENARIO

AR00028073

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (W/O Transit Corridor) - PM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	0.97	1.00	0.95	1.00		0.95
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3433	1583	3539	1583		3539
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3433	1583	3539	1583		3539
Volume (vph)	915	41	1730	948	0	2297
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	995	45	1880	1030	0	2497
RTOR Reduction (vph)	0	18	0	317	0	0
Lane Group Flow (vph)	995	27	1880	713	0	2497
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	35.0	35.0	87.0	87.0		87.0
Effective Green, g (s)	35.0	35.0	87.0	87.0		87.0
Actuated g/C Ratio	0.27	0.27	0.67	0.67		0.67
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	924	426	2368	1059		2368
v/s Ratio Prot	c0.29		0.53			c0.71
v/s Ratio Perm		0.02		0.45		
v/c Ratio	1.08	0.06	0.79	0.67		1.05
Uniform Delay, d1	47.5	35.3	15.2	12.9		21.5
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	52.5	0.1	2.8	3.4		34.9
Delay (s)	100.0	35.4	18.0	16.4		56.4
Level of Service	F	D	B	B		E
Approach Delay (s)	97.2		17.4			56.4
Approach LOS	F		B			E

Intersection Summary			
HCM Average Control Delay	45.4	HCM Level of Service	D
HCM Volume to Capacity ratio	1.06		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	96.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (W/O Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	0.95			0.91	
Frt						0.86	1.00	1.00			0.99	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	3539			5016	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	3539			5016	
Volume (vph)	0	0	0	0	0	303	367	2420	0	0	2922	290
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	329	399	2630	0	0	3176	315
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	8	0
Lane Group Flow (vph)	0	0	0	0	0	329	399	2630	0	0	3483	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						150.0	34.6	150.0			107.4	
Effective Green, g (s)						150.0	34.6	150.0			107.4	
Actuated g/C Ratio						1.00	0.23	1.00			0.72	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	408	3539			3591	
v/s Ratio Prot							c0.23	0.74			c0.69	
v/s Ratio Perm						0.20						
v/c Ratio						0.20	0.98	0.74			0.97	
Uniform Delay, d1						0.0	57.3	0.0			19.8	
Progression Factor						1.00	1.12	1.00			1.00	
Incremental Delay, d2						0.3	28.5	0.9			9.5	
Delay (s)						0.3	92.5	0.9			29.3	
Level of Service						A	F	A			C	
Approach Delay (s)		0.0			0.3			12.9			29.3	
Approach LOS		A			A			B			C	

Intersection Summary			
HCM Average Control Delay	20.7	HCM Level of Service	C
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	89.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	0.97	1.00	0.95	1.00		0.91
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3433	1583	3539	1583		5085
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3433	1583	3539	1583		5085
Volume (vph)	724	37	1781	498	0	1309
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	787	40	1936	541	0	1423
RTOR Reduction (vph)	0	10	0	196	0	0
Lane Group Flow (vph)	787	30	1936	345	0	1423
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	26.8	26.8	61.1	61.1		61.1
Effective Green, g (s)	26.8	26.8	61.1	61.1		61.1
Actuated g/C Ratio	0.28	0.28	0.64	0.64		0.64
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	959	442	2255	1009		3240
v/s Ratio Prot	c0.23		c0.55			0.28
v/s Ratio Perm		0.02		0.22		
v/c Ratio	0.82	0.07	0.86	0.34		0.44
Uniform Delay, d1	32.3	25.4	13.9	8.1		8.8
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	5.7	0.1	4.5	0.9		0.4
Delay (s)	38.0	25.4	18.5	9.0		9.2
Level of Service	D	C	B	A		A
Approach Delay (s)	37.4		16.4			9.2
Approach LOS	D		B			A

Intersection Summary			
HCM Average Control Delay	17.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	95.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	0.91			0.91	
Frt						0.86	1.00	1.00			0.98	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5085			4960	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5085			4960	
Volume (vph)	0	0	0	0	0	530	165	1748	0	0	1697	333
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	576	179	1900	0	0	1845	362
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	15	0
Lane Group Flow (vph)	0	0	0	0	0	576	179	1900	0	0	2192	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						110.0	15.2	110.0			86.8	
Effective Green, g (s)						110.0	15.2	110.0			86.8	
Actuated g/C Ratio						1.00	0.14	1.00			0.79	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	245	5085			3914	
v/s Ratio Prot							c0.10	0.37			c0.44	
v/s Ratio Perm						0.36						
v/c Ratio						0.36	0.73	0.37			0.56	
Uniform Delay, d1						0.0	45.4	0.0			4.4	
Progression Factor						1.00	1.07	1.00			1.00	
Incremental Delay, d2						0.6	9.5	0.2			0.6	
Delay (s)						0.6	57.9	0.2			5.0	
Level of Service						A	E	A			A	
Approach Delay (s)		0.0			0.6			5.2			5.0	
Approach LOS		A			A			A			A	

Intersection Summary			
HCM Average Control Delay	4.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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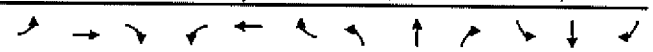
HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.86			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	1583	6408			5085
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	1583	6408			5085
Volume (vph)	403	363	2072	0	0	1509
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	438	395	2252	0	0	1640
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	438	395	2252	0	0	1640
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	17.4	110.0	84.6			84.6
Effective Green, g (s)	17.4	110.0	84.6			84.6
Actuated g/C Ratio	0.16	1.00	0.77			0.77
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	543	1583	4928			3911
v/s Ratio Prot	c0.13		c0.35			0.32
v/s Ratio Perm		0.25				
v/c Ratio	0.81	0.25	0.46			0.42
Uniform Delay, d1	44.7	0.0	4.5			4.3
Progression Factor	1.00	1.00	0.76			1.01
Incremental Delay, d2	8.6	0.4	0.3			0.3
Delay (s)	53.2	0.4	3.7			4.7
Level of Service	D	A	A			A
Approach Delay (s)	28.2		3.7			4.7
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	8.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp — 2030 + PRO (without Transit Corridor) - AM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.91		0.97	0.91				1.00			1.00
Frt		0.98		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		5006		3433	5085				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		5006		3433	5085				1611			1611
Volume (vph)	0	2066	240	498	721	0	0	0	429	0	0	481
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	2246	261	541	784	0	0	0	466	0	0	523
RTOR Reduction (vph)	0	9	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2498	0	541	784	0	0	0	466	0	0	523
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		79.5		22.5	110.0				110.0			110.0
Effective Green, g (s)		79.5		22.5	110.0				110.0			110.0
Actuated g/C Ratio		0.72		0.20	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		3618		702	5085				1611			1611
v/s Ratio Prot		c0.50		c0.16	0.15							
v/s Ratio Perm									0.29			0.32
v/c Ratio		0.69		0.77	0.15				0.29			0.32
Uniform Delay, d1		8.4		41.3	0.0				0.0			0.0
Progression Factor		0.65		1.45	1.00				1.00			1.00
Incremental Delay, d2		0.8		1.6	0.0				0.5			0.5
Delay (s)		6.3		61.4	0.0				0.5			0.5
Level of Service		A		E	A				A			A
Approach Delay (s)		6.3			25.1			0.5			0.5	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	10.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0				4.0			
Lane Util. Factor	1.00	*0.99			*0.99				1.00			
Frt	1.00	1.00			0.95				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	5532			5269				1611			
Flt Permitted	0.95	1.00			1.00				1.00			
Satd. Flow (perm)	1770	5532			5269				1611			
Volume (vph)	1165	1330	0	0	1218	567	0	0	911	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1177	1343	0	0	1230	573	0	0	920	0	0	0
RTOR Reduction (vph)	0	0	0	0	57	0	0	0	0	0	0	0
Lane Group Flow (vph)	1177	1343	0	0	1746	0	0	0	920	0	0	0
Turn Type	Prot								Free			
Protected Phases	5	2			6							
Permitted Phases									Free			
Actuated Green, G (s)	67.0	110.0			35.0				110.0			
Effective Green, g (s)	67.0	110.0			35.0				110.0			
Actuated g/C Ratio	0.61	1.00			0.32				1.00			
Clearance Time (s)	4.0	4.0			4.0							
Vehicle Extension (s)	3.0	3.0			3.0							
Lane Grp Cap (vph)	1078	5532			1677				1611			
v/s Ratio Prot	c0.67	0.24			c0.33							
v/s Ratio Perm									0.57			
v/c Ratio	1.09	0.24			1.04				0.57			
Uniform Delay, d1	21.5	0.0			37.5				0.0			
Progression Factor	0.34	1.00			1.00				1.00			
Incremental Delay, d2	53.4	0.1			33.6				1.5			
Delay (s)	60.7	0.1			71.1				1.5			
Level of Service	E	A			E				A			
Approach Delay (s)		28.4			71.1			1.5			0.0	
Approach LOS		C			E			A			A	

Intersection Summary				
HCM Average Control Delay	38.4	HCM Level of Service	D	
HCM Volume to Capacity ratio	1.07			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	107.4%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	1.00	*0.99	1.00		1.00	1.00		*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.98	1.00		0.97	1.00
Satd. Flow (prot)	3504	5532	1583	1770	5532	1583		1780	1583		3568	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (perm)	3504	5532	1583	1770	5532	1583		1780	1583		3568	1583
Volume (vph)	147	1938	155	119	1619	156	56	5	48	92	45	113
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	160	2107	168	129	1760	170	61	5	52	100	49	123
RTOR Reduction (vph)	0	0	74	0	0	91	0	0	45	0	0	111
Lane Group Flow (vph)	160	2107	94	129	1760	79	0	66	7	0	149	12
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	13.7	48.2	48.2	10.2	44.7	44.7		12.8	12.8		9.6	9.6
Effective Green, g (s)	13.7	48.2	48.2	10.2	44.7	44.7		12.8	12.8		9.6	9.6
Actuated g/C Ratio	0.14	0.50	0.50	0.11	0.46	0.46		0.13	0.13		0.10	0.10
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	496	2755	788	187	2555	731		235	209		354	157
v/s Ratio Prot	c0.05	c0.38		c0.07	0.32			c0.04			c0.04	
v/s Ratio Perm			0.06			0.05			0.00			0.01
v/c Ratio	0.32	0.76	0.12	0.69	0.69	0.11		0.28	0.03		0.42	0.08
Uniform Delay, d1	37.4	19.7	13.0	41.8	20.6	14.8		37.9	36.6		41.0	39.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	0.4	1.3	0.1	10.1	0.8	0.1		3.0	0.3		0.8	0.2
Delay (s)	37.8	21.0	13.0	51.9	21.3	14.8		40.8	36.9		41.8	39.8
Level of Service	D	C	B	D	C	B		D	D		D	D
Approach Delay (s)		21.6			22.7			39.1			40.9	
Approach LOS		C			C			D			D	

Intersection Summary				
HCM Average Control Delay	23.6	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.66			
Actuated Cycle Length (s)	96.8	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	65.8%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road

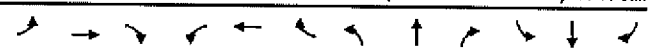
2030 + PRO (wilhout Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3510		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3510		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	96	24	12	72	4	235	48	4056	53	92	1419	170
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	97	24	12	73	4	237	48	4097	54	93	1433	172
RTOR Reduction (vph)	0	6	0	0	0	102	0	0	10	0	0	52
Lane Group Flow (vph)	0	127	0	73	4	135	48	4097	44	93	1433	120
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		10.6		10.0	10.0	10.0	7.4	101.0	101.0	7.9	101.5	101.5
Effective Green, g (s)		10.6		10.0	10.0	10.0	7.4	101.0	101.0	7.9	101.5	101.5
Actuated g/C Ratio		0.07		0.07	0.07	0.07	0.05	0.69	0.69	0.05	0.70	0.70
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		256		122	128	109	90	3840	1099	96	3859	1104
v/s Ratio Prot		c0.04		0.04	0.00		0.03	c0.74		c0.05	0.26	
v/s Ratio Perm						c0.09			0.03			0.08
v/c Ratio		0.50		0.60	0.03	1.24	0.53	1.07	0.04	0.97	0.37	0.11
Uniform Delay, d1		64.9		65.8	63.2	67.8	67.4	22.2	7.0	68.7	9.0	7.2
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1.5		7.7	0.1	165.3	6.0	36.3	0.1	80.7	0.3	0.2
Delay (s)		66.4		73.5	63.3	233.0	73.3	58.6	7.1	149.4	9.3	7.4
Level of Service		E		E	E	F	E	E	A	F	A	A
Approach Delay (s)		66.4			193.8			58.1			16.7	
Approach LOS		E			F			E			B	

Intersection Summary				
HCM Average Control Delay	53.9	HCM Level of Service	D	
HCM Volume to Capacity ratio	1.03			
Actuated Cycle Length (s)	145.5	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	108.2%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Road & Fort Weaver Road

2030 + PRO (without Transit Corridor) - AM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1785	1583		1862	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.32	1.00		0.70	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		596	1583		1311	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	851	126	403	4	484	262	299	3044	1	21	949	532
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	860	127	407	4	489	265	302	3075	1	21	959	537
RTOR Reduction (vph)	0	0	0	0	0	37	0	0	0	0	0	204
Lane Group Flow (vph)	0	987	407	0	493	228	302	3075	1	21	959	333
Turn Type	Perm		Free	Perm		Perm	Prot		Free	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8			Free			6
Actuated Green, G (s)		75.0	149.6		75.0	75.0	27.9	60.2	149.6	2.4	34.7	34.7
Effective Green, g (s)		75.0	149.6		75.0	75.0	27.9	60.2	149.6	2.4	34.7	34.7
Actuated g/C Ratio		0.50	1.00		0.50	0.50	0.19	0.40	1.00	0.02	0.23	0.23
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		299	1583		657	794	330	2226	1583	28	1283	367
v/s Ratio Prot							c0.17	c0.56		0.01	0.17	
v/s Ratio Perm		c1.66	0.26		0.38	0.14			0.00			0.21
v/c Ratio		3.30	0.26		0.75	0.29	0.92	1.38	0.00	0.75	0.75	0.91
Uniform Delay, d1		37.3	0.0		29.8	21.7	59.7	44.7	0.0	73.3	53.4	55.9
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1044.0	0.4		4.8	0.2	28.7	174.5	0.0	71.8	4.0	28.4
Delay (s)		1081.3	0.4		34.6	21.9	88.4	219.2	0.0	145.1	57.4	84.3
Level of Service		F	A		C	C	F	F	A	F	E	F
Approach Delay (s)		765.7			30.2			207.5			68.1	
Approach LOS		F			C			F			E	

Intersection Summary				
HCM Average Control Delay	268.8	HCM Level of Service	F	
HCM Volume to Capacity ratio	2.43			
Actuated Cycle Length (s)	149.6	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	154.9%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

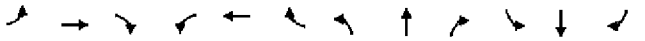
AR00028078

HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00		1.00	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	0.85		0.95		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1766	1583		1765		1770	5532	1583	1770	5532	1583
Flt Permitted	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1766	1583		1765		1770	5532	1583	1770	5532	1583
Volume (vph)	468	31	36	10	339	217	89	2658	1	251	1023	85
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	473	31	36	10	342	219	90	2685	1	254	1033	86
RTOR Reduction (vph)	0	0	0	0	15	0	0	0	0	0	0	47
Lane Group Flow (vph)	246	258	36	0	556	0	90	2685	1	254	1033	39
Turn Type	Split		Free	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free						2			6
Actuated Green, G (s)	20.0	20.0	150.0		33.0		12.3	65.0	65.0	16.0	68.7	68.7
Effective Green, g (s)	20.0	20.0	150.0		33.0		12.3	65.0	65.0	16.0	68.7	68.7
Actuated g/C Ratio	0.13	0.13	1.00		0.22		0.08	0.43	0.43	0.11	0.46	0.46
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	234	235	1583		388		145	2397	686	189	2534	725
v/s Ratio Prot	0.14	c0.15			c0.32		0.05	c0.49		c0.14	c0.19	
v/s Ratio Perm			0.02						0.00			0.02
v/c Ratio	1.05	1.10	0.02		1.43		0.62	1.12	0.00	1.34	0.41	0.05
Uniform Delay, d1	65.0	65.0	0.0		58.5		66.6	42.5	24.1	67.0	27.1	22.6
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	73.0	87.4	0.0		209.3		8.0	60.3	0.0	185.8	0.5	0.1
Delay (s)	138.0	152.4	0.0		267.8		74.6	102.8	24.1	252.8	27.6	22.7
Level of Service	F	F	A		F		E	F	C	F	C	C
Approach Delay (s)		135.6			267.8			101.9			68.9	
Approach LOS		F			F			F			E	

Intersection Summary			
HCM Average Control Delay	114.8	HCM Level of Service	F
HCM Volume to Capacity ratio	1.24		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0
Intersection Capacity Utilization	124.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
10: Farrington Hwy & D Street — 2030 + PRO (without Transit Corridor) - AM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	*0.99		*0.99	*0.99			*0.99	*0.99	*0.99	*0.99	
Frt	1.00	1.00		1.00	0.99			0.91	0.85	1.00	0.91	
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5532		3504	5478			1669	1567	1752	1678	
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5532		3504	5478			1669	1567	1752	1678	
Volume (vph)	146	1756	0	240	899	63	0	65	347	205	230	345
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	147	1774	0	242	908	64	0	66	351	207	232	348
RTOR Reduction (vph)	0	0	0	0	8	0	0	59	212	0	49	0
Lane Group Flow (vph)	147	1774	0	242	964	0	0	120	26	207	531	0
Turn Type	Prot			Prot					Perm	Split		
Protected Phases	5	2		1	6			8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	12.1	42.8		7.0	37.7			12.2	12.2	32.0	32.0	
Effective Green, g (s)	12.1	42.8		7.0	37.7			12.2	12.2	32.0	32.0	
Actuated g/C Ratio	0.11	0.39		0.06	0.34			0.11	0.11	0.29	0.29	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	195	2152		223	1877			185	174	510	488	
v/s Ratio Prot	0.08	c0.32		c0.07	0.18			c0.07		0.12	c0.32	
v/s Ratio Perm									0.02			
v/c Ratio	0.75	0.82		1.09	0.51			0.65	0.15	0.41	1.09	
Uniform Delay, d1	47.5	30.2		51.5	28.8			46.9	44.2	31.4	39.0	
Progression Factor	0.72	0.57		0.66	0.52			1.00	1.00	1.00	1.00	
Incremental Delay, d2	10.6	2.6		84.4	1.0			7.9	0.4	0.5	66.8	
Delay (s)	44.7	19.7		118.4	15.9			54.8	44.6	31.9	105.8	
Level of Service	D	B		F	B			D	D	C	F	
Approach Delay (s)		21.6			36.3			49.0			86.3	
Approach LOS		C			D			D			F	

Intersection Summary			
HCM Average Control Delay	40.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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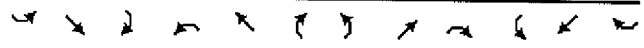
HCM Signalized Intersection Capacity Analysis
11: Farrington Hwy & E Street — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	*0.99			*0.99			1.00		1.00	1.00	
Frt	1.00	0.99			1.00			1.00		1.00	0.92	
Flt Protected	0.95	1.00			1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5503			5515			1812		1770	1722	
Flt Permitted	0.95	1.00			1.00			0.97		0.95	1.00	
Satd. Flow (perm)	1770	5503			5515			1812		1770	1722	
Volume (vph)	51	1764	64	0	1217	27	218	189	5	133	49	50
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	1917	70	0	1323	29	237	205	5	145	53	54
RTOR Reduction (vph)	0	4	0	0	2	0	0	1	0	0	34	0
Lane Group Flow (vph)	55	1983	0	0	1350	0	0	446	0	145	73	0
Turn Type	Prot						Split			Split		
Protected Phases	5	2			6		8	8		4	4	
Permitted Phases												
Actuated Green, G (s)	4.8	54.6			45.8			30.0		13.4	13.4	
Effective Green, g (s)	4.8	54.6			45.8			30.0		13.4	13.4	
Actuated g/C Ratio	0.04	0.50			0.42			0.27		0.12	0.12	
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	77	2731			2296			494		216	210	
v/s Ratio Prot	0.03	c0.36			0.24			c0.25		c0.08	0.04	
v/s Ratio Perm												
v/c Ratio	0.71	0.73			0.59			0.90		0.67	0.35	
Uniform Delay, d1	51.9	21.8			24.8			38.6		46.2	44.3	
Progression Factor	0.90	0.78			0.63			1.00		1.00	1.00	
Incremental Delay, d2	21.3	1.3			0.9			19.7		7.9	1.0	
Delay (s)	68.0	18.4			16.5			58.3		54.1	45.3	
Level of Service	E	B			B			E		D	D	
Approach Delay (s)		19.7			16.5			58.3			50.4	
Approach LOS		B			B			E			D	

Intersection Summary				
HCM Average Control Delay	24.8	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.77			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	71.2%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — 2030 + PRO (without Transit Corridor) - AM Peak



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	*0.99	*0.99	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	3538	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	3538	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Volume (vph)	377	708	799	572	579	161	338	441	485	80	743	707
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	381	715	807	578	585	163	341	445	490	81	751	714
RTOR Reduction (vph)	0	20	155	0	0	98	0	0	247	0	0	253
Lane Group Flow (vph)	381	961	386	578	585	65	341	445	243	81	751	461
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	26.1	64.0	64.0	34.9	72.8	72.8	21.1	67.2	67.2	13.9	60.0	60.0
Effective Green, g (s)	26.1	64.0	64.0	34.9	72.8	72.8	21.1	67.2	67.2	13.9	60.0	60.0
Actuated g/C Ratio	0.13	0.33	0.33	0.18	0.37	0.37	0.11	0.34	0.34	0.07	0.31	0.31
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	467	1155	512	624	1370	588	377	1264	543	126	1129	485
v/s Ratio Prot	0.11	c0.27		c0.16	0.16		c0.10	0.12		0.05	0.20	
v/s Ratio Perm			0.25			0.04			0.15			c0.29
v/c Ratio	0.82	0.83	0.75	0.93	0.43	0.11	0.90	0.35	0.45	0.64	0.67	0.95
Uniform Delay, d1	82.6	61.0	59.0	79.3	46.0	40.4	86.5	48.1	50.0	88.6	59.2	66.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	10.5	5.3	6.2	19.8	1.0	0.4	24.3	0.2	0.6	10.7	1.5	26.8
Delay (s)	93.2	66.3	65.2	99.1	47.0	40.8	110.7	48.3	50.6	99.3	60.7	95.4
Level of Service	F	E	E	F	D	D	F	D	D	F	E	F
Approach Delay (s)		71.4			68.9			65.9			76.8	
Approach LOS		E			E			E			E	

Intersection Summary				
HCM Average Control Delay	71.6	HCM Level of Service	E	
HCM Volume to Capacity ratio	0.90			
Actuated Cycle Length (s)	196.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	87.9%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

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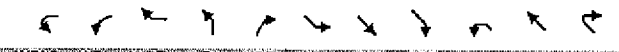
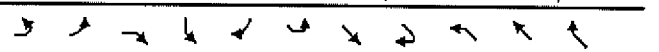
HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road — 2030 + PRO (without Transit Corridor) - AM Peak



Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99		1.00				*0.99	1.00	0.97	*0.99	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504		1583				3688	1583	3433	3688	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504		1583				3688	1583	3433	3688	
Volume (vph)	1414	0	115	0	0	0	1103	248	585	244	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1428	0	116	0	0	0	1114	251	591	246	0
RTOR Reduction (vph)	0	0	70	0	0	0	0	173	0	0	0
Lane Group Flow (vph)	1428	0	46	0	0	0	1114	78	591	246	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	40.0		40.0				31.0	31.0	17.0	52.0	
Effective Green, g (s)	40.0		40.0				31.0	31.0	17.0	52.0	
Actuated g/C Ratio	0.40		0.40				0.31	0.31	0.17	0.52	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1402		633				1143	491	584	1916	
v/s Ratio Prot	c0.41		0.03				c0.30		c0.17	0.07	
v/s Ratio Perm								0.05			
v/c Ratio	1.02		0.07				0.97	0.16	1.01	0.13	
Uniform Delay, d1	30.0		18.5				34.1	25.0	41.5	12.3	
Progression Factor	1.00		1.00				1.00	1.00	0.40	0.48	
Incremental Delay, d2	28.8		0.0				21.2	0.7	34.6	0.1	
Delay (s)	58.8		18.6				55.3	25.7	51.1	6.0	
Level of Service	E		B				E	C	D	A	
Approach Delay (s)		55.8		0.0			49.9			37.9	
Approach LOS		E		A			D			D	

Intersection Summary			
HCM Average Control Delay	49.6	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road — 2030 + PRO (without Transit Corridor) - AM Peak



Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		1.00			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		1583			3433	3688			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		1583			3433	3688			3688	3135
Volume (vph)	51	0	689	0	0	803	1714	0	0	778	2380
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	0	696	0	0	811	1731	0	0	786	2404
RTOR Reduction (vph)	0	0	18	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	52	0	678	0	0	811	1731	0	0	786	2404
Turn Type	Prot		custom			Prot					Free
Protected Phases	4		4			1	6			2	
Permitted Phases											Free
Actuated Green, G (s)	29.0		29.0			29.4	63.0			29.6	100.0
Effective Green, g (s)	29.0		29.0			29.4	63.0			29.6	100.0
Actuated g/C Ratio	0.29		0.29			0.29	0.63			0.30	1.00
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	513		459			1009	2323			1092	3135
v/s Ratio Prot	0.03		c0.43			0.24	0.47			0.21	
v/s Ratio Perm											c0.77
v/c Ratio	0.10		1.48			0.80	0.75			0.72	0.77
Uniform Delay, d1	26.0		35.5			32.6	12.9			31.5	0.0
Progression Factor	1.00		1.00			0.94	0.29			1.00	1.00
Incremental Delay, d2	0.1		225.8			1.1	0.5			4.1	1.9
Delay (s)	26.1		261.3			31.6	4.3			35.6	1.9
Level of Service	C		F			C	A			D	A
Approach Delay (s)		244.9		0.0			13.0			10.2	
Approach LOS		F		A			B			B	

Intersection Summary			
HCM Average Control Delay	38.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	96.7%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

AR00028081

HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	5532	1583	3504	5532	1583	3504	3688	1583	3504	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	5532	1583	3504	5532	1583	3504	3688	1583	3504	3688	1583
Volume (vph)	765	1166	567	463	1804	349	544	404	227	176	488	810
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	773	1178	573	468	1822	353	549	408	229	178	493	818
RTOR Reduction (vph)	0	0	221	0	0	152	0	0	153	0	0	228
Lane Group Flow (vph)	773	1178	352	468	1822	201	549	408	76	178	493	590
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	27.0	48.7	48.7	23.3	45.0	45.0	26.0	49.7	49.7	12.3	36.0	36.0
Effective Green, g (s)	27.0	48.7	48.7	23.3	45.0	45.0	26.0	49.7	49.7	12.3	36.0	36.0
Actuated g/C Ratio	0.18	0.32	0.32	0.16	0.30	0.30	0.17	0.33	0.33	0.08	0.24	0.24
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	631	1795	514	544	1660	475	607	1222	525	287	885	380
v/s Ratio Prot	c0.22	0.21		0.13	c0.33		c0.16	0.11		0.05	0.13	
v/s Ratio Perm			c0.22			0.13			0.05			c0.37
v/c Ratio	1.23	0.66	0.69	0.86	1.10	0.42	0.90	0.33	0.14	0.62	0.56	1.55
Uniform Delay, d1	61.5	43.5	44.0	61.8	52.5	42.1	60.8	37.7	35.2	66.6	50.0	57.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	114.9	0.9	3.6	13.1	53.9	0.6	19.4	0.7	0.6	4.1	2.5	261.3
Delay (s)	176.4	44.3	47.8	74.9	106.4	42.7	80.1	38.4	35.8	70.7	52.5	318.3
Level of Service	F	D	D	E	F	D	F	D	D	E	D	F
Approach Delay (s)		85.6			92.3			57.2			200.7	
Approach LOS		F			F			E			F	

Intersection Summary				
HCM Average Control Delay	105.4	HCM Level of Service	F	
HCM Volume to Capacity ratio	1.23			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	110.5%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connector — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99	0.86	*0.99	*0.99		*0.99	*0.99		*0.99	1.00	*0.99
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5532	1362	3504	5424		3504	3608		3504	1863	3135
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	5532	1362	3504	5424		3504	3608		3504	1863	3135
Volume (vph)	51	2067	233	489	940	141	220	163	28	367	107	329
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	2088	235	494	949	142	222	165	28	371	108	332
RTOR Reduction (vph)	0	0	105	0	17	0	0	13	0	0	0	38
Lane Group Flow (vph)	52	2088	130	494	1074	0	222	180	0	371	108	294
Turn Type	Prot		Perm	Prot			Prot			Prot		pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2									8
Actuated Green, G (s)	6.7	54.9	54.9	17.9	66.1		12.4	11.9		14.0	13.5	31.4
Effective Green, g (s)	6.7	54.9	54.9	17.9	66.1		12.4	11.9		14.0	13.5	31.4
Actuated g/C Ratio	0.06	0.48	0.48	0.16	0.58		0.11	0.10		0.12	0.12	0.27
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	103	2648	652	547	3126		379	374		428	219	968
v/s Ratio Prot	0.03	c0.38		c0.14	0.20		0.06	0.05		c0.11	c0.06	0.05
v/s Ratio Perm			0.10									0.05
v/c Ratio	0.50	0.79	0.20	0.90	0.34		0.59	0.48		0.87	0.49	0.30
Uniform Delay, d1	52.4	25.0	17.2	47.5	12.8		48.7	48.5		49.4	47.4	33.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.9	2.5	0.7	18.2	0.3		2.3	1.0		16.6	1.7	0.2
Delay (s)	56.2	27.5	17.9	65.7	13.1		51.0	49.5		66.1	49.1	33.2
Level of Service	E	C	B	E	B		D	D		E	D	C
Approach Delay (s)		27.2			29.5			50.3			50.3	
Approach LOS		C			C			D			D	

Intersection Summary				
HCM Average Control Delay	33.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.76			
Actuated Cycle Length (s)	114.7	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	84.8%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
17: East-West Rd. & North-South Road — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	*0.99	0.95		0.97	*0.99		*0.99	*0.99		*0.99	*0.99	
Frt	1.00	0.95		1.00	0.87		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3504	3363		3433	3217		3504	5428		3504	5407	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3504	3363		3433	3217		3504	5428		3504	5407	
Volume (vph)	244	225	112	245	113	652	207	1454	209	193	970	173
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	265	245	122	266	123	709	225	1580	227	210	1054	188
RTOR Reduction (vph)	0	51	0	0	196	0	0	19	0	0	25	0
Lane Group Flow (vph)	265	316	0	266	636	0	225	1788	0	210	1217	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	13.0	23.4		13.3	23.7		11.7	37.1		16.0	41.4	
Effective Green, g (s)	13.0	23.4		13.3	23.7		11.7	37.1		16.0	41.4	
Actuated g/C Ratio	0.12	0.22		0.13	0.22		0.11	0.35		0.15	0.39	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	431	744		432	721		387	1903		530	2116	
v/s Ratio Prot	0.08	0.09		c0.08	c0.20		c0.06	c0.33		c0.06	0.23	
v/s Ratio Perm												
v/c Ratio	0.61	0.42		0.62	1.30dr		0.58	0.94		0.40	0.58	
Uniform Delay, d1	44.0	35.4		43.8	39.7		44.7	33.3		40.5	25.3	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.6	0.4		2.6	12.3		2.2	10.6		2.2	1.1	
Delay (s)	46.6	35.8		46.4	52.0		46.9	43.9		42.7	26.4	
Level of Service	D	D		D	D		D	D		D	C	
Approach Delay (s)		40.3			50.7			44.2			28.8	
Approach LOS		D			D			D			C	

Intersection Summary				
HCM Average Control Delay	40.8	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.77			
Actuated Cycle Length (s)	105.8	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	82.8%	ICU Level of Service	E	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway — 2030 + PRO (without Transit Corridor) - AM Peak

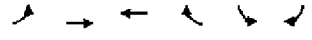
Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		1.00	0.91		0.97	0.91	1.00	1.00	0.91	1.00
Frt	1.00	0.98		1.00	0.92		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5001		1770	4670		3433	5085	1583	1770	5085	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5001		1770	4670		3433	5085	1583	1770	5085	1583
Volume (vph)	245	519	64	229	500	597	860	315	316	118	637	491
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	266	564	70	249	543	649	935	342	343	128	692	534
RTOR Reduction (vph)	0	11	0	0	154	0	0	0	213	0	0	230
Lane Group Flow (vph)	266	623	0	249	1038	0	935	342	130	128	692	304
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases									4			8
Actuated Green, G (s)	22.0	33.7		22.3	34.0		39.0	52.6	52.6	14.6	28.2	28.2
Effective Green, g (s)	22.0	33.7		22.3	34.0		39.0	52.6	52.6	14.6	28.2	28.2
Actuated g/C Ratio	0.16	0.24		0.16	0.24		0.28	0.38	0.38	0.10	0.20	0.20
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	280	1211		284	1141		962	1921	598	186	1030	321
v/s Ratio Prot	c0.15	0.12		0.14	c0.22		c0.27	0.07		0.07	0.14	
v/s Ratio Perm									0.08			c0.19
v/c Ratio	0.95	0.51		0.88	1.20dr		0.97	0.18	0.22	0.69	0.67	0.95
Uniform Delay, d1	58.1	45.7		57.1	51.1		49.6	28.9	29.3	60.1	51.2	54.6
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	39.8	1.6		24.7	12.2		22.3	0.0	0.2	10.1	1.7	36.3
Delay (s)	97.9	47.2		81.8	63.3		71.9	28.9	29.5	70.2	53.0	91.1
Level of Service	F	D		F	E		E	C	C	E	D	F
Approach Delay (s)		62.2			66.5			53.8			69.6	
Approach LOS		E			E			D			E	

Intersection Summary				
HCM Average Control Delay	62.7	HCM Level of Service	E	
HCM Volume to Capacity ratio	0.92			
Actuated Cycle Length (s)	139.2	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	86.8%	ICU Level of Service	E	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

AR00028083

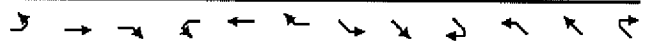
HCM Signalized Intersection Capacity Analysis
19: East-West Rd. & Old Fort Weaver Rd — 2030 + PRO (without Transit Corridor) - AM Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	3539	1583	3433	1583
Flt Permitted	0.56	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1046	1863	3539	1583	3433	1583
Volume (vph)	21	893	310	1006	487	45
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	21	902	313	1016	492	45
RTOR Reduction (vph)	0	0	0	461	0	31
Lane Group Flow (vph)	21	902	313	555	492	14
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Actuated Green, G (s)	29.3	29.3	29.3	29.3	16.3	16.3
Effective Green, g (s)	29.3	29.3	29.3	29.3	16.3	16.3
Actuated g/C Ratio	0.55	0.55	0.55	0.55	0.30	0.30
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	572	1018	1935	865	1044	481
v/s Ratio Prot		c0.48	0.09		c0.14	
v/s Ratio Perm	0.02			0.35		0.01
v/c Ratio	0.04	0.89	0.16	0.64	0.47	0.03
Uniform Delay, d1	5.6	10.7	6.0	8.5	15.1	13.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	9.4	0.0	1.6	1.5	0.1
Delay (s)	5.6	20.1	6.1	10.1	16.7	13.2
Level of Service	A	C	A	B	B	B
Approach Delay (s)		19.7	9.2		16.4	
Approach LOS		B	A		B	

Intersection Summary				
HCM Average Control Delay	14.1	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.74			
Actuated Cycle Length (s)	53.6	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	72.3%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
20: Farrington Hwy & B Street — 2030 + PRO (without Transit Corridor) - AM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	1770	1863	1583	3433	1863	1583
Volume (vph)	215	1127	203	124	897	87	49	137	126	343	223	206
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	234	1225	221	135	975	95	53	149	137	373	242	224
RTOR Reduction (vph)	0	0	107	0	0	64	0	0	10	0	0	58
Lane Group Flow (vph)	234	1225	114	135	975	31	53	149	127	373	242	166
Turn Type	Prot		pm+ov	Prot		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6		7	4	5	3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	10.4	31.0	41.0	5.0	25.6	25.6	3.5	17.7	28.1	10.0	24.2	29.2
Effective Green, g (s)	10.4	31.0	41.0	5.0	25.6	25.6	3.5	17.7	28.1	10.0	24.2	29.2
Actuated g/C Ratio	0.13	0.39	0.51	0.06	0.32	0.32	0.04	0.22	0.35	0.13	0.30	0.37
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	448	1377	894	215	1137	508	78	414	638	431	566	659
v/s Ratio Prot	c0.07	c0.35	0.02	0.04	0.28		0.03	0.08	0.03	c0.11	c0.13	0.02
v/s Ratio Perm			0.06			0.02			0.05			0.09
v/c Ratio	0.52	0.89	0.13	0.63	0.86	0.06	0.68	0.36	0.20	0.87	0.43	0.25
Uniform Delay, d1	32.3	22.8	10.1	36.4	25.3	18.7	37.5	26.2	18.0	34.2	22.2	17.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.1	7.4	0.1	5.6	6.6	0.0	21.0	2.4	0.2	16.4	2.4	0.2
Delay (s)	33.4	30.2	10.1	42.1	31.9	18.8	58.6	28.6	18.1	50.6	24.6	17.8
Level of Service	C	C	B	D	C	B	E	C	B	D	C	B
Approach Delay (s)		28.0			32.0			29.1			34.3	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM Average Control Delay	30.6	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.71			
Actuated Cycle Length (s)	79.7	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	65.0%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028084

HCM Signalized Intersection Capacity Analysis
21: East-West Rd. & A Street — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1842		1770	1863	1583	1770	1597		1770	1630	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1842		1770	1863	1583	1770	1597		1770	1630	
Volume (vph)	90	328	27	31	700	74	93	7	140	44	7	37
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	357	29	34	761	80	101	8	152	48	8	40
RTOR Reduction (vph)	0	2	0	0	0	34	0	134	0	0	36	0
Lane Group Flow (vph)	98	384	0	34	761	46	101	26	0	48	12	0
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6						
Actuated Green, G (s)	7.8	44.1		2.2	38.5	38.5	9.7	9.7		7.7	7.7	
Effective Green, g (s)	7.8	44.1		2.2	38.5	38.5	9.7	9.7		7.7	7.7	
Actuated g/C Ratio	0.10	0.55		0.03	0.48	0.48	0.12	0.12		0.10	0.10	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	173	1019		49	900	765	215	194		171	157	
v/s Ratio Prot	c0.06	0.21		0.02	c0.41		c0.06	0.02		c0.03	0.01	
v/s Ratio Perm						0.03						
v/c Ratio	0.57	0.38		0.69	0.85	0.06	0.47	0.14		0.28	0.08	
Uniform Delay, d1	34.3	10.0		38.4	18.0	11.0	32.6	31.3		33.4	32.8	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.2	0.2		34.8	7.4	0.0	1.6	0.3		0.9	0.2	
Delay (s)	38.5	10.3		73.2	25.4	11.0	34.2	31.6		34.3	33.0	
Level of Service	D	B		E	C	B	C	C		C	C	
Approach Delay (s)		16.0			25.9			32.6			33.6	
Approach LOS		B			C			C			C	

Intersection Summary				
HCM Average Control Delay	24.6	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.69			
Actuated Cycle Length (s)	79.7	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	67.5%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
22: Farrington Hwy & 2nd Avenue — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		0.97	0.95	1.00	1.00	0.95	0.88	0.97	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5044		3433	3539	1583	1770	3539	2787	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5044		3433	3539	1583	1770	3539	2787	3433	3539	1583
Volume (vph)	172	1091	63	241	945	299	98	391	547	241	259	138
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	187	1186	68	262	1027	325	107	425	595	262	282	150
RTOR Reduction (vph)	0	6	0	0	0	213	0	0	17	0	0	109
Lane Group Flow (vph)	187	1248	0	262	1027	112	107	425	578	262	282	41
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		Perm
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases						6			8			4
Actuated Green, G (s)	15.0	40.0		13.0	38.0	38.0	11.0	30.2	43.2	10.8	30.0	30.0
Effective Green, g (s)	15.0	40.0		13.0	38.0	38.0	11.0	30.2	43.2	10.8	30.0	30.0
Actuated g/C Ratio	0.14	0.36		0.12	0.35	0.35	0.10	0.27	0.39	0.10	0.27	0.27
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	241	1834		406	1223	547	177	972	1196	337	965	432
v/s Ratio Prot	0.11	c0.25		0.08	c0.29		0.06	0.12	c0.06	c0.08	0.08	
v/s Ratio Perm						0.07			0.15			0.03
v/c Ratio	0.78	0.68		0.65	0.84	0.21	0.60	0.44	0.48	0.78	0.29	0.09
Uniform Delay, d1	45.9	29.6		46.3	33.2	25.4	47.4	32.9	25.0	48.4	31.6	29.9
Progression Factor	1.00	1.00		0.59	0.84	1.27	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.4	2.1		2.8	5.6	0.7	5.7	1.4	0.3	10.8	0.8	0.4
Delay (s)	60.3	31.7		29.8	27.0	32.9	63.1	34.3	25.3	59.2	32.4	30.3
Level of Service	E	C		C	C	C	D	C	C	E	C	C
Approach Delay (s)		35.4			28.6			31.4			42.0	
Approach LOS		D			C			C			D	

Intersection Summary				
HCM Average Control Delay	33.2	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.66			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	66.7%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028085

HCM Unsignalized Intersection Capacity Analysis
23: 2nd Avenue & Kunia Road

2030 + PRO (without Transit Corridor) - AM Peak

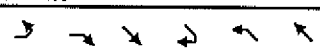
Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	1976	301	0	5208
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	2148	327	0	5661
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			870			
pX, platoon unblocked	0.91	0.91			0.91	
vC, conflicting volume	3727	701			2475	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3698	358			2317	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	3	578			192	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	0	614	614	614	634	1415	1415	1415	1415
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	0	327	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.36	0.36	0.36	0.37	0.83	0.83	0.83	0.83
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A								
Approach Delay (s)	0.0	0.0				0.0			
Approach LOS	A								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
24: 3rd Avenue & Kunia Road

2030 + PRO (without Transit Corridor) - AM Peak



Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	7	1846	129	0	5208
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	8	2007	140	0	5661
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			1234			
pX, platoon unblocked	0.98	0.98			0.98	
vC, conflicting volume	3492	572			2147	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3483	510			2113	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	98			100	
cM capacity (veh/h)	5	499			251	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	8	573	573	573	427	1415	1415	1415	1415
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	8	0	0	0	140	0	0	0	0
cSH	499	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.02	0.34	0.34	0.34	0.25	0.83	0.83	0.83	0.83
Queue Length 95th (ft)	1	0	0	0	0	0	0	0	0
Control Delay (s)	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B								
Approach Delay (s)	12.3	0.0				0.0			
Approach LOS	B								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

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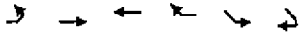
HCM Signalized Intersection Capacity Analysis
25: East-West Rd. & B Street — 2030 + PRO (without Transit Corridor) - AM Peak



Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Volume (vph)	156	302	313	86	648	492
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	170	328	340	93	704	535
RTOR Reduction (vph)	0	0	0	71	0	268
Lane Group Flow (vph)	170	328	340	22	704	267
Turn Type	Prot			Prot		Prot
Protected Phases	5	2	6	6	4	4
Permitted Phases						
Actuated Green, G (s)	7.9	26.9	15.0	15.0	28.1	28.1
Effective Green, g (s)	7.9	26.9	15.0	15.0	28.1	28.1
Actuated g/C Ratio	0.13	0.43	0.24	0.24	0.45	0.45
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	222	795	444	377	789	706
v/s Ratio Prot	c0.10	0.18	c0.18	0.01	c0.40	0.17
v/s Ratio Perm						
v/c Ratio	0.77	0.41	0.77	0.06	0.89	0.38
Uniform Delay, d1	26.7	12.6	22.4	18.5	16.1	11.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.5	0.3	7.7	0.1	14.5	1.5
Delay (s)	41.2	12.9	30.1	18.6	30.6	13.2
Level of Service	D	B	C	B	C	B
Approach Delay (s)		22.6	27.6		23.1	
Approach LOS		C	C		C	

Intersection Summary			
HCM Average Control Delay	23.9	HCM Level of Service	C
HCM Volume to Capacity ratio	0.84		
Actuated Cycle Length (s)	63.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
26: Farrington Hwy & — 2030 + PRO (without Transit Corridor) - AM Peak

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3688	3688	1583
Flt Permitted	0.95	1.00	0.25	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	466	3688	3688	1583
Volume (vph)	109	234	51	1066	1384	134
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	110	236	52	1077	1398	135
RTOR Reduction (vph)	0	5	0	0	0	81
Lane Group Flow (vph)	110	231	52	1077	1398	54
Turn Type		Perm	Perm			Perm
Protected Phases	6			4	8	
Permitted Phases		6	4			8
Actuated Green, G (s)	16.0	16.0	16.0	16.0	16.0	16.0
Effective Green, g (s)	16.0	16.0	16.0	16.0	16.0	16.0
Actuated g/C Ratio	0.40	0.40	0.40	0.40	0.40	0.40
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Grp Cap (vph)	708	633	186	1475	1475	633
v/s Ratio Prot	0.06			0.29	c0.38	
v/s Ratio Perm		c0.15	0.11			0.03
v/c Ratio	0.16	0.36	0.28	0.73	0.95	0.09
Uniform Delay, d1	7.7	8.4	8.1	10.2	11.6	7.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	1.6	3.7	3.2	13.9	0.3
Delay (s)	8.1	10.0	11.8	13.4	25.5	7.7
Level of Service	A	B	B	B	C	A
Approach Delay (s)	9.4			13.3	23.9	
Approach LOS	A			B	C	

Intersection Summary			
HCM Average Control Delay	18.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	40.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

AR00028087

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	*0.99	1.00	*0.99	1.00		*0.99
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3504	1583	3688	1583		5532
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3504	1583	3688	1583		5532
Volume (vph)	892	41	2670	918	0	2765
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	901	41	2697	927	0	2793
RTOR Reduction (vph)	0	4	0	180	0	0
Lane Group Flow (vph)	901	37	2697	747	0	2793
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	36.0	36.0	106.0	106.0		106.0
Effective Green, g (s)	36.0	36.0	106.0	106.0		106.0
Actuated g/C Ratio	0.24	0.24	0.71	0.71		0.71
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	841	380	2606	1119		3909
v/s Ratio Prot	c0.26		c0.73			0.50
v/s Ratio Perm		0.02		0.47		
v/c Ratio	1.07	0.10	1.03	0.67		0.71
Uniform Delay, d1	57.0	44.4	22.0	12.2		13.0
Progression Factor	1.00	1.00	1.14	1.31		1.00
Incremental Delay, d2	52.0	0.1	26.1	2.7		1.1
Delay (s)	109.0	44.5	51.2	18.6		14.2
Level of Service	F	D	D	B		B
Approach Delay (s)	106.2		42.9			14.2
Approach LOS	F		D			B

Intersection Summary			
HCM Average Control Delay	40.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	105.9%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	*0.99			*0.99	
Frt						0.86	1.00	1.00			0.99	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5532			5455	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5532			5455	
Volume (vph)	0	0	0	0	0	1230	427	2358	0	0	3316	341
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	0	0	0	0	1242	431	2382	0	0	3349	344
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	9	0
Lane Group Flow (vph)	0	0	0	0	0	1242	431	2382	0	0	3684	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						150.0	35.0	150.0			107.0	
Effective Green, g (s)						150.0	35.0	150.0			107.0	
Actuated g/C Ratio						1.00	0.23	1.00			0.71	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	413	5532			3891	
v/s Ratio Prot							c0.24	0.43			c0.68	
v/s Ratio Perm						0.77						
v/c Ratio						0.77	1.04	0.43			0.95	
Uniform Delay, d1						0.0	57.5	0.0			19.0	
Progression Factor						1.00	0.93	1.00			0.76	
Incremental Delay, d2						3.6	53.4	0.2			4.0	
Delay (s)						3.6	106.9	0.2			18.5	
Level of Service						A	F	A			B	
Approach Delay (s)		0.0			3.6			16.6			18.5	
Approach LOS		A			A			B			B	

Intersection Summary			
HCM Average Control Delay	15.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	102.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

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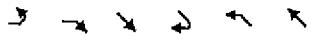
HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak



Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	*0.99	1.00	*0.99			*0.99
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3504	1583	7376			5532
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3504	1583	7376			5532
Volume (vph)	530	584	4854	0	0	2355
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	576	635	5276	0	0	2560
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	576	635	5276	0	0	2560
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	29.2	150.0	112.8			112.8
Effective Green, g (s)	29.2	150.0	112.8			112.8
Actuated g/C Ratio	0.19	1.00	0.75			0.75
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	682	1583	5547			4160
v/s Ratio Prot	c0.16		c0.72			0.46
v/s Ratio Perm		0.40				
v/c Ratio	0.84	0.40	0.95			0.62
Uniform Delay, d1	58.2	0.0	16.2			8.6
Progression Factor	1.00	1.00	1.01			0.97
Incremental Delay, d2	9.4	0.8	5.0			0.6
Delay (s)	67.6	0.8	21.4			8.9
Level of Service	E	A	C			A
Approach Delay (s)	32.6		21.4			8.9
Approach LOS	C		C			A

Intersection Summary			
HCM Average Control Delay	19.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	141.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		*0.99		*0.99	*0.99				1.00			1.00
Frt		0.98		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		5402		3504	5532				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		5402		3504	5532				1611			1611
Volume (vph)	0	2308	429	779	1962	0	0	0	440	0	0	903
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	2331	433	787	1982	0	0	0	444	0	0	912
RTOR Reduction (vph)	0	21	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2743	0	787	1982	0	0	0	444	0	0	912
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		79.0		63.0	150.0				150.0			150.0
Effective Green, g (s)		79.0		63.0	150.0				150.0			150.0
Actuated g/C Ratio		0.53		0.42	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		2845		1472	5532				1611			1611
v/s Ratio Prot		c0.51		0.22	0.36							
v/s Ratio Perm									0.28			c0.57
v/c Ratio		0.96		0.53	0.36				0.28			0.57
Uniform Delay, d1		34.1		32.5	0.0				0.0			0.0
Progression Factor		0.23		1.00	1.00				1.00			1.00
Incremental Delay, d2		5.7		0.0	0.0				0.4			1.4
Delay (s)		13.5		32.6	0.0				0.4			1.4
Level of Service		B		C	A				A			A
Approach Delay (s)		13.5			9.3			0.4			1.4	
Approach LOS		B			A			A			A	

Intersection Summary			
HCM Average Control Delay	9.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0				4.0			
Lane Util. Factor	1.00	*0.99			*0.99				1.00			
Frt	1.00	1.00			0.96				0.86			
Flt Protected	0.95	1.00			1.00				1.00			
Satd. Flow (prot)	1770	5532			5285				1611			
Flt Permitted	0.95	1.00			1.00				1.00			
Satd. Flow (perm)	1770	5532			5285				1611			
Volume (vph)	1429	1319	0	0	2743	1164	0	0	647	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1443	1332	0	0	2771	1176	0	0	654	0	0	0
RTOR Reduction (vph)	0	0	0	0	9	0	0	0	0	0	0	0
Lane Group Flow (vph)	1443	1332	0	0	3938	0	0	0	654	0	0	0
Turn Type	Prot								Free			
Protected Phases	5	2			6							
Permitted Phases									Free			
Actuated Green, G (s)	71.0	150.0			71.0				150.0			
Effective Green, g (s)	71.0	150.0			71.0				150.0			
Actuated g/C Ratio	0.47	1.00			0.47				1.00			
Clearance Time (s)	4.0	4.0			4.0							
Vehicle Extension (s)	3.0	3.0			3.0							
Lane Grp Cap (vph)	838	5532			2502				1611			
v/s Ratio Prot	c0.82	0.24			c0.75							
v/s Ratio Perm									0.41			
v/c Ratio	1.72	0.24			1.57				0.41			
Uniform Delay, d1	39.5	0.0			39.5				0.0			
Progression Factor	0.52	1.00			0.69				1.00			
Incremental Delay, d2	327.4	0.1			258.5				0.8			
Delay (s)	347.9	0.1			285.7				0.8			
Level of Service	F	A			F				A			
Approach Delay (s)		180.9			285.7			0.8			0.0	
Approach LOS		F			F			A			A	

Intersection Summary			
HCM Average Control Delay	221.0	HCM Level of Service	F
HCM Volume to Capacity ratio	1.65		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	164.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	1.00	*0.99	1.00		1.00	1.00		*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (prot)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (perm)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Volume (vph)	286	1564	116	135	3511	515	197	29	130	243	28	194
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	289	1580	117	136	3546	520	199	29	131	245	28	196
RTOR Reduction (vph)	0	0	49	0	0	136	0	0	41	0	0	106
Lane Group Flow (vph)	289	1580	68	136	3546	384	0	228	90	0	273	90
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	11.9	86.6	86.6	16.3	91.0	91.0		16.0	16.0		15.1	15.1
Effective Green, g (s)	11.9	86.6	86.6	16.3	91.0	91.0		16.0	16.0		15.1	15.1
Actuated g/C Ratio	0.08	0.58	0.58	0.11	0.61	0.61		0.11	0.11		0.10	0.10
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	278	3194	914	192	3356	960		190	169		355	159
v/s Ratio Prot	c0.08	0.29		c0.08	c0.64			c0.13			c0.08	
v/s Ratio Perm			0.04			0.24			0.06			0.06
v/c Ratio	1.04	0.49	0.07	0.71	1.06	0.40		1.20	0.53		1.39dl	0.57
Uniform Delay, d1	69.0	18.8	14.0	64.6	29.5	15.3		67.0	63.5		65.8	64.3
Progression Factor	1.06	1.07	1.44	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	63.8	0.5	0.2	11.3	33.2	1.2		129.5	11.5		9.6	4.5
Delay (s)	137.1	20.6	20.2	75.9	62.7	16.6		196.5	74.9		75.4	68.9
Level of Service	F	C	C	E	E	B		F	E		E	E
Approach Delay (s)		37.5			57.4			152.1			72.7	
Approach LOS		D			E			F			E	

Intersection Summary			
HCM Average Control Delay	57.6	HCM Level of Service	E
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	106.1%	ICU Level of Service	G
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

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HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3518		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3518		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	209	37	13	62	4	231	56	2896	100	231	4375	62
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	211	37	13	63	4	233	57	2925	101	233	4419	63
RTOR Reduction (vph)	0	3	0	0	0	187	0	0	27	0	0	17
Lane Group Flow (vph)	0	258	0	63	4	46	57	2925	74	233	4419	66
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		14.8		5.0	5.0	5.0	4.0	92.0	92.0	21.0	109.0	109.0
Effective Green, g (s)		14.8		5.0	5.0	5.0	4.0	92.0	92.0	21.0	109.0	109.0
Actuated g/C Ratio		0.10		0.03	0.03	0.03	0.03	0.62	0.62	0.14	0.73	0.73
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		350		59	63	53	48	3420	979	250	4052	1160
v/s Ratio Prot		c0.07		c0.04	0.00		c0.03	0.53		0.13	c0.80	
v/s Ratio Perm						0.03			0.05			0.04
v/c Ratio		1.19dl		1.07	0.06	0.86	1.19	0.86	0.08	0.93	1.09	0.06
Uniform Delay, d1		65.1		71.9	69.6	71.5	72.4	23.0	11.4	63.2	19.9	5.6
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		79		137.3	0.4	73.0	189.9	3.0	0.2	38.7	45.5	0.1
Delay (s)		73.0		209.2	70.1	144.6	262.3	26.0	11.5	101.9	65.4	5.6
Level of Service		E		F	E	F	F	C	B	F	E	A
Approach Delay (s)		73.0			157.2			29.9			66.2	
Approach LOS		E			F			C			E	

Intersection Summary			
HCM Average Control Delay	56.3	HCM Level of Service	E
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	148.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	116.1%	ICU Level of Service	H
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Road & Fort Weaver Road — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		1.00	1.00		1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96	1.00		0.99	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		1790	1583		1849	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.52	1.00		0.26	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		969	1583		493	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	837	200	483	37	219	89	563	2123	3	193	3255	1002
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	845	202	488	37	221	90	569	2144	3	195	3288	1012
RTOR Reduction (vph)	0	0	0	0	0	42	0	0	0	0	0	315
Lane Group Flow (vph)	0	1047	488	0	258	48	569	2144	3	195	3288	697
Turn Type	Perm		Free	Perm		Perm	Prot		Free	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases	4		Free	8		8			Free			6
Actuated Green, G (s)		68.0	150.0		68.0	68.0	21.0	61.0	150.0	9.0	49.0	49.0
Effective Green, g (s)		68.0	150.0		68.0	68.0	21.0	61.0	150.0	9.0	49.0	49.0
Actuated g/C Ratio		0.45	1.00		0.45	0.45	0.14	0.41	1.00	0.06	0.33	0.33
Clearance Time (s)		4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)		3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)		439	1583		223	718	248	2250	1583	106	1807	517
v/s Ratio Prot							c0.32	0.39		0.11	c0.59	
v/s Ratio Perm		c1.08	0.31		0.52	0.03			0.00			0.44
v/c Ratio		2.38	0.31		1.16	0.07	2.29	0.95	0.00	1.84	1.82	1.35
Uniform Delay, d1		41.0	0.0		41.0	23.1	64.5	43.1	0.0	70.5	50.5	50.5
Progression Factor		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		630.2	0.5		109.1	0.0	595.1	10.7	0.0	412.0	371.0	169.1
Delay (s)		671.2	0.5		150.1	23.2	659.6	53.8	0.0	482.5	421.5	219.6
Level of Service		F	A		F	C	F	D	A	F	F	F
Approach Delay (s)		458.0			117.3			180.7			378.7	
Approach LOS		F			F			F			F	

Intersection Summary			
HCM Average Control Delay	322.9	HCM Level of Service	F
HCM Volume to Capacity ratio	2.17		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	177.9%	ICU Level of Service	H
Analysis Period (min)	15		

c Critical Lane Group

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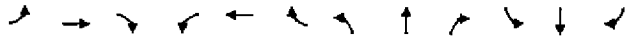
HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road

2030 + PRO (without Transit Corridor) - PM Peak



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00		1.00	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	0.85		0.91		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1761	1583		1693		1770	5532	1583	1770	5532	1583
Flt Permitted	0.95	0.96	1.00		1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1761	1583		1693		1770	5532	1583	1770	5532	1583
Volume (vph)	725	23	43	9	151	326	45	2103	75	514	3074	519
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	732	23	43	9	153	329	45	2124	76	519	3105	524
RTOR Reduction (vph)	0	0	0	0	49	0	0	0	7	0	0	205
Lane Group Flow (vph)	368	387	43	0	442	0	45	2124	69	519	3105	319
Turn Type	Split		Free	Split			Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free						2			6
Actuated Green, G (s)	28.0	28.0	150.0		26.0		4.0	49.0	49.0	31.0	76.0	76.0
Effective Green, g (s)	28.0	28.0	150.0		26.0		4.0	49.0	49.0	31.0	76.0	76.0
Actuated g/C Ratio	0.19	0.19	1.00		0.17		0.03	0.33	0.33	0.21	0.51	0.51
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	327	329	1583		293		47	1807	517	366	2803	802
v/s Ratio Prot	0.21	c0.22			c0.26		0.03	c0.38		c0.29	0.56	
v/s Ratio Perm			0.03						0.04			0.20
v/c Ratio	1.13	1.18	0.03		1.51		0.96	1.18	0.13	1.42	1.11	0.40
Uniform Delay, d1	61.0	61.0	0.0		62.0		72.9	50.5	35.5	59.5	37.0	22.9
Progression Factor	1.00	1.00	1.00		1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	88.1	106.5	0.0		246.1		114.0	85.1	0.5	203.5	54.4	1.5
Delay (s)	149.1	167.5	0.0		308.1		186.9	135.6	36.1	263.0	91.4	24.3
Level of Service	F	F	A		F		F	F	D	F	F	C
Approach Delay (s)		150.0			308.1			133.3			104.4	
Approach LOS		F			F			F			F	

Intersection Summary				
HCM Average Control Delay	130.6	HCM Level of Service	F	
HCM Volume to Capacity ratio	1.30			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	131.6%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
10: Farrington Hwy & D Street

2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	*0.99		*0.99	*0.99			*0.99	*0.99	*0.99	*0.99	
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	0.99	
Satd. Flow (prot)	1770	5532		3504	5473			1844	1567	1752	1614	
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	0.99	
Satd. Flow (perm)	1770	5532		3504	5473			1844	1567	1752	1614	
Volume (vph)	99	2335	0	425	2265	175	0	179	45	357	7	259
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	100	2359	0	429	2288	177	0	181	45	361	7	262
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	40	0	82	0
Lane Group Flow (vph)	100	2359	0	429	2459	0	0	181	5	291	257	0
Turn Type	Prot			Prot					Perm	Split		
Protected Phases	5	2		1	6			8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	10.0	72.6		19.0	81.6			16.0	16.0	26.4	26.4	
Effective Green, g (s)	10.0	72.6		19.0	81.6			16.0	16.0	26.4	26.4	
Actuated g/C Ratio	0.07	0.48		0.13	0.54			0.11	0.11	0.18	0.18	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	118	2677		444	2977			197	167	308	284	
v/s Ratio Prot	0.06	c0.43		c0.12	0.45			c0.10		c0.17	0.16	
v/s Ratio Perm									0.00			
v/c Ratio	0.85	0.88		0.97	0.83			0.92	0.03	0.94	0.90	
Uniform Delay, d1	69.2	34.8		65.2	28.3			66.4	60.0	61.1	60.6	
Progression Factor	1.03	0.70		0.91	0.77			1.00	1.00	1.00	1.00	
Incremental Delay, d2	26.4	2.8		32.1	2.6			41.5	0.1	36.6	29.6	
Delay (s)	97.6	27.0		91.7	24.4			107.8	60.1	97.7	90.2	
Level of Service	F	C		F	C			F	E	F	F	
Approach Delay (s)		29.9			34.4			98.3			93.6	
Approach LOS		C			C			F			F	

Intersection Summary				
HCM Average Control Delay	40.9	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.91			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	98.9%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
11: Farrington Hwy & E Street

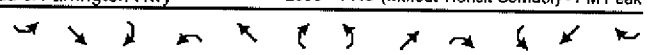
2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Lane Util. Factor	1.00	*0.99			*0.99			1.00		1.00	1.00	
Frt	1.00	0.98			1.00			1.00		1.00	0.94	
Flt Protected	0.95	1.00			1.00			0.97		0.95	1.00	
Satd. Flow (prot)	1770	5428			5519			1801		1770	1743	
Flt Permitted	0.95	1.00			1.00			0.97		0.95	1.00	
Satd. Flow (perm)	1770	5428			5519			1801		1770	1743	
Volume (vph)	77	2202	316	0	2482	42	203	110	5	227	130	97
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	78	2224	321	0	2507	42	205	111	5	229	131	98
RTOR Reduction (vph)	0	14	0	0	1	0	0	0	0	0	18	0
Lane Group Flow (vph)	78	2531	0	0	2548	0	0	321	0	229	211	0
Turn Type	Prot						Split			Split		
Protected Phases	5	2			6		8	8		4	4	
Permitted Phases												
Actuated Green, G (s)	7.0	90.2			79.2			27.8		20.0	20.0	
Effective Green, g (s)	7.0	90.2			79.2			27.8		20.0	20.0	
Actuated g/C Ratio	0.05	0.60			0.53			0.19		0.13	0.13	
Clearance Time (s)	4.0	4.0			4.0			4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0			3.0		3.0	3.0	
Lane Grp Cap (vph)	83	3264			2914			334		236	232	
v/s Ratio Prot	0.04	c0.47			c0.46			c0.18		c0.13	0.12	
v/s Ratio Perm												
v/c Ratio	0.94	0.78			0.87			0.96		0.97	0.91	
Uniform Delay, d1	71.3	22.3			31.0			60.6		64.7	64.1	
Progression Factor	0.73	0.41			0.77			1.00		1.00	1.00	
Incremental Delay, d2	55.9	1.1			2.1			38.8		50.0	35.0	
Delay (s)	107.7	10.2			26.0			99.3		114.7	99.1	
Level of Service	F	B			C			F		F	F	
Approach Delay (s)		13.1			26.0			99.3			106.9	
Approach LOS		B			C			F			F	

Intersection Summary			
HCM Average Control Delay	30.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	96.6%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy

2030 + PRO (without Transit Corridor) - PM Peak



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	*0.99	*0.99	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	3533	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	3533	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Volume (vph)	493	483	724	355	405	113	678	660	746	226	1028	677
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	498	488	731	359	409	114	685	667	754	228	1038	684
RTOR Reduction (vph)	0	21	286	0	0	94	0	0	232	0	0	202
Lane Group Flow (vph)	498	657	255	359	409	20	685	667	522	228	1038	482
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	28.8	38.3	38.3	21.8	31.3	31.3	38.7	74.0	74.0	27.2	62.5	62.5
Effective Green, g (s)	28.8	38.3	38.3	21.8	31.3	31.3	38.7	74.0	74.0	27.2	62.5	62.5
Actuated g/C Ratio	0.16	0.22	0.22	0.12	0.18	0.18	0.22	0.42	0.42	0.15	0.35	0.35
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	569	763	339	431	651	279	765	1539	661	272	1300	558
v/s Ratio Prot	c0.14	c0.19		0.10	0.11		c0.20	0.18		0.13	0.28	
v/s Ratio Perm			0.16			0.01			0.33			c0.30
v/c Ratio	0.88	0.86	0.75	0.83	0.63	0.07	0.90	0.43	0.79	0.84	0.80	0.86
Uniform Delay, d1	72.5	66.9	65.1	76.0	67.6	60.9	67.3	36.7	44.9	72.9	51.7	53.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.1	9.8	9.1	12.9	4.5	0.5	13.0	0.2	6.2	19.7	3.5	13.1
Delay (s)	86.6	76.7	74.1	88.9	72.2	61.4	80.3	36.9	51.1	92.6	55.2	66.5
Level of Service	F	E	E	F	E	E	F	D	D	F	E	E
Approach Delay (s)		78.8			77.6			56.1			63.6	
Approach LOS		E			E			E			E	

Intersection Summary			
HCM Average Control Delay	67.0	HCM Level of Service	E
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	177.3	Sum of lost time (s)	12.0
Intersection Capacity Utilization	92.3%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

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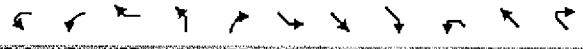
HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road — 2030 + PRO (without Transit Corridor) - PM Peak



Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99		1.00				*0.99	1.00	0.97	*0.99	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504		1583				3688	1583	3433	3688	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504		1583				3688	1583	3433	3688	
Volume (vph)	2099	0	412	0	0	0	495	86	368	585	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	2120	0	416	0	0	0	500	87	372	591	0
RTOR Reduction (vph)	0	0	32	0	0	0	0	73	0	0	0
Lane Group Flow (vph)	2120	0	384	0	0	0	500	14	372	591	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	81.6		81.6				20.5	20.5	15.9	40.4	
Effective Green, g (s)	81.6		81.6				20.5	20.5	15.9	40.4	
Actuated g/C Ratio	0.63		0.63				0.16	0.16	0.12	0.31	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	2199		994				582	250	420	1146	
v/s Ratio Prot	c0.61		0.24				c0.14		c0.11	0.16	
v/s Ratio Perm								0.01			
v/c Ratio	0.96		0.39				0.86	0.05	0.89	0.52	
Uniform Delay, d1	22.8		11.9				53.3	46.5	56.2	36.8	
Progression Factor	1.00		1.00				1.00	1.00	0.61	0.97	
Incremental Delay, d2	11.9		0.3				15.2	0.4	16.4	1.3	
Delay (s)	34.7		12.1				68.6	46.9	50.9	37.0	
Level of Service	C		B				E	D	D	D	
Approach Delay (s)		31.0		0.0			65.3			42.4	
Approach LOS		C		A			E			D	

Intersection Summary			
HCM Average Control Delay	38.6	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	115.9%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		1.00			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		1583			3433	3688			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		1583			3433	3688			3688	3135
Volume (vph)	92	0	1018	0	0	207	2387	0	0	861	2122
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	93	0	1028	0	0	209	2411	0	0	870	2143
RTOR Reduction (vph)	0	0	1	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	93	0	1027	0	0	209	2411	0	0	870	2143
Turn Type	Prot		custom			Prot					Free
Protected Phases	4		4			1	6			2	
Permitted Phases											Free
Actuated Green, G (s)	58.0		58.0			12.6	64.0			47.4	130.0
Effective Green, g (s)	58.0		58.0			12.6	64.0			47.4	130.0
Actuated g/C Ratio	0.45		0.45			0.10	0.49			0.36	1.00
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	790		706			333	1816			1345	3135
v/s Ratio Prot	0.05		c0.65			0.06	c0.65			0.24	
v/s Ratio Perm											0.68
v/c Ratio	0.12		1.46			0.63	1.33			0.65	0.68
Uniform Delay, d1	21.0		36.0			56.4	33.0			34.3	0.0
Progression Factor	1.00		1.00			1.15	0.70			1.00	1.00
Incremental Delay, d2	0.1		212.7			1.2	148.8			2.4	1.2
Delay (s)	21.1		248.7			66.0	171.9			36.8	1.2
Level of Service	C		F			E	F			D	A
Approach Delay (s)		229.9		0.0			163.5			11.5	
Approach LOS		F		A			F			B	

Intersection Summary			
HCM Average Control Delay	106.7	HCM Level of Service	F
HCM Volume to Capacity ratio	1.39		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	115.9%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	5532	1583	3504	5532	1583	3504	3688	1583	3504	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	5532	1583	3504	5532	1583	3504	3688	1583	3504	3688	1583
Volume (vph)	815	1917	650	880	1657	393	411	756	542	539	920	915
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	823	1936	657	889	1674	397	415	764	547	544	929	924
RTOR Reduction (vph)	0	0	166	0	0	186	0	0	258	0	0	269
Lane Group Flow (vph)	823	1936	491	889	1674	212	415	764	289	544	929	655
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	30.0	46.0	46.0	29.0	45.0	45.0	18.0	34.0	34.0	25.0	41.0	41.0
Effective Green, g (s)	30.0	46.0	46.0	29.0	45.0	45.0	18.0	34.0	34.0	25.0	41.0	41.0
Actuated g/C Ratio	0.20	0.31	0.31	0.19	0.30	0.30	0.12	0.23	0.23	0.17	0.27	0.27
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	701	1696	485	677	1660	475	420	836	359	584	1008	433
v/s Ratio Prot	0.23	c0.35		c0.25	0.30		0.12	c0.21		0.16	0.25	
v/s Ratio Perm			0.31			0.13			0.18			c0.41
v/c Ratio	1.17	1.14	1.01	1.31	1.01	0.45	0.99	0.91	0.81	0.93	0.92	1.51
Uniform Delay, d1	60.0	52.0	52.0	60.5	52.5	42.4	65.9	56.6	54.9	61.7	52.9	54.5
Progression Factor	1.00	1.00	1.00	0.88	0.97	1.25	1.00	1.00	1.00	0.91	0.90	0.77
Incremental Delay, d2	92.9	71.3	44.2	147.4	19.3	1.8	41.1	16.1	17.4	11.6	7.4	236.0
Delay (s)	152.9	123.3	96.2	200.5	70.3	54.9	106.9	72.7	72.3	67.8	55.0	277.9
Level of Service	F	F	F	F	E	D	F	E	E	E	E	F
Approach Delay (s)		125.2			107.4			80.8			143.8	
Approach LOS		F			F			F			F	

Intersection Summary				
HCM Average Control Delay	117.1	HCM Level of Service	F	
HCM Volume to Capacity ratio	1.27			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	112.6%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connector — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.97	*0.99	0.86	*0.99	*0.99		*0.99	*0.99		*0.99	1.00	*0.99
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	3433	5532	1362	3504	5397		3504	3445		3504	1863	3135
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	3433	5532	1362	3504	5397		3504	3445		3504	1863	3135
Volume (vph)	73	1846	475	676	1942	380	315	427	334	390	121	770
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	74	1865	480	683	1962	384	318	431	337	394	122	778
RTOR Reduction (vph)	0	0	169	0	18	0	0	87	0	0	0	34
Lane Group Flow (vph)	74	1865	311	683	2328	0	318	681	0	394	122	744
Turn Type	Prot		Perm	Prot			Prot			Prot		pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2									8
Actuated Green, G (s)	8.0	63.0	63.0	23.0	78.0		33.6	34.0		14.0	14.4	37.4
Effective Green, g (s)	8.0	63.0	63.0	23.0	78.0		33.6	34.0		14.0	14.4	37.4
Actuated g/C Ratio	0.05	0.42	0.42	0.15	0.52		0.22	0.23		0.09	0.10	0.25
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	183	2323	572	537	2808		785	781		327	179	865
v/s Ratio Prot	0.02	0.34		c0.19	c0.43		0.09	c0.20		c0.11	0.07	0.13
v/s Ratio Perm			0.23									0.11
v/c Ratio	0.40	0.80	0.54	1.27	0.83		0.41	0.87		1.20	0.68	0.86
Uniform Delay, d1	68.7	38.1	32.7	63.5	30.4		49.7	55.9		68.0	65.6	53.8
Progression Factor	1.00	1.00	1.00	0.72	0.39		1.00	1.00		0.65	0.65	0.52
Incremental Delay, d2	1.5	3.1	3.7	123.7	0.3		0.3	10.5		95.0	1.0	0.9
Delay (s)	70.2	41.1	36.4	169.4	12.2		50.0	66.5		139.3	43.5	28.9
Level of Service	E	D	D	F	B		D	E		F	D	C
Approach Delay (s)		41.1			47.7			61.6			63.9	
Approach LOS		D			D			E			E	

Intersection Summary				
HCM Average Control Delay	50.3	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.94			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	105.5%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
17: East-West Rd. & North-South Road — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	*0.99	0.95		0.97	*0.99		*0.99	*0.99		*0.99	*0.99	
Frt	1.00	0.94		1.00	0.89		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3504	3313		3433	3283		3504	5404		3504	5396	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3504	3313		3433	3283		3504	5404		3504	5396	
Volume (vph)	310	312	232	367	193	531	110	1553	284	611	1718	337
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	313	315	234	371	195	536	111	1569	287	617	1735	340
RTOR Reduction (vph)	0	94	0	0	237	0	0	23	0	0	25	0
Lane Group Flow (vph)	313	455	0	371	494	0	111	1833	0	617	2050	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	14.9	20.9		16.4	22.4		7.7	48.1		26.0	66.4	
Effective Green, g (s)	14.9	20.9		16.4	22.4		7.7	48.1		26.0	66.4	
Actuated g/C Ratio	0.12	0.16		0.13	0.18		0.06	0.38		0.20	0.52	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	410	543		442	577		212	2040		715	2812	
v/s Ratio Prot	0.09	0.14		c0.11	c0.15		0.03	c0.34		c0.18	0.38	
v/s Ratio Perm												
v/c Ratio	0.76	0.84		0.84	1.05dr		0.52	0.90		0.86	0.73	
Uniform Delay, d1	54.5	51.6		54.2	50.9		58.1	37.4		49.0	23.6	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.2	10.8		13.1	12.0		2.3	6.8		13.1	1.7	
Delay (s)	62.7	62.4		67.3	62.9		60.4	44.2		62.1	25.2	
Level of Service	E	E		E	E		E	D		E	C	
Approach Delay (s)		62.5			64.4			45.1			33.7	
Approach LOS		E			E			D			C	

Intersection Summary				
HCM Average Control Delay	45.9	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.85			
Actuated Cycle Length (s)	127.4	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	98.4%	ICU Level of Service	F	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway — 2030 + PRO (without Transit Corridor) - PM Peak

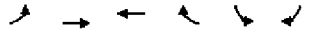
Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99		1.00	*0.99		*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.98		1.00	0.94		1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5408		1770	5196		3504	5532	1583	1770	5532	1583
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5408		1770	5196		3504	5532	1583	1770	5532	1583
Volume (vph)	378	879	155	507	1075	735	716	643	505	121	568	352
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	382	888	157	512	1086	742	723	649	510	122	574	356
RTOR Reduction (vph)	0	19	0	0	82	0	0	0	290	0	0	305
Lane Group Flow (vph)	382	1026	0	512	1746	0	723	649	220	122	574	51
Turn Type	Prot			Prot			Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases									4			8
Actuated Green, G (s)	29.0	37.9		44.1	53.0		29.0	36.4	36.4	13.6	21.0	21.0
Effective Green, g (s)	29.0	37.9		44.1	53.0		29.0	36.4	36.4	13.6	21.0	21.0
Actuated g/C Ratio	0.20	0.26		0.30	0.36		0.20	0.25	0.25	0.09	0.14	0.14
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	347	1385		527	1861		687	1361	389	163	785	225
v/s Ratio Prot	c0.22	0.19		c0.29	c0.34		c0.21	0.12		0.07	c0.10	
v/s Ratio Perm									0.14			0.03
v/c Ratio	1.10	0.74		0.97	1.15dr		1.05	0.48	0.56	0.75	0.73	0.22
Uniform Delay, d1	59.5	50.5		51.3	45.9		59.5	47.7	48.9	65.5	60.8	56.3
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	78.2	3.6		31.8	10.7		48.9	0.3	1.9	17.0	3.5	0.5
Delay (s)	137.7	54.1		83.2	56.6		108.4	47.9	50.7	82.5	64.3	56.8
Level of Service	F	D		F	E		F	D	D	F	E	E
Approach Delay (s)		76.5			62.4			71.9			63.9	
Approach LOS		E			E			E			E	

Intersection Summary				
HCM Average Control Delay	68.3	HCM Level of Service	E	
HCM Volume to Capacity ratio	0.95			
Actuated Cycle Length (s)	148.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	102.9%	ICU Level of Service	G	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

AR00028096

HCM Signalized Intersection Capacity Analysis
19: East-West Rd. & Old Fort Weaver Rd — 2030 + PRO (without Transit Corridor) - PM Peak



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	3539	1583	3433	1583
Flt Permitted	0.25	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	466	1863	3539	1583	3433	1583
Volume (vph)	37	621	829	955	898	94
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	37	627	837	965	907	95
RTOR Reduction (vph)	0	0	0	560	0	55
Lane Group Flow (vph)	37	627	837	405	907	40
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Actuated Green, G (s)	21.0	21.0	21.0	21.0	21.0	21.0
Effective Green, g (s)	21.0	21.0	21.0	21.0	21.0	21.0
Actuated g/C Ratio	0.42	0.42	0.42	0.42	0.42	0.42
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	196	782	1486	665	1442	665
v/s Ratio Prot		c0.34	0.24		c0.26	
v/s Ratio Perm	0.08			0.26		0.03
v/c Ratio	0.19	0.80	0.56	0.61	0.63	0.06
Uniform Delay, d1	9.1	12.7	11.0	11.3	11.4	8.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.5	5.9	0.5	1.6	2.1	0.2
Delay (s)	9.6	18.6	11.5	12.9	13.5	8.8
Level of Service	A	B	B	B	B	A
Approach Delay (s)		18.1	12.3		13.1	
Approach LOS		B	B		B	

Intersection Summary				
HCM Average Control Delay	13.6	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.72			
Actuated Cycle Length (s)	50.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	69.1%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
20: Farrington Hwy & B Street — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	*0.99	1.00	0.97	*0.99	1.00	1.00	1.00	1.00	*0.99	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3688	1583	3433	3688	1583	1770	1863	1583	3504	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3688	1583	3433	3688	1583	1770	1863	1583	3504	1863	1583
Volume (vph)	229	1443	356	554	1792	80	152	182	307	274	143	178
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	231	1458	360	560	1810	81	154	184	310	277	144	180
RTOR Reduction (vph)	0	0	45	0	0	23	0	0	8	0	0	16
Lane Group Flow (vph)	231	1458	315	560	1810	58	154	184	302	277	144	164
Turn Type	Prot		pm+ov	Prot		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6		7	4	5	3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	24.0	73.3	85.3	31.7	81.0	81.0	13.0	17.0	41.0	12.0	16.0	47.7
Effective Green, g (s)	24.0	73.3	85.3	31.7	81.0	81.0	13.0	17.0	41.0	12.0	16.0	47.7
Actuated g/C Ratio	0.16	0.49	0.57	0.21	0.54	0.54	0.09	0.11	0.27	0.08	0.11	0.32
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	549	1802	942	726	1992	855	153	211	433	280	199	546
v/s Ratio Prot	0.07	c0.40	0.03	0.16	c0.49		c0.09	c0.10	0.11	0.08	0.08	0.06
v/s Ratio Perm			0.17			0.04			0.08			0.04
v/c Ratio	0.42	0.81	0.33	0.77	0.91	0.07	1.01	0.87	0.70	0.99	0.72	0.30
Uniform Delay, d1	56.7	32.4	17.2	55.7	31.2	16.5	68.5	65.4	48.9	68.9	64.9	38.6
Progression Factor	0.82	0.76	0.24	0.99	0.45	0.06	1.00	1.00	1.00	1.00	0.93	1.01
Incremental Delay, d2	0.2	1.5	0.1	2.1	3.3	0.1	74.5	35.8	4.8	44.0	16.3	0.2
Delay (s)	46.7	26.1	4.2	57.4	17.4	1.0	143.0	101.3	53.8	112.7	76.8	39.0
Level of Service	D	C	A	E	B	A	F	F	D	F	E	D
Approach Delay (s)		24.6			26.0			88.5			82.0	
Approach LOS		C			C			F			F	

Intersection Summary				
HCM Average Control Delay	38.4	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.87			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	86.8%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
21: East-West Rd. & A Street — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1844		1770	1863	1583	1770	1599		1770	1631	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1844		1770	1863	1583	1770	1599		1770	1631	
Volume (vph)	170	768	56	34	689	616	91	8	140	46	6	31
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	185	835	61	37	749	670	99	9	152	50	7	34
RTOR Reduction (vph)	0	2	0	0	0	285	0	136	0	0	31	0
Lane Group Flow (vph)	185	894	0	37	749	385	99	25	0	50	10	0
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6						
Actuated Green, G (s)	12.6	59.8		5.3	52.5	52.5	10.7	10.7		8.2	8.2	
Effective Green, g (s)	12.6	59.8		5.3	52.5	52.5	10.7	10.7		8.2	8.2	
Actuated g/C Ratio	0.13	0.60		0.05	0.52	0.52	0.11	0.11		0.08	0.08	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	223	1103		94	978	831	189	171		145	134	
v/s Ratio Prot	0.10	c0.48		0.02	c0.40		c0.06	0.02		c0.03	0.01	
v/s Ratio Perm						0.24						
v/c Ratio	0.83	0.81		0.39	0.77	0.46	0.52	0.15		0.34	0.07	
Uniform Delay, d1	42.7	15.7		45.8	18.9	14.9	42.2	40.5		43.4	42.4	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	21.8	6.5		2.7	3.6	0.4	2.6	0.4		1.4	0.2	
Delay (s)	64.4	22.2		48.5	22.5	15.3	44.8	40.9		44.8	42.6	
Level of Service	E	C		D	C	B	D	D		D	D	
Approach Delay (s)		29.4			19.9			42.4			43.8	
Approach LOS		C			B			D			D	

Intersection Summary				
HCM Average Control Delay	26.2	HCM Level of Service		C
HCM Volume to Capacity ratio	0.74			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)		16.0
Intersection Capacity Utilization	72.9%	ICU Level of Service		C
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
22: Farrington Hwy & 2nd Avenue — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99		*0.99	*0.99	1.00	1.00	0.95	*0.99	*0.99	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5469		3504	3688	1583	1770	3539	3135	3504	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5469		3504	3688	1583	1770	3539	3135	3504	3539	1583
Volume (vph)	186	1527	127	690	1836	246	106	297	513	556	356	320
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	188	1542	128	697	1855	248	107	300	518	564	360	323
RTOR Reduction (vph)	0	7	0	0	0	70	0	0	5	0	0	161
Lane Group Flow (vph)	188	1663	0	697	1855	178	107	300	513	564	360	162
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		Perm
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases						6			8			4
Actuated Green, G (s)	16.0	54.0		34.0	72.0	72.0	11.5	23.0	57.0	23.0	34.5	34.5
Effective Green, g (s)	16.0	54.0		34.0	72.0	72.0	11.5	23.0	57.0	23.0	34.5	34.5
Actuated g/C Ratio	0.11	0.36		0.23	0.48	0.48	0.08	0.15	0.38	0.15	0.23	0.23
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	189	1969		794	1770	760	136	543	1275	537	814	364
v/s Ratio Prot	c0.11	0.30		0.20	c0.50		c0.06	c0.08	0.09	c0.16	0.10	
v/s Ratio Perm						0.11			0.07			0.10
v/c Ratio	0.99	0.84		0.88	1.05	0.23	0.79	0.55	0.40	1.05	0.44	0.45
Uniform Delay, d1	67.0	44.1		56.0	39.0	22.9	68.0	58.7	34.0	63.5	49.5	49.5
Progression Factor	0.79	0.72		0.53	0.31	0.01	1.00	1.00	1.00	0.80	0.76	0.59
Incremental Delay, d2	50.7	3.1		5.2	29.0	0.3	25.2	4.0	0.2	27.8	0.2	0.4
Delay (s)	103.3	34.9		34.8	41.2	0.6	93.3	62.8	34.2	78.6	38.0	29.7
Level of Service	F	C		C	D	A	F	E	C	E	D	C
Approach Delay (s)		41.8			36.0			50.3			54.2	
Approach LOS		D			D			D			D	

Intersection Summary				
HCM Average Control Delay	42.8	HCM Level of Service		D
HCM Volume to Capacity ratio	0.97			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)		16.0
Intersection Capacity Utilization	98.5%	ICU Level of Service		F
Analysis Period (min)	15			
c Critical Lane Group				

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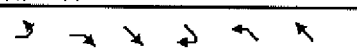
HCM Unsignalized Intersection Capacity Analysis
23: 2nd Avenue & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	4998	440	0	5283
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	5433	478	0	5742
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			870			
pX, platoon unblocked						
vC, conflicting volume	7107	1597			5911	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	7107	1597			5911	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	0	95			7	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	0	1552	1552	1552	1254	1436	1436	1436	1436
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	0	478	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.91	0.91	0.91	0.74	0.84	0.84	0.84	0.84
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A								
Approach Delay (s)	0.0	0.0				0.0			
Approach LOS	A								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	83.1%	ICU Level of Service	E
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
24: 3rd Avenue & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak



Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	4808	189	0	5283
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	5226	205	0	5742
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			1234			
pX, platoon unblocked						
vC, conflicting volume	6764	1409			5432	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	6764	1409			5432	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	0	128			11	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	0	1493	1493	1493	952	1436	1436	1436	1436
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	0	205	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.88	0.88	0.88	0.56	0.84	0.84	0.84	0.84
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A								
Approach Delay (s)	0.0	0.0				0.0			
Approach LOS	A								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	79.9%	ICU Level of Service	D
Analysis Period (min)	15		

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HCM Signalized Intersection Capacity Analysis
25: East-West Rd. & B Street — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1752	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1752	1583
Volume (vph)	519	371	763	98	342	533
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	524	375	771	99	345	538
RTOR Reduction (vph)	0	0	0	43	0	407
Lane Group Flow (vph)	524	375	771	56	345	131
Turn Type	Prot			Prot		Prot
Protected Phases	5	2	6	6	4	4
Permitted Phases						
Actuated Green, G (s)	35.0	89.0	50.0	50.0	23.0	23.0
Effective Green, g (s)	35.0	89.0	50.0	50.0	23.0	23.0
Actuated g/C Ratio	0.29	0.74	0.42	0.42	0.19	0.19
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	516	1382	776	660	336	303
v/s Ratio Prot	c0.30	0.20	c0.41	0.04	c0.20	0.08
v/s Ratio Perm						
v/c Ratio	1.02	0.27	0.99	0.09	1.03	0.43
Uniform Delay, d1	42.5	5.0	34.8	21.2	48.5	42.7
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	43.6	0.5	30.8	0.3	56.1	4.4
Delay (s)	86.1	5.5	65.6	21.4	104.6	47.2
Level of Service	F	A	E	C	F	D
Approach Delay (s)		52.5	60.6		69.6	
Approach LOS		D	E		E	

Intersection Summary			
HCM Average Control Delay	60.8	HCM Level of Service	E
HCM Volume to Capacity ratio	1.01		
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
26: Btwn Fort Barret Rd and N/S Rd & Farrington Hwy — 2030 + PRO (without Transit Corridor) - PM Peak

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3688	3688	1583
Flt Permitted	0.95	1.00	0.05	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	98	3688	3688	1583
Volume (vph)	200	209	96	1497	2295	155
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	202	211	97	1512	2318	157
RTOR Reduction (vph)	0	14	0	0	0	38
Lane Group Flow (vph)	202	197	97	1512	2318	119
Turn Type		Perm	Perm			Perm
Protected Phases	6			4	8	
Permitted Phases		6	4			8
Actuated Green, G (s)	16.0	16.0	76.0	76.0	76.0	76.0
Effective Green, g (s)	16.0	16.0	76.0	76.0	76.0	76.0
Actuated g/C Ratio	0.16	0.16	0.76	0.76	0.76	0.76
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	283	253	74	2803	2803	1203
v/s Ratio Prot	0.11			0.41	0.63	
v/s Ratio Perm		c0.12	c0.99			0.08
v/c Ratio	0.71	0.78	1.31	0.54	0.83	0.10
Uniform Delay, d1	39.8	40.3	12.0	4.9	7.8	3.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.3	20.6	208.6	0.2	2.1	0.0
Delay (s)	54.1	60.9	220.6	5.1	9.9	3.2
Level of Service	D	E	F	A	A	A
Approach Delay (s)	57.6			18.1	9.5	
Approach LOS	E			B	A	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	1.21		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	89.6%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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APPENDIX A-5
MITIGATIONS
YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR SCENARIO

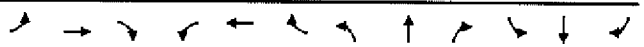
AR00028101

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (with Transit Corridor) - AM Peak Miligations

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	0.97	1.00	0.95	1.00		0.91
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3433	1583	3539	1583		5085
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3433	1583	3539	1583		5085
Volume (vph)	718	37	1770	492	0	1301
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	725	37	1788	497	0	1314
RTOR Reduction (vph)	0	17	0	171	0	0
Lane Group Flow (vph)	725	20	1788	326	0	1314
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	25.0	25.0	63.1	63.1		63.1
Effective Green, g (s)	25.0	25.0	63.1	63.1		63.1
Actuated g/C Ratio	0.26	0.26	0.66	0.66		0.66
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	893	412	2324	1039		3339
v/s Ratio Prot	c0.21		c0.51			0.26
v/s Ratio Perm		0.01		0.21		
v/c Ratio	0.81	0.05	0.77	0.31		0.39
Uniform Delay, d1	33.3	26.6	11.5	7.1		7.6
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	5.7	0.0	2.5	0.8		0.3
Delay (s)	39.0	26.7	14.0	7.9		8.0
Level of Service	D	C	B	A		A
Approach Delay (s)	38.4		12.7			8.0
Approach LOS	D		B			A

Intersection Summary			
HCM Average Control Delay	15.8	HCM Level of Service	B
HCM Volume to Capacity ratio	0.78		
Actuated Cycle Length (s)	96.1	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.1%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (with Transit Corridor) - AM Peak Miligations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	0.91			0.91	
Frt						0.86	1.00	1.00			0.98	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5085			4960	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5085			4960	
Volume (vph)	0	0	0	0	0	530	163	1731	0	0	1685	331
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	576	177	1882	0	0	1832	360
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	15	0
Lane Group Flow (vph)	0	0	0	0	0	576	177	1882	0	0	2177	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						110.0	15.0	110.0			87.0	
Effective Green, g (s)						110.0	15.0	110.0			87.0	
Actuated g/C Ratio						1.00	0.14	1.00			0.79	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	241	5085			3923	
v/s Ratio Prot							c0.10	0.37			c0.44	
v/s Ratio Perm						0.36						
v/c Ratio						0.36	0.73	0.37			0.55	
Uniform Delay, d1						0.0	45.6	0.0			4.3	
Progression Factor						1.00	1.07	1.00			1.00	
Incremental Delay, d2						0.6	9.7	0.2			0.6	
Delay (s)						0.6	58.7	0.2			4.9	
Level of Service						A	E	A			A	
Approach Delay (s)	0.0			0.6				5.2			4.9	
Approach LOS	A			A				A			A	

Intersection Summary			
HCM Average Control Delay	4.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.58		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	55.6%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road

2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.86			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	1583	6408			5085
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	1583	6408			5085
Volume (vph)	402	358	2072	0	0	1541
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	437	389	2252	0	0	1675
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	437	389	2252	0	0	1675
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	17.9	110.0	84.1			84.1
Effective Green, g (s)	17.9	110.0	84.1			84.1
Actuated g/C Ratio	0.16	1.00	0.76			0.76
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	559	1583	4899			3888
v/s Ratio Prot	c0.13		c0.35			0.33
v/s Ratio Perm		0.25				
v/c Ratio	0.78	0.25	0.46			0.43
Uniform Delay, d1	44.2	0.0	4.7			4.5
Progression Factor	1.00	1.00	0.53			0.92
Incremental Delay, d2	7.0	0.4	0.3			0.3
Delay (s)	51.2	0.4	2.8			4.5
Level of Service	D	A	A			A
Approach Delay (s)	27.3		2.8			4.5
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	7.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp

2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.91		0.97	0.91				1.00			1.00
Frt		0.98		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		5001		3433	5085				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		5001		3433	5085				1611			1611
Volume (vph)	0	1885	235	496	705	0	0	0	429	0	0	350
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	2049	255	539	766	0	0	0	466	0	0	380
RTOR Reduction (vph)	0	10	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2294	0	539	766	0	0	0	466	0	0	380
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		81.4		20.6	110.0				110.0			110.0
Effective Green, g (s)		81.4		20.6	110.0				110.0			110.0
Actuated g/C Ratio		0.74		0.19	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		3701		643	5085				1611			1611
v/s Ratio Prot		c0.46		c0.16	0.15							
v/s Ratio Perm									0.29			0.24
v/c Ratio		0.62		0.84	0.15				0.29			0.24
Uniform Delay, d1		6.9		43.1	0.0				0.0			0.0
Progression Factor		0.42		0.54	1.00				1.00			1.00
Incremental Delay, d2		0.6		8.6	0.1				0.5			0.3
Delay (s)		3.5		31.8	0.1				0.5			0.3
Level of Service		A		C	A				A			A
Approach Delay (s)		3.5			13.2			0.5			0.3	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM Average Control Delay	5.7	HCM Level of Service	A
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	62.5%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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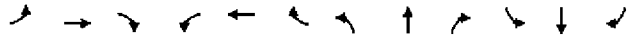
HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps 2030 + PRO (with Transit Corridor) - AM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0			4.0			
Lane Util. Factor	0.97	*0.99			*0.99	1.00			1.00			
Frt	1.00	1.00			1.00	0.85			0.86			
Flt Protected	0.95	1.00			1.00	1.00			1.00			
Satd. Flow (prot)	3433	5532			5532	1583			1611			
Flt Permitted	0.95	1.00			1.00	1.00			1.00			
Satd. Flow (perm)	3433	5532			5532	1583			1611			
Volume (vph)	928	1386	0	0	1200	567	0	0	904	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	937	1400	0	0	1212	573	0	0	913	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	68	0	0	0	0	0	0
Lane Group Flow (vph)	937	1400	0	0	1212	505	0	0	913	0	0	0
Turn Type	Prot					Perm			Free			
Protected Phases	5	2			6							
Permitted Phases						6			Free			
Actuated Green, G (s)	51.1	110.0			50.9	50.9			110.0			
Effective Green, g (s)	51.1	110.0			50.9	50.9			110.0			
Actuated g/C Ratio	0.48	1.00			0.46	0.46			1.00			
Clearance Time (s)	4.0	4.0			4.0	4.0						
Vehicle Extension (s)	3.0	3.0			3.0	3.0						
Lane Grp Cap (vph)	1595	5532			2560	732			1611			
v/s Ratio Prot	0.27	0.25			0.22							
v/s Ratio Perm						c0.32			c0.57			
v/c Ratio	0.59	0.25			0.47	0.69			0.57			
Uniform Delay, d1	21.7	0.0			20.3	23.3			0.0			
Progression Factor	1.07	1.00			1.00	1.00			1.00			
Incremental Delay, d2	0.5	0.1			0.6	5.3			1.5			
Delay (s)	23.7	0.1			21.0	28.6			1.5			
Level of Service	C	A			C	C			A			
Approach Delay (s)		9.5			23.4			1.5			0.0	
Approach LOS		A			C			A			A	

Intersection Summary				
HCM Average Control Delay	13.0	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.63			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	4.0	
Intersection Capacity Utilization	68.2%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	0.97	0.91	1.00	1.00	0.91	1.00		1.00	1.00		0.95	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (prot)	3433	5085	1583	1770	5085	1583		1780	1583		3424	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (perm)	3433	5085	1583	1770	5085	1583		1780	1583		3424	1583
Volume (vph)	144	1990	155	119	1681	156	56	5	48	92	45	33
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	157	2163	168	129	1827	170	61	5	52	100	49	36
RTOR Reduction (vph)	0	0	78	0	0	82	0	0	47	0	0	33
Lane Group Flow (vph)	157	2163	90	129	1827	88	0	66	5	0	149	3
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	9.2	44.5	44.5	7.6	42.9	42.9		8.1	8.1		7.0	7.0
Effective Green, g (s)	9.2	44.5	44.5	7.6	42.9	42.9		8.1	8.1		7.0	7.0
Actuated g/C Ratio	0.11	0.53	0.53	0.09	0.52	0.52		0.10	0.10		0.08	0.08
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	380	2720	847	162	2622	816		173	154		288	133
v/s Ratio Prot	0.05	c0.43		c0.07	0.36			c0.04			c0.04	
v/s Ratio Perm			0.06			0.06			0.00			0.00
v/c Ratio	0.41	0.80	0.11	0.80	0.70	0.11		0.38	0.03		0.52	0.02
Uniform Delay, d1	34.5	15.7	9.5	37.0	15.2	10.3		35.2	34.0		36.5	35.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	0.7	1.7	0.1	23.1	0.8	0.1		6.3	0.4		1.6	0.1
Delay (s)	35.2	17.3	9.6	60.1	16.1	10.4		41.5	34.4		38.1	35.0
Level of Service	D	B	A	E	B	B		D	C		D	D
Approach Delay (s)		17.9			18.3			36.4			37.5	
Approach LOS		B			B			D			D	

Intersection Summary				
HCM Average Control Delay	19.3	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.72			
Actuated Cycle Length (s)	83.2	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	66.8%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road — 2030 + PRO (with Transit Corridor) - AM Peak Miligations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3510		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3510		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	96	24	12	71	4	234	48	3857	52	91	1306	170
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	97	24	12	72	4	236	48	3896	53	92	1319	172
RTOR Reduction (vph)	0	6	0	0	0	110	0	0	10	0	0	53
Lane Group Flow (vph)	0	127	0	72	4	126	48	3896	43	92	1319	119
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		10.6		11.0	11.0	11.0	6.9	99.0	99.0	8.8	100.9	100.9
Effective Green, g (s)		10.6		11.0	11.0	11.0	6.9	99.0	99.0	8.8	100.9	100.9
Actuated g/C Ratio		0.07		0.08	0.08	0.08	0.05	0.68	0.68	0.06	0.69	0.69
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		256		134	141	120	84	3767	1078	107	3839	1099
v/s Ratio Prot		c0.04		0.04	0.00		0.03	c0.70		c0.05	0.24	
v/s Ratio Perm						c0.08			0.03			0.08
v/c Ratio		0.50		0.54	0.03	1.05	0.57	1.03	0.04	0.86	0.34	0.11
Uniform Delay, d1		64.8		64.7	62.2	67.2	67.8	23.2	7.6	67.7	8.9	7.4
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		1.5		4.1	0.1	96.2	9.1	24.5	0.1	45.5	0.2	0.2
Delay (s)		66.4		68.8	62.3	163.4	76.9	47.7	7.7	113.2	9.2	7.6
Level of Service		E		E	E	F	E	D	A	F	A	A
Approach Delay (s)		66.4			140.3			47.5			15.1	
Approach LOS		E			F			D			B	

Intersection Summary			
HCM Average Control Delay	44.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	145.4	Sum of lost time (s)	16.0
Intersection Capacity Utilization	104.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Rd & Fort Weaver Road — 2030 + PRO (with Transit Corridor) - AM Peak Miligations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.94	1.00	1.00		0.95	1.00	0.97	*0.99		1.00	*0.99	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	4990	1863	1583		3537	1583	3433	5532		1770	5532	1583
Flt Permitted	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	4990	1863	1583		3537	1583	3433	5532		1770	5532	1583
Volume (vph)	701	73	393	4	344	230	283	3028	1	20	925	444
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	708	74	397	4	347	232	286	3059	1	20	934	448
RTOR Reduction (vph)	0	0	0	0	0	57	0	0	0	0	0	246
Lane Group Flow (vph)	708	74	397	0	351	175	286	3060	0	20	934	202
Turn Type	Split		Free	Split		Perm	Prot			Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free			8						6
Actuated Green, G (s)	15.9	15.9	100.9		11.0	11.0	12.6	56.4		1.6	45.4	45.4
Effective Green, g (s)	15.9	15.9	100.9		11.0	11.0	12.6	56.4		1.6	45.4	45.4
Actuated g/C Ratio	0.16	0.16	1.00		0.11	0.11	0.12	0.56		0.02	0.45	0.45
Clearance Time (s)	4.0	4.0			4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	786	294	1583		386	173	429	3092		28	2489	712
v/s Ratio Prot	c0.14	0.04			0.10		c0.08	c0.55		0.01	0.17	
v/s Ratio Perm			0.25			c0.11						0.13
v/c Ratio	0.90	0.25	0.25		0.91	1.01	0.67	0.99		0.71	0.38	0.28
Uniform Delay, d1	41.7	37.3	0.0		44.5	45.0	42.1	22.0		49.4	18.4	17.5
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	13.4	0.5	0.4		24.5	71.4	3.9	13.9		60.5	0.4	1.0
Delay (s)	55.2	37.7	0.4		69.0	116.4	46.0	35.9		110.0	18.8	18.5
Level of Service	E	D	A		E	F	D	D		F	B	B
Approach Delay (s)		35.6			87.9			36.8			20.0	
Approach LOS		D			F			D			B	

Intersection Summary			
HCM Average Control Delay	37.5	HCM Level of Service	D
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	100.9	Sum of lost time (s)	16.0
Intersection Capacity Utilization	98.2%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

AR00028105

HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00	1.00	1.00	*0.99	1.00	0.97	*0.99	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1766	1583		1860	1583	1770	5532	1583	3433	5532	1583
Flt Permitted	0.95	0.96	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1766	1583		1860	1583	1770	5532	1583	3433	5532	1583
Volume (vph)	487	31	36	10	339	213	89	2631	1	248	1028	49
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	472	31	36	10	342	215	90	2658	1	251	1038	49
RTOR Reduction (vph)	0	0	0	0	0	112	0	0	0	0	0	26
Lane Group Flow (vph)	245	258	36	0	352	103	90	2658	1	251	1038	23
Turn Type	Split		Free	Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free			8			2			6
Actuated Green, G (s)	16.0	16.0	130.0		23.0	23.0	13.0	64.0	64.0	11.0	62.0	62.0
Effective Green, g (s)	16.0	16.0	130.0		23.0	23.0	13.0	64.0	64.0	11.0	62.0	62.0
Actuated g/C Ratio	0.12	0.12	1.00		0.18	0.18	0.10	0.49	0.49	0.08	0.48	0.48
Clearance Time (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	216	217	1583		329	280	177	2723	779	290	2638	755
v/s Ratio Prot	0.14	c0.15			c0.19		0.05	c0.48		c0.07	0.19	
v/s Ratio Perm			c0.02			0.07			0.00			0.01
v/c Ratio	1.13	1.19	0.02		1.07	0.37	0.51	0.98	0.00	0.87	0.39	0.03
Uniform Delay, d1	57.0	57.0	0.0		53.5	47.1	55.5	32.3	16.8	56.8	21.9	18.1
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	102.1	121.5	0.0		69.4	0.8	2.3	12.5	0.0	22.6	0.4	0.1
Delay (s)	159.1	178.5	0.0		122.9	47.9	57.8	44.7	16.8	81.3	22.3	18.1
Level of Service	F	F	A		F	D	E	D	B	F	C	B
Approach Delay (s)		157.8			94.5			45.2			33.3	
Approach LOS		F			F			D			C	

Intersection Summary				
HCM Average Control Delay	59.2	HCM Level of Service	E	
HCM Volume to Capacity ratio	1.01			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	103.4%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
10: Farrington Hwy & D Street — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	0.91		0.97	0.91			0.95	0.95	0.95	0.95	
Frt	1.00	1.00		1.00	0.98			0.86	0.85	1.00	0.91	
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5085		3433	4982			1528	1504	1681	1607	
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5085		3433	4982			1528	1504	1681	1607	
Volume (vph)	130	1588	0	270	679	106	0	17	347	178	191	304
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	131	1604	0	273	686	107	0	17	351	180	193	307
RTOR Reduction (vph)	0	0	0	0	17	0	0	161	162	0	52	0
Lane Group Flow (vph)	131	1604	0	273	776	0	0	31	14	180	448	0
Turn Type	Prot			Prot					Perm	Split		
Protected Phases	5	2		1	6			8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	12.8	45.0		9.0	41.2			8.5	8.5	31.5	31.5	
Effective Green, g (s)	12.8	45.0		9.0	41.2			8.5	8.5	31.5	31.5	
Actuated g/C Ratio	0.12	0.41		0.08	0.37			0.08	0.08	0.29	0.29	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	206	2080		281	1866			118	116	481	460	
v/s Ratio Prot	0.07	c0.32		c0.08	0.16			c0.02		0.11	c0.28	
v/s Ratio Perm									0.01			
v/c Ratio	0.64	0.77		0.97	0.42			0.26	0.12	0.37	0.97	
Uniform Delay, d1	46.4	28.1		50.4	25.5			47.8	47.3	31.4	38.8	
Progression Factor	0.75	0.84		0.79	0.57			1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.4	2.4		45.4	0.7			1.2	0.5	0.5	34.9	
Delay (s)	40.1	26.1		85.3	15.1			49.0	47.7	31.9	73.8	
Level of Service	D	C		F	B			D	D	C	E	
Approach Delay (s)		27.2			33.1			48.4			62.7	
Approach LOS		C			C			D			E	

Intersection Summary				
HCM Average Control Delay	37.1	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.81			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	79.0%	ICU Level of Service	D	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
11: Farrington Hwy & E Street — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	0.91			0.91		1.00	1.00		1.00	1.00	
Frt	1.00	1.00			1.00		1.00	0.99		1.00	0.92	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5061			5065		1770	1844		1770	1720	
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5061			5065		1770	1844		1770	1720	
Volume (vph)	49	1600	52	0	957	26	202	68	5	113	47	49
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	49	1616	53	0	967	26	204	69	5	114	47	49
RTOR Reduction (vph)	0	2	0	0	2	0	0	3	0	0	36	0
Lane Group Flow (vph)	49	1667	0	0	991	0	204	71	0	114	60	0
Turn Type	Prot						Split			Split		
Protected Phases	5	2			6		8	8		4	4	
Permitted Phases												
Actuated Green, G (s)	8.0	68.7			56.7		17.2	17.2		12.1	12.1	
Effective Green, g (s)	8.0	68.7			56.7		17.2	17.2		12.1	12.1	
Actuated g/C Ratio	0.07	0.62			0.52		0.16	0.16		0.11	0.11	
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	129	3161			2611		277	288		195	189	
v/s Ratio Prot	0.03	c0.33			0.20		c0.12	0.04		c0.06	0.03	
v/s Ratio Perm												
v/c Ratio	0.38	0.53			0.38		0.74	0.25		0.58	0.31	
Uniform Delay, d1	48.6	11.6			16.1		44.2	40.7		46.6	45.1	
Progression Factor	1.00	1.00			0.65		1.00	1.00		1.00	1.00	
Incremental Delay, d2	1.9	0.6			0.3		9.8	0.5		4.4	1.0	
Delay (s)	50.5	12.2			10.8		54.0	41.2		51.0	46.1	
Level of Service	D	B			B		D	D		D	D	
Approach Delay (s)		13.3			10.8			50.6			48.7	
Approach LOS		B			B			D			D	

Intersection Summary				
HCM Average Control Delay	18.1	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.57			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	56.6%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.91	0.91	0.97	0.95	1.00	0.97	0.95	1.00	1.00	0.95	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3263	1441	3433	3539	1583	3433	3539	1583	1770	3539	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3263	1441	3433	3539	1583	3433	3539	1583	1770	3539	1583
Volume (vph)	377	707	798	572	578	159	338	438	485	78	739	704
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	381	714	806	578	584	161	341	442	490	79	746	711
RTOR Reduction (vph)	0	21	14	0	0	70	0	0	61	0	0	49
Lane Group Flow (vph)	381	931	554	578	584	91	341	442	429	79	746	662
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov	Prot		pm+ov
Protected Phases	1	6	7	5	2	3	7	4	5	3	8	1
Permitted Phases			6			2			4			8
Actuated Green, G (s)	22.0	44.1	58.2	24.1	46.2	56.3	14.1	36.6	60.7	10.1	32.6	54.6
Effective Green, g (s)	22.0	44.1	58.2	24.1	46.2	56.3	14.1	36.6	60.7	10.1	32.6	54.6
Actuated g/C Ratio	0.17	0.34	0.44	0.18	0.35	0.43	0.11	0.28	0.46	0.08	0.25	0.42
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	577	1099	685	632	1249	729	370	990	782	137	881	709
v/s Ratio Prot	0.11	c0.29	c0.09	0.17	0.17	0.01	0.10	0.12	c0.10	0.04	0.21	c0.16
v/s Ratio Perm			0.30			0.05			0.17			0.26
v/c Ratio	0.66	0.85	0.81	0.91	0.47	0.12	0.92	0.45	0.55	0.58	0.85	0.93
Uniform Delay, d1	51.0	40.3	31.5	52.4	32.8	22.5	57.9	38.8	25.2	58.3	46.8	36.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.8	6.2	7.0	17.8	1.3	0.1	27.9	0.3	0.8	5.8	7.6	19.3
Delay (s)	53.8	46.5	38.5	70.2	34.1	22.5	85.7	39.1	26.0	64.1	54.3	55.7
Level of Service	D	D	D	E	C	C	F	D	C	E	D	E
Approach Delay (s)		45.5			48.5			46.6			55.5	
Approach LOS		D			D			D			E	

Intersection Summary				
HCM Average Control Delay	48.9	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.88			
Actuated Cycle Length (s)	130.9	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	87.8%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028107

HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99		1.00				*0.99	1.00	0.97	*0.99	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504		1583				3688	1583	3433	3688	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504		1583				3688	1583	3433	3688	
Volume (vph)	1338	0	115	0	0	0	1099	248	518	222	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1352	0	116	0	0	0	1110	251	523	224	0
RTOR Reduction (vph)	0	0	71	0	0	0	0	168	0	0	0
Lane Group Flow (vph)	1352	0	45	0	0	0	1110	83	523	224	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	39.0		39.0				33.0	33.0	16.0	53.0	
Effective Green, g (s)	39.0		39.0				33.0	33.0	16.0	53.0	
Actuated g/C Ratio	0.39		0.39				0.33	0.33	0.16	0.53	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1367		617				1217	522	549	1955	
v/s Ratio Prot	c0.39		0.03				c0.30		c0.15	0.06	
v/s Ratio Perm								0.05			
v/c Ratio	0.99		0.07				0.91	0.16	0.95	0.11	
Uniform Delay, d1	30.3		19.2				32.1	23.7	41.6	11.8	
Progression Factor	1.00		1.00				1.00	1.00	0.43	0.67	
Incremental Delay, d2	21.5		0.1				11.8	0.6	24.1	0.1	
Delay (s)	51.8		19.2				43.9	24.3	42.1	8.0	
Level of Service	D		B				D	C	D	A	
Approach Delay (s)		49.2		0.0			40.3			31.9	
Approach LOS		D		A			D			C	

Intersection Summary			
HCM Average Control Delay	42.2	HCM Level of Service	D
HCM Volume to Capacity ratio	0.95		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		0.88			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		2787			3433	3688			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		2787			3433	3688			3688	3135
Volume (vph)	51	0	633	0	0	802	1634	0	0	689	2305
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	0	639	0	0	810	1651	0	0	696	2328
RTOR Reduction (vph)	0	0	36	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	52	0	603	0	0	810	1651	0	0	696	2328
Turn Type	Prot		custom			Prot					Free
Protected Phases	4		4			1	6			2	
Permitted Phases											Free
Actuated Green, G (s)	25.8		25.8			29.7	66.2			32.5	100.0
Effective Green, g (s)	25.8		25.8			29.7	66.2			32.5	100.0
Actuated g/C Ratio	0.26		0.26			0.30	0.66			0.32	1.00
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	457		719			1020	2441			1199	3135
v/s Ratio Prot	0.03		0.22			0.24	0.45			0.19	
v/s Ratio Perm											c0.74
v/c Ratio	0.11		0.84			0.79	0.68			0.58	0.74
Uniform Delay, d1	28.4		35.1			32.3	10.3			28.1	0.0
Progression Factor	1.00		1.00			1.01	0.49			1.00	1.00
Incremental Delay, d2	0.1		8.5			1.4	0.5			2.1	1.6
Delay (s)	28.5		43.6			34.2	5.5			30.1	1.6
Level of Service	C		D			C	A			C	A
Approach Delay (s)		42.4		0.0			15.0			8.2	
Approach LOS		D		A			B			A	

Intersection Summary			
HCM Average Control Delay	14.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.74		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	0.0
Intersection Capacity Utilization	74.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	0.88
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	5532	1583	5256	5532	1583	3504	3688	1583	3504	3688	2787
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	5532	1583	5256	5532	1583	3504	3688	1583	3504	3688	2787
Volume (vph)	514	1147	563	459	1739	344	542	393	224	172	483	713
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	519	1159	569	464	1757	347	547	397	226	174	488	720
RTOR Reduction (vph)	0	0	273	0	0	193	0	0	186	0	0	386
Lane Group Flow (vph)	519	1159	296	464	1757	154	547	397	40	174	488	334
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	20.3	35.5	35.5	26.8	42.0	42.0	22.0	21.0	21.0	20.0	19.0	19.0
Effective Green, g (s)	20.3	35.5	35.5	26.8	42.0	42.0	22.0	21.0	21.0	20.0	19.0	19.0
Actuated g/C Ratio	0.17	0.30	0.30	0.22	0.35	0.35	0.18	0.18	0.18	0.17	0.16	0.16
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	596	1646	471	1181	1948	557	646	649	279	587	587	444
v/s Ratio Prot	c0.15	0.21		0.09	c0.32		c0.16	0.11		0.05	c0.13	
v/s Ratio Perm			0.19			0.10			0.03			0.12
v/c Ratio	0.87	0.70	0.63	0.39	0.90	0.28	0.85	0.61	0.14	0.30	0.83	0.75
Uniform Delay, d1	48.2	37.2	36.2	39.3	36.7	27.7	47.0	45.4	41.5	43.5	48.6	47.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.1	1.4	2.6	0.2	6.3	0.3	13.0	4.3	1.1	0.3	12.9	11.2
Delay (s)	61.4	38.6	38.8	39.5	42.9	28.0	60.0	49.7	42.6	43.8	61.5	59.1
Level of Service	E	D	D	D	D	C	E	D	D	D	E	E
Approach Delay (s)		43.9			40.3			53.1			56.0	
Approach LOS		D			D			D			E	

Intersection Summary				
HCM Average Control Delay	46.8	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.84			
Actuated Cycle Length (s)	119.3	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	90.4%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connector 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	0.86	0.86	0.97	0.91		0.97	0.95		0.97	1.00	0.88
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	4806	1362	3433	4987		3433	3461		3433	1863	2787
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	4806	1362	3433	4987		3433	3461		3433	1863	2787
Volume (vph)	51	2024	224	471	934	138	217	161	28	353	103	300
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	2044	226	476	943	139	219	163	28	357	104	303
RTOR Reduction (vph)	0	0	105	0	17	0	0	14	0	0	0	70
Lane Group Flow (vph)	52	2044	121	476	1065	0	219	177	0	357	104	233
Turn Type	Prot		Perm	Prot			Prot			Prot		pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2									8
Actuated Green, G (s)	4.1	40.8	40.8	13.0	49.7		14.0	10.9		13.9	10.8	23.8
Effective Green, g (s)	4.1	40.8	40.8	13.0	49.7		14.0	10.9		13.9	10.8	23.8
Actuated g/C Ratio	0.04	0.43	0.43	0.14	0.53		0.15	0.12		0.15	0.11	0.25
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	77	2073	587	472	2620		508	399		504	213	819
v/s Ratio Prot	0.03	c0.43		c0.14	0.21		0.06	0.05		c0.10	c0.06	0.04
v/s Ratio Perm			0.09									0.04
v/c Ratio	0.68	0.99	0.21	1.01	0.41		0.43	0.44		0.71	0.49	0.28
Uniform Delay, d1	44.6	26.6	16.8	40.8	13.6		36.7	39.0		38.4	39.3	28.5
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	20.9	16.7	0.8	43.6	0.5		0.6	0.8		4.5	1.8	0.2
Delay (s)	65.5	43.3	17.6	84.4	14.0		37.3	39.8		42.9	41.1	28.7
Level of Service	E	D	B	F	B		D	D		D	D	C
Approach Delay (s)		41.3			35.5			38.4			37.1	
Approach LOS		D			D			D			D	

Intersection Summary				
HCM Average Control Delay	38.7	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.87			
Actuated Cycle Length (s)	94.6	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	83.0%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
17: East-West Rd. & North-South Road — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	0.97	0.95		0.97	0.95		0.97	0.91	1.00	0.97	0.91	
Frt	1.00	0.95		1.00	0.87		1.00	1.00	0.85	1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3433	3362		3433	3066		3433	5085	1583	3433	4969	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3433	3362		3433	3066		3433	5085	1583	3433	4969	
Volume (vph)	243	224	112	239	75	614	207	1442	206	189	954	172
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	245	226	113	241	76	620	209	1457	208	191	964	174
RTOR Reduction (vph)	0	59	0	0	183	0	0	0	129	0	23	0
Lane Group Flow (vph)	245	280	0	241	513	0	209	1457	79	191	1115	0
Turn Type	Prot			Prot			Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)	12.6	21.3		11.7	20.4		10.2	40.1	40.1	16.0	45.9	
Effective Green, g (s)	12.6	21.3		11.7	20.4		10.2	40.1	40.1	16.0	45.9	
Actuated g/C Ratio	0.12	0.20		0.11	0.19		0.10	0.38	0.38	0.15	0.44	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	412	681		382	595		333	1940	604	523	2170	
v/s Ratio Prot	c0.07	0.08		0.07	c0.17		c0.06	c0.29		0.06	c0.22	
v/s Ratio Perm									0.05			
v/c Ratio	0.59	0.41		0.63	1.27dr		0.63	0.75	0.13	0.37	0.51	
Uniform Delay, d1	43.8	36.4		44.6	41.0		45.6	28.2	21.2	40.0	21.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	2.3	0.4		3.4	12.3		3.7	2.7	0.5	2.0	0.9	
Delay (s)	46.1	36.9		48.0	53.3		49.3	30.9	21.6	42.0	22.4	
Level of Service	D	D		D	D		D	C	C	D	C	
Approach Delay (s)		40.7			51.9			31.9			25.2	
Approach LOS		D			D			C			C	

Intersection Summary				
HCM Average Control Delay	35.1	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.74			
Actuated Cycle Length (s)	105.1	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	75.5%	ICU Level of Service	D	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99	1.00	1.00	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5532	1583	1770	5532	1583	3504	5532	1583	1770	5532	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5532	1583	1770	5532	1583	3504	5532	1583	1770	5532	1583
Volume (vph)	245	517	64	222	496	588	855	315	316	118	637	483
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	247	522	65	224	501	594	864	318	319	119	643	488
RTOR Reduction (vph)	0	0	51	0	0	375	0	0	202	0	0	253
Lane Group Flow (vph)	247	522	14	224	501	219	864	318	117	119	643	235
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2			6			4			8
Actuated Green, G (s)	15.9	21.2	21.2	14.8	20.1	20.1	25.9	35.4	35.4	9.2	18.7	18.7
Effective Green, g (s)	15.9	21.2	21.2	14.8	20.1	20.1	25.9	35.4	35.4	9.2	18.7	18.7
Actuated g/C Ratio	0.16	0.22	0.22	0.15	0.21	0.21	0.27	0.37	0.37	0.10	0.19	0.19
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	291	1214	347	271	1151	329	939	2027	580	169	1071	306
v/s Ratio Prot	c0.14	0.09		0.13	0.09		c0.25	0.06		0.07	0.12	
v/s Ratio Perm			0.01			c0.14			0.07			c0.15
v/c Ratio	0.85	0.43	0.04	0.83	0.44	0.66	0.92	0.16	0.20	0.70	0.60	0.77
Uniform Delay, d1	39.2	32.5	29.7	39.7	33.3	35.2	34.3	20.6	20.9	42.4	35.5	36.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	20.0	1.1	0.2	18.3	1.2	10.2	13.9	0.0	0.2	12.5	1.0	11.0
Delay (s)	59.2	33.6	29.9	57.9	34.5	45.3	48.2	20.6	21.1	54.9	36.5	47.8
Level of Service	E	C	C	E	C	D	D	C	C	D	D	D
Approach Delay (s)		40.9			43.3			36.6			42.7	
Approach LOS		D			D			D			D	

Intersection Summary				
HCM Average Control Delay	40.7	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.81			
Actuated Cycle Length (s)	96.6	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	74.3%	ICU Level of Service	D	
Analysis Period (min)	15			

c Critical Lane Group

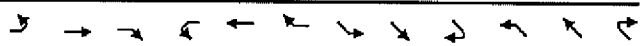
AR00028110

HCM Signalized Intersection Capacity Analysis
19: East-West Rd. & Old Fort Weaver Rd — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	3539	1583	3433	1583
Flt Permitted	0.58	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1080	1863	3539	1583	3433	1583
Volume (vph)	21	765	277	795	402	45
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	21	773	280	803	406	45
RTOR Reduction (vph)	0	0	0	426	0	25
Lane Group Flow (vph)	21	773	280	377	406	20
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Actuated Green, G (s)	39.7	39.7	39.7	39.7	36.8	36.8
Effective Green, g (s)	39.7	39.7	39.7	39.7	36.8	36.8
Actuated g/C Ratio	0.47	0.47	0.47	0.47	0.44	0.44
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	507	875	1663	744	1495	689
v/s Ratio Prot		c0.41	0.08		c0.12	
v/s Ratio Perm	0.02			0.24		0.01
v/c Ratio	0.04	0.88	0.17	0.51	0.27	0.03
Uniform Delay, d1	12.1	20.3	12.9	15.6	15.3	13.6
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	10.5	0.0	0.5	0.4	0.1
Delay (s)	12.1	30.8	12.9	16.1	15.7	13.7
Level of Service	B	C	B	B	B	B
Approach Delay (s)		30.3	15.3		15.5	
Approach LOS		C	B		B	

Intersection Summary				
HCM Average Control Delay	20.5	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.59			
Actuated Cycle Length (s)	84.5	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	59.2%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
20: Farrington Hwy & B Street — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	1770	1863	1583	3433	1863	1583
Volume (vph)	206	1094	186	119	866	83	47	137	121	331	223	198
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	224	1189	202	129	941	90	51	149	132	360	242	215
RTOR Reduction (vph)	0	0	95	0	0	57	0	0	17	0	0	52
Lane Group Flow (vph)	224	1189	107	129	941	33	51	149	115	360	242	163
Turn Type	Prot		pm+ov	Prot		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6		7	4	5	3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	11.1	35.4	48.2	8.7	33.0	33.0	3.9	18.1	29.2	12.8	27.0	35.7
Effective Green, g (s)	11.1	35.4	48.2	8.7	33.0	33.0	3.9	18.1	29.2	12.8	27.0	35.7
Actuated g/C Ratio	0.12	0.39	0.53	0.10	0.36	0.36	0.04	0.20	0.32	0.14	0.30	0.39
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	419	1377	908	328	1283	574	76	371	578	483	553	691
v/s Ratio Prot	c0.07	c0.34	0.02	0.04	0.27		0.03	0.08	0.02	c0.10	c0.13	0.02
v/s Ratio Perm			0.05			0.02			0.05			0.08
v/c Ratio	0.53	0.86	0.12	0.39	0.73	0.06	0.67	0.40	0.20	0.75	0.44	0.24
Uniform Delay, d1	37.5	25.6	10.7	38.7	25.2	18.9	42.9	31.7	22.4	37.5	25.9	18.5
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.3	5.9	0.1	0.8	2.2	0.0	20.8	3.2	0.2	6.2	2.5	0.2
Delay (s)	38.8	31.4	10.8	39.5	27.4	18.9	63.8	35.0	22.6	43.7	28.4	18.7
Level of Service	D	C	B	D	C	B	E	C	C	D	C	B
Approach Delay (s)		29.9			28.1			34.5			32.6	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM Average Control Delay	30.3	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.66			
Actuated Cycle Length (s)	91.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	63.6%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
21: East-West Rd. & A Street — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.85		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1842		1770	1863	1583	1770	1591		1770	1630	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1842		1770	1863	1583	1770	1591		1770	1630	
Volume (vph)	86	324	26	31	625	27	26	4	135	43	7	37
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	93	352	28	34	679	29	28	4	147	47	8	40
RTOR Reduction (vph)	0	2	0	0	0	13	0	132	0	0	36	0
Lane Group Flow (vph)	93	378	0	34	679	16	28	19	0	47	12	0
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6						
Actuated Green, G (s)	7.6	38.9		3.0	34.3	34.3	7.3	7.3		7.4	7.4	
Effective Green, g (s)	7.6	38.9		3.0	34.3	34.3	7.3	7.3		7.4	7.4	
Actuated g/C Ratio	0.10	0.54		0.04	0.47	0.47	0.10	0.10		0.10	0.10	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	185	987		73	880	748	178	160		180	166	
v/s Ratio Prot	c0.05	0.21		0.02	c0.36		c0.02	0.01		c0.03	0.01	
v/s Ratio Perm						0.01						
v/c Ratio	0.50	0.38		0.47	0.77	0.02	0.16	0.12		0.26	0.07	
Uniform Delay, d1	30.7	9.8		34.0	15.9	10.2	29.8	29.7		30.1	29.5	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.1	0.2		4.6	4.2	0.0	0.4	0.3		0.8	0.2	
Delay (s)	32.9	10.1		38.7	20.1	10.2	30.3	30.0		30.9	29.7	
Level of Service	C	B		D	C	B	C	C		C	C	
Approach Delay (s)		14.6			20.6			30.1			30.3	
Approach LOS		B			C			C			C	

Intersection Summary				
HCM Average Control Delay	20.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.59			
Actuated Cycle Length (s)	72.6	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	62.9%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
22: Farrington Hwy & 2nd Avenue — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		0.97	0.95	1.00	1.00	0.95	0.88	0.97	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5043		3433	3539	1583	1770	3539	2787	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5043		3433	3539	1583	1770	3539	2787	3433	3539	1583
Volume (vph)	166	1029	61	223	746	239	95	391	446	225	259	133
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	180	1118	66	242	811	260	103	425	485	245	282	145
RTOR Reduction (vph)	0	5	0	0	0	176	0	0	58	0	0	108
Lane Group Flow (vph)	180	1179	0	242	811	84	103	425	427	245	282	37
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		Perm
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases						6			8			4
Actuated Green, G (s)	26.0	52.8		15.2	42.0	42.0	12.7	27.0	42.2	19.0	33.3	33.3
Effective Green, g (s)	26.0	52.8		15.2	42.0	42.0	12.7	27.0	42.2	19.0	33.3	33.3
Actuated g/C Ratio	0.20	0.41		0.12	0.32	0.32	0.10	0.21	0.32	0.15	0.26	0.26
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	354	2048		401	1143	511	173	735	905	502	907	405
v/s Ratio Prot	0.10	c0.23		0.07	c0.23		0.06	c0.12	0.06	c0.07	0.08	
v/s Ratio Perm						0.05			0.10			0.02
v/c Ratio	0.51	0.58		0.60	0.71	0.16	0.60	0.58	0.47	0.49	0.31	0.09
Uniform Delay, d1	46.3	29.9		54.5	38.6	31.5	56.2	46.4	35.0	51.0	39.1	36.8
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.2	1.2		2.6	3.7	0.7	5.4	3.3	0.4	0.7	0.9	0.4
Delay (s)	47.5	31.1		57.1	42.4	32.1	61.6	49.7	35.4	51.8	40.0	37.3
Level of Service	D	C		E	D	C	E	D	D	D	D	D
Approach Delay (s)		33.3			43.1			44.1			43.7	
Approach LOS		C			D			D			D	

Intersection Summary				
HCM Average Control Delay	40.3	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.60			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	60.4%	ICU Level of Service	B	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Unsignalized Intersection Capacity Analysis
23: 2nd Avenue & Kunia Road — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	1679	234	0	4777
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	1825	254	0	5192
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			870			
pX, platoon unblocked						
vC, conflicting volume	3250	583			2079	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3250	583			2079	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	7	455			263	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	0	521	521	521	515	1298	1298	1298	1298
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	0	254	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.31	0.31	0.31	0.30	0.76	0.76	0.76	0.76
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A								
Approach Delay (s)	0.0	0.0				0.0			
Approach LOS	A								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
24: 3rd Avenue & Kunia Road — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	7	1593	86	0	4777
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	8	1732	93	0	5192
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			1234			
pX, platoon unblocked						
vC, conflicting volume	3076	480			1825	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3076	480			1825	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	99			100	
cM capacity (veh/h)	9	532			331	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	8	495	495	495	341	1298	1298	1298	1298
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	8	0	0	0	93	0	0	0	0
cSH	532	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.01	0.29	0.29	0.29	0.20	0.76	0.76	0.76	0.76
Queue Length 95th (ft)	1	0	0	0	0	0	0	0	0
Control Delay (s)	11.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B								
Approach Delay (s)	11.9	0.0				0.0			
Approach LOS	B								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	72.6%	ICU Level of Service	C
Analysis Period (min)	15		

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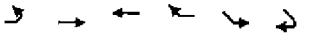
HCM Signalized Intersection Capacity Analysis
25: East-West Rd. & B Street — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations



Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Volume (vph)	153	234	314	85	643	369
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	166	254	341	92	699	401
RTOR Reduction (vph)	0	0	0	72	0	157
Lane Group Flow (vph)	166	254	341	20	699	244
Turn Type	Prot			Prot		Prot
Protected Phases	5	2	6	6	4	4
Permitted Phases						
Actuated Green, G (s)	15.2	45.1	25.9	25.9	65.5	65.5
Effective Green, g (s)	15.2	45.1	25.9	25.9	65.5	65.5
Actuated g/C Ratio	0.13	0.38	0.22	0.22	0.55	0.55
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	227	708	407	346	978	874
v/s Ratio Prot	c0.09	0.14	c0.18	0.01	c0.40	0.15
v/s Ratio Perm						
v/c Ratio	0.73	0.36	0.84	0.06	0.71	0.28
Uniform Delay, d1	49.7	26.4	44.3	36.7	19.6	14.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	11.5	0.3	14.0	0.1	4.5	0.8
Delay (s)	61.2	26.7	58.3	36.8	24.1	14.9
Level of Service	E	C	E	D	C	B
Approach Delay (s)		40.3	53.7		20.7	
Approach LOS		D	D		C	

Intersection Summary			
HCM Average Control Delay	32.3	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	118.6	Sum of lost time (s)	12.0
Intersection Capacity Utilization	70.6%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
26: Farrington Hwy & — 2030 + PRO (with Transit Corridor) - AM Peak Mitigations

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3688	3688	1583
Flt Permitted	0.95	1.00	0.13	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	240	3688	3688	1583
Volume (vph)	100	233	46	1060	1373	132
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	101	235	46	1071	1387	133
RTOR Reduction (vph)	0	31	0	0	0	55
Lane Group Flow (vph)	101	204	46	1071	1387	78
Turn Type		Perm	Perm			Perm
Protected Phases	6			4	8	
Permitted Phases		6	4			8
Actuated Green, G (s)	33.0	33.0	59.0	59.0	59.0	59.0
Effective Green, g (s)	33.0	33.0	59.0	59.0	59.0	59.0
Actuated g/C Ratio	0.33	0.33	0.59	0.59	0.59	0.59
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Grp Cap (vph)	584	522	142	2176	2176	934
v/s Ratio Prot	0.06			0.29	c0.38	
v/s Ratio Perm		c0.13	0.19			0.05
v/c Ratio	0.17	0.39	0.32	0.49	0.64	0.08
Uniform Delay, d1	23.8	25.8	10.4	11.8	13.5	8.8
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.6	2.2	6.0	0.8	1.4	0.2
Delay (s)	24.4	28.0	16.3	12.6	14.9	9.0
Level of Service	C	C	B	B	B	A
Approach Delay (s)	26.9			12.8	14.4	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	15.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.0%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

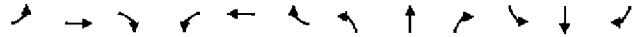
AR00028114

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	*0.99	1.00	*0.99	1.00		*0.99
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3504	1583	3688	1583		5532
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3504	1583	3688	1583		5532
Volume (vph)	882	41	2658	907	0	2752
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	891	41	2685	916	0	2780
RTOR Reduction (vph)	0	4	0	206	0	0
Lane Group Flow (vph)	891	37	2685	710	0	2780
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	32.0	32.0	90.0	90.0		90.0
Effective Green, g (s)	32.0	32.0	90.0	90.0		90.0
Actuated g/C Ratio	0.25	0.25	0.69	0.69		0.69
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	863	390	2553	1096		3830
v/s Ratio Prot	c0.25		c0.73			0.50
v/s Ratio Perm		0.02		0.45		
v/c Ratio	1.03	0.10	1.05	0.65		0.73
Uniform Delay, d1	49.0	37.8	20.0	11.2		12.4
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	39.3	0.1	33.3	3.0		1.2
Delay (s)	88.3	37.9	53.3	14.1		13.6
Level of Service	F	D	D	B		B
Approach Delay (s)	86.1		43.3			13.6
Approach LOS	F		D			B

Intersection Summary			
HCM Average Control Delay	37.5	HCM Level of Service	D
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	105.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	*0.99			*0.99	
Frt						0.86	1.00	1.00			0.99	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5532			5455	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5532			5455	
Volume (vph)	0	0	0	0	0	1230	423	2335	0	0	3295	339
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	0	0	0	0	1242	427	2359	0	0	3328	342
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	20	0
Lane Group Flow (vph)	0	0	0	0	0	1242	427	2359	0	0	3650	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						70.0	17.0	70.0			45.0	
Effective Green, g (s)						70.0	17.0	70.0			45.0	
Actuated g/C Ratio						1.00	0.24	1.00			0.64	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	430	5532			3507	
v/s Ratio Prot							c0.24	0.43			c0.67	
v/s Ratio Perm						0.77						
v/c Ratio						0.77	0.99	0.43			1.04	
Uniform Delay, d1						0.0	26.4	0.0			12.5	
Progression Factor						1.00	0.96	1.00			1.00	
Incremental Delay, d2						3.6	35.1	0.2			27.2	
Delay (s)						3.6	60.5	0.2			39.7	
Level of Service						A	E	A			D	
Approach Delay (s)		0.0			3.6			9.4			39.7	
Approach LOS		A			A			A			D	

Intersection Summary			
HCM Average Control Delay	22.9	HCM Level of Service	C
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	101.3%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

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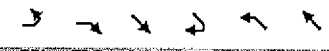
HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road

2030 + PRO (With Transit Corridor) - PM Peak Mitigations

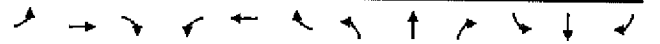


Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	*0.99	1.00	*0.99			*0.99
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3504	1583	7376			5532
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3504	1583	7376			5532
Volume (vph)	527	578	4322	0	0	2231
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	573	628	4698	0	0	2425
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	573	628	4698	0	0	2425
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	13.7	70.0	48.3			48.3
Effective Green, g (s)	13.7	70.0	48.3			48.3
Actuated g/C Ratio	0.20	1.00	0.69			0.69
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	686	1583	5089			3817
v/s Ratio Prot	c0.16		c0.64			0.44
v/s Ratio Perm		0.40				
v/c Ratio	0.84	0.40	0.92			0.64
Uniform Delay, d1	27.1	0.0	9.3			6.0
Progression Factor	1.00	1.00	0.37			1.00
Incremental Delay, d2	8.7	0.7	3.2			0.8
Delay (s)	35.7	0.7	6.6			6.8
Level of Service	D	A	A			A
Approach Delay (s)	17.4		6.6			6.8
Approach LOS	B		A			A

Intersection Summary			
HCM Average Control Delay	8.2	HCM Level of Service	A
HCM Volume to Capacity ratio	0.90		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	130.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ram

2030 + PRO (With Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.91		0.97	0.91				1.00			1.00
Frt		0.97		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		4947		3433	5085				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		4947		3433	5085				1611			1611
Volume (vph)	0	1884	416	774	1938	0	0	0	439	0	0	729
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	2048	452	841	2107	0	0	0	477	0	0	792
RTOR Reduction (vph)	0	15	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2485	0	841	2107	0	0	0	477	0	0	792
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		78.0		44.0	130.0				130.0			130.0
Effective Green, g (s)		78.0		44.0	130.0				130.0			130.0
Actuated g/C Ratio		0.60		0.34	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		2968		1162	5085				1611			1611
v/s Ratio Prot		c0.50		c0.24	0.41							
v/s Ratio Perm									0.30			0.49
v/c Ratio		0.84		0.72	0.41				0.30			0.49
Uniform Delay, d1		20.9		37.7	0.0				0.0			0.0
Progression Factor		0.33		1.35	1.00				1.00			1.00
Incremental Delay, d2		1.8		1.3	0.1				0.5			1.1
Delay (s)		8.7		52.2	0.1				0.5			1.1
Level of Service		A		D	A				A			A
Approach Delay (s)		8.7			15.0			0.5			1.1	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM Average Control Delay	10.0	HCM Level of Service	A
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	74.4%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

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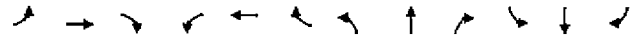
HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps 2030 + PRO (With Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0			4.0			
Lane Util. Factor	0.97	*0.99			*0.99	1.00			1.00			
Frt	1.00	1.00			1.00	0.85			0.86			
Flt Protected	0.95	1.00			1.00	1.00			1.00			
Satd. Flow (prot)	3433	5532			5532	1583			1611			
Flt Permitted	0.95	1.00			1.00	1.00			1.00			
Satd. Flow (perm)	3433	5532			5532	1583			1611			
Volume (vph)	1027	1297	0	0	2713	1164	0	0	638	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1037	1310	0	0	2740	1176	0	0	644	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	16	0	0	0	0	0	0
Lane Group Flow (vph)	1037	1310	0	0	2740	1160	0	0	644	0	0	0
Turn Type	Prot					Perm			Free			
Protected Phases	5	2			6							
Permitted Phases						6			Free			
Actuated Green, G (s)	47.8	130.0			74.2	74.2			130.0			
Effective Green, g (s)	47.8	130.0			74.2	74.2			130.0			
Actuated g/C Ratio	0.37	1.00			0.57	0.57			1.00			
Clearance Time (s)	4.0	4.0			4.0	4.0						
Vehicle Extension (s)	3.0	3.0			3.0	3.0						
Lane Grp Cap (vph)	1262	5532			3157	904			1611			
v/s Ratio Prot	c0.30	0.24			0.50							
v/s Ratio Perm						c0.73			0.40			
v/c Ratio	0.82	0.24			0.87	1.28			0.40			
Uniform Delay, d1	37.2	0.0			23.7	27.9			0.0			
Progression Factor	0.48	1.00			0.69	0.65			1.00			
Incremental Delay, d2	3.0	0.1			0.3	128.1			0.7			
Delay (s)	20.7	0.1			16.7	146.3			0.7			
Level of Service	C	A			B	F			A			
Approach Delay (s)		9.2			55.6			0.7			0.0	
Approach LOS		A			E			A			A	

Intersection Summary			
HCM Average Control Delay	34.7	HCM Level of Service	C
HCM Volume to Capacity ratio	1.10		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	108.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	1.00	*0.99	1.00		1.00	1.00		*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (prot)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (perm)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Volume (vph)	282	1537	116	135	3576	515	197	29	130	243	28	99
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	285	1553	117	136	3612	520	199	29	131	245	28	100
RTOR Reduction (vph)	0	0	56	0	0	154	0	0	47	0	0	89
Lane Group Flow (vph)	285	1553	61	136	3612	366	0	228	84	0	273	11
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	10.6	67.6	67.6	18.0	75.0	75.0		14.0	14.0		14.4	14.4
Effective Green, g (s)	10.6	67.6	67.6	18.0	75.0	75.0		14.0	14.0		14.4	14.4
Actuated g/C Ratio	0.08	0.52	0.52	0.14	0.58	0.58		0.11	0.11		0.11	0.11
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	286	2877	823	245	3192	913		192	170		391	175
v/s Ratio Prot	c0.08	0.28		0.08	c0.65			c0.13			c0.08	
v/s Ratio Perm			0.04			0.23			0.05			0.01
v/c Ratio	1.00	0.54	0.07	0.56	1.13	0.40		1.19	0.49		1.26dl	0.06
Uniform Delay, d1	59.7	20.6	15.6	52.3	27.5	15.1		58.0	54.7		55.7	51.8
Progression Factor	0.86	1.01	1.16	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	51.2	0.7	0.2	2.7	63.7	1.3		124.6	9.8		5.4	0.2
Delay (s)	102.7	21.8	18.2	55.0	91.2	16.4		182.6	64.5		61.1	51.9
Level of Service	F	C	B	D	F	B		F	E		E	D
Approach Delay (s)		33.4			81.0			139.5			58.6	
Approach LOS		C			F			F			E	

Intersection Summary			
HCM Average Control Delay	69.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.07		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	107.3%	ICU Level of Service	G
Analysis Period (min)	15		

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

AR00028117

HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor		*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt		0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)		3518		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted		0.96		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)		3518		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	209	37	13	61	4	229	56	2756	89	228	4188	82
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	211	37	13	62	4	231	57	2784	90	230	4230	83
RTOR Reduction (vph)	0	3	0	0	0	213	0	0	25	0	0	18
Lane Group Flow (vph)	0	258	0	62	4	18	57	2784	65	230	4230	65
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases		4			8			5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)		14.8		5.0	5.0	5.0	5.0	89.0	89.0	24.0	108.0	108.0
Effective Green, g (s)		14.8		5.0	5.0	5.0	5.0	89.0	89.0	24.0	108.0	108.0
Actuated g/C Ratio		0.10		0.03	0.03	0.03	0.03	0.60	0.60	0.16	0.73	0.73
Clearance Time (s)		4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)		3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)		350		59	63	53	59	3309	947	285	4015	1149
v/s Ratio Prot		c0.07		c0.04	0.00		0.03	c0.50		0.13	c0.76	
v/s Ratio Perm						0.01			0.04			0.04
v/c Ratio		1.19dl		1.05	0.06	0.35	0.97	0.84	0.07	0.81	1.05	0.06
Uniform Delay, d1		65.1		71.9	69.6	70.3	71.8	24.2	12.5	60.2	20.4	5.8
Progression Factor		1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2		7.9		132.1	0.4	3.9	104.1	2.8	0.1	15.3	31.0	0.1
Delay (s)		73.0		204.0	70.1	74.2	175.9	27.0	12.7	75.4	51.4	5.9
Level of Service		E		F	E	E	F	C	B	E	D	A
Approach Delay (s)		73.0			101.3			29.4			51.8	
Approach LOS		E			F			C			D	

Intersection Summary				
HCM Average Control Delay	46.1	HCM Level of Service	D	
HCM Volume to Capacity ratio	1.02			
Actuated Cycle Length (s)	148.8	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	112.5%	ICU Level of Service	H	
Analysis Period (min)	15			

dl Defacto Left Lane. Recode with 1 though lane as a left lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Rd & Fort Weaver Road 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.94	1.00	1.00		0.95	1.00	0.97	*0.99		1.00	*0.99	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	4990	1863	1583		3514	1583	3433	5531		1770	5532	1583
Flt Permitted	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	4990	1863	1583		3514	1583	3433	5531		1770	5532	1583
Volume (vph)	731	189	418	37	214	48	539	2120	3	190	3187	884
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	738	191	422	37	216	48	544	2141	3	192	3219	893
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	197
Lane Group Flow (vph)	738	191	422	0	253	48	544	2144	0	192	3219	696
Turn Type	Split		Free	Split		Free	Prot			Prot		Perm
Protected Phases		4			8			5	2		1	6	
Permitted Phases			Free			Free						6
Actuated Green, G (s)	17.0	17.0	130.0		8.0	130.0	18.0	70.5		16.5	71.0	71.0
Effective Green, g (s)	17.0	17.0	130.0		8.0	130.0	18.0	70.5		18.5	71.0	71.0
Actuated g/C Ratio	0.13	0.13	1.00		0.06	1.00	0.14	0.54		0.14	0.55	0.55
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	653	244	1583		216	1583	475	3000		252	3021	865
v/s Ratio Prot	c0.15	0.10			c0.07		c0.16	0.39		0.11	c0.58	
v/s Ratio Perm			0.27			0.03						0.44
v/c Ratio	1.13	0.78	0.27		1.17	0.03	1.15	0.71		0.76	1.07	0.80
Uniform Delay, d1	56.5	54.7	0.0		61.0	0.0	56.0	22.2		53.6	29.5	23.9
Progression Factor	1.07	1.08	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	74.2	12.6	0.3		115.2	0.0	87.6	1.5		12.7	37.2	7.8
Delay (s)	134.6	71.6	0.3		176.2	0.0	143.6	23.7		66.4	66.7	31.7
Level of Service	F	E	A		F	A	F	C		E	E	C
Approach Delay (s)		83.8			146.1			48.0			59.4	
Approach LOS		F			F			D			E	

Intersection Summary				
HCM Average Control Delay	62.8	HCM Level of Service	E	
HCM Volume to Capacity ratio	1.10			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	111.2%	ICU Level of Service	H	
Analysis Period (min)	15			

c Critical Lane Group

AR00028118

HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00	1.00	1.00	*0.99	1.00	0.97	*0.99	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.95	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1761	1583		1858	1583	1770	5532	1583	3433	5532	1583
Flt Permitted	0.95	0.95	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1761	1583		1858	1583	1770	5532	1583	3433	5532	1583
Volume (vph)	723	22	43	9	151	320	45	2086	75	506	3054	518
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	730	22	43	9	153	323	45	2107	76	511	3085	523
RTOR Reduction (vph)	0	0	0	0	0	295	0	0	6	0	0	38
Lane Group Flow (vph)	366	386	43	0	162	28	45	2107	70	511	3085	485
Turn Type	Split		Free	Split		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	4	4		8	8		5	2	8	1	6	4
Permitted Phases			Free			8			2			6
Actuated Green, G (s)	20.0	20.0	138.8		12.0	12.0	4.7	66.7	78.7	24.1	86.1	106.1
Effective Green, g (s)	20.0	20.0	138.8		12.0	12.0	4.7	66.7	78.7	24.1	86.1	106.1
Actuated g/C Ratio	0.14	0.14	1.00		0.09	0.09	0.03	0.48	0.57	0.17	0.62	0.76
Clearance Time (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	252	254	1583		161	137	60	2658	898	596	3432	1256
v/s Ratio Prot	0.21	c0.22			c0.09		0.03	0.38	0.01	c0.15	c0.56	0.06
v/s Ratio Perm			0.03			0.02			0.04			0.25
v/c Ratio	1.45	1.52	0.03		1.01	0.20	0.75	0.79	0.08	0.86	0.90	0.39
Uniform Delay, d1	59.4	59.4	0.0		63.4	59.0	66.5	30.2	13.6	55.7	22.6	5.5
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	224.4	253.0	0.0		72.6	0.7	40.4	2.5	0.0	11.7	4.3	0.2
Delay (s)	283.8	312.4	0.0		136.0	59.7	106.9	32.8	13.6	67.4	26.9	5.7
Level of Service	F	F	A		F	E	F	C	B	E	C	A
Approach Delay (s)		282.3			85.2			33.6			29.2	
Approach LOS		F			F			C			C	

Intersection Summary			
HCM Average Control Delay	60.4	HCM Level of Service	E
HCM Volume to Capacity ratio	0.99		
Actuated Cycle Length (s)	138.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	104.7%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
10: Farrington Hwy & D Street — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	*0.99		*0.99	*0.99			*0.99	*0.99	*0.99	*0.99	
Frt	1.00	1.00		1.00	1.00			1.00	0.85	1.00	0.92	
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	0.98	
Satd. Flow (prot)	1770	5532		3504	5506			1844	1567	1752	1659	
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	0.98	
Satd. Flow (perm)	1770	5532		3504	5506			1844	1567	1752	1659	
Volume (vph)	108	2029	0	408	2186	73	0	79	45	226	9	92
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	117	2205	0	443	2376	79	0	86	49	246	10	100
RTOR Reduction (vph)	0	0	0	0	3	0	0	0	45	0	34	0
Lane Group Flow (vph)	117	2205	0	443	2452	0	0	86	4	174	148	0
Turn Type	Prot			Prot					Perm	Split		
Protected Phases	5	2		1	6			8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	12.9	65.4		21.0	73.5			11.3	11.3	16.3	16.3	
Effective Green, g (s)	12.9	65.4		21.0	73.5			11.3	11.3	16.3	16.3	
Actuated g/C Ratio	0.10	0.50		0.16	0.57			0.09	0.09	0.13	0.13	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	176	2783		566	3113			160	136	220	208	
v/s Ratio Prot	0.07	c0.40		0.13	c0.45			c0.05		c0.10	0.09	
v/s Ratio Perm									0.00			
v/c Ratio	0.66	0.79		0.78	0.79			0.54	0.03	0.79	0.71	
Uniform Delay, d1	56.5	26.7		52.3	22.1			56.8	54.3	55.2	54.6	
Progression Factor	0.98	0.71		0.87	0.35			1.00	1.00	1.00	1.00	
Incremental Delay, d2	6.2	1.6		6.4	1.9			3.4	0.1	17.4	10.9	
Delay (s)	61.3	20.5		41.7	9.7			60.3	54.4	72.6	65.5	
Level of Service	E	C		D	A			E	D	E	E	
Approach Delay (s)		22.5			14.6			58.2			69.0	
Approach LOS		C			B			E			E	

Intersection Summary			
HCM Average Control Delay	22.2	HCM Level of Service	C
HCM Volume to Capacity ratio	0.76		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	76.8%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

AR00028119

HCM Signalized Intersection Capacity Analysis
11: Farrington Hwy & E Street — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	*0.99			*0.99		1.00	1.00		1.00	1.00	
Frt	1.00	0.98			1.00		1.00	0.99		1.00	0.94	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5421			5518		1770	1851		1770	1744	
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5421			5518		1770	1851		1770	1744	
Volume (vph)	75	1950	303	0	2238	40	179	106	5	182	125	93
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	82	2120	329	0	2433	43	195	115	5	198	136	101
RTOR Reduction (vph)	0	16	0	0	1	0	0	1	0	0	21	0
Lane Group Flow (vph)	82	2433	0	0	2475	0	195	119	0	198	216	0
Turn Type	Prot						Split			Split		
Protected Phases	5	2			6		8	8		4	4	
Permitted Phases												
Actuated Green, G (s)	8.0	81.5			69.5		18.9	18.9		17.6	17.6	
Effective Green, g (s)	8.0	81.5			69.5		18.9	18.9		17.6	17.6	
Actuated g/C Ratio	0.06	0.63			0.53		0.15	0.15		0.14	0.14	
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	109	3399			2950		257	269		240	236	
v/s Ratio Prot	0.05	c0.45			c0.45		c0.11	0.06		0.11	c0.12	
v/s Ratio Perm												
v/c Ratio	0.75	0.72			0.84		0.76	0.44		0.82	0.92	
Uniform Delay, d1	60.0	16.4			25.5		53.4	50.7		54.7	55.5	
Progression Factor	0.87	0.76			0.32		1.00	1.00		1.00	1.00	
Incremental Delay, d2	14.7	0.7			1.8		12.1	1.2		20.1	36.4	
Delay (s)	66.8	13.2			10.0		65.5	51.9		74.8	91.8	
Level of Service	E	B			B		E	D		E	F	
Approach Delay (s)		14.9			10.0			60.3			84.1	
Approach LOS		B			B			E			F	

Intersection Summary				
HCM Average Control Delay	20.5	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.82			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	83.8%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	*0.99	*0.99	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	3544	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	3544	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Volume (vph)	493	482	722	355	404	111	677	654	746	225	961	763
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	498	487	729	359	408	112	684	661	754	227	971	771
RTOR Reduction (vph)	0	32	13	0	0	74	0	0	199	0	0	248
Lane Group Flow (vph)	498	626	545	359	408	38	684	661	555	227	971	523
Turn Type	Prot		pm+ov	Prot		pm+ov	Prot		Perm	Prot		Perm
Protected Phases	1	6	7	5	2	3	7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	18.0	23.3	48.3	13.7	19.0	35.0	25.0	50.0	50.0	16.0	41.0	41.0
Effective Green, g (s)	18.0	23.3	48.3	13.7	19.0	35.0	25.0	50.0	50.0	16.0	41.0	41.0
Actuated g/C Ratio	0.15	0.20	0.41	0.12	0.16	0.29	0.21	0.42	0.42	0.13	0.34	0.34
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	530	694	636	403	589	519	736	1550	665	238	1271	545
v/s Ratio Prot	0.14	c0.18	0.18	c0.10	0.11	0.01	c0.20	0.18		0.13	0.26	
v/s Ratio Perm			0.17			0.01			0.35			c0.33
v/c Ratio	0.94	0.90	0.86	0.89	0.69	0.07	0.93	0.43	0.83	0.95	0.76	0.96
Uniform Delay, d1	50.0	46.7	32.2	51.9	47.2	30.3	46.1	24.4	30.8	51.1	34.7	38.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	24.6	14.9	11.0	21.0	6.6	0.1	17.9	0.2	8.8	45.2	2.8	28.6
Delay (s)	74.6	61.7	43.2	72.9	53.8	30.4	64.1	24.6	39.6	96.4	37.5	66.8
Level of Service	E	E	D	E	D	C	E	C	D	F	D	E
Approach Delay (s)		59.4			58.6			42.9			55.8	
Approach LOS		E			E			D			E	

Intersection Summary				
HCM Average Control Delay	53.0	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.93			
Actuated Cycle Length (s)	119.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	90.4%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99		1.00				*0.99	1.00	0.97	*0.99	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504		1583				3688	1583	3433	3688	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504		1583				3688	1583	3433	3688	
Volume (vph)	1986	0	412	0	0	0	469	86	302	514	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	2006	0	416	0	0	0	474	87	305	519	0
RTOR Reduction (vph)	0	0	47	0	0	0	0	71	0	0	0
Lane Group Flow (vph)	2006	0	369	0	0	0	474	16	305	519	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	6		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	86.3		86.3				26.0	26.0	15.7	45.7	
Effective Green, g (s)	86.3		86.3				26.0	26.0	15.7	45.7	
Actuated g/C Ratio	0.62		0.62				0.19	0.19	0.11	0.33	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	2160		976				685	294	385	1204	
v/s Ratio Prot	c0.57		0.23				c0.13		c0.09	0.14	
v/s Ratio Perm								0.01			
v/c Ratio	0.93		0.38				0.69	0.05	0.79	0.43	
Uniform Delay, d1	24.1		13.4				53.3	46.9	60.6	37.0	
Progression Factor	1.00		1.00				1.00	1.00	0.70	1.06	
Incremental Delay, d2	7.6		0.2				5.7	0.4	7.7	0.8	
Delay (s)	31.7		13.7				58.9	47.2	49.8	39.9	
Level of Service	C		B				E	D	D	D	
Approach Delay (s)		26.6		0.0			57.1			43.6	
Approach LOS		C		A			E			D	

Intersection Summary			
HCM Average Control Delay	36.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		0.88			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		2787			3433	3688			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		2787			3433	3688			3688	3135
Volume (vph)	92	0	952	0	0	206	2248	0	0	724	2003
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	93	0	962	0	0	208	2271	0	0	731	2023
RTOR Reduction (vph)	0	0	4	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	93	0	958	0	0	208	2271	0	0	731	2023
Turn Type	Prot		custom			Prot					Free
Protected Phases	4		4			1	6			2	
Permitted Phases											Free
Actuated Green, G (s)	24.0		24.0			16.0	38.0			18.0	70.0
Effective Green, g (s)	24.0		24.0			16.0	38.0			18.0	70.0
Actuated g/C Ratio	0.34		0.34			0.23	0.54			0.26	1.00
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	607		956			785	2002			948	3135
v/s Ratio Prot	0.05		c0.34			0.06	c0.62			0.20	
v/s Ratio Perm											0.65
v/c Ratio	0.15		1.00			0.26	1.13			0.77	0.65
Uniform Delay, d1	16.0		23.0			22.2	16.0			24.1	0.0
Progression Factor	1.00		1.00			1.00	1.19			1.00	1.00
Incremental Delay, d2	0.1		29.6			0.1	63.7			6.0	1.0
Delay (s)	16.1		52.6			22.2	82.7			30.1	1.0
Level of Service	B		D			C	F			C	A
Approach Delay (s)		49.4		0.0			77.6			8.8	
Approach LOS		D		A			E			A	

Intersection Summary			
HCM Average Control Delay	42.7	HCM Level of Service	D
HCM Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	81.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	1.00	*0.99	*0.99	0.88
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	5532	1583	5256	5532	1583	3504	3688	1583	3504	3688	2787
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	5532	1583	5256	5532	1583	3504	3688	1583	3504	3688	2787
Volume (vph)	717	1856	607	876	1562	386	407	740	537	529	847	758
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	724	1875	613	885	1578	390	411	747	542	534	856	766
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	724	1875	613	885	1578	390	411	747	542	534	856	766
Turn Type	Prot		Free	Prot		Free	Prot		Free	Prot		Free
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			Free			Free			Free			Free
Actuated Green, G (s)	25.0	41.0	120.0	20.0	36.0	120.0	16.0	25.0	120.0	18.0	27.0	120.0
Effective Green, g (s)	25.0	41.0	120.0	20.0	36.0	120.0	16.0	25.0	120.0	18.0	27.0	120.0
Actuated g/C Ratio	0.21	0.34	1.00	0.17	0.30	1.00	0.13	0.21	1.00	0.15	0.22	1.00
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	730	1890	1583	876	1660	1583	467	768	1583	526	830	2787
v/s Ratio Prot	c0.21	c0.34		0.17	0.29		0.12	0.20		c0.15	c0.23	
v/s Ratio Perm			c0.39			0.25			0.34			0.27
v/c Ratio	0.99	0.99	0.39	1.01	0.95	0.25	0.88	0.97	0.34	1.02	1.03	0.27
Uniform Delay, d1	47.4	39.3	0.0	50.0	41.1	0.0	51.1	47.2	0.0	51.0	46.5	0.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	31.1	18.9	0.7	33.0	13.1	0.4	20.5	26.5	0.6	43.1	39.5	0.2
Delay (s)	78.5	58.2	0.7	83.0	54.3	0.4	71.6	73.6	0.6	94.1	86.0	0.2
Level of Service	E	E	A	F	D	A	E	E	A	F	F	A
Approach Delay (s)		51.8			55.8			49.8			57.6	
Approach LOS		D			E			D			E	

Intersection Summary				
HCM Average Control Delay	53.9	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.98			
Actuated Cycle Length (s)	120.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	101.4%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connector 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99	0.86	*0.99	*0.99		*0.99	*0.99		*0.99	1.00	*0.99
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.94		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5532	1362	3504	5396		3504	3466		3504	1863	3135
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	5532	1362	3504	5396		3504	3466		3504	1863	3135
Volume (vph)	73	1834	457	642	1906	374	273	421	282	374	117	717
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	74	1853	462	648	1925	378	276	425	285	378	118	724
RTOR Reduction (vph)	0	0	205	0	25	0	0	93	0	0	0	17
Lane Group Flow (vph)	74	1853	257	648	2278	0	276	617	0	378	118	707
Turn Type	Prot		Perm	Prot			Prot			Prot		pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2									8
Actuated Green, G (s)	8.8	46.8	46.8	26.4	64.4		14.5	24.6		16.2	26.3	52.7
Effective Green, g (s)	8.8	46.8	46.8	26.4	64.4		14.5	24.6		16.2	26.3	52.7
Actuated g/C Ratio	0.07	0.36	0.36	0.20	0.50		0.11	0.19		0.12	0.20	0.41
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	120	1992	490	712	2673		391	656		437	377	1271
v/s Ratio Prot	0.04	c0.33		c0.18	0.42		0.08	c0.18		c0.11	0.06	0.11
v/s Ratio Perm			0.19									0.11
v/c Ratio	0.62	0.93	0.52	0.91	0.85		0.71	0.94		0.86	0.31	0.56
Uniform Delay, d1	59.0	40.0	32.8	50.6	28.6		55.7	52.0		55.8	44.2	29.7
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.54	0.48	0.81
Incremental Delay, d2	9.1	9.3	4.0	15.8	3.7		5.7	21.6		7.2	0.2	0.2
Delay (s)	68.0	49.3	36.8	66.4	32.3		61.4	73.6		37.6	21.3	24.3
Level of Service	E	D	D	E	C		E	E		D	C	C
Approach Delay (s)		47.5			39.8			70.2			28.1	
Approach LOS		D			D			E			C	

Intersection Summary				
HCM Average Control Delay	44.3	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.92			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	101.8%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
17: East-West Rd & North-South Road — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99	0.95		0.97	*0.99		*0.99	*0.99	1.00	*0.99	*0.99	
Frt	1.00	0.94		1.00	0.89		1.00	1.00	0.85	1.00	0.97	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504	3313		3433	3283		3504	5532	1583	3504	5358	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504	3313		3433	3283		3504	5532	1583	3504	5358	
Volume (vph)	308	312	232	361	192	525	110	1530	277	504	1626	432
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	311	315	234	365	194	530	111	1545	280	509	1642	436
RTOR Reduction (vph)	0	102	0	0	197	0	0	0	172	0	39	0
Lane Group Flow (vph)	311	447	0	365	527	0	111	1545	108	509	2039	0
Turn Type	Prot			Prot			Prot		Perm	Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases									2			
Actuated Green, G (s)	14.5	21.3		14.6	21.4		7.7	45.1	45.1	20.0	57.4	
Effective Green, g (s)	14.5	21.3		14.6	21.4		7.7	45.1	45.1	20.0	57.4	
Actuated g/C Ratio	0.12	0.18		0.12	0.18		0.07	0.39	0.39	0.17	0.49	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	434	603		428	600		231	2132	610	599	2629	
v/s Ratio Prot	0.09	0.13		c0.11	c0.16		0.03	0.28		c0.15	c0.38	
v/s Ratio Perm									0.07			
v/c Ratio	0.72	0.74		0.85	1.10dr		0.48	0.72	0.18	0.85	0.78	
Uniform Delay, d1	49.3	45.2		50.1	46.5		52.7	30.7	23.7	47.0	24.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00	1.00	1.00	1.00	
Incremental Delay, d2	5.6	4.9		15.1	13.7		1.6	2.2	0.6	14.1	2.3	
Delay (s)	54.8	50.1		65.2	60.3		54.3	32.8	24.3	61.1	26.8	
Level of Service	D	D		E	E		D	C	C	E	C	
Approach Delay (s)		51.8			61.9			32.8			33.6	
Approach LOS		D			E			C			C	

Intersection Summary				
HCM Average Control Delay	40.5	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.78			
Actuated Cycle Length (s)	117.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	88.8%	ICU Level of Service	E	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

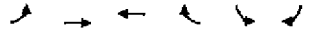
Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99	1.00	1.00	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5532	1583	1770	5532	1583	3504	5532	1583	1770	5532	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5532	1583	1770	5532	1583	3504	5532	1583	1770	5532	1583
Volume (vph)	378	875	155	494	1001	725	704	643	505	121	568	339
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	382	884	157	499	1011	732	711	649	510	122	574	342
RTOR Reduction (vph)	0	0	122	0	0	285	0	0	341	0	0	297
Lane Group Flow (vph)	382	884	35	499	1011	447	711	649	169	122	574	45
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases			2			6			4			8
Actuated Green, G (s)	26.9	26.6	26.6	36.3	36.0	36.0	25.0	30.2	30.2	10.6	15.8	15.8
Effective Green, g (s)	26.9	26.6	26.6	36.3	36.0	36.0	25.0	30.2	30.2	10.6	15.8	15.8
Actuated g/C Ratio	0.22	0.22	0.22	0.30	0.30	0.30	0.21	0.25	0.25	0.09	0.13	0.13
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	398	1229	352	537	1664	476	732	1396	399	157	730	209
v/s Ratio Prot	0.22	0.16		c0.28	0.18		c0.20	0.12		0.07	c0.10	
v/s Ratio Perm			0.02			c0.28			0.11			0.03
v/c Ratio	0.96	0.72	0.10	0.93	0.61	0.94	0.97	0.46	0.42	0.78	0.79	0.22
Uniform Delay, d1	45.9	43.1	37.0	40.5	35.8	40.8	47.0	37.9	37.5	53.4	50.3	46.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	34.3	3.6	0.6	22.5	1.7	28.7	26.2	0.2	0.7	21.1	5.6	0.5
Delay (s)	80.2	46.7	37.6	62.9	37.5	69.5	73.2	38.2	38.2	74.5	55.9	46.9
Level of Service	F	D	D	E	D	E	E	D	D	E	E	D
Approach Delay (s)		54.7			53.6			51.5			55.1	
Approach LOS		D			D			D			E	

Intersection Summary				
HCM Average Control Delay	53.5	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.91			
Actuated Cycle Length (s)	119.7	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	88.7%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

AR00028123

HCM Signalized Intersection Capacity Analysis
19: East-West Rd & Old Fort Weaver Rd — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	3539	1583	3433	1583
Flt Permitted	0.23	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	433	1863	3539	1583	3433	1583
Volume (vph)	37	533	689	948	805	93
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	37	538	696	958	813	94
RTOR Reduction (vph)	0	0	0	0	0	38
Lane Group Flow (vph)	37	538	696	958	813	56
Turn Type	Perm			pm+ov		Perm
Protected Phases		4	8	6	6	
Permitted Phases	4			8		6
Actuated Green, G (s)	44.6	44.6	44.6	122.0	77.4	77.4
Effective Green, g (s)	44.6	44.6	44.6	122.0	77.4	77.4
Actuated g/C Ratio	0.34	0.34	0.34	0.94	0.60	0.60
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	149	639	1214	1583	2044	942
v/s Ratio Prot		c0.29	0.20	c0.36	0.24	
v/s Ratio Perm	0.09			0.24		0.04
v/c Ratio	0.25	0.84	0.57	0.61	0.40	0.06
Uniform Delay, d1	30.7	39.4	34.9	0.6	13.9	11.0
Progression Factor	0.69	0.77	0.81	1.00	0.75	0.43
Incremental Delay, d2	0.7	8.0	0.2	0.2	0.2	0.0
Delay (s)	22.0	38.4	28.5	0.7	10.7	4.8
Level of Service	C	D	C	A	B	A
Approach Delay (s)		37.4	12.4		10.1	
Approach LOS		D	B		B	

Intersection Summary			
HCM Average Control Delay	16.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	68.7%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
20: Farrington Hwy & B Street — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	*0.99	1.00	0.97	*0.99	1.00	1.00	1.00	1.00	*0.99	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3688	1583	3433	3688	1583	1770	1863	1583	3504	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3688	1583	3433	3688	1583	1770	1863	1583	3504	1863	1583
Volume (vph)	221	1384	344	375	1728	74	146	282	195	264	143	171
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	223	1398	347	379	1745	75	147	285	197	267	144	173
RTOR Reduction (vph)	0	0	43	0	0	28	0	0	9	0	0	34
Lane Group Flow (vph)	223	1398	304	379	1745	47	147	285	188	267	144	139
Turn Type	Prot		pm+ov	Prot		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6		7	4	5	3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	9.0	55.5	66.5	15.5	62.0	62.0	17.3	20.7	29.7	11.0	14.4	29.9
Effective Green, g (s)	9.0	55.5	66.5	15.5	62.0	62.0	17.3	20.7	29.7	11.0	14.4	29.9
Actuated g/C Ratio	0.08	0.47	0.56	0.13	0.52	0.52	0.15	0.17	0.25	0.09	0.12	0.25
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	260	1724	687	448	1926	827	258	325	396	325	226	399
v/s Ratio Prot	0.06	0.38	0.03	c0.11	c0.47		0.08	c0.15	0.04	c0.08	0.08	0.05
v/s Ratio Perm			0.16			0.03			0.08			0.04
v/c Ratio	0.86	0.81	0.34	0.85	0.91	0.06	0.57	0.88	0.47	0.82	0.64	0.35
Uniform Delay, d1	54.2	27.1	14.2	50.4	25.7	14.0	47.2	47.8	37.9	52.9	49.7	36.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	23.3	4.3	0.2	13.7	7.6	0.1	2.9	22.3	0.9	15.3	5.8	0.5
Delay (s)	77.5	31.4	14.4	64.1	33.3	14.1	50.1	70.0	38.8	68.1	55.4	37.0
Level of Service	E	C	B	E	C	B	D	E	D	E	E	D
Approach Delay (s)		33.6			38.0			55.6			55.8	
Approach LOS		C			D			E			E	

Intersection Summary			
HCM Average Control Delay	40.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.87		
Actuated Cycle Length (s)	118.7	Sum of lost time (s)	12.0
Intersection Capacity Utilization	89.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

AR00028124

HCM Signalized Intersection Capacity Analysis
21: East-West Rd & A Street — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.85		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1841		1770	1863	1583	1770	1585		1770	1631	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1841		1770	1863	1583	1770	1585		1770	1631	
Volume (vph)	164	661	55	34	683	513	12	1	135	44	6	31
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	178	718	60	37	742	558	13	1	147	48	7	34
RTOR Reduction (vph)	0	2	0	0	0	174	0	138	0	0	32	0
Lane Group Flow (vph)	178	776	0	37	742	384	13	10	0	48	9	0
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6						
Actuated Green, G (s)	18.4	92.7		4.8	79.1	79.1	7.7	7.7		8.8	8.8	
Effective Green, g (s)	18.4	92.7		4.8	79.1	79.1	7.7	7.7		8.8	8.8	
Actuated g/C Ratio	0.14	0.71		0.04	0.61	0.61	0.06	0.06		0.07	0.07	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	251	1313		65	1134	963	105	94		120	110	
v/s Ratio Prot	c0.10	0.42		0.02	c0.40		c0.01	0.01		c0.03	0.01	
v/s Ratio Perm						0.24						
v/c Ratio	0.71	0.59		0.57	0.65	0.40	0.12	0.10		0.40	0.08	
Uniform Delay, d1	53.2	9.3		61.6	16.6	13.2	58.0	57.9		58.1	56.8	
Progression Factor	1.00	1.00		0.96	0.35	0.08	1.00	1.00		1.00	1.00	
Incremental Delay, d2	8.8	2.0		4.9	1.3	0.5	0.6	0.5		2.2	0.3	
Delay (s)	62.1	11.2		64.2	7.2	1.6	58.5	58.4		60.3	57.2	
Level of Service	E	B		E	A	A	E	E		E	E	
Approach Delay (s)		20.7			6.4			58.4			58.8	
Approach LOS		C			A			E			E	

Intersection Summary				
HCM Average Control Delay	16.9	HCM Level of Service	B	
HCM Volume to Capacity ratio	0.61			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	70.1%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

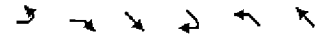
HCM Signalized Intersection Capacity Analysis
22: Farrington Hwy & 2nd Avenue — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		0.97	0.95	1.00	1.00	0.95	0.88	0.97	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5021		3433	3539	1583	1770	3539	2787	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5021		3433	3539	1583	1770	3539	2787	3433	3539	1583
Volume (vph)	180	1404	130	555	1708	237	103	297	410	515	356	308
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	196	1526	141	603	1857	258	112	323	446	560	387	335
RTOR Reduction (vph)	0	8	0	0	0	80	0	0	7	0	0	169
Lane Group Flow (vph)	196	1659	0	603	1857	178	112	323	439	560	387	166
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		Perm
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases						6			8			4
Actuated Green, G (s)	14.0	52.0		26.0	64.0	64.0	11.0	16.0	42.0	20.0	25.0	25.0
Effective Green, g (s)	14.0	52.0		26.0	64.0	64.0	11.0	16.0	42.0	20.0	25.0	25.0
Actuated g/C Ratio	0.11	0.40		0.20	0.49	0.49	0.08	0.12	0.32	0.15	0.19	0.19
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	191	2008		687	1742	779	150	436	900	528	681	304
v/s Ratio Prot	c0.11	0.33		0.18	c0.52		0.06	c0.09	0.10	c0.16	c0.11	
v/s Ratio Perm						0.11			0.06			0.10
v/c Ratio	1.03	0.83		0.88	1.07	0.23	0.75	0.74	0.49	1.06	0.57	0.55
Uniform Delay, d1	58.0	34.9		50.5	33.0	18.9	58.1	55.0	35.3	55.0	47.6	47.4
Progression Factor	1.00	1.00		0.70	0.56	0.10	0.75	0.73	0.71	0.80	0.76	0.64
Incremental Delay, d2	72.1	4.0		6.9	36.7	0.4	13.8	8.1	0.3	42.2	1.3	2.7
Delay (s)	130.1	39.0		42.2	55.0	2.3	57.1	48.2	25.3	86.3	37.6	33.0
Level of Service	F	D		D	E	A	E	D	C	F	D	C
Approach Delay (s)		48.6			47.2			37.7			57.6	
Approach LOS		D			D			D			E	

Intersection Summary				
HCM Average Control Delay	48.3	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.98			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	93.4%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028125

HCM Unsignalized Intersection Capacity Analysis
23: 2nd Avenue & Kunia Road
2030 + PRO (With Transit Corridor) - PM Peak Mitigations

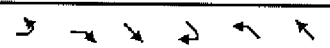


Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	4551	349	0	4748
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	4947	379	0	5161
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			868			
pX, platoon unblocked	0.37	0.37			0.37	
vC, conflicting volume	6427	1426			5326	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	10601	0			7607	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	0	399			0	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	0	1413	1413	1413	1086	1290	1290	1290	1290
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	0	379	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.83	0.83	0.83	0.64	0.76	0.76	0.76	0.76
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A								
Approach Delay (s)	0.0	0.0				0.0			
Approach LOS	A								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	75.1%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
24: 3rd Avenue & Kunia Road
2030 + PRO (With Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	4433	118	0	4297
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	4818	128	0	4671
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			1232			
pX, platoon unblocked	0.41	0.41			0.41	
vC, conflicting volume	6050	1269			4947	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	9049	0			6332	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	0	440			2	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	0	1377	1377	1377	817	1168	1168	1168	1168
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	0	128	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.81	0.81	0.81	0.48	0.69	0.69	0.69	0.69
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A								
Approach Delay (s)	0.0	0.0				0.0			
Approach LOS	A								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	69.5%	ICU Level of Service	C
Analysis Period (min)	15		

AR00028126

HCM Signalized Intersection Capacity Analysis
25: East-West Rd & B Street — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Volume (vph)	414	290	644	95	337	588
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	450	315	700	103	366	639
RTOR Reduction (vph)	0	0	0	45	0	395
Lane Group Flow (vph)	450	315	700	58	366	244
Turn Type	Prot			Prot		Prot
Protected Phases	5	2	6	6	4	4
Permitted Phases						
Actuated Green, G (s)	36.0	93.0	53.0	53.0	29.0	29.0
Effective Green, g (s)	36.0	93.0	53.0	53.0	29.0	29.0
Actuated g/C Ratio	0.28	0.72	0.41	0.41	0.22	0.22
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	490	1333	760	645	395	353
v/s Ratio Prot	c0.25	0.17	c0.38	0.04	c0.21	0.15
v/s Ratio Perm						
v/c Ratio	0.92	0.24	0.92	0.09	0.93	0.69
Uniform Delay, d1	45.6	6.3	36.5	23.7	49.5	46.4
Progression Factor	0.80	0.66	1.68	2.63	1.00	1.00
Incremental Delay, d2	19.3	0.3	16.5	0.2	30.1	10.6
Delay (s)	55.6	4.6	77.7	62.5	79.6	57.0
Level of Service	E	A	E	E	E	E
Approach Delay (s)		34.6	75.8		85.2	
Approach LOS		C	E		E	

Intersection Summary				
HCM Average Control Delay	59.4	HCM Level of Service	E	
HCM Volume to Capacity ratio	0.92			
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	85.5%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
26: Farrington Hwy & — 2030 + PRO (With Transit Corridor) - PM Peak Mitigations

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3688	3688	1583
Flt Permitted	0.95	1.00	0.05	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	98	3688	3688	1583
Volume (vph)	199	173	94	1485	2229	137
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	201	175	95	1500	2252	138
RTOR Reduction (vph)	0	16	0	0	0	33
Lane Group Flow (vph)	201	159	95	1500	2252	105
Turn Type		Perm	Perm			Perm
Protected Phases	6			4	8	
Permitted Phases		6	4			8
Actuated Green, G (s)	16.0	16.0	76.0	76.0	76.0	76.0
Effective Green, g (s)	16.0	16.0	76.0	76.0	76.0	76.0
Actuated g/C Ratio	0.16	0.16	0.76	0.76	0.76	0.76
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Grp Cap (vph)	283	253	74	2803	2803	1203
v/s Ratio Prot	c0.11			0.41	0.61	
v/s Ratio Perm		0.10	c0.97			0.07
v/c Ratio	0.71	0.63	1.28	0.54	0.80	0.09
Uniform Delay, d1	39.8	39.2	12.0	4.9	7.4	3.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.1	11.3	198.5	0.7	2.6	0.1
Delay (s)	53.9	50.5	210.5	5.6	9.9	3.2
Level of Service	D	D	F	A	A	A
Approach Delay (s)	52.3			17.8	9.6	
Approach LOS	D			B	A	

Intersection Summary				
HCM Average Control Delay	16.3	HCM Level of Service	B	
HCM Volume to Capacity ratio	1.18			
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	87.8%	ICU Level of Service	E	
Analysis Period (min)	15			

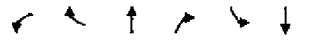
c Critical Lane Group

AR00028127

APPENDIX A-6
MITIGATIONS
YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR
SCENARIO

AR00028128

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations



Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	0.97	1.00	0.95	1.00		0.91
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3433	1583	3539	1583		5085
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3433	1583	3539	1583		5085
Volume (vph)	724	37	1781	498	0	1309
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	787	40	1936	541	0	1423
RTOR Reduction (vph)	0	10	0	196	0	0
Lane Group Flow (vph)	787	30	1936	345	0	1423
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	26.8	26.8	61.1	61.1		61.1
Effective Green, g (s)	26.8	26.8	61.1	61.1		61.1
Actuated g/C Ratio	0.28	0.28	0.64	0.64		0.64
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	959	442	2255	1009		3240
v/s Ratio Prot	c0.23		c0.55			0.28
v/s Ratio Perm		0.02		0.22		
v/c Ratio	0.82	0.07	0.86	0.34		0.44
Uniform Delay, d1	32.3	25.4	13.9	8.1		8.8
Progression Factor	1.00	1.00	1.00	1.00		1.00
Incremental Delay, d2	5.7	0.1	4.5	0.9		0.4
Delay (s)	38.0	25.4	18.5	9.0		9.2
Level of Service	D	C	B	A		A
Approach Delay (s)	37.4		16.4			9.2
Approach LOS	D		B			A

Intersection Summary			
HCM Average Control Delay	17.9	HCM Level of Service	B
HCM Volume to Capacity ratio	0.85		
Actuated Cycle Length (s)	95.9	Sum of lost time (s)	8.0
Intersection Capacity Utilization	76.6%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	0.91			0.91	
Frt						0.86	1.00	1.00			0.98	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5085			4960	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5085			4960	
Volume (vph)	0	0	0	0	0	530	165	1748	0	0	1697	333
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	0	0	0	0	576	179	1900	0	0	1845	362
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	15	0
Lane Group Flow (vph)	0	0	0	0	0	576	179	1900	0	0	2192	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						110.0	15.1	110.0			86.9	
Effective Green, g (s)						110.0	15.1	110.0			86.9	
Actuated g/C Ratio						1.00	0.14	1.00			0.79	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	243	5085			3918	
v/s Ratio Prot							c0.10	0.37			c0.44	
v/s Ratio Perm						0.36						
v/c Ratio						0.36	0.74	0.37			0.56	
Uniform Delay, d1						0.0	45.5	0.0			4.3	
Progression Factor						1.00	1.07	1.00			1.00	
Incremental Delay, d2						0.6	9.8	0.2			0.6	
Delay (s)						0.6	58.5	0.2			4.9	
Level of Service						A	E	A			A	
Approach Delay (s)	0.0			0.6				5.2			4.9	
Approach LOS	A			A				A			A	

Intersection Summary			
HCM Average Control Delay	4.5	HCM Level of Service	A
HCM Volume to Capacity ratio	0.59		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	56.0%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	0.97	1.00	0.86			0.91
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3433	1583	6408			5085
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3433	1583	6408			5085
Volume (vph)	403	363	2072	0	0	1509
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	438	395	2252	0	0	1640
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	438	395	2252	0	0	1640
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	17.4	110.0	84.6			84.6
Effective Green, g (s)	17.4	110.0	84.6			84.6
Actuated g/C Ratio	0.16	1.00	0.77			0.77
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	543	1583	4928			3911
v/s Ratio Prot	c0.13		c0.35			0.32
v/s Ratio Perm		0.25				
v/c Ratio	0.81	0.25	0.46			0.42
Uniform Delay, d1	44.7	0.0	4.5			4.3
Progression Factor	1.00	1.00	0.76			1.02
Incremental Delay, d2	8.6	0.4	0.3			0.3
Delay (s)	53.2	0.4	3.8			4.8
Level of Service	D	A	A			A
Approach Delay (s)	28.2		3.8			4.8
Approach LOS	C		A			A

Intersection Summary			
HCM Average Control Delay	8.4	HCM Level of Service	A
HCM Volume to Capacity ratio	0.52		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	49.8%	ICU Level of Service	A
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		0.91		0.97	0.91				1.00			1.00
Frt		0.98		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		5006		3433	5085				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		5006		3433	5085				1611			1611
Volume (vph)	0	2066	240	498	721	0	0	0	429	0	0	481
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	0	2246	261	541	784	0	0	0	466	0	0	523
RTOR Reduction (vph)	0	12	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2495	0	541	784	0	0	0	466	0	0	523
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		71.2		30.8	110.0				110.0			110.0
Effective Green, g (s)		71.2		30.8	110.0				110.0			110.0
Actuated g/C Ratio		0.65		0.28	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		3240		961	5085				1611			1611
v/s Ratio Prot		c0.50		c0.16	0.15							
v/s Ratio Perm									0.29			0.32
v/c Ratio		0.77		0.56	0.15				0.29			0.32
Uniform Delay, d1		13.6		33.8	0.0				0.0			0.0
Progression Factor		0.52		1.90	1.00				1.00			1.00
Incremental Delay, d2		1.3		0.6	0.1				0.5			0.5
Delay (s)		8.3		65.0	0.1				0.5			0.5
Level of Service		A		E	A				A			A
Approach Delay (s)		8.3			26.6			0.5			0.5	
Approach LOS		A			C			A			A	

Intersection Summary			
HCM Average Control Delay	11.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	66.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps 2030 + PRO (without Transit Corridor) - AM Peak Miligations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0			4.0			
Lane Util. Factor	0.97	*0.99			*0.99	1.00			1.00			
Frt	1.00	1.00			1.00	0.85			0.86			
Flt Protected	0.95	1.00			1.00	1.00			1.00			
Satd. Flow (prot)	3433	5532			5532	1583			1611			
Flt Permitted	0.95	1.00			1.00	1.00			1.00			
Satd. Flow (perm)	3433	5532			5532	1583			1611			
Volume (vph)	1165	1330	0	0	1218	567	0	0	911	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1177	1343	0	0	1230	573	0	0	920	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	55	0	0	0	0	0	0
Lane Group Flow (vph)	1177	1343	0	0	1230	518	0	0	920	0	0	0
Turn Type	Prot					Perm			Free			
Protected Phases	5	2			6							
Permitted Phases						6			Free			
Actuated Green, G (s)	64.6	110.0			37.4	37.4			110.0			
Effective Green, g (s)	64.6	110.0			37.4	37.4			110.0			
Actuated g/C Ratio	0.59	1.00			0.34	0.34			1.00			
Clearance Time (s)	4.0	4.0			4.0	4.0						
Vehicle Extension (s)	3.0	3.0			3.0	3.0						
Lane Grp Cap (vph)	2016	5532			1881	538			1611			
v/s Ratio Prot	0.34	0.24			0.22							
v/s Ratio Perm						c0.33			c0.57			
v/c Ratio	0.58	0.24			0.65	0.96			0.57			
Uniform Delay, d1	14.3	0.0			30.8	35.6			0.0			
Progression Factor	0.23	1.00			1.00	1.00			1.00			
Incremental Delay, d2	0.3	0.1			1.8	30.5			1.5			
Delay (s)	3.6	0.1			32.6	66.1			1.5			
Level of Service	A	A			C	E			A			
Approach Delay (s)		1.7			43.2			1.5			0.0	
Approach LOS		A			D			A			A	

Intersection Summary			
HCM Average Control Delay	16.0	HCM Level of Service	B
HCM Volume to Capacity ratio	0.71		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	75.0%	ICU Level of Service	D
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street 2030 + PRO (without Transit Corridor) - AM Peak Miligations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	1.00	*0.99	1.00		1.00	1.00		*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (prot)	3504	5532	1583	1770	5532	1583		1780	1583		3568	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.97	1.00
Satd. Flow (perm)	3504	5532	1583	1770	5532	1583		1780	1583		3568	1583
Volume (vph)	147	1938	155	119	1699	156	56	5	48	92	45	33
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	160	2107	168	129	1847	170	61	5	52	100	49	36
RTOR Reduction (vph)	0	0	75	0	0	92	0	0	49	0	0	33
Lane Group Flow (vph)	160	2107	93	129	1847	78	0	66	3	0	149	3
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	17.9	47.9	47.9	9.7	39.7	39.7		5.4	5.4		7.2	7.2
Effective Green, g (s)	17.9	47.9	47.9	9.7	39.7	39.7		5.4	5.4		7.2	7.2
Actuated g/C Ratio	0.21	0.56	0.56	0.11	0.46	0.46		0.06	0.06		0.08	0.08
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	728	3074	880	199	2548	729		112	99		298	132
v/s Ratio Prot	0.05	c0.38		c0.07	c0.33			c0.04			c0.04	
v/s Ratio Perm			0.06			0.05			0.00			0.00
v/c Ratio	0.22	0.69	0.11	0.65	0.72	0.11		0.59	0.03		0.50	0.02
Uniform Delay, d1	28.4	13.7	9.0	36.6	18.8	13.2		39.3	37.9		37.8	36.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	0.2	0.6	0.1	7.1	1.0	0.1		20.7	0.6		1.3	0.1
Delay (s)	28.5	14.4	9.1	43.7	19.9	13.3		60.1	38.6		39.1	36.3
Level of Service	C	B	A	D	B	B		E	D		D	D
Approach Delay (s)		15.0			20.8			50.6			38.6	
Approach LOS		B			C			D			D	

Intersection Summary			
HCM Average Control Delay	19.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.66		
Actuated Cycle Length (s)	86.2	Sum of lost time (s)	16.0
Intersection Capacity Utilization	65.8%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.91	*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.97		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1610	3509		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted	0.95	0.97		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1610	3509		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	96	24	12	72	4	235	48	4056	53	92	1419	170
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	97	24	12	73	4	237	48	4097	54	93	1433	172
RTOR Reduction (vph)	0	10	0	0	0	101	0	0	10	0	0	51
Lane Group Flow (vph)	49	74	0	73	4	136	48	4097	44	93	1433	121
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)	9.8	9.8		10.0	10.0	10.0	7.4	101.0	101.0	7.9	101.5	101.5
Effective Green, g (s)	9.8	9.8		10.0	10.0	10.0	7.4	101.0	101.0	7.9	101.5	101.5
Actuated g/C Ratio	0.07	0.07		0.07	0.07	0.07	0.05	0.70	0.70	0.05	0.70	0.70
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	109	238		122	129	109	91	3861	1105	97	3880	1110
v/s Ratio Prot	c0.03	0.02		0.04	0.00		0.03	c0.74		c0.05	0.26	
v/s Ratio Perm						c0.09			0.03			0.08
v/c Ratio	0.45	0.31		0.60	0.03	1.24	0.53	1.06	0.04	0.96	0.37	0.11
Uniform Delay, d1	64.9	64.2		65.4	62.8	67.3	66.9	21.8	6.8	68.2	8.7	7.0
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	2.9	0.7		7.7	0.1	165.4	5.4	34.0	0.1	77.0	0.3	0.2
Delay (s)	67.8	65.0		73.1	62.9	232.8	72.4	55.9	6.9	145.3	9.0	7.2
Level of Service	E	E		E	E	F	E	E	A	F	A	A
Approach Delay (s)		66.0			193.5			55.5			16.3	
Approach LOS		E			F			E			B	

Intersection Summary				
HCM Average Control Delay	52.0	HCM Level of Service	D	
HCM Volume to Capacity ratio	1.02			
Actuated Cycle Length (s)	144.7	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	106.3%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Road & Fort Weaver Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.94	1.00	1.00		1.00	1.00	0.97	*0.99		1.00	*0.99	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	4990	1863	1583		1862	1583	3433	5532		1770	5532	1583
Flt Permitted	0.95	1.00	1.00		1.00	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	4990	1863	1583		1862	1583	3433	5532		1770	5532	1583
Volume (vph)	851	126	403	4	484	262	299	3044	1	21	949	532
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	860	127	407	4	489	265	302	3075	1	21	959	537
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	291
Lane Group Flow (vph)	860	127	407	0	493	265	302	3076	0	21	959	246
Turn Type	Split		Free	Split		Free	Prot				Prot	Perm
Protected Phases	4	4		8	8		5	2			1	6
Permitted Phases			Free			Free						6
Actuated Green, G (s)	31.5	31.5	145.0		14.1	145.0	17.0	81.1			2.3	66.4	66.4
Effective Green, g (s)	31.5	31.5	145.0		14.1	145.0	17.0	81.1			2.3	66.4	66.4
Actuated g/C Ratio	0.22	0.22	1.00		0.10	1.00	0.12	0.56			0.02	0.46	0.46
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0			4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0			3.0	3.0	3.0
Lane Grp Cap (vph)	1084	405	1583		181	1583	402	3094			28	2533	725
v/s Ratio Prot	c0.17	0.07			c0.26		c0.09	c0.56			0.01	0.17	
v/s Ratio Perm			0.26			0.17							0.16
v/c Ratio	0.79	0.31	0.26		2.72	0.17	0.75	0.99			0.75	0.38	0.34
Uniform Delay, d1	53.7	47.7	0.0		65.5	0.0	62.0	31.7			71.1	25.8	25.2
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00			1.00	1.00	1.00
Incremental Delay, d2	4.1	0.4	0.4		791.1	0.2	7.7	14.9			71.8	0.4	1.3
Delay (s)	57.7	48.1	0.4		856.5	0.2	69.7	46.6			142.9	26.2	26.5
Level of Service	E	D	A		F	A	E	D			F	C	C
Approach Delay (s)		40.1			557.2			48.7				27.9	
Approach LOS		D			F			D				C	

Intersection Summary				
HCM Average Control Delay	97.2	HCM Level of Service	F	
HCM Volume to Capacity ratio	1.14			
Actuated Cycle Length (s)	145.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	117.4%	ICU Level of Service	H	
Analysis Period (min)	15			
c Critical Lane Group				

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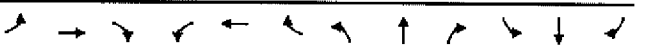
HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00	1.00	1.00	*0.99	1.00	0.97	*0.99	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1766	1583		1860	1583	1770	5532	1583	3433	5532	1583
Flt Permitted	0.95	0.96	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1766	1583		1860	1583	1770	5532	1583	3433	5532	1583
Volume (vph)	468	31	36	10	339	217	89	2658	1	251	1023	85
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	473	31	36	10	342	219	90	2685	1	254	1033	86
RTOR Reduction (vph)	0	0	0	0	0	97	0	0	0	0	0	33
Lane Group Flow (vph)	246	258	36	0	352	122	90	2685	1	254	1033	53
Turn Type	Split		Free	Split		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	4	4		8	8		5	2	8	1	6	4
Permitted Phases			Free			8			2			6
Actuated Green, G (s)	20.0	20.0	140.0		26.0	26.0	11.6	68.0	94.0	10.0	66.4	86.4
Effective Green, g (s)	20.0	20.0	140.0		26.0	26.0	11.6	68.0	94.0	10.0	66.4	86.4
Actuated g/C Ratio	0.14	0.14	1.00		0.19	0.19	0.08	0.49	0.67	0.07	0.47	0.62
Clearance Time (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	250	252	1583		345	294	147	2687	1063	245	2624	1022
v/s Ratio Prot	0.14	c0.15			c0.19		0.05	c0.49	0.00	c0.07	0.19	0.01
v/s Ratio Perm			c0.02			0.08			0.00			0.03
v/c Ratio	0.98	1.02	0.02		1.02	0.42	0.61	1.00	0.00	1.04	0.39	0.05
Uniform Delay, d1	59.8	60.0	0.0		57.0	50.3	62.0	36.0	7.6	65.0	23.8	10.6
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	52.1	63.0	0.0		53.7	1.0	7.3	17.2	0.0	67.4	0.4	0.0
Delay (s)	111.9	123.0	0.0		110.7	51.2	69.4	53.2	7.6	132.4	24.2	10.6
Level of Service	F	F	A		F	D	E	D	A	F	C	B
Approach Delay (s)		109.7			87.9			53.7			43.4	
Approach LOS		F			F			D			D	

Intersection Summary			
HCM Average Control Delay	60.5	HCM Level of Service	E
HCM Volume to Capacity ratio	0.98		
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	104.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
10: Farrington Hwy & D Street — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	*0.99		*0.99	*0.99			*0.99	*0.99	*0.99	*0.99	
Frt	1.00	1.00		1.00	0.99			0.91	0.85	1.00	0.91	
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	
Satd. Flow (prot)	1770	5532		3504	5478			1669	1567	1752	1678	
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	1.00	
Satd. Flow (perm)	1770	5532		3504	5478			1669	1567	1752	1678	
Volume (vph)	146	1756	0	240	899	63	0	65	347	205	230	345
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	147	1774	0	242	908	64	0	66	351	207	232	348
RTOR Reduction (vph)	0	0	0	0	8	0	0	59	212	0	49	0
Lane Group Flow (vph)	147	1774	0	242	964	0	0	120	26	207	531	0
Turn Type	Prot			Prot					Perm	Split		
Protected Phases	5	2		1	6			8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	12.0	42.8		7.0	37.8			12.2	12.2	32.0	32.0	
Effective Green, g (s)	12.0	42.8		7.0	37.8			12.2	12.2	32.0	32.0	
Actuated g/C Ratio	0.11	0.39		0.06	0.34			0.11	0.11	0.29	0.29	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	193	2152		223	1882			185	174	510	488	
v/s Ratio Prot	0.08	c0.32		c0.07	0.18			c0.07		0.12	c0.32	
v/s Ratio Perm									0.02			
v/c Ratio	0.76	0.82		1.09	0.51			0.65	0.15	0.41	1.09	
Uniform Delay, d1	47.6	30.2		51.5	28.8			46.9	44.2	31.4	39.0	
Progression Factor	0.74	0.81		0.61	0.39			1.00	1.00	1.00	1.00	
Incremental Delay, d2	13.1	3.0		84.4	1.0			7.9	0.4	0.5	66.8	
Delay (s)	48.2	27.5		115.8	12.2			54.8	44.6	31.9	105.8	
Level of Service	D	C		F	B			D	D	C	F	
Approach Delay (s)		29.1			32.6			49.0			86.3	
Approach LOS		C			C			D			F	

Intersection Summary			
HCM Average Control Delay	42.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	86.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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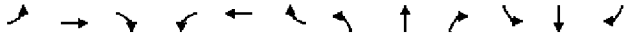
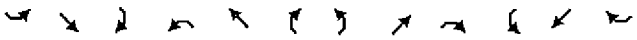
HCM Signalized Intersection Capacity Analysis
11: Farrington Hwy & E Street — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	*0.99			*0.99		1.00	1.00		1.00	1.00	
Frt	1.00	0.99			1.00		1.00	1.00		1.00	0.92	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5503			5515		1770	1856		1770	1722	
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5503			5515		1770	1856		1770	1722	
Volume (vph)	51	1764	64	0	1217	27	218	189	5	133	49	50
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	55	1917	70	0	1323	29	237	205	5	145	53	54
RTOR Reduction (vph)	0	3	0	0	1	0	0	1	0	0	34	0
Lane Group Flow (vph)	55	1984	0	0	1351	0	237	209	0	145	73	0
Turn Type	Prot						Split			Split		
Protected Phases	5	2			6		8	8		4	4	
Permitted Phases												
Actuated Green, G (s)	4.8	65.4			56.6		19.2	19.2		13.4	13.4	
Effective Green, g (s)	4.8	65.4			56.6		19.2	19.2		13.4	13.4	
Actuated g/C Ratio	0.04	0.59			0.51		0.17	0.17		0.12	0.12	
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	77	3272			2838		309	324		216	210	
v/s Ratio Prot	0.03	c0.36			0.24		c0.13	0.11		c0.08	0.04	
v/s Ratio Perm												
v/c Ratio	0.71	0.61			0.48		0.77	0.65		0.67	0.35	
Uniform Delay, d1	51.9	14.1			17.2		43.3	42.2		46.2	44.3	
Progression Factor	1.00	1.00			0.59		1.00	1.00		1.00	1.00	
Incremental Delay, d2	26.8	0.8			0.4		10.8	4.4		7.9	1.0	
Delay (s)	78.7	15.0			10.6		54.1	46.6		54.1	45.3	
Level of Service	E	B			B		D	D		D	D	
Approach Delay (s)		16.7			10.6			50.6			50.4	
Approach LOS		B			B			D			D	

Intersection Summary			
HCM Average Control Delay	20.5	HCM Level of Service	C
HCM Volume to Capacity ratio	0.65		
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	63.2%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations



Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	*0.99	*0.99	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.96	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	3539	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	3539	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Volume (vph)	377	708	799	572	579	161	338	441	485	80	743	707
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	381	715	807	578	585	163	341	445	490	81	751	714
RTOR Reduction (vph)	0	35	160	0	0	112	0	0	276	0	0	257
Lane Group Flow (vph)	381	944	383	578	585	51	341	445	214	81	751	457
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	17.3	34.2	34.2	20.0	36.9	36.9	12.9	39.9	39.9	8.6	35.6	35.6
Effective Green, g (s)	17.3	34.2	34.2	20.0	36.9	36.9	12.9	39.9	39.9	8.6	35.6	35.6
Actuated g/C Ratio	0.15	0.29	0.29	0.17	0.31	0.31	0.11	0.34	0.34	0.07	0.30	0.30
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	511	1020	451	590	1146	492	381	1240	532	128	1106	475
v/s Ratio Prot	0.11	c0.27		c0.16	c0.16		c0.10	0.12		0.05	0.20	
v/s Ratio Perm			0.24			0.03			0.14			c0.29
v/c Ratio	0.75	0.93	0.85	0.98	0.51	0.10	0.90	0.36	0.40	0.63	0.68	0.96
Uniform Delay, d1	48.6	41.0	39.8	49.1	33.5	29.1	52.2	29.7	30.3	53.5	36.5	40.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	5.9	13.6	13.9	31.5	1.6	0.4	22.5	0.2	0.5	9.8	1.7	31.6
Delay (s)	54.4	54.6	53.7	80.6	35.1	29.5	74.7	29.9	30.8	63.3	38.2	72.5
Level of Service	D	D	D	F	D	C	E	C	C	E	D	E
Approach Delay (s)		54.3			54.3			42.2			55.4	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM Average Control Delay	52.0	HCM Level of Service	D
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	118.7	Sum of lost time (s)	20.0
Intersection Capacity Utilization	87.9%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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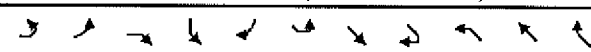
HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99		1.00				*0.99	1.00	0.97	*0.99	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504		1583				3688	1583	3433	3688	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504		1583				3688	1583	3433	3688	
Volume (vph)	1414	0	115	0	0	0	1103	248	585	244	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1428	0	116	0	0	0	1114	251	591	246	0
RTOR Reduction (vph)	0	0	70	0	0	0	0	173	0	0	0
Lane Group Flow (vph)	1428	0	46	0	0	0	1114	78	591	246	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	40.0		40.0				31.0	31.0	17.0	52.0	
Effective Green, g (s)	40.0		40.0				31.0	31.0	17.0	52.0	
Actuated g/C Ratio	0.40		0.40				0.31	0.31	0.17	0.52	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1402		633				1143	491	584	1918	
v/s Ratio Prot	c0.41		0.03				c0.30		c0.17	0.07	
v/s Ratio Perm								0.05			
v/c Ratio	1.02		0.07				0.97	0.16	1.01	0.13	
Uniform Delay, d1	30.0		18.5				34.1	25.0	41.5	12.3	
Progression Factor	1.00		1.00				1.00	1.00	0.44	0.48	
Incremental Delay, d2	28.8		0.0				21.2	0.7	35.9	0.1	
Delay (s)	58.8		18.6				55.3	25.7	54.1	6.1	
Level of Service	E		B				E	C	D	A	
Approach Delay (s)		55.8		0.0			49.9			40.0	
Approach LOS		E		A			D			D	

Intersection Summary			
HCM Average Control Delay	50.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	63.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations



Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		0.88			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		2787			3433	5532			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		2787			3433	5532			3688	3135
Volume (vph)	51	0	689	0	0	803	1714	0	0	778	2380
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	0	696	0	0	811	1731	0	0	786	2404
RTOR Reduction (vph)	0	0	34	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	52	0	662	0	0	811	1731	0	0	786	2404
Turn Type	Prot		custom			Prot					Free
Protected Phases	4					1	6			2	
Permitted Phases			4								Free
Actuated Green, G (s)	26.9		26.9			28.7	65.1			32.4	100.0
Effective Green, g (s)	26.9		26.9			28.7	65.1			32.4	100.0
Actuated g/C Ratio	0.27		0.27			0.29	0.65			0.32	1.00
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	476		750			985	3601			1195	3135
v/s Ratio Prot	0.03					0.24	0.31			0.21	
v/s Ratio Perm			c0.24								c0.77
v/c Ratio	0.11		0.88			0.82	0.48			0.66	0.77
Uniform Delay, d1	27.5		35.0			33.3	8.9			29.0	0.0
Progression Factor	1.00		1.00			0.97	0.23			1.00	1.00
Incremental Delay, d2	0.1		11.9			1.3	0.1			2.8	1.9
Delay (s)	27.6		47.0			33.5	2.1			31.9	1.9
Level of Service	C		D			C	A			C	A
Approach Delay (s)		45.6		0.0			12.1			9.3	
Approach LOS		D		A			B			A	

Intersection Summary			
HCM Average Control Delay	14.6	HCM Level of Service	B
HCM Volume to Capacity ratio	0.80		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	63.9%	ICU Level of Service	B
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	*0.99	*0.99	*0.99	1.00	*0.99	*0.99	*0.99	*0.99	*0.99	*0.99
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	5532	3135	5256	5532	1583	3504	3688	3135	3504	3688	3135
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	5532	3135	5256	5532	1583	3504	3688	3135	3504	3688	3135
Volume (vph)	765	1166	567	463	1804	349	544	404	227	176	488	810
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	773	1178	573	468	1822	353	549	408	229	178	493	818
RTOR Reduction (vph)	0	0	0	0	0	207	0	0	0	0	0	542
Lane Group Flow (vph)	773	1178	573	468	1822	146	549	408	229	178	493	276
Turn Type	Prot		Free	Prot		Perm	Prot		Free	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			Free			2			Free			8
Actuated Green, G (s)	24.0	46.4	110.0	14.6	37.0	37.0	17.0	22.2	110.0	10.8	16.0	16.0
Effective Green, g (s)	24.0	46.4	110.0	14.6	37.0	37.0	17.0	22.2	110.0	10.8	16.0	16.0
Actuated g/C Ratio	0.22	0.42	1.00	0.13	0.34	0.34	0.15	0.20	1.00	0.10	0.15	0.15
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	765	2333	3135	698	1861	532	542	744	3135	344	536	456
v/s Ratio Prot	c0.22	0.21		0.09	c0.33		c0.16	0.11		0.05	c0.13	
v/s Ratio Perm			0.18			0.09			0.07			0.09
v/c Ratio	1.01	0.50	0.18	0.67	0.98	0.27	1.01	0.55	0.07	0.52	0.92	0.61
Uniform Delay, d1	43.0	23.4	0.0	45.4	36.1	26.7	46.5	39.4	0.0	47.1	46.4	44.0
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	35.1	0.2	0.1	2.5	16.0	0.3	41.9	2.9	0.0	1.3	23.4	5.9
Delay (s)	78.1	23.5	0.1	47.9	52.1	27.0	88.4	42.3	0.0	48.4	69.7	49.9
Level of Service	E	C	A	D	D	C	F	D	A	D	E	D
Approach Delay (s)		34.9			46.0			55.5			56.3	
Approach LOS		C			D			E			E	

Intersection Summary				
HCM Average Control Delay	46.5	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.98			
Actuated Cycle Length (s)	110.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	99.0%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connecto 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99	0.86	*0.99	*0.99		*0.99	*0.99		*0.99	1.00	*0.99
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.98		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5532	1362	3504	5424		3504	3608		3504	1863	3135
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	5532	1362	3504	5424		3504	3608		3504	1863	3135
Volume (vph)	51	2067	233	489	940	141	220	163	28	367	107	329
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	52	2088	235	494	949	142	222	165	28	371	108	332
RTOR Reduction (vph)	0	0	105	0	17	0	0	13	0	0	0	38
Lane Group Flow (vph)	52	2088	130	494	1074	0	222	180	0	371	108	294
Turn Type	Prot		Perm	Prot			Prot			Prot		pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2									8
Actuated Green, G (s)	6.7	54.9	54.9	17.9	66.1		12.4	11.9		14.0	13.5	31.4
Effective Green, g (s)	6.7	54.9	54.9	17.9	66.1		12.4	11.9		14.0	13.5	31.4
Actuated g/C Ratio	0.06	0.48	0.48	0.16	0.58		0.11	0.10		0.12	0.12	0.27
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	103	2648	652	547	3126		379	374		428	219	968
v/s Ratio Prot	0.03	c0.38		c0.14	0.20		0.06	0.05		c0.11	c0.06	0.05
v/s Ratio Perm			0.10									0.05
v/c Ratio	0.50	0.79	0.20	0.90	0.34		0.59	0.48		0.87	0.49	0.30
Uniform Delay, d1	52.4	25.0	17.2	47.5	12.8		48.7	48.5		49.4	47.4	33.0
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	3.9	2.5	0.7	18.2	0.3		2.3	1.0		16.6	1.7	0.2
Delay (s)	56.2	27.5	17.9	65.7	13.1		51.0	49.5		66.1	49.1	33.2
Level of Service	E	C	B	E	B		D	D		E	D	C
Approach Delay (s)		27.2			29.5			50.3			50.3	
Approach LOS		C			C			D			D	

Intersection Summary				
HCM Average Control Delay	33.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.76			
Actuated Cycle Length (s)	114.7	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	84.8%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028136

HCM Signalized Intersection Capacity Analysis
17: East-West Rd. & North-South Road 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	*0.99	0.95		0.97	*0.99		*0.99	*0.99		*0.99	*0.99	
Frt	1.00	0.95		1.00	0.87		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3504	3363		3433	3217		3504	5428		3504	5407	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3504	3363		3433	3217		3504	5428		3504	5407	
Volume (vph)	244	225	112	245	113	652	207	1454	209	193	970	173
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	265	245	122	266	123	709	225	1580	227	210	1054	188
RTOR Reduction (vph)	0	57	0	0	177	0	0	19	0	0	25	0
Lane Group Flow (vph)	265	310	0	266	655	0	225	1788	0	210	1216	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	13.0	24.1		12.5	23.6		11.0	38.0		16.0	43.0	
Effective Green, g (s)	13.0	24.1		12.5	23.6		11.0	38.0		16.0	43.0	
Actuated g/C Ratio	0.12	0.23		0.12	0.22		0.10	0.36		0.15	0.40	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	427	760		403	712		362	1935		526	2181	
v/s Ratio Prot	0.08	0.09		c0.08	c0.20		c0.06	c0.33		c0.06	0.22	
v/s Ratio Perm												
v/c Ratio	0.62	0.41		0.66	1.36dr		0.62	0.92		0.40	0.56	
Uniform Delay, d1	44.5	35.2		45.0	40.6		45.8	32.9		41.0	24.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	2.8	0.4		4.0	17.2		3.3	9.0		2.3	1.0	
Delay (s)	47.3	35.5		49.0	57.8		49.1	41.9		43.2	25.5	
Level of Service	D	D		D	E		D	D		D	C	
Approach Delay (s)		40.4			55.7			42.7			28.1	
Approach LOS		D			E			D			C	

Intersection Summary			
HCM Average Control Delay	41.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.81		
Actuated Cycle Length (s)	106.6	Sum of lost time (s)	16.0
Intersection Capacity Utilization	82.8%	ICU Level of Service	E
Analysis Period (min)	15		

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

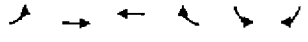
Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		0.97	0.91	1.00	0.97	0.91	1.00	1.00	0.91	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5001		3433	5085	1583	3433	5085	1583	1770	5085	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5001		3433	5085	1583	3433	5085	1583	1770	5085	1583
Volume (vph)	245	519	64	229	500	597	860	315	316	118	637	491
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	266	564	70	249	543	649	935	342	343	128	692	534
RTOR Reduction (vph)	0	15	0	0	0	396	0	0	215	0	0	203
Lane Group Flow (vph)	266	619	0	249	543	253	935	342	128	128	692	331
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6			4			8
Actuated Green, G (s)	16.0	23.8		11.2	19.0	19.0	28.0	37.4	37.4	11.6	21.0	21.0
Effective Green, g (s)	16.0	23.8		11.2	19.0	19.0	28.0	37.4	37.4	11.6	21.0	21.0
Actuated g/C Ratio	0.16	0.24		0.11	0.19	0.19	0.28	0.37	0.37	0.12	0.21	0.21
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	283	1190		384	966	301	961	1902	592	205	1068	332
v/s Ratio Prot	c0.15	0.12		0.07	0.11		c0.27	0.07		0.07	0.14	
v/s Ratio Perm						c0.16			0.08			c0.21
v/c Ratio	0.94	0.52		0.65	0.56	0.84	0.97	0.18	0.22	0.62	0.65	1.00
Uniform Delay, d1	41.5	33.1		42.5	36.7	39.0	35.6	21.0	21.3	42.1	36.1	39.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	37.2	1.6		3.7	2.4	23.7	22.5	0.0	0.2	5.8	1.4	48.2
Delay (s)	78.7	34.8		46.3	39.1	62.7	58.1	21.1	21.5	47.9	37.5	87.7
Level of Service	E	C		D	D	E	E	C	C	D	D	F
Approach Delay (s)		47.8			51.0			42.6			58.3	
Approach LOS		D			D			D			E	

Intersection Summary			
HCM Average Control Delay	49.7	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	76.4%	ICU Level of Service	D
Analysis Period (min)	15		

c Critical Lane Group

AR00028137

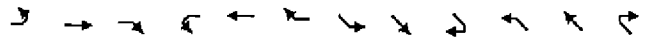
HCM Signalized Intersection Capacity Analysis
19: East-West Rd. & Old Fort Weaver Rd 2030 + PRO (without Transit Corridor) - AM Peak Mitigations



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	3539	1583	3433	1583
Flt Permitted	0.56	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1046	1863	3539	1583	3433	1583
Volume (vph)	21	893	310	1006	487	45
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	21	902	313	1016	492	45
RTOR Reduction (vph)	0	0	0	467	0	29
Lane Group Flow (vph)	21	902	313	549	492	16
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Actuated Green, G (s)	45.8	45.8	45.8	45.8	31.0	31.0
Effective Green, g (s)	45.8	45.8	45.8	45.8	31.0	31.0
Actuated g/C Ratio	0.54	0.54	0.54	0.54	0.37	0.37
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	565	1006	1911	855	1255	579
v/s Ratio Prot		c0.48	0.09		c0.14	
v/s Ratio Perm	0.02			0.35		0.01
v/c Ratio	0.04	0.90	0.16	0.64	0.39	0.03
Uniform Delay, d1	9.2	17.4	9.8	13.7	19.9	17.2
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.0	10.4	0.0	1.7	0.9	0.1
Delay (s)	9.2	27.8	9.9	15.4	20.8	17.3
Level of Service	A	C	A	B	C	B
Approach Delay (s)		27.4	14.1		20.5	
Approach LOS		C	B		C	

Intersection Summary			
HCM Average Control Delay	19.7	HCM Level of Service	B
HCM Volume to Capacity ratio	0.69		
Actuated Cycle Length (s)	84.8	Sum of lost time (s)	8.0
Intersection Capacity Utilization	72.3%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
20: Farrington Hwy & B Street 2030 + PRO (without Transit Corridor) - AM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	0.95	1.00	0.97	0.95	1.00	1.00	1.00	1.00	0.97	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3539	1583	3433	3539	1583	1770	1863	1583	3433	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3539	1583	3433	3539	1583	1770	1863	1583	3433	1863	1583
Volume (vph)	215	1127	203	124	897	87	49	137	126	343	223	206
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	234	1225	221	135	975	95	53	149	137	373	242	224
RTOR Reduction (vph)	0	0	102	0	0	60	0	0	12	0	0	60
Lane Group Flow (vph)	234	1225	119	135	975	35	53	149	125	373	242	164
Turn Type	Prot		pm+ov	Prot		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6		7	4	5	3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	11.5	36.7	50.1	8.6	33.8	33.8	4.4	18.1	29.6	13.4	27.1	35.7
Effective Green, g (s)	11.5	36.7	50.1	8.6	33.8	33.8	4.4	18.1	29.6	13.4	27.1	35.7
Actuated g/C Ratio	0.12	0.40	0.54	0.09	0.36	0.36	0.05	0.20	0.32	0.14	0.29	0.38
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	425	1400	923	318	1289	577	84	363	573	496	544	677
v/s Ratio Prot	c0.07	c0.35	0.02	0.04	0.28		0.03	0.08	0.03	c0.11	c0.13	0.02
v/s Ratio Perm			0.06			0.02			0.05			0.08
v/c Ratio	0.55	0.88	0.13	0.42	0.76	0.06	0.63	0.41	0.22	0.75	0.44	0.24
Uniform Delay, d1	38.2	25.9	10.6	39.8	25.9	19.2	43.4	32.7	23.1	38.1	26.7	19.4
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.5	6.4	0.1	0.9	2.6	0.0	14.4	3.4	0.2	6.4	2.6	0.2
Delay (s)	39.8	32.3	10.6	40.7	28.5	19.2	57.8	36.1	23.3	44.5	29.4	19.6
Level of Service	D	C	B	D	C	B	E	D	C	D	C	B
Approach Delay (s)		30.5			29.1			34.3			33.5	
Approach LOS		C			C			C			C	

Intersection Summary			
HCM Average Control Delay	31.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.70		
Actuated Cycle Length (s)	92.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	65.0%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

AR00028138

HCM Signalized Intersection Capacity Analysis
21: East-West Rd. & A Street — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1842		1770	1863	1583	1770	1597		1770	1630	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1842		1770	1863	1583	1770	1597		1770	1630	
Volume (vph)	90	328	27	31	700	74	93	7	140	44	7	37
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	98	357	29	34	761	80	101	8	152	48	8	40
RTOR Reduction (vph)	0	2	0	0	0	39	0	133	0	0	36	0
Lane Group Flow (vph)	98	384	0	34	761	41	101	27	0	48	12	0
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6						
Actuated Green, G (s)	5.0	41.3		2.2	38.5	38.5	9.5	9.5		7.5	7.5	
Effective Green, g (s)	5.0	41.3		2.2	38.5	38.5	9.5	9.5		7.5	7.5	
Actuated g/C Ratio	0.07	0.54		0.03	0.50	0.50	0.12	0.12		0.10	0.10	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	116	994		51	938	797	220	198		174	160	
v/s Ratio Prot	c0.06	c0.21		0.02	c0.41		c0.06	0.02		c0.03	0.01	
v/s Ratio Perm						0.03						
v/c Ratio	0.84	0.39		0.67	0.81	0.05	0.46	0.14		0.28	0.07	
Uniform Delay, d1	35.4	10.2		36.8	16.0	9.7	31.1	29.8		32.0	31.3	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	40.0	0.3		28.3	5.4	0.0	1.5	0.3		0.9	0.2	
Delay (s)	75.3	10.5		65.1	21.3	9.7	32.6	30.2		32.8	31.5	
Level of Service	E	B		E	C	A	C	C		C	C	
Approach Delay (s)		23.6			22.0			31.1			32.2	
Approach LOS		C			C			C			C	

Intersection Summary				
HCM Average Control Delay	24.4	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.72			
Actuated Cycle Length (s)	76.5	Sum of lost time (s)	20.0	
Intersection Capacity Utilization	67.5%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
22: Farrington Hwy & 2nd Avenue — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	0.91		0.97	0.95	1.00	1.00	0.95	0.88	0.97	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5044		3433	3539	1583	1770	3539	2787	3433	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5044		3433	3539	1583	1770	3539	2787	3433	3539	1583
Volume (vph)	172	1091	63	241	945	299	98	391	547	241	259	138
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	187	1186	68	262	1027	325	107	425	595	262	282	150
RTOR Reduction (vph)	0	4	0	0	0	159	0	0	47	0	0	115
Lane Group Flow (vph)	187	1250	0	262	1027	166	107	425	548	262	282	35
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		Perm
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases						6			8			4
Actuated Green, G (s)	29.0	67.1		17.9	56.0	56.0	14.1	28.0	45.9	21.0	34.9	34.9
Effective Green, g (s)	29.0	67.1		17.9	56.0	56.0	14.1	28.0	45.9	21.0	34.9	34.9
Actuated g/C Ratio	0.19	0.45		0.12	0.37	0.37	0.09	0.19	0.31	0.14	0.23	0.23
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	342	2256		410	1321	591	166	661	853	481	823	368
v/s Ratio Prot	0.11	c0.25		0.08	c0.29		0.06	c0.12	0.08	c0.08	0.08	
v/s Ratio Perm						0.11			0.12			0.02
v/c Ratio	0.55	0.55		0.64	0.78	0.28	0.64	0.64	0.64	0.54	0.34	0.09
Uniform Delay, d1	54.6	30.5		63.0	41.5	32.9	65.5	56.4	45.0	60.0	48.0	45.2
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	1.8	1.0		3.3	4.6	1.2	8.3	4.8	1.7	1.3	1.1	0.5
Delay (s)	56.4	31.4		66.2	46.1	34.1	73.8	61.1	46.6	61.3	49.1	45.7
Level of Service	E	C		E	D	C	E	E	D	E	D	D
Approach Delay (s)		34.7			46.9			54.7			53.0	
Approach LOS		C			D			D			D	

Intersection Summary				
HCM Average Control Delay	46.0	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.66			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	66.7%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028139

HCM Unsignalized Intersection Capacity Analysis
23: 2nd Avenue & Kunia Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	1976	301	0	5208
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	2148	327	0	5661
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			870			
pX, platoon unblocked	0.91	0.91			0.91	
vC, conflicting volume	3727	701			2475	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3698	358			2317	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	3	578			192	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	0	614	614	614	634	1415	1415	1415	1415
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	0	327	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.36	0.36	0.36	0.37	0.83	0.83	0.83	0.83
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A								
Approach Delay (s)	0.0	0.0				0.0			
Approach LOS	A								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
24: 3rd Avenue & Kunia Road — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	7	1846	129	0	5208
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	8	2007	140	0	5661
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			1234			
pX, platoon unblocked	0.98	0.98			0.98	
vC, conflicting volume	3492	572			2147	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	3483	510			2113	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	98			100	
cM capacity (veh/h)	5	499			251	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	8	573	573	573	427	1415	1415	1415	1415
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	8	0	0	0	140	0	0	0	0
cSH	499	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.02	0.34	0.34	0.34	0.25	0.83	0.83	0.83	0.83
Queue Length 95th (ft)	1	0	0	0	0	0	0	0	0
Control Delay (s)	12.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	B								
Approach Delay (s)	12.3	0.0				0.0			
Approach LOS	B								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	78.8%	ICU Level of Service	D
Analysis Period (min)	15		

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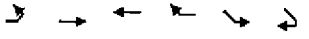
HCM Signalized Intersection Capacity Analysis
25: East-West Rd. & B Street — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations



Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	1.00	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1770	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1770	1583
Volume (vph)	156	302	313	86	648	492
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	170	328	340	93	704	535
RTOR Reduction (vph)	0	0	0	73	0	208
Lane Group Flow (vph)	170	328	340	20	704	327
Turn Type	Prot			Prot		Prot
Protected Phases	5	2	6	6	4	4
Permitted Phases						
Actuated Green, G (s)	15.4	45.3	25.9	25.9	65.5	65.5
Effective Green, g (s)	15.4	45.3	25.9	25.9	65.5	65.5
Actuated g/C Ratio	0.13	0.38	0.22	0.22	0.55	0.55
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	229	710	406	345	976	873
v/s Ratio Prot	c0.10	0.18	c0.18	0.01	c0.40	0.21
v/s Ratio Perm						
v/c Ratio	0.74	0.46	0.84	0.06	0.72	0.37
Uniform Delay, d1	49.8	27.6	44.4	36.8	19.9	15.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	12.2	0.5	14.0	0.1	4.6	1.2
Delay (s)	62.0	28.1	58.4	36.9	24.5	16.3
Level of Service	E	C	E	D	C	B
Approach Delay (s)		39.7	53.8		20.9	
Approach LOS		D	D		C	

Intersection Summary			
HCM Average Control Delay	31.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.75		
Actuated Cycle Length (s)	118.8	Sum of lost time (s)	12.0
Intersection Capacity Utilization	71.0%	ICU Level of Service	C
Analysis Period (min)	15		

c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
26: Farrington Hwy & — 2030 + PRO (without Transit Corridor) - AM Peak Mitigations

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3688	3688	1583
Flt Permitted	0.95	1.00	0.13	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	235	3688	3688	1583
Volume (vph)	109	234	51	1066	1384	134
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	110	236	52	1077	1398	135
RTOR Reduction (vph)	0	30	0	0	0	55
Lane Group Flow (vph)	110	206	52	1077	1398	80
Turn Type		Perm	Perm			Perm
Protected Phases	6			4	8	
Permitted Phases		6	4			8
Actuated Green, G (s)	33.0	33.0	59.0	59.0	59.0	59.0
Effective Green, g (s)	33.0	33.0	59.0	59.0	59.0	59.0
Actuated g/C Ratio	0.33	0.33	0.59	0.59	0.59	0.59
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Grp Cap (vph)	584	522	139	2176	2176	934
v/s Ratio Prot	0.06			0.29	c0.38	
v/s Ratio Perm		c0.13	0.22			0.05
v/c Ratio	0.19	0.39	0.37	0.49	0.64	0.09
Uniform Delay, d1	23.9	25.8	10.8	11.9	13.5	8.9
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.7	2.2	7.5	0.8	1.5	0.2
Delay (s)	24.6	28.0	18.3	12.7	15.0	9.0
Level of Service	C	C	B	B	B	A
Approach Delay (s)	27.0			12.9	14.5	
Approach LOS	C			B	B	

Intersection Summary			
HCM Average Control Delay	15.3	HCM Level of Service	B
HCM Volume to Capacity ratio	0.55		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	59.4%	ICU Level of Service	B
Analysis Period (min)	15		

c Critical Lane Group

AR00028141

HCM Signalized Intersection Capacity Analysis
1: Kunia Loop & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	WBL	WBR	NBT	NBR	SBL	SBT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0		4.0
Lane Util. Factor	*0.99	1.00	*0.99	1.00		*0.99
Frt	1.00	0.85	1.00	0.85		1.00
Flt Protected	0.95	1.00	1.00	1.00		1.00
Satd. Flow (prot)	3504	1583	3688	1583		5532
Flt Permitted	0.95	1.00	1.00	1.00		1.00
Satd. Flow (perm)	3504	1583	3688	1583		5532
Volume (vph)	892	41	2670	918	0	2765
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	901	41	2697	927	0	2793
RTOR Reduction (vph)	0	4	0	180	0	0
Lane Group Flow (vph)	901	37	2697	747	0	2793
Turn Type		Perm		Perm		
Protected Phases	8		2			6
Permitted Phases		8		2		
Actuated Green, G (s)	37.0	37.0	105.0	105.0		105.0
Effective Green, g (s)	37.0	37.0	105.0	105.0		105.0
Actuated g/C Ratio	0.25	0.25	0.70	0.70		0.70
Clearance Time (s)	4.0	4.0	4.0	4.0		4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0		3.0
Lane Grp Cap (vph)	864	390	2582	1108		3872
v/s Ratio Prot	c0.26		c0.73			0.50
v/s Ratio Perm		0.02		0.47		
v/c Ratio	1.04	0.10	1.04	0.67		0.72
Uniform Delay, d1	56.5	43.6	22.5	12.8		13.6
Progression Factor	1.00	1.00	1.14	1.39		1.00
Incremental Delay, d2	42.4	0.1	29.5	2.8		1.2
Delay (s)	98.9	43.7	55.2	20.5		14.8
Level of Service	F	D	E	C		B
Approach Delay (s)	96.5		46.3			14.8
Approach LOS	F		D			B

Intersection Summary			
HCM Average Control Delay	40.8	HCM Level of Service	D
HCM Volume to Capacity ratio	1.04		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	105.9%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
2: H-1 WB On-Ramp & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)						4.0	4.0	4.0			4.0	
Lane Util. Factor						1.00	1.00	*0.99			*0.99	
Frt						0.86	1.00	1.00			0.99	
Flt Protected						1.00	0.95	1.00			1.00	
Satd. Flow (prot)						1611	1770	5532			5455	
Flt Permitted						1.00	0.95	1.00			1.00	
Satd. Flow (perm)						1611	1770	5532			5455	
Volume (vph)	0	0	0	0	0	1230	427	2358	0	0	3316	341
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	0	0	0	0	1242	431	2382	0	0	3349	344
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	9	0
Lane Group Flow (vph)	0	0	0	0	0	1242	431	2382	0	0	3684	0
Turn Type						Free	Prot					
Protected Phases							5	2			6	
Permitted Phases						Free						
Actuated Green, G (s)						150.0	37.3	150.0			104.7	
Effective Green, g (s)						150.0	37.3	150.0			104.7	
Actuated g/C Ratio						1.00	0.25	1.00			0.70	
Clearance Time (s)							4.0	4.0			4.0	
Vehicle Extension (s)							3.0	3.0			3.0	
Lane Grp Cap (vph)						1611	440	5532			3808	
v/s Ratio Prot							c0.24	0.43			c0.68	
v/s Ratio Perm						0.77						
v/c Ratio						0.77	0.98	0.43			0.97	
Uniform Delay, d1						0.0	56.0	0.0			21.1	
Progression Factor						1.00	1.02	1.00			0.57	
Incremental Delay, d2						3.6	34.6	0.2			5.8	
Delay (s)						3.6	91.7	0.2			17.7	
Level of Service						A	F	A			B	
Approach Delay (s)	0.0			3.6				14.2			17.7	
Approach LOS	A			A				B			B	

Intersection Summary			
HCM Average Control Delay	14.2	HCM Level of Service	B
HCM Volume to Capacity ratio	0.97		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	102.0%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

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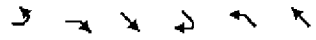
HCM Signalized Intersection Capacity Analysis
3: H-1 EB & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0			4.0
Lane Util. Factor	*0.99	1.00	*0.99			*0.99
Frt	1.00	0.85	1.00			1.00
Flt Protected	0.95	1.00	1.00			1.00
Satd. Flow (prot)	3504	1583	7376			5532
Flt Permitted	0.95	1.00	1.00			1.00
Satd. Flow (perm)	3504	1583	7376			5532
Volume (vph)	530	584	4854	0	0	2355
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	576	635	5276	0	0	2560
RTOR Reduction (vph)	0	0	0	0	0	0
Lane Group Flow (vph)	576	635	5276	0	0	2560
Turn Type		Free				
Protected Phases	4		6			2
Permitted Phases		Free				
Actuated Green, G (s)	27.1	150.0	114.9			114.9
Effective Green, g (s)	27.1	150.0	114.9			114.9
Actuated g/C Ratio	0.18	1.00	0.77			0.77
Clearance Time (s)	4.0		4.0			4.0
Vehicle Extension (s)	3.0		3.0			3.0
Lane Grp Cap (vph)	633	1583	5650			4238
v/s Ratio Prot	c0.16		c0.72			0.46
v/s Ratio Perm		0.40				
v/c Ratio	0.91	0.40	0.93			0.60
Uniform Delay, d1	60.3	0.0	14.4			7.6
Progression Factor	1.00	1.00	0.85			0.86
Incremental Delay, d2	17.0	0.8	3.9			0.6
Delay (s)	77.3	0.8	16.1			7.2
Level of Service	E	A	B			A
Approach Delay (s)	37.1		16.1			7.2
Approach LOS	D		B			A

Intersection Summary			
HCM Average Control Delay	16.4	HCM Level of Service	B
HCM Volume to Capacity ratio	0.93		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	141.0%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
4: Farrington Hwy & Fort Weaver Road SB Ramp — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)		4.0		4.0	4.0				4.0			4.0
Lane Util. Factor		*0.99		*0.99	*0.99				1.00			1.00
Frt		0.98		1.00	1.00				0.86			0.86
Flt Protected		1.00		0.95	1.00				1.00			1.00
Satd. Flow (prot)		5402		3504	5532				1611			1611
Flt Permitted		1.00		0.95	1.00				1.00			1.00
Satd. Flow (perm)		5402		3504	5532				1611			1611
Volume (vph)	0	2308	429	779	1962	0	0	0	440	0	0	903
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	0	2331	433	787	1982	0	0	0	444	0	0	912
RTOR Reduction (vph)	0	18	0	0	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	0	2746	0	787	1982	0	0	0	444	0	0	912
Turn Type				Prot					Free			Free
Protected Phases		2		1	6							
Permitted Phases									Free			Free
Actuated Green, G (s)		92.0		50.0	150.0				150.0			150.0
Effective Green, g (s)		92.0		50.0	150.0				150.0			150.0
Actuated g/C Ratio		0.61		0.33	1.00				1.00			1.00
Clearance Time (s)		4.0		4.0	4.0							
Vehicle Extension (s)		3.0		3.0	3.0							
Lane Grp Cap (vph)		3313		1168	5532				1611			1611
v/s Ratio Prot		c0.51		c0.22	0.36							
v/s Ratio Perm									0.28			0.57
v/c Ratio		0.83		0.67	0.36				0.28			0.57
Uniform Delay, d1		22.8		43.0	0.0				0.0			0.0
Progression Factor		0.26		1.14	1.00				1.00			1.00
Incremental Delay, d2		1.1		0.8	0.1				0.4			1.4
Delay (s)		7.1		49.8	0.1				0.4			1.4
Level of Service		A		D	A				A			A
Approach Delay (s)		7.1			14.2			0.4			1.4	
Approach LOS		A			B			A			A	

Intersection Summary			
HCM Average Control Delay	8.8	HCM Level of Service	A
HCM Volume to Capacity ratio	0.77		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	83.0%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

AR00028143

HCM Signalized Intersection Capacity Analysis
5: Farrington Hwy & Fort Weaver Road NB Ramps 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0	4.0			4.0			
Lane Util. Factor	0.97	*0.99			*0.99	1.00			1.00			
Frt	1.00	1.00			1.00	0.85			0.86			
Flt Protected	0.95	1.00			1.00	1.00			1.00			
Satd. Flow (prot)	3433	5532			5532	1583			1611			
Flt Permitted	0.95	1.00			1.00	1.00			1.00			
Satd. Flow (perm)	3433	5532			5532	1583			1611			
Volume (vph)	1429	1319	0	0	2743	1164	0	0	647	0	0	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	1443	1332	0	0	2771	1176	0	0	654	0	0	0
RTOR Reduction (vph)	0	0	0	0	0	1	0	0	0	0	0	0
Lane Group Flow (vph)	1443	1332	0	0	2771	1175	0	0	654	0	0	0
Turn Type	Prot					Perm			Free			
Protected Phases	5	2			6							
Permitted Phases						6			Free			
Actuated Green, G (s)	51.0	150.0			91.0	91.0			150.0			
Effective Green, g (s)	51.0	150.0			91.0	91.0			150.0			
Actuated g/C Ratio	0.34	1.00			0.61	0.61			1.00			
Clearance Time (s)	4.0	4.0			4.0	4.0						
Vehicle Extension (s)	3.0	3.0			3.0	3.0						
Lane Grp Cap (vph)	1167	5532			3356	960			1611			
v/s Ratio Prot	c0.42	0.24			0.50							
v/s Ratio Perm						c0.74			0.41			
v/c Ratio	1.24	0.24			0.83	1.22			0.41			
Uniform Delay, d1	49.5	0.0			23.2	29.5			0.0			
Progression Factor	0.59	1.00			0.32	0.31			1.00			
Incremental Delay, d2	111.5	0.1			0.2	101.6			0.8			
Delay (s)	140.5	0.1			7.6	110.7			0.8			
Level of Service	F	A			A	F			A			
Approach Delay (s)		73.1			38.3			0.8			0.0	
Approach LOS		E			D			A			A	

Intersection Summary			
HCM Average Control Delay	48.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.23		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	119.5%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
6: Farrington Hwy & Leoku Street 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00	1.00	*0.99	1.00		1.00	1.00		*0.99	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85		1.00	0.85		1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (prot)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00		0.96	1.00		0.96	1.00
Satd. Flow (perm)	3504	5532	1583	1770	5532	1583		1785	1583		3530	1583
Volume (vph)	286	1564	116	135	3606	515	197	29	130	243	28	99
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	289	1580	117	136	3642	520	199	29	131	245	28	100
RTOR Reduction (vph)	0	0	50	0	0	132	0	0	42	0	0	87
Lane Group Flow (vph)	289	1580	67	136	3642	388	0	228	89	0	273	13
Turn Type	Prot		Perm	Prot		Perm	Split		Perm	Split		Perm
Protected Phases	7	4		3	8		2	2		6	6	
Permitted Phases			4			8			2			6
Actuated Green, G (s)	11.9	85.8	85.8	16.1	90.0	90.0		17.0	17.0		15.1	15.1
Effective Green, g (s)	11.9	85.8	85.8	16.1	90.0	90.0		17.0	17.0		15.1	15.1
Actuated g/C Ratio	0.08	0.57	0.57	0.11	0.60	0.60		0.11	0.11		0.10	0.10
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0
Lane Grp Cap (vph)	278	3164	905	190	3319	950		202	179		355	159
v/s Ratio Prot	c0.08	0.29		c0.08	c0.66			c0.13			c0.08	
v/s Ratio Perm			0.04			0.24			0.06			0.01
v/c Ratio	1.04	0.50	0.07	0.72	1.10	0.41		1.13	0.50		1.39dl	0.08
Uniform Delay, d1	69.0	19.2	14.3	64.7	30.0	15.9		66.5	62.5		65.8	61.2
Progression Factor	0.97	1.38	2.12	1.00	1.00	1.00		1.00	1.00		1.00	1.00
Incremental Delay, d2	63.8	0.5	0.2	12.1	49.2	1.3		102.2	9.6		9.6	0.2
Delay (s)	130.7	27.0	30.6	76.8	79.2	17.2		168.7	72.1		75.4	61.4
Level of Service	F	C	C	E	E	B		F	E		E	E
Approach Delay (s)		42.3			71.6			133.5			71.6	
Approach LOS		D			E			F			E	

Intersection Summary			
HCM Average Control Delay	66.5	HCM Level of Service	E
HCM Volume to Capacity ratio	1.03		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	108.0%	ICU Level of Service	G
Analysis Period (min)	15		
dl Defacto Left Lane. Recode with 1 though lane as a left lane.			
c Critical Lane Group			

AR00028144

HCM Signalized Intersection Capacity Analysis
7: Laulaunui Street & Fort Weaver Road 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.91	*0.99		1.00	1.00	1.00	1.00	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.97		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1610	3523		1770	1863	1583	1770	5532	1583	1770	5532	1583
Flt Permitted	0.95	0.97		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1610	3523		1770	1863	1583	1770	5532	1583	1770	5532	1583
Volume (vph)	209	37	13	62	4	231	56	2896	100	231	4375	62
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	211	37	13	63	4	233	57	2925	101	233	4419	63
RTOR Reduction (vph)	0	5	0	0	0	213	0	0	27	0	0	17
Lane Group Flow (vph)	108	150	0	63	4	20	57	2925	74	233	4419	66
Turn Type	Split			Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases						8			2			6
Actuated Green, G (s)	13.7	13.7		5.0	5.0	5.0	5.0	89.0	89.0	24.0	108.0	108.0
Effective Green, g (s)	13.7	13.7		5.0	5.0	5.0	5.0	89.0	89.0	24.0	108.0	108.0
Actuated g/C Ratio	0.09	0.09		0.03	0.03	0.03	0.03	0.60	0.60	0.16	0.73	0.73
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	149	327		60	63	54	60	3333	954	288	4045	1158
v/s Ratio Prot	c0.07	0.04		c0.04	0.00		0.03	c0.53		0.13	c0.80	
v/s Ratio Perm						0.01			0.05			0.04
v/c Ratio	0.71	0.46		1.05	0.06	0.38	0.95	0.88	0.08	0.81	1.09	0.06
Uniform Delay, d1	65.1	63.5		71.3	69.1	69.8	71.2	24.8	12.2	59.6	19.8	5.6
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.8	1.0		130.8	0.4	4.4	97.0	3.6	0.2	15.3	46.3	0.1
Delay (s)	79.9	64.5		202.2	69.5	74.2	168.2	28.4	12.4	74.9	66.2	5.7
Level of Service	E	E		F	E	E	F	C	B	E	E	A
Approach Delay (s)		70.8			101.0			30.4			65.5	
Approach LOS		E			F			C			E	

Intersection Summary			
HCM Average Control Delay	54.1	HCM Level of Service	D
HCM Volume to Capacity ratio	1.05		
Actuated Cycle Length (s)	147.7	Sum of lost time (s)	16.0
Intersection Capacity Utilization	110.3%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
8: Old Fort Weaver Rd & Fort Weaver Road 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	0.94	1.00	1.00		1.00	1.00	0.97	*0.99		1.00	*0.99	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	4990	1863	1583		1849	1583	3433	5531		1770	5532	1583
Flt Permitted	0.95	1.00	1.00		0.99	1.00	0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	4990	1863	1583		1849	1583	3433	5531		1770	5532	1583
Volume (vph)	837	200	483	37	219	89	563	2123	3	193	3255	1002
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	845	202	488	37	221	90	569	2144	3	195	3288	1012
RTOR Reduction (vph)	0	0	0	0	0	0	0	0	0	0	0	2
Lane Group Flow (vph)	845	202	488	0	258	90	569	2147	0	195	3288	1010
Turn Type	Split		Free	Split		Free	Prot			Prot		pm+ov
Protected Phases	4	4		8	8		5	2		1	6	4
Permitted Phases			Free			Free						6
Actuated Green, G (s)	22.0	22.0	150.0		9.0	150.0	22.0	82.4		20.6	81.0	103.0
Effective Green, g (s)	22.0	22.0	150.0		9.0	150.0	22.0	82.4		20.6	81.0	103.0
Actuated g/C Ratio	0.15	0.15	1.00		0.06	1.00	0.15	0.55		0.14	0.54	0.69
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	732	273	1583		111	1583	504	3038		243	2987	1129
v/s Ratio Prot	c0.17	0.11			c0.14		c0.17	0.39		0.11	c0.59	0.13
v/s Ratio Perm			c0.31			0.06						0.51
v/c Ratio	1.15	0.74	0.31		2.32	0.06	1.13	0.71		0.80	1.10	0.89
Uniform Delay, d1	64.0	61.3	0.0		70.5	0.0	64.0	24.9		62.7	34.5	19.1
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00		1.00	1.00	1.00
Incremental Delay, d2	84.6	10.1	0.5		623.2	0.1	80.6	1.4		17.2	51.2	9.3
Delay (s)	148.6	71.3	0.5		693.7	0.1	144.6	26.3		79.9	85.7	28.4
Level of Service	F	E	A		F	A	F	C		E	F	C
Approach Delay (s)		91.3			514.3			51.1			72.5	
Approach LOS		F			F			D			E	

Intersection Summary			
HCM Average Control Delay	86.2	HCM Level of Service	F
HCM Volume to Capacity ratio	1.20		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0
Intersection Capacity Utilization	121.8%	ICU Level of Service	H
Analysis Period (min)	15		
c Critical Lane Group			

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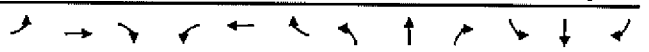
HCM Signalized Intersection Capacity Analysis
9: Renton Road & Fort Weaver Road — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	1.00		1.00	1.00	1.00	*0.99	1.00	0.97	*0.99	1.00
Frt	1.00	1.00	0.85		1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	0.96	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1752	1761	1583		1858	1583	1770	5532	1583	3433	5532	1583
Flt Permitted	0.95	0.96	1.00		1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1752	1761	1583		1858	1583	1770	5532	1583	3433	5532	1583
Volume (vph)	725	23	43	9	151	326	45	2103	75	514	3074	519
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	732	23	43	9	153	329	45	2124	76	519	3105	524
RTOR Reduction (vph)	0	0	0	0	0	225	0	0	11	0	0	230
Lane Group Flow (vph)	368	387	43	0	162	104	45	2124	65	519	3105	294
Turn Type	Split		Free	Split		Perm	Prot		Perm	Prot		Perm
Protected Phases	4	4		8	8		5	2		1	6	
Permitted Phases			Free			8			2			6
Actuated Green, G (s)	16.0	16.0	100.8		9.0	9.0	3.2	43.0	43.0	16.8	56.6	56.6
Effective Green, g (s)	16.0	16.0	100.8		9.0	9.0	3.2	43.0	43.0	16.8	56.6	56.6
Actuated g/C Ratio	0.16	0.16	1.00		0.09	0.09	0.03	0.43	0.43	0.17	0.56	0.56
Clearance Time (s)	4.0	4.0			4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0			3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	278	280	1583		166	141	56	2360	675	572	3106	889
v/s Ratio Prot	0.21	c0.22			c0.09		0.03	c0.38		0.15	c0.56	
v/s Ratio Perm			0.03			0.07			0.04			0.19
v/c Ratio	1.32	1.38	0.03		0.98	0.74	0.80	0.90	0.10	0.91	1.00	0.33
Uniform Delay, d1	42.4	42.4	0.0		45.8	44.8	48.5	26.9	17.3	41.2	22.1	11.9
Progression Factor	1.00	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	168.6	192.7	0.0		62.1	18.1	55.1	6.1	0.3	18.1	16.1	1.0
Delay (s)	211.0	235.1	0.0		107.9	62.9	103.6	32.9	17.6	59.3	38.2	12.9
Level of Service	F	F	A		F	E	F	C	B	E	D	B
Approach Delay (s)		211.3			77.7			33.8			37.6	
Approach LOS		F			E			C			D	

Intersection Summary			
HCM Average Control Delay	57.1	HCM Level of Service	E
HCM Volume to Capacity ratio	1.08		
Actuated Cycle Length (s)	100.8	Sum of lost time (s)	16.0
Intersection Capacity Utilization	105.2%	ICU Level of Service	G
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
10: Farrington Hwy & D Street — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Lane Util. Factor	1.00	*0.99		*0.99	*0.99			*0.99	*0.99	*0.99	*0.99	
Frt	1.00	1.00		1.00	0.99			1.00	0.85	1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00			1.00	1.00	0.95	0.99	
Satd. Flow (prot)	1770	5532		3504	5473			1844	1567	1752	1613	
Flt Permitted	0.95	1.00		0.95	1.00			1.00	1.00	0.95	0.99	
Satd. Flow (perm)	1770	5532		3504	5473			1844	1567	1752	1613	
Volume (vph)	99	2335	0	425	2265	175	0	179	45	357	7	259
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	100	2359	0	429	2288	177	0	181	45	361	7	262
RTOR Reduction (vph)	0	0	0	0	6	0	0	0	40	0	84	0
Lane Group Flow (vph)	100	2359	0	429	2459	0	0	181	5	293	253	0
Turn Type	Prot			Prot					Perm	Split		
Protected Phases	5	2		1	6			8		4	4	
Permitted Phases									8			
Actuated Green, G (s)	10.7	69.8		20.0	79.1			17.2	17.2	27.0	27.0	
Effective Green, g (s)	10.7	69.8		20.0	79.1			17.2	17.2	27.0	27.0	
Actuated g/C Ratio	0.07	0.47		0.13	0.53			0.11	0.11	0.18	0.18	
Clearance Time (s)	4.0	4.0		4.0	4.0			4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0			3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	126	2574		467	2886			211	180	315	290	
v/s Ratio Prot	0.06	c0.43		0.12	c0.45			c0.10		c0.17	0.16	
v/s Ratio Perm									0.00			
v/c Ratio	0.79	0.92		0.92	0.85			0.86	0.03	0.93	0.87	
Uniform Delay, d1	68.6	37.4		64.2	30.4			65.2	59.0	60.6	59.8	
Progression Factor	1.05	0.65		0.78	0.55			1.00	1.00	1.00	1.00	
Incremental Delay, d2	19.2	4.4		21.6	3.2			27.4	0.1	33.0	23.6	
Delay (s)	91.3	28.8		71.7	19.8			92.6	59.0	93.5	83.4	
Level of Service	F	C		E	B			F	E	F	F	
Approach Delay (s)		31.4			27.5			85.9			88.1	
Approach LOS		C			C			F			F	

Intersection Summary			
HCM Average Control Delay	37.3	HCM Level of Service	D
HCM Volume to Capacity ratio	0.89		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	98.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
11: Farrington Hwy & E Street — 2030 + PRO (without Transit Corridor) - PM Peak Miligations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	*0.99			*0.99		1.00	1.00		1.00	1.00	
Frt	1.00	0.98			1.00		1.00	0.99		1.00	0.94	
Flt Protected	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	5428			5519		1770	1851		1770	1743	
Flt Permitted	0.95	1.00			1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	5428			5519		1770	1851		1770	1743	
Volume (vph)	77	2202	318	0	2482	42	203	110	5	227	130	97
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	78	2224	321	0	2507	42	205	111	5	229	131	98
RTOR Reduction (vph)	0	13	0	0	1	0	0	1	0	0	18	0
Lane Group Flow (vph)	78	2532	0	0	2548	0	205	115	0	229	211	0
Turn Type	Prot						Split			Split		
Protected Phases	5	2			6		8	8		4	4	
Permitted Phases												
Actuated Green, G (s)	8.0	94.5			82.5		22.2	22.2		21.3	21.3	
Effective Green, g (s)	8.0	94.5			82.5		22.2	22.2		21.3	21.3	
Actuated g/C Ratio	0.05	0.63			0.55		0.15	0.15		0.14	0.14	
Clearance Time (s)	4.0	4.0			4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0			3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	94	3420			3035		262	274		251	248	
v/s Ratio Prot	0.04	c0.47			c0.46		c0.12	0.06		c0.13	0.12	
v/s Ratio Perm												
v/c Ratio	0.83	0.74			0.84		0.78	0.42		0.91	0.85	
Uniform Delay, d1	70.3	19.2			28.2		61.6	58.1		63.4	62.8	
Progression Factor	0.75	0.55			0.65		1.00	1.00		1.00	1.00	
Incremental Delay, d2	27.8	0.8			1.5		14.1	1.0		34.2	23.3	
Delay (s)	80.6	11.4			19.8		75.7	59.1		97.6	86.1	
Level of Service	F	B			B		E	E		F	F	
Approach Delay (s)		13.5			19.8			69.7			91.9	
Approach LOS		B			B			E			F	

Intersection Summary				
HCM Average Control Delay	25.2	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.82			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	90.5%	ICU Level of Service	E	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
12: Fort Barrette Road & Farrington Hwy — 2030 + PRO (without Transit Corridor) - PM Peak Miligations

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	*0.99	*0.99	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.95	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	3507	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	3507	1567	3504	3688	1583	3504	3688	1583	1770	3688	1583
Volume (vph)	493	483	724	355	405	113	678	660	746	226	1028	677
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	498	488	731	359	409	114	685	667	754	228	1038	684
RTOR Reduction (vph)	0	55	251	0	0	94	0	0	206	0	0	221
Lane Group Flow (vph)	498	670	243	359	409	20	685	667	548	228	1038	463
Turn Type	Prot		Perm	Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			6			2			4			8
Actuated Green, G (s)	19.1	26.2	26.2	13.0	20.1	20.1	24.4	45.2	45.2	16.6	37.4	37.4
Effective Green, g (s)	19.1	26.2	26.2	13.0	20.1	20.1	24.4	45.2	45.2	16.6	37.4	37.4
Actuated g/C Ratio	0.16	0.22	0.22	0.11	0.17	0.17	0.21	0.39	0.39	0.14	0.32	0.32
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	572	765	351	389	634	272	731	1425	612	251	1179	506
v/s Ratio Prot	c0.14	c0.19		0.10	0.11		c0.20	0.18		0.13	0.28	
v/s Ratio Perm			0.16			0.01			c0.35			0.29
v/c Ratio	0.87	0.88	0.69	0.92	0.65	0.07	0.94	0.47	0.90	0.91	0.88	0.91
Uniform Delay, d1	47.7	43.6	41.7	51.5	45.1	40.6	45.5	26.9	33.7	49.5	37.7	38.3
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	13.6	8.9	5.8	27.1	5.0	0.5	19.3	0.2	15.6	33.1	7.9	21.1
Delay (s)	61.3	52.5	47.5	78.6	50.1	41.1	64.9	27.1	49.2	82.6	45.6	59.4
Level of Service	E	D	D	E	D	D	E	C	D	F	D	E
Approach Delay (s)		53.6			60.6			47.3			54.7	
Approach LOS		D			E			D			D	

Intersection Summary				
HCM Average Control Delay	52.9	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.87			
Actuated Cycle Length (s)	117.0	Sum of lost time (s)	8.0	
Intersection Capacity Utilization	92.3%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

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HCM Signalized Intersection Capacity Analysis
13: WB Ramps & North-South Road — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	WBL2	WBL	WBR	NBL	NBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Lane Util. Factor	*0.99		1.00				*0.99	1.00	0.97	*0.99	
Frt	1.00		0.85				1.00	0.85	1.00	1.00	
Flt Protected	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (prot)	3504		1583				3688	1583	3433	3688	
Flt Permitted	0.95		1.00				1.00	1.00	0.95	1.00	
Satd. Flow (perm)	3504		1583				3688	1583	3433	3688	
Volume (vph)	2099	0	412	0	0	0	495	86	368	585	0
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	2120	0	416	0	0	0	500	87	372	591	0
RTOR Reduction (vph)	0	0	57	0	0	0	0	70	0	0	0
Lane Group Flow (vph)	2120	0	359	0	0	0	500	17	372	591	0
Turn Type	Prot		custom					Perm	Prot		
Protected Phases	8		8				6		5	2	
Permitted Phases								6			
Actuated Green, G (s)	74.0		74.0				25.1	25.1	18.9	48.0	
Effective Green, g (s)	74.0		74.0				25.1	25.1	18.9	48.0	
Actuated g/C Ratio	0.57		0.57				0.19	0.19	0.15	0.37	
Clearance Time (s)	4.0		4.0				4.0	4.0	4.0	4.0	
Vehicle Extension (s)	3.0		3.0				3.0	3.0	3.0	3.0	
Lane Grp Cap (vph)	1995		901				712	306	499	1352	
v/s Ratio Prot	c0.61		0.23				c0.14		c0.11	0.16	
v/s Ratio Perm								0.01			
v/c Ratio	1.06		0.40				0.70	0.05	0.75	0.43	
Uniform Delay, d1	28.0		15.6				49.0	42.8	53.2	30.8	
Progression Factor	1.00		1.00				1.00	1.00	1.00	1.00	
Incremental Delay, d2	39.2		0.3				5.7	0.3	6.0	1.0	
Delay (s)	67.2		15.9				54.7	43.1	59.2	31.8	
Level of Service	E		B				D	D	E	C	
Approach Delay (s)		58.8		0.0			53.0			42.4	
Approach LOS		E		A			D			D	

Intersection Summary			
HCM Average Control Delay	54.1	HCM Level of Service	D
HCM Volume to Capacity ratio	0.94		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	88.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
14: EB Ramps & North-South Road — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL2	EBL	EBR	SBL	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations											
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0		4.0			4.0	4.0			4.0	4.0
Lane Util. Factor	1.00		0.88			0.97	*0.99			*0.99	*0.99
Frt	1.00		0.85			1.00	1.00			1.00	0.85
Flt Protected	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (prot)	1770		2787			3433	5532			3688	3135
Flt Permitted	0.95		1.00			0.95	1.00			1.00	1.00
Satd. Flow (perm)	1770		2787			3433	5532			3688	3135
Volume (vph)	92	0	1018	0	0	207	2387	0	0	861	2122
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	93	0	1028	0	0	209	2411	0	0	870	2143
RTOR Reduction (vph)	0	0	3	0	0	0	0	0	0	0	0
Lane Group Flow (vph)	93	0	1025	0	0	209	2411	0	0	870	2143
Turn Type	Prot		custom			Prot					Free
Protected Phases	4		4			1	6			2	
Permitted Phases											Free
Actuated Green, G (s)	23.0		23.0			9.3	39.0			25.7	70.0
Effective Green, g (s)	23.0		23.0			9.3	39.0			25.7	70.0
Actuated g/C Ratio	0.33		0.33			0.13	0.56			0.37	1.00
Clearance Time (s)	4.0		4.0			4.0	4.0			4.0	
Vehicle Extension (s)	3.0		3.0			3.0	3.0			3.0	
Lane Grp Cap (vph)	582		916			456	3082			1354	3135
v/s Ratio Prot	0.05		c0.37			0.06	c0.44			0.24	
v/s Ratio Perm											c0.68
v/c Ratio	0.16		1.12			0.46	0.78			0.64	0.68
Uniform Delay, d1	16.7		23.5			28.0	12.2			18.3	0.0
Progression Factor	1.00		1.00			1.00	1.00			0.67	1.00
Incremental Delay, d2	0.1		68.2			0.7	2.1			0.9	0.5
Delay (s)	16.8		91.7			28.8	14.2			13.2	0.5
Level of Service	B		F			C	B			B	A
Approach Delay (s)		85.5		0.0			15.4			4.1	
Approach LOS		F		A			B			A	

Intersection Summary			
HCM Average Control Delay	22.0	HCM Level of Service	C
HCM Volume to Capacity ratio	0.86		
Actuated Cycle Length (s)	70.0	Sum of lost time (s)	4.0
Intersection Capacity Utilization	88.4%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

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HCM Signalized Intersection Capacity Analysis
15: North-South Road & Farrington Hwy 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	SEL	SET	SER	NWL	NWT	NWR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	*0.99	*0.99	0.86	*0.99	*0.99	1.00	*0.99	*0.99	0.88	*0.99	*0.99	0.88
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3504	5532	2787	5256	5532	1583	3504	3688	2787	3504	3688	2787
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3504	5532	2787	5256	5532	1583	3504	3688	2787	3504	3688	2787
Volume (vph)	815	1917	650	880	1657	393	411	756	542	539	920	915
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	823	1936	657	889	1674	397	415	764	547	544	929	924
RTOR Reduction (vph)	0	0	0	0	0	163	0	0	0	0	0	522
Lane Group Flow (vph)	823	1936	657	889	1674	234	415	764	547	544	929	402
Turn Type	Prot		Free	Prot		Perm	Prot		Free	Prot		Perm
Protected Phases	1	6		5	2		7	4		3	8	
Permitted Phases			Free			2			Free			8
Actuated Green, G (s)	33.0	48.0	140.0	29.0	44.0	44.0	16.0	27.0	140.0	20.0	31.0	31.0
Effective Green, g (s)	33.0	48.0	140.0	29.0	44.0	44.0	16.0	27.0	140.0	20.0	31.0	31.0
Actuated g/C Ratio	0.24	0.34	1.00	0.21	0.31	0.31	0.11	0.19	1.00	0.14	0.22	0.22
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	826	1897	2787	1089	1739	498	400	711	2787	501	817	617
v/s Ratio Prot	c0.23	c0.35		0.17	0.30		0.12	0.21		c0.16	c0.25	
v/s Ratio Perm			0.24			0.15			0.20			0.14
v/c Ratio	1.00	1.02	0.24	0.82	0.96	0.47	1.04	1.07	0.20	1.09	1.14	0.65
Uniform Delay, d1	53.4	46.0	0.0	53.0	47.2	38.6	62.0	56.5	0.0	60.0	54.5	49.6
Progression Factor	1.03	0.90	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	19.8	19.3	0.1	4.8	14.4	3.2	55.0	55.6	0.2	65.4	76.4	5.3
Delay (s)	75.1	60.6	0.1	57.8	61.6	41.8	117.0	112.1	0.2	125.4	130.9	54.8
Level of Service	E	E	A	E	E	D	F	F	A	F	F	D
Approach Delay (s)		52.4			57.8			77.8			100.4	
Approach LOS		D			E			E			F	

Intersection Summary				
HCM Average Control Delay	69.1	HCM Level of Service	E	
HCM Volume to Capacity ratio	1.08			
Actuated Cycle Length (s)	140.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	105.8%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
16: North-South Road & North UH Connecto 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	NBL	NBT	NBR	SBL	SBT	SBR	NEL	NET	NER	SWL	SWT	SWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99	0.86	*0.99	*0.99		*0.99	*0.99		*0.99	1.00	*0.99
Frt	1.00	1.00	0.85	1.00	0.98		1.00	0.93		1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (prot)	1770	5532	1362	3504	5397		3504	3445		3504	1863	3135
Flt Permitted	0.95	1.00	1.00	0.95	1.00		0.95	1.00		0.95	1.00	1.00
Satd. Flow (perm)	1770	5532	1362	3504	5397		3504	3445		3504	1863	3135
Volume (vph)	73	1846	475	676	1942	380	315	427	334	390	121	770
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	74	1865	480	683	1962	384	318	431	337	394	122	778
RTOR Reduction (vph)	0	0	189	0	22	0	0	95	0	0	0	14
Lane Group Flow (vph)	74	1865	291	683	2324	0	318	673	0	394	122	764
Turn Type	Prot		Perm	Prot			Prot			Prot		pm+ov
Protected Phases	5	2		1	6		7	4		3	8	1
Permitted Phases			2									8
Actuated Green, G (s)	12.0	54.4	54.4	31.0	73.4		17.8	30.6		18.0	30.8	61.8
Effective Green, g (s)	12.0	54.4	54.4	31.0	73.4		17.8	30.6		18.0	30.8	61.8
Actuated g/C Ratio	0.08	0.36	0.36	0.21	0.49		0.12	0.20		0.12	0.21	0.41
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0		4.0	4.0		4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0		3.0	3.0		3.0	3.0	3.0
Lane Grp Cap (vph)	142	2006	494	724	2641		416	703		420	383	1292
v/s Ratio Prot	0.04	c0.34		c0.19	0.43		0.09	c0.20		c0.11	0.07	0.12
v/s Ratio Perm			0.21									0.12
v/c Ratio	0.52	0.93	0.59	0.94	0.88		0.76	0.96		0.94	0.32	0.59
Uniform Delay, d1	66.2	46.0	38.8	58.6	34.3		64.1	59.1		65.4	50.7	34.3
Progression Factor	1.00	1.00	1.00	1.00	1.00		1.00	1.00		0.70	0.97	0.59
Incremental Delay, d2	3.4	9.2	5.1	20.7	4.8		8.1	23.7		4.5	0.0	0.1
Delay (s)	69.7	55.2	43.9	79.3	38.9		72.2	82.8		50.2	49.1	20.3
Level of Service	E	E	D	E	D		E	F		D	D	C
Approach Delay (s)		53.4			48.0			79.7			32.1	
Approach LOS		D			D			E			C	

Intersection Summary				
HCM Average Control Delay	51.4	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.94			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	105.5%	ICU Level of Service	G	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028149

HCM Signalized Intersection Capacity Analysis
17: East-West Rd. & North-South Road 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Lane Util. Factor	*0.99	0.95		0.97	*0.99		*0.99	*0.99		*0.99	*0.99	
Frt	1.00	0.94		1.00	0.89		1.00	0.98		1.00	0.98	
Flt Protected	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (prot)	3504	3313		3433	3283		3504	5404		3504	5396	
Flt Permitted	0.95	1.00		0.95	1.00		0.95	1.00		0.95	1.00	
Satd. Flow (perm)	3504	3313		3433	3283		3504	5404		3504	5396	
Volume (vph)	310	312	232	367	193	531	110	1553	284	611	1718	337
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	313	315	234	371	195	536	111	1569	287	617	1735	340
RTOR Reduction (vph)	0	98	0	0	224	0	0	28	0	0	31	0
Lane Group Flow (vph)	313	451	0	371	507	0	111	1828	0	617	2045	0
Turn Type	Prot			Prot			Prot			Prot		
Protected Phases	7	4		3	8		5	2		1	6	
Permitted Phases												
Actuated Green, G (s)	14.1	20.0		12.0	17.9		6.9	40.0		20.0	53.1	
Effective Green, g (s)	14.1	20.0		12.0	17.9		6.9	40.0		20.0	53.1	
Actuated g/C Ratio	0.13	0.19		0.11	0.17		0.06	0.37		0.19	0.49	
Clearance Time (s)	4.0	4.0		4.0	4.0		4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0		3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	457	614		381	544		224	2001		649	2653	
v/s Ratio Prot	0.09	0.14		c0.11	c0.15		0.03	c0.34		c0.18	0.38	
v/s Ratio Perm												
v/c Ratio	0.68	0.73		0.97	1.11dr		0.50	0.91		0.95	0.77	
Uniform Delay, d1	44.8	41.5		47.8	44.4		48.9	32.4		43.5	22.5	
Progression Factor	1.00	1.00		1.00	1.00		1.00	1.00		1.00	1.00	
Incremental Delay, d2	4.2	4.6		38.9	22.9		1.7	7.9		25.1	2.2	
Delay (s)	49.1	46.1		86.7	67.3		50.6	40.3		68.6	24.7	
Level of Service	D	D		F	E		D	D		E	C	
Approach Delay (s)		47.1			73.9			40.9			34.8	
Approach LOS		D			E			D			C	

Intersection Summary				
HCM Average Control Delay	44.7	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.91			
Actuated Cycle Length (s)	108.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	98.4%	ICU Level of Service	F	
Analysis Period (min)	15			

dr Defacto Right Lane. Recode with 1 though lane as a right lane.
c Critical Lane Group

HCM Signalized Intersection Capacity Analysis
18: North-South Road & Kapolei Parkway 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

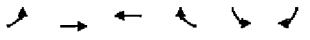
Movement	NBL	NBT	NBR	SBL	SBT	SBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99		0.97	*0.99	1.00	*0.99	*0.99	1.00	1.00	*0.99	1.00
Frt	1.00	0.98		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5408		3433	5532	1583	3504	5532	1583	1770	5532	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5408		3433	5532	1583	3504	5532	1583	1770	5532	1583
Volume (vph)	378	879	155	507	1075	735	716	643	505	121	568	352
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	382	888	157	512	1086	742	723	649	510	122	574	356
RTOR Reduction (vph)	0	21	0	0	0	304	0	0	304	0	0	297
Lane Group Flow (vph)	382	1024	0	512	1086	438	723	649	206	122	574	59
Turn Type	Prot			Prot		Perm	Prot		Perm	Prot		Perm
Protected Phases	5	2		1	6		7	4		3	8	
Permitted Phases						6			4			8
Actuated Green, G (s)	29.3	45.9		23.4	40.0	40.0	27.9	32.4	32.4	11.5	16.0	16.0
Effective Green, g (s)	29.3	45.9		23.4	40.0	40.0	27.9	32.4	32.4	11.5	16.0	16.0
Actuated g/C Ratio	0.23	0.36		0.18	0.31	0.31	0.22	0.25	0.25	0.09	0.12	0.12
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	401	1921		622	1713	490	757	1387	397	158	685	196
v/s Ratio Prot	c0.22	0.19		0.15	0.20		c0.21	0.12		0.07	c0.10	
v/s Ratio Perm						c0.28			0.13			0.04
v/c Ratio	0.95	0.53		0.82	0.63	0.89	0.96	0.47	0.52	0.77	0.84	0.30
Uniform Delay, d1	49.3	33.1		50.9	38.3	42.6	50.0	41.1	41.7	57.6	55.3	51.5
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	32.7	1.1		8.7	1.8	21.4	22.2	0.3	1.1	20.5	8.8	0.9
Delay (s)	82.0	34.2		59.6	40.1	64.0	72.2	41.3	42.8	78.1	64.2	52.4
Level of Service	F	C		E	D	E	E	D	D	E	E	D
Approach Delay (s)		47.0			51.9			53.6			61.8	
Approach LOS		D			D			D			E	

Intersection Summary				
HCM Average Control Delay	52.9	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.92			
Actuated Cycle Length (s)	129.2	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	87.4%	ICU Level of Service	E	
Analysis Period (min)	15			

c Critical Lane Group

AR00028150

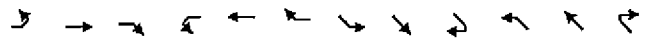
HCM Signalized Intersection Capacity Analysis
19: East-West Rd. & Old Fort Weaver Rd 2030 + PRO (without Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	0.95	1.00	0.97	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	3539	1583	3433	1583
Flt Permitted	0.19	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	351	1863	3539	1583	3433	1583
Volume (vph)	37	621	829	955	898	94
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	37	627	837	965	907	95
RTOR Reduction (vph)	0	0	0	595	0	42
Lane Group Flow (vph)	37	627	837	370	907	53
Turn Type	Perm			Perm		Perm
Protected Phases		4	8		6	
Permitted Phases	4			8		6
Actuated Green, G (s)	49.9	49.9	49.9	49.9	72.1	72.1
Effective Green, g (s)	49.9	49.9	49.9	49.9	72.1	72.1
Actuated g/C Ratio	0.38	0.38	0.38	0.38	0.55	0.55
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	135	715	1358	608	1904	878
v/s Ratio Prot		c0.34	0.24		c0.26	
v/s Ratio Perm	0.11			0.23		0.03
v/c Ratio	0.27	0.88	0.62	0.61	0.48	0.06
Uniform Delay, d1	27.6	37.2	32.3	32.2	17.5	13.3
Progression Factor	1.22	1.20	1.00	1.00	1.00	1.00
Incremental Delay, d2	0.9	9.4	0.8	1.7	0.9	0.1
Delay (s)	34.5	54.1	33.2	33.9	18.4	13.5
Level of Service	C	D	C	C	B	B
Approach Delay (s)		53.0	33.6		17.9	
Approach LOS		D	C		B	

Intersection Summary			
HCM Average Control Delay	32.8	HCM Level of Service	C
HCM Volume to Capacity ratio	0.64		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	69.1%	ICU Level of Service	C
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
20: Farrington Hwy & B Street 2030 + PRO (without Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	0.97	*0.99	1.00	0.97	*0.99	1.00	1.00	1.00	1.00	*0.99	1.00	1.00
Frt	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	3433	3688	1583	3433	3688	1583	1770	1863	1583	3504	1863	1583
Flt Permitted	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	3433	3688	1583	3433	3688	1583	1770	1863	1583	3504	1863	1583
Volume (vph)	229	1443	356	554	1792	80	152	182	307	274	143	178
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	231	1458	360	560	1810	81	154	184	310	277	144	180
RTOR Reduction (vph)	0	0	46	0	0	23	0	0	5	0	0	16
Lane Group Flow (vph)	231	1458	314	560	1810	58	154	184	305	277	144	164
Turn Type	Prot		pm+ov	Prot		Perm	Prot		pm+ov	Prot		pm+ov
Protected Phases	5	2	3	1	6		7	4	5	3	8	1
Permitted Phases			2			6			4			8
Actuated Green, G (s)	31.0	72.8	84.8	32.2	74.0	74.0	13.0	17.0	48.0	12.0	16.0	48.2
Effective Green, g (s)	31.0	72.8	84.8	32.2	74.0	74.0	13.0	17.0	48.0	12.0	16.0	48.2
Actuated g/C Ratio	0.21	0.49	0.57	0.21	0.49	0.49	0.09	0.11	0.32	0.08	0.11	0.32
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	709	1790	937	737	1819	781	153	211	507	280	199	551
v/s Ratio Prot	0.07	c0.40	0.03	0.16	c0.49		c0.09	c0.10	0.12	0.08	0.08	0.06
v/s Ratio Perm			0.17			0.04			0.07			0.04
v/c Ratio	0.33	0.81	0.34	0.76	1.00	0.07	1.01	0.87	0.60	0.99	0.72	0.30
Uniform Delay, d1	50.6	32.9	17.5	55.3	37.8	20.0	68.5	65.4	43.0	68.9	64.9	38.2
Progression Factor	1.00	1.00	1.00	0.95	0.48	0.09	1.00	1.00	1.00	1.00	0.91	0.96
Incremental Delay, d2	0.3	4.2	0.2	1.8	12.2	0.1	74.5	35.8	2.0	44.0	16.3	0.2
Delay (s)	50.9	37.1	17.7	54.2	30.4	1.9	143.0	101.3	45.0	113.2	75.5	37.0
Level of Service	D	D	B	D	C	A	F	F	D	F	E	D
Approach Delay (s)		35.2			34.9			84.3			81.4	
Approach LOS		D			C			F			F	

Intersection Summary			
HCM Average Control Delay	45.4	HCM Level of Service	D
HCM Volume to Capacity ratio	0.91		
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	86.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

AR00028151

HCM Signalized Intersection Capacity Analysis
21: East-West Rd. & A Street — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	SEL	SET	SER	NWL	NWT	NWR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Lane Util. Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Frt	1.00	0.99		1.00	1.00	0.85	1.00	0.86		1.00	0.88	
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (prot)	1770	1844		1770	1863	1583	1770	1599		1770	1631	
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00		0.95	1.00	
Satd. Flow (perm)	1770	1844		1770	1863	1583	1770	1599		1770	1631	
Volume (vph)	170	768	56	34	689	616	91	8	140	46	6	31
Peak-hour factor, PHF	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Adj. Flow (vph)	185	835	61	37	749	670	99	9	152	50	7	34
RTOR Reduction (vph)	0	1	0	0	0	240	0	139	0	0	32	0
Lane Group Flow (vph)	185	895	0	37	749	430	99	22	0	50	9	0
Turn Type	Prot			Prot		Perm	Split			Split		
Protected Phases	5	2		1	6		4	4		8	8	
Permitted Phases						6						
Actuated Green, G (s)	34.6	105.3		6.2	76.9	76.9	13.0	13.0		9.5	9.5	
Effective Green, g (s)	34.6	105.3		6.2	76.9	76.9	13.0	13.0		9.5	9.5	
Actuated g/C Ratio	0.23	0.70		0.04	0.51	0.51	0.09	0.09		0.06	0.06	
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0		4.0	4.0	
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0		3.0	3.0	
Lane Grp Cap (vph)	408	1294		73	955	812	153	139		112	103	
v/s Ratio Prot	c0.10	c0.49		0.02	c0.40		c0.06	0.01		c0.03	0.01	
v/s Ratio Perm						0.27						
v/c Ratio	0.45	0.69		0.51	0.78	0.53	0.65	0.16		0.45	0.09	
Uniform Delay, d1	49.6	12.9		70.4	29.8	24.5	66.3	63.4		67.7	66.2	
Progression Factor	1.00	1.00		1.00	1.00	1.00	1.00	1.00		1.00	1.00	
Incremental Delay, d2	0.8	3.0		5.4	4.3	0.6	9.1	0.5		2.8	0.4	
Delay (s)	50.4	16.0		75.8	34.1	25.1	75.3	64.0		70.5	66.5	
Level of Service	D	B		E	C	C	E	E		E	E	
Approach Delay (s)		21.9			31.0			68.3			68.7	
Approach LOS		C			C			E			E	

Intersection Summary				
HCM Average Control Delay	32.1	HCM Level of Service	C	
HCM Volume to Capacity ratio	0.69			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	12.0	
Intersection Capacity Utilization	72.9%	ICU Level of Service	C	
Analysis Period (min)	15			
c Critical Lane Group				

HCM Signalized Intersection Capacity Analysis
22: Farrington Hwy & 2nd Avenue — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	EBL	EBT	EBR	WBL	WBT	WBR	NBL	NBT	NBR	SBL	SBT	SBR
Lane Configurations												
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	*0.99		*0.99	*0.99	1.00	1.00	0.95	*0.99	*0.99	0.95	1.00
Frt	1.00	0.99		1.00	1.00	0.85	1.00	1.00	0.85	1.00	1.00	0.85
Flt Protected	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (prot)	1770	5469		3504	3688	1583	1770	3539	3135	3504	3539	1583
Flt Permitted	0.95	1.00		0.95	1.00	1.00	0.95	1.00	1.00	0.95	1.00	1.00
Satd. Flow (perm)	1770	5469		3504	3688	1583	1770	3539	3135	3504	3539	1583
Volume (vph)	186	1527	127	690	1836	246	106	297	513	558	356	320
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	188	1542	128	697	1855	248	107	300	518	564	360	323
RTOR Reduction (vph)	0	7	0	0	0	70	0	0	5	0	0	161
Lane Group Flow (vph)	188	1663	0	697	1855	178	107	300	513	564	360	162
Turn Type	Prot			Prot		Perm	Prot		pm+ov	Prot		Perm
Protected Phases	5	2		1	6		3	8	1	7	4	
Permitted Phases						6			8			4
Actuated Green, G (s)	16.0	54.0		34.0	72.0	72.0	11.5	23.0	57.0	23.0	34.5	34.5
Effective Green, g (s)	16.0	54.0		34.0	72.0	72.0	11.5	23.0	57.0	23.0	34.5	34.5
Actuated g/C Ratio	0.11	0.36		0.23	0.48	0.48	0.08	0.15	0.38	0.15	0.23	0.23
Clearance Time (s)	4.0	4.0		4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0		3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	189	1969		794	1770	760	136	543	1275	537	814	364
v/s Ratio Prot	c0.11	0.30		0.20	c0.50		c0.06	c0.08	0.09	c0.16	0.10	
v/s Ratio Perm						0.11			0.07			0.10
v/c Ratio	0.99	0.84		0.88	1.05	0.23	0.79	0.55	0.40	1.05	0.44	0.45
Uniform Delay, d1	67.0	44.1		56.0	39.0	22.9	68.0	58.7	34.0	63.5	49.5	49.5
Progression Factor	0.77	0.76		0.69	0.56	0.13	1.00	1.00	1.00	0.78	0.74	0.63
Incremental Delay, d2	50.5	3.0		6.0	29.9	0.4	25.2	4.0	0.2	27.8	0.2	0.4
Delay (s)	101.8	36.6		44.4	51.8	3.3	93.3	62.8	34.2	77.4	36.6	31.4
Level of Service	F	D		D	D	A	F	E	C	E	D	C
Approach Delay (s)		43.2			45.7			50.3			53.7	
Approach LOS		D			D			D			D	

Intersection Summary				
HCM Average Control Delay	47.1	HCM Level of Service	D	
HCM Volume to Capacity ratio	0.97			
Actuated Cycle Length (s)	150.0	Sum of lost time (s)	16.0	
Intersection Capacity Utilization	98.5%	ICU Level of Service	F	
Analysis Period (min)	15			
c Critical Lane Group				

AR00028152

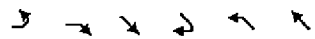
HCM Unsignalized Intersection Capacity Analysis
23: 2nd Avenue & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak Miligations

Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	0	4998	440	0	5283
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	0	5433	478	0	5742
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			870			
pX, platoon unblocked						
vC, conflicting volume	7107	1597			5911	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	7107	1597			5911	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	100			100	
cM capacity (veh/h)	0	95			7	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	0	1552	1552	1552	1254	1436	1436	1436	1436
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	0	0	0	0	478	0	0	0	0
cSH	1700	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.00	0.91	0.91	0.91	0.74	0.84	0.84	0.84	0.84
Queue Length 95th (ft)	0	0	0	0	0	0	0	0	0
Control Delay (s)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	A								
Approach Delay (s)	0.0	0.0				0.0			
Approach LOS	A								

Intersection Summary			
Average Delay	0.0		
Intersection Capacity Utilization	83.1%	ICU Level of Service	E
Analysis Period (min)	15		

HCM Unsignalized Intersection Capacity Analysis
24: 3rd Avenue & Kunia Road — 2030 + PRO (without Transit Corridor) - PM Peak Miligations



Movement	EBL	EBR	SET	SER	NWL	NWT
Lane Configurations						
Sign Control	Stop		Free			Free
Grade	0%		0%			0%
Volume (veh/h)	0	14	4808	189	0	5283
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92
Hourly flow rate (vph)	0	15	5226	205	0	5742
Pedestrians						
Lane Width (ft)						
Walking Speed (ft/s)						
Percent Blockage						
Right turn flare (veh)						
Median type	None					
Median storage veh)						
Upstream signal (ft)			1234			
pX, platoon unblocked						
vC, conflicting volume	6764	1409			5432	
vC1, stage 1 conf vol						
vC2, stage 2 conf vol						
vCu, unblocked vol	6764	1409			5432	
tC, single (s)	6.8	6.9			4.1	
tC, 2 stage (s)						
tF (s)	3.5	3.3			2.2	
p0 queue free %	100	88			100	
cM capacity (veh/h)	0	128			11	

Direction, Lane #	EB 1	SE 1	SE 2	SE 3	SE 4	NW 1	NW 2	NW 3	NW 4
Volume Total	15	1493	1493	1493	952	1436	1436	1436	1436
Volume Left	0	0	0	0	0	0	0	0	0
Volume Right	15	0	0	0	205	0	0	0	0
cSH	128	1700	1700	1700	1700	1700	1700	1700	1700
Volume to Capacity	0.12	0.88	0.88	0.88	0.56	0.84	0.84	0.84	0.84
Queue Length 95th (ft)	10	0	0	0	0	0	0	0	0
Control Delay (s)	36.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Lane LOS	E								
Approach Delay (s)	36.9	0.0				0.0			
Approach LOS	E								

Intersection Summary			
Average Delay	0.1		
Intersection Capacity Utilization	82.8%	ICU Level of Service	E
Analysis Period (min)	15		

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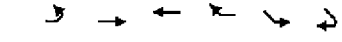
HCM Signalized Intersection Capacity Analysis
25: East-West Rd. & B Street — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations



Movement	EBL	EBT	WBT	WBR	SEL	SER
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	1.00	*0.99	1.00
Frt	1.00	1.00	1.00	0.85	1.00	0.85
Flt Protected	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (prot)	1770	1863	1863	1583	1752	1583
Flt Permitted	0.95	1.00	1.00	1.00	0.95	1.00
Satd. Flow (perm)	1770	1863	1863	1583	1752	1583
Volume (vph)	519	371	763	98	342	533
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	524	375	771	99	345	538
RTOR Reduction (vph)	0	0	0	39	0	406
Lane Group Flow (vph)	524	375	771	60	345	132
Turn Type	Prot			Prot		Prot
Protected Phases	5	2	6	6	4	4
Permitted Phases						
Actuated Green, G (s)	38.0	97.0	55.0	55.0	25.0	25.0
Effective Green, g (s)	38.0	97.0	55.0	55.0	25.0	25.0
Actuated g/C Ratio	0.29	0.75	0.42	0.42	0.19	0.19
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	517	1390	788	670	337	304
v/s Ratio Prot	c0.30	0.20	c0.41	0.04	c0.20	0.08
v/s Ratio Perm						
v/c Ratio	1.01	0.27	0.98	0.09	1.02	0.43
Uniform Delay, d1	46.0	5.2	36.9	22.5	52.5	46.3
Progression Factor	1.00	1.00	1.29	2.07	1.00	1.00
Incremental Delay, d2	43.0	0.5	24.5	0.2	55.2	4.5
Delay (s)	89.0	5.7	72.1	46.8	107.7	50.7
Level of Service	F	A	E	D	F	D
Approach Delay (s)		54.3	69.2		73.0	
Approach LOS		D	E		E	

Intersection Summary			
HCM Average Control Delay	65.4	HCM Level of Service	E
HCM Volume to Capacity ratio	1.00		
Actuated Cycle Length (s)	130.0	Sum of lost time (s)	12.0
Intersection Capacity Utilization	97.9%	ICU Level of Service	F
Analysis Period (min)	15		
c Critical Lane Group			

HCM Signalized Intersection Capacity Analysis
26: Btwn Fort Barret Rd and N/S Rd & Farrington Hwy — 2030 + PRO (without Transit Corridor) - PM Peak Mitigations

Movement	SEL	SER	NEL	NET	SWT	SWR
Lane Configurations						
Ideal Flow (vphpl)	1900	1900	1900	1900	1900	1900
Total Lost time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Lane Util. Factor	1.00	1.00	1.00	*0.99	*0.99	1.00
Frt	1.00	0.85	1.00	1.00	1.00	0.85
Flt Protected	0.95	1.00	0.95	1.00	1.00	1.00
Satd. Flow (prot)	1770	1583	1770	3688	3688	1583
Flt Permitted	0.95	1.00	0.05	1.00	1.00	1.00
Satd. Flow (perm)	1770	1583	98	3688	3688	1583
Volume (vph)	200	209	96	1497	2295	155
Peak-hour factor, PHF	0.99	0.99	0.99	0.99	0.99	0.99
Adj. Flow (vph)	202	211	97	1512	2318	157
RTOR Reduction (vph)	0	14	0	0	0	38
Lane Group Flow (vph)	202	197	97	1512	2318	119
Turn Type		Perm	Perm			Perm
Protected Phases	6			4	8	
Permitted Phases		6	4			8
Actuated Green, G (s)	16.0	16.0	76.0	76.0	76.0	76.0
Effective Green, g (s)	16.0	16.0	76.0	76.0	76.0	76.0
Actuated g/C Ratio	0.16	0.16	0.76	0.76	0.76	0.76
Clearance Time (s)	4.0	4.0	4.0	4.0	4.0	4.0
Vehicle Extension (s)	3.0	3.0	3.0	3.0	3.0	3.0
Lane Grp Cap (vph)	283	253	74	2803	2803	1203
v/s Ratio Prot	0.11			0.41	0.63	
v/s Ratio Perm		c0.12	c0.99			0.08
v/c Ratio	0.71	0.78	1.31	0.54	0.83	0.10
Uniform Delay, d1	39.8	40.3	12.0	4.9	7.8	3.1
Progression Factor	1.00	1.00	1.00	1.00	1.00	1.00
Incremental Delay, d2	14.3	20.6	208.6	0.2	2.1	0.0
Delay (s)	54.1	60.9	220.6	5.1	9.9	3.2
Level of Service	D	E	F	A	A	A
Approach Delay (s)	57.6			18.1	9.5	
Approach LOS	E			B	A	

Intersection Summary			
HCM Average Control Delay	17.0	HCM Level of Service	B
HCM Volume to Capacity ratio	1.21		
Actuated Cycle Length (s)	100.0	Sum of lost time (s)	8.0
Intersection Capacity Utilization	89.8%	ICU Level of Service	E
Analysis Period (min)	15		
c Critical Lane Group			

AR00028154

APPENDIX B

REEWAY SEGMENT LOS ANALYSIS

AR00028155

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	1582	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	439	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	603	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	603	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	10.6	pc/mi/ln
Level of service, LOS	**A**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3808	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1058	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1451	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1451	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	25.5	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028156

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7067	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1963	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2020	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2020	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	56.6	mi/h
Number of lanes, N	4	
Density, D	35.7	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4468	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1241	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1703	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Rural Freeway	

LOS and Performance Measures

Flow rate, vp	1703	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	59.9	mi/h
Number of lanes, N	3	
Density, D	28.4	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028157

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/16/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H2 NB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2004)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	1777	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	494	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	677	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	677	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	11.9	pc/mi/ln
Level of service, LOS	**B**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**HI WB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	1482	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	412	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	565	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	565	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	9.9	pc/mi/ln
Level of service, LOS	**A**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028158

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3331	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	925	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1269	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1269	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	22.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4366	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1213	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1248	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1248	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	21.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028159

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3069	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	853	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1170	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1170	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	20.5	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H2 SB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2004)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4078	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1133	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1554	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1554	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	27.3	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028160

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	1762	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	489	**v**
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	672	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	672	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	11.8	pc/mi/ln
Level of service, LOS	**B**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4077	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1133	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1554	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1554	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	27.3	pc/mi/ln
Level of service, LOS	**D**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028161

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4446	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1235	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1271	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1271	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	21.7	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	2652	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	737	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1011	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1011	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	17.7	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028162

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H2 NB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2004)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3196	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	888	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1218	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1218	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	21.4	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	2223	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	618	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	847	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	847	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	14.9	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028163

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	PM Peak
Freeway/Direction:	**H1 WB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Existing (Year 2005)
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4079	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1133	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1555	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	65.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	62.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1555	pc/h/ln
Free-flow speed, FFS	62.0	mi/h
Average passenger-car speed, S	62.0	mi/h
Number of lanes, N	3	
Density, D	25.1	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7425	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2063	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2122	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2122	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	54.9	mi/h
Number of lanes, N	4	
Density, D	38.6	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028164

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	7/13/2006
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2005)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5824	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1618	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2220	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2220	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	51.8	mi/h
Number of lanes, N	3	
Density, D	42.8	pc/mi/ln
Level of service, LOS	E	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	BPK
Agency or Company:	Wilbur Smith Associates
Date Performed:	
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H2 SB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	**Existing (Year 2004)**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	2534	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	704	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	966	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	966	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	16.9	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028165

APPENDIX B-2
YEAR 2030 CONDITIONS

AR00028166

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5434	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1509	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2071	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjnstment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2071	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	54.8	mi/h
Number of lanes, N	3	
Density, D	37.8	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	8197	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2277	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2343	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2343	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	**F**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028167

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/7/07
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	9906	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2752	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2265	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2265	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	52.2	mi/h
Number of lanes, N	5	
Density, D	43.4	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7512	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2087	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2147	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Rural Freeway	

LOS and Performance Measures

Flow rate, vp	2147	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	55.3	mi/h
Number of lanes, N	4	
Density, D	38.8	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028168

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H2 NB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3184	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	884	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1213	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1213	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	21.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3259	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	905	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1242	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1242	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	21.8	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028169

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3735	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1038	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1068	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1068	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	18.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/7/07
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4366	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1213	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	998	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	998	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	60.0	mi/h
Number of lanes, N	5	
Density, D	16.6	pc/mi/ln
Level of service, LOS	B	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028170

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3069	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	853	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1170	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1170	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	20.5	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H2 SB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6273	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1743	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1793	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1793	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.3	mi/h
Number of lanes, N	4	
Density, D	30.7	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028171

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4680	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1300	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1784	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1784	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	56.9	mi/h
Number of lanes, N	3	
Density, D	31.3	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**N/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5833	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1620	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1667	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1667	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	28.5	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028172

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/7/07
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7137	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1983	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1632	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1632	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	60.0	mi/h
Number of lanes, N	5	
Density, D	27.2	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4249	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1180	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1619	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1619	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	28.4	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028173

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H2 NB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6220	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1728	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2371	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2371	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6365	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1768	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2426	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2426	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028174

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7860	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2183	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2247	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2247	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	51.9	mi/h
Number of lanes, N	4	
Density, D	43.3	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/7/07
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7931	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2203	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1511	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	6	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1511	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	60.0	mi/h
Number of lanes, N	6	
Density, D	25.2	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028175

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7766	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2157	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2220	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2220	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	52.7	mi/h
Number of lanes, N	4	
Density, D	42.2	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	TSO
Agency or Company:	Wilbur Smith Associates
Date Performed:	11/15/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H2 SB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4616	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1282	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1319	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1319	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	22.5	pc/mi/ln
Level of service, LOS	**C**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028176

APPENDIX B-3
YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR SCENARIO

AR00028177

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5892	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1637	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2246	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2246	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	51.1	mi/h
Number of lanes, N	3	
Density, D	43.9	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	9143	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2540	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2613	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2613	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	**F**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028178

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/8/07
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030 with Reduction**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	11906	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	3307	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2723	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2723	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	5	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	2030 with Transit Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	8435	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2343	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2411	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2411	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028179

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MH
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H2 NB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3597	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	999	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1371	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1371	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	24.1	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MH
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, v	3756	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1043	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1431	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1431	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	25.1	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028180

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/2006
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4491	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1248	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1284	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1284	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	21.9	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/8/07
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030 with Reduction**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5858	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1627	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1340	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1340	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	60.0	mi/h
Number of lanes, N	5	
Density, D	22.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028181

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3757	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1044	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1432	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1432	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	25.1	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H2 SB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6581	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1828	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1881	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1881	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	57.9	mi/h
Number of lanes, N	4	
Density, D	32.5	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028182

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 With Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5334	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1482	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2033	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2033	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	55.3	mi/h
Number of lanes, N	3	
Density, D	36.7	pc/mi/ln
Level of service, LOS	E	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6891	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1914	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1970	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1970	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	57.2	mi/h
Number of lanes, N	4	
Density, D	34.5	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028183

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/8/07
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030 with Reduction**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	9139	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2539	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2090	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2090	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	56.5	mi/h
Number of lanes, N	5	
Density, D	37.0	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5173	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1437	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1971	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1971	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	3	
Density, D	35.2	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028184

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H2 NB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6663	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1851	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2539	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measnres

Flow rate, vp	2539	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7022	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1951	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2676	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjnstment, fLN	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2676	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	**F**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028185

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	8875	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2465	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2537	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2537	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/8/07
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030 with Reduction**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	10131	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2814	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1931	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	6	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1931	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	58.7	mi/h
Number of lanes, N	6	
Density, D	32.9	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028186

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	8781	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2439	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2510	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2510	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H2 SB**
From/To:	**At Xa Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5070	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1408	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1449	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1449	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	24.8	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028187

APPENDIX B-4
YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR
SCENARIO

AR00028188

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5928	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1647	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2259	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2259	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	50.8	mi/h
Number of lanes, N	3	
Density, D	44.5	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	9217	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2560	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2635	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2635	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	**F**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028189

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/8/07
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030 without Reduction**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	12062	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	3351	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2758	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2758	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	5	
Density, D		pc/mi/ln
Level of service, LOS	**F**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	2030 with Transit Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	8435	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2343	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2411	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2411	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	**F**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028190

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H2 NB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3629	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1008	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1383	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1383	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	24.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3794	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1054	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1446	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Laue width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1446	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	25.4	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028191

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	4549	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1264	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1300	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1300	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	22.2	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/8/07
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030 with Reduction**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5858	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1627	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1340	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1340	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	60.0	mi/h
Number of lanes, N	5	
Density, D	22.3	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028192

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	3811	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1059	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1452	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1452	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	57.0	mi/h
Number of lanes, N	3	
Density, D	25.5	pc/mi/ln
Level of service, LOS	C	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**AM Peak**
Freeway/Direction:	**H2 SB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6605	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1835	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1888	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1888	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	57.9	mi/h
Number of lanes, N	4	
Density, D	32.6	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028193

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5392	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1498	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2055	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2055	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	55.0	mi/h
Number of lanes, N	3	
Density, D	37.3	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6985	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1940	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1997	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1997	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	56.9	mi/h
Number of lanes, N	4	
Density, D	35.1	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028194

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/8/07
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030 without Reduction**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	9309	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2586	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2129	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	5	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2129	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	55.7	mi/h
Number of lanes, N	5	
Density, D	38.2	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 EB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 with Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5173	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1437	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1971	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1971	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S	56.0	mi/h
Number of lanes, N	3	
Density, D	35.2	pc/mi/ln
Level of service, LOS	**E**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028195

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H2 NB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	6668	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1852	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2541	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2541	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**S/O Makakilo Drive**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	7080	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1967	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2698	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	3	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	3.0	mi/h
Free-flow speed, FFS	57.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2698	pc/h/ln
Free-flow speed, FFS	57.0	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	3	
Density, D		pc/mi/ln
Level of service, LOS	F	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028196

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Kunia Rd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	8964	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2490	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2562	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2562	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	**F**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	2/8/07
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**W/O Paiwa St**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030 with Reduction**
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	10131	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2814	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1931	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	6	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	0.0	mi/h
Free-flow speed, FFS	60.0	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1931	pc/h/ln
Free-flow speed, FFS	60.0	mi/h
Average passenger-car speed, S	58.7	mi/h
Number of lanes, N	6	
Density, D	32.9	pc/mi/ln
Level of service, LOS	D	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028197

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H1 WB**
From/To:	**E/O Kamehameha Hwy**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	8867	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	2463	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	2534	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	2534	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S		mi/h
Number of lanes, N	4	
Density, D		pc/mi/ln
Level of service, LOS	**F**	

Overall results are not computed when free-flow speed is less than 55 mph.

HCS+: Basic Freeway Segments Release 5.2

Operational Analysis

Analyst:	MM
Agency or Company:	Wilbur Smith Associates
Date Performed:	12/22/06
Analysis Time Period:	**PM Peak**
Freeway/Direction:	**H2 SB**
From/To:	**At Ka Uka Blvd**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030 without Reduction
Description:	East Kapolei TIAR

Flow Inputs and Adjustments

Volume, V	5108	veh/h
Peak-hour factor, PHF	0.90	
Peak 15-min volume, v15	1419	v
Trucks and buses	5	%
Recreational vehicles	2	%
Terrain type:	Level	
Grade	0.00	%
Segment length	0.00	mi
Trucks and buses PCE, ET	1.5	
Recreational vehicle PCE, ER	1.2	
Heavy vehicle adjustment, fHV	0.972	
Driver population factor, fp	1.00	
Flow rate, vp	1460	pc/h/ln

Speed Inputs and Adjustments

Lane width	12.0	ft
Right-shoulder lateral clearance	6.0	ft
Interchange density	0.50	interchange/mi
Number of lanes, N	4	
Free-flow speed:	Base	
FFS or BFFS	60.0	mi/h
Lane width adjustment, fLW	0.0	mi/h
Lateral clearance adjustment, fLC	0.0	mi/h
Interchange density adjustment, fID	0.0	mi/h
Number of lanes adjustment, fN	1.5	mi/h
Free-flow speed, FFS	58.5	mi/h
	Urban Freeway	

LOS and Performance Measures

Flow rate, vp	1460	pc/h/ln
Free-flow speed, FFS	58.5	mi/h
Average passenger-car speed, S	58.5	mi/h
Number of lanes, N	4	
Density, D	25.0	pc/mi/ln
Level of service, LOS	**C**	

Overall results are not computed when free-flow speed is less than 55 mph.

AR00028198

APPENDIX C

RAMP FREEWAY JUNCTION LOS ANALYSIS

AR00028199

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Existing**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	57.0	mph
Volume on freeway	5197	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	530	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5197		530			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1444		147			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	5774		589			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.589 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3641 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5774	6810	No
v_{12}	3641	4400	No
$v_{FO} = v_F - v_R$	5185	6810	No
v_R	589	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 31.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.481	
Space mean speed in ramp influence area,	S_R = 49.8	mph
Space mean speed in outer lanes,	S_O = 58.1	mph
Space mean speed for all vehicles,	S = 52.6	mph

AR00028200

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**AM Peak**
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Loop Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	Existing
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	57.0	mph
Volume on freeway	4667	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1765	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4667		1765			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1296		490			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	5186		1961			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3412 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5186	6810	No
v_{12}	3412	4400	No
$v_{FO} = v_F - v_R$	3225	6810	No
v_R	1961	3800	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 20.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.604	
Space mean speed in ramp influence area,	S_R = 47.9	mph
Space mean speed in outer lanes,	S_O = 59.5	mph
Space mean speed for all vehicles,	S = 51.4	mph

AR00028201

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Existing**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	57.0	mph
Volume on freeway	2902	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	429	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2902	429		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	806	119		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3224	477		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 1907 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3701	6810	No
v_{R12}	2384	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 20.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.328	
Space mean speed in ramp influence area,	S_R = 52.1	mph
Space mean speed in outer lanes,	S_O = 54.1	mph
Space mean speed for all vehicles,	S = 52.8	mph

AR00028202

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Existing**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	57.0	mph
Volume on freeway	3808	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	756	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3808		756			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1058		210			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	4231		840			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.616 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2927 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4231	6810	No
v_{12}	2927	4400	No
$v_{FO} = v_F - v_R$	3391	6810	No
v_R	840	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 24.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **C**

Speed Estimation

Intermediate speed variable,	D_S = 0.504	
Space mean speed in ramp influence area,	S_R = 49.4	mph
Space mean speed in outer lanes,	S_O = 61.3	mph
Space mean speed for all vehicles,	S = 52.6	mph

AR00028203

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Existing**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	57.0	mph
Volume on freeway	7368	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1230	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	7368		1230			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2047		342			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	8187		1367			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.492 Using Equation 5

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4725 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	8187	6810	Yes
v_{12}	4725	4400	Yes
$v_{FO} = v_F - v_R$	6820	6810	Yes
v_R	1367	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 40.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.551	
Space mean speed in ramp influence area,	S_R = 48.7	mph
Space mean speed in outer lanes,	S_O = 52.9	mph
Space mean speed for all vehicles,	S = 50.4	mph

AR00028204

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**PM Peak**
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Loop Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	Existing
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	57.0	mph
Volume on freeway	6138	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	2657	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	6138		2657			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1705		738			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	6820		2952			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.450 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4693 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6820	6810	Yes
v_{12}	4693	4400	Yes
$v_{FO} = v_F - v_R$	3868	6810	No
v_R	2952	3800	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 31.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.694	
Space mean speed in ramp influence area,	S_R = 46.6	mph
Space mean speed in outer lanes,	S_O = 58.1	mph
Space mean speed for all vehicles,	S = 49.7	mph

AR00028205

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Existing**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	3	
Free-flow speed on freeway	57.0	mph
Volume on freeway	3481	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	598	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3481	598		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	967	166		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3868	664		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.591 Using Equation 1

$v_{12} = v_F (P_{FM})$ = 2288 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4532	6810	No
v_{R12}	2952	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 25.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **C**

Speed Estimation

Intermediate speed variable,	M_S = 0.361	
Space mean speed in ramp influence area,	S_R = 51.6	mph
Space mean speed in outer lanes,	S_O = 53.1	mph
Space mean speed for all vehicles,	S = 52.1	mph

AR00028206

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Existing**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	3	
Free-flow speed on freeway	57.0	mph
Volume on freeway	4077	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	497	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4077		497			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1133		138			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	4530		552			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.621 Using Equation 5

$v_{12} = v_R + (v - v_F) P_{FD}$ = 3024 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4530	6810	No
v_{12}	3024	4400	No
$v_{FO} = v - v_R$	3978	6810	No
v_R	552	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 25.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **C**

Speed Estimation

Intermediate speed variable,	D_S = 0.478	
Space mean speed in ramp influence area,	S_R = 49.8	mph
Space mean speed in outer lanes,	S_O = 60.6	mph
Space mean speed for all vehicles,	S = 53.0	mph

AR00028207

APPENDIX C-2
YEAR 2030 CONDITIONS

AR00028208

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	H1 WB
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	3537	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	280	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3537		280			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	983		78			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	3930		311			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1889 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3930	9140	No
v_{12}	1889	4400	No
$v_{FO} = v_F - v_R$	3619	9140	No
v_R	311	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 16.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.456	
Space mean speed in ramp influence area,	S_R = 51.0	mph
Space mean speed in outer lanes,	S_O = 64.1	mph
Space mean speed for all vehicles,	S = 57.0	mph

AR00028209

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/7/2007
Analysis time period:	**AM Peak**
Freeway/Dir of Travel:	**H1 WB**
Junction:	F Weaver Rd & H1 Loop Off Ramp
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	3567	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	235	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3567	235		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	991	65		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3963	261		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 1224 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	3963	9140	No
v_{12}	1224	4400	No
$v_{FO} = v_F - v_R$	3702	9140	No
v_R	261	3800	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 1.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **A**

Speed Estimation

Intermediate speed variable,	D_S = 0.451	
Space mean speed in ramp influence area,	S_R = 51.1	mph
Space mean speed in outer lanes,	S_O = 62.7	mph
Space mean speed for all vehicles,	S = 58.6	mph

AR00028210

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	3257	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	478	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3257	478		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	905	133		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3619	531		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.311 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1124 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4150	9140	No
v_{R12}	1655	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 15.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **B**

Speed Estimation

Intermediate speed variable,	M_S = 0.306	
Space mean speed in ramp influence area,	S_R = 53.4	mph
Space mean speed in outer lanes,	S_O = 55.8	mph
Space mean speed for all vehicles,	S = 54.8	mph

AR00028211

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8197	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	639	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	8197		639			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2277		178			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	9108		710			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4372 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	9108	9140	No
v_{12}	4372	4400	No
$v_{FO} = v_F - v_R$	8398	9140	No
v_R	710	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 37.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **E**

Speed Estimation

Intermediate speed variable,	D_S = 0.492	
Space mean speed in ramp influence area,	S_R = 50.4	mph
Space mean speed in outer lanes,	S_O = 58.8	mph
Space mean speed for all vehicles,	S = 54.5	mph

AR00028212

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/7/2007
Analysis time period:	**AM Peak**
Freeway/Dir of Travel:	**H-1 EB**
Junction:	Fort Weaver Rd & H-1 On Ramp
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8333	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1667	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	751	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	8333	1667	751	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	2315	463	209	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	9259	1852	834	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1935 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	11111	9140	Yes
v_{R12}	3787	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 24.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 0.388	
Space mean speed in ramp influence area,	S_R = 52.1	mph
Space mean speed in outer lanes,	S_O = 43.8	mph
Space mean speed for all vehicles,	S = 46.3	mph

AR00028213

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**AM Peak**
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**F Weaver Rd & H-1 Loop On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	7558	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	751	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1807	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	7558	751	1807	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	2099	209	502	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	8398	834	2008	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.273 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 2291 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	9232	9140	Yes
v_{R12}	3125	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 26.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 0.375	
Space mean speed in ramp influence area,	S_R = 52.3	mph
Space mean speed in outer lanes,	S_O = 47.5	mph
Space mean speed for all vehicles,	S = 49.0	mph

AR00028214

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**AM Peak**
Freeway/Dir of Travel:	**H1 WB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	3735	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	927	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	3735		927			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1038		258			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	4150		1030			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2390 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4150	9140	No
v_{12}	2390	4400	No
$v_{FO} = v_F - v_R$	3120	9140	No
v_R	1030	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 20.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.521	
Space mean speed in ramp influence area,	S_R = 49.9	mph
Space mean speed in outer lanes,	S_O = 64.2	mph
Space mean speed for all vehicles,	S = 55.1	mph

AR00028215

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	H-1 WB
Junction:	North-South Rd and H-1 On Ramp
Jurisdiction:	Kapolei
Analysis Year:	Year 2030
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	2808	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	415	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2808	415		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	780	115		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3120	461		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.319 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 997 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	3581	9140	No
v_{R12}	1458	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 13.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.303	
Space mean speed in ramp influence area,	S_R = 53.5	mph
Space mean speed in outer lanes,	S_O = 56.5	mph
Space mean speed for all vehicles,	S = 55.2	mph

AR00028216

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5681	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	298	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5681		298			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1578		83			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, E_T	1.5		1.5			
Recreational vehicle PCE, E_R	1.2		1.2			
Heavy vehicle adjustment, f_{HV}	1.000		1.000			
Driver population factor, f_P	1.00		1.00			
Flow rate, v_p	6312		331			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2939 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6312	9140	No
v_{12}	2939	4400	No
$v_{FO} = v_F - v_R$	5981	9140	No
v_R	331	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 25.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.458	
Space mean speed in ramp influence area,	S_R = 50.9	mph
Space mean speed in outer lanes,	S_O = 61.5	mph
Space mean speed for all vehicles,	S = 56.1	mph

AR00028217

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	H-1 EB
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5383	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	2814	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5383	2814		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1495	782		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	5981	3127		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1250 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{EQ}	9108	9140	No
v_{R12}	4377	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 28.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	M_S = 0.526	
Space mean speed in ramp influence area,	S_R = 49.8	mph
Space mean speed in outer lanes,	S_O = 51.6	mph
Space mean speed for all vehicles,	S = 50.7	mph

AR00028218

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8777	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	303	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	8777		303			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2438		84			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	9752		337			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v - v_F) P_{FD}$ = 4442 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	9752	9140	Yes
v_{12}	4442	4400	Yes
$v_{FO} = v - v_R$	9415	9140	Yes
v_R	337	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 38.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.458	
Space mean speed in ramp influence area,	S_R = 50.9	mph
Space mean speed in outer lanes,	S_O = 57.7	mph
Space mean speed for all vehicles,	S = 54.4	mph

AR00028219

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/7/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Loop Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8519	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1126	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	8519	1126		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	2366	313		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	0.00 %	0.00 %	%	
Length	0.00 mi	0.00 mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	9466	1251		pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3387 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	9466	9140	Yes
v_{12}	3387	4400	No
$v_{FO} = v_F - v_R$	8215	9140	No
v_R	1251	3800	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 19.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.541	
Space mean speed in ramp influence area,	S_R = 49.6	mph
Space mean speed in outer lanes,	S_O = 56.2	mph
Space mean speed for all vehicles,	S = 53.7	mph

AR00028220

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	7348	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	512	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	7348	512		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	2041	142		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	8164	569		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.306 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 2498 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	8733	9140	No
v_{R12}	3067	4600	No

Level of Service Determination (if not F)

Density, $D = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 25.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.370	
Space mean speed in ramp influence area,	S_R = 52.4	mph
Space mean speed in outer lanes,	S_O = 48.8	mph
Space mean speed for all vehicles,	S = 50.0	mph

AR00028221

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5833	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	873	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5833		873			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1620		243			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	6481		970			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3373 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6481	9140	No
v_{12}	3373	4400	No
$v_{FO} = v_F - v_R$	5511	9140	No
v_R	970	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 28.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.515	
Space mean speed in ramp influence area,	S_R = 50.0	mph
Space mean speed in outer lanes,	S_O = 62.0	mph
Space mean speed for all vehicles,	S = 55.1	mph

AR00028222

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/7/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5881	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1423	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	843	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5881	1423	843	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1634	395	234	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	6534	1581	937	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1366 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	8115	9140	No
v_{R12}	2947	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 18.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **B**

Speed Estimation

Intermediate speed variable,	M_S = 0.290	
Space mean speed in ramp influence area,	S_R = 53.7	mph
Space mean speed in outer lanes,	S_O = 50.3	mph
Space mean speed for all vehicles,	S = 51.5	mph

AR00028223

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**PM Peak**
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**F Weaver Rd & H-1 Loop On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	4960	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	843	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	1313	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4960	843	1313	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1378	234	365	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	5511	937	1459	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.260 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1433 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6448	9140	No
v_{R12}	2370	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 20.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.328	
Space mean speed in ramp influence area,	S_R = 53.1	mph
Space mean speed in outer lanea,	S_O = 53.0	mph
Space mean speed for all vehicles,	S = 53.0	mph

AR00028224

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**PM Peak**
Freeway/Dir of Travel:	**H1 WB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	Year 2030
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	7860	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1602	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	7860		1602			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2183		445			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	8733		1780			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4812 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	8733	9140	No
v_{12}	4812	4400	Yes
$v_{FO} = v_F - v_R$	6953	9140	No
v_R	1780	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 41.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.588	
Space mean speed in ramp influence area,	S_R = 48.8	mph
Space mean speed in outer lanes,	S_O = 60.4	mph
Space mean speed for all vehicles,	S = 53.4	mph

AR00028225

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	7860	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	230	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	7860	230		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	2183	64		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	8733	256		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.345 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 3014 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	8989	9140	No
v_{R12}	3270	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 27.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **C**

Speed Estimation

Intermediate speed variable,	M_S = 0.389	
Space mean speed in ramp influence area,	S_R = 52.1	mph
Space mean speed in outer lanes,	S_O = 48.6	mph
Space mean speed for all vehicles,	S = 49.8	mph

AR00028226

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	H1 EB
Junction:	North South Rd & H1 Dff Ramp
Jurisdiction:	Kapolei
Analysis Year:	Year 2030
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	4589	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	396	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4589		396			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1275		110			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	5099		440			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2471 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5099	9140	No
v_{12}	2471	4400	No
$v_{FO} = v_F - v_R$	4659	9140	No
v_R	440	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 21.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.468	
Space mean speed in ramp influence area,	S_R = 50.8	mph
Space mean speed in outer lanes,	S_O = 62.9	mph
Space mean speed for all vehicles,	S = 56.4	mph

AR00028227

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**Year 2030**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	4193	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1640	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4193	1640		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1165	456		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	4659	1822		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 974 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	6481	9140	No
v_{R12}	2796	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 17.0 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **B**

Speed Estimation

Intermediate speed variable,	M_S = 0.280	
Space mean speed in ramp influence area,	S_R = 53.9	mph
Space mean speed in outer lanes,	S_O = 53.7	mph
Space mean speed for all vehicles,	S = 53.8	mph

AR00028228

APPENDIX C-3
YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO A: WITH TRANSIT CORRIDOR SCENARIO

AR00028229

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5299	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	280	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5299		280			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1472		78			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%	%	
Length	0.00	mi	0.00	mi	mi	
Trucks and buses PCE, E_T	1.5		1.5			
Recreational vehicle PCE, E_R	1.2		1.2			
Heavy vehicle adjustment, f_{HV}	1.000		1.000			
Driver population factor, f_P	1.00		1.00			
Flow rate, vp	5888		311			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2743 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5888	9140	No
v_{12}	2743	4400	No
$v_{FO} = v_F - v_R$	5577	9140	No
v_R	311	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = 23.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.456	
Space mean speed in ramp influence area,	S_R = 51.0	mph
Space mean speed in outer lanes,	S_O = 61.9	mph
Space mean speed for all vehicles,	S = 56.3	mph

AR00028230

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/8/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Loop Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	4984	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1078	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4984		1078			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1384		299			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	5538		1198			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2326 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5538	9140	No
v_{12}	2326	4400	No
$v_{FO} = v_F - v_R$	4340	9140	No
v_R	1198	3800	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 10.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	D_S = 0.536	
Space mean speed in ramp influence area,	S_R = 49.7	mph
Space mean speed in outer lanes,	S_O = 61.8	mph
Space mean speed for all vehicles,	S = 56.1	mph

AR00028231

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	3906	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	585	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3906	585		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1085	163		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	4340	650		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.296 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1284 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4990	9140	No
v_{R12}	1934	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 17.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **B**

Speed Estimation

Intermediate speed variable,	M_S = 0.313	
Space mean speed in ramp influence area,	S_R = 53.3	mph
Space mean speed in outer lanes,	S_O = 54.8	mph
Space mean speed for all vehicles,	S = 54.2	mph

AR00028232

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**203D + Project w Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	9143	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	812	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	9143		812			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2540		226			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	10159		902			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4938 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	10159	9140	Yes
v_{12}	4938	4400	Yes
$v_{FO} = v_F - v_R$	9257	9140	Yes
v_R	902	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 42.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.509	
Space mean speed in ramp influence area,	S_R = 50.1	mph
Space mean speed in outer lanes,	S_O = 57.9	mph
Space mean speed for all vehicles,	S = 53.8	mph

AR00028233

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/8/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**Fort Weaver Rd & H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	9082	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	2893	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	751	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	9082	2893	751	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	2523	804	209	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	10091	3214	834	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2109 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	13305	9140	Yes
v_{R12}	5323	4600	Yes

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 36.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 1.015	
Space mean speed in ramp influence area,	S_R = 41.7	mph
Space mean speed in outer lanes,	S_O = 41.8	mph
Space mean speed for all vehicles,	S = 41.8	mph

AR00028234

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**AM Peak**
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**F Weaver Rd & H-1 Loop On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	2030 + Project w Transit Red
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8331	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	751	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	3030	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	8331	751	3030	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	2314	209	842	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	9257	834	3367	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.273 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 2526 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	10091	9140	Yes
v_{R12}	3360	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 28.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 0.398	
Space mean speed in ramp influence area,	S_R = 51.9	mph
Space mean speed in outer lanes,	S_O = 45.6	mph
Space mean speed for all vehicles,	S = 47.5	mph

AR00028235

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Pro with Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	4491	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1628	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4491		1628			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1248		452			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	4990		1809			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3196 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	4990	9140	No
v_{12}	3196	4400	No
$v_{FO} = v - v_R$	3181	9140	No
v_R	1809	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 27.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.591	
Space mean speed in ramp influence area,	S_R = 48.8	mph
Space mean speed in outer lanes,	S_O = 64.2	mph
Space mean speed for all vehicles,	S = 53.4	mph

AR00028236

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Pro with Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	2863	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	967	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2863	967		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	795	269		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3181	1074		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.243 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 772 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4255	9140	No
v_{R12}	1846	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 16.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **B**

Speed Estimation

Intermediate speed variable,	M_S = 0.311	
Space mean speed in ramp influence area,	S_R = 53.4	mph
Space mean speed in outer lanes,	S_O = 56.0	mph
Space mean speed for all vehicles,	S = 54.8	mph

AR00028237

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	H1 EB
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Pro with Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	6081	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	762	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	6081		762			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1689		212			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	6757		847			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3424 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6757	9140	No
v_{12}	3424	4400	No
$v_{FD} = v_F - v_R$	5910	9140	No
v_R	847	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 29.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.504	
Space mean speed in ramp influence area,	S_R = 50.2	mph
Space mean speed in outer lanes,	S_O = 61.6	mph
Space mean speed for all vehicles,	S = 55.2	mph

AR00028238

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Pro with Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5319	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	3824	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5319	3824		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1478	1062		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	5910	4249		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_{12F}(P_{FM})$ = 1235 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	10159	9140	Yes
v_{R12}	5484	4600	Yes

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 36.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 1.155	
Space mean speed in ramp influence area,	S_R = 39.4	mph
Space mean speed in outer lanes,	S_O = 51.7	mph
Space mean speed for all vehicles,	S = 44.3	mph

AR00028239

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2D30 + Project w Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	10977	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	303	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	10977		303			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	3049		84			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	12197		337			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 5508 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	12197	9140	Yes
v_{12}	5508	4400	Yes
$v_{FO} = v_F - v_R$	11860	9140	Yes
v_R	337	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 47.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.458	
Space mean speed in ramp influence area,	S_R = 50.9	mph
Space mean speed in outer lanes,	S_O = 55.0	mph
Space mean speed for all vehicles,	S = 53.1	mph

AR00028240

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/8/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**Hl WB**
Junction:	**F Weaver Rd & Hl Loop Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	10544	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	2354	vph
Length of first accal/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	10544		2354			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2929		654			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	11716		2616			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v - v_F) P_{FD}$ = 4982 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	11716	9140	Yes
v_{12}	4982	4400	Yes
$v_{FO} = v - v_R$	9100	9140	No
v_R	2616	3800	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\ v_{12} - 0.009\ L_D$ = 33.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.663	
Space mean speed in ramp influence area,	S_R = 47.6	mph
Space mean speed in outer lanes,	S_O = 54.9	mph
Space mean speed for all vehicles,	S = 51.5	mph

AR00028241

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w Transit Rad**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8190	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	685	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	8190	685		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	2275	190		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	9100	761		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.282 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 2566 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	9861	9140	Yes
v_{R12}	3327	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 27.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 0.395	
Space mean speed in ramp influence area,	S_R = 52.0	mph
Space mean speed in outer lanes,	S_O = 46.2	mph
Space mean speed for all vehicles,	S = 48.0	mph

AR00028242

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w Transit Rad**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	6891	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1121	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	6891		1121			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1914		311			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	7657		1246			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4041 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7657	9140	No
v_{12}	4041	4400	No
$v_{FO} = v_F - v_R$	6411	9140	No
v_R	1246	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 34.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.540	
Space mean speed in ramp influence area,	S_R = 49.6	mph
Space mean speed in outer lanes,	S_O = 61.0	mph
Space mean speed for all vehicles,	S = 54.4	mph

AR00028243

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/8/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	6613	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	2615	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	843	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	6613	2615	843	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1837	726	234	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	7348	2906	937	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1536 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	10254	9140	Yes
v_{R12}	4442	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 29.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 0.547
Space mean speed in ramp influence area,	S_R = 49.5 mph
Space mean speed in outer lanes,	S_O = 48.3 mph
Space mean speed for all vehicles,	S = 48.8 mph

AR00028244

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**PM Peak**
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**F Weaver Rd & H-1 Loop On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	2030 + Project w Transit Red
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5770	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	843	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	2502	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5770	843	2502	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1603	234	695	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	6411	937	2780	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.260 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1667 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7348	9140	No
v_{R12}	2604	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 22.2 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **C**

Speed Estimation

Intermediate speed variable,	M_S = 0.339
Space mean speed in ramp influence area,	S_R = 52.9 mph
Space mean speed in outer lanes,	S_O = 51.5 mph
Space mean speed for all vehicles,	S = 52.0 mph

AR00028245

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	H1 WB
Junction:	North South Rd & H1 Off Ramp
Jurisdiction:	Kapolei
Analysis Year:	2030 + Pro with Transit Rad.
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8875	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	2511	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	8875		2511			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2465		698			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	9861		2790			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 5873 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	9861	9140	Yes
v_{12}	5873	4400	Yes
$v_{FO} = v_F - v_R$	7071	9140	No
v_R	2790	2000	Yes

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 50.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	D_S = 0.679	
Space mean speed in ramp influence area,	S_R = 47.3	mph
Space mean speed in outer lanes,	S_O = 60.3	mph
Space mean speed for all vehicles,	S = 51.8	mph

AR00028246

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Pro with Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	6364	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	957	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	6364	957		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1768	266		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	7071	1063		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.244 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1727 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	8134	9140	No
v_{R12}	2790	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 23.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.349	
Space mean speed in ramp influence area,	S_R = 52.7	mph
Space mean speed in outer lanes,	S_O = 49.7	mph
Space mean speed for all vehicles,	S = 50.7	mph

AR00028247

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Pro with Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5405	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1060	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5405		1060			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1501		294			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	6006		1178			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3283 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6006	9140	No
v_{12}	3283	4400	No
$v_{FO} = v_F - v_R$	4828	9140	No
v_R	1178	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 28.0- pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.534	
Space mean speed in ramp influence area,	S_R = 49.7	mph
Space mean speed in outer lanes,	S_O = 62.8	mph
Space mean speed for all vehicles,	S = 54.9	mph

AR00028248

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	H-1 EB
Junction:	North-South Rd and H-1 On Ramp
Jurisdiction:	Kapolei
Analysis Year:	2030 + Pro with Transit Red.
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	4345	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	2546	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4345	2546		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1207	707		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	4828	2829		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1009 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7657	9140	No
v_{R12}	3838	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 24.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.397	
Space mean speed in ramp influence area,	S_R = 51.9	mph
Space mean speed in outer lanes,	S_O = 53.4	mph
Space mean speed for all vehicles,	S = 52.7	mph

AR00028249

APPENDIX C-4
YEAR 2030 PLUS PROJECT CONDITIONS
SCENARIO B: WITHOUT TRANSIT CORRIDOR
SCENARIO

AR00028250

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5415	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	280	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5415		280			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1504		78			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	6017		311			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2799 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6017	9140	No
v_{12}	2799	4400	No
$v_{FO} = v_F - v_R$	5706	9140	No
v_R	311	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = 23.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	D_S = 0.456	
Space mean speed in ramp influence area,	S_R = 51.0	mph
Space mean speed in outer lanes,	S_O = 61.8	mph
Space mean speed for all vehicles,	S = 56.2	mph

AR00028251

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/8/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Loop Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5109	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1153	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5109		1153			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1419		320			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	5677		1281			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 2424 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5677	9140	No
v_{12}	2424	4400	No
$v_{FO} = v_F - v_R$	4396	9140	No
v_R	1281	3800	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 11.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **B**

Speed Estimation

Intermediate speed variable,	D_S = 0.543	
Space mean speed in ramp influence area,	S_R = 49.5	mph
Space mean speed in outer lanes,	S_O = 61.7	mph
Space mean speed for all vehicles,	S = 55.9	mph

AR00028252

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	3956	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	593	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	3956	593		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1099	165		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	4396	659		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.295 Using Equation 4

$v_{12} = v_{F} (P_{FM}) =$ 1296 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	5055	9140	No
v_{R12}	1955	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A =$ 17.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **B**

Speed Estimation

Intermediate speed variable,	M_S = 0.314	
Space mean speed in ramp influence area,	S_R = 53.3	mph
Space mean speed in outer lanes,	S_O = 54.7	mph
Space mean speed for all vehicles,	S = 54.2	mph

AR00028253

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	9217	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	826	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	9217		826			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2560		229			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	10241		918			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4983 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	10241	9140	Yes
v_{12}	4983	4400	Yes
$v_{FO} = v_F - v_R$	9323	9140	Yes
v_R	918	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 42.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	D_S = 0.511	
Space mean speed in ramp influence area,	S_R = 50.1	mph
Space mean speed in outer lanes,	S_O = 57.8	mph
Space mean speed for all vehicles,	S = 53.8	mph

AR00028254

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/8/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**Fort Weaver Rd & H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	9142	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	2999	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	751	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	9142	2999	751	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	2539	833	209	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	10158	3332	834	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 2123 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	13490	9140	Yes
v_{R12}	5455	4600	Yes

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 37.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 1.128	
Space mean speed in ramp influence area,	S_R = 39.9	mph
Space mean apeed in outer lanes,	S_O = 41.7	mph
Space mean speed for all vehicles,	S = 40.9	mph

AR00028255

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**AM Peak**
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**F Weaver Rd & H-1 Loop On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	2030 + Project w/o Transit Rad
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8391	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	751	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	3126	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	8391	751	3126	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	2331	209	868	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	9323	834	3473	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.273 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 2544 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	10157	9140	Yes
v_{R12}	3378	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 28.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 0.400	
Space mean speed in ramp influence area,	S_R = 51.9	mph
Space mean speed in outer lanes,	S_O = 45.4	mph
Space mean speed for all vehicles,	S = 47.4	mph

AR00028256

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030+ Pro without Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	4549	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1682	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	4549		1682			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1264		467			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	5054		1869			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3258 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	5054	9140	No
v_{12}	3258	4400	No
$v_{FO} = v_F - v_R$	3185	9140	No
v_R	1869	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 27.8 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **C**

Speed Estimation

Intermediate speed variable,	D_S = 0.596	
Space mean speed in ramp influence area,	S_R = 48.7	mph
Space mean speed in outer lanes,	S_O = 64.2	mph
Space mean speed for all vehicles,	S = 53.2	mph

AR00028257

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030+ Pro without Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	2867	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1010	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	2867	1010		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	796	281		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	3186	1122		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.237 Using Equation 4

$v_{12} = v_R (P_{FM})$ = 755 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	4308	9140	No
v_{R12}	1877	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 16.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence B

Speed Estimation

Intermediate speed variable,	M_S = 0.311	
Space mean speed in ramp influence area,	S_R = 53.4	mph
Space mean speed in outer lanes,	S_O = 55.9	mph
Space mean speed for all vehicles,	S = 54.8	mph

AR00028258

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030+ Pro without Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	6309	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	798	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	6309		798			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1753		222			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	7010		887			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3557 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7010	9140	No
v_{12}	3557	4400	No
$v_{FO} = v_F - v_R$	6123	9140	No
v_R	887	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 30.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.508	
Space mean speed in ramp influence area,	S_R = 50.1	mph
Space mean speed in outer lanes,	S_O = 61.3	mph
Space mean speed for all vehicles,	S = 55.1	mph

AR00028259

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	AM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030+ Pro without Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5511	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	3706	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5511	3706		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1531	1029		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	6123	4118		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_{F}(P_{FM})$ = 1280 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	10241	9140	Yes
v_{R12}	5398	4600	Yes

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\, v_R + 0.0078\, v_{12} - 0.00627\, L_A$ = 36.3 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 1.078	
Space mean speed in ramp influence area,	S_R = 40.7	mph
Space mean speed in outer lanes,	S_0 = 51.2	mph
Space mean speed for all vehicles,	S = 45.1	mph

AR00028260

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	11163	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	303	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	11163		303			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	3101		84			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, E_T	1.5		1.5			
Recreational vehicle PCE, E_R	1.2		1.2			
Heavy vehicle adjustment, f_{HV}	1.000		1.000			
Driver population factor, f_P	1.00		1.00			
Flow rate, v_p	12403		337			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 5598 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	12403	9140	Yes
v_{12}	5598	4400	Yes
$v_{FO} = v_F - v_R$	12066	9140	Yes
v_R	337	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 47.9 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.458	
Space mean speed in ramp influence area,	S_R = 50.9	mph
Space mean speed in outer lanes,	S_O = 54.8	mph
Space mean speed for all vehicles,	S = 53.0	mph

AR00028261

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/8/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**F Weaver Rd & H1 Loop Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	10757	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	2495	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	10757		2495			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2988		693			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	11952		2772			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.260 Using Equation 0

$v_{12} = v_R + (v - v_F) P_{FD}$ = 5159 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	11952	9140	Yes
v_{12}	5159	4400	Yes
$v_{FO} = v_F - v_R$	9180	9140	Yes
v_R	2772	3800	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = 35.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	D_S = 0.677	
Space mean speed in ramp influence area,	S_R = 47.3	mph
Space mean speed in outer lanes,	S_O = 54.8	mph
Space mean speed for all vehicles,	S = 51.3	mph

AR00028262

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8262	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	702	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	8262	702		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	2295	195		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	9180	780		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.280 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 2567 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	9960	9140	Yes
v_{R12}	3347	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 28.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	M_S = 0.397	
Space mean speed in ramp influence area,	S_R = 52.0	mph
Space mean speed in outer lanes,	S_O = 45.9	mph
Space mean speed for all vehicles,	S = 47.8	mph

AR00028263

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**F Weaver Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Rad**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	6985	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1146	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exiat?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	6985		1146			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1940		318			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	7761		1273			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 4102 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	7761	9140	No
v_{12}	4102	4400	No
$v_{FO} = v_F - v_R$	6488	9140	No
v_R	1273	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 35.0+ pc/mi/ln

Level of service for ramp-freeway junction areas of influence **E**

Speed Estimation

Intermediate speed variable,	D_S = 0.543	
Space mean speed in ramp influence area,	S_R = 49.5	mph
Space mean speed in outer lanes,	S_0 = 60.9	mph
Space mean speed for all vehicles,	S = 54.3	mph

AR00028264

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	2/8/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**Fort Weaver Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030 + Project w/o Transit Red**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	6682	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	2743	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	843	vph
Position of adjacent Ramp	Downstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	6682	2743	843	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1856	762	234	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	7424	3048	937	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1552 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	10472	9140	Yes
v_{R12}	4600	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 30.5 pc/mi/ln

Level of service for ramp-freeway junction areas of influence F

Speed Estimation

Intermediate speed variable,	M_S = 0.604	
Space mean speed in ramp influence area,	S_R = 48.5	mph
Space mean speed in outer lanes,	S_O = 48.2	mph
Space mean speed for all vehicles,	S = 48.3	mph

AR00028265

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	**PM Peak**
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**F Weaver Rd & H-1 Loop On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	2030 + Project w/o Transit Red
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5839	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	843	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	Yes	
Volume on adjacent Ramp	2601	vph
Position of adjacent Ramp	Upstream	
Type of adjacent Ramp	On	
Distance to adjacent Ramp	500	ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	5839	843	2601	vph
Peak-hour factor, PHF	0.90	0.90	0.90	
Peak 15-min volume, v15	1622	234	723	v
Trucks and buses	0	0	0	%
Recreational vehicles	0	0	0	%
Terrain type:	Level	Level	Level	
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5	1.5	
Recreational vehicle PCE, ER	1.2	1.2	1.2	
Heavy vehicle adjustment, fHV	1.000	1.000	1.000	
Driver population factor, fP	1.00	1.00	1.00	
Flow rate, vp	6488	937	2890	pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.260 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1687 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7425	9140	No
v_{R12}	2624	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 22.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.340	
Space mean speed in ramp influence area,	S_R = 52.9	mph
Space mean speed in outer lanes,	S_O = 51.4	mph
Space mean speed for all vehicles,	S = 51.9	mph

AR00028266

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 WB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030+ Pro without Transit Rad.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	8964	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	2588	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	8964		2588			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	2490		719			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	9960		2876			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 5965 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	9960	9140	Yes
v_{12}	5965	4400	Yes
$v_{FO} = v_F - v_R$	7084	9140	No
v_R	2876	2000	Yes

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086 v_{12} - 0.009 L_D$ = 51.1 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **F**

Speed Estimation

Intermediate speed variable,	D_S = 0.687	
Space mean speed in ramp influence area,	S_R = 47.2	mph
Space mean speed in outer lanes,	S_0 = 60.3	mph
Space mean speed for all vehicles,	S = 51.7	mph

AR00028267

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 WB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030+ Pro without Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	6376	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-flow speed on ramp	35.0	mph
Volume on ramp	1020	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	6376	1020		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1771	283		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	7084	1133		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.235 Using Equation 4

$v_{12} = v_F (P_{FM})$ = 1668 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	8217	9140	No
v_{R12}	2801	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 23.7 pc/mi/ln

Level of service for ramp-freeway junction areas of influence C

Speed Estimation

Intermediate speed variable,	M_S = 0.350	
Space mean speed in ramp influence area,	S_R = 52.7	mph
Space mean speed in outer lanes,	S_O = 49.5	mph
Space mean speed for all vehicles,	S = 50.6	mph

AR00028268

HCS+: Ramps and Ramp Junctions Release 5.2

Diverge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H1 EB**
Junction:	**North South Rd & H1 Off Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030+ Pro without Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Diverge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	5478	vph

Off Ramp Data

Side of freeway	Right	
Number of lanes in ramp	1	
Free-Flow speed on ramp	35.0	mph
Volume on ramp	1116	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane		ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent ramp		vph
Position of adjacent ramp		
Type of adjacent ramp		
Distance to adjacent ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway		Ramp		Adjacent Ramp	
Volume, V (vph)	5478		1116			vph
Peak-hour factor, PHF	0.90		0.90			
Peak 15-min volume, v15	1522		310			v
Trucks and buses	0		0			%
Recreational vehicles	0		0			%
Terrain type:	Level		Level			
Grade	0.00	%	0.00	%		%
Length	0.00	mi	0.00	mi		mi
Trucks and buses PCE, ET	1.5		1.5			
Recreational vehicle PCE, ER	1.2		1.2			
Heavy vehicle adjustment, fHV	1.000		1.000			
Driver population factor, fP	1.00		1.00			
Flow rate, vp	6087		1240			pcph

Estimation of V12 Diverge Areas

L_{EQ} = (Equation 25-8 or 25-9)

P_{FD} = 0.436 Using Equation 8

$v_{12} = v_R + (v_F - v_R) P_{FD}$ = 3353 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
$v_{Fi} = v_F$	6087	9140	No
v_{12}	3353	4400	No
$v_{FO} = v_F - v_R$	4847	9140	No
v_R	1240	2000	No

Level of Service Determination (if not F)

Density, $D_R = 4.252 + 0.0086\, v_{12} - 0.009\, L_D$ = 28.6 pc/mi/ln

Level of service for ramp-freeway junction areas of influence D

Speed Estimation

Intermediate speed variable,	D_S = 0.540	
Space mean speed in ramp influence area,	S_R = 49.6	mph
Space mean speed in outer lanes,	S_O = 62.7	mph
Space mean speed for all vehicles,	S = 54.7	mph

AR00028269

HCS+: Ramps and Ramp Junctions Release 5.2

Merge Analysis

Analyst:	MM
Agency/Co.:	Wilbur Smith Associates
Date performed:	1/5/2007
Analysis time period:	PM Peak
Freeway/Dir of Travel:	**H-1 EB**
Junction:	**North-South Rd and H-1 On Ramp**
Jurisdiction:	Kapolei
Analysis Year:	**2030+ Pro without Transit Red.**
Description:	East Kapolei TIAR

Freeway Data

Type of analysis	Merge	
Number of lanes in freeway	4	
Free-flow speed on freeway	58.5	mph
Volume on freeway	4362	vph

On Ramp Data

Side of freeway	Right	
Number of lanes in ramp	2	
Free-flow speed on ramp	35.0	mph
Volume on ramp	2623	vph
Length of first accel/decel lane	500	ft
Length of second accel/decel lane	500	ft

Adjacent Ramp Data (if one exists)

Does adjacent ramp exist?	No	
Volume on adjacent Ramp		vph
Position of adjacent Ramp		
Type of adjacent Ramp		
Distance to adjacent Ramp		ft

Conversion to pc/h Under Base Conditions

Junction Components	Freeway	Ramp	Adjacent Ramp	
Volume, V (vph)	4362	2623		vph
Peak-hour factor, PHF	0.90	0.90		
Peak 15-min volume, v15	1212	729		v
Trucks and buses	0	0		%
Recreational vehicles	0	0		%
Terrain type:	Level	Level		
Grade	%	%	%	
Length	mi	mi	mi	
Trucks and buses PCE, ET	1.5	1.5		
Recreational vehicle PCE, ER	1.2	1.2		
Heavy vehicle adjustment, fHV	1.000	1.000		
Driver population factor, fP	1.00	1.00		
Flow rate, vp	4847	2914		pcph

Estimation of V12 Merge Areas

L_{EQ} = (Equation 25-2 or 25-3)

P_{FM} = 0.209 Using Equation 0

$v_{12} = v_F (P_{FM})$ = 1013 pc/h

Capacity Checks

	Actual	Maximum	LOS F?
v_{FO}	7761	9140	No
v_{R12}	3927	4600	No

Level of Service Determination (if not F)

Density, $D_R = 5.475 + 0.00734\ v_R + 0.0078\ v_{12} - 0.00627\ L_A$ = 25.4 pc/mi/ln

Level of service for ramp-freeway junction areas of influence **C**

Speed Estimation

Intermediate speed variable,	M_S = 0.414	
Space mean speed in ramp influence area,	S_R = 51.7	mph
Space mean speed in outer lanes,	S_O = 53.4	mph
Space mean speed for all vehicles,	S = 52.5	mph

AR00028270

APPENDIX D

SIGNAL WARRANT ANALYSIS

AR00028271

Figure 4C-101. Traffic Signal Warrants Worksheet (Sheet 1 of 4)

Year 2030 Conditions

(#2)

DIST Honolulu CD RTE KPM

CALC: TSO DATE 2/12/07
CHK _____ DATE _____

Major St: Kunia Rd. Critical Approach Speed 40 km/h mph
Minor St: H1 WB Ramps Critical Approach Speed _____ km/h

Critical speed of major street traffic > 64 km/h (40 mph) ☐ } RURAL (R)
In built up area of isolated community of < 10,000 population ☐ } or
☒ URBAN (U)

WARRANT 3 - Peak Hour PART A or PART B SATISFIED YES ☒ NO ☐

PART A SATISFIED YES ☐ NO ☐
(All parts 1, 2, and 3 below must be satisfied)

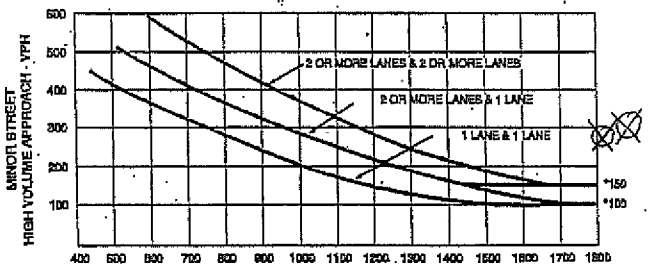
1. The total delay experienced for traffic on one minor street approach controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach and five vehicle-hours for a two-lane approach; AND — Yes ☐ No ☐
2. The volume on the same minor street approach equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND — Yes ☐ No ☐
3. The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches. — Yes ☐ No ☐

PART B SATISFIED YES ☒ NO ☐

APPROACH LANES	One	2 or More	AM	PM	Hour	
Both Approaches - Major Street		☒	310	1540		
Highest Approaches - Minor Street	☒		280	307		

The plotted points for vehicles per hour on major streets (both approaches) and the corresponding per hour higher volume vehicle minor street approach (one direction only) for one hour (any consecutive 15 minute period) fall above the applicable curves in MUTCD Figure 4C-3 or 4C-4.

Figure 4C-3. Warrant 3, Peak Hour



MAJOR STREET—TOTAL OF BOTH APPROACHES—
VEHICLES PER HOUR (VPH)

*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

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Figure 4C-101. Traffic Signal Warrants Worksheet (Sheet 1 of 4)

Year 2030 Conditions

(#10)

DIST Honolulu CD RTE KPM

CALC: TSO DATE 2/12/07
CHK _____ DATE _____

Major St: Farrington Hwy Critical Approach Speed _____ km/h
Minor St: East Old Fort Weaver Rd. Critical Approach Speed _____ km/h

Critical speed of major street traffic > 64 km/h (40 mph) ☐ } RURAL (R)
In built up area of isolated community of < 10,000 population ☐ } or
☒ URBAN (U)

WARRANT 3 - Peak Hour PART A or PART B SATISFIED YES ☒ NO ☐

PART A SATISFIED YES ☐ NO ☐
(All parts 1, 2, and 3 below must be satisfied)

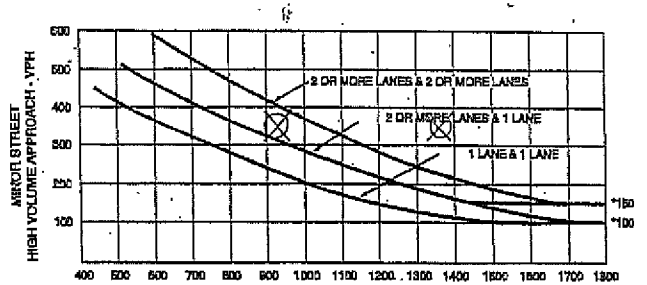
1. The total delay experienced for traffic on one minor street approach controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach and five vehicle-hours for a two-lane approach; AND — Yes ☐ No ☐
2. The volume on the same minor street approach equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND — Yes ☐ No ☐
3. The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches. — Yes ☐ No ☐

PART B SATISFIED YES ☒ NO ☐

APPROACH LANES	One	2 or More	AM	PM	Hour	
Both Approaches - Major Street		☒	928	1358		
Highest Approaches - Minor Street	☒		342	354		

The plotted points for vehicles per hour on major streets (both approaches) and the corresponding per hour higher volume vehicle minor street approach (one direction only) for one hour (any consecutive 15 minute period) fall above the applicable curves in MUTCD Figure 4C-3 or 4C-4.

Figure 4C-3. Warrant 3, Peak Hour



MAJOR STREET—TOTAL OF BOTH APPROACHES—
VEHICLES PER HOUR (VPH)

*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

AR00028272

Figure 4C-101. Traffic Signal Warrants Worksheet (Sheet 1 of 4)

Year 2030 Conditions

DIST Honolulu CD RTE KPM

CALC: TSO DATE 2/12/07
CHK _____ DATE _____

Major St: Farrington Hwy
Minor St: West Old Fort Weaver Rd.

Critical Approach Speed 40 km/h mph
Critical Approach Speed _____ km/h

#11

Critical speed of major street traffic > 84 km/h (40 mph) ☐ } RURAL (R)
In built up area of isolated community of < 10,000 population ☐ } or
☒ URBAN (U)

WARRANT 3 - Peak Hour — PART A or PART B SATISFIED YES ☒ NO ☐

PART A — SATISFIED YES ☐ NO ☐
(All parts 1, 2, and 3 below must be satisfied)

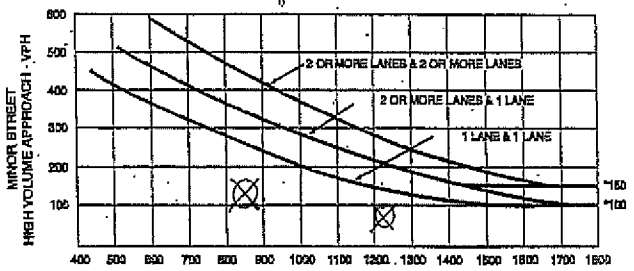
1. The total delay experienced for traffic on one minor street approach controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach and five vehicle-hours for a two-lane approach; AND — Yes ☐ No ☐
2. The volume on the same minor street approach equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND — Yes ☐ No ☐
3. The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches. — Yes ☐ No ☐

PART B — SATISFIED YES ☒ NO ☐

APPROACH LANES	One	2 or More	AM	PM	Hour
Both Approaches - Major Street		X	854	1221	
Highest Approaches - Minor Street	X		120	80	

The plotted points for vehicles per hour on major streets (both approaches) and the corresponding per hour higher volume vehicle minor street approach (one direction only) for one hour (any consecutive 15 minute period) fall above the applicable curves in MUTCD Figure 4C-3 or 4C-4.

Figure 4C-3. Warrant 3, Peak Hour



MAJOR STREET—TOTAL OF BOTH APPROACHES—
VEHICLES PER HOUR (VPH)

*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

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Figure 4C-101. Traffic Signal Warrants Worksheet (Sheet 1 of 4)

Year 2030 Conditions

DIST Honolulu CD RTE KPM

CALC: TSO DATE 2/12/07
CHK _____ DATE _____

Major St: East-West Rd.
Minor St: Old Fort Weaver Rd.

Critical Approach Speed 40 km/h mph
Critical Approach Speed _____ km/h

#19

Critical speed of major street traffic > 84 km/h (40 mph) ☐ } RURAL (R)
In built up area of isolated community of < 10,000 population ☐ } or
☒ URBAN (U)

WARRANT 3 - Peak Hour — PART A or PART B SATISFIED YES ☒ NO ☐

PART A — SATISFIED YES ☐ NO ☐
(All parts 1, 2, and 3 below must be satisfied)

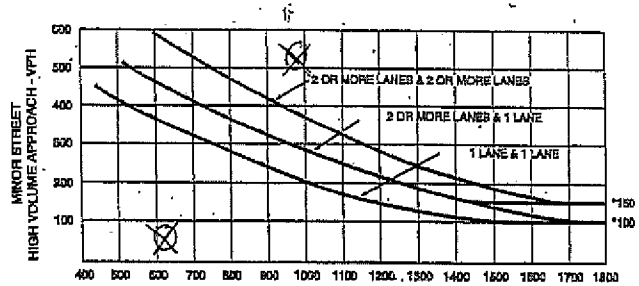
1. The total delay experienced for traffic on one minor street approach controlled by a STOP sign equals or exceeds four vehicle-hours for a one-lane approach and five vehicle-hours for a two-lane approach; AND — Yes ☐ No ☐
2. The volume on the same minor street approach equals or exceeds 100 vph for one moving lane of traffic or 150 vph for two moving lanes; AND — Yes ☐ No ☐
3. The total entering volume serviced during the hour equals or exceeds 800 vph for intersections with four or more approaches or 650 vph for intersections with three approaches. — Yes ☐ No ☐

PART B — SATISFIED YES ☒ NO ☐

APPROACH LANES	One	2 or More	AM	PM	Hour
Both Approaches - Major Street		X	611	993	
Highest Approaches - Minor Street		X	42	518	

The plotted points for vehicles per hour on major streets (both approaches) and the corresponding per hour higher volume vehicle minor street approach (one direction only) for one hour (any consecutive 15 minute period) fall above the applicable curves in MUTCD Figure 4C-3 or 4C-4.

Figure 4C-3. Warrant 3, Peak Hour



MAJOR STREET—TOTAL OF BOTH APPROACHES—
VEHICLES PER HOUR (VPH)

*Note: 150 vph applies as the lower threshold volume for a minor-street approach with two or more lanes and 100 vph applies as the lower threshold volume for a minor-street approach with one lane.

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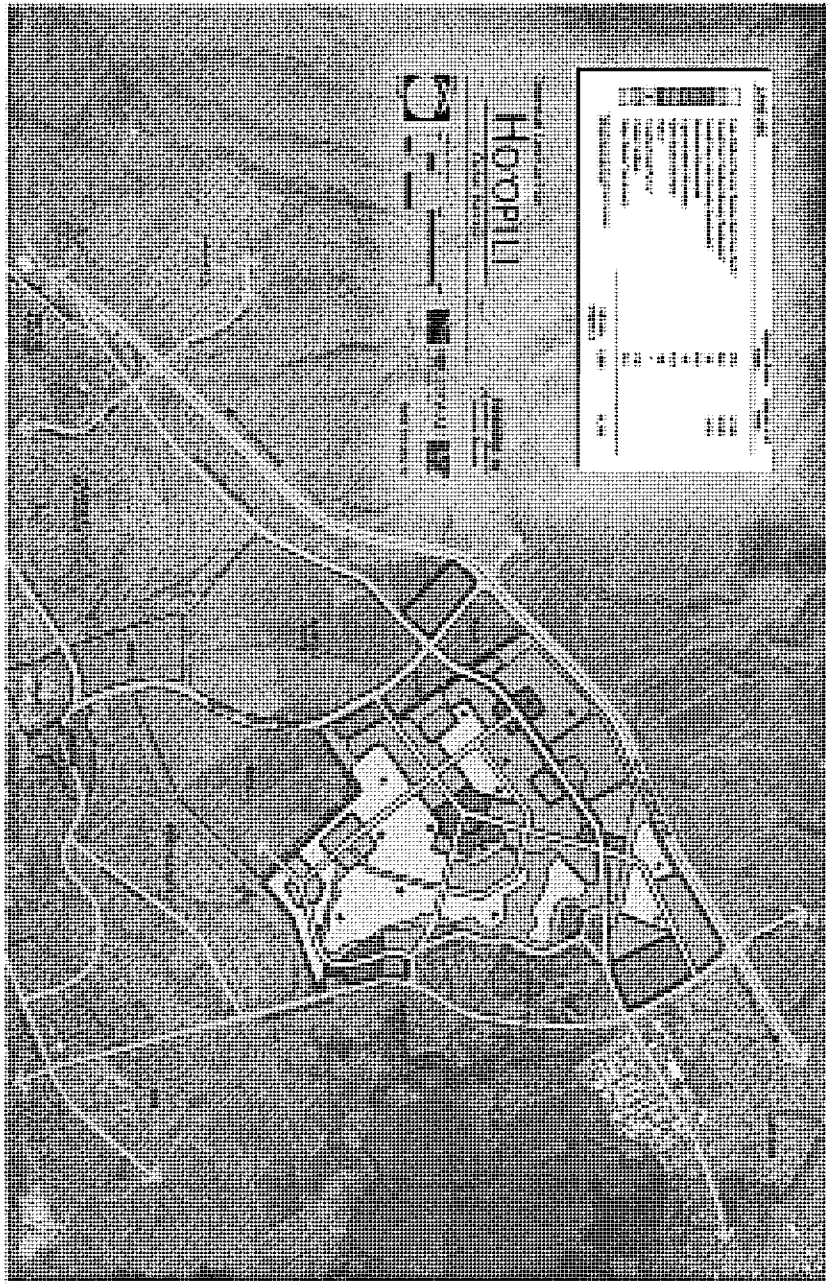
APPENDIX E

HO'OPILI CONCEPTUAL LANDUSE PLAN

AR00028274



APPENDIX E-2

OMPO MODEL LAND USE ASSUMPTIONS

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I[illegible]OMPO T[illegible]M[illegible]
[illegible]L[illegible]U[illegible]M[illegible]

The following presents the most recent land use assumptions incorporated in the OMPO model. These same assumptions were used in calculating the travel demand for the proposed Project.

2000 Land Use Model Inputs to the Travel Model

Table 1. Estimated 1994 Base-Year Households

District		Total Households in 1994 Base Year			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	6,153	6,281	128	2.1%
2	Kakaako	2,853	2,361	(492)	-17.3%
3	Makiki	16,190	15,649	(541)	-3.3%
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	Kalihi	8,876	8,705	(171)	-1.9%
11	Iwilei	5,163	5,389	226	4.4%
12	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	Waianae	9,787	9,787	(0)	0.0%
19	NorthShore	5,465	5,489	24	0.4%
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]	[illegible]	[illegible]

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Table 2. Estimated 2000 Households

District		Total Households				2000-1994 Gain (Loss)	
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim
1	Downtown	6,635	6,631	(4)	-0.1%	482	350
2	Kakaako	3,077	3,096	19	0.6%	224	735
3	Makiki	17,459	17,394	(65)	-0.4%	1,269	1,745
4	McCully	16,198	16,550	352	2.2%	1,177	1,443
5	Waikiki	12,577	12,059	(518)	-4.1%	914	727
6	Diamond Hd	9,504	9,988	484	5.1%	691	968
7	Kaimuki	10,147	10,970	823	8.1%	737	1,559
8	Manoa	6,207	6,202	(5)	-0.1%	451	308
9	Nuuanu	11,746	12,505	759	6.5%	853	1,175
10	Kalihi	9,572	9,888	316	3.3%	696	1,183
11	Iwilei	5,568	5,850	282	5.1%	405	461
12	Airport PH	5,847	6,211	364	6.2%	425	361
13	Salt Lake	14,951	14,673	(278)	-1.9%	1,086	1,303
14	PC Alea	23,744	24,502	758	3.2%	1,725	2,543
15	Waipahu	17,491	19,167	1,676	9.6%	1,271	3,246
16	Mililani	25,305	25,000	(305)	-1.2%	1,839	5,403
17	Ewa	18,906	20,117	1,211	6.4%	1,374	2,576
18	Waianae	10,554	9,543	(1,011)	-9.6%	767	(244)
19	NorthShore	5,893	5,033	(860)	-14.6%	428	(456)
20	Koolauloa	3,682	2,651	(1,031)	-28.0%	268	(763)
21	Kaneohe	19,288	18,375	(913)	-4.7%	1,402	515
22	Kailua	16,154	14,678	(1,476)	-9.1%	1,174	(316)
23	E Honolulu	15,945	15,366	(579)	-3.6%	1,159	608
	Total	286,450	286,449	(1)	0.0%	20,814	25,430

Table 3. Estimated 2000 Housing Units

District		Housing Units				% Vacancy	
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim
1	Downtown	7,121	6,655	(466)	-6.5%	6.8%	0.4%
2	Kakaako	3,970	2,989	(981)	-24.7%	22.5%	-3.6%
3	Makiki	19,044	17,478	(1,566)	-8.2%	8.3%	0.5%
4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	Kalihi	10,133	10,313	180	1.8%	5.5%	4.1%
11	Iwilei	6,152	5,963	(189)	-3.1%	9.5%	1.9%
12	Airport PH	6,523	6,397	(126)	-1.9%	10.4%	2.9%
13	Salt Lake	16,389	15,175	(1,214)	-7.4%	8.8%	3.3%
14	PC Alea	24,588	26,009	1,421	5.8%	3.4%	5.8%
15	Waipahu	18,471	20,414	1,943	10.5%	5.3%	6.1%
16	Mililani	27,407	27,550	143	0.5%	7.7%	9.3%
17	Ewa	20,775	22,728	1,953	9.4%	9.0%	11.5%
18	Waianae	12,378	12,096	(282)	-2.3%	14.7%	21.1%
19	NorthShore	6,648	6,913	265	4.0%	11.4%	27.2%
20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
21	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
22	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
23	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

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Table 4. Estimated 2000 Population Living in Households

District		Population Living in Households				Average Size of Household		
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	%+/- Diff.
1	Downtown	13,737	16,469	2,732	19.9%	2.07	2.48	20.0%
2	Kakaako	5,707	8,007	2,300	40.3%	1.85	2.59	39.4%
3	Makiki	33,850	43,321	9,471	28.0%	1.94	2.49	28.5%
4	McCully	31,696	40,684	8,988	28.4%	1.96	2.46	25.6%
5	Waikiki	21,682	28,620	6,938	32.0%	1.72	2.37	37.7%
6	Diamond Hd	25,577	28,543	2,966	11.6%	2.69	2.86	6.2%
7	Kaimuki	28,101	31,602	3,501	12.5%	2.77	2.86	4.0%
8	Manoa	16,646	17,760	1,114	6.7%	2.68	2.86	6.8%
9	Nuuanu	30,828	35,539	4,711	15.3%	2.62	2.84	8.3%
10	Kalihi	37,587	30,835	(6,752)	-18.0%	3.93	3.12	-20.6%
11	Iwilei	20,209	17,485	(2,724)	-13.5%	3.63	2.99	-17.6%
12	Airport PH	19,785	19,018	(767)	-3.9%	3.38	3.06	-9.5%
13	Salt Lake	46,134	45,075	(1,059)	-2.3%	3.09	3.07	-0.4%
14	PC Alea	71,380	75,325	3,945	5.5%	3.01	3.07	2.3%
15	Waipahu	62,575	61,492	(1,083)	-1.7%	3.58	3.21	-10.3%
16	Mililani	79,488	78,729	(759)	-1.0%	3.14	3.15	0.3%
17	Ewa	68,202	61,355	(6,847)	-10.0%	3.61	3.05	-15.5%
18	Waianae	41,877	30,781	(11,096)	-26.5%	3.97	3.23	-18.7%
19	NorthShore	17,980	17,185	(795)	-4.4%	3.05	3.41	11.9%
20	Koolauloa	13,793	9,267	(4,526)	-32.8%	3.75	3.50	-6.7%
21	Kaneohe	61,371	56,588	(4,783)	-7.8%	3.18	3.08	-3.2%
22	Kailua	51,001	45,302	(5,699)	-11.2%	3.16	3.09	-2.2%
23	E Honolulu	46,005	46,222	217	0.5%	2.89	3.01	4.3%
	Total	845,211	845,204	(7)	0.0%	2.95	2.95	0.0%

Table 5. Estimated 2000 Mean Household Income[2]

District		Mean Household Income		
No.	Name	Conventional	UrbanSim	%+/- Diff.
1	Downtown	$ 29,675	$ 33,664	13.4%
2	Kakaako	$ 19,477	$ 21,067	8.2%
3	Makiki	$ 104,506	$ 112,846	8.0%
4	McCully	$ 81,878	$ 100,865	23.2%
5	Waikiki	$ 69,235	$ 73,445	6.1%
6	Diamond Hd	$ 77,280	$ 80,521	4.2%
7	Kaimuki	$ 80,541	$ 83,835	4.1%
8	Manoa	$ 62,675	$ 55,153	-11.9%
9	Nuuanu	$ 94,869	$ 100,479	5.9%
10	Kalihi	$ 64,537	$ 72,380	12.2%
11	Iwilei	$ 28,152	$ 34,051	21.0%
12	Airport PH	$ 29,833	$ 39,295	31.7%
13	Salt Lake	$ 111,270	$ 109,003	-2.0%
14	PC Alea	$ 209,921	$ 193,063	-7.9%
15	Waipahu	$ 138,727	$ 139,531	0.6%
16	Mililani	$ 156,351	$ 180,906	14.3%
17	Ewa	$ 141,304	$ 138,487	-2.0%
18	Waianae	$ 60,780	$ 61,647	1.4%
19	NorthShore	$ 38,531	$ 37,337	-3.1%
20	Koolauloa	$ 22,544	$ 21,309	-7.3%
21	Kaneohe	$ 135,974	$ 141,785	9.1%
22	Kailua	$ 147,219	$ 120,857	-17.9%
23	E Honolulu	$ 181,207	$ 146,494	-19.2%
	Total	$ 48,830	$ 48,556	-0.5%

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Table 6. 1994 Base-Year Total Employment

District No.	District Name	Total Employment in 1994 Base Year Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	61,660	60,580	(1,080)	-1.8%
2	Kakaako	24,666	26,564	1,898	7.7%
3	Makiki	18,996	18,221	(775)	-4.1%
4	McCully	[illegible]	[illegible]	[illegible]	[illegible]
5	Waikiki	[illegible]	[illegible]	[illegible]	[illegible]
6	Diamond Hd	[illegible]	[illegible]	[illegible]	[illegible]
7	Kaimuki	[illegible]	[illegible]	[illegible]	[illegible]
8	Manoa	[illegible]	[illegible]	[illegible]	[illegible]
9	Nuuanu	[illegible]	[illegible]	[illegible]	[illegible]
10	Kalihi	5,025	5,510	485	9.7%
11	Iwilei	34,395	36,751	2,356	6.8%
12	Airport PH	[illegible]	[illegible]	[illegible]	[illegible]
13	Salt Lake	[illegible]	[illegible]	[illegible]	[illegible]
14	PC Area	[illegible]	[illegible]	[illegible]	[illegible]
15	Waipahu	[illegible]	[illegible]	[illegible]	[illegible]
16	Mililani	[illegible]	[illegible]	[illegible]	[illegible]
17	Ewa	[illegible]	[illegible]	[illegible]	[illegible]
18	Waianae	6,853	6,829	(24)	-0.3%
19	NorthShore	3,907	3,910	3	0.1%
20	Koolauloa	[illegible]	[illegible]	[illegible]	[illegible]
21	Kaneohe	[illegible]	[illegible]	[illegible]	[illegible]
22	Kailua	[illegible]	[illegible]	[illegible]	[illegible]
23	E Honolulu	[illegible]	[illegible]	[illegible]	[illegible]
	Total	[illegible]	[illegible]	[illegible]	[illegible]

Table 7. Estimated 2000 Total Employment

District No.	District Name	Total Employment Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	57,110	61,941	4,831	8.5%
2	Kakaako	24,878	23,128	(1,750)	-7.0%
3	Makiki	[illegible]	[illegible]	[illegible]	[illegible]
4	McCully	[illegible]	[illegible]	[illegible]	[illegible]
5	Waikiki	[illegible]	[illegible]	[illegible]	[illegible]
6	Diamond Hd	[illegible]	[illegible]	[illegible]	[illegible]
7	Kaimuki	[illegible]	[illegible]	[illegible]	[illegible]
8	Manoa	[illegible]	[illegible]	[illegible]	[illegible]
9	Nuuanu	[illegible]	[illegible]	[illegible]	[illegible]
10	Kalihi	5,877	6,555	678	11.5%
11	Iwilei	39,155	38,949	(206)	-0.5%
12	Airport PH	[illegible]	[illegible]	[illegible]	[illegible]
13	Salt Lake	[illegible]	[illegible]	[illegible]	[illegible]
14	PC Area	[illegible]	[illegible]	[illegible]	[illegible]
15	Waipahu	[illegible]	[illegible]	[illegible]	[illegible]
16	Mililani	[illegible]	[illegible]	[illegible]	[illegible]
17	Ewa	[illegible]	[illegible]	[illegible]	[illegible]
18	Waianae	7,902	7,702	(200)	-2.5%
19	NorthShore	4,629	4,556	(73)	-1.6%
20	Koolauloa	5,934	5,233	(701)	-11.8%
21	Kaneohe	21,972	23,267	1,295	5.9%
22	Kailua	15,660	15,733	73	0.5%
23	E Honolulu	6,794	7,938	1,144	16.8%
	Total	499,307	499,307	-	0.0%

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Table 8. Estimated 2000 Accessibilities

District		Access to Employment			Access to Population		
No.	Name	0-Cars	1-Car	2+ Car	0-Cars	1-Car	2+ Car
1	Downtown	0.463	0.882	1.000	0.729	0.845	0.933
2	Kakaako	0.121	0.432	0.892	0.345	0.492	0.895
3	Makiki	0.248	0.423	0.864	0.922	0.974	1.000
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
10	Kalihi	0.368	0.429	0.799	0.726	0.799	0.960
11	Iwilei	1.000	1.000	0.941	0.799	0.871	0.989
[illegible]							
[illegible]							
[illegible]							
[illegible]							
[illegible]							
18	Waianae	0.016	0.055	0.225	0.038	0.106	0.328
19	NorthShore	0.030	0.069	0.249	0.051	0.121	0.343
20	Koolauloa	0.009	0.043	0.183	0.016	0.069	0.242
21	Kaneohe	0.111	0.177	0.495	0.329	0.406	0.641
22	Kailua	0.120	0.176	0.455	0.287	0.362	0.589
23	E Honolulu	0.041	0.126	0.505	0.110	0.229	0.621

Table 9. Estimated 2000 Employment in Wholesale/TCPU and Manufacturing Sectors

District		Wholesale/TCPU Employment				Manufacturing Employment			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	5,290	5,286	(4)	-0.1%	1,449	4,937	3,488	240.7%
2	Kakaako	4,226	3,962	(263)	-6.2%	2,028	1,139	(889)	-43.8%
3	Makiki	1,187	1,022	(165)	-13.9%	559	319	(240)	-42.9%
4	McCully	2,014	1,829	(185)	-9.2%	1,274	549	(725)	-56.9%
5	Waikiki	902	853	(49)	-5.4%	616	938	322	52.3%
6	Diamond Hd	332	309	(23)	-6.9%	294	130	(164)	-55.8%
7	Kaimuki	239	229	(10)	-4.2%	483	245	(238)	-49.3%
8	Manoa	308	300	(8)	-2.6%	125	81	(44)	-35.2%
9	Nuuanu	167	182	15	9.0%	286	183	(102)	-35.8%
10	Kalihi	116	114	(2)	-1.7%	95	53	(42)	-44.2%
11	Iwilei	5,576	5,424	(152)	-2.7%	7,963	6,077	(1,886)	-23.7%
12	Airport PH	12,198	11,466	(732)	-6.0%	5,289	3,966	(1,323)	-25.0%
13	Salt Lake	527	802	275	52.2%	1,419	2,987	1,568	110.5%
14	PC Area	1,467	1,736	269	18.3%	2,849	2,706	(143)	-5.0%
15	Waipahu	735	821	83	11.2%	1,498	1,135	(363)	-24.2%
16	Mililani	1,454	1,684	230	15.8%	570	1,414	844	148.1%
17	Ewa	1,073	1,132	59	5.5%	2,234	1,161	(1,073)	-48.0%
18	Waianae	207	281	74	35.7%	136	207	71	52.2%
19	NorthShore	142	250	108	76.1%	373	278	(95)	-25.5%
20	Koolauloa	242	341	99	40.9%	103	210	107	103.9%
21	Kaneohe	810	989	179	22.1%	427	1,140	713	167.0%
22	Kailua	557	759	202	36.3%	671	902	231	34.4%
23	E Honolulu	437	437	-	0.0%	216	201	(17)	-7.8%
	Total	40,208	40,208	-	0.0%	30,958	30,958	-	0.0%

Table 10. Estimated 2000 Employment in FIRE and Service Sectors

District		Finance, Insur., Real Est. Employment				Service Employment			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	10,207	9,894	(313)	-3.1%	23,941	25,989	2,048	8.6%
2	Kakaako	1,539	1,610	71	4.6%	7,387	6,783	(604)	-8.2%
3	Makiki	1,474	1,340	(134)	-9.1%	13,443	11,658	(1,785)	-13.3%
4	McCully	4,609	3,690	(919)	-19.9%	10,699	9,292	(1,407)	-13.2%
5	Waikiki	1,737	1,571	(166)	-9.6%	9,225	6,689	(2,536)	-27.5%
6	Diamond Hd	668	614	(62)	-7.8%	4,934	4,395	(540)	-11.1%
7	Kaimuki	509	429	(81)	-15.9%	4,349	3,426	(923)	-21.2%
8	Manoa	342	338	(4)	-1.2%	11,785	7,980	(3,805)	-32.3%
9	Nuuanu	528	446	(82)	-15.5%	8,939	6,036	(2,903)	-32.5%
10	Kalihi	277	237	(40)	-14.4%	3,652	3,703	51	1.4%
11	Iwilei	2,499	2,636	137	5.5%	11,581	11,842	261	2.3%
12	Airport PH	1,619	1,678	59	3.6%	9,758	13,930	4,172	42.8%
13	Salt Lake	188	961	775	416.7%	8,548	11,412	2,864	33.5%
14	PC Area	1,215	1,477	262	21.6%	9,017	10,551	1,534	17.0%
15	Waipahu	591	653	62	10.5%	5,309	5,468	159	3.0%
16	Mililani	1,233	1,492	259	21.2%	7,978	11,190	3,212	40.3%
17	Ewa	1,018	916	(102)	-10.0%	6,129	7,049	920	15.0%
18	Waianae	291	284	(7)	-2.4%	3,642	3,323	(319)	-8.8%
19	NorthShore	153	154	1	0.7%	1,465	1,468	3	0.2%
20	Koolauloa	228	262	34	14.9%	3,244	2,297	(947)	-29.2%
21	Kaneohe	568	753	185	32.6%	6,750	8,084	1,334	19.8%
22	Kailua	715	813	98	13.7%	7,903	6,738	(1,165)	-14.7%
23	E Honolulu	522	479	(43)	-8.2%	2,799	3,184	385	13.8%
	Total	32,716	32,716	-	0.0%	182,477	182,477	-	0.0%

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Table 11. Estimated 2000 Employment in Military and Government Sectors

District		Military Employment				Government Employment			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff
1	Downtown	115	135	20	17.4%	9,329	7,626	(1,703)	-18.3%
2	Kakaako	240	314	74	30.8%	1,739	1,982	243	14.0%
3	Makiki	35	134	99	282.9%	1,610	1,384	(226)	-14.0%
4	McCully	30	118	88	286.7%	392	576	184	46.9%
5	Waikiki	148	207	59	39.9%	395	499	94	23.8%
6	Diamond Hd	344	389	45	13.1%	740	1,289	549	74.2%
7	Kaimuki	8	153	145	1812.5%	154	475	321	208.4%
8	Manoa	82	249	167	203.7%	339	468	129	38.1%
9	Nuuanu	38	202	166	481.1%	280	483	203	75.1%
10	Kalihi	4	232	228	5700.0%	391	613	222	56.8%
11	Iwilei	134	295	161	120.1%	1,325	2,012	687	51.8%
12	Airport PH	10,163	9,071	(1,092)	-10.7%	6,363	5,331	(1,032)	-16.2%
13	Salt Lake	6,116	5,661	(455)	-7.4%	3,403	3,371	(32)	-0.9%
14	PC Alea	2,671	2,758	87	3.3%	1,512	1,040	(472)	-31.2%
15	Waipahu	4	364	360	9000.0%	571	717	146	25.6%
16	Mililani	12,230	11,258	(972)	-7.9%	2,586	2,687	101	3.9%
17	Ewa	354	742	388	109.6%	951	1,266	315	33.1%
18	Waianae	47	317	270	574.5%	392	393	1	0.3%
19	NorthShore	126	203	77	61.1%	59	131	72	122.0%
20	Koolauloa	33	60	27	81.8%	134	190	56	41.8%
21	Koneohe	7,216	6,701	(515)	-7.1%	1,461	1,058	(403)	-27.6%
22	Kailua	288	559	271	94.1%	610	829	219	35.9%
23	E Honolulu	-	304	304	n/a	240	525	285	119.2%
Total		40,424	40,424	-	0.0%	34,956	34,956	-	0.0%

Table 12. Estimated 2000 Employment in Agriculture and Construction Sectors

District		Agricultural Employment				Construction Employment			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	290	168	(122)	-42.1%	848	1,162	316	37.4%
2	Kakaako	221	155	(66)	-29.9%	908	929	21	2.3%
3	Makiki	20	42	22	110.0%	893	765	(128)	-14.3%
4	McCully	141	105	(36)	-25.5%	528	493	(35)	-6.6%
5	Waikiki	84	68	(6)	-8.5%	364	395	31	8.5%
6	Diamond Hd	10	55	45	450.0%	423	383	(40)	-9.5%
7	Kaimuki	53	84	31	58.5%	270	270	-	0.0%
8	Manoa	30	80	50	166.7%	276	245	(31)	-11.2%
9	Nuuanu	17	68	51	300.0%	220	236	16	7.3%
10	Kalihi	37	75	38	102.7%	312	248	(66)	-21.2%
11	Iwilei	287	229	(58)	-20.2%	2,494	2,621	127	5.1%
12	Airport PH	71	280	209	294.4%	1,940	1,906	(34)	-1.8%
13	Salt Lake	-	123	123	n/a	775	860	85	11.0%
14	PC Alea	116	226	107	90.7%	1,339	1,458	119	8.9%
15	Waipahu	66	192	126	190.9%	1,746	1,651	(95)	-5.4%
16	Mililani	667	599	(68)	-10.2%	2,232	2,281	48	2.2%
17	Ewa	245	329	84	34.3%	3,515	3,171	(344)	-9.8%
18	Waianae	665	438	(227)	-34.1%	944	867	(77)	-8.2%
19	NorthShore	462	265	(197)	-42.6%	502	463	(39)	-7.8%
20	Koolauloa	422	237	(185)	-43.8%	189	240	51	27.0%
21	Koneohe	379	413	34	9.0%	831	723	(108)	-13.0%
22	Kailua	394	339	(55)	-14.0%	758	1,024	266	35.1%
23	E Honolulu	54	156	102	188.9%	784	710	(84)	-10.8%
Total		4,743	4,743	-	0.0%	23,099	23,099	-	0.0%

Table 13. Estimated 2000 Employment in the Retail Sector

District		Resident-Oriented Retail Employment				Visitor-Oriented Retail Employment			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff
1	Downtown	4,819	6,026	1,207	25.0%	-	-	-	n/a
2	Kakaako	6,213	5,918	(295)	-4.7%	-	-	-	n/a
3	Makiki	2,145	2,181	36	1.7%	-	-	-	n/a
4	McCully	6,634	6,334	(300)	-4.5%	2,049	1,589	(460)	-22.4%
5	Waikiki				n/a	17,740	15,864	(1,876)	-10.6%
6	Diamond Hd	3,019	3,219	200	6.6%	-	-	-	n/a
7	Kaimuki	1,827	1,920	93	5.1%	-	-	-	n/a
8	Manoa	1,019	1,048	29	2.8%	-	-	-	n/a
9	Nuuanu	896	1,067	171	19.1%	-	-	-	n/a
10	Kalihi	855	1,035	180	21.1%	-	-	-	n/a
11	Iwilei	6,613	7,066	453	6.9%	-	-	-	n/a
12	Airport PH	8,208	7,838	(371)	-4.5%	-	-	-	n/a
13	Salt Lake	2,053	3,066	1,013	49.3%	-	-	-	n/a
14	PC Alea	7,115	6,437	(678)	-9.5%	-	-	-	n/a
15	Waipahu	4,370	4,092	(278)	-6.4%	-	-	-	n/a
16	Mililani	3,837	3,997	160	4.2%	-	-	-	n/a
17	Ewa	2,456	2,893	437	17.8%	-	-	-	n/a
18	Waianae	1,344	1,385	41	3.1%	-	-	-	n/a
19	NorthShore	1,130	1,136	6	0.5%	-	-	-	n/a
20	Koolauloa	1,005	1,080	75	7.5%	-	-	-	n/a
21	Koneohe	3,092	3,005	(87)	-2.8%	-	-	-	n/a
22	Kailua	3,245	3,290	45	1.4%	-	-	-	n/a
23	E Honolulu	1,452	1,651	199	13.7%	-	-	-	n/a
Total		73,348	75,684	2,336	3.2%	19,789	17,453	(2,336)	-11.8%

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Table 14. Estimated 2000 Hotel Rooms and Employment in the Hotel Sector

District		Hotel Rooms		Hotel Employment			
No.	Name	Conventional	UrbanSim	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	26	1,195	824	718	(106)	-12.9%
2	Kakaako	-	561	378	336	(42)	-11.1%
3	Makiki	39	573	307	343	36	11.7%
4	McCully	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
5	Waikiki	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
6	Diamond Hd	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
7	Kaimuki	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
8	Manoa	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	Nuuanu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	Kalihi	-	412	138	247	109	79.0%
11	Iwilei	-	1,247	683	747	64	9.4%
12	Airport PH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	Salt Lake	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	PC Alea	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	Waipahu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	Mililani	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	Ewa	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	Waianae	-	347	234	207	(27)	-11.5%
19	NorthShore	-	347	217	208	(9)	-4.1%
20	Koolauloa	537	528	334	316	(18)	-5.4%
21	Kaneohe	16	601	438	361	(77)	-17.6%
22	Kailua	14	803	519	480	(39)	-7.5%
23	E Honolulu	-	485	278	290	12	4.3%
	Total	27,711	27,697	16,589	16,589	-	0.0%

Table 15. Estimated 2000 Public and Private College Students

District		Public College Students				Private College Students			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	-	-	-	n/a	5,218	5,008	(210)	-4.0%
2	Kakaako	-	-	-	n/a	-	-	-	n/a
3	Makiki	-	-	-	n/a	33	32	(1)	-3.0%
4	McCully	-	-	-	n/a	139	133	(6)	-4.3%
5	Waikiki	-	-	-	n/a	-	-	-	n/a
6	Diamond Hd	8,163	7,833	(330)	-4.0%	-	-	-	n/a
7	Kaimuki	-	-	-	n/a	888	852	(36)	-4.1%
8	Manoa	22,234	21,337	(897)	-4.0%	-	-	-	n/a
9	Nuuanu	-	-	-	n/a	-	-	-	n/a
10	Kalihi	-	-	-	n/a	-	-	-	n/a
11	Iwilei	5,260	5,048	(212)	-4.0%	-	-	-	n/a
12	Airport PH	-	-	-	n/a	-	-	-	n/a
13	Salt Lake	-	-	-	n/a	-	-	-	n/a
14	PC Alea	-	-	-	n/a	-	-	-	n/a
15	Waipahu	7,906	7,587	(319)	-4.0%	-	-	-	n/a
16	Mililani	-	-	-	n/a	-	-	-	n/a
17	Ewa	-	-	-	n/a	-	-	-	n/a
18	Waianae	-	-	-	n/a	-	-	-	n/a
18	NorthShore	-	-	-	n/a	-	-	-	n/a
20	Koolauloa	-	-	-	n/a	2,193	2,104	(89)	-4.1%
21	Kaneohe	1,814	1,741	(73)	-4.0%	-	-	-	n/a
22	Kailua	-	-	-	n/a	-	-	-	n/a
23	E Honolulu	-	-	-	n/a	122	117	(5)	-4.1%
	Total	45,377	43,546	(1,831)	-4.0%	8,593	8,248	(347)	-4.0%

Table 16. Estimated 2000 Public and Private K-12 Students

District		Public K-12 Students				Private K-12 Students			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	1,681	1,662	(19)	-1.1%	688	681	(7)	-1.0%
2	Kakaako	2,229	3,345	1,116	50.1%	-	-	-	n/a
3	Makiki	992	1,303	311	31.4%	6,251	8,210	1,959	31.3%
4	McCully	3,089	3,946	857	27.7%	2,075	2,651	576	27.8%
5	Waikiki	893	1,422	529	59.2%	255	406	151	59.2%
6	Diamond Hd	4,034	4,237	203	5.0%	76	80	4	5.3%
7	Kaimuki	3,110	3,515	403	13.0%	2,705	3,053	348	12.9%
8	Manoa	1,847	1,759	112	6.8%	1,988	2,123	135	6.8%
9	Nuuanu	6,080	6,849	769	12.6%	3,026	3,411	385	12.7%
10	Kalihi	5,104	4,512	(592)	-11.6%	4,478	3,962	(516)	-11.5%
11	Iwilei	5,298	4,327	(971)	-18.3%	824	673	(151)	-18.3%
12	Airport PH	6,232	4,542	(1,690)	-27.1%	923	673	(250)	-27.1%
13	Salt Lake	8,502	7,451	(1,051)	-12.4%	254	223	(31)	-12.2%
14	PC Alea	13,610	12,853	(757)	-5.6%	884	835	(49)	-5.5%
15	Waipahu	7,913	6,976	(937)	-11.8%	690	609	(81)	-11.9%
16	Mililani	16,537	13,752	(2,785)	-16.8%	1,263	1,051	(212)	-16.8%
17	Ewa	8,753	8,122	(631)	-7.2%	450	417	(33)	-7.3%
18	Waianae	11,043	8,067	(2,976)	-26.9%	100	73	(27)	-27.0%
19	NorthShore	2,781	2,411	(370)	-13.3%	275	238	(37)	-13.5%
20	Koolauloa	4,234	3,108	(1,126)	-26.6%	-	-	-	n/a
21	Kaneohe	8,693	7,064	(1,619)	-18.6%	1,031	840	(191)	-18.5%
22	Kailua	8,484	7,106	(1,378)	-16.2%	1,383	1,159	(224)	-16.2%
23	E Honolulu	6,055	5,493	(562)	-9.3%	516	470	(49)	-9.4%
	Total	136,984	123,820	(13,164)	-9.6%	30,128	31,828	1,700	5.6%

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2030 Land Use Model Inputs to the Travel Model

Table 1. Estimated 2030 Households

District		Total Households				% Change Since 2000	
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim
1	Downtown	12,024	8,174	(3,850)	-32.0%	81.2%	23.3%
2	Kakaako	17,001	4,093	(12,908)	-75.9%	452.5%	32.2%
3	Makiki	20,887	19,605	(1,282)	-6.1%	19.6%	12.7%
4	McCully	20,417	18,853	(1,564)	-7.7%	26.0%	13.9%
5	Waikiki	15,341	13,553	(1,788)	-11.7%	22.0%	12.4%
6	Diamond Hd	10,194	13,954	3,760	36.9%	7.3%	39.7%
7	Kaimuki	11,499	15,180	3,681	32.0%	13.3%	38.4%
8	Manoa	6,545	8,014	1,469	22.4%	5.4%	29.2%
9	Nuuanu	13,497	16,394	2,897	21.5%	14.9%	31.1%
10	Kalihi	10,302	13,839	3,537	34.3%	7.6%	40.0%
11	Iwilei	7,284	6,592	(692)	-9.5%	30.8%	12.7%
12	Airport PH	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
13	Salt Lake	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
14	PC Alea	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
15	Waipahu	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
16	Mililani	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
17	Ewa	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
18	Waianae	13,694	14,864	1,170	8.5%	29.8%	55.8%
19	NorthShore	6,853	6,548	(305)	-4.5%	16.3%	30.1%
20	Koolauloa	4,668	4,981	313	6.7%	26.8%	87.9%
21	Kaneohe	20,301	24,259	3,958	19.5%	5.3%	32.0%
22	Kailua	16,908	21,076	4,168	24.7%	4.7%	43.6%
23	E Honolulu	18,477	25,008	6,531	35.3%	15.9%	62.7%
Total		386,998	386,999	1	0.0%	35.1%	35.1%

Table 2. Estimated 2030 Housing Units and Vacancy Rates[2]

District		2030 Housing Units				% Change Since 2000		% Vacancy	
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Conventional	UrbanSim
1	Downtown	13,585	8,222	(5,343)	-39.4%	90.5%	23.5%	11.4%	0.6%
2	Kakaako	20,722	3,956	(16,766)	-80.9%	422.0%	32.4%	18.0%	-3.5%
3	Makiki	22,782	19,785	(2,997)	-13.2%	19.6%	13.2%	8.3%	0.9%
4	McCully	23,047	19,054	(3,993)	-17.3%	26.3%	13.5%	11.4%	1.1%
5	Waikiki	24,474	13,751	(10,723)	-43.8%	21.9%	12.5%	37.3%	1.4%
6	Diamond Hd	11,016	14,401	3,385	30.7%	7.0%	35.4%	7.5%	3.1%
7	Kaimuki	12,024	15,550	3,526	29.3%	13.1%	37.1%	4.4%	2.4%
8	Manoa	6,881	8,578	1,697	24.7%	5.7%	24.9%	4.9%	6.6%
9	Nuuanu	14,337	16,766	2,429	16.9%	15.0%	30.3%	5.9%	2.2%
10	Kalihi	10,921	14,272	3,351	30.7%	7.8%	38.4%	5.7%	3.0%
11	Iwilei	8,062	6,896	(1,166)	-14.5%	31.0%	15.6%	9.7%	4.4%
12	Airport PH	7,666	7,678	12	0.2%	17.5%	20.0%	9.9%	4.7%
13	Salt Lake	16,791	18,747	1,956	11.6%	2.3%	23.5%	6.6%	2.9%
14	PC Alea	24,913	35,022	10,109	40.6%	1.3%	34.7%	3.5%	3.0%
15	Waipahu	32,978	28,949	(4,029)	-12.2%	78.5%	41.8%	4.8%	4.2%
16	Mililani	30,682	36,836	6,154	20.1%	11.9%	33.7%	7.4%	4.1%
17	Ewa	60,399	32,456	(27,943)	-46.3%	190.7%	42.8%	8.9%	9.2%
18	Waianae	15,969	17,584	1,615	10.1%	29.0%	45.4%	14.2%	15.5%
19	NorthShore	7,775	10,482	2,707	34.8%	17.0%	51.6%	11.9%	37.5%
20	Koolauloa	5,563	6,671	1,108	19.9%	24.4%	48.3%	16.1%	25.3%
21	Kaneohe	21,153	27,653	6,500	30.7%	5.3%	31.9%	4.0%	12.3%
22	Kailua	17,664	23,559	5,895	33.9%	4.7%	33.1%	4.3%	10.9%
23	E Honolulu	19,434	28,056	8,622	34.1%	16.2%	43.8%	4.9%	4.0%
Total		428,818	413,024	(15,794)	-3.7%	35.7%	32.1%	9.8%	8.3%

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Table 3. Estimated 2030 Population Living in Households

District	Population Living in Households				% Change Since 2000		Average Size of Household		
No. Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Conventional	UrbanSim	%+/- Diff.
1 Downtown	22,928	20,173	(2,755)	-12.0%	65.9%	22.5%	1.91	2.47	29.4%
2 Kakaako	30,540	11,901	(18,639)	-61.0%	435.1%	45.6%	1.80	2.91	61.5%
3 Makiki	39,983	50,179	10,196	25.5%	16.1%	15.8%	1.91	2.66	33.7%
4 McCully	39,119	48,914	9,795	25.0%	23.4%	20.2%	1.92	2.59	35.4%
5 Waiaki	26,034	35,219	9,185	35.4%	39.1%	24.1%	1.70	2.62	54.4%
6 Diamond Hd	25,609	39,559	13,750	77.6%	4.8%	38.6%	2.53	2.93	15.8%
7 Kaimuki	31,418	43,206	11,888	37.8%	11.6%	37.0%	2.23	2.85	27.4%
8 Manoa	17,050	21,858	4,808	28.2%	2.4%	23.1%	2.61	2.73	4.7%
9 Nuuanu	34,512	45,022	10,410	30.1%	12.3%	26.7%	2.66	2.76	7.1%
10 Kalihi	39,959	38,795	(1,163)	-2.9%	6.3%	25.8%	3.88	2.80	-27.7%
11 Iwilei	24,811	17,711	(7,100)	-28.6%	22.8%	1.3%	3.41	2.69	-21.1%
12 Airport PH	22,883	20,542	(2,341)	-10.2%	15.7%	8.0%	3.31	2.81	-15.2%
13 Salt Lake	25,375	25,545	170	0.7%	0.2%	12.1%	3.02	2.78	-8.2%
14 PC Alea	79,822	85,549	25,018	33.5%	37.2%	2.94	2.82	-4.2%	
15 Waipahu	100,144	77,733	(22,411)	-22.4%	60.7%	26.4%	3.19	2.90	-12.1%
16 Mililani	83,228	104,986	21,758	26.1%	4.2%	23.3%	2.93	2.97	1.4%
17 Ewa	164,545	61,917	(102,628)	-55.6%	170.6%	33.5%	3.36	2.78	-17.1%
18 Waianae	56,252	43,627	(6,625)	-13.2%	20.0%	41.7%	3.57	2.94	-20.0%
19 NorthShore	19,560	21,561	2,001	10.2%	8.8%	25.5%	2.25	3.29	15.4%
20 Koolauloa	15,971	16,922	951	6.0%	15.8%	82.5%	3.42	3.40	-0.7%
21 Kaneohe	60,074	69,405	9,331	15.5%	2.1%	22.5%	2.96	2.86	-3.3%
22 Kailua	49,733	58,362	8,629	17.4%	-2.0%	18.9%	2.94	2.77	-5.9%
23 E Honolulu	49,513	71,943	22,430	45.3%	-7.6%	55.6%	2.65	2.68	1.4%
Total	1,086,348	1,086,308	(42)	0.0%	29.5%	29.5%	2.81	2.81	0.0%

Table 4. Estimated 2030 Mean Household Income[3]

District	Mean Household Income			% Change Since 2000	
No. Name	Conventional	UrbanSim	%+/- Diff.	Conventional	UrbanSim
1 Downtown	$ 28,091	$ 33,662	19.8%	-5.3%	0.0%
2 Kakaako	$ 45,776	$ 25,561	-44.2%	135.0%	21.3%
3 Makiki	$ 68,544	$ 100,212	46.2%	-34.4%	-11.2%
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10 Kalihi	$ 38,422	$ 81,901	113.2%	-40.5%	13.2%
11 Iwilei	$ 19,575	$ 31,252	59.7%	-30.5%	-8.2%
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[illegible]					
18 Waianae	$ 43,480	$ 103,361	137.7%	-28.5%	67.7%
19 NorthShore	$ 24,350	$ 48,945	101.0%	-36.8%	31.1%
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Table 5. Estimated 2030 Total Employment and Non-Residential Floor Area[4]

District	Total Employment				% Change Since 2000		Non-Residential Sq Ft (000's)		
No. Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	2000	2030	% Change
1 Downtown	64,983	70,923	5,940	9.1%	13.8%	14.5%	25,907	29,455	9.5%
2 Kakaako	39,634	30,199	(9,435)	-23.8%	59.5%	30.6%	11,123	14,070	26.5%
3 Makiki	23,200	21,666	(1,534)	-6.6%	7.0%	12.9%	7,247	7,595	4.8%
4 McCully	40,727	30,518	(10,209)	-25.1%	35.8%	17.0%	10,228	10,991	7.5%
5 Waiaki	44,913	31,419	(13,494)	-30.0%	21.6%	-2.3%	12,677	13,124	3.5%
6 Diamond Hd	13,675	14,604	929	6.8%	20.1%	24.0%	4,023	5,129	27.5%
7 Kaimuki	9,669	10,913	1,255	13.0%	18.1%	43.4%	2,154	2,834	31.5%
8 Manoa	15,581	13,192	(2,389)	-15.3%	7.7%	20.1%	4,338	4,602	6.1%
9 Nuuanu	14,189	11,447	(2,742)	-19.3%	23.9%	25.8%	2,678	3,066	14.5%
10 Kalihi	7,949	9,156	1,207	15.2%	35.3%	39.7%	1,674	2,488	32.7%
11 Iwilei	42,091	44,404	2,313	5.5%	7.5%	14.0%	23,824	24,039	10.2%
12 Airport PH	57,214	75,244	18,030	31.5%	1.0%	32.7%	34,588	39,833	15.2%
13 Salt Lake	25,062	33,934	8,872	35.4%	7.7%	15.1%	11,826	12,327	4.2%
14 PC Alea	31,650	37,854	6,204	19.6%	12.4%	30.0%	11,171	13,587	22.6%
15 Waipahu	33,956	22,996	(10,959)	-32.3%	121.4%	47.0%	6,178	9,251	49.8%
16 Mililani	38,425	51,554	13,129	34.2%	15.0%	38.3%	14,766	17,226	16.7%
17 Ewa	63,932	30,599	(33,333)	-52.1%	246.1%	58.9%	7,799	13,781	76.7%
18 Waianae	11,196	12,680	1,484	13.3%	41.7%	64.6%	2,668	5,021	88.4%
19 NorthShore	4,137	6,802	2,665	64.4%	-10.6%	49.3%	1,406	2,242	59.4%
20 Koolauloa	6,753	7,316	563	8.3%	13.8%	39.8%	1,883	2,523	35.5%
21 Kaneohe	22,169	31,312	9,153	41.3%	0.9%	34.6%	8,340	9,927	19.0%
22 Kailua	15,435	20,352	4,916	31.8%	-1.4%	29.4%	5,481	6,435	17.2%
23 E Honolulu	6,349	13,854	7,505	118.2%	-8.5%	74.5%	2,250	3,625	61.1%
Total	532,938	532,938	-	0.0%	35.8%	35.8%	219,305	253,273	15.7%

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Table 6. Estimated 2000 and 2030 Home Access to Employment Ratings

District	0-Cars			1-Car			2-Cars		
No. Name	2000	2030	% Change	2000	2030	% Change	2000	2030	% Change
1 Downtown	6,674	2,279	-65.9%	15,836	15,820	-0.1%	44,503	15,117	-66.0%
2 Kakaako	1,720	2,701	57.0%	7,747	16,388	111.5%	39,674	15,521	-60.9%
3 Makiki	3,618	3,113	-11.5%	7,591	16,461	116.7%	38,433	15,452	-59.8%
4 McCully	4,595	3,234	-29.6%	7,132	17,748	148.8%	35,040	16,783	-52.1%
5 Waikiki	2,009	3,773	87.8%	4,938	19,587	346.7%	31,434	18,127	-42.3%
6 Diamond Hd	5,750	5,029	-12.5%	7,866	20,391	159.2%	30,978	18,810	-39.3%
7 Kaimuki	5,820	5,099	-32.7%	5,928	20,892	249.2%	29,981	19,043	-36.5%
8 Manoa	4,756	4,875	2.5%	7,044	19,147	171.8%	32,382	17,518	-45.9%
9 Nuuanu	4,274	3,721	-12.9%	8,204	19,712	103.7%	38,857	15,408	-58.2%
10 Kalihi	5,222	4,160	-20.3%	7,693	16,171	110.2%	35,549	14,850	-58.2%
11 Iwilei	14,195	3,200	-77.5%	17,953	15,009	-16.4%	41,860	14,122	-66.3%
12 Airport PH	6,636	4,288	-35.4%	8,695	16,856	93.8%	34,358	15,716	-54.3%
13 Salt Lake	4,133	5,314	28.6%	6,398	18,220	184.8%	32,682	16,665	-49.0%
14 PC Area	3,648	6,818	86.9%	5,668	22,478	296.5%	29,787	20,808	-30.1%
15 Waipahu	1,774	7,645	331.0%	3,517	30,441	765.5%	24,927	23,391	-6.2%
16 Mililani	2,098	10,569	427.4%	3,614	37,799	946.4%	22,668	37,501	64.0%
17 Ewa	708	9,770	1279.8%	2,072	41,055	1880.9%	18,535	40,493	118.5%
18 Waianae	227	42,921	18786.9%	669	128,363	12882.4%	10,032	130,006	1195.9%
19 NorthShore	420	21,152	4941.3%	1,245	63,869	5028.9%	11,081	64,691	482.9%
20 Koolauloa	130	16,853	12884.4%	772	66,544	8517.8%	8,162	65,794	706.1%
21 Kaneohe	1,589	7,702	390.9%	3,160	25,859	718.8%	22,022	23,953	8.8%
22 Kailua	1,699	6,318	272.4%	3,166	26,141	725.7%	20,283	24,514	21.0%
23 E Honolulu	583	5,176	1301.7%	2,258	30,581	1254.2%	22,484	28,410	26.4%
Total	79,963	188,698	136.0%	139,094	702,092	404.8%	653,832	678,592	3.8%

Table 7. Estimated 2000 and 2030 Work Access to Population Ratings

District	0-Cars			1-Car			2-Cars		
No. Name	2000	2030	% Change	2000	2030	% Change	2000	2030	% Change
1 Downtown	10,254	4,064	-60.2%	14,312	31,302	118.7%	50,635	29,094	-42.5%
2 Kakaako	4,820	4,685	-2.8%	8,330	32,129	285.7%	48,587	29,535	-39.2%
3 Makiki	12,903	5,003	-61.2%	16,495	30,870	87.2%	54,264	28,294	-47.9%
4 McCully	11,158	4,909	-56.0%	14,367	32,948	129.3%	51,262	30,487	-40.5%
5 Waikiki	4,955	5,737	15.8%	7,897	35,000	343.3%	44,761	32,994	-26.3%
6 Diamond Hd	13,990	7,990	-45.8%	15,935	36,551	115.3%	45,264	33,217	-31.2%
7 Kaimuki	10,173	7,569	-25.2%	13,119	37,007	182.1%	46,518	33,579	-28.0%
8 Manoa	8,673	7,368	-15.0%	11,878	34,600	191.3%	48,941	31,771	-35.5%
9 Nuuanu	10,955	6,105	-44.3%	14,616	30,957	111.9%	52,196	27,841	-46.6%
10 Kalihi	10,162	6,612	-34.9%	13,536	29,607	118.7%	52,096	26,401	-49.3%
11 Iwilei	11,174	5,135	-54.0%	14,746	28,729	94.8%	53,642	26,079	-51.4%
12 Airport PH	3,682	6,391	64.6%	7,005	31,198	345.4%	47,283	27,520	-41.8%
13 Salt Lake	4,315	8,258	91.6%	7,495	32,946	339.6%	46,883	29,075	-38.0%
14 PC Area	5,384	9,607	78.3%	9,404	37,782	301.8%	48,643	33,764	-27.6%
15 Waipahu	4,849	10,851	123.8%	7,801	50,621	585.9%	41,953	46,796	11.5%
16 Mililani	3,648	15,741	309.1%	6,209	53,469	922.1%	36,304	60,194	70.5%
17 Ewa	1,656	14,092	750.8%	3,889	68,193	1652.8%	31,790	64,447	102.7%
18 Waianae	532	62,863	11712.6%	1,799	210,063	11576.4%	17,758	204,910	1052.0%
19 NorthShore	717	31,364	4274.6%	2,045	104,855	5027.1%	18,621	101,332	444.2%
20 Koolauloa	222	25,345	11776.3%	1,174	113,423	9564.5%	13,113	107,570	720.3%
21 Kaneohe	4,604	12,176	164.5%	6,916	45,333	555.5%	34,750	40,760	17.3%
22 Kailua	4,014	10,026	149.8%	6,132	45,563	642.8%	31,936	41,477	29.9%
23 E Honolulu	1,544	12,480	708.8%	3,881	54,119	1294.5%	33,730	49,378	46.4%
Total	146,736	285,016	94.6%	209,752	1,218,271	480.8%	950,799	1,136,404	19.5%

Table 8. Estimated 2030 Employment in Wholesale/TCPU and Manufacturing Sectors

District	Wholesale/TCPU Employment				Manufacturing Employment			
No. Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1 Downtown	6,117	6,155	38	0.6%	1,499	8,935	5,436	362.6%
2 Kakaako	5,320	3,169	(2,151)	-40.4%	1,975	1,695	(280)	-14.2%
3 Makiki	1,369	737	(632)	-46.2%	569	185	(384)	-67.5%
4 McCully	2,796	1,110	(1,686)	-60.3%	1,270	293	(977)	-76.9%
5 Waikiki	1,410	891	(519)	-36.8%	816	1,039	423	89.7%
6 Diamond Hd	542	197	(345)	-63.7%	331	59	(272)	-82.2%
7 Kaimuki	386	193	(193)	-50.0%	445	183	(262)	-63.4%
8 Manoa	417	223	(194)	-46.5%	118	66	(52)	-44.1%
9 Nuuanu	391	265	(126)	-32.2%	268	134	(134)	-50.0%
10 Kalihi	208	256	48	23.1%	108	82	(26)	-24.1%
11 Iwilei	6,305	5,293	(1,012)	-16.1%	7,954	4,099	(3,855)	-48.5%
12 Airport PH	12,651	12,601	(50)	-0.4%	5,257	4,144	(1,113)	-21.2%
13 Salt Lake	762	1,740	978	128.3%	1,441	3,699	2,257	156.6%
14 PC Area	1,943	3,468	1,525	78.5%	2,846	2,492	(354)	-12.4%
15 Waipahu	1,003	1,911	908	90.5%	3,219	1,070	(2,149)	-66.8%
16 Mililani	1,591	3,522	1,931	121.4%	568	2,812	2,244	395.1%
17 Ewa	3,984	2,004	(1,980)	-49.7%	4,279	1,188	(3,091)	-72.2%
18 Waianae	255	1,072	817	320.4%	136	603	467	343.4%
19 NorthShore	146	548	402	275.3%	335	460	125	37.3%
20 Koolauloa	305	531	226	74.1%	141	398	257	182.3%
21 Kaneohe	936	2,240	1,304	139.3%	427	1,816	1,389	325.3%
22 Kailua	669	1,419	750	112.1%	670	1,071	401	59.8%
23 E Honolulu	510	471	(39)	-7.6%	218	188	(30)	-13.8%
Total	50,016	50,016	-	0.0%	34,690	34,690	-	0.0%

Table 9. Estimated 2030 Employment in FIRE and Service Sectors

District	Finance, Insur., Real Est. Employment				Service Employment			
No. Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1 Downtown	11,088	7,327	(3,759)	-33.9%	27,838	33,879	6,041	21.7%
2 Kakaako	2,165	1,682	(483)	-22.3%	13,856	11,845	(2,011)	-14.5%
3 Makiki	1,584	944	(640)	-40.4%	14,515	13,280	(1,235)	-8.5%
4 McCully	5,381	1,853	(3,528)	-65.6%	15,698	11,564	(4,134)	-26.3%
5 Waikiki	2,279	1,224	(1,055)	-46.3%	12,009	7,928	(4,081)	-34.0%
6 Diamond Hd	908	276	(632)	-69.6%	6,564	4,207	(2,357)	-36.2%
7 Kaimuki	624	317	(307)	-49.2%	5,278	3,360	(1,918)	-36.3%
8 Manoa	474	193	(281)	-59.3%	12,534	7,804	(4,730)	-37.7%
9 Nuuanu	782	444	(338)	-43.2%	10,623	5,758	(4,865)	-45.8%
10 Kalihi	456	441	(15)	-3.3%	5,255	4,175	(1,080)	-20.6%
11 Iwilei	2,911	2,234	(677)	-23.3%	14,263	17,066	2,803	19.7%
12 Airport PH	1,652	3,612	1,960	59.6%	11,212	27,592	16,380	146.1%
13 Salt Lake	337	2,729	2,391	709.5%	9,653	14,207	4,554	47.2%
14 PC Area	1,532	3,445	1,913	124.9%	11,161	14,350	3,189	28.6%
15 Waipahu	1,935	1,688	(247)	-12.8%	16,099	7,747	(8,352)	-51.9%
16 Mililani	1,860	5,157	3,297	177.3%	13,825	20,869	7,244	53.2%
17 Ewa	3,370	1,126	(2,244)	-66.6%	22,102	11,753	(10,349)	-46.8%
18 Waianae	472	1,044	572	121.2%	6,784	4,837	(1,947)	-28.7%
19 NorthShore	152	647	495	325.7%	1,268	1,997	729	57.5%
20 Koolauloa	270	691	421	155.9%	3,840	2,547	(1,293)	-33.7%
21 Kaneohe	609	3,085	2,476	406.6%	7,288	12,885	5,597	77.0%
22 Kailua	739	1,759	1,020	138.0%	8,296	7,908	(388)	-4.7%
23 E Honolulu	526	487	(39)	-7.4%	3,078	5,301	2,223	72.2%
Total	42,304	42,304	-	0.0%	252,839	252,839	-	0.0%

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Table 10. Estimated 2030 Employment in Military and Government Sectors

District		Military Employment				Government Employment			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	149	319	170	114.1%	9,425	3,558	(5,867)	-62.2%
2	Kakaako	205	524	319	155.6%	1,917	1,548	(369)	-19.2%
3	Makiki	44	526	482	1095.5%	1,460	1,621	161	11.0%
4	McCully	21	439	418	1990.5%	442	2,364	1,922	434.8%
5	Waikiki	148	485	337	227.7%	425	1,403	978	230.1%
6	Diamond Hd	345	541	196	56.8%	690	2,620	1,930	279.7%
7	Kaimuki	7	508	501	7157.1%	227	1,800	1,573	693.0%
8	Manoa	82	656	574	700.0%	353	1,368	1,015	287.5%
9	Nuuanu	37	910	873	2359.5%	289	1,381	1,092	377.9%
10	Kalihi	3	771	768	25600.0%	405	1,112	707	174.8%
11	Iwilei	133	1,004	871	654.9%	1,363	2,505	1,142	83.8%
12	Airport PH	10,340	6,544	(3,796)	-36.7%	5,894	4,793	(1,101)	-18.7%
13	Salt Lake	5,924	3,763	(2,161)	-36.5%	3,930	2,072	(1,858)	-47.3%
14	PC Alea	2,675	3,381	706	26.4%	1,548	1,252	(296)	-19.1%
15	Waipahu	4	1,785	1,781	44525.0%	594	1,650	1,056	177.8%
16	Mililani	12,223	7,040	(5,183)	-42.4%	2,627	1,916	(711)	-27.1%
17	Ewa	354	2,356	2,002	565.5%	6,763	2,757	(4,006)	-59.2%
18	Waianae	45	1,043	998	2217.8%	404	620	216	53.5%
19	NorthShore	138	322	184	133.3%	82	470	408	658.1%
20	Koolauloa	20	214	194	970.0%	133	504	371	278.9%
21	Kaneohe	7,211	4,613	(2,598)	-36.0%	1,475	817	(658)	-44.6%
22	Kailua	289	1,478	1,189	411.4%	623	1,033	410	65.8%
23	E Honolulu	-	1,175	1,175	n/a	244	2,129	1,885	772.5%
Total		40,397	40,397	-	0.0%	41,293	41,293	-	0.0%

Table 11. Estimated 2030 Employment in Agriculture and Construction Sectors

District		Agricultural Employment				Construction Employment			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	310	102	(208)	-67.1%	1,641	1,998	357	21.8%
2	Kakaako	253	135	(118)	-46.6%	3,191	1,358	(1,833)	-57.4%
3	Makiki	31	94	63	203.2%	740	480	(260)	-35.1%
4	McCully	174	110	(64)	-36.8%	1,802	296	(1,506)	-83.6%
5	Waikiki	117	93	(24)	-20.5%	1,524	667	(857)	-56.2%
6	Diamond Hd	28	78	50	178.6%	390	201	(189)	-48.5%
7	Kaimuki	52	109	57	109.6%	405	187	(218)	-53.8%
8	Manoa	35	114	79	225.7%	241	162	(79)	-32.8%
9	Nuuanu	29	139	110	379.3%	519	227	(292)	-56.3%
10	Kalihi	46	121	75	163.0%	308	289	(19)	-6.2%
11	Iwilei	303	240	(63)	-20.8%	868	2,565	1,697	191.1%
12	Airport PH	77	498	421	546.8%	514	3,775	3,261	634.4%
13	Salt Lake	4	219	215	5375.0%	277	1,308	1,031	372.2%
14	PC Alea	131	382	251	191.6%	708	2,132	1,424	201.1%
15	Waipahu	142	320	178	125.4%	3,282	1,665	(1,617)	-49.3%
16	Mililani	339	532	193	56.9%	1,041	2,889	1,848	177.5%
17	Ewa	728	469	(259)	-35.6%	7,675	2,500	(5,175)	-67.4%
18	Waianae	648	321	(327)	-50.5%	560	866	306	54.6%
19	NorthShore	624	152	(472)	-75.6%	300	391	91	30.3%
20	Koolauloa	376	149	(227)	-60.4%	181	291	110	60.8%
21	Kaneohe	452	426	(26)	-5.8%	612	1,332	720	117.6%
22	Kailua	421	344	(77)	-18.3%	426	1,402	976	229.1%
23	E Honolulu	58	229	173	298.9%	245	469	224	91.4%
Total		5,378	5,378	-	0.0%	27,470	27,470	-	0.0%

Table 12. Estimated 2030 Employment in the Retail Sector

District		Resident-Oriented Retail Employment				Visitor-Oriented Retail Employment			
No.	Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1	Downtown	5,873	10,123	4,250	72.4%	-	-	-	n/a
2	Kakaako	9,552	7,868	(1,684)	-17.6%	-	-	-	n/a
3	Makiki	2,477	3,272	795	32.1%	-	-	-	n/a
4	McCully	9,149	8,320	(829)	-9.1%	2,064	1,520	(544)	-26.4%
5	Waikiki	-	-	-	n/a	19,805	14,097	(5,709)	-28.8%
6	Diamond Hd	3,241	4,358	1,117	34.5%	-	-	-	n/a
7	Kaimuki	1,904	2,959	1,055	55.4%	-	-	-	n/a
8	Manoa	1,087	1,835	748	68.8%	-	-	-	n/a
9	Nuuanu	990	1,799	809	81.7%	-	-	-	n/a
10	Kalihi	929	1,509	580	62.4%	-	-	-	n/a
11	Iwilei	7,103	8,283	1,180	16.6%	-	-	-	n/a
12	Airport PH	8,215	10,254	2,039	24.8%	-	-	-	n/a
13	Salt Lake	2,392	3,998	1,606	67.1%	-	-	-	n/a
14	PC Alea	8,050	6,600	(1,450)	-18.0%	-	-	-	n/a
15	Waipahu	7,877	4,863	(3,014)	-38.3%	-	-	-	n/a
16	Mililani	4,448	6,460	2,012	45.2%	-	-	-	n/a
17	Ewa	12,285	5,489	(6,796)	-55.3%	-	-	-	n/a
18	Waianae	1,578	2,156	580	36.8%	-	-	-	n/a
19	NorthShore	1,106	1,533	427	38.6%	-	-	-	n/a
20	Koolauloa	1,217	1,645	428	35.2%	-	-	-	n/a
21	Kaneohe	3,148	3,939	791	25.1%	-	-	-	n/a
22	Kailua	3,291	3,652	361	11.0%	-	-	-	n/a
23	E Honolulu	1,472	2,721	1,249	84.9%	-	-	-	n/a
Total		97,152	103,436	6,284	6.4%	21,870	15,617	(6,253)	-28.6%

Table 13. Estimated 2030 Hotel Rooms and Employment in the Hotel Sector

District		Hotel Rooms		Hotel Employment				Resort Condo Units	
No.	Name	Conventional	UrbanSim	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim
1	Downtown	69	1,032	1,045	527	(518)	-49.6%	77	160
2	Kakaako	-	730	1,250	375	(875)	-70.0%	-	-
3	Makiki	40	1,028	411	527	116	28.2%	21	27
4	McCully	1,164	5,164	1,930	2,650	720	37.3%	401	227
5	Waikiki	23,205	6,997	6,579	3,592	(2,987)	-45.4%	9,673	10,477
6	Diamond Hd	893	4,025	606	2,067	1,461	241.1%	3	1
7	Kaimuki	-	2,563	330	1,317	987	299.1%	-	-
8	Manoa	40	1,501	240	771	531	221.3%	11	1
9	Nuuanu	-	761	261	390	129	49.4%	-	-
10	Kalihi	-	782	231	400	169	73.2%	-	-
11	Iwilei	-	2,135	878	1,095	217	24.7%	-	-
12	Airport PH	863	2,981	1,202	1,531	329	27.4%	290	55
13	Salt Lake	-	392	362	201	(161)	-44.5%	-	-
14	PC Alea	29	890	1,056	352	(704)	-66.7%	44	99
15	Waipahu	-	970	-	497	497	n/a	-	-
16	Mililani	659	697	103	357	254	246.6%	74	22
17	Ewa	8,770	1,868	2,392	957	(1,435)	-60.0%	2	1
18	Waianae	382	231	316	118	(198)	-62.7%	1,121	702
19	NorthShore	-	551	6	282	276	4800.0%	544	24
20	Koolauloa	1,620	675	270	346	76	28.1%	118	77
21	Kaneohe	109	352	21	179	159	752.4%	147	16
22	Kailua	141	558	12	266	274	2283.3%	190	20
23	E Honolulu	-	1,336	-	684	684	n/a	-	-
Total		37,984	38,020	19,501	19,501	-	0.0%	12,714	11,009

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Table 14. Estimated 2030 Public and Private College Students

District	Public College Students				Private College Students			
No. Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1 Downtown	-	-	-	n/a	6,315	6,766	451	7.1%
2 Kakaako	-	-	-	n/a	-	-	-	n/a
3 Makiki	-	-	-	n/a	40	44	4	10.0%
4 McCully	-	-	-	n/a	168	178	10	6.0%
5 Waikiki	-	-	-	n/a	-	-	-	n/a
6 Diamond Hd	9,879	10,582	703	7.1%	-	-	-	n/a
7 Kaimuki	-	-	-	n/a	1,075	1,151	76	7.1%
8 Manoa	26,908	28,827	1,919	7.1%	-	-	-	n/a
9 Nuuanu	-	-	-	n/a	-	-	-	n/a
10 Kalihi	-	-	-	n/a	-	-	-	n/a
11 Iwilei	6,366	6,821	455	7.1%	-	-	-	n/a
12 Airport PH	-	-	-	n/a	-	-	-	n/a
13 Salt Lake	-	-	-	n/a	-	-	-	n/a
14 PC Alea	-	-	-	n/a	-	-	-	n/a
15 Waipahu	9,568	10,249	681	7.1%	-	-	-	n/a
16 Mililani	-	-	-	n/a	-	-	-	n/a
17 Ewa	7,600	-	(7,600)	-100.0%	-	-	-	n/a
18 Walanae	-	-	-	n/a	-	-	-	n/a
19 NorthShore	-	-	-	n/a	-	-	-	n/a
20 Koolauloa	-	-	-	n/a	2,654	2,843	189	7.1%
21 Kaneohe	2,195	2,352	157	7.2%	-	-	-	n/a
22 Kailua	-	-	-	n/a	-	-	-	n/a
23 E Honolulu	-	-	-	n/a	148	158	10	6.8%
Total	62,516	58,831	(3,685)	-5.9%	10,400	11,140	740	7.1%

Table 15. Estimated 2030 Public and Private K-12 Students

District	Public K-12 Students				Private K-12 Students			
No. Name	Conventional	UrbanSim	Difference	%+/- Diff.	Conventional	UrbanSim	Difference	%+/- Diff.
1 Downtown	2,512	2,193	(319)	-12.7%	1,175	898	(277)	-23.6%
2 Kakaako	11,692	5,221	(6,471)	-55.3%	-	-	-	n/a
3 Makiki	1,172	1,469	297	25.3%	6,843	9,254	2,611	38.3%
4 McCully	3,649	4,788	1,139	31.2%	2,451	3,217	766	31.3%
5 Waikiki	1,085	1,801	716	66.0%	255	514	259	101.6%
6 Diamond Hd	4,329	6,414	2,085	48.2%	76	123	47	61.8%
7 Kaimuki	3,111	5,144	2,033	65.3%	2,721	4,471	1,750	64.3%
8 Manoa	1,847	2,378	731	44.4%	1,989	2,869	880	44.2%
9 Nuuanu	6,735	9,500	2,765	41.1%	3,398	4,728	1,330	39.1%
10 Kalihi	5,774	6,027	253	4.4%	5,065	5,293	228	4.5%
11 Iwilei	6,506	4,311	(2,195)	-33.7%	1,082	670	(412)	-38.1%
12 Airport PH	5,571	4,010	(1,561)	-29.3%	840	594	(246)	-29.3%
13 Salt Lake	8,370	7,860	(510)	-6.1%	246	235	(11)	-4.5%
14 PC Alea	12,836	16,156	3,320	25.9%	831	1,050	219	26.4%
15 Waipahu	12,319	7,744	(4,575)	-37.1%	680	666	(14)	-2.1%
16 Mililani	15,649	16,118	469	3.0%	1,195	1,235	40	3.3%
17 Ewa	20,845	9,916	(10,929)	-52.4%	450	507	57	12.7%
18 Walanae	13,041	10,117	(2,924)	-22.4%	119	92	(27)	-22.7%
19 NorthShore	2,887	2,934	47	1.6%	285	290	5	1.8%
20 Koolauloa	4,798	5,490	692	14.4%	-	-	-	n/a
21 Kaneohe	8,202	8,068	(134)	-1.7%	976	960	(16)	-1.6%
22 Kailua	7,825	8,822	997	12.7%	1,276	1,440	164	12.9%
23 E Honolulu	8,218	6,495	2,277	38.8%	532	727	195	36.7%
Total	166,873	154,974	(11,899)	-7.1%	32,285	39,833	7,548	23.4%

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APPENDIX M
Conceptual Water Master Plan

Conceptual Water Master Plan for the Hoopili Project in Ewa, Oahu

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Introduction

The proposed Hoopili project would consist of residential, commercial, industrial, mixed uses, parks, and public facilities on 1555 acres of land in Ewa, Oahu. Figure 1 is a conceptual land use plan for the project which would be undertaken by the D.R. Horton-Schuler Division. It is the intention of the developer to use non-potable water for irrigation to limit the project's use of potable water.

This conceptual water master plan identifies the required supply and offsite water system infrastructure for both the potable and non-potable systems. Because the present land use plan is conceptual in nature and the project's interior roadways have not yet been defined, sizing and analyses of the project's interior distribution mains are not presented herein.

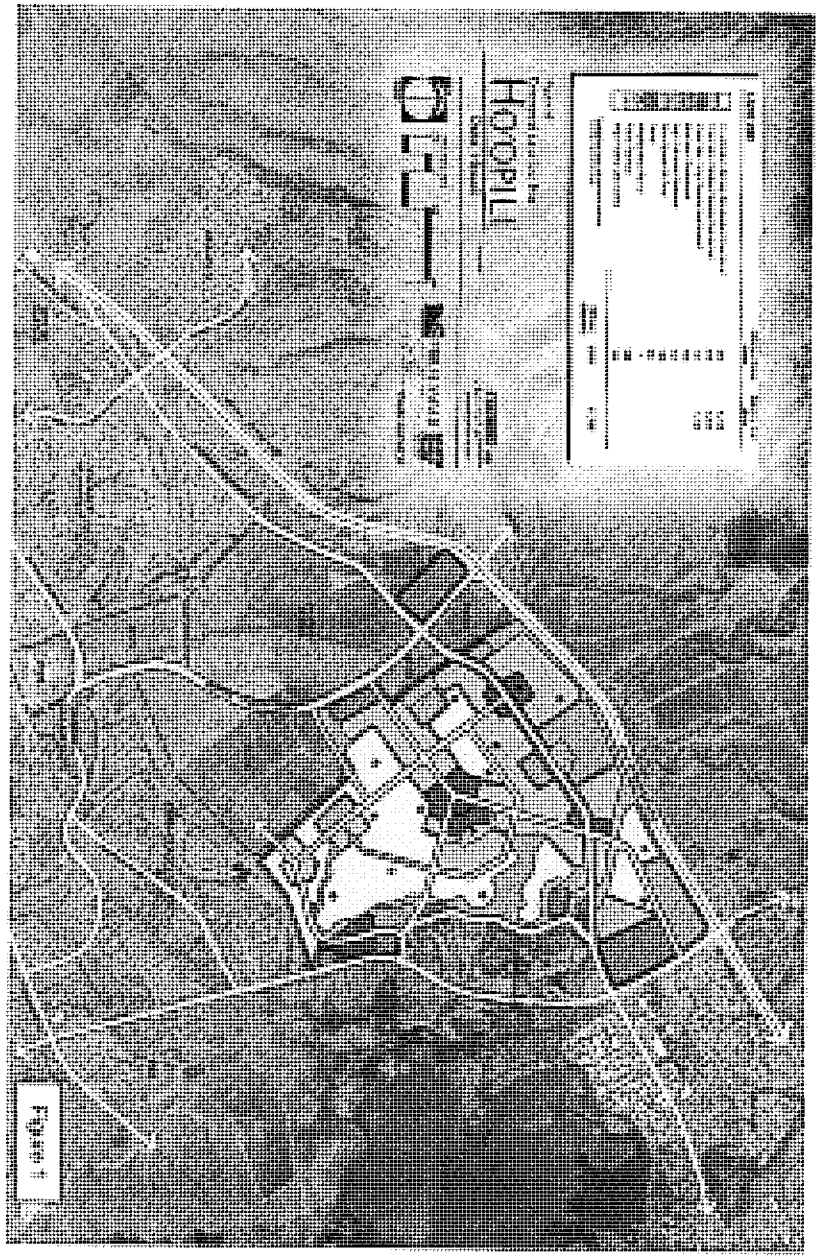
Delineation of Service Pressure Zones

Potable System. The potable system would be built to Honolulu Board of Water Supply (BWS) standards and dedicated to that agency. To incorporate the Hoopili system into that of BWS, two service pressure zones would be created: a lower, 228-foot zone to match existing BWS storage reservoirs in Kunia and Honouliuli; and an upper service zone, tentatively selected at 440-foot elevation. Depending on land acquisition and other issues that will be evaluated subsequently, the upper service zone may use a 395- rather than 440-foot tank spillway elevation. Figure 2 shows the boundary of the two service pressure zones. About two-thirds of the project area is in the upper service zone.

Non-Potable System. At present, BWS' regional non-potable system does not serve the Hoopili project area. As such, the Hoopili non-potable system would be privately owned and operated at least initially. However, to make future dedication to BWS possible if and when the BWS regional system is expanded, the private Hoopili system would use a compatible service zone delineation. For the purposes of this conceptual water master plan, it is assumed that the non-potable system's service zone delineation would be identical to the potable system: a lower 228-foot; and an upper 440-foot zone. It is recognized that the lower zone may ultimately be based on a 215- rather than 228-foot tank.

Projected Potable and Non-Potable Supply Requirements

Table 1 summarizes water use demand factors and infrastructure sizing criteria that are the basis of this master plan. The water use criteria are identical to those formulated by BWS and incorporated into the Ewa Water Master Plan done by the Ewa Plain Water Development Corporation (EPWDC) in 1987. These criteria allow for a difference between water use and water demand. The water use amount establishes the well supply requirement. Water demand is nominally 20 percent greater than water use and it is the basis of reservoir and pipeline sizing. The infrastucture sizing criteria reflect the fact that the non-potable system will initially be supplied by direct pumping without reservoir storage.



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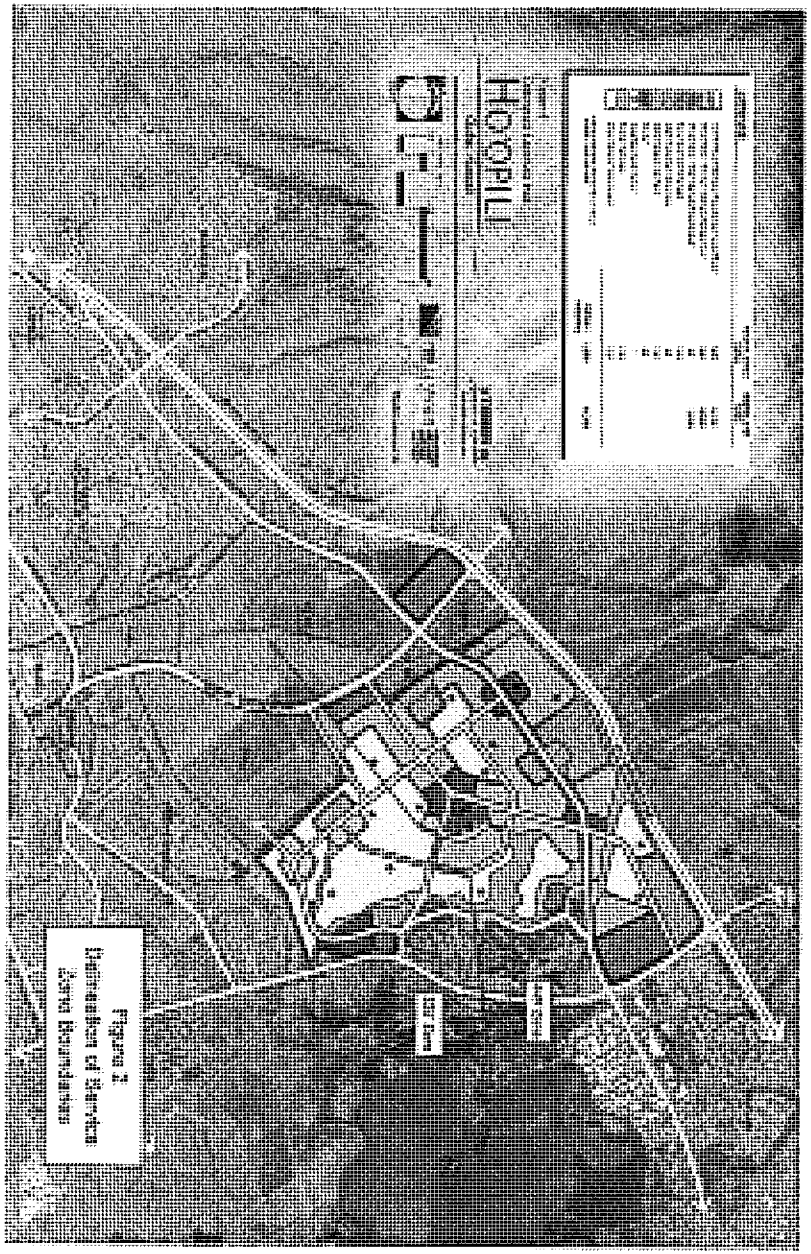

Figure 2
Delineation of Service Zone Boundaries

Table 1. Summary of Water System Design Criteria

WATER USE CRITERIA

Land Use	Unit	All Potable System	Dual System			
			Average Water Use		Average Daily Demand	
			Potable	Non-Potable	Potable	Non-Potable
Residential						
Single Family	GPD / Unit	500	345	155	414	186
Multi-Family Low Rise	GPD / Unit	400	276	124	331	149
Multi-Family High Rise	GPD / Unit	300	207	93	248	112
Commercial	GPD / Acre	3,000	1,800	1,200	2,160	1,440
Resort	GPD / Unit	350	203	147	244	176
	GPD / Acre	4,000	2,320	1,680	2,784	2,016
Golf Course and Parks	GPD / Acre	4,000	600	3,400	720	4,080
School	GPD / Student	60	35	25	42	30
Industrial	GPD / Acre	4,000	1,184	2,816	1,421	3,379
Commercial / Industrial	GPD / 1,000 Ft^2	100	60	40	72	48
Commercial / Residential	GPD / 1,000 Ft^2	120	83	37	100	44

PIPELINE, STORAGE, AND WELL PUMP SIZING CRITERIA

1. Demand Factors

   a. AVERAGE DAY DEMAND. For land uses served by a dual system, a 1.2 factor is applied to the AVERAGE WATER USE rates to derive the AVERAGE DAY DEMAND. For land uses served only by the potable system, AVERAGE WATER USE and AVERAGE DAY DEMAND are identical.

   b. MAXIMUM DAY DEMAND = (1.5) AVERAGE DAY DEMAND.
   c. PEAK HOUR RATE = (3.0) AVERAGE DAY DEMAND

   (Note: Peak rate in the non-potable pipelines is defined as delivery of the Maximum Day Demand in a 12-hour period. This is equivalent to 3.0 times the Average Demand).

2. Fire protection will be provided by the potable system.

3. Reservoir Storage:

   a. The potable reservoir storage volume shall be equivalent to the maximum day demand.
   b. The private non-potable system will be supplied by direct well pumping with no reservoir storage.

4. Potable and non-potable pipelines shall be sized for PEAK HOUR flowrates with a minimum residual pressure of 40 psi and maximum velocity in the main of 6 feet per second (fps) for potable lines and 8 fps for non-potable lines. Hydraulic analyses will utilize tank spillway elevations as the initial hydraulic grade line elevations. Pipelines providing fire protection shall also be sized for MAXIMUM DAY flow plus fire flow with a residual of 20 psi at the critical fire hydrant. Hydraulic analyses will use three-quarters full tank water surface elevations as initial hydraulic grade line elevations.

5. Well pumps for potable system shall provide MAXIMUM DAY DEMAND in an operating time of 16 hours with the largest pump unit as standby. The well pumps for the private non-potable systems shall provide the MAXIMUM DAY DEMAND in a time of 12 hours with the largest pump as standby.

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Based on the land use plan shown on Figure 1 and the water use criteria in Table 1, the Hoopili project's potable and non-potable water use and water demand totals are summarized below. The total potable supply requirement for both service zones is 3.87 MGD. It has been reduced by 1.75 MGD by the commitment to install a dual water system in both service zones throughout the project

Projected Average Potable Water Use and Average Potable Water Demand

Service Pressure Zone	Average Water Use (MGD)	Average Water Demand (MGD)
440-Foot	2.98	3.52
228-Foot	0.91	1.02
Both Zones	3.87	4.54

Projected Average Non-Potable Water Use and Average Non-Potable Demand

Service Pressure Zone	Average Water Use (MGD)	Average Water Demand (MGD)
440-Foot	1.44	1.74
228-Foot	0.31	0.37
Both Zones	1.75	2.11

Potable System

Well Supply. At full build-out, the Hoopili project will require an average potable well supply of 3.87 MGD. It is intended that the well supply would be provided from existing BWS sources with the developer paying the appropriate Facilities Charges. BWS' Ewa Shaft (State No. 2202-21) has a permitted use of 12.154 MGD and its entire allocation has been committed to development in the Ewa Development Plan area on a first-come, first-serve basis. Depending on the remaining unallocated supply from the Ewa Shaft at the time the Hoopili project is built-out, other BWS sources may also provide some of the supply. These other sources may include existing BWS wells in Waipahu that serve the Ewa area and/or a desalinization plant at the makai end of Campbell Industrial Park.

Reservoir Storage. Storage for the Hoopili project will be required in the 440- and 228-foot service zones. Required storage in the 440-foot zone is 5.28 million gallons (MG), the project's maximum day demand at full build-out. A 5.5 MG tank would be installed next to the existing 1.0 MG Honouliuli 440 tank to meet this requirement.

Required reservoir storage in the 228-foot service zone, again based on maximum day demand at full build-out, is 1.53 MG. BWS owns a site next to its existing 5.0 MG Honouliuli 228 tank which is large enough for a 5.5 MG tank. Ultimately, BWS will install a large storage tank at this site funded by Facilities Charges it collects. The Hoopili project will pay the applicable portion of Facilities Charges for storage as its contribution to the construction of that storage reservoir.

Offsite Transmission for the 440-Foot Service Zone. Figure 3 illustrates how transmission from the new 5.5 MG, 440-foot tank to the Hoopili project makai of H-1 freeway would be accomplished. It consists of the following:

- The 42-inch main between the existing Honouliuli 440 and Honouliuli 228 tanks would be converted to a transmission/distribution main for the Hoopili project. The mauka-makai transmission of water from BWS' Honouliuli wells between the 440 and 228 tanks would occur through a new 24-inch pipeline installed by the Hoopili developer. The size of the existing 42-inch pipeline was selected when it was anticipated that the Honouliuli Well Fields (Honouliuli Wells I and II) would ultimately consist of 12 wells with a combined pumping capacity of 21,000 GPM. With BWS' acquisition of the Ewa Shaft, the Honouliuli Well fields will not be expanded beyond their present six wells and combined 7875 GPM pumping capacity. A 24-inch pipeline will provide adequate capacity for these six wells.

- A new booster pump station would be installed at the existing Honouliuli 228 tank site to deliver water via the existing 42-inch pipeline up to the new Honouliuli 440 tank. As water in the 440 tank would "float" on the system, separate inflow and outflow would be installed at the tank to create positive turnover in the tank.

- Makai of the Honouliuli 228-foot tank, the transmission pipeline would be sized for the project's requirements in the 440-foot zone. Tentatively, the size of the pipeline beneath H-1 freeway to Farrington Highway would be 30-inch. Two routes for the pipeline have been preliminarily investigated, tunneling beneath the freeway or running the line back (east) to and beneath the Honouliuli Gulch Bridge. If there is insufficient space to go beneath the bridge, the tunneling option would be selected. BWS may consider oversizing the 30-inch pipe for use by other projects in the 440-foot zone.

Proposed University of Hawaii West Oahu (UHWO) 440'-System. A 440-foot service zone to serve the UHWO campus is currently in the preliminary design stage. There have been discussions between UHWO and Hoopili regarding combining the offsite elements of both 440-foot zone systems. Such a combination may include the following:

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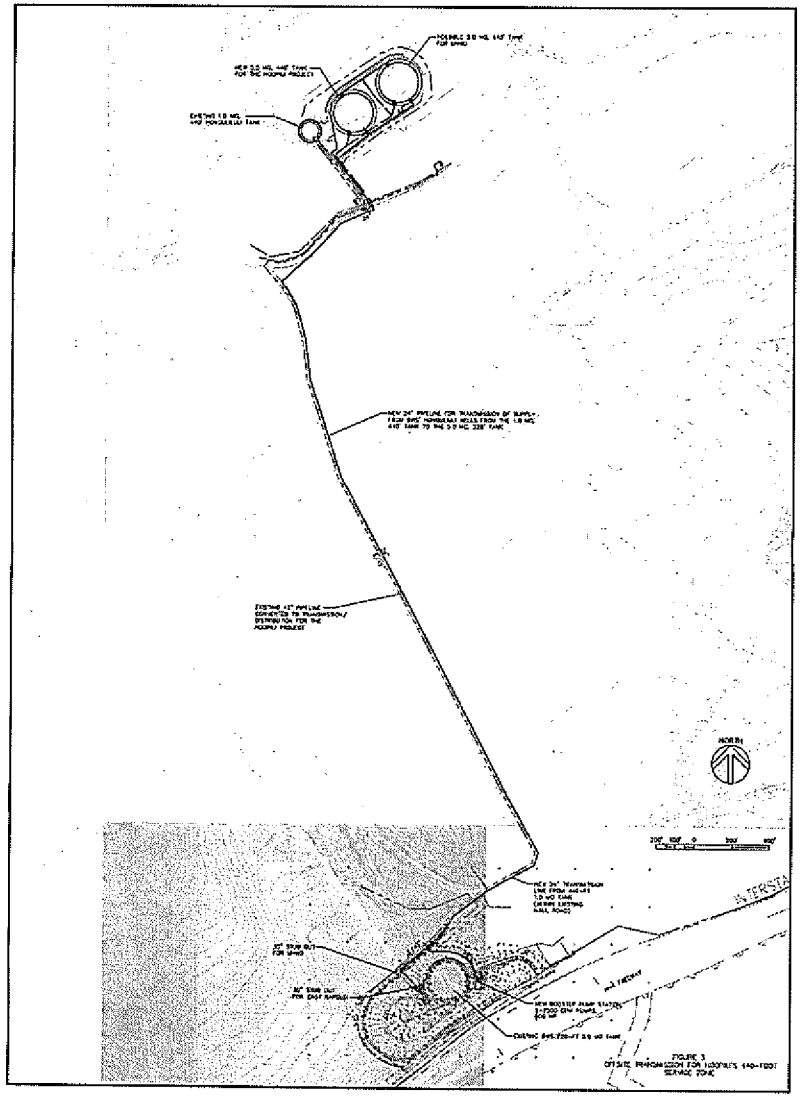

- UHWO, which has a 5.0 MG storage requirement in the 440-foot zone, would build its tank next to the existing 1.0 MG Honouliuli 440 and proposed 5.5 MG 440 tank for Hoopili.

- UHWO and Hoopili would share in the construction of the booster station at the 5.0 MG Honouliuli 228 tank and the 24-inch mauka-makai transmission pipeline described above.

- The existing 42-inch main, which will be converted for use by Hoopili, would have adequate capacity for the UHWO project as well.

- Transmission/distribution to UHWO from the site of the Honouliuli 228 tank could either run on the mauka side of H-1 freeway or participate with Hoopili in a route beneath H-1 freeway.

Offsite Transmission for the 228-Foot Service Zone. Existing transmission for the 228-foot service zone on the east side of the Ewa Plain is provided by a 42-inch pipeline which runs from the 5.0 MG Honouliuli 228 tank back to and beneath the Honouliuli Gulch Bridge. It then takes a diagonal path to the intersection of Farrington Highway and "Pipeline" Road and then goes down Pipeline Road to users. The pipeline was installed by EPWDC in the 1980s and has no available capacity for the Hoopili project. Hoopili's requirements in the 228-foot zone are relatively modest, an average demand of 1.02 MGD and peak of 3.08 MGD. A new pipeline, tentatively selected to be 20-inch, would be installed from the Honouliuli 228 tank across or beneath H-1 freeway (the pipe size is discussed in a section following). As with the pipeline from the 440-foot tank(s), the crossing of H-1 freeway would either be by a tunnel beneath the freeway or the longer route back to and beneath the Honouliuli Gulch Bridge. BWS may also elect to oversize this pipeline.

Relocation of the Existing 42-Inch, 228-Foot Service Zone Pipeline. The existing 42-inch main down Pipeline Road cuts across Hoopili development areas and is not aligned with the project's major roadways. Realignment of major sections of the 42-inch main and/or adjustments to the land use plan will be necessary.

Hydraulic Analyses. As this water master plan is based on a conceptual land use plan, the roadways and distribution pipelines within the Hoopili project are not yet defined. Service to Hoopili's 440-foot zone would essentially be a stand-alone system. As such, its hydraulic analysis can be deferred until after the land use plan is finalized. Hoopili's 228-foot zone would be incorporated into BWS' Fort Weaver Road corridor system. Even at the present conceptual land use plan level, it is important to demonstrate that the addition of the Hoopili project will not adversely impact service to present and future customers in the Fort Weaver Corridor and in Kapolei and Barbers Point. Details of these analyses are presented in Appendices A, B, and C and can be summarized as follows:

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- Appendix A illustrates the hydraulic model used for the simulations, including a new 20-inch pipeline for Hoopili's 228-foot service zone.

- Appendix B is a simulation for "existing" conditions in BWS' system in the Fort Weaver corridor. It includes full build-out of the Ewa by Gentry and Ocean Pointe projects. For continuity and clarity, this computer run is identical to the simulation in Appendix A of the "November 2006 Potable and Non-Potable Water Master Plans for the Ocean Pointe Project in Ewa, Oahu". Details of the assumptions incorporated in this analysis are explained in that report.

- Appendix C is simulation with the addition of a 20-inch pipeline to and through Hoopili's 228-foot zone to BWS' Fort Weaver Corridor system.

The simulation results in Appendix C demonstrate that a 20-inch pipeline from the Honouliuli 228 tank down to and through Hoopili's 228-foot service zone, with two points of connection to the existing 42-inch pipeline, would decrease flow and velocities in the 42-inch main and increase delivery pressures to customers in the lower portion of BWS' 228-foot service zone by about two (2) psi.

Non-Potable System

Well Supply. At least until BWS' regional non-potable system is expanded to include the Hoopili project area, supply for its non-potable system would be provided from the battery of wells commonly known as EP 5 & 6 and identified as State Well Nos. 2202-03 to 14 (old Well Nos. 259 A to L). This battery consists of 12 wells which were drilled in 1896-97. All of the wells have 12-inch casing to 70-foot depths and total depths which vary between 303 and 312 feet. The lower 233 to 242 feet of the wells are open hole. Nominal ground elevation at the well battery is 50 feet.

The battery has two 36-inch pipe manifolds, each of which connects six wells to a common header which delivers water into a square-shaped and very deep concrete vault (the vault is 22 feet on a side and 48 feet deep). The two manifold pipelines enter the vault on opposite sides and each has its own isolation gate valve in the vault. At the close of plantation operations in the 1990s, a 4500 GPM end suction pump was connected to one of the manifolds (EP 5) and a 5600 GPM end suction pump was connected to the other (EP 6). Their combined pumping capacity of 10,100 GPM (14.5 MGD) is far greater than would be required for the Hoopili project.

At present, smaller-sized, end suction pumps are connected to the manifolds and these provide agricultural irrigation for Aloun Farms in the area of the Hoopili project. To convert the EP 5 & 6 facility for use by the Hoopili project, the following would be done:

- The present end-suction pumps, electrical equipment, and all piping (back to the incoming isolation valves) would be removed from the vault.

- As best as can be determined from measurements and old records, the bottom of the vault is on the order of two to three feet above sea level. The piezometric head in the volcanics tapped by the 12 wells is 17 to 18 feet above sea level. The isolation valves on both manifolds would be opened, thereby filling the vault and creating a sump with a water depth on the order of 14 to 16 feet.

- Two pump stations, one for each of Hoopili's two service pressure zones, would be installed at ground level over the vault. Each station would have multiple line shaft turbine pumps and automated start/stop operation based on service pressure. Their operation would be essentially identical to golf course pump stations.

- Based on BWS' design criteria and the fact that the system would initially have no reservoir storage, the well pumping capacity would be selected to provide the maximum day supply requirement in a 12-hour period. This conforms with BWS' Non-Potable Water System Planning Factors and Design Standards (Revised November 3, 2006). Based on this, the station pumping capacities that would be installed for the Hoopili project would be as follows:

Service Pressure Zone	Average Demand (MGD)	Station Pumping Capacity	
		Required MGD	Nominal GPM
228	1.74	5.22	3700
440	0.37	1.11	800

Water Use Permit (WUP) for EP 5 & 6. There are three former plantation well batteries along old Fort Weaver Road in lower Honouliuli. In addition to EP 5 & 6, the other two well batteries are EP 3 & 4 (State Nos. 2102-02 and 04-22) and EP 7 & 8 (State Nos. 2202-15 to 20). In January 2000, the Commission on Water Resource Management (CWRM) revoked the individual WUPs for these three batteries and reconsolidated them under one new permit, WUP No. 805. The permitted use of 7.969 MGD under WUP No. 805 can be drawn from any of the well batteries but the use is specifically limited to agriculture. Landscape irrigation of an urbanized area such as the Hoopili project does not qualify as an agricultural use. It will be necessary to modify WUP No. 805 or to obtain a new permit for Hoopili's non-potable use. CWRM's processing procedures are the same for a WUP modification as they are for obtaining a new permit. Based on the project's current concept plan, the required permitted use for Hoopili would be 1.75 MGD. The remaining amount of WUP 805 would not be needed by the project and

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would become available for other users in the Waipahu-Waiawa Aquifer System. Use of the EP 3 & 4 and EP 7 & 8 well batteries would also no longer be needed as all of the project's non-potable supply would be drawn from the EP 5 & 6 well battery.

Reservoir Storage. Unless and until BWS' regional non-potable system is expanded to provide service to the Hoopili project area, the non-potable system would have direct pumping from EP 5 & 6 with no reservoir storage.

Transmission/Distribution Pipelines in the Lower (215- or 228-Foot) Service Zone. BWS' (draft) Ewa Non-Potable Water Master Plan envisions the installation of a storage reservoir on the west side of the North-South Road and on the makai side of H-1 freeway. The tank would have a 215- or 228-foot spillway elevation. This possible storage tank location is on the opposite side of the Hoopili project from the EP 5 & 6 well battery (EP 5 & 6 is on the eastern edge of the project site and just off old Fort Weaver Road). To enable the initial, pumped delivery system using EP 5 & 6 to be compatible with BWS' expansion of its regional non-potable system, all pipelines would meet BWS' construction standards and their sizes would be selected for both pumped delivery from EP 5 & 6 and gravity delivery from BWS' North-South Road Reservoir.

Transmission/Distribution Pipelines in the Upper (440-Foot) Service Zone. BWS' (draft) Ewa Non-Potable Water Master Plan does not include an upper service zone above the North-South Road Reservoir. If one were to be constructed, a tank mauka of H-1 freeway and booster pumping to it would be required. In addition to Hoopili, such an upper system could also serve UH West Oahu and the State DLNR parcels adjacent to Farrington Highway. As with the lower service zone system, Hoopili's non-potable pipelines in its upper service zone would meet BWS standards and would be sized for both pumped supply from EP 5 & 6 and gravity delivery from a possible BWS reservoir on the mauka side of H-1.

Appendix A

Hydraulic Model for Simulations of BWS' 228-Foot Service Zone in the Fort Weaver Corridor

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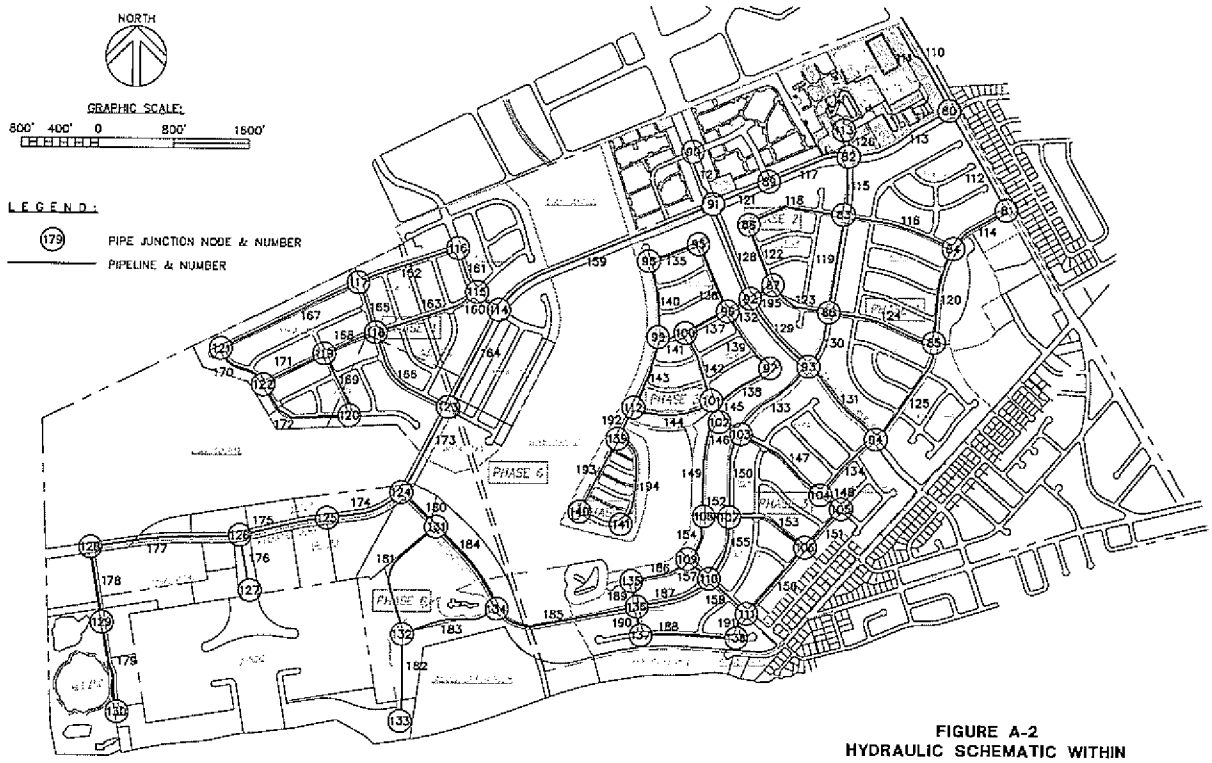

FIGURE A-2
HYDRAULIC SCHEMATIC WITHIN OCEAN POINTE

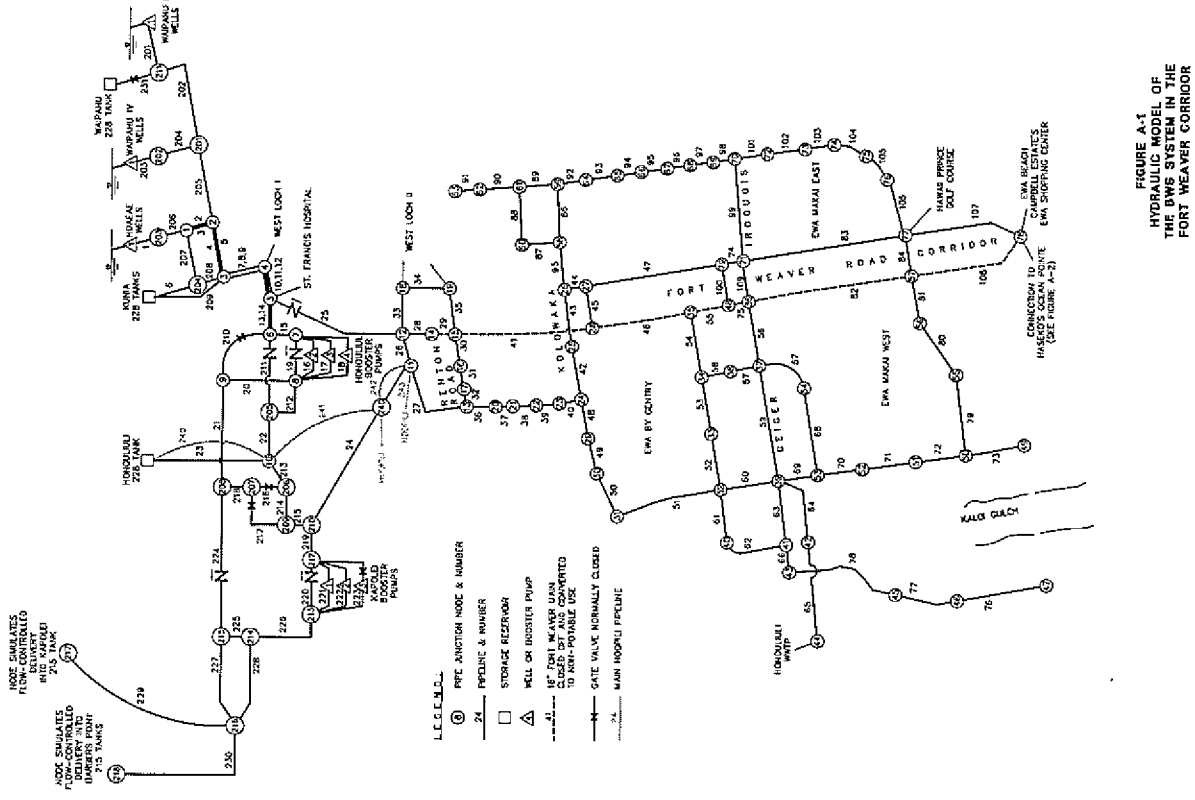

FIGURE A-1
HYDRAULIC MODEL OF THE BWS SYSTEM IN THE FORT WEAVER CORRIDOR

Appendix B

Computer Simulation of "Existing Conditions" in BWS' 228-Foot Service Zone in the Fort Weaver Corridor

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          * * * * * * * * * *   K Y P I P E 2   * * * * * * * * * *
          *   University of Kentucky Hydraulic Analysis Program     *
          * Distribution of Pressure and Flows in Piping Networks  *
          *          1000 PIPE VERSION - 1.10   (08/25/92)         *
          * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
```

DATE: 3/17/2003
TIME: 10:50:11

INPUT DATA FILENAME ---------- OP2003.DAT
TABULATED OUTPUT FILENAME ------- OP2003.OUT
POSTPROCESSOR RESULTS FILENAME --- OP2003.RES

SUMMARY OF ORIGINAL DATA

UNITS SPECIFIED

FLOWRATE ..... = gallons/minute
HEAD (HGL) ..... = feet
PRESSURE ..... = psig

PIPELINE DATA

STATUS CODE: XX -CLOSED PIPE FG -FIXED GRADE NODE PU -PUMP LINE
CV -CHECK VALVE RV -REGULATING VALVE

PIPE NUMBER	NODE NOS. #1	#2	LENGTH (ft)	DIAMETER (in)	ROUGHNESS COEFF.	MINOR LOSS COEFF.	FGN-HGL (ft)
1-FGPU	0	1	30.0	36.0	130.00	.00	10.00
2	1	2	1000.0	30.0	130.00	.00	
3	1	2	1000.0	12.0	110.00	.00	
4	2	3	2500.0	36.0	130.00	.00	
5	2	3	2500.0	30.0	130.00	.00	
6-FG	0	3	2600.0	20.0	120.00	.00	223.00
7	3	4	1350.0	36.0	130.00	.00	
8	3	4	1350.0	30.0	130.00	.00	
9	3	4	1350.0	20.0	120.00	.00	
10	4	5	1650.0	36.0	130.00	.00	
11	4	5	1650.0	30.0	130.00	.00	
12	4	5	1650.0	20.0	120.00	.00	
13	5	6	1850.0	36.0	130.00	.00	
14	5	6	1850.0	30.0	130.00	.00	
15	6	7	370.0	30.0	130.00	.00	

16-PU	7	8	20.0	30.0	130.00	.00	
17-PU	7	8	20.0	30.0	130.00	.00	
18-PU	7	8	20.0	30.0	130.00	.00	
19-CV	7	8	20.0	30.0	130.00	.00	
20	8	9	70.0	30.0	130.00	.00	
21	9	10	3000.0	30.0	130.00	.00	
22	9	10	3000.0	30.0	130.00	.00	
23-FG	0	10	4530.0	42.0	130.00	.00	223.00
24	10	11	8250.0	42.0	130.00	.00	
25-CV	5	12	7150.0	16.0	120.00	.00	
26	11	12	1900.0	16.0	120.00	.00	
27	11	13	3750.0	42.0	130.00	.00	
28	12	14	2850.0	16.0	120.00	.00	
29-XX	14	15	650.0	16.0	120.00	.00	
30	16	15	1300.0	16.0	120.00	.00	
31	17	16	700.0	16.0	120.00	.00	
32	13	17	200.0	16.0	120.00	.00	
33	12	18	2000.0	12.0	110.00	.00	
34	18	19	1800.0	12.0	110.00	.00	
35	15	19	3200.0	12.0	110.00	.00	
36	13	20	1250.0	36.0	130.00	.00	
37	20	21	230.0	36.0	130.00	.00	
38	21	22	200.0	36.0	130.00	.00	
39	22	23	200.0	36.0	130.00	.00	
40	23	24	380.0	36.0	130.00	.00	
41-XX	15	28	2480.0	16.0	120.00	.00	
42	24	25	1100.0	36.0	130.00	.00	
43	25	26	180.0	30.0	130.00	.00	
44	26	27	100.0	36.0	130.00	.00	
45	28	27	150.0	16.0	120.00	.00	
46-XX	28	35	2000.0	16.0	120.00	.00	
47	27	29	2450.0	36.0	130.00	.00	
48	24	29	110.0	16.0	120.00	.00	
49	29	30	730.0	12.0	110.00	.00	
50	30	31	970.0	12.0	110.00	.00	
51	31	32	1700.0	12.0	110.00	.00	
52	33	32	570.0	12.0	110.00	.00	
53	34	33	580.0	12.0	110.00	.00	
54	35	34	800.0	12.0	110.00	.00	
55-XX	35	48	730.0	16.0	120.00	.00	
56	36	37	700.0	12.0	110.00	.00	
57	38	37	350.0	12.0	110.00	.00	
58	34	38	700.0	12.0	110.00	.00	
59	37	39	1300.0	12.0	110.00	.00	
60	32	39	870.0	12.0	110.00	.00	
61	32	40	1140.0	12.0	110.00	.00	
62	40	41	1150.0	12.0	110.00	.00	
63	39	41	1390.0	12.0	110.00	.00	
64	39	42	1480.0	12.0	110.00	.00	
65	42	44	122.0	12.0	110.00	.00	
66	41	43	890.0	16.0	120.00	.00	
67	37	54	1000.0	12.0	110.00	.00	
68	54	53	1030.0	12.0	110.00	.00	
69	53	39	730.0	12.0	110.00	.00	
70	53	52	805.0	12.0	110.00	.00	

71	52	51	400.0	12.0	110.00	.00
72	50	51	580.0	12.0	110.00	.00
73	50	49	965.0	12.0	110.00	.00
74	79	71	150.0	36.0	130.00	.00
75-XX	48	36	170.0	16.0	120.00	.00
76	46	47	1390.0	8.0	110.00	.00
77	45	46	1390.0	12.0	110.00	.00
78	43	45	1390.0	12.0	110.00	.00
79	55	50	1015.0	12.0	110.00	.00
80	56	55	1000.0	12.0	110.00	.00
81	57	56	465.0	12.0	110.00	.00
82-XX	36	57	2000.0	16.0	120.00	.00
83	71	77	2000.0	36.0	130.00	.00
84	77	57	150.0	12.0	110.00	.00
85	26	58	360.0	12.0	110.00	.00
86	58	59	630.0	12.0	110.00	.00
87	58	60	650.0	8.0	110.00	.00
88	60	61	650.0	8.0	110.00	.00
89	59	61	550.0	12.0	110.00	.00
90	61	62	720.0	12.0	110.00	.00
91	62	63	950.0	12.0	110.00	.00
92	59	64	310.0	12.0	110.00	.00
93	64	65	420.0	12.0	110.00	.00
94	65	66	320.0	12.0	110.00	.00
95	67	66	570.0	12.0	110.00	.00
96	68	67	400.0	12.0	110.00	.00
97	69	68	250.0	12.0	110.00	.00
98	70	69	330.0	12.0	110.00	.00
99	71	70	1320.0	12.0	110.00	.00
100	79	48	40.0	16.0	120.00	.00
101	70	72	420.0	12.0	110.00	.00
102	72	73	390.0	12.0	110.00	.00
103	73	74	780.0	12.0	110.00	.00
104	75	74	465.0	12.0	110.00	.00
105	76	75	810.0	12.0	110.00	.00
106	77	76	700.0	12.0	110.00	.00
107	77	78	1580.0	36.0	130.00	.00
108-XX	57	78	1580.0	16.0	120.00	.00
109	71	36	210.0	12.0	110.00	.00
110	78	80	900.0	20.0	120.00	.00
111	78	80	900.0	12.0	110.00	.00
112	80	81	1210.0	20.0	120.00	.00
113	80	82	1200.0	16.0	120.00	.00
114	81	84	710.0	16.0	120.00	.00
115	82	83	650.0	8.0	110.00	.00
116	84	83	1200.0	8.0	110.00	.00
117	82	89	1530.0	16.0	120.00	.00
118	83	85	1030.0	8.0	110.00	.00
119	84	86	1050.0	16.0	120.00	.00
120	89	90	1070.0	12.0	110.00	.00
121	90	87	950.0	12.0	110.00	.00
122	85	87	620.0	8.0	110.00	.00
123	86	85	1150.0	8.0	110.00	.00
124	87	88	1050.0	8.0	110.00	.00
125	86	88	1200.0	16.0	120.00	.00

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126	90	91	790.0	8.0	110.00	.00
127	87	93	1030.0	12.0	110.00	.00
128	88	94	820.0	16.0	120.00	.00
129	91	92	810.0	8.0	110.00	.00
130	92	93	410.0	8.0	110.00	.00
131	93	94	1100.0	8.0	110.00	.00
132	94	95	280.0	16.0	110.00	.00
133	93	100	900.0	12.0	110.00	.00
134	95	101	540.0	12.0	110.00	.00
135	100	101	900.0	8.0	110.00	.00
136	100	102	720.0	12.0	110.00	.00
137	101	103	950.0	12.0	110.00	.00
138	102	103	560.0	12.0	110.00	.00
139	103	104	380.0	8.0	110.00	.00
140	102	105	840.0	16.0	120.00	.00
141	105	107	940.0	16.0	120.00	.00
142	107	109	1400.0	16.0	120.00	.00
143	109	110	620.0	16.0	120.00	.00
144	104	106	700.0	8.0	110.00	.00
145	106	108	1300.0	8.0	110.00	.00
146-XX	108	110	2050.0	8.0	110.00	.00
147	110	111	1400.0	16.0	120.00	.00
148	91	96	300.0	8.0	110.00	.00
149	96	97	780.0	8.0	110.00	.00
150	92	97	870.0	8.0	110.00	.00
151	97	98	380.0	8.0	110.00	.00
152	98	99	880.0	8.0	110.00	.00
153	98	99	1440.0	8.0	110.00	.00
154	89	112	970.0	20.0	120.00	.00
155	112	113	2420.0	20.0	120.00	.00
156	113	114	900.0	20.0	120.00	.00
157	114	115	2250.0	16.0	120.00	.00
158	115	116	1760.0	16.0	120.00	.00
159	116	117	1350.0	16.0	120.00	.00
160	117	118	1080.0	16.0	120.00	.00

P U M P D A T A

THERE IS A PUMP IN LINE 1 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
415.00	.00
230.00	6700.00
105.00	9450.00

THERE IS A PUMP IN LINE 16 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
150.00	.00
110.00	5000.00
45.00	8200.00

THERE IS A PUMP IN LINE 17 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
150.00	.00
110.00	5000.00
45.00	8200.00

THERE IS A PUMP IN LINE 18 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
150.00	.00
110.00	5000.00
45.00	8200.00

J U N C T I O N N O D E D A T A

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	CONNECTING PIPES					
1		.00	120.00	1	2	3			
2		.00	75.00	2	3	4	5		
3		.00	77.00	4	5	6	7	8	9
4		958.00	50.00	7	8	9	10	11	12
5		208.00	85.00	10	11	12	13	14	25
6		.00	95.00	13	14	15			
7		.00	98.00	15	16	17	18	19	
8		.00	98.00	16	17	18	19	20	
9		.00	102.00	20	21	22			
10		20830.00	175.00	21	22	23	24		
11		.00	55.00	24	26	27			
12		471.00	25.00	25	26	28	33		
13		312.00	45.00	27	32	36			
14		.00	45.00	28	29				
15		250.00	45.00	29	30	35	41		
16		334.00	45.00	30	31				
17		125.00	45.00	31	32				
18		469.00	20.00	33	34				
19		469.00	30.00	34	35				
20		243.00	38.00	36	37				
21		143.00	37.00	37	38				
22		143.00	36.00	38	39				
23		144.00	35.00	39	40				
24		.00	34.00	40	42	48			
25		.00	33.00	42	43				
26		.00	28.00	43	44	85			

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27	.00	28.00	44	45	47		
28	.00	27.00	41	45	46		
29	199.00	35.00	48	49			
30	373.00	36.00	49	50			
31	429.00	37.00	50	51			
32	.00	34.00	51	52	60	61	
33	198.00	33.00	52	53			
34	183.00	31.00	53	54	58		
35	.00	34.00	46	54	55		
36	.00	34.00	55	75	82	109	
37	.00	34.00	56	57	59	67	
38	323.00	33.00	57	58			
39	.00	33.00	59	60	63	64	69
40	301.00	33.00	61	62			
41	.00	34.00	62	63	66		
42	42.00	34.00	64	65			
43	101.00	34.00	66	78			
44	1042.00	33.00	65				
45	219.00	30.00	77	78			
46	219.00	28.00	76	77			
47	198.00	25.00	76				
48	.00	35.00	55	75	100		
49	150.00	25.00	73				
50	178.00	26.00	72	73	79		
51	355.00	27.00	71	72			
52	.00	28.00	70	71			
53	70.00	29.00	68	69	70		
54	311.00	31.00	67	68			
55	199.00	27.00	79	80			
56	353.00	27.00	80	81			
57	.00	28.00	81	82	84	108	
58	.00	32.00	85	86	87		
59	.00	31.00	86	89	92		
60	166.00	31.00	87	88			
61	8.00	31.00	88	89	90		
62	127.00	32.00	90	91			
63	323.00	38.00	91				
64	180.00	30.00	92	93			
65	334.00	30.00	93	94			
66	525.00	30.00	94	95			
67	106.00	30.00	95	96			
68	106.00	30.00	96	97			
69	106.00	30.00	97	98			
70	.00	32.00	98	99	101		
71	.00	34.00	74	83	99	109	
72	422.00	32.00	101	102			
73	294.00	31.00	102	103			
74	228.00	30.00	103	104			
75	527.00	30.00	104	105			
76	193.00	29.00	105	106			
77	31.00	28.00	83	84	106	107	
78	4185.00	20.00	107	108	110	111	
79	.00	35.00	47	74	100		
80	.00	25.00	110	111	112	113	
81	29.80	25.00	112	114			

82	141.80	25.00	113	115	117	
83	274.60	25.00	115	116	118	
84	171.70	25.00	114	116	119	
85	213.80	25.00	118	122	123	
86	278.90	25.00	119	123	125	
87	197.60	25.00	121	122	124	127
88	91.50	25.00	124	125	128	
89	266.70	25.00	117	120	154	
90	229.60	25.00	120	121	126	
91	126.70	20.00	126	129	148	
92	72.80	20.00	129	130	150	
93	93.80	20.00	127	130	131	133
94	93.80	20.00	128	131	132	
95	44.60	20.00	132	134		
96	.00	20.00	148	149		
97	29.70	20.00	149	150	151	
98	68.80	20.00	151	152	153	
99	68.80	20.00	152	153		
100	85.90	20.00	133	135	136	
101	85.90	20.00	134	135	137	
102	36.70	15.00	136	138	140	
103	36.70	15.00	137	138	139	
104	.00	15.00	139	144		
105	183.30	15.00	140	141		
106	22.10	15.00	144	145		
107	170.50	15.00	141	142		
108	.00	15.00	145	146		
109	210.00	15.00	142	143		
110	121.50	15.00	143	146	147	
111	188.50	15.00	147			
112	179.20	25.00	154	155		
113	707.00	20.00	155	156		
114	527.30	20.00	156	157		
115	1059.20	15.00	157	158		
116	285.50	15.00	158	159		
117	165.70	15.00	159	160		
118	165.70	15.00	160			

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 10
MAXIMUM AND MINIMUM VELOCITIES = 10

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(p) = 160
NUMBER OF JUNCTION NODES .....(j) = 118
NUMBER OF PRIMARY LOOPS .....(l) = 40
NUMBER OF FIXED GRADE NODES .....(f) = 3
NUMBER OF SUPPLY ZONES .....(z) = 1

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SIMULATION RESULTS

THE RESULTS ARE OBTAINED AFTER 4 TRIALS WITH AN ACCURACY = .00302

PIPELINE RESULTS

STATUS CODE: XX -CLOSED PIPE FG -FIXED GRADE NODE PU -PUMP LINE
CV -CHECK VALVE RV -REGULATING VALVE TK -STORAGE TANK

PIPE NUMBER	NODE NOS. #1	#2	FLOWRATE (gpm)	HEAD LOSS (ft)	PUMP HEAD (ft)	MINOR LOSS (ft)	LINE VELO. (ft/s)	HL/ 1000 (ft/ft)
1-FGPU	0	1	8647.30	.02	143.67	.00	2.73	.65
2	1	2	8036.31	1.39	.00	.00	3.65	1.39
3	1	2	611.06	1.39	.00	.00	1.73	1.39
4	2	3	5340.74	.67	.00	.00	1.68	.27
5	2	3	3306.64	.67	.00	.00	1.50	.27
6-FG	0	3	12802.12	71.41	.00	.00	13.07	27.47
7	3	4	11811.99	1.57	.00	.00	3.72	1.17
8	3	4	7313.19	1.57	.00	.00	3.32	1.17
9	3	4	2324.33	1.57	.00	.00	2.37	1.17
10	4	5	11284.43	1.77	.00	.00	3.56	1.07
11	4	5	6986.55	1.77	.00	.00	3.17	1.07
12	4	5	2220.52	1.77	.00	.00	2.27	1.07
13	5	6	12527.44	2.40	.00	.00	3.95	1.30
14	5	6	7756.07	2.40	.00	.00	3.52	1.30
15	6	7	20283.50	2.85	.00	.00	9.21	7.71
16-PU	7	8	6761.17	.02	77.94	.00	3.07	1.01
17-PU	7	8	6761.17	.02	77.94	.00	3.07	1.01
18-PU	7	8	6761.17	.02	77.94	.00	3.07	1.01
19-XXCV	7	8						
20	8	9	20283.50	.54	.00	.00	9.21	7.71
21	9	10	10141.75	6.41	.00	.00	4.60	2.14
22	9	10	10141.75	6.41	.00	.00	4.60	2.14
23-FG	0	10	23679.20	9.04	.00	.00	5.48	1.99
24	10	11	23132.70	15.76	.00	.00	5.36	1.91
25-XXCV	5	12						
26	11	12	1260.69	2.11	.00	.00	2.01	1.11
27	11	13	21872.01	6.46	.00	.00	5.06	1.72
28	12	14	.00	.00	.00	.00	.00	.00
29-XX	14	15						
30	16	15	398.31	.17	.00	.00	.64	.13
31	17	16	732.31	.28	.00	.00	1.17	.41
32	13	17	857.31	.11	.00	.00	1.37	.54
33	12	18	789.69	4.46	.00	.00	2.24	2.23
34	18	19	320.69	.76	.00	.00	.91	.42
35	15	19	148.31	.32	.00	.00	.42	.10

36	13	20	20702.70	4.12	.00	.00	6.53	3.29
37	20	21	20459.70	.74	.00	.00	6.45	3.22
38	21	22	20316.70	.64	.00	.00	6.40	3.18
39	22	23	20173.70	.63	.00	.00	6.36	3.14
40	23	24	20029.70	1.18	.00	.00	6.31	3.10
41-XX	15	28						
42	24	25	17955.43	2.78	.00	.00	5.66	2.53
43	25	26	17955.43	1.11	.00	.00	8.15	6.15
44	26	27	16197.92	.21	.00	.00	5.11	2.09
45	28	27	.00	.00	.00	.00	.00	.00
46-XX	28	35						
47	27	79	16197.92	5.12	.00	.00	5.11	2.09
48	24	29	2074.27	.31	.00	.00	3.31	2.80
49	29	30	1875.27	8.08	.00	.00	5.32	11.07
50	30	31	1502.27	7.12	.00	.00	4.26	7.34
51	31	32	1073.27	6.70	.00	.00	3.04	3.94
52	33	32	27.23	.00	.00	.00	.08	.00
53	34	33	225.23	.13	.00	.00	.64	.22
54	35	34	.00	.00	.00	.00	.00	.00
55-XX	35	48						
56	36	37	2004.88	8.77	.00	.00	5.69	12.53
57	38	37	-731.23	.68	.00	.00	2.07	1.94
58	34	38	-408.23	.46	.00	.00	1.16	.66
59	37	39	666.27	2.12	.00	.00	1.89	1.63
60	32	39	505.81	.85	.00	.00	1.43	.98
61	32	40	594.69	1.50	.00	.00	1.69	1.32
62	40	41	293.69	.41	.00	.00	.83	.36
63	39	41	443.31	1.06	.00	.00	1.26	.77
64	39	42	1084.00	5.94	.00	.00	3.07	4.01
65	42	44	1042.00	.45	.00	.00	2.96	3.73
66	41	43	737.00	.37	.00	.00	1.18	.41
67	37	54	607.38	1.37	.00	.00	1.72	1.37
68	54	53	296.38	.37	.00	.00	.84	.36
69	53	39	355.22	.37	.00	.00	1.01	.51
70	53	52	-128.85	.06	.00	.00	.37	.08
71	52	51	-128.85	.03	.00	.00	.37	.08
72	50	51	483.85	.52	.00	.00	1.37	.90
73	50	49	150.00	.10	.00	.00	.43	.10
74	79	71	16197.92	.31	.00	.00	5.11	2.09
75-XX	48	36						
76	46	47	198.00	1.72	.00	.00	1.26	1.24
77	45	46	417.00	.95	.00	.00	1.18	.68
78	43	45	636.00	2.08	.00	.00	1.80	1.49
79	55	50	811.85	2.38	.00	.00	2.30	2.35
80	56	55	1010.85	3.53	.00	.00	2.87	3.53
81	57	56	1363.85	2.85	.00	.00	3.87	6.14
82-XX	36	57						
83	71	77	13163.44	2.85	.00	.00	4.15	1.42
84	77	57	1363.85	.92	.00	.00	3.87	6.14
85	26	58	1757.51	3.53	.00	.00	4.99	9.02
86	58	59	1361.36	3.85	.00	.00	3.86	6.12
87	58	60	396.15	2.91	.00	.00	2.53	4.48
88	60	61	230.15	1.07	.00	.00	1.47	1.64
89	59	61	227.85	.12	.00	.00	.65	.22
90	61	62	458.00	.57	.00	.00	1.28	.79

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91	62	63	323.00	.40	.00	.00	.92	.43
92	59	64	1133.51	1.35	.00	.00	3.22	4.36
93	64	65	953.51	1.33	.00	.00	2.70	3.16
94	65	66	619.51	.46	.00	.00	1.76	1.42
95	67	66	-94.51	.02	.00	.00	.27	.04
96	68	67	11.49	.00	.00	.00	.03	.00
97	69	68	117.49	.02	.00	.00	.33	.07
98	70	69	223.49	.07	.00	.00	.63	.22
99	71	70	1029.60	4.81	.00	.00	2.92	3.65
100	75	48	.00	.00	.00	.00	.00	.00
101	70	72	806.11	.95	.00	.00	2.29	2.32
102	72	73	384.11	.23	.00	.00	1.09	.59
103	73	74	90.11	.03	.00	.00	.26	.04
104	75	74	137.89	.04	.00	.00	.39	.09
105	76	75	664.89	1.31	.00	.00	1.89	1.62
106	77	76	857.89	1.82	.00	.00	2.43	2.60
107	77	78	10910.70	1.59	.00	.00	3.44	1.01
108-XX	57	78						
109	71	36	2004.88	2.63	.00	.00	5.69	12.53
110	78	80	5427.26	5.04	.00	.00	5.54	5.60
111	78	80	1298.44	5.04	.00	.00	3.68	5.60
112	80	81	3092.59	2.39	.00	.00	3.16	1.98
113	80	82	3633.11	9.48	.00	.00	5.80	7.90
114	81	84	3062.79	4.09	.00	.00	4.89	5.76
115	82	83	266.56	1.40	.00	.00	1.70	2.15
116	84	83	355.42	4.40	.00	.00	2.27	3.66
117	82	89	3224.76	9.69	.00	.00	5.15	6.34
118	83	85	347.37	3.62	.00	.00	2.22	3.51
119	84	86	2535.67	4.26	.00	.00	4.05	4.06
120	89	90	-131.54	.09	.00	.00	.37	.08
121	90	87	-472.25	.82	.00	.00	1.34	.86
122	85	87	467.44	3.77	.00	.00	2.98	6.09
123	86	85	333.86	3.75	.00	.00	2.13	3.26
124	87	88	-391.85	4.61	.00	.00	2.50	4.39
125	86	88	1922.91	2.92	.00	.00	3.07	2.43
126	90	91	111.11	.34	.00	.00	.71	.43
127	87	93	189.43	.16	.00	.00	.54	.16
128	88	94	1439.56	1.17	.00	.00	2.30	1.42
129	91	92	-78.16	.18	.00	.00	.50	.22
130	92	93	-255.69	.82	.00	.00	1.63	1.99
131	93	94	-335.07	3.61	.00	.00	2.14	3.29
132	94	95	1010.69	.24	.00	.00	1.61	.87
133	93	100	175.01	.12	.00	.00	.50	.14
134	95	101	966.09	1.75	.00	.00	2.74	3.24
135	100	101	-251.39	1.74	.00	.00	1.60	1.93
136	100	102	340.51	.14	.00	.00	.97	.47
137	101	103	628.79	1.39	.00	.00	1.78	1.46
138	102	103	-569.99	.68	.00	.00	1.62	1.22
139	103	104	22.10	.01	.00	.00	.14	.02
140	102	105	873.80	.47	.00	.00	1.39	.56
141	105	107	690.50	.34	.00	.00	1.10	.36
142	107	109	520.00	.30	.00	.00	.83	.22
143	109	110	310.00	.05	.00	.00	.49	.08
144	104	106	22.10	.01	.00	.00	.14	.02
145	106	108	.00	.00	.00	.00	.00	.00

146-XX	108	110						
147	110	111	188.50	.05	.00	.00	.30	.03
148	91	96	62.57	.04	.00	.00	.40	.15
149	96	97	62.57	.11	.00	.00	.40	.15
150	92	97	104.73	.33	.00	.00	.67	.38
151	97	98	137.60	.24	.00	.00	.88	.63
152	98	99	38.94	.05	.00	.00	.25	.06
153	98	99	29.86	.05	.00	.00	.19	.04
154	89	112	3089.60	1.92	.00	.00	3.16	1.97
155	112	113	2910.40	4.28	.00	.00	2.97	1.77
156	113	114	2203.40	.95	.00	.00	2.25	1.06
157	114	115	1676.10	4.24	.00	.00	2.67	1.89
158	115	116	616.90	.52	.00	.00	.98	.30
159	116	117	331.40	.13	.00	.00	.53	.09
160	117	118	165.70	.03	.00	.00	.26	.03

JUNCTION NODE RESULTS

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	JUNCTION ELEVATION (ft)	PRESSURE HEAD (ft)	JUNCTION PRESSURE (psi)
1		.00	153.65	120.00	33.65	14.58
2		.00	152.26	75.00	77.26	33.48
3		.00	151.59	77.00	74.59	32.32
4		958.00	150.02	50.00	100.02	43.34
5		208.00	148.25	85.00	63.25	27.41
6		.00	145.84	95.00	50.84	22.03
7		.00	143.00	98.00	45.00	19.50
8		.00	220.91	98.00	122.91	53.26
9		.00	220.37	102.00	118.37	51.29
10		20830.00	213.96	175.00	38.96	16.88
11		.00	198.21	55.00	143.21	62.06
12		471.00	196.09	25.00	171.09	74.14
13		312.00	191.75	45.00	146.75	63.59
14		.00	196.09	45.00	151.09	65.47
15		250.00	191.19	45.00	146.19	63.35
16		334.00	191.36	45.00	146.36	63.42
17		125.00	191.64	45.00	146.64	63.54
18		469.00	191.63	20.00	171.63	74.37
19		469.00	190.87	30.00	160.87	69.71
20		243.00	187.63	38.00	149.63	64.84
21		143.00	186.89	37.00	149.89	64.95
22		143.00	186.25	36.00	150.25	65.11
23		144.00	185.62	35.00	150.62	65.27
24		.00	184.45	34.00	150.45	65.19
25		.00	181.66	33.00	148.66	64.42
26		.00	180.55	28.00	152.55	66.10
27		.00	180.34	28.00	152.34	66.01
28		.00	180.34	27.00	153.34	66.45
29		199.00	184.14	35.00	149.14	64.63
30		373.00	176.06	36.00	140.06	60.69
31		429.00	168.93	37.00	131.93	57.17

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32	.00	162.23	34.00	128.23	55.57
33	198.00	162.23	33.00	129.23	56.00
34	183.00	162.36	31.00	131.36	56.92
35	.00	162.36	34.00	128.36	55.62
36	.00	172.27	34.00	138.27	59.92
37	.00	163.50	34.00	129.50	56.12
38	323.00	162.82	33.00	129.82	56.26
39	.00	161.38	33.00	128.38	55.63
40	301.00	160.73	33.00	127.73	55.35
41	.00	160.32	34.00	126.32	54.74
42	42.00	155.44	34.00	121.44	52.63
43	101.00	159.95	34.00	125.95	54.58
44	1042.00	154.99	33.00	121.99	52.86
45	219.00	157.87	30.00	127.87	55.41
46	219.00	156.92	28.00	128.92	55.87
47	198.00	155.20	25.00	130.20	56.42
48	.00	175.22	35.00	140.22	60.76
49	150.00	162.27	25.00	137.27	59.48
50	178.00	162.37	26.00	136.37	59.09
51	355.00	161.85	27.00	134.85	58.43
52	.00	161.81	28.00	133.81	57.99
53	70.00	161.75	29.00	132.75	57.53
54	311.00	162.13	31.00	131.13	56.82
55	199.00	164.75	27.00	137.75	59.69
56	353.00	168.28	27.00	141.28	61.22
57	.00	171.13	28.00	143.13	62.02
58	.00	177.01	32.00	145.01	62.84
59	.00	173.16	31.00	142.16	61.60
60	166.00	174.10	31.00	143.10	62.01
61	8.00	173.04	31.00	142.04	61.55
62	127.00	172.47	32.00	140.47	60.87
63	323.00	172.07	38.00	134.07	58.09
64	180.00	171.81	30.00	141.81	61.45
65	334.00	170.48	30.00	140.48	60.87
66	525.00	170.02	30.00	140.02	60.68
67	106.00	170.00	30.00	140.00	60.67
68	106.00	170.00	30.00	140.00	60.67
69	106.00	170.02	30.00	140.02	60.67
70	.00	170.09	32.00	138.09	59.84
71	.00	174.90	34.00	140.90	61.06
72	422.00	169.14	32.00	137.14	59.43
73	294.00	168.91	31.00	137.91	59.76
74	228.00	168.88	30.00	138.88	60.18
75	527.00	168.92	30.00	138.92	60.20
76	193.00	170.23	29.00	141.23	61.20
77	31.00	172.05	28.00	144.05	62.42
78	4185.00	170.46	20.00	150.46	65.20
79	.00	175.22	35.00	140.22	60.76
80	.00	165.42	25.00	140.42	60.85
81	29.80	163.03	25.00	138.03	59.81
82	141.80	155.94	25.00	130.94	56.74
83	274.60	154.54	25.00	129.54	56.13
84	171.70	158.94	25.00	133.94	58.04
85	213.80	150.92	25.00	125.92	54.57
86	278.90	154.67	25.00	129.67	56.19

87	197.60	147.15	25.00	122.15	52.93
88	91.50	151.76	25.00	126.76	54.93
89	266.70	146.24	25.00	121.24	52.54
90	229.60	146.33	25.00	121.33	52.58
91	126.70	145.99	20.00	125.99	54.60
92	72.80	146.17	20.00	126.17	54.68
93	93.80	146.98	20.00	126.98	55.03
94	93.80	150.59	20.00	130.59	56.59
95	44.60	150.35	20.00	130.35	56.48
96	.00	145.95	20.00	125.95	54.50
97	29.70	145.84	20.00	125.84	54.53
98	68.80	145.60	20.00	125.60	54.43
99	68.80	145.55	20.00	125.55	54.40
100	85.90	146.86	20.00	126.86	54.97
101	85.90	148.60	20.00	128.60	55.73
102	36.70	146.52	15.00	131.52	56.99
103	36.70	147.21	15.00	132.21	57.29
104	.00	147.20	15.00	132.20	57.29
105	183.30	146.05	15.00	131.05	56.79
106	22.10	147.18	15.00	132.18	57.28
107	170.50	145.71	15.00	130.71	56.64
108	.00	147.18	15.00	132.18	57.28
109	210.00	145.40	15.00	130.40	56.51
110	121.50	145.35	15.00	130.35	56.49
111	188.50	145.31	15.00	130.31	56.47
112	179.20	144.33	25.00	119.33	51.71
113	707.00	140.05	20.00	120.05	52.02
114	527.30	139.10	20.00	119.10	51.61
115	1059.20	134.86	15.00	119.86	51.94
116	285.50	134.34	15.00	119.34	51.71
117	165.70	134.21	15.00	119.21	51.66
118	165.70	134.18	15.00	119.18	51.65

MAXIMUM AND MINIMUM VALUES

PRESSURES

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
18	74.37	1	14.58
12	74.14	10	16.88
19	69.71	7	19.50
28	66.45	6	22.03
26	66.10	5	27.41
27	66.01	3	32.32
14	65.47	2	33.48
33	65.27	4	43.34
78	65.20	9	51.29
24	65.19	114	51.61

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V E L O C I T I E S

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
6	13.07	96	.03
25	9.21	52	.08
20	9.21	139	.14
43	8.15	144	.14
36	6.53	153	.19
37	6.45	152	.25
38	6.40	103	.26
39	6.36	160	.26
40	6.31	95	.27
113	5.80	147	.30

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM FIXED GRADE NODES
(-) OUTFLOWS FROM THE SYSTEM INTO FIXED GRADE NODES

PIPE NUMBER	FLOWRATE (gpm)
1	8647.38
6	12802.12
23	23679.20

NET SYSTEM INFLOW = 45128.70
NET SYSTEM OUTFLOW = .00
NET SYSTEM DEMAND = 45128.70

D A T A C H A N G E S F O R N E X T S I M U L A T I O N

D E M A N D C H A N G E S

DEMAND TYPE = 1 - GDF = .500

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND (gpm)
10	20833.00
111	4094.00

****

S I M U L A T I O N R E S U L T S

****

THE RESULTS ARE OBTAINED AFTER 3 TRIALS WITH AN ACCURACY = .00048

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE FG -FIXED GRADE NODE PU -PUMP LINE
CV -CHECK VALVE RV -REGULATING VALVE TK -STORAGE TANK

PIPE NUMBER	NODE NOS. #1	#2	FLOWRATE (gpm)	HEAD LOSS (ft)	PUMP HEAD (ft)	MINOR LOSS (ft)	LINE VELO. (ft/s)	HL/ 1000 (ft/ft)
1-FGPU	0	1	8548.21	.02	148.33	.00	2.69	.64
2	1	2	7944.15	1.36	.00	.00	3.61	1.36
3	1	2	604.06	1.36	.00	.00	1.71	1.36
4	2	3	5279.49	.66	.00	.00	1.66	.26
5	2	3	3268.72	.66	.00	.00	1.48	.26
6-FG	0	3	12339.74	66.71	.00	.00	12.60	25.66
7	3	4	11502.72	1.50	.00	.00	3.63	1.11
8	3	4	7122.75	1.50	.00	.00	3.23	1.11
9	3	4	2263.48	1.50	.00	.00	2.31	1.11
10	4	5	11238.95	1.75	.00	.00	3.54	1.06
11	4	5	6958.43	1.75	.00	.00	3.16	1.06
12	4	5	2211.57	1.75	.00	.00	2.26	1.06
13	5	6	12540.61	2.41	.00	.00	3.95	1.30
14	5	6	7764.34	2.41	.00	.00	3.52	1.30
15	6	7	20304.95	2.86	.00	.00	9.22	7.72
16-PU	7	8	6768.32	.02	77.79	.00	3.07	1.01
17-PU	7	8	6768.32	.02	77.79	.00	3.07	1.01
18-PU	7	8	6768.32	.02	77.79	.00	3.07	1.01
19-XXCV	7	8						
20	8	9	20304.95	.54	.00	.00	9.22	7.72
21	9	10	10152.48	6.42	.00	.00	4.61	2.14
22	9	10	10152.48	6.42	.00	.00	4.61	2.14
23-FG	0	10	16094.15	4.42	.00	.00	3.73	.98
24	10	11	15566.10	7.57	.00	.00	3.60	.92
25-XXCV	5	12						
26	11	12	733.57	.78	.00	.00	1.17	.41
27	11	13	14832.53	3.15	.00	.00	3.43	.84
28	12	14	.00	.00	.00	.00	.00	.00
29-XX	14	15						
30	16	15	95.93	.01	.00	.00	.15	.01
31	17	16	262.93	.04	.00	.00	.42	.06
32	13	17	325.43	.02	.00	.00	.52	.09
33	12	18	498.07	1.90	.00	.00	1.41	.95
34	18	19	263.57	.53	.00	.00	.75	.29
35	15	19	-29.07	.02	.00	.00	.08	.00
36	13	20	14351.10	2.09	.00	.00	4.52	1.67
37	20	21	14229.60	.38	.00	.00	4.48	1.65
38	21	22	14158.10	.33	.00	.00	4.46	1.63
39	22	23	14086.60	.32	.00	.00	4.44	1.61

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40	23	24	14014.60	.61	.00	.00	4.42	1.60
41-XX	15	28						
42	24	25	12841.88	1.50	.00	.00	4.05	1.36
43	25	26	12841.88	.60	.00	.00	5.83	3.31
44	26	27	11804.22	.12	.00	.00	3.72	1.16
45	28	27	.00	.00	.00	.00	.00	.00
46-XX	28	35						
47	27	29	11804.22	2.85	.00	.00	3.72	1.16
48	24	29	1172.72	.11	.00	.00	1.87	.97
49	29	30	1073.22	2.88	.00	.00	3.04	3.94
50	30	31	886.72	2.68	.00	.00	2.52	2.77
51	31	32	672.22	2.82	.00	.00	1.91	1.66
52	33	32	-35.07	.00	.00	.00	.10	.01
53	34	33	63.93	.01	.00	.00	.18	.02
54	35	34	.00	.00	.00	.00	.00	.00
55-XX	35	48						
56	36	37	977.74	2.32	.00	.00	2.77	3.31
57	38	37	-316.93	.14	.00	.00	.90	.41
58	34	38	-155.43	.08	.00	.00	.44	.11
59	37	39	335.38	.59	.00	.00	.95	.46
60	32	39	320.13	.36	.00	.00	.91	.42
61	32	40	317.02	.47	.00	.00	.90	.41
62	40	41	166.52	.14	.00	.00	.47	.12
63	39	41	201.98	.25	.00	.00	.57	.18
64	39	42	542.00	1.64	.00	.00	1.54	1.11
65	42	44	521.00	.13	.00	.00	1.48	1.03
66	41	43	368.50	.10	.00	.00	.59	.11
67	37	54	325.43	.43	.00	.00	.92	.43
68	54	53	169.93	.13	.00	.00	.48	.13
69	53	39	88.47	.03	.00	.00	.25	.04
70	53	52	46.46	.01	.00	.00	.13	.01
71	52	51	46.46	.00	.00	.00	.13	.01
72	50	51	131.04	.05	.00	.00	.37	.08
73	50	49	75.00	.03	.00	.00	.21	.03
74	79	71	11804.22	.17	.00	.00	3.72	1.16
75-XX	48	36						
76	46	47	99.00	.48	.00	.00	.63	.34
77	45	46	208.50	.26	.00	.00	.59	.19
78	43	45	318.00	.58	.00	.00	.90	.41
79	55	50	295.04	.37	.00	.00	.84	.36
80	56	55	394.54	.62	.00	.00	1.12	.52
81	57	56	571.04	.57	.00	.00	1.62	1.22
82-XX	36	57						
83	71	77	10314.94	1.81	.00	.00	3.25	.91
84	77	57	571.04	.18	.00	.00	1.62	1.22
85	26	58	1037.66	1.33	.00	.00	2.94	3.70
86	58	59	810.09	1.47	.00	.00	2.30	2.34
87	58	60	227.57	1.04	.00	.00	1.45	1.60
88	60	61	144.57	.45	.00	.00	.92	.69
89	59	61	84.43	.02	.00	.00	.24	.04
90	61	62	225.00	.16	.00	.00	.64	.22
91	62	63	161.50	.11	.00	.00	.45	.12
92	59	64	725.66	.59	.00	.00	2.06	1.91
93	64	65	635.66	.63	.00	.00	1.80	1.49
94	65	66	468.66	.27	.00	.00	1.33	.85

95	67	66	-206.16	.11	.00	.00	.58	.19
96	68	67	-153.16	.04	.00	.00	.43	.11
97	69	68	-100.16	.01	.00	.00	.28	.05
98	70	69	-47.16	.00	.00	.00	.13	.01
99	71	70	511.54	1.32	.00	.00	1.45	1.00
100	79	48	.00	.00	.00	.00	.00	.00
101	70	72	558.70	.48	.00	.00	1.58	1.18
102	72	73	347.70	.19	.00	.00	.99	.49
103	73	74	200.70	.14	.00	.00	.57	.18
104	75	74	-86.70	.02	.00	.00	.25	.04
105	76	75	176.80	.11	.00	.00	.50	.14
106	77	76	273.30	.22	.00	.00	.78	.31
107	77	78	9455.10	1.22	.00	.00	2.98	.77
108-XX	57	78						
109	71	36	977.74	.70	.00	.00	2.77	3.31
110	78	80	5941.20	5.96	.00	.00	6.07	6.63
111	78	80	1421.40	5.96	.00	.00	4.03	6.63
112	80	81	3847.34	3.59	.00	.00	3.93	2.96
113	80	82	3515.26	8.92	.00	.00	5.61	7.43
114	81	84	3832.44	6.19	.00	.00	6.12	8.72
115	82	83	405.48	3.04	.00	.00	2.59	4.68
116	84	83	243.39	2.18	.00	.00	1.55	1.82
117	82	89	3038.88	8.68	.00	.00	4.85	5.68
118	83	85	511.57	7.41	.00	.00	3.27	7.19
119	84	86	3503.20	7.76	.00	.00	5.59	7.39
120	89	90	1360.73	6.54	.00	.00	3.86	6.11
121	90	87	725.88	1.81	.00	.00	2.06	1.91
122	85	87	631.56	6.59	.00	.00	4.03	10.63
123	86	85	226.88	1.84	.00	.00	1.45	1.60
124	87	88	-191.55	1.22	.00	.00	1.22	1.17
125	86	88	3136.87	7.22	.00	.00	5.01	6.02
126	90	91	520.05	5.86	.00	.00	3.32	7.42
127	87	93	1450.19	7.08	.00	.00	4.11	6.88
128	88	94	2899.56	4.27	.00	.00	4.63	5.20
129	91	92	261.37	1.68	.00	.00	1.67	2.07
130	92	93	336.65	1.36	.00	.00	2.15	3.31
131	93	94	-354.89	4.02	.00	.00	2.27	3.65
132	94	95	2497.77	1.30	.00	.00	3.99	4.64
133	93	100	2094.83	12.23	.00	.00	5.94	13.59
134	95	101	2475.47	10.00	.00	.00	7.02	18.52
135	100	101	-442.62	4.95	.00	.00	2.82	5.50
136	100	102	2494.50	13.52	.00	.00	7.08	18.78
137	101	103	1989.90	11.74	.00	.00	5.64	12.36
138	102	103	-1960.50	6.73	.00	.00	5.56	12.02
139	103	104	11.05	.00	.00	.00	.07	.01
140	102	105	4436.65	9.61	.00	.00	7.08	11.44
141	105	107	4345.00	10.35	.00	.00	6.93	11.01
142	107	109	4259.75	14.85	.00	.00	6.80	10.61
143	109	110	4154.75	5.28	.00	.00	6.63	10.13
144	104	106	11.05	.00	.00	.00	.07	.01
145	106	108	.00	.00	.00	.00	.00	.00
146-XX	108	110						
147	110	111	4094.00	13.80	.00	.00	6.53	9.86
148	91	96	195.33	.36	.00	.00	1.25	1.21
149	96	97	195.33	.94	.00	.00	1.25	1.21

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150	92	97	-111.68	.37	.00	.00	.71	.43
151	97	98	68.80	.07	.00	.00	.44	.18
152	98	99	19.47	.01	.00	.00	.12	.02
153	98	99	14.93	.01	.00	.00	.10	.01
154	89	112	1544.80	.53	.00	.00	1.58	.55
155	112	113	1455.20	1.18	.00	.00	1.49	.49
156	113	114	1101.70	.26	.00	.00	1.13	.29
157	114	115	838.05	1.18	.00	.00	1.34	.52
158	115	116	308.45	.14	.00	.00	.49	.08
159	116	117	165.70	.04	.00	.00	.26	.03
160	117	118	82.85	.01	.00	.00	.13	.01

JUNCTION NODE RESULTS

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	JUNCTION ELEVATION (ft)	PRESSURE HEAD (ft)	JUNCTION PRESSURE (psi)
1		.00	158.31	120.00	38.31	16.60
2		.00	156.95	75.00	81.95	35.51
3		.00	156.29	77.00	79.29	34.36
4		479.00	154.79	50.00	104.79	45.41
5		104.00	153.04	85.00	68.04	29.48
6		.00	150.63	95.00	55.63	24.11
7		.00	147.77	98.00	49.77	21.57
8		.00	225.54	98.00	127.54	55.27
9		.00	225.00	102.00	123.00	53.30
10		20833.00	218.58	175.00	43.58	18.88
11		.00	211.01	55.00	156.01	67.61
12		235.50	210.24	25.00	185.24	80.27
13		156.00	207.87	45.00	162.87	70.58
14		.00	210.24	45.00	165.24	71.60
15		125.00	207.80	45.00	162.80	70.54
16		167.00	207.81	45.00	162.81	70.55
17		62.50	207.85	45.00	162.85	70.57
18		234.50	208.34	20.00	188.34	81.61
19		234.50	207.81	30.00	177.81	77.05
20		121.50	205.78	38.00	167.78	72.70
21		71.50	205.40	37.00	168.40	72.97
22		71.50	205.08	36.00	169.08	73.27
23		72.00	204.75	35.00	169.75	73.56
24		.00	204.14	34.00	170.14	73.73
25		.00	202.65	33.00	169.65	73.51
26		.00	202.05	28.00	174.05	75.42
27		.00	201.94	28.00	173.94	75.37
28		.00	201.94	27.00	174.94	75.81
29		99.50	204.04	35.00	169.04	73.25
30		186.50	201.16	36.00	165.16	71.57
31		214.50	198.48	37.00	161.48	69.97
32		.00	195.66	34.00	161.66	70.05
33		99.00	195.66	33.00	162.66	70.49
34		91.50	195.67	31.00	164.67	71.36
35		.00	195.67	34.00	161.67	70.06

36	.00	198.21	34.00	164.21	71.16
37	.00	195.89	34.00	161.89	70.15
38	161.50	195.75	33.00	162.75	70.52
39	.00	195.30	33.00	162.30	70.33
40	150.50	195.20	33.00	162.20	70.28
41	.00	195.05	34.00	161.05	69.79
42	21.00	193.66	34.00	159.66	69.18
43	50.50	194.95	34.00	160.95	69.75
44	521.00	193.53	33.00	160.53	69.56
45	109.50	194.37	30.00	164.37	71.23
46	109.50	194.11	28.00	166.11	71.98
47	99.00	193.63	25.00	168.63	73.07
48	.00	199.08	35.00	164.08	71.10
49	75.00	195.33	25.00	170.33	73.81
50	89.00	195.36	26.00	169.36	73.39
51	177.50	195.31	27.00	168.31	72.94
52	.00	195.32	28.00	167.32	72.50
53	35.00	195.33	29.00	166.33	72.08
54	155.50	195.46	31.00	164.46	71.27
55	99.50	195.73	27.00	168.73	73.11
56	176.50	196.34	27.00	169.34	73.30
57	.00	196.91	28.00	168.91	73.20
58	.00	200.72	32.00	168.72	73.11
59	.00	199.25	31.00	168.25	72.91
60	83.00	199.68	31.00	168.68	73.09
61	4.00	199.23	31.00	168.23	72.90
62	63.50	199.07	32.00	167.07	72.40
63	161.50	198.96	38.00	160.96	69.75
64	90.00	198.66	30.00	168.66	73.08
65	167.00	198.03	30.00	168.03	72.81
66	262.50	197.76	30.00	167.76	72.69
67	53.00	197.65	30.00	167.65	72.65
68	53.00	197.61	30.00	167.61	72.63
69	53.00	197.60	30.00	167.60	72.62
70	.00	197.59	32.00	165.59	71.76
71	.00	198.91	34.00	164.91	71.46
72	211.00	197.11	32.00	165.11	71.55
73	147.00	196.92	31.00	165.92	71.90
74	114.00	196.78	30.00	166.78	72.27
75	263.50	196.76	30.00	166.76	72.26
76	96.50	196.88	29.00	167.88	72.75
77	15.50	197.10	28.00	169.10	73.28
78	2092.50	195.88	20.00	175.88	76.21
79	.00	199.08	35.00	164.08	71.10
80	.00	189.91	25.00	164.91	71.46
81	14.90	186.33	25.00	161.33	69.91
82	70.90	180.99	25.00	155.99	67.60
83	137.30	177.95	25.00	152.95	66.28
84	85.85	180.13	25.00	155.13	67.22
85	106.90	170.54	25.00	145.54	63.07
86	139.45	172.38	25.00	147.38	63.86
87	98.80	163.95	25.00	138.95	60.21
88	45.75	165.15	25.00	140.15	60.73
89	133.35	172.31	25.00	147.31	63.83
90	114.80	165.77	25.00	140.77	61.00

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91	63.35	159.91	20.00	139.91	60.63
92	36.40	158.23	20.00	138.23	59.90
93	46.90	156.87	20.00	136.87	59.31
94	46.90	160.89	20.00	140.89	61.05
95	22.30	159.59	20.00	139.59	60.49
96	.00	159.55	20.00	139.55	60.47
97	14.85	158.60	20.00	138.60	60.06
98	34.40	158.54	20.00	138.54	60.03
99	34.48	158.52	20.00	138.52	60.03
100	42.95	144.64	20.00	124.64	54.01
101	42.95	149.59	20.00	129.59	56.16
102	18.35	131.12	15.00	116.12	50.32
103	18.35	137.85	15.00	122.85	53.24
104	.00	137.85	15.00	122.85	53.23
105	91.65	121.51	15.00	106.51	46.15
106	11.05	137.84	15.00	122.84	53.23
107	85.25	111.16	15.00	96.16	41.67
108	.00	137.84	15.00	122.84	53.23
109	105.00	96.31	15.00	81.31	35.23
110	60.75	90.03	15.00	75.03	32.51
111	4094.00	76.23	15.00	61.23	26.53
112	89.60	171.78	25.00	146.78	63.60
113	353.50	170.59	20.00	150.59	65.26
114	263.65	170.33	20.00	150.33	65.14
115	529.60	169.15	15.00	154.15	66.80
116	142.75	169.01	15.00	154.01	66.74
117	82.85	168.98	15.00	153.98	66.72
118	82.85	168.97	15.00	153.97	66.72

MAXIMUM AND MINIMUM VALUES

PRESSURES

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
18	82.61	1	16.60
12	80.27	10	18.88
19	77.05	7	21.57
78	76.21	6	24.11
28	75.81	111	26.53
26	75.42	5	29.48
27	75.37	110	32.51
49	73.81	3	34.36
24	73.73	109	35.23
23	73.56	2	35.51

VELOCITIES

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
6	12.60	139	.07
15	9.22	144	.07
20	9.22	35	.08
140	7.08	153	.10
136	7.08	52	.10
134	7.02	152	.12
141	6.93	70	.13
142	6.80	71	.13
143	6.63	160	.13
147	6.53	98	.13

SUMMARY OF INFLOWS AND OUTFLOWS

(+) INFLOWS INTO THE SYSTEM FROM FIXED GRADE NODES
(-) OUTFLOWS FROM THE SYSTEM INTO FIXED GRADE NODES

PIPE NUMBER	FLOWRATE (gpm)
1	8548.21
6	12339.74
23	16094.15

NET SYSTEM INFLOW = 36982.09
NET SYSTEM OUTFLOW = .00
NET SYSTEM DEMAND = 36982.11

DATA CHANGES FOR NEXT SIMULATION

DEMAND CHANGES

DEMAND TYPE = 1 - GDF = .500

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND (gpm)
118	4083.00
10	20833.00

****
SIMULATION RESULTS
****

THE RESULTS ARE OBTAINED AFTER 3 TRIALS WITH AN ACCURACY = .00288

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P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE FG -FIXED GRADE NODE PU -PUMP LINE
CV -CHECK VALVE RV -REGULATING VALVE TK -STORAGE TANK

PIPE NUMBER	NODE NOS. #1	#2	FLOWRATE (gpm)	HEAD LOSS (ft)	PUMP HEAD (ft)	MINOR LOSS (ft)	LINE VELO. (ft/s)	HL/ 1000 (ft/ft)
1-FGPU	0	1	8548.21	.02	148.33	.00	2.69	.64
2	1	2	7944.15	1.36	.00	.00	3.61	1.36
3	1	2	604.06	1.36	.00	.00	1.71	1.36
4	2	3	5279.49	.66	.00	.00	1.66	.26
5	2	3	3268.72	.66	.00	.00	1.48	.26
6-FG	0	3	12339.75	66.71	.00	.00	12.60	25.66
7	3	4	11502.73	1.50	.00	.00	3.63	1.11
8	3	4	7121.75	1.50	.00	.00	3.23	1.11
9	3	4	2263.48	1.50	.00	.00	2.31	1.11
10	4	5	11238.95	1.75	.00	.00	3.54	1.06
11	4	5	6958.44	1.75	.00	.00	3.16	1.06
12	4	5	2211.58	1.75	.00	.00	2.26	1.06
13	5	6	12540.62	2.41	.00	.00	3.95	1.30
14	5	6	7764.35	2.41	.00	.00	3.52	1.30
15	6	7	20304.97	2.86	.00	.00	9.22	7.72
16-PU	7	8	6768.32	.02	77.79	.00	3.07	1.01
17-PU	7	8	6768.32	.02	77.79	.00	3.07	1.01
18-PU	7	8	6768.32	.02	77.79	.00	3.07	1.01
19-XXCV	7	8						
20	8	9	20304.97	.54	.00	.00	9.22	7.72
21	9	10	10152.48	6.42	.00	.00	4.61	2.14
22	9	10	10152.48	6.42	.00	.00	4.61	2.14
23-FG	0	10	16094.53	4.42	.00	.00	3.73	.98
24	10	11	15566.50	7.57	.00	.00	3.60	.92
25-XXCV	5	12						
26	11	12	733.58	.78	.00	.00	1.17	.41
27	11	13	14832.92	3.15	.00	.00	3.43	.84
28	12	14	.00	.00	.00	.00	.00	.00
29-XX	14	15						
30	16	15	95.92	.01	.00	.00	.15	.01
31	17	16	262.92	.04	.00	.00	.42	.06
32	13	17	325.42	.02	.00	.00	.52	.09
33	12	18	498.08	1.90	.00	.00	1.41	.95
34	18	19	263.50	.53	.00	.00	.75	.29
35	15	19	-29.08	.02	.00	.00	.08	.00
36	13	20	14351.50	2.09	.00	.00	4.52	1.67
37	20	21	14230.00	.38	.00	.00	4.48	1.65
38	21	22	14158.50	.33	.00	.00	4.46	1.63
39	22	23	14087.00	.32	.00	.00	4.44	1.61
40	23	24	14015.00	.61	.00	.00	4.42	1.60
41-XX	15	28						
42	24	25	12842.26	1.50	.00	.00	4.05	1.36
43	25	26	12842.26	.60	.00	.00	5.83	3.31

44	26	27	11804.59	.12	.00	.00	3.72	1.16
45	28	27	.00	.00	.00	.00	.00	.00
46-XX	28	35						
47	27	29	11804.59	2.85	.00	.00	3.72	1.16
48	24	29	1172.74	.11	.00	.00	1.87	.97
49	29	30	1073.24	2.88	.00	.00	3.04	3.94
50	30	31	886.74	2.68	.00	.00	2.52	2.77
51	31	32	672.24	2.82	.00	.00	1.91	1.66
52	33	32	-35.08	.00	.00	.00	.10	.01
53	34	33	63.92	.01	.00	.00	.18	.02
54	35	34	.00	.00	.00	.00	.00	.00
55-XX	35	48						
56	36	37	977.74	2.32	.00	.00	2.77	3.31
57	38	37	-316.92	.14	.00	.00	.90	.41
58	34	38	-155.42	.08	.00	.00	.44	.11
59	37	39	335.38	.59	.00	.00	.95	.46
60	32	39	320.14	.36	.00	.00	.91	.42
61	32	40	317.02	.47	.00	.00	.90	.41
62	40	41	166.52	.14	.00	.00	.47	.12
63	39	41	201.98	.25	.00	.00	.57	.18
64	39	42	542.00	1.64	.00	.00	1.54	1.11
65	42	44	521.00	.13	.00	.00	1.48	1.03
66	41	43	368.50	.10	.00	.00	.59	.11
67	37	54	325.43	.43	.00	.00	.92	.43
68	54	53	169.93	.13	.00	.00	.48	.13
69	53	39	88.46	.03	.00	.00	.25	.04
70	53	52	46.48	.01	.00	.00	.13	.01
71	52	51	46.48	.00	.00	.00	.13	.01
72	50	51	131.02	.05	.00	.00	.37	.08
73	50	49	75.00	.03	.00	.00	.21	.03
74	79	71	11804.59	.17	.00	.00	3.72	1.16
75-XX	48	36						
76	46	47	99.00	.48	.00	.00	.63	.34
77	45	46	208.50	.26	.00	.00	.59	.19
78	43	45	318.00	.58	.00	.00	.90	.41
79	55	50	295.02	.37	.00	.00	.84	.36
80	56	55	394.52	.62	.00	.00	1.12	.62
81	57	56	571.02	.57	.00	.00	1.62	1.22
82-XX	36	57						
83	71	77	10315.31	1.81	.00	.00	3.25	.91
84	77	57	571.02	.18	.00	.00	1.62	1.22
85	26	58	1037.68	1.33	.00	.00	2.94	3.70
86	58	59	810.11	1.47	.00	.00	2.30	2.34
87	58	60	227.57	1.04	.00	.00	1.45	1.60
88	60	61	144.57	.45	.00	.00	.92	.69
89	59	61	84.43	.02	.00	.00	.24	.04
90	61	62	225.00	.16	.00	.00	.64	.22
91	62	63	161.50	.11	.00	.00	.46	.12
92	59	64	725.68	.59	.00	.00	2.06	1.91
93	64	65	635.68	.63	.00	.00	1.80	1.49
94	65	66	468.68	.27	.00	.00	1.33	.85
95	67	66	-206.18	.11	.00	.00	.58	.19
96	68	67	-153.18	.04	.00	.00	.43	.11
97	69	68	-100.18	.01	.00	.00	.28	.05
98	70	69	-47.18	.00	.00	.00	.13	.01

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99	71	70	531.54	1.32	.00	.00	1.45	1.00
100	79	48	.00	.00	.00	.00	.00	.00
101	70	72	558.71	.48	.00	.00	1.58	1.18
102	72	73	347.71	.19	.00	.00	.99	.49
103	73	74	200.71	.14	.00	.00	.57	.18
104	75	74	-86.71	.02	.00	.00	.25	.04
105	76	75	176.79	.11	.00	.00	.50	.14
106	77	76	273.29	.22	.00	.00	.78	.31
107	77	78	9455.50	1.22	.00	.00	2.98	.77
108-XX	57	78						
109	71	36	977.74	.70	.00	.00	2.77	3.31
110	78	80	5941.53	5.96	.00	.00	6.07	6.63
111	78	80	1421.47	5.96	.00	.00	4.03	6.63
112	80	81	3011.59	2.28	.00	.00	3.08	1.88
113	80	82	4351.41	13.24	.00	.00	6.94	11.04
114	81	84	2996.69	3.93	.00	.00	4.78	5.53
115	82	83	-74.05	.13	.00	.00	.47	.20
116	84	83	453.75	6.91	.00	.00	2.90	5.76
117	82	89	4354.57	16.91	.00	.00	6.95	11.05
118	83	85	242.39	1.86	.00	.00	1.55	1.80
119	84	86	2457.09	4.02	.00	.00	3.92	3.83
120	89	90	-1323.73	6.22	.00	.00	3.75	5.81
121	90	87	-1180.04	4.46	.00	.00	3.35	4.70
122	85	87	514.95	4.51	.00	.00	3.29	7.28
123	86	85	379.45	4.76	.00	.00	2.42	4.14
124	87	88	-463.94	6.30	.00	.00	2.96	6.00
125	86	88	1938.18	2.96	.00	.00	3.09	2.47
126	90	91	-258.49	1.51	.00	.00	1.65	2.03
127	87	93	-299.96	.38	.00	.00	.85	.37
128	88	94	1428.50	1.15	.00	.00	2.28	1.40
129	91	92	-226.92	1.29	.00	.00	1.45	1.60
130	92	93	-441.89	2.25	.00	.00	2.82	5.48
131	93	94	-389.64	4.78	.00	.00	2.49	4.34
132	94	95	991.96	.23	.00	.00	1.58	.84
133	93	100	-399.11	.57	.00	.00	1.13	.63
134	95	101	969.66	1.76	.00	.00	2.75	3.26
135	100	101	-290.98	2.28	.00	.00	1.86	2.53
136	100	102	-151.08	.08	.00	.00	.43	.10
137	101	103	635.73	1.42	.00	.00	1.80	1.49
138	102	103	-606.33	.77	.00	.00	1.72	1.37
139	103	104	11.05	.00	.00	.00	.07	.01
140	102	105	436.90	.13	.00	.00	.70	.16
141	105	107	345.25	.10	.00	.00	.55	.10
142	107	109	260.00	.08	.00	.00	.41	.06
143	109	110	155.00	.01	.00	.00	.25	.02
144	104	106	11.05	.00	.00	.00	.07	.01
145	106	108	.00	.00	.00	.00	.00	.00
146-XX	100	110						
147	110	111	94.25	.01	.00	.00	.15	.01
148	91	96	-94.92	.10	.00	.00	.61	.32
149	96	97	-94.92	.25	.00	.00	.61	.32
150	92	97	178.57	.89	.00	.00	1.14	1.02
151	97	98	60.80	.07	.00	.00	.44	.18
152	98	99	19.47	.01	.00	.00	.12	.02
153	98	99	14.93	.01	.00	.00	.10	.01

154	89	112	5544.95	5.66	.00	.00	5.66	5.83
155	112	113	5455.35	13.69	.00	.00	5.57	5.66
156	113	114	5101.85	4.50	.00	.00	5.21	5.00
157	114	115	4838.20	30.22	.00	.00	7.72	13.43
158	115	116	4308.60	19.07	.00	.00	6.87	10.84
159	116	117	4165.85	13.74	.00	.00	6.65	10.18
160	117	118	4083.00	10.59	.00	.00	6.51	9.81

JUNCTION NODE RESULTS

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	JONCTION ELEVATION (ft)	PRESSURE HEAD (ft)	JUNCTION PRESSURE (psi)
1		.00	158.31	120.00	38.31	16.60
2		.00	156.95	75.00	81.95	35.51
3		.00	156.29	77.00	79.29	34.36
4		479.00	154.79	50.00	104.79	45.41
5		104.00	153.04	85.00	68.04	29.48
6		.00	150.63	95.00	55.63	24.11
7		.00	147.77	98.00	49.77	21.57
8		.00	225.54	98.00	127.54	55.27
9		.00	225.00	102.00	123.00	53.30
10		20833.00	218.58	175.00	43.58	18.88
11		.00	211.01	55.00	156.01	67.61
12		235.50	210.24	25.00	185.24	80.27
13		156.00	207.87	45.00	162.87	70.58
14		.00	210.24	45.00	165.24	71.60
15		125.00	207.80	45.00	162.80	70.54
16		167.00	207.81	45.00	162.81	70.55
17		62.50	207.85	45.00	162.85	70.57
18		234.50	208.34	20.00	188.34	81.61
19		234.50	207.81	30.00	177.81	77.05
20		121.50	205.78	38.00	167.78	72.70
21		71.50	205.40	37.00	168.40	72.97
22		71.50	205.07	36.00	169.07	73.27
23		72.00	204.75	35.00	169.75	73.56
24		.00	204.14	34.00	170.14	73.73
25		.00	202.65	33.00	169.65	73.51
26		.00	202.05	28.00	174.05	75.42
27		.00	201.94	28.00	173.94	75.37
28		.00	201.94	27.00	174.94	75.81
29		99.50	204.04	35.00	169.04	73.25
30		186.50	201.16	36.00	165.16	71.57
31		214.50	198.48	37.00	161.48	69.97
32		.00	195.66	34.00	161.66	70.05
33		99.00	195.66	33.00	162.66	70.49
34		91.50	195.57	31.00	164.67	71.36
35		.00	195.67	34.00	161.67	70.06
36		.00	198.21	34.00	164.21	71.16
37		.00	195.89	34.00	161.89	70.15
38		161.50	195.75	33.00	162.75	70.52
39		.00	195.30	33.00	162.30	70.33

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40	150.50	195.19	33.00	162.19	70.28
41	.00	195.05	34.00	161.05	69.79
42	21.00	193.65	34.00	159.65	69.18
43	50.50	194.95	34.00	160.95	69.74
44	521.00	193.53	33.00	160.53	69.56
45	109.50	194.37	30.00	164.37	71.23
46	109.50	194.11	28.00	166.11	71.98
47	99.00	193.63	25.00	168.63	73.07
48	.00	199.08	35.00	164.08	71.10
49	75.00	195.33	25.00	170.33	73.81
50	89.00	195.36	26.00	169.36	73.39
51	177.50	195.31	27.00	168.31	72.94
52	.00	195.32	28.00	167.32	72.50
53	35.00	195.33	29.00	166.33	72.08
54	155.50	195.46	31.00	164.46	71.27
55	99.50	195.72	27.00	168.72	73.11
56	176.50	196.34	27.00	169.34	73.38
57	.00	196.91	28.00	168.91	73.19
58	.00	200.72	32.00	168.72	73.11
59	.00	199.25	31.00	168.25	72.91
60	83.00	199.68	31.00	168.68	73.09
61	4.00	199.23	31.00	168.23	72.90
62	63.50	199.07	32.00	167.07	72.40
63	161.50	198.96	38.00	160.96	69.75
64	90.00	198.65	30.00	168.65	73.08
65	167.00	198.03	30.00	168.03	72.81
66	262.50	197.76	30.00	167.76	72.69
67	53.00	197.65	30.00	167.65	72.65
68	53.00	197.61	30.00	167.61	72.63
69	53.00	197.59	30.00	167.59	72.62
70	.00	197.59	32.00	165.59	71.76
71	.00	198.91	34.00	164.91	71.46
72	211.00	197.11	32.00	165.11	71.55
73	147.00	196.92	31.00	165.92	71.90
74	114.00	196.78	30.00	166.78	72.27
75	263.50	196.76	30.00	166.76	72.26
76	96.50	196.88	29.00	167.88	72.75
77	15.50	197.09	28.00	169.09	73.27
78	2092.50	195.88	20.00	175.88	76.21
79	.00	199.08	35.00	164.08	71.10
80	.00	189.91	25.00	164.91	71.46
81	14.90	187.63	25.00	162.63	70.47
82	70.90	176.67	25.00	151.67	65.72
83	137.30	176.80	25.00	151.80	65.78
84	85.85	183.71	25.00	158.71	68.77
85	106.90	174.94	25.00	149.94	64.97
86	139.45	179.68	25.00	154.68	67.03
87	98.80	170.43	25.00	145.43	63.02
88	45.75	176.72	25.00	151.72	65.75
89	133.35	159.76	25.00	134.76	58.40
90	114.80	165.98	25.00	140.98	61.09
91	63.35	167.58	20.00	147.58	63.95
92	36.40	168.87	20.00	148.87	64.51
93	46.90	170.81	20.00	150.81	65.35
94	46.90	175.57	20.00	155.57	67.42

95	22.30	175.34	20.00	155.34	67.31
96	.00	167.68	20.00	147.68	63.99
97	14.85	167.98	20.00	147.98	64.13
98	34.40	167.92	20.00	147.92	64.10
99	34.40	167.90	20.00	147.90	64.09
100	42.95	171.38	20.00	151.38	65.60
101	42.95	173.58	20.00	153.58	66.55
102	18.35	171.45	15.00	156.45	67.80
103	18.35	172.16	15.00	157.16	68.10
104	.00	172.15	15.00	157.15	68.10
105	91.65	171.32	15.00	156.32	67.74
106	11.05	172.15	15.00	157.15	68.10
107	85.25	171.22	15.00	156.22	67.70
108	.00	172.15	15.00	157.15	68.10
109	105.00	171.14	15.00	156.14	67.66
110	60.75	171.13	15.00	156.13	67.65
111	94.25	171.11	15.00	156.11	67.65
112	89.60	154.10	25.00	129.10	55.94
113	353.50	140.41	20.00	120.41	52.18
114	263.65	135.91	20.00	115.91	50.23
115	529.60	105.69	15.00	90.69	39.30
116	142.75	86.62	15.00	71.62	31.04
117	82.85	72.88	15.00	57.88	25.08
118	4083.00	62.29	15.00	47.29	20.49

MAXIMUM AND MINIMUM VALUES

PRESSURES

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)
18	81.61
12	80.27
19	77.05
78	76.21
28	75.81
26	75.42
27	75.37
49	73.81
24	73.73
23	73.56

JUNCTION NUMBER	MINIMUM PRESSURES (psi)
1	16.60
10	18.88
118	20.49
7	21.57
6	24.11
117	25.08
5	29.48
116	31.04
3	34.36
2	35.51

VELOCITIES

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)
6	12.60
15	9.22

PIPE NUMBER	MINIMUM VELOCITY (ft/s)
139	.07
144	.07

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20	9.22	35	.08
157	7.72	153	.10
117	6.95	52	.10
113	6.94	152	.12
158	6.87	70	.13
159	6.65	71	.13
160	6.51	98	.13
110	6.07	147	.15

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM FIXED GRADE NODES
(-) OUTFLOWS FROM THE SYSTEM INTO FIXED GRADE NODES

PIPE NUMBER	FLOWRATE (gpm)
1	8548.21
6	12339.75
23	16094.53

NET SYSTEM INFLOW = 36982.50
NET SYSTEM OUTFLOW = .00
NET SYSTEM DEMAND = 36982.50

**** KYPIPE SIMULATION COMPLETED ****

DATE: 3/17/2003
TIME: 10:50:12

Appendix C

Computer Simulation of BWS' 228-Foot Service Zone in the Fort Weaver Corridor With the Addition of the Hoopili Project

AR00028312

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          * * * * * * * * * *  K Y P I P E 2  * * * * * * * * * *
          *   University of Kentucky Hydraulic Analysis Program   *
          * Distribution of Pressure and Flows in Piping Networks *
          *         1000 PIPE VERSION - 1.10   (08/25/92)         *
          * * * * * * * * * * * * * * * * * * * * * * * * * * * * *


DATE: 11/16/2006
TIME:  8:47: 0

INPUT DATA FILENAME ---------------- HOOPILI.DAT
TABULATED OUTPUT FILENAME ---------- HOOPILI.OUT
POSTPROCESSOR RESULTS FILENAME ----- HOOPILI.RES


                 ***********************************************
                  S U M M A R Y   O F   O R I G I N A L   D A T A
                 ***********************************************


U N I T S   S P E C I F I E D

   FLOWRATE ............. = gallons/minute
   HEAD (HGL) ........... = feet
   PRESSURE ............. = psig


P I P E L I N E   D A T A

STATUS CODE:   XX -CLOSED PIPE     FG -FIXED GRADE NODE     PU -PUMP LINE
               CV -CHECK VALVE     RV -REGULATING VALVE

  PIPE       NODE NOS.      LENGTH     DIAMETER    ROUGHNESS    MINOR LOSS    FGN-HGL
 NUMBER      #1     #2        (ft)       (in)        COEFF.       COEFF.        (ft)
-------------------------------------------------------------------------------------
   1-FGPU     0    203        50.0       36.0       130.00          .00       10.00
   2          1      2       980.0       30.0       130.00          .00
   3          1      2       980.0       12.0       110.00          .00
   4          2      3      2500.0       36.0       130.00          .00
   5          2      3      2500.0       30.0       130.00          .00
   6-FG       0    204      1800.0       20.0       120.00          .00      228.00
   7          3      4      1350.0       36.0       130.00          .00
   8          3      4      1350.0       30.0       130.00          .00
   9          3      4      1350.0       20.0       120.00          .00
  10          4      5      1650.0       36.0       130.00          .00
  11          4      5      1650.0       30.0       130.00          .00
  12          4      5      1650.0       20.0       120.00          .00
  13          5      6      1850.0       36.0       130.00          .00
  14          5      6      1850.0       30.0       130.00          .00
  15          6      7       370.0       30.0       130.00          .00
  16-XXPU     7      8        20.0       30.0       130.00          .00
  17-XXPU     7      8        20.0       30.0       130.00          .00
  18-XXPU     7      8        20.0       30.0       130.00          .00
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  19-CV       7      8        20.0       30.0       130.00          .00
  20          8      9        70.0       30.0       130.00          .00
  21          9    208      3000.0       30.0       130.00          .00
  22        205     10      3000.0       30.0       130.00          .00
  23-FG       0     10      4530.0       42.0       130.00          .00      228.00
  24        210     11      8250.0       42.0       130.00          .00
  25-CV       5     12      7150.0       16.0       120.00          .00
  26         12     11      1900.0       16.0       120.00          .00
  27         11     13      3750.0       42.0       130.00          .00
  28         12     14      2850.0       16.0       120.00          .00
  29-XX      14     15       650.0       16.0       120.00          .00
  30         16     15      1300.0       16.0       120.00          .00
  31         17     16       700.0       16.0       120.00          .00
  32         13     17       200.0       16.0       120.00          .00
  33         12     18      2000.0       12.0       110.00          .00
  34         18     19      1800.0       12.0       110.00          .00
  35         15     19      3200.0       12.0       110.00          .00
  36         13     20      1250.0       36.0       130.00          .00
  37         20     21       230.0       36.0       130.00          .00
  38         21     22       200.0       36.0       130.00          .00
  39         22     23       200.0       36.0       130.00          .00
  40         23     24       380.0       36.0       130.00          .00
  41-XX      15     28      2480.0       16.0       120.00          .00
  42         24     25      1100.0       36.0       130.00          .00
  43         25     26       180.0       30.0       130.00          .00
  44         26     27       100.0       36.0       130.00          .00
  45         28     27       150.0       16.0       120.00          .00
  46-XX      28     35      2000.0       16.0       120.00          .00
  47         27     79      2450.0       36.0       130.00          .00
  48         24     29       110.0       16.0       120.00          .00
  49         29     30       730.0       12.0       110.00          .00
  50         30     31       970.0       12.0       110.00          .00
  51         31     32      1700.0       12.0       110.00          .00
  52         33     32       570.0       12.0       110.00          .00
  53         34     33       580.0       12.0       110.00          .00
  54         35     34       800.0       12.0       110.00          .00
  55-XX      35     48       730.0       16.0       120.00          .00
  56         36     37       700.0       12.0       110.00          .00
  57         37     38       350.0       12.0       110.00          .00
  58         30     34       700.0       12.0       110.00          .00
  59         37     39      1300.0       12.0       110.00          .00
  60         32     39       870.0       12.0       110.00          .00
  61         32     40      1140.0       12.0       110.00          .00
  62         40     41      1150.0       12.0       110.00          .00
  63         39     41      1390.0       12.0       110.00          .00
  64         39     42      1480.0       12.0       110.00          .00
  65         42     44       122.0       12.0       110.00          .00
  66         41     43       890.0       16.0       120.00          .00
  67         37     54      1000.0       12.0       110.00          .00
  68         54     53      1030.0       12.0       110.00          .00
  69         53     39       730.0       12.0       110.00          .00
  70         52     53       805.0       12.0       110.00          .00
  71         51     52       400.0       12.0       110.00          .00
  72         50     51       580.0       12.0       110.00          .00
  73         50     49       965.0       12.0       110.00          .00
  74         79     71       150.0       36.0       130.00          .00
  75-XX      48     36       170.0       16.0       120.00          .00
  76         46     47      1390.0        8.0       110.00          .00
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AR00028313

77	45	46	1390.0	12.0	110.00	.00
78	43	45	1390.0	12.0	110.00	.00
79	55	50	1015.0	12.0	110.00	.00
80	56	55	1000.0	12.0	110.00	.00
81	57	56	465.0	12.0	110.00	.00
82-XX	36	57	2000.0	16.0	120.00	.00
83	71	77	2000.0	36.0	130.00	.00
84	77	57	150.0	12.0	110.00	.00
85	26	58	360.0	12.0	110.00	.00
86	58	59	630.0	12.0	110.00	.00
87	58	60	650.0	8.0	110.00	.00
88	60	61	650.0	8.0	110.00	.00
89	59	61	550.0	12.0	110.00	.00
90	61	62	720.0	12.0	110.00	.00
91	62	63	950.0	12.0	110.00	.00
92	59	64	310.0	12.0	110.00	.00
93	64	65	420.0	12.0	110.00	.00
94	65	66	320.0	12.0	110.00	.00
95	66	67	570.0	12.0	110.00	.00
96	68	67	400.0	12.0	110.00	.00
97	69	68	250.0	12.0	110.00	.00
98	70	69	330.0	12.0	110.00	.00
99	71	70	1320.0	12.0	110.00	.00
100	79	48	40.0	16.0	120.00	.00
101	70	72	410.0	12.0	110.00	.00
102	72	73	390.0	12.0	110.00	.00
103	73	74	780.0	12.0	110.00	.00
104	75	74	465.0	12.0	110.00	.00
105	76	75	810.0	12.0	110.00	.00
106	77	76	700.0	12.0	110.00	.00
107	77	78	1580.0	36.0	130.00	.00
108-XX	57	78	1580.0	16.0	120.00	.00
109	71	36	210.0	12.0	110.00	.00
110	78	80	900.0	20.0	120.00	.00
111	78	80	900.0	12.0	110.00	.00
112	80	81	1220.0	20.0	120.00	.00
113	80	82	1170.0	16.0	120.00	.00
114	01	84	700.0	16.0	120.00	.00
115	82	83	630.0	8.0	110.00	.00
116	84	83	1200.0	8.0	110.00	.00
117	82	89	900.0	16.0	120.00	.00
118	83	85	1060.0	8.0	110.00	.00
119	83	86	1035.0	8.0	110.00	.00
120	84	85	1050.0	16.0	120.00	.00
121	89	91	650.0	16.0	120.00	.00
122	87	88	710.0	0.0	110.00	.00
123	86	87	665.0	8.0	110.00	.00
124	85	86	1150.0	8.0	110.00	.00
125	85	94	1200.0	16.0	120.00	.00
126	82	113	280.0	8.0	110.00	.00
127	91	90	620.0	12.0	110.00	.00
128	91	92	1070.0	12.0	110.00	.00
129	93	92	950.0	12.0	110.00	.00
130	86	93	600.0	8.0	110.00	.00
131	94	93	1050.0	8.0	110.00	.00
132	92	96	280.0	8.0	110.00	.00
133	93	103	1040.0	12.0	110.00	.00
134	94	104	800.0	16.0	120.00	.00

135	95	98	550.0	8.0	110.00	.00	
136	96	95	780.0	8.0	110.00	.00	
137	96	100	520.0	8.0	110.00	.00	
138	97	101	730.0	8.0	110.00	.00	
139	96	97	770.0	8.0	110.00	.00	
140	98	99	800.0	8.0	110.00	.00	
141	100	99	310.0	8.0	110.00	.00	
142	101	100	810.0	8.0	110.00	.00	
143	99	112	790.0	8.0	110.00	.00	
144	101	112	870.0	8.0	110.00	.00	
145	102	101	150.0	8.0	110.00	.00	
146	103	102	270.0	8.0	110.00	.00	
147	104	103	1120.0	8.0	110.00	.00	
148	104	105	250.0	12.0	110.00	.00	
149	102	108	1090.0	8.0	110.00	.00	
150	103	107	900.0	12.0	110.00	.00	
151	105	106	560.0	12.0	110.00	.00	
152	107	108	290.0	8.0	110.00	.00	
153	106	107	920.0	8.0	110.00	.00	
154	108	109	500.0	8.0	110.00	.00	
155	107	110	710.0	12.0	110.00	.00	
156	106	111	930.0	12.0	110.00	.00	
157	109	110	310.0	8.0	110.00	.00	
158	111	110	550.0	8.0	110.00	.00	
159	91	114	2540.0	20.0	120.00	.00	
160	114	115	300.0	8.0	110.00	.00	
201-XXPU	0	211	50.0	24.0	130.00	.00	10.00
202	211	201	6650.0	36.0	130.00	.00	
203-PGPU	0	202	50.0	24.0	130.00	.00	10.00
204-XX	202	201	1900.0	20.0	120.00	.00	
205	201	2	4830.0	36.0	130.00	.00	
206	203	1	420.0	30.0	130.00	.00	
207	1	204	2700.0	12.0	110.00	.00	
208	204	3	800.0	20.0	120.00	.00	
209-PG	0	3	2600.0	24.0	130.00	.00	228.00
210-XX	6	9	150.0	30.0	130.00	.00	
211-CV	6	205	220.0	30.0	130.00	.00	
212	8	205	240.0	30.0	130.00	.00	
213	10	206	40.0	42.0	130.00	.00	
214	206	209	20.0	42.0	130.00	.00	
215	209	210	85.0	42.0	130.00	.00	
216-XX	207	206	50.0	30.0	130.00	.00	
217-XX	207	209	70.0	30.0	130.00	.00	
218	208	207	10.0	30.0	130.00	.00	
219	210	212	150.0	42.0	130.00	.00	
220-CV	212	213	50.0	24.0	130.00	.00	
221-PU	212	213	50.0	24.0	130.00	.00	
222-PU	212	213	50.0	24.0	130.00	.00	
223-XXPU	212	213	50.0	24.0	130.00	.00	
224-CV	208	215	260.0	30.0	130.00	.00	
225	214	215	60.0	24.0	130.00	.00	
226	213	214	110.0	42.0	130.00	.00	
227	215	216	14300.0	30.0	130.00	.00	
228	214	216	14300.0	36.0	130.00	.00	
229	216	217	2430.0	36.0	130.00	.00	
230	216	218	10400.0	30.0	130.00	.00	
231-XXFG	0	211	30.0	36.0	130.00	.00	228.00
161	115	116	510.0	8.0	110.00	.00	

AR00028314

162	116	117	1110.0	8.0	110.00	.00	
163	115	118	1150.0	8.0	110.00	.00	
164	114	123	1160.0	20.0	120.00	.00	
165	118	117	550.0	8.0	110.00	.00	
166	123	118	1160.0	8.0	110.00	.00	
167	117	121	1600.0	8.0	110.00	.00	
168	118	119	600.0	8.0	110.00	.00	
169	119	120	700.0	8.0	110.00	.00	
170	121	122	620.0	8.0	110.00	.00	
171	119	122	720.0	8.0	110.00	.00	
172	122	120	1090.0	8.0	110.00	.00	
173	123	124	1050.0	20.0	120.00	.00	
174	124	125	880.0	16.0	120.00	.00	
175	125	126	910.0	16.0	120.00	.00	
176	126	127	620.0	16.0	120.00	.00	
177	126	128	1600.0	16.0	120.00	.00	
178	128	129	830.0	16.0	120.00	.00	
179	129	130	950.0	16.0	120.00	.00	
180	131	124	510.0	16.0	120.00	.00	
181	131	132	1340.0	12.0	110.00	.00	
182	132	133	1010.0	16.0	120.00	.00	
183	134	132	1020.0	12.0	110.00	.00	
184	134	131	1090.0	16.0	120.00	.00	
185	136	134	1570.0	16.0	120.00	.00	
186	109	135	660.0	8.0	110.00	.00	
187	110	136	830.0	16.0	120.00	.00	
188	138	137	1040.0	8.0	110.00	.00	
189	135	136	200.0	8.0	110.00	.00	
190	137	136	280.0	8.0	110.00	.00	
191	111	138	290.0	8.0	110.00	.00	
192	112	139	380.0	8.0	110.00	.00	
193	139	140	900.0	8.0	110.00	.00	
194	139	141	1030.0	8.0	110.00	.00	
240-FG	0	10	2600.0	16.0	130.00	.00	228.00
241	10	240	7115.0	16.0	130.00	.00	
242	240	11	2750.0	16.0	120.00	.00	
243	240	11	2750.0	42.0	130.00	.00	

P U M P D A T A

THERE IS A PUMP IN LINE 1 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
415.00	.00
230.00	6700.00
105.00	9450.00

THERE IS A PUMP IN LINE 16 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
138.00	.00
110.00	4900.00
101.00	6000.00

THERE IS A PUMP IN LINE 17 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
138.00	.00
110.00	4900.00
101.00	6000.00

THERE IS A PUMP IN LINE 18 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
138.00	.00
110.00	4900.00
101.00	6000.00

THERE IS A PUMP IN LINE 201 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
345.00	.00
236.00	5700.00
200.00	6600.00

THERE IS A PUMP IN LINE 203 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
362.00	.00
250.00	3150.00
187.00	3900.00

THERE IS A PUMP IN LINE 221 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
85.00	.00
55.50	10500.00
48.00	11500.00

THERE IS A PUMP IN LINE 222 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
85.00	.00
55.50	10500.00
48.00	11500.00

THERE IS A PUMP IN LINE 223 DESCRIBED BY THE FOLLOWING DATA:

HEAD (ft)	FLOWRATE (gpm)
85.00	.00
55.50	10500.00
48.00	11500.00

AR00028315

JUNCTION NODE DATA

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	JUNCTION ELEVATION (ft)	CONNECTING PIPES					
1		.00	120.00	2	3	206	207		
2		.00	75.00	2	3	4	5	205	
3		.00	77.00	4	5	7	8	9	208
				209					
4		958.00	50.00	7	8	9	10	11	12
5		208.00	85.00	10	11	12	13	14	25
6		.00	95.00	13	14	15	210	211	
7		.00	98.00	15	16	17	18	19	
8		.00	98.00	16	17	18	19	20	212
9		.00	102.00	20	21	210			
10		.00	175.00	22	23	213	240	241	
11		1063.00	55.00	24	26	27	242	243	
12		471.00	25.00	25	26	28	33		
13		312.00	45.00	27	32	36			
14		.00	45.00	28	29				
15		250.00	45.00	29	30	35	41		
16		334.00	45.00	30	31				
17		125.00	45.00	31	32				
18		469.00	20.00	33	34				
19		469.00	30.00	34	35				
20		243.00	38.00	36	37				
21		143.00	37.00	37	38				
22		143.00	36.00	38	39				
23		144.00	35.00	39	40				
24		.00	34.00	40	42	48			
25		.00	33.00	42	43				
26		.00	28.00	43	44	85			
27		.00	28.00	44	45	47			
28		.00	27.00	41	45	46			
29		199.00	35.00	48	49				
30		373.00	36.00	49	50				
31		429.00	37.00	50	51				
32		.00	34.00	51	52	60	61		
33		198.00	33.00	52	53				
34		183.00	31.00	53	54	58			
35		.00	34.00	46	54	55			
36		.00	34.00	56	75	82	109		
37		.00	34.00	56	57	59	67		
38		323.00	33.00	57	58				
39		.00	33.00	59	60	63	64	69	
40		302.00	33.00	61	62				
41		.00	34.00	62	63	66			
42		42.00	34.00	64	65				
43		101.00	34.00	66	78				
44		1042.00	33.00	65					
45		219.00	30.00	77	78				
46		219.00	28.00	76	77				
47		198.00	25.00	76					

48	.00	35.00	55	75	100	
49	150.00	25.00	73			
50	178.00	26.00	72	73	79	
51	355.00	27.00	71	72		
52	.00	28.00	70	71		
53	70.00	29.00	68	69	70	
54	311.00	31.00	67	68		
55	199.00	27.00	79	00		
56	353.00	27.00	80	81		
57	.00	28.00	81	82	84	108
58	.00	32.00	85	86	87	
59	.00	31.00	86	89	92	
60	166.00	31.00	87	88		
61	8.00	31.00	88	89	90	
62	127.00	32.00	90	91		
63	323.00	38.00	91			
64	180.00	30.00	92	93		
65	334.00	30.00	93	94		
66	525.00	30.00	94	95		
67	106.00	30.00	95	96		
68	106.00	30.00	96	97		
69	106.00	30.00	97	98		
70	.00	32.00	98	99	101	
71	.00	34.00	74	83	99	109
72	422.00	32.00	101	102		
73	294.00	31.00	102	103		
74	228.00	30.00	103	104		
75	527.00	30.00	104	105		
76	193.00	29.00	105	106		
77	31.00	28.00	83	84	106	107
78	4185.00	20.00	107	108	110	111
79	.00	35.00	47	74	100	
80	53.90	25.00	110	111	112	113
81	68.80	25.00	112	114		
82	.00	25.00	113	115	117	126
83	220.80	25.00	115	116	118	119
84	157.20	25.00	114	116	120	
85	329.20	25.00	118	120	124	125
86	126.50	25.00	119	123	124	130
87	102.90	25.00	122	123		
88	.00	25.00	122			
89	126.70	25.00	117	121		
90	306.70	25.00	127			
91	6.50	20.00	121	127	128	159
92	.00	20.00	128	129	132	
93	33.80	20.00	129	130	131	133
94	197.40	20.00	125	131	134	
95	41.80	20.00	135	136		
96	84.50	20.00	132	136	137	139
97	42.60	20.00	138	139		
98	41.80	20.00	135	140		
99	57.70	20.00	140	141	143	
100	58.50	20.00	137	141	142	
101	58.50	20.00	138	142	144	145
102	.00	15.00	145	146	149	
103	97.00	15.00	133	146	147	150
104	97.80	15.00	134	147	148	
105	40.60	15.00	148	151		

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106	36.50	15.00	151	153	156			
107	63.90	15.00	150	152	153	155		
108	36.50	15.00	149	152	154			
109	36.40	15.00	154	157	186			
110	.00	15.00	155	157	158	187		
111	36.40	15.00	156	158	191			
112	15.90	25.00	143	144	192			
113	281.60	20.00	126					
114	66.00	20.00	159	160	164			
115	161.70	20.00	160	161	163			
116	147.60	20.00	161	162				
117	86.00	20.00	162	165	167			
118	100.00	20.00	163	165	166	168		
119	63.70	20.00	168	169	171			
120	63.70	20.00	169	172				
121	44.80	20.00	167	170				
122	108.50	20.00	170	171	172			
123	142.00	20.00	164	166	173			
124	13.30	20.00	173	174	180			
125	441.70	20.00	174	175				
126	138.10	20.00	175	176	177			
127	190.80	20.00	176					
128	194.60	20.00	177	178				
129	38.70	20.00	178	179				
130	220.60	20.00	179					
131	276.20	20.00	180	181	184			
132	265.40	20.00	181	182	183			
133	202.80	20.00	182					
134	101.20	20.00	183	184	185			
135	63.50	20.00	186	189				
136	63.50	20.00	185	187	189	190		
137	63.50	20.00	188	190				
138	.00	20.00	188	191				
139	.00	20.00	192	193	194			
140	65.60	20.00	193					
141	65.60	20.00	194					
201	.00	70.00	202	204	205			
202	.00	135.00	203	204				
203	.00	130.00	1	206				
204	.00	80.00	6	207	208			
205	.00	102.00	22	211	212			
206	.00	175.00	213	214	216			
207	.00	175.00	216	217	218			
208	.00	175.00	21	218	224			
209	.00	175.00	214	215	217			
210	.00	175.00	24	215	219			
211	.00	208.00	201	202	231			
212	.00	175.00	219	220	221	222	223	
213	.00	175.00	220	221	222	223	226	
214	.00	175.00	225	226	228			
215	.00	175.00	224	225	227			
216	.00	130.00	227	228	229	230		
217	8333.00	215.00	229					
218	12500.00	215.00	230					
240	1063.00	95.00	241	242	243			

O U T P U T O P T I O N D A T A

OUTPUT SELECTION: ALL RESULTS ARE INCLUDED IN THE TABULATED OUTPUT
MAXIMUM AND MINIMUM PRESSURES = 10
MAXIMUM AND MINIMUM VELOCITIES = 10

S Y S T E M C O N F I G U R A T I O N

NUMBER OF PIPES .....(p) = 229
NUMBER OF JUNCTION NODES .....(j) = 160
NUMBER OF PRIMARY LOOPS .....(l) = 62
NUMBER OF FIXED GRADE NODES .....(f) = 8
NUMBER OF SUPPLY ZONES .....(z) = 1

****
S I M U L A T I O N R E S U L T S
****

THE RESULTS ARE OBTAINED AFTER 5 TRIALS WITH AN ACCURACY = .00068

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE FG -FIXED GRADE NODE PU -PUMP LINE
CV -CHECK VALVE RV -REGULATING VALVE TK -STORAGE TANK

PIPE NUMBER	NODE NOS. #1	#2	FLOWRATE (gpm)	HEAD LOSS (ft)	PUMP HEAD (ft)	MINOR LOSS (ft)	LINE VELO. (ft/s)	HL/ 1000 (ft/ft)
1-FGPU	0	203	7032.00	.02	216.07	.00	2.22	.45
2	1	2	6440.89	.90	.00	.00	2.92	.92
3	1	2	489.75	.90	.00	.00	1.39	.92
4	2	3	4280.46	.44	.00	.00	1.35	.18
5	2	3	2650.18	.44	.00	.00	1.20	.18
6-FG	0	204	2570.04	2.54	.00	.00	2.63	1.41
7	3	4	7806.58	.73	.00	.00	2.46	.54
8	3	4	4833.33	.73	.00	.00	2.19	.54
9	3	4	1536.16	.73	.00	.00	1.57	.54
10	4	5	7279.02	.78	.00	.00	2.29	.40
11	4	5	4506.70	.78	.00	.00	2.05	.48
12	4	5	1432.35	.78	.00	.00	1.46	.48
13	5	6	6712.62	.76	.00	.00	2.12	.41
14	5	6	4156.02	.76	.00	.00	1.89	.41
15	6	7	3931.33	.14	.00	.00	1.78	.37
16-XXPU	7	8						
17-XXPU	7	8						
18-XXPU	7	8						
19-CV	7	8	3931.33	.01	.00	.00	1.78	.37
20	8	9	.00	.00	.00	.00	.00	.00
21	9	208	.00	.00	.00	.00	.00	.00
22	205	10	10868.64	7.28	.00	.00	4.93	2.43
23-FG	0	10	29461.46	13.54	.00	.00	6.82	2.99

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24	210	11	20799.42	12.94	.00	.00	4.82	1.57
25-CV	5	12	2141.43	21.22	.00	.00	3.42	2.97
26	12	11	752.24	.81	.00	.00	1.20	.43
27	11	13	21266.12	6.13	.00	.00	4.92	1.63
28	12	14	.00	.00	.00	.00	.00	.00
29-XX	14	15						
30	16	15	269.82	.08	.00	.00	.43	.06
31	17	16	603.82	.20	.00	.00	.96	.28
32	13	17	728.82	.08	.00	.00	1.16	.40
33	12	18	918.18	5.90	.00	.00	2.68	2.96
34	18	19	449.18	1.41	.00	.00	1.27	.78
35	15	19	19.82	.01	.00	.00	.06	.00
36	13	20	20225.30	3.94	.00	.08	6.37	3.16
37	20	21	19982.30	.71	.00	.00	6.30	3.09
38	21	22	19839.30	.61	.00	.08	6.25	3.04
39	22	23	19696.30	.60	.00	.00	6.21	3.00
40	23	24	19552.30	1.13	.00	.00	6.16	2.96
41-XX	15	28						
42	24	25	17492.12	2.65	.00	.00	5.51	2.41
43	25	26	17492.12	1.05	.00	.00	7.94	5.86
44	26	27	15752.08	.20	.00	.00	4.96	1.99
45	28	27	.00	.00	.00	.00	.00	.00
46-XX	28	35						
47	27	79	15752.08	4.87	.00	.00	4.96	1.99
48	24	29	2060.19	.30	.00	.00	3.29	2.76
49	29	30	1861.19	7.97	.00	.00	5.28	10.92
50	30	31	1488.19	7.00	.00	.00	4.22	7.22
51	31	32	1059.19	6.53	.00	.00	3.00	3.84
52	33	32	32.37	.00	.00	.80	.09	.01
53	34	33	230.37	.13	.00	.00	.65	.23
54	35	34	.00	.00	.00	.00	.00	.00
55-XX	35	48						
56	36	37	2008.83	8.80	.08	.00	5.70	12.58
57	37	38	736.37	.69	.08	.00	2.09	1.96
58	38	34	413.37	.47	.00	.00	1.17	.67
59	37	39	666.95	2.12	.00	.00	1.89	1.63
60	32	39	498.73	.83	.00	.00	1.41	.95
61	32	40	592.82	1.50	.00	.00	1.68	1.31
62	40	41	291.82	.41	.00	.00	.83	.35
63	39	41	445.18	1.07	.00	.00	1.26	.77
64	39	42	1084.00	5.94	.00	.00	3.07	4.01
65	42	44	1042.00	.45	.00	.00	2.96	3.73
66	41	43	737.00	.37	.00	.00	1.18	.41
67	37	54	605.51	1.36	.00	.00	1.72	1.36
68	54	53	294.51	.37	.00	.00	.84	.36
69	53	39	363.49	.39	.00	.00	1.03	.53
70	52	53	138.98	.07	.00	.00	.39	.09
71	51	52	138.98	.04	.00	.00	.39	.09
72	50	51	493.98	.54	.00	.00	1.40	.94
73	50	49	150.00	.10	.00	.00	.43	.10
74	79	71	15752.08	.30	.00	.00	4.96	1.99
75-XX	48	36						
76	46	47	198.00	1.72	.00	.00	1.26	1.24
77	45	46	417.00	.95	.00	.00	1.18	.68
78	43	45	636.00	2.08	.00	.00	1.80	1.49
79	55	50	821.98	2.44	.00	.00	2.33	2.40
80	56	55	1020.98	3.59	.00	.00	2.90	3.59
81	57	56	1373.98	2.89	.00	.80	3.90	6.22

82-XX	36	57						
83	71	77	12712.07	2.67	.00	.00	4.01	1.34
84	77	57	1373.98	.93	.00	.00	3.90	6.22
85	26	58	1740.03	3.47	.00	.00	4.94	9.64
86	58	59	1347.11	3.78	.00	.00	3.82	6.00
87	58	60	392.92	2.87	.00	.00	2.51	4.41
88	60	61	226.92	1.04	.00	.00	1.45	1.60
89	59	61	231.08	.13	.00	.00	.66	.23
90	61	62	458.00	.57	.00	.00	1.28	.79
91	62	63	323.00	.40	.00	.00	.92	.43
92	59	64	1116.03	1.31	.00	.00	3.17	4.23
93	64	65	936.03	1.28	.00	.00	2.66	3.06
94	65	66	602.03	.43	.00	.00	1.71	1.35
95	66	67	77.03	.02	.00	.00	.22	.03
96	68	67	28.97	.00	.00	.00	.08	.00
97	69	68	134.97	.02	.00	.00	.38	.08
98	70	69	240.97	.08	.00	.00	.68	.25
99	71	70	1031.19	4.83	.00	.00	2.93	3.66
100	79	48	.00	.00	.00	.00	.00	.00
101	70	72	790.22	.92	.00	.00	2.24	2.23
102	72	73	368.22	.21	.00	.00	1.04	.54
103	73	74	74.22	.02	.00	.00	.21	.03
104	75	74	153.78	.05	.00	.00	.44	.11
105	76	75	680.78	1.37	.00	.00	1.93	1.70
106	77	76	873.78	1.88	.00	.00	2.48	2.69
107	77	78	10433.30	1.46	.00	.00	3.29	.93
108-XX	57	78						
109	71	36	2088.83	2.64	.00	.00	5.70	12.58
110	70	80	5042.03	4.40	.00	.00	5.15	4.89
111	78	80	1206.27	4.40	.00	.00	3.42	4.89
112	80	81	2884.85	2.12	.00	.00	2.95	1.74
113	80	82	3309.55	7.78	.00	.00	5.28	6.65
114	81	84	2816.05	3.45	.80	.00	4.49	4.93
115	82	83	268.83	1.38	.00	.00	1.72	2.19
116	84	83	318.18	3.58	.08	.00	2.03	2.99
117	82	89	2759.12	4.27	.00	.00	4.40	4.75
118	83	85	47.28	.09	.00	.00	.30	.09
119	83	86	318.93	3.10	.00	.00	2.04	3.00
120	84	85	2340.67	3.60	.00	.00	3.73	3.50
121	89	91	2632.42	2.83	.00	.00	4.20	4.35
122	87	88	.00	.00	.00	.00	.00	.00
123	86	87	102.90	.25	.00	.00	.66	.37
124	85	86	296.40	3.01	.00	.00	1.89	2.62
125	85	94	1762.35	2.48	.00	.00	2.61	2.07
126	82	113	281.60	.67	.00	.00	1.80	2.38
127	91	90	306.70	.24	.00	.00	.87	.39
128	91	92	160.25	.12	.00	.00	.45	.12
129	93	92	210.38	.18	.00	.00	.68	.19
130	86	93	385.94	2.56	.00	.00	2.46	4.27
131	94	93	315.66	3.09	.80	.00	2.01	2.94
132	92	96	370.63	1.11	.00	.00	2.37	3.96
133	93	103	457.41	.84	.00	.00	1.30	.81
134	94	104	1249.29	.88	.00	.00	1.99	1.09
135	95	98	56.69	.07	.00	.00	.36	.12
136	96	95	98.49	.27	.00	.00	.63	.34
137	96	100	114.83	.24	.00	.00	.73	.45
138	97	101	30.21	.03	.00	.00	.19	.04
139	96	97	72.81	.15	.00	.00	.46	.19

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140	98	99	14.89	.01	.00	.00	.10	.01
141	100	99	98.62	.11	.00	.00	.63	.34
142	101	100	42.29	.06	.00	.00	.27	.07
143	99	112	55.81	.09	.00	.00	.36	.12
144	101	112	91.29	.26	.00	.00	.58	.30
145	102	101	161.07	.13	.00	.00	1.03	.85
146	103	102	245.11	.50	.00	.00	1.56	1.84
147	104	103	303.18	3.06	.00	.00	1.94	2.73
148	104	105	848.31	.64	.00	.00	2.41	2.55
149	102	108	83.24	.27	.00	.00	.53	.25
150	103	107	417.68	.62	.00	.00	1.18	.69
151	105	106	807.71	1.30	.00	.00	2.29	2.33
152	107	108	124.12	.15	.00	.00	.79	.52
153	106	107	248.30	1.74	.00	.00	1.58	1.89
154	108	109	170.86	.47	.00	.00	1.09	.94
155	107	110	477.95	.63	.00	.00	1.36	.88
156	106	111	522.91	.97	.00	.00	1.48	1.04
157	109	110	10.71	.00	.00	.00	.07	.01
158	111	110	291.15	1.39	.00	.00	1.86	2.53
159	91	114	2158.97	2.58	.00	.00	2.20	1.02
160	114	115	520.04	2.22	.00	.00	3.32	7.42
201-XXPU	0	211						
202	211	201	.00	.00	.00	.00	.00	.00
203-PGPU	0	202	.00	.00	362.00	.00	.00	.00
204-XX	202	201						
205	201	2	.00	.00	.00	.00	.00	.00
206	203	1	7032.00	.46	.00	.00	3.19	1.08
207	1	204	101.36	.13	.00	.00	.29	.05
208	204	3	2679.40	1.21	.00	.00	2.74	1.52
209-PG	0	3	4566.02	3.75	.00	.00	3.24	1.44
210-XX	6	9						
211-CV	6	205	6937.31	.23	.00	.00	3.15	1.06
212	8	205	3931.33	.09	.00	.00	1.78	.37
213	10	206	41632.42	.23	.00	.00	9.64	5.67
214	206	209	41632.42	.11	.00	.00	9.64	5.67
215	209	210	41632.42	.48	.00	.00	9.64	5.67
216-XX	207	206						
217-XX	207	209						
218	208	207	.00	.00	.00	.00	.00	.00
219	210	212	20833.00	.24	.00	.00	4.82	1.57
220-XXCV	212	213						
221-PU	212	213	10416.50	.33	56.08	.00	7.39	6.65
222-PU	213	213	10416.50	.33	56.08	.00	7.39	6.65
223-XXPU	212	213						
224-XXCV	208	215						
225	214	215	7933.44	.24	.00	.00	5.63	4.02
226	213	214	20833.00	.17	.00	.00	4.82	1.57
227	215	216	7933.44	19.38	.00	.00	3.60	1.36
228	214	216	12899.56	19.62	.00	.00	4.07	1.37
229	216	217	8333.00	1.48	.00	.00	2.63	.61
230	216	218	12500.00	32.71	.00	.00	5.67	3.15
231-XXPG	0	211						
161	115	116	218.82	.76	.00	.00	1.40	1.49
162	116	117	71.22	.21	.00	.00	.45	.19
163	115	118	139.51	.75	.00	.00	.89	.65
164	114	123	1572.93	.66	.00	.00	1.61	.57
165	118	117	108.18	.22	.00	.00	.69	.40
166	123	118	255.96	2.31	.00	.00	1.63	2.00

167	117	121	93.40	.49	.00	.00	.60	.31
168	118	119	187.30	.67	.00	.00	1.20	1.12
169	119	120	62.29	.10	.00	.00	.40	.15
170	121	122	48.60	.06	.00	.00	.31	.09
171	119	122	61.31	.10	.00	.00	.39	.14
172	122	120	1.41	.00	.00	.00	.01	.00
173	123	124	1174.97	.35	.00	.00	1.20	.33
174	124	125	1224.50	.93	.00	.00	1.95	1.05
175	125	126	782.80	.42	.00	.00	1.25	.46
176	126	127	190.80	.02	.00	.00	.30	.03
177	126	128	453.90	.27	.00	.00	.72	.17
178	128	129	259.30	.05	.00	.00	.41	.06
179	129	130	220.60	.04	.00	.00	.35	.04
180	131	124	62.83	.00	.00	.00	.10	.00
181	131	132	164.99	.16	.00	.00	.47	.12
182	132	133	202.80	.04	.00	.00	.32	.04
183	134	132	303.21	.39	.00	.00	.86	.38
184	134	131	504.02	.22	.00	.00	.80	.20
185	136	134	908.43	.95	.00	.00	1.45	.61
186	109	135	123.75	.34	.00	.00	.79	.52
187	110	136	779.81	.38	.00	.00	1.24	.46
188	138	137	195.36	1.26	.00	.00	1.25	1.21
189	135	136	60.25	.04	.00	.00	.30	.14
190	137	136	131.86	.16	.00	.00	.84	.58
191	111	138	195.36	.35	.00	.00	1.25	1.21
192	112	139	131.20	.22	.00	.00	.84	.58
193	139	140	65.60	.14	.00	.00	.42	.16
194	139	141	65.60	.17	.00	.00	.42	.16
240-PG	0	10	3142.77	13.54	.00	.00	5.01	5.21
241	10	240	1840.45	13.76	.00	.00	2.94	1.93
242	240	11	59.76	.01	.00	.00	.10	.00
243	240	11	717.69	.01	.00	.00	.17	.00

JUNCTION NODE RESULTS

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	JUNCTION ELEVATION (ft)	PRESSURE HEAD (ft)	JUNCTION PRESSURE (psi)
1		.00	225.59	120.00	105.59	45.76
2		.00	224.69	75.00	149.69	64.87
3		.00	224.25	77.00	147.25	63.81
4		958.00	223.51	50.00	173.51	75.19
5		208.00	222.73	85.00	137.73	59.68
6		.00	221.97	95.00	126.97	55.02
7		.00	221.84	98.00	123.84	53.66
8		.00	221.83	98.00	123.83	53.66
9		.00	221.83	102.00	119.83	51.93
10		.00	214.46	175.00	39.46	17.10
11		1063.00	200.69	55.00	145.69	63.13
12		471.00	201.50	25.00	176.50	76.49
13		312.00	194.56	45.00	149.56	64.81
14		.00	201.50	45.00	156.50	67.82
15		250.00	194.20	45.00	149.20	64.65
16		334.00	194.28	45.00	149.28	64.69
17		125.00	194.48	45.00	149.48	64.78

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18	469.00	195.60	20.00	175.60	76.09
19	469.00	194.19	30.00	164.19	71.15
20	243.00	190.62	38.00	152.62	66.13
21	143.00	189.91	37.00	152.91	66.26
22	143.00	189.30	36.00	153.30	66.43
23	144.00	188.70	35.00	153.70	66.60
24	.00	187.57	34.00	153.57	66.55
25	.00	184.92	33.00	151.92	65.83
26	.00	183.86	28.00	155.86	67.54
27	.00	183.67	28.00	155.67	67.46
28	.00	183.67	27.00	156.67	67.89
29	199.00	187.27	35.00	152.27	65.98
30	373.00	179.30	36.00	143.30	62.10
31	429.00	172.30	37.00	135.30	58.63
32	.00	165.76	34.00	131.76	57.10
33	198.00	165.77	33.00	132.77	57.53
34	183.00	165.90	31.00	134.90	58.46
35	.00	165.90	34.00	131.90	57.15
36	.00	175.86	34.00	141.86	61.47
37	.00	167.06	34.00	133.06	57.66
38	323.00	166.37	33.00	133.37	57.79
39	.00	164.94	33.00	131.94	57.17
40	301.00	164.27	33.00	131.27	56.88
41	.00	163.86	34.00	129.86	56.27
42	42.00	159.00	34.00	125.00	54.17
43	101.00	163.50	34.00	129.50	56.12
44	1042.00	160.54	33.00	125.54	54.40
45	219.00	161.42	30.00	131.42	56.95
46	219.00	160.47	28.00	132.47	57.40
47	198.00	158.74	25.00	133.74	57.96
48	.00	178.80	35.00	143.80	62.31
49	150.00	165.87	25.00	140.87	61.05
50	178.00	165.97	26.00	139.97	60.66
51	355.00	165.43	27.00	138.43	59.99
52	.00	165.39	28.00	137.39	59.54
53	70.00	165.32	29.00	136.32	59.07
54	311.00	165.69	31.00	134.69	58.37
55	199.00	168.41	27.00	141.41	61.28
56	353.00	172.00	27.00	145.00	62.83
57	.00	174.90	28.00	146.90	63.66
58	.00	180.39	32.00	148.39	64.30
59	.00	176.61	31.00	145.61	63.10
60	166.00	177.53	31.00	146.53	63.49
61	8.00	176.49	31.00	145.49	63.05
62	127.00	175.92	32.00	143.92	62.37
63	323.00	175.52	38.00	137.52	59.59
64	180.00	175.30	30.00	145.30	62.96
65	334.00	174.02	30.00	144.02	62.41
66	525.00	173.59	30.00	143.59	62.22
67	106.00	173.57	30.00	143.57	62.21
68	106.00	173.57	30.00	143.57	62.21
69	106.00	173.59	30.00	143.59	62.22
70	.00	173.67	32.00	141.67	61.39
71	.00	178.50	34.00	144.50	62.62
72	422.00	172.76	32.00	140.76	60.99
73	294.00	172.55	31.00	141.55	61.34
74	228.00	172.52	30.00	142.52	61.76
75	527.00	172.57	30.00	142.57	61.78

76	193.00	173.95	29.00	144.95	62.81
77	31.00	175.83	28.00	147.83	64.06
78	4185.00	174.37	20.00	154.37	66.89
79	.00	178.80	35.00	143.80	62.31
80	53.90	169.97	25.00	144.97	62.82
81	68.80	167.85	25.00	142.85	61.90
82	.00	162.19	25.00	137.19	59.45
83	220.80	160.81	25.00	135.81	58.85
84	157.20	164.39	25.00	139.39	60.40
85	329.20	160.72	25.00	135.72	58.81
86	126.50	157.71	25.00	132.71	57.51
87	102.90	157.46	25.00	132.46	57.40
88	.00	157.46	25.00	132.46	57.40
89	126.70	157.92	25.00	132.92	57.60
90	306.70	154.85	25.00	129.85	56.27
91	6.50	155.09	20.00	135.09	58.54
92	.00	154.96	20.00	134.96	58.48
93	33.80	155.15	20.00	135.15	58.56
94	197.40	158.24	20.00	138.24	59.90
95	41.80	153.59	20.00	133.59	57.89
96	84.50	153.86	20.00	133.86	58.00
97	42.60	153.71	20.00	133.71	57.94
98	41.80	153.52	20.00	133.52	57.86
99	57.70	153.52	20.00	133.52	57.86
100	58.50	153.62	20.00	133.62	57.90
101	58.50	153.68	20.00	133.68	57.93
102	.00	153.81	15.00	138.81	60.15
103	97.80	154.30	15.00	139.30	60.36
104	97.80	157.36	15.00	142.36	61.69
105	40.60	156.72	15.00	141.72	61.41
106	36.50	155.42	15.00	140.42	60.85
107	63.90	153.69	15.00	138.69	60.10
108	36.50	153.53	15.00	138.53	60.03
109	36.40	153.06	15.00	138.06	59.83
110	.00	153.06	15.00	138.06	59.83
111	36.40	154.45	15.00	139.45	60.43
112	15.90	153.42	25.00	128.42	55.65
113	281.60	161.52	20.00	141.52	61.33
114	66.00	152.51	20.00	132.51	57.42
115	161.70	150.28	20.00	130.28	56.46
116	147.60	149.52	20.00	129.52	56.13
117	86.00	149.31	20.00	129.31	56.04
118	100.00	149.54	20.00	129.54	56.13
119	63.70	148.87	20.00	128.87	55.84
120	63.70	148.76	20.00	128.76	55.80
121	44.80	148.82	20.00	128.82	55.82
122	108.50	148.76	20.00	128.76	55.80
123	142.00	151.85	20.00	131.85	57.14
124	13.30	151.51	20.00	131.51	56.99
125	441.70	150.58	20.00	130.58	56.58
126	138.10	150.16	20.00	130.16	56.40
127	190.00	150.14	20.00	130.14	56.39
128	194.60	149.89	20.00	129.89	56.29
129	38.70	149.84	20.00	129.84	56.26
130	220.60	149.00	20.00	129.80	56.25
131	276.20	151.51	20.00	131.51	56.99
132	265.40	151.34	20.00	131.34	56.92
133	202.80	151.30	20.00	131.30	56.90

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134	101.20	151.73	20.00	131.73	57.08
135	63.50	152.72	20.00	132.72	57.51
136	63.50	152.68	20.00	132.68	57.50
137	63.50	152.85	20.00	132.85	57.57
138	.00	154.10	20.00	134.10	58.11
139	.00	153.20	20.00	133.20	57.72
140	65.60	153.06	20.00	133.06	57.66
141	65.60	153.04	20.00	133.04	57.65
201	.00	224.69	70.00	154.69	67.03
202	.00	372.00	135.00	237.00	102.70
203	.00	226.05	130.00	96.05	41.62
204	.00	225.46	80.00	145.46	63.03
205	.00	221.74	102.00	119.74	51.89
206	.00	214.23	175.00	39.23	17.00
207	.00	221.83	175.00	46.83	20.29
208	.00	221.83	175.00	46.83	20.29
209	.00	214.12	175.00	39.12	16.95
210	.00	213.64	175.00	38.64	16.74
211	.00	224.69	208.00	16.69	7.23
212	.00	213.40	175.00	38.40	16.64
213	.00	269.15	175.00	94.15	40.80
214	.00	268.97	175.00	93.97	40.72
215	.00	268.73	175.00	93.73	40.62
216	.00	249.36	130.00	119.36	51.72
217	8333.00	247.87	215.00	32.87	14.24
218	12500.00	216.65	215.00	1.65	.71
240	1063.00	200.70	95.00	105.70	45.80

MAXIMUM AND MINIMUM VALUES

PRESSURES

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
202	102.70	218	.71
12	76.49	211	7.23
18	76.09	217	14.24
4	75.19	212	16.64
19	71.15	210	16.74
28	67.89	209	16.95
14	67.82	206	17.00
26	67.54	10	17.10
27	67.46	207	20.29
201	67.03	208	20.29

VELOCITIES

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
213	9.64	172	.01
214	9.64	35	.05

215	9.64	157	.07
43	7.94	96	.08
221	7.39	52	.09
222	7.39	140	.10
23	6.82	242	.10
36	6.37	180	.10
37	6.30	243	.17
38	6.25	138	.19

SUMMARY OF INFLOWS AND OUTFLOWS

(+) INFLOWS INTO THE SYSTEM FROM FIXED GRADE NODES
(-) OUTFLOWS FROM THE SYSTEM INTO FIXED GRADE NODES

PIPE NUMBER	FLOWRATE (gpm)
1	7032.00
6	2578.04
23	29461.46
203	.00
209	4566.02
240	3142.77

NET SYSTEM INFLOW = 46780.30
NET SYSTEM OUTFLOW = .00
NET SYSTEM DEMAND = 46780.30

DATA CHANGES FOR NEXT SIMULATION

DEMAND CHANGES

DEMAND TYPE = 1 - GDF = .500

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND (gpm)
217	8333.00
218	12500.00
130	4072.00

****
SIMULATION RESULTS
****

THE RESULTS ARE OBTAINED AFTER 2 TRIALS WITH AN ACCURACY = .00482

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P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE FG -FIXED GRADE NODE PU -PUMP LINE
CV -CHECK VALVE RV -REGULATING VALVE TK -STORAGE TANK

PIPE NUMBER	NODE NOS. #1	#2	FLOWRATE (gpm)	HEAD LOSS (ft)	PUMP HEAD (ft)	MINOR LOSS (ft)	LINE VELO. (ft/s)	HL/ 1000 (ft/ft)
1-FGPU	0	203	6984.69	.02	210.08	.00	2.20	.44
2	1	2	6260.22	.86	.00	.00	2.84	.87
3	1	2	476.01	.86	.00	.00	1.35	.87
4	2	3	4160.39	.42	.00	.00	1.31	.17
5	2	3	2575.84	.42	.00	.00	1.17	.17
6-FG	0	204	1607.56	1.06	.00	.00	1.64	.59
7	3	4	6357.27	.50	.00	.00	2.00	.37
8	3	4	3936.01	.50	.00	.00	1.79	.37
9	3	4	1250.97	.50	.00	.00	1.28	.37
10	4	5	6093.49	.56	.00	.00	1.92	.34
11	4	5	3772.70	.56	.00	.00	1.71	.34
12	4	5	1199.06	.56	.00	.00	1.22	.34
13	5	6	5799.55	.58	.00	.00	1.83	.31
14	5	6	3590.71	.58	.00	.00	1.63	.31
15	6	7	3396.26	.10	.00	.00	1.54	.28
16-XXPU	7	8						
17-XXPU	7	8						
18-XXPU	7	8						
19-CV	7	8	3396.26	.01	.00	.00	1.54	.28
20	8	9	.00	.00	.00	.00	.00	.00
21	9	208	.00	.00	.00	.00	.00	.00
22	205	10	9390.26	5.55	.00	.00	4.26	1.85
23-FG	0	10	23696.32	9.05	.00	.00	5.49	2.00
24	210	11	13560.59	5.86	.00	.00	3.14	.71
25-CV	5	12	1571.00	11.96	.00	.00	2.51	1.67
26	12	11	740.69	.79	.00	.00	1.18	.42
27	11	13	14459.04	3.00	.00	.00	3.35	.80
28	12	14	.00	.00	.00	.00	.00	.00
29-XX	14	15						
30	16	15	-.81	.00	.00	.00	.00	.00
31	17	16	166.19	.02	.00	.00	.27	.03
32	13	17	228.69	.01	.00	.00	.36	.05
33	12	18	594.81	2.64	.00	.00	1.69	1.32
34	18	19	360.31	.94	.00	.00	1.02	.52
35	15	19	-125.81	.24	.00	.00	.36	.07
36	13	20	14074.35	2.02	.00	.00	4.44	1.61
37	20	21	13952.85	.36	.00	.00	4.40	1.59
38	21	22	13881.35	.31	.00	.00	4.38	1.57
39	22	23	13809.85	.31	.00	.00	4.35	1.56
40	23	24	13737.85	.59	.00	.00	4.33	1.54
41-XX	15	28						
42	24	25	12575.39	1.44	.00	.00	3.96	1.31
43	25	26	12575.39	.57	.00	.00	5.71	3.18
44	26	27	11548.85	.11	.00	.00	3.64	1.12
45	28	27	.00	.00	.00	.00	.00	.00
46-XX	28	35						
47	27	79	11548.85	2.74	.00	.00	3.64	1.12
48	34	29	1162.46	.11	.00	.00	1.85	.96
49	29	30	1062.96	2.82	.00	.00	3.02	3.87

50	30	31	876.46	2.63	.00	.00	2.49	2.71
51	31	32	661.96	2.74	.00	.00	1.88	1.61
52	33	32	-31.62	.00	.00	.00	.09	.01
53	34	33	67.38	.01	.00	.00	.19	.02
54	35	34	.00	.00	.00	.00	.00	.00
55-XX	35	48						
56	36	37	978.65	2.32	.00	.00	2.78	3.32
57	37	38	320.38	.15	.00	.00	.91	.42
58	38	34	158.88	.08	.00	.00	.45	.11
59	37	39	334.53	.59	.00	.00	.95	.45
60	32	39	314.97	.35	.00	.00	.89	.41
61	32	40	315.37	.46	.00	.00	.89	.41
62	40	41	164.87	.14	.00	.00	.47	.12
63	39	41	203.63	.25	.00	.00	.58	.18
64	39	42	542.00	1.64	.00	.00	1.54	1.11
65	42	44	521.00	.13	.00	.00	1.48	1.03
66	41	43	368.50	.10	.00	.00	.59	.11
67	37	54	323.74	.43	.00	.00	.92	.43
68	54	53	168.24	.13	.00	.00	.48	.13
69	53	39	96.13	.03	.00	.00	.27	.05
70	52	53	-37.11	.01	.00	.00	.11	.01
71	51	52	-37.11	.00	.00	.00	.11	.01
72	50	51	140.39	.05	.00	.00	.40	.09
73	50	49	75.00	.03	.00	.00	.21	.03
74	79	71	11548.85	.17	.00	.00	3.64	1.12
75-XX	48	36						
76	46	47	99.00	.48	.00	.00	.63	.34
77	45	46	208.50	.26	.00	.00	.59	.19
78	43	45	318.00	.58	.00	.00	.90	.41
79	55	50	304.39	.39	.00	.00	.86	.38
00	56	55	403.89	.64	.00	.00	1.15	.64
81	57	56	580.39	.59	.00	.00	1.65	1.26
82-XX	36	57						
83	71	77	10059.04	1.73	.00	.00	3.17	.87
84	77	57	580.39	.19	.00	.00	1.65	1.26
85	26	58	1026.55	1.31	.00	.00	2.91	3.63
86	58	59	801.05	1.44	.00	.00	2.27	2.29
87	58	60	225.49	1.03	.00	.00	1.44	1.58
88	60	61	142.49	.44	.00	.00	.91	.67
89	59	61	86.51	.02	.00	.00	.25	.04
90	61	62	225.00	.16	.00	.00	.64	.22
91	62	63	161.50	.11	.00	.00	.46	.12
92	59	64	714.55	.57	.00	.00	2.03	1.85
93	64	65	624.55	.61	.00	.00	1.77	1.45
94	65	66	457.55	.26	.00	.00	1.30	.81
95	66	67	195.05	.10	.00	.00	.55	.17
96	68	67	-142.05	.04	.00	.00	.40	.09
97	69	68	-89.05	.01	.00	.00	.25	.04
98	70	69	-36.05	.00	.00	.00	.10	.01
99	71	70	511.15	1.32	.00	.00	1.45	1.00
100	79	48	.00	.00	.00	.00	.00	.00
101	70	72	547.20	.46	.00	.00	1.55	1.13
102	72	73	336.20	.18	.00	.00	.95	.46
103	73	74	189.20	.12	.00	.00	.54	.16
104	75	74	-75.20	.01	.00	.00	.21	.03
105	76	75	188.30	.13	.00	.00	.53	.16
106	77	76	284.80	.24	.00	.00	.81	.34
107	77	78	9178.35	1.15	.00	.00	2.89	.73

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108-XX	57	78						
109	71	36	978.65	.70	.00	.00	2.78	3.32
110	78	80	5717.88	5.56	.00	.00	5.84	6.17
111	78	80	1367.97	5.56	.00	.00	3.88	6.17
112	80	81	3154.47	2.50	.00	.00	3.22	2.05
113	80	82	3904.43	10.56	.00	.00	6.23	9.03
114	81	84	3120.07	4.17	.00	.00	4.98	5.96
115	82	83	183.81	.68	.00	.00	1.17	1.08
116	84	83	362.65	4.56	.00	.00	2.31	3.80
117	82	89	3579.81	6.92	.00	.00	5.71	7.69
118	83	85	62.96	.16	.00	.00	.40	.15
119	83	86	373.10	4.15	.00	.00	2.38	4.01
120	84	85	2678.82	4.72	.00	.00	4.27	4.49
121	89	91	3516.46	4.83	.00	.00	5.61	7.44
122	87	88	.00	.00	.00	.00	.00	.00
123	86	87	51.45	.07	.00	.00	.33	.10
124	85	86	345.34	4.00	.00	.00	2.20	3.47
125	85	94	2231.04	3.85	.00	.00	3.56	3.20
126	82	113	140.80	.18	.00	.00	.90	.66
127	91	90	193.35	.07	.00	.00	.43	.11
128	91	92	-218.63	.22	.00	.00	.62	.21
129	93	92	682.64	.85	.00	.00	1.37	.90
130	86	93	603.75	5.87	.00	.00	3.85	9.78
131	94	93	452.41	6.02	.00	.00	2.89	5.73
132	92	96	264.02	.59	.00	.00	1.69	2.11
133	93	103	556.61	1.21	.00	.00	1.58	1.17
134	94	104	1680.73	1.52	.00	.00	2.68	1.90
135	95	98	43.08	.04	.00	.00	.27	.07
136	96	95	63.98	.12	.00	.00	.41	.15
137	96	100	91.64	.15	.00	.00	.58	.30
138	97	101	44.84	.06	.00	.00	.29	.08
139	96	97	66.14	.13	.00	.00	.42	.16
140	98	99	22.18	.02	.00	.00	.14	.02
141	100	99	42.55	.02	.00	.00	.27	.07
142	101	100	-19.84	.01	.00	.00	.13	.02
143	99	112	35.89	.04	.00	.00	.23	.05
144	101	112	37.66	.05	.00	.00	.24	.06
145	102	101	2.23	.00	.00	.00	.01	.00
146	103	102	216.63	.39	.00	.00	1.37	1.44
147	104	103	424.85	5.71	.00	.00	2.71	5.10
148	104	105	1206.98	1.22	.00	.00	3.42	4.90
149	102	108	212.40	1.54	.00	.00	1.36	1.41
150	103	107	717.93	1.68	.00	.00	2.06	1.87
151	105	106	1186.68	2.66	.00	.00	3.37	4.74
152	107	108	148.41	.21	.00	.00	.95	.73
153	106	107	363.43	3.51	.00	.00	2.32	3.82
154	108	109	342.56	1.71	.00	.00	2.19	3.42
155	107	110	901.00	2.02	.00	.00	2.56	2.85
156	106	111	805.00	2.15	.00	.00	2.28	2.31
157	109	110	101.82	.11	.00	.00	.65	.36
158	111	110	670.18	3.38	.00	.00	3.00	6.15
159	91	114	3578.49	6.58	.00	.00	3.65	2.59
160	114	115	401.03	1.37	.00	.00	2.56	4.58
201-XXPU	0	211						
202	211	201	.00	.00	.00	.00	.00	.00
203-FGPU	0	202	.00	.00	362.00	.00	.00	.00
204-XX	202	201						
205	201	2	.00	.00	.00	.00	.00	.00

206	203	1	6984.69	.45	.00	.00	3.17	1.07
207	1	204	248.46	.71	.00	.00	.70	.26
208	204	3	1856.02	.61	.00	.00	1.90	.77
209-FG	0	3	2952.00	1.67	.00	.00	2.09	.64
210-XX	6	9						
211-CV	6	205	5994.00	.18	.00	.00	2.72	.81
212	8	205	3396.26	.07	.00	.00	1.54	.28
213	10	206	34393.59	.16	.00	.00	7.96	3.98
214	206	209	34393.59	.08	.00	.00	7.96	3.98
215	209	210	34393.59	.34	.00	.00	7.96	3.98
216-XX	207	206						
217-XX	207	209						
218	208	207	.00	.00	.00	.00	.00	.00
219	210	212	20833.00	.24	.00	.00	4.82	1.57
220-XXCV	212	213						
221-PU	212	213	10416.50	.33	56.08	.00	7.39	6.65
222-PU	212	213	10416.50	.33	56.08	.00	7.39	6.65
223-XXPU	212	213						
224-XXCV	208	215						
225	214	215	7933.44	.24	.00	.00	5.63	4.02
226	213	214	20833.00	.17	.00	.00	4.82	1.57
227	215	216	7933.44	19.38	.00	.00	3.60	1.36
228	214	216	12899.56	19.62	.00	.00	4.07	1.37
229	216	217	8333.00	1.48	.00	.00	2.63	.61
230	216	218	12500.00	32.71	.00	.00	5.67	3.15
231-XXFG	0	211						
161	115	116	169.78	.48	.00	.00	1.08	.93
162	116	117	95.98	.36	.00	.00	.61	.32
163	115	118	150.41	.86	.00	.00	.96	.75
164	114	123	3144.46	2.37	.00	.00	3.21	2.04
165	118	117	.94	.00	.00	.00	.01	.00
166	123	118	-13.03	.01	.00	.00	.08	.01
167	117	121	53.91	.18	.00	.00	.34	.11
168	118	119	86.44	.16	.00	.00	.55	.27
169	119	120	27.78	.02	.00	.00	.18	.03
170	121	122	31.51	.03	.00	.00	.20	.04
171	119	122	26.80	.02	.00	.00	.17	.03
172	122	120	4.07	.00	.00	.00	.03	.00
173	123	124	3086.49	2.07	.00	.00	3.15	1.97
174	124	125	4573.95	10.65	.00	.00	7.30	12.10
175	125	126	4353.10	10.05	.00	.00	6.95	11.04
176	126	127	95.40	.01	.00	.00	.15	.01
177	126	128	4188.65	16.45	.00	.00	6.68	10.28
178	128	129	4091.35	8.17	.00	.00	6.53	9.85
179	129	130	4072.00	9.27	.00	.00	6.50	9.76
180	131	124	1494.11	.78	.00	.00	2.38	1.52
181	131	132	-279.54	.44	.00	.00	.79	.33
182	132	133	101.40	.01	.00	.00	.16	.01
183	134	132	513.64	1.03	.00	.00	1.46	1.01
184	134	131	1352.67	1.38	.00	.00	2.16	1.27
185	136	134	1916.91	3.80	.00	.00	3.06	2.42
186	109	135	222.54	1.02	.00	.00	1.42	1.54
187	110	136	1473.00	1.23	.00	.00	2.35	1.48
188	138	137	316.62	3.08	.00	.00	2.02	2.96
189	135	136	190.79	.32	.00	.00	1.22	1.16
190	137	136	284.87	.68	.00	.00	1.82	2.43
191	111	138	316.62	.86	.00	.00	2.02	2.96
192	112	139	65.60	.06	.00	.00	.42	.16

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193	139	140	32.80	.04	.00	.80	.21	.04
194	139	141	32.80	.05	.00	.80	.21	.04
240-FG	8	10	2527.78	9.05	.00	.00	4.03	3.48
241	10	240	1220.76	6.43	.00	.00	1.95	.90
242	240	11	46.88	.01	.00	.00	.07	.00
243	240	11	642.39	.01	.00	.00	.15	.00

J U N C T I O N N O D E R E S U L T S

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	JUNCTION ELEVATION (ft)	PRESSURE HEAD (ft)	JUNCTION PRESSURE (psi)
1		.00	227.60	120.00	107.60	46.63
2		.00	226.75	75.00	151.75	65.76
3		.00	226.33	77.00	149.33	64.71
4		479.00	225.83	50.00	175.83	76.19
5		104.00	225.26	85.00	140.26	60.78
6		.00	224.68	95.00	129.68	56.20
7		.00	224.58	98.00	126.58	54.85
8		.00	224.58	98.00	126.58	54.85
9		.00	224.58	102.00	122.58	53.12
10		.00	218.95	175.00	43.95	19.05
11		531.50	212.51	55.00	157.51	68.26
12		235.50	213.30	25.00	188.30	81.60
13		156.00	209.51	45.00	164.51	71.29
14		.00	213.30	45.00	168.30	72.93
15		125.00	209.49	45.00	164.49	71.28
16		167.00	209.49	45.00	164.49	71.28
17		62.50	209.51	45.00	164.51	71.29
18		234.50	210.66	20.00	190.66	82.62
19		234.50	209.72	30.00	179.72	77.88
20		121.50	207.50	38.00	169.50	73.45
21		71.50	207.13	37.00	170.13	73.72
22		71.50	206.82	36.00	170.82	74.02
23		72.00	206.51	35.00	171.51	74.32
24		.00	205.92	34.00	171.92	74.50
25		.00	204.48	33.00	171.48	74.31
26		.00	203.91	28.00	175.91	76.23
27		.00	203.80	28.00	175.80	76.18
28		.00	203.80	27.00	176.80	76.61
29		99.50	205.82	35.00	170.82	74.02
30		186.50	202.99	36.00	166.99	72.36
31		214.50	200.37	37.00	163.37	70.79
32		.00	197.63	34.00	163.63	70.91
33		99.00	197.63	33.00	164.63	71.34
34		91.50	197.64	31.08	166.64	72.21
35		.00	197.64	34.00	163.64	70.91
36		.00	200.20	34.00	166.20	72.02
37		.00	197.87	34.00	163.87	71.01
38		161.50	197.72	33.00	164.72	71.38
39		.00	197.28	33.00	164.28	71.19
40		150.50	197.17	33.00	164.17	71.14
41		.00	197.03	34.00	163.03	70.65
42		21.00	195.64	34.00	161.64	70.04
43		50.50	196.93	34.00	162.93	70.60

44	521.00	195.51	33.00	162.51	70.42
45	109.50	196.35	30.00	166.35	72.09
46	109.50	196.09	28.00	168.09	72.84
47	99.00	195.61	25.00	170.61	73.93
48	.00	201.06	35.00	166.06	71.96
49	75.00	197.33	25.00	172.33	74.67
50	89.00	197.35	26.00	171.35	74.25
51	177.50	197.30	27.00	170.30	73.80
52	.00	197.31	28.00	169.31	73.37
53	35.00	197.31	29.00	168.31	72.94
54	155.50	197.44	31.00	166.44	72.13
55	99.50	197.74	27.00	170.74	73.99
56	176.50	198.39	27.00	171.39	74.27
57	.00	198.97	28.00	170.97	74.09
58	.00	202.61	32.00	170.61	73.93
59	.00	201.16	31.00	170.16	73.74
60	83.00	201.58	31.00	170.58	73.92
61	4.00	201.14	31.00	170.14	73.73
62	63.50	200.98	32.00	168.98	73.23
63	161.50	200.87	38.00	162.87	70.58
64	90.00	200.59	30.00	170.59	73.92
65	167.00	199.98	30.00	169.98	73.66
66	262.50	199.72	30.00	169.72	73.55
67	53.00	199.63	30.00	169.63	73.50
68	53.00	199.59	30.00	169.59	73.49
69	53.00	199.58	30.00	169.58	73.48
70	.00	199.58	32.00	167.58	72.62
71	.00	200.89	34.00	166.89	72.32
72	211.00	199.11	32.00	167.11	72.42
73	147.00	198.93	31.00	167.93	72.77
74	114.00	198.81	30.00	168.81	73.15
75	263.50	198.80	30.00	168.80	73.15
76	96.50	198.93	29.00	169.93	73.63
77	15.50	199.16	28.00	171.16	74.17
78	2092.50	196.01	20.00	178.01	77.14
79	.00	201.06	35.00	166.06	71.96
80	26.95	192.45	25.00	167.45	72.56
81	34.40	189.95	25.00	164.95	71.48
82	.00	181.89	25.00	156.89	67.98
83	118.40	181.21	25.00	156.21	67.69
84	78.60	185.78	25.00	160.78	69.67
85	164.60	181.06	25.00	156.06	67.63
86	63.25	177.06	25.00	152.06	65.89
87	51.45	176.99	25.00	151.99	65.86
88	.00	176.99	25.00	151.99	65.86
89	63.35	174.97	25.00	149.97	64.99
90	153.35	170.07	25.00	145.07	62.86
91	3.25	170.13	20.00	150.13	65.06
92	.00	170.36	20.00	150.36	65.15
93	16.90	171.19	20.00	151.19	65.52
94	98.70	177.21	20.00	157.21	68.13
95	20.90	169.64	20.00	149.64	64.85
96	42.25	169.76	20.00	149.76	64.90
97	21.30	169.64	20.00	149.64	64.84
98	20.90	169.60	20.00	149.60	64.83
99	28.85	169.59	20.00	149.59	64.82
100	29.25	169.61	20.00	149.61	64.83
101	29.25	169.59	20.00	149.59	64.82

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102	.00	169.59	15.00	154.59	66.99
103	48.90	169.98	15.00	154.98	67.16
104	48.90	175.70	15.00	160.70	69.64
105	20.30	174.47	15.00	159.47	69.10
106	18.25	171.82	15.00	156.82	67.95
107	31.95	168.29	15.00	153.29	66.43
108	18.25	168.05	15.00	153.05	66.32
109	18.20	166.34	15.00	151.34	65.58
110	.00	166.27	15.00	151.27	65.55
111	18.20	169.67	15.00	154.67	67.02
112	7.95	169.54	25.00	144.54	62.63
113	140.80	181.70	20.00	161.70	70.07
114	33.00	163.55	20.00	143.55	62.21
115	80.85	162.18	20.00	142.18	61.61
116	73.80	161.70	20.00	141.70	61.40
117	43.00	161.34	20.00	141.34	61.25
118	50.00	161.32	20.00	141.32	61.24
119	31.85	161.16	20.00	141.16	61.17
120	31.85	161.14	20.00	141.14	61.16
121	22.40	161.16	20.00	141.16	61.17
122	54.25	161.14	20.00	141.14	61.16
123	71.00	161.19	20.00	141.19	61.18
124	6.65	159.12	20.00	139.12	60.28
125	220.85	148.47	20.00	128.47	55.67
126	69.05	138.42	20.00	118.42	51.31
127	95.40	138.41	20.00	118.41	51.31
128	97.30	121.96	20.00	101.96	44.18
129	19.35	113.79	20.00	93.79	40.64
130	4072.00	104.52	20.00	84.52	36.63
131	138.10	159.89	20.00	139.89	60.62
132	132.70	160.33	20.00	140.33	60.81
133	101.40	160.32	20.00	140.32	60.81
134	50.60	161.28	20.00	141.28	61.22
135	31.75	165.32	20.00	145.32	62.97
136	31.75	165.04	20.00	145.04	62.85
137	31.75	165.72	20.00	145.72	63.15
138	.00	168.81	20.00	148.81	64.48
139	.00	169.48	20.00	149.48	64.77
140	32.80	169.44	20.00	149.44	64.76
141	32.80	169.43	20.00	149.43	64.75
201	.00	226.75	70.00	156.75	67.92
202	.00	372.00	135.00	237.00	102.70
203	.00	228.05	130.00	98.05	42.49
204	.00	226.94	80.00	146.94	63.67
205	.00	224.51	102.00	122.51	53.09
206	.00	218.79	175.00	43.79	18.98
207	.00	224.58	175.00	49.58	21.48
208	.00	224.58	175.00	49.58	21.48
209	.00	218.71	175.00	43.71	18.94
210	.00	218.38	175.00	43.38	18.80
211	.00	226.75	208.00	18.75	8.12
212	.00	218.14	175.00	43.14	18.69
213	.00	273.89	175.00	98.89	42.85
214	.00	273.71	175.00	98.71	42.78
215	.00	273.47	175.00	98.47	42.67
216	.00	254.10	130.00	124.10	53.77
217	8333.00	252.61	215.00	37.61	16.30
218	12500.00	221.39	215.00	6.39	2.77

240	531.50	212.52	95.00	117.52	50.93

MAXIMUM AND MINIMUM VALUES

PRESSURES

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
202	102.70	216	2.77
18	82.62	211	8.12
12	81.60	217	16.30
19	77.88	212	18.69
78	77.14	210	18.80
28	76.61	209	18.94
26	76.23	206	18.98
4	76.19	10	19.05
27	76.18	207	21.48
49	74.67	208	21.48

VELOCITIES

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
213	7.96	30	.00
214	7.96	165	.01
215	7.96	145	.01
221	7.39	172	.03
222	7.39	242	.07
174	7.30	166	.08
176	6.95	52	.09
177	6.68	98	.10
178	6.53	70	.11
179	6.50	71	.11

SUMMARY OF INFLOWS AND OUTFLOWS

(+) INFLOWS INTO THE SYSTEM FROM FIXED GRADE NODES
(-) OUTFLOWS FROM THE SYSTEM INTO FIXED GRADE NODES

PIPE NUMBER	FLOWRATE (gpm)
1	6984.69
6	1607.56
23	23696.32
203	.00
209	2952.00
240	2527.78

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NET SYSTEM INFLOW = 37768.35
NET SYSTEM OUTFLOW = .00
NET SYSTEM DEMAND = 37768.35

D A T A C H A N G E S F O R N E X T S I M U L A T I O N

D E M A N D C H A N G E S

DEMAND TYPE = 1 - GDF = .500

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND (gpm)
217	8333.00
218	12500.00
133	4073.00

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S I M U L A T I O N R E S U L T S
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THE RESULTS ARE OBTAINED AFTER 2 TRIALS WITH AN ACCURACY = .00386

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE FG -FIXED GRADE NODE PU -PUMP LINE
CV -CHECK VALVE RV -REGULATING VALVE TK -STORAGE TANK

PIPE NUMBER	NODE NOS. #1	#2	FLOWRATE (gpm)	HEAD LOSS (ft)	PUMP HEAD (ft)	MINOR LOSS (ft)	LINE VELO. (ft/s)	HL/ 1000 (ft/ft)
1-FGPU	0	203	6984.64	.02	218.08	.00	2.20	.44
2	1	2	6267.06	.86	.00	.00	2.84	.88
3	1	2	476.53	.86	.00	.00	1.35	.88
4	2	3	4164.93	.42	.00	.00	1.31	.17
5	2	3	2578.66	.42	.00	.00	1.17	.17
6-FG	0	204	1610.12	1.06	.00	.00	1.64	.59
7	3	4	6358.96	.50	.00	.00	2.00	.37
8	3	4	3937.06	.50	.00	.00	1.79	.37
9	3	4	1251.30	.50	.00	.00	1.28	.37
10	4	5	6095.18	.56	.00	.00	1.92	.34
11	4	5	3773.74	.56	.00	.00	1.71	.34
12	4	5	1199.39	.56	.00	.00	1.22	.34
13	5	6	5801.04	.58	.00	.00	1.83	.31
14	5	6	3591.63	.58	.00	.00	1.63	.31
15	6	7	3397.13	.10	.00	.00	1.54	.28
16-XXPU	7	8						
17-XXPU	7	8						

18-XXPU	7	8						
19-CV	7	8	3397.13	.01	.00	.00	1.54	.28
20	8	9	.00	.00	.00	.00	.00	.00
21	9	208	.00	.00	.00	.00	.00	.00
22	205	10	9392.67	5.56	.00	.00	4.26	1.85
23-FG	0	10	23702.50	9.05	.00	.00	5.49	2.00
24	210	11	13569.12	5.87	.00	.00	3.14	.71
25-CV	5	12	1571.64	11.97	.00	.00	2.51	1.67
26	12	11	741.08	.79	.00	.00	1.18	.42
27	11	13	14468.69	3.00	.00	.00	3.35	.80
28	12	14	.00	.00	.00	.00	.00	.00
29-XX	14	15						
30	16	15	-1.07	.00	.00	.00	.00	.00
31	17	16	165.93	.02	.00	.00	.26	.03
32	13	17	228.43	.01	.00	.00	.36	.05
33	12	18	595.07	2.64	.00	.00	1.69	1.32
34	18	19	360.57	.94	.00	.00	1.02	.52
35	15	19	-126.07	.24	.00	.00	.36	.07
36	13	20	14084.25	2.02	.00	.00	4.44	1.61
37	20	21	13962.75	.37	.00	.00	4.40	1.59
38	21	22	13891.25	.31	.00	.00	4.38	1.57
39	22	23	13819.75	.31	.00	.00	4.36	1.56
40	23	24	13747.75	.59	.00	.00	4.33	1.54
41-XX	15	28						
42	24	25	12584.97	1.44	.00	.00	3.97	1.31
43	25	26	12584.97	.57	.00	.00	5.71	3.18
44	26	27	11558.16	.11	.00	.00	3.64	1.12
45	28	27	.00	.00	.00	.00	.00	.00
46-XX	28	35						
47	27	79	11558.16	2.74	.00	.00	3.64	1.12
48	24	29	1162.78	.11	.00	.00	1.86	.96
49	29	30	1063.28	2.83	.00	.00	3.02	3.87
50	30	31	876.78	2.63	.00	.00	2.49	2.71
51	31	32	662.28	2.74	.00	.00	1.88	1.61
52	33	32	-31.62	.00	.00	.00	.09	.01
53	34	33	67.38	.01	.00	.00	.19	.02
54	35	34	.00	.00	.00	.00	.00	.00
55-XX	35	48						
56	36	37	978.81	2.32	.00	.00	2.78	3.32
57	37	38	320.38	.15	.00	.00	.91	.42
58	38	34	158.88	.08	.00	.00	.45	.11
59	37	39	334.70	.59	.00	.00	.95	.46
60	32	39	315.20	.35	.00	.00	.89	.41
61	32	40	315.46	.46	.00	.00	.89	.41
62	40	41	164.96	.14	.00	.00	.47	.12
63	39	41	203.54	.25	.00	.00	.58	.18
64	39	42	542.00	1.64	.00	.00	1.54	1.11
65	42	44	521.00	.13	.00	.00	1.48	1.03
66	41	43	368.50	.10	.00	.00	.59	.11
67	37	54	323.73	.43	.00	.00	.92	.43
68	54	53	168.23	.13	.00	.00	.48	.13
69	53	39	95.64	.03	.00	.00	.27	.04
70	52	53	-37.59	.01	.00	.00	.11	.01
71	51	52	-37.59	.00	.00	.00	.11	.01
72	50	51	139.91	.05	.00	.00	.40	.09
73	50	49	75.00	.03	.00	.00	.21	.03
74	79	71	11558.16	.17	.00	.00	3.64	1.12
75-XX	48	36						

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76	46	47	99.00	.48	.00	.00	.63	.34
77	45	46	208.50	.26	.00	.00	.59	.19
78	43	45	318.00	.58	.00	.00	.90	.41
79	55	50	303.91	.39	.00	.00	.86	.38
80	56	55	403.41	.64	.00	.00	1.14	.64
81	57	56	579.91	.59	.00	.00	1.64	1.26
82-XX	36	57						
83	71	77	10068.21	1.73	.00	.00	3.17	.87
84	77	57	579.91	.19	.00	.00	1.64	1.26
85	26	58	1026.81	1.31	.00	.00	2.91	3.63
86	58	59	801.27	1.44	.00	.00	2.27	2.29
87	58	60	225.54	1.03	.00	.00	1.44	1.58
88	60	61	142.54	.44	.00	.00	.91	.67
89	59	61	86.46	.02	.00	.00	.25	.04
90	61	62	225.00	.16	.00	.00	.64	.22
91	62	63	161.50	.11	.00	.00	.46	.12
92	59	64	714.81	.58	.00	.00	2.03	1.86
93	64	65	624.81	.61	.00	.00	1.77	1.45
94	65	66	457.81	.26	.00	.00	1.30	.81
95	66	67	195.31	.10	.00	.00	.55	.17
96	68	67	-142.31	.04	.00	.00	.40	.09
97	69	68	-89.31	.01	.00	.00	.25	.04
98	70	69	-36.31	.00	.00	.00	.10	.01
99	71	70	511.14	1.32	.00	.00	1.45	1.00
100	79	48	.00	.00	.00	.00	.00	.00
101	70	72	547.45	.46	.00	.00	1.55	1.13
102	72	73	336.45	.18	.00	.00	.95	.46
103	73	74	189.45	.12	.00	.00	.54	.16
104	75	74	-75.45	.01	.00	.00	.21	.03
105	76	75	188.05	.13	.00	.00	.53	.16
106	77	76	284.55	.24	.00	.00	.81	.34
107	77	78	9188.25	1.16	.00	.00	2.90	.73
108-XX	57	78						
109	71	36	978.81	.70	.00	.00	2.78	3.32
110	78	80	5725.87	5.57	.00	.00	5.85	6.19
111	78	80	1369.88	5.57	.00	.00	3.09	6.19
112	80	81	3181.14	2.54	.00	.00	3.25	2.08
113	80	82	3887.66	10.48	.00	.00	6.20	8.96
114	01	84	3146.74	4.24	.00	.00	5.02	6.05
115	82	83	207.42	.85	.00	.00	1.32	1.35
116	04	03	361.92	4.55	.00	.00	2.31	3.79
117	82	89	3539.44	6.78	.00	.00	5.65	7.53
118	03	85	83.28	.26	.00	.00	.53	.25
119	83	86	375.65	4.20	.00	.00	2.40	4.06
120	84	85	2706.23	4.81	.00	.00	4.32	4.58
121	89	91	3476.09	4.73	.00	.00	5.55	7.28
122	87	88	.00	.00	.00	.00	.00	.00
123	86	87	51.45	.07	.00	.00	.33	.10
124	85	86	342.82	3.94	.00	.00	2.19	3.43
125	85	94	2202.09	4.01	.00	.00	3.64	3.34
126	82	113	140.80	.18	.00	.00	.90	.66
127	91	90	153.35	.07	.00	.00	.43	.11
128	91	92	-64.37	.02	.00	.00	.18	.02
129	93	92	396.38	.59	.00	.00	1.12	.62
130	86	93	603.77	5.87	.00	.00	3.85	9.78
131	94	93	443.62	5.80	.00	.00	2.83	5.52
132	92	96	332.01	.90	.00	.00	2.12	3.23
133	93	103	634.12	1.55	.00	.00	1.80	1.49

134	94	104	1739.76	1.62	.00	.00	2.78	2.02
135	95	98	57.42	.07	.00	.00	.37	.13
136	96	95	78.32	.17	.00	.00	.50	.22
137	96	100	122.51	.27	.00	.00	.78	.51
138	97	101	67.62	.12	.00	.00	.43	.17
139	96	97	88.92	.22	.00	.00	.57	.28
140	98	99	36.52	.04	.00	.00	.23	.05
141	100	99	41.57	.02	.00	.00	.27	.07
142	101	100	-51.69	.08	.00	.00	.33	.10
143	99	112	49.24	.07	.00	.00	.31	.09
144	101	112	24.31	.02	.00	.00	.16	.03
145	102	101	-65.76	.02	.00	.00	.42	.16
146	103	102	185.88	.30	.00	.00	1.19	1.10
147	104	103	425.52	5.73	.00	.00	2.72	5.11
148	104	105	1265.35	1.34	.00	.00	3.59	5.34
149	102	108	251.64	2.11	.00	.00	1.61	1.93
150	103	107	024.85	2.18	.00	.00	2.34	2.42
151	105	106	1245.05	2.90	.00	.00	3.53	5.19
152	107	108	152.50	.22	.00	.00	.97	.76
153	106	107	371.64	3.66	.00	.00	2.37	3.98
154	108	109	385.89	2.13	.00	.00	2.46	4.27
155	107	110	1012.04	2.51	.00	.00	2.87	3.53
156	106	111	855.16	2.41	.00	.00	2.43	2.59
157	109	110	120.52	.15	.00	.00	.77	.49
158	111	110	497.91	3.76	.00	.00	3.18	6.84
159	91	114	3383.86	5.93	.00	.00	3.46	2.34
160	114	115	391.65	1.32	.00	.00	2.50	4.39
201-XXPU	0	211						
202	211	201	.00	.00	.00	.00	.00	.00
203-FGPU	0	202	.00	.00	362.00	.00	.00	.00
204-XX	202	201						
205	201	2	.00	.00	.00	.00	.00	.00
206	203	1	6984.64	.45	.00	.00	3.17	1.07
207	1	204	241.05	.67	.00	.00	.68	.25
208	204	3	1851.17	.61	.00	.00	1.89	.76
209-FG	0	3	2952.55	1.67	.00	.00	2.09	.64
210-XX	6	9						
211-CV	6	205	5995.54	.18	.00	.00	2.72	.81
212	8	205	3397.13	.07	.00	.00	1.54	.28
213	10	206	34402.13	.16	.00	.00	7.97	3.98
214	206	209	34402.13	.08	.00	.00	7.97	3.98
215	209	210	34402.13	.34	.00	.00	7.97	3.98
216-XX	207	206						
217-XX	207	209						
218	208	207	.00	.00	.00	.00	.00	.00
219	210	212	20833.00	.24	.00	.00	4.82	1.57
220-XXCV	212	213						
221-PU	212	213	10416.50	.33	56.08	.00	7.39	6.65
222-PU	212	213	10416.50	.33	56.08	.00	7.39	6.65
223-XXPU	212	213						
224-XXCV	208	215						
225	214	215	7933.44	.24	.00	.00	5.63	4.02
226	213	214	20833.00	.17	.00	.00	4.82	1.57
227	215	216	7933.44	19.38	.00	.00	3.60	1.36
228	214	216	12899.56	19.62	.00	.00	4.07	1.37
229	216	217	8333.00	1.48	.00	.00	2.63	.61
230	216	218	12500.00	32.71	.00	.00	5.67	3.15
231-XXFG	0	211						

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161	115	116	166.38	.46	.00	.00	1.06	.90
162	116	117	92.58	.34	.00	.00	.59	.30
163	115	118	144.43	.80	.00	.00	.92	.69
164	114	123	2959.21	2.11	.00	.00	3.02	1.82
165	118	117	2.51	.00	.00	.00	.02	.00
166	123	118	-3.66	.00	.00	.00	.02	.00
167	117	121	52.09	.17	.00	.00	.33	.10
168	118	119	88.26	.17	.00	.00	.56	.28
169	119	120	28.63	.02	.00	.00	.18	.03
170	121	122	29.69	.02	.00	.00	.19	.04
171	119	122	27.78	.02	.00	.00	.18	.03
172	122	120	3.22	.00	.00	.00	.02	.00
173	123	124	2891.86	1.83	.00	.00	2.95	1.75
174	124	125	612.25	.26	.00	.00	.98	.29
175	125	126	391.40	.12	.00	.00	.62	.13
176	126	127	95.40	.01	.00	.00	.15	.01
177	126	128	226.95	.07	.00	.00	.36	.05
178	128	129	129.65	.01	.00	.00	.21	.02
179	129	130	110.30	.01	.00	.00	.18	.01
180	131	124	-2272.96	1.69	.00	.00	3.63	3.31
181	131	132	1955.40	16.03	.00	.00	5.55	11.96
182	132	133	4073.00	9.86	.00	.00	6.50	9.76
183	134	132	2250.30	15.83	.00	.00	6.38	15.52
184	134	131	-179.46	.03	.00	.00	.29	.03
185	136	134	2121.44	4.58	.00	.00	3.38	2.92
186	109	135	247.17	1.23	.00	.00	1.58	1.87
187	110	136	1630.47	1.49	.00	.00	2.60	1.79
188	138	137	339.04	3.49	.00	.00	2.16	3.36
189	135	136	215.42	.41	.00	.00	1.37	1.45
190	137	136	307.29	.78	.00	.00	1.96	2.80
191	111	138	339.04	.97	.00	.00	2.16	3.36
192	112	139	65.60	.06	.00	.00	.42	.16
193	139	140	32.80	.04	.00	.00	.21	.04
194	139	141	32.80	.05	.00	.00	.21	.04
240-FG	0	10	2528.44	9.05	.00	.00	4.03	3.48
241	10	240	1221.49	6.44	.00	.00	1.95	.90
242	240	11	46.92	.01	.00	.00	.07	.00
243	240	11	643.07	.01	.00	.00	.15	.00

JUNCTION NODE RESULTS

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	JUNCTION ELEVATION (ft)	PRESSURE HEAD (ft)	JUNCTION PRESSURE (psi)
1		.00	227.61	120.00	107.61	46.63
2		.00	226.75	75.00	151.75	65.76
3		.00	226.33	77.00	149.33	64.71
4		479.00	225.83	50.00	175.83	76.19
5		104.00	225.26	85.00	140.26	60.78
6		.00	224.68	95.00	129.68	56.20
7		.00	224.58	98.00	126.58	54.85
8		.00	224.57	98.00	126.57	54.85
9		.00	224.57	102.00	122.57	53.12
10		.00	218.95	175.00	43.95	19.04
11		531.50	212.50	55.00	157.50	68.25

12	235.50	213.29	25.00	188.29	81.59
13	156.00	209.50	45.00	164.50	71.28
14	.00	213.29	45.00	168.29	72.93
15	125.00	209.47	45.00	164.47	71.27
16	167.00	209.47	45.00	164.47	71.27
17	62.50	209.49	45.00	164.49	71.28
18	234.50	210.65	20.00	190.65	82.62
19	234.50	209.71	30.00	179.71	77.87
20	121.50	207.48	38.00	169.48	73.44
21	71.50	207.12	37.00	170.12	73.72
22	71.50	206.80	36.00	170.80	74.01
23	72.00	206.49	35.00	171.49	74.31
24	.00	205.90	34.00	171.90	74.49
25	.00	204.46	33.00	171.46	74.30
26	.00	203.89	28.00	175.89	76.22
27	.00	203.78	28.00	175.78	76.17
28	.00	203.78	27.00	176.78	76.60
29	99.50	205.80	35.00	170.80	74.01
30	186.50	202.97	36.00	166.97	72.35
31	214.50	200.34	37.00	163.34	70.78
32	.00	197.61	34.00	163.61	70.90
33	99.00	197.60	33.00	164.60	71.33
34	91.50	197.62	31.00	166.62	72.20
35	.00	197.62	34.00	163.62	70.90
36	.00	200.17	34.00	166.17	72.01
37	.00	197.84	34.00	163.84	71.00
38	161.50	197.70	33.00	164.70	71.37
39	.00	197.25	33.00	164.25	71.18
40	150.50	197.14	33.00	164.14	71.13
41	.00	197.00	34.00	163.00	70.63
42	21.00	195.61	34.00	161.61	70.03
43	50.50	196.90	34.00	162.90	70.59
44	521.00	195.48	33.00	162.48	70.41
45	109.50	196.32	30.00	166.32	72.07
46	109.50	196.06	28.00	168.06	72.83
47	99.00	195.58	25.00	170.58	73.92
48	.00	201.03	35.00	166.03	71.95
49	75.00	197.30	25.00	172.30	74.66
50	89.00	197.33	26.00	171.33	74.24
51	177.50	197.27	27.00	170.27	73.79
52	.00	197.28	28.00	169.28	73.35
53	35.00	197.28	29.00	168.28	72.92
54	155.50	197.42	31.00	166.42	72.11
55	99.50	197.71	27.00	170.71	73.98
56	176.50	198.36	27.00	171.36	74.25
57	.00	198.94	28.00	170.94	74.08
58	.00	202.58	32.00	170.58	73.92
59	.00	201.14	31.00	170.14	73.73
60	83.00	201.56	31.00	170.56	73.91
61	4.00	201.12	31.00	170.12	73.72
62	63.50	200.96	32.00	168.96	73.22
63	161.50	200.85	38.00	162.85	70.57
64	90.00	200.56	30.00	170.56	73.91
65	167.00	199.95	30.00	169.95	73.65
66	262.50	199.69	30.00	169.69	73.53
67	53.00	199.60	30.00	169.60	73.49
68	53.00	199.56	30.00	169.56	73.48
69	53.00	199.55	30.00	169.55	73.47

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70	.00	199.55	32.00	167.55	72.60
71	.00	200.87	34.00	166.87	72.31
72	211.00	199.09	32.00	167.09	72.40
73	147.00	198.91	31.00	167.91	72.76
74	114.00	198.78	30.00	168.78	73.14
75	263.50	198.77	30.00	168.77	73.13
76	96.50	198.90	29.00	169.90	73.62
77	15.50	199.13	28.00	171.13	74.16
78	2092.50	197.97	20.00	177.97	77.12
79	.00	201.03	35.00	166.03	71.95
80	26.95	192.40	25.00	167.40	72.54
81	34.40	189.86	25.00	164.86	71.44
82	.00	181.93	25.00	156.93	68.00
83	110.40	181.07	25.00	156.07	67.63
84	78.60	185.62	25.00	160.62	69.60
85	164.60	180.82	25.00	155.82	67.52
86	63.25	176.87	25.00	151.87	65.81
87	51.45	176.80	25.00	151.80	65.78
88	.00	176.80	25.00	151.80	65.78
89	63.35	175.15	25.00	150.15	65.06
90	153.35	170.35	25.00	145.35	62.99
91	3.25	170.42	20.00	150.42	65.18
92	.00	170.44	20.00	150.44	65.19
93	16.90	171.00	20.00	151.00	65.44
94	98.70	176.81	20.00	156.81	67.95
95	20.90	169.36	20.00	149.36	64.72
96	42.25	169.54	20.00	149.54	64.80
97	21.30	169.32	20.00	149.32	64.71
98	20.90	169.29	20.00	149.29	64.69
99	28.85	169.25	20.00	149.25	64.67
100	29.25	169.27	20.00	149.27	64.68
101	29.25	169.19	20.00	149.19	64.65
102	.00	169.16	15.00	154.16	66.80
103	48.90	169.46	15.00	154.46	66.93
104	48.90	175.19	15.00	160.19	69.42
105	20.30	173.86	15.00	158.86	68.84
106	18.25	170.95	15.00	155.95	67.58
107	31.95	167.28	15.00	152.28	65.99
108	18.25	167.05	15.00	152.05	65.89
109	18.20	164.92	15.00	149.92	64.97
110	.00	164.77	15.00	149.77	64.90
111	18.20	168.55	15.00	153.55	66.54
112	7.95	169.16	25.00	144.16	62.47
113	140.80	181.74	20.00	161.74	70.09
114	33.00	164.48	20.00	144.48	62.61
115	80.85	163.17	20.00	143.17	62.04
116	73.80	162.71	20.00	142.71	61.84
117	43.00	162.37	20.00	142.37	61.69
118	50.00	162.37	20.00	142.37	61.69
119	31.85	162.21	20.00	142.21	61.62
120	31.85	162.18	20.00	142.18	61.61
121	22.40	162.20	20.00	142.20	61.62
122	54.25	162.18	20.00	142.18	61.61
123	71.00	162.37	20.00	142.37	61.69
124	6.65	160.53	20.00	140.53	60.90
125	220.85	160.28	20.00	140.28	60.79
126	69.05	160.16	20.00	140.16	60.74
127	95.40	160.16	20.00	140.16	60.73

128	97.30	160.09	20.00	140.09	60.70
129	19.35	160.07	20.00	140.07	60.70
130	110.30	160.06	20.00	140.06	60.69
131	138.10	158.84	20.00	138.84	60.17
132	132.70	142.81	20.00	122.81	53.22
133	4073.00	132.95	20.00	112.95	48.95
134	50.60	158.81	20.00	138.81	60.15
135	31.75	163.69	20.00	143.69	62.26
136	31.75	163.29	20.00	143.29	62.09
137	31.75	164.07	20.00	144.07	62.43
138	.00	167.57	20.00	147.57	63.95
139	.00	169.10	20.00	149.10	64.61
140	32.80	169.06	20.00	149.06	64.59
141	32.80	169.06	20.00	149.06	64.59
201	.00	226.75	70.00	156.75	67.92
202	.00	372.00	135.00	237.00	102.70
203	.00	228.06	130.00	98.06	42.49
204	.00	226.94	80.00	146.94	63.67
205	.00	224.51	102.00	122.51	53.09
206	.00	218.79	175.00	43.79	18.98
207	.00	224.57	175.00	49.57	21.48
208	.00	224.57	175.00	49.57	21.48
209	.00	218.71	175.00	43.71	18.94
210	.00	218.37	175.00	43.37	18.79
211	.00	226.75	208.00	18.75	8.12
212	.00	218.13	175.00	43.13	18.69
213	.00	273.88	175.00	98.88	42.85
214	.00	273.71	175.00	98.71	42.77
215	.00	273.47	175.00	98.47	42.67
216	.00	254.09	130.00	124.09	53.77
217	8333.00	252.61	215.00	37.61	16.30
218	12500.00	221.38	215.00	6.38	2.77
240	531.50	213.51	95.00	117.51	50.92

MAXIMUM AND MINIMUM VALUES

PRESSURES

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
202	102.70	218	2.77
18	82.62	211	8.12
12	81.59	217	16.30
19	77.87	212	18.69
78	77.12	210	18.79
28	76.60	209	18.94
26	76.22	206	18.98
4	76.19	10	19.04
27	76.17	207	21.48
49	74.66	208	21.48

VELOCITIES

AR00028329

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
213	7.97	30	.00
214	7.97	165	.02
215	7.97	172	.02
221	7.39	166	.02
222	7.39	242	.07
182	6.50	52	.09
183	6.38	98	.10
113	6.20	70	.11
110	5.85	71	.11
43	5.71	243	.15

S U M M A R Y O F I N F L O W S A N D O U T F L O W S

(+) INFLOWS INTO THE SYSTEM FROM FIXED GRADE NODES
(-) OUTFLOWS FROM THE SYSTEM INTO FIXED GRADE NODES

PIPE NUMBER	FLOWRATE (gpm)
1	6984.64
6	1610.12
23	23702.50
203	.00
209	2952.55
240	2528.44

NET SYSTEM INFLOW = 37778.26
NET SYSTEM OUTFLOW = .00
NET SYSTEM DEMAND = 37778.25

D A T A C H A N G E S F O R N E X T S I M U L A T I O N

D E M A N D C H A N G E S

DEMAND TYPE = 1 - GDF = .500

THE FOLLOWING SPECIFIC DEMAND CHANGES ARE MADE :

JUNCTION NUMBER	DEMAND (gpm)
217	8333.00
218	12500.00
141	1033.00

****
S I M U L A T I O N R E S U L T S

****

THE RESULTS ARE OBTAINED AFTER 3 TRIALS WITH AN ACCURACY = .00116

P I P E L I N E R E S U L T S

STATUS CODE: XX -CLOSED PIPE FG -FIXED GRADE NODE PU -PUMP LINE
CV -CHECK VALVE RV -REGULATING VALVE TK -STORAGE TANK

PIPE NUMBER	NODE NOS. #1	#2	FLOWRATE (gpm)	HEAD LOSS (ft)	PUMP HEAD (ft)	MINOR LOSS (ft)	LINE VELO. (ft/s)	HL/ 1000 (ft/ft)
1-FGPU	0	203	6973.67	.02	218.54	.00	2.20	.44
2	1	2	6232.88	.85	.00	.00	2.83	.87
3	1	2	473.94	.85	.00	.00	1.34	.87
4	2	3	4142.22	.42	.00	.00	1.31	.17
5	2	3	2564.60	.42	.00	.00	1.16	.17
6-FG	0	204	1320.45	.74	.00	.00	1.35	.41
7	3	4	5923.32	.44	.00	.00	1.87	.32
8	3	4	3667.34	.44	.00	.00	1.66	.32
9	3	4	1165.58	.44	.00	.00	1.19	.32
10	4	5	5659.54	.49	.00	.00	1.78	.30
11	4	5	3504.02	.49	.00	.00	1.59	.30
12	4	5	1113.67	.49	.00	.00	1.14	.30
13	5	6	5427.83	.51	.00	.00	1.71	.28
14	5	6	3360.56	.51	.00	.00	1.53	.28
15	6	7	3178.58	.09	.00	.00	1.44	.25
16-XXPU	7	8						
17-XXPU	7	8						
18-XXPU	7	8						
19-CV	7	8	3178.58	.00	.00	.00	1.44	.25
20	8	9	.00	.00	.00	.00	.00	.00
21	9	206	.00	.00	.00	.00	.00	.00
22	205	10	8788.39	4.91	.00	.00	3.99	1.64
23-FG	0	10	21732.33	7.71	.00	.00	5.03	1.70
24	210	11	11002.21	3.98	.00	.00	2.55	.48
25-CV	5	12	1384.85	9.47	.00	.00	2.21	1.32
26	12	11	634.78	.59	.00	.00	1.01	.31
27	11	13	11577.78	1.99	.00	.00	2.68	.53
28	12	14	.00	.00	.00	.00	.00	.00
29-XX	14	15						
30	16	15	79.43	.01	.00	.00	.13	.01
31	17	16	246.43	.04	.00	.00	.39	.05
32	13	17	308.93	.02	.00	.00	.49	.08
33	12	18	514.57	2.02	.00	.00	1.46	1.01
34	18	19	280.07	.59	.00	.00	.79	.33
35	15	19	-45.57	.04	.00	.00	.13	.01
36	13	20	11112.85	1.30	.00	.00	3.50	1.04
37	20	21	10991.35	.23	.00	.00	3.46	1.02
38	21	22	10919.85	.20	.00	.00	3.44	1.01
39	22	23	10848.35	.20	.00	.00	3.42	1.00
40	23	24	10776.35	.37	.00	.00	3.40	.98
41-XX	15	28						
42	24	25	9715.90	.89	.00	.00	3.06	.81
43	25	26	9715.90	.36	.00	.00	4.41	1.97

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44	26	27	8808.38	.07	.00	.00	2.78	.68
45	28	27	.00	.00	.00	.00	.00	.00
46-XX	28	35						
47	27	79	8808.38	1.66	.00	.00	2.78	.68
48	24	29	1050.45	.09	.00	.00	1.69	.81
49	29	30	960.95	2.34	.00	.00	2.73	3.21
50	30	31	774.45	2.09	.00	.00	2.20	2.15
51	31	32	559.95	2.01	.00	.00	1.59	1.18
52	33	32	5.08	.00	.00	.00	.01	.00
53	34	33	104.08	.03	.00	.00	.30	.05
54	35	34	.00	.00	.00	.00	.00	.00
55-XX	35	48						
56	36	37	996.37	2.40	.00	.00	2.83	3.43
57	37	38	357.08	.18	.00	.00	1.01	.51
58	38	34	195.58	.12	.00	.00	.55	.17
59	37	39	332.34	.58	.00	.00	.94	.45
60	32	39	264.54	.26	.00	.00	.75	.29
61	32	40	300.49	.42	.00	.00	.85	.37
62	40	41	149.99	.12	.00	.00	.43	.10
63	39	41	218.51	.29	.00	.00	.62	.21
64	39	42	542.00	1.64	.00	.00	1.54	1.11
65	42	44	521.00	.13	.00	.00	1.48	1.03
66	41	43	368.50	.10	.00	.00	.59	.11
67	37	54	306.95	.39	.00	.00	.87	.39
68	54	53	151.45	.11	.00	.00	.43	.10
69	53	39	163.63	.09	.00	.00	.46	.12
70	52	53	47.18	.01	.00	.00	.13	.01
71	51	52	47.18	.00	.00	.00	.13	.01
72	50	51	224.68	.13	.00	.00	.64	.22
73	50	49	75.00	.03	.00	.00	.21	.03
74	79	71	8808.38	.10	.00	.00	2.78	.68
75-XX	48	36						
76	46	47	99.00	.48	.00	.00	.63	.34
77	45	46	208.50	.26	.00	.00	.59	.19
78	43	45	318.00	.58	.00	.00	.90	.41
79	55	50	388.68	.61	.00	.00	1.10	.60
80	56	55	488.18	.92	.00	.00	1.38	.92
81	57	56	664.68	.75	.00	.00	1.89	1.62
82-XX	36	57						
83	71	77	7299.40	.96	.00	.00	2.30	.48
84	77	57	664.68	.24	.00	.00	1.89	1.62
85	26	58	907.52	1.04	.00	.00	2.57	2.89
86	58	59	704.14	1.14	.00	.00	2.00	1.80
87	58	60	203.39	.85	.00	.00	1.30	1.30
88	60	61	120.39	.32	.00	.00	.77	.49
89	59	61	108.61	.03	.00	.00	.31	.06
90	61	62	225.00	.16	.00	.00	.64	.22
91	62	63	161.50	.11	.00	.00	.46	.12
92	59	64	595.52	.41	.00	.00	1.69	1.32
93	64	65	505.52	.41	.00	.00	1.43	.98
94	65	66	338.52	.15	.00	.00	.96	.46
95	66	67	76.02	.02	.00	.00	.22	.03
96	68	67	-23.02	.00	.00	.00	.07	.00
97	69	68	29.98	.00	.00	.00	.09	.01
98	70	69	82.98	.01	.00	.00	.24	.03
99	71	70	512.61	1.32	.00	.00	1.45	1.00
100	79	48	.00	.00	.00	.00	.00	.00
101	70	72	429.63	.30	.00	.00	1.22	.72

102	72	73	218.63	.08	.00	.00	.62	.21
103	73	74	71.63	.02	.00	.00	.20	.03
104	75	74	42.37	.00	.00	.00	.12	.01
105	76	75	305.87	.31	.00	.00	.87	.39
106	77	76	402.37	.45	.00	.00	1.14	.64
107	77	78	6216.85	.56	.00	.00	1.96	.36
108-XX	57	78						
109	71	36	996.37	.72	.00	.00	2.83	3.43
110	78	80	3328.12	2.04	.00	.00	3.40	2.27
111	78	80	796.23	2.04	.00	.00	2.26	2.27
112	80	81	1898.19	.98	.00	.00	1.94	.80
113	80	82	2199.21	3.65	.00	.00	3.51	3.12
114	81	84	1863.79	1.61	.00	.00	2.97	2.30
115	82	83	173.15	.61	.00	.00	1.11	.97
116	84	83	211.00	1.67	.00	.00	1.35	1.40
117	82	89	1885.27	2.11	.00	.00	3.01	2.34
118	83	85	46.15	.09	.00	.00	.29	.08
119	83	86	227.59	1.66	.00	.00	1.45	1.61
120	84	85	1574.19	1.76	.00	.00	2.51	1.68
121	89	91	1821.92	1.43	.00	.00	2.91	2.20
122	87	88	.00	.00	.00	.00	.00	.00
123	86	87	51.45	.07	.00	.00	.33	.10
124	85	86	208.74	1.57	.00	.00	1.33	1.37
125	85	94	1247.00	1.31	.00	.00	1.99	1.09
126	82	113	140.80	.18	.00	.00	.90	.66
127	91	90	153.35	.07	.00	.00	.43	.11
128	91	92	418.04	.74	.00	.00	1.19	.69
129	93	92	207.53	.18	.00	.00	.59	.19
130	86	93	321.63	1.83	.00	.00	2.05	3.05
131	94	93	255.74	2.09	.00	.00	1.63	1.99
132	92	96	625.57	2.92	.00	.00	3.99	10.44
133	93	103	352.94	.52	.00	.00	1.00	.50
134	94	104	892.56	.47	.00	.00	1.42	.59
135	95	98	184.93	.60	.00	.00	1.18	1.09
136	96	95	205.83	1.04	.00	.00	1.31	1.33
137	96	100	262.22	1.08	.00	.00	1.67	2.09
138	97	101	93.97	.23	.00	.00	.60	.31
139	96	97	115.27	.35	.00	.00	.74	.46
140	98	99	164.03	.70	.00	.00	1.05	.88
141	100	99	376.48	1.26	.00	.00	2.40	4.08
142	101	100	143.51	.55	.00	.00	.92	.68
143	99	112	511.66	5.68	.00	.00	3.27	7.20
144	101	112	562.09	7.45	.00	.00	3.59	8.56
145	102	101	640.88	1.64	.00	.00	4.09	10.92
146	103	102	446.65	1.51	.00	.00	2.85	5.60
147	104	103	250.26	2.14	.00	.00	1.60	1.91
148	104	105	593.40	.33	.00	.00	1.68	1.31
149	102	108	-194.22	1.30	.00	.00	1.24	1.20
150	103	107	107.65	.05	.00	.00	.31	.06
151	105	106	573.10	.69	.00	.00	1.63	1.23
152	107	108	147.10	.21	.00	.00	.94	.72
153	106	107	200.83	1.17	.00	.00	1.28	1.27
154	108	109	-65.37	.08	.00	.00	.42	.16
155	107	110	129.43	.06	.00	.00	.37	.08
156	106	111	354.02	.47	.00	.00	1.00	.50
157	109	110	-81.58	.07	.00	.00	.52	.24
158	111	110	209.52	.76	.00	.00	1.34	1.38
159	91	114	1247.27	.93	.00	.00	1.27	.37

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160	114	115	264.52	.64	.00	.00	1.69	2.12
201-XXPU	0	211						
202	211	201	.00	.00	.00	.00	.00	.00
203-FGPU	0	202	.00	.00	362.00	.00	.00	.00
204-XX	202	201						
205	201	2	.00	.00	.00	.00	.00	.00
206	203	1	6973.67	.45	.00	.00	3.17	1.07
207	1	204	266.85	.81	.00	.00	.76	.30
208	204	3	1587.30	.46	.00	.00	1.62	.58
209-FG	0	3	2462.12	1.20	.00	.00	1.75	.46
210-XX	6	9						
211-CV	6	205	5609.81	.16	.00	.00	2.55	.71
212	8	205	3178.58	.06	.00	.00	1.44	.25
213	10	206	31835.21	.14	.00	.00	7.37	3.45
214	206	209	31835.21	.07	.00	.00	7.37	3.45
215	209	210	31835.21	.29	.00	.00	7.37	3.45
216-XX	207	206						
217-XX	207	209						
218	208	207	.00	.00	.00	.00	.00	.00
219	210	212	20833.00	.24	.00	.00	4.82	1.57
220-XXCV	212	213						
221-PU	212	213	10416.50	.33	56.08	.00	7.39	6.65
222-PU	212	213	10416.50	.33	56.08	.00	7.39	6.65
223-XXPU	212	213						
224-XXCV	208	215						
225	214	215	7933.44	.24	.00	.00	5.63	4.02
226	213	214	20833.00	.17	.00	.00	4.82	1.57
227	215	216	7933.44	19.38	.00	.00	3.60	1.36
228	214	216	12899.56	19.62	.00	.00	4.07	1.37
229	216	217	8333.00	1.48	.00	.00	2.63	.61
230	216	218	12500.00	32.71	.00	.00	5.67	3.15
231-XXFG	0	211						
161	115	116	111.36	.22	.00	.00	.71	.43
162	116	117	37.56	.06	.00	.00	.24	.06
163	115	118	72.31	.22	.00	.00	.46	.19
164	114	123	949.76	.26	.00	.00	.97	.22
165	118	117	52.54	.06	.00	.00	.34	.11
166	123	118	123.48	.60	.00	.00	.79	.52
167	117	121	47.10	.14	.00	.00	.30	.09
168	118	119	93.25	.18	.00	.00	.60	.31
169	119	120	30.95	.03	.00	.00	.20	.04
170	121	122	24.70	.02	.00	.00	.16	.03
171	119	122	30.45	.03	.00	.00	.19	.04
172	122	120	.90	.00	.00	.00	.01	.00
173	123	124	755.27	.15	.00	.00	.77	.15
174	124	125	612.25	.26	.00	.00	.98	.29
175	125	126	391.40	.12	.00	.00	.62	.13
176	126	127	95.40	.01	.00	.00	.15	.01
177	126	128	226.95	.07	.00	.00	.36	.05
178	128	129	129.65	.01	.00	.00	.21	.02
179	129	130	110.30	.01	.00	.00	.18	.01
180	131	124	-136.37	.01	.00	.00	.22	.02
181	131	132	103.38	.07	.00	.00	.29	.05
182	132	133	101.40	.01	.00	.00	.16	.01
183	134	132	130.72	.08	.00	.00	.37	.08
184	134	131	105.11	.01	.00	.00	.17	.01
185	136	134	286.43	.11	.00	.00	.46	.07
186	109	135	-1.99	.00	.00	.00	.01	.00

187	110	136	257.36	.05	.00	.00	.41	.06
188	138	137	126.30	.56	.00	.00	.81	.54
189	135	136	-33.74	.03	.00	.00	.22	.05
190	137	136	94.55	.09	.00	.00	.60	.32
191	111	138	126.30	.16	.00	.00	.81	.54
192	112	139	1065.80	10.64	.00	.00	6.80	28.01
193	139	140	32.80	.04	.00	.00	.21	.04
194	139	141	1033.00	27.23	.00	.00	6.59	26.43
240-FG	0	10	2318.29	7.71	.00	.00	3.70	2.96
241	10	240	1003.80	4.48	.00	.00	1.60	.63
242	240	11	32.12	.00	.00	.00	.05	.00
243	240	11	440.18	.00	.00	.00	.10	.00

JUNCTION NODE RESULTS

JUNCTION NUMBER	JUNCTION TITLE	EXTERNAL DEMAND (gpm)	HYDRAULIC GRADE (ft)	JUNCTION ELEVATION (ft)	PRESSURE HEAD (ft)	JUNCTION PRESSURE (psi)
1		.00	228.07	120.00	108.07	46.83
2		.00	227.22	75.00	152.22	65.96
3		.00	226.80	77.00	149.80	64.91
4		479.00	226.37	50.00	176.37	76.43
5		104.00	225.87	85.00	140.87	61.05
6		.00	225.36	95.00	130.36	56.49
7		.00	225.27	98.00	127.27	55.15
8		.00	225.27	98.00	127.27	55.15
9		.00	225.27	102.00	123.27	53.42
10		.00	220.29	175.00	45.29	19.63
11		531.50	215.81	55.00	160.81	69.69
12		235.50	216.41	25.00	191.41	82.94
13		156.00	213.82	45.00	168.82	73.16
14		.00	216.41	45.00	171.41	74.28
15		125.00	213.76	45.00	168.76	73.13
16		167.00	213.77	45.00	168.77	73.13
17		62.50	213.81	45.00	168.81	73.15
18		234.50	214.39	20.00	194.39	84.23
19		234.50	213.80	30.00	183.80	79.65
20		121.50	212.52	38.00	174.52	75.63
21		71.50	212.29	37.00	175.29	75.96
22		71.50	212.09	36.00	176.09	76.30
23		72.00	211.89	35.00	176.89	76.65
24		.00	211.51	34.00	177.51	76.92
25		.00	210.62	33.00	177.62	76.97
26		.00	210.27	28.00	182.27	78.98
27		.00	210.20	28.00	182.20	78.95
28		.00	210.20	27.00	183.20	79.39
29		99.50	211.43	35.00	176.43	76.45
30		186.50	209.08	36.00	173.08	75.00
31		214.50	207.00	37.00	170.00	73.66
32		.00	204.99	34.00	170.99	74.09
33		99.00	204.99	33.00	171.99	74.53
34		91.50	205.02	31.00	174.02	75.41
35		.00	205.02	34.00	171.02	74.11
36		.00	207.72	34.00	173.72	75.28
37		.00	205.32	34.00	171.32	74.24

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38	161.50	205.14	33.00	172.14	74.59
39	.00	204.73	33.00	171.73	74.42
40	150.50	204.56	33.00	171.56	74.34
41	.00	204.44	34.00	170.44	73.86
42	21.00	203.09	34.00	169.09	73.27
43	50.50	204.34	34.00	170.34	73.82
44	521.00	202.96	33.00	169.96	73.65
45	109.50	203.77	30.00	173.77	75.30
46	109.50	203.50	28.00	175.50	76.05
47	99.00	203.03	25.00	178.03	77.15
48	.00	208.54	35.00	173.54	75.20
49	75.00	204.93	25.00	179.93	77.97
50	89.00	204.96	26.00	178.96	77.55
51	177.50	204.83	27.00	177.83	77.06
52	.00	204.83	28.00	176.83	76.63
53	35.00	204.82	29.00	175.82	76.19
54	155.50	204.93	31.00	173.93	75.37
55	99.50	205.57	27.00	178.57	77.38
56	176.50	206.49	27.00	179.49	77.78
57	.00	207.24	28.00	179.24	77.67
58	.00	209.23	32.00	177.23	76.80
59	.00	208.09	31.00	177.09	76.74
60	83.00	208.38	31.00	177.38	76.86
61	4.00	208.06	31.00	177.06	76.73
62	63.50	207.90	32.00	175.90	76.22
63	161.50	207.79	38.00	169.79	73.58
64	90.00	207.68	30.00	177.68	76.99
65	167.00	207.27	30.00	177.27	76.82
66	262.50	207.12	30.00	177.12	76.75
67	53.00	207.10	30.00	177.10	76.75
68	53.00	207.10	30.00	177.10	76.74
69	53.00	207.10	30.00	177.10	76.75
70	.00	207.12	32.00	175.12	75.88
71	.00	208.44	34.00	174.44	75.59
72	211.00	206.82	32.00	174.82	75.76
73	147.00	206.74	31.00	175.74	76.15
74	114.00	206.72	30.00	176.72	76.58
75	263.50	206.72	30.00	176.72	76.58
76	96.50	207.04	29.00	178.04	77.15
77	15.50	207.48	28.00	179.48	77.78
78	2092.50	206.92	20.00	186.92	81.00
79	.00	208.54	35.00	173.54	75.20
80	26.95	204.88	25.00	179.88	77.95
81	34.40	203.91	25.00	178.91	77.53
82	.00	201.23	25.00	176.23	76.37
83	110.40	200.63	25.00	175.63	76.10
84	78.60	202.30	25.00	177.30	76.83
85	164.50	200.54	25.00	175.54	76.07
86	63.25	198.96	25.00	173.96	75.38
87	51.45	198.90	25.00	173.90	75.35
88	.00	198.90	25.00	173.90	75.35
89	63.35	199.12	25.00	174.12	75.45
90	153.35	197.63	25.00	172.63	74.81
91	3.25	197.69	20.00	177.69	77.00
92	.00	196.96	20.00	176.96	76.68
93	16.90	197.14	20.00	177.14	76.76
94	98.70	199.23	20.00	179.23	77.67
95	20.90	193.00	20.00	173.00	74.97

96	42.25	194.04	20.00	174.04	75.42
97	21.30	193.68	20.00	173.68	75.26
98	20.90	192.40	20.00	172.40	74.70
99	28.85	191.69	20.00	171.69	74.40
100	29.25	192.95	20.00	172.95	74.95
101	29.25	193.47	20.00	173.47	75.17
102	.00	195.10	15.00	180.10	78.04
103	48.90	196.61	15.00	181.61	78.70
104	48.90	198.76	15.00	183.76	79.63
105	20.30	198.43	15.00	183.43	79.49
106	18.25	197.74	15.00	182.74	79.19
107	31.95	196.56	15.00	181.56	78.68
108	18.25	196.41	15.00	181.41	78.61
109	18.20	196.49	15.00	181.49	78.64
110	.00	196.51	15.00	181.51	78.65
111	18.20	197.27	15.00	182.27	78.98
112	7.95	186.01	25.00	161.01	69.77
113	140.80	201.05	20.00	181.05	78.46
114	33.00	196.76	20.00	176.76	76.60
115	80.85	196.12	20.00	176.12	76.32
116	73.80	195.91	20.00	175.91	76.23
117	43.00	195.84	20.00	175.84	76.20
118	50.00	195.90	20.00	175.90	76.22
119	31.85	195.72	20.00	175.72	76.14
120	31.85	195.69	20.00	175.69	76.13
121	22.40	195.70	20.00	175.70	76.14
122	54.25	195.69	20.00	175.69	76.13
123	71.00	196.50	20.00	176.50	76.48
124	6.65	196.35	20.00	176.35	76.42
125	220.85	196.09	20.00	176.09	76.31
126	69.05	195.98	20.00	175.98	76.26
127	95.40	195.97	20.00	175.97	76.25
128	97.30	195.90	20.00	175.90	76.22
129	19.35	195.89	20.00	175.89	76.22
130	110.30	195.88	20.00	175.88	76.21
131	138.10	196.34	20.00	176.34	76.41
132	132.70	196.27	20.00	176.27	76.38
133	101.40	196.26	20.00	176.26	76.38
134	50.60	196.35	20.00	176.35	76.42
135	31.75	196.49	20.00	176.49	76.48
136	31.75	196.46	20.00	176.46	76.47
137	31.75	196.55	20.00	176.55	76.50
138	.00	197.11	20.00	177.11	76.75
139	.00	175.37	20.00	155.37	67.33
140	32.80	175.33	20.00	155.33	67.31
141	1033.00	148.14	20.00	128.14	55.53
201	.00	227.22	70.00	157.22	68.13
202	.00	372.00	135.00	237.00	102.70
203	.00	228.52	130.00	98.52	42.69
204	.00	227.26	80.00	147.26	63.81
205	.00	225.21	102.00	123.21	53.39
206	.00	220.15	175.00	45.15	19.57
207	.00	225.27	175.00	50.27	21.78
208	.00	225.27	175.00	50.27	21.78
209	.00	220.08	175.00	45.08	19.54
210	.00	219.79	175.00	44.79	19.41
211	.00	227.22	208.00	19.22	8.33
212	.00	219.56	175.00	44.56	19.31

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213	.00	275.30	175.00	100.30	43.46
214	.00	275.13	175.00	100.13	43.39
215	.00	274.89	175.00	99.89	43.29
216	.00	255.51	130.00	125.51	54.39
217	8333.00	254.03	215.00	39.03	16.91
218	12500.00	222.80	215.00	7.80	3.38
240	531.50	215.82	95.00	120.82	52.35

MAXIMUM AND MINIMUM VALUES

PRESSURES

JUNCTION NUMBER	MAXIMUM PRESSURES (psi)	JUNCTION NUMBER	MINIMUM PRESSURES (psi)
202	102.70	218	3.38
18	84.23	211	8.33
12	82.94	217	16.91
78	81.00	212	19.31
19	79.65	210	19.41
104	79.63	209	19.54
105	79.49	206	19.57
28	79.39	10	19.63
106	79.19	207	21.78
111	78.98	208	21.78

VELOCITIES

PIPE NUMBER	MAXIMUM VELOCITY (ft/s)	PIPE NUMBER	MINIMUM VELOCITY (ft/s)
221	7.39	172	.01
222	7.39	106	.01
213	7.37	52	.01
214	7.37	242	.05
215	7.37	96	.07
192	6.80	97	.09
194	6.59	243	.10
230	5.67	104	.12
225	5.63	30	.13
23	5.03	35	.13

SUMMARY OF INFLOWS AND OUTFLOWS

(+) INFLOWS INTO THE SYSTEM FROM FIXED GRADE NODES
(-) OUTFLOWS FROM THE SYSTEM INTO FIXED GRADE NODES

PIPE NUMBER	FLOWRATE (gpm)
1	6973.67

6	1320.45
23	21732.33
203	.00
209	2462.12
240	2318.29

NET SYSTEM INFLOW = 34806.85
NET SYSTEM OUTFLOW = .00
NET SYSTEM DEMAND = 34806.85

**** KYPIPE SIMULATION COMPLETED ****

DATE: 11/16/2006
TIME: 8:47: 0

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Appendix D

Water Line Tunnel Under H-1 Freeway
For the
Hoopili Project

The Hoopili project proposes to construct a tunnel under the H-1 Freeway to deliver water from both the 228 and 440 storage systems to the Hoopili project boundaries. This corridor will be used if there is insufficient space within the Honouliuli Gulch crossing. The Honouliuli Gulch crossing contains BWS water lines delivering water from the existing BWS 228 and 440 storage systems.

A plan and profile of the tunnel is contained on the exhibits within this appendix. The tunnel will have a mauka terminus in the existing Honouliuli 228 Reservoir site and the makai terminus in the mixed use industrial area of the Hoopili project. A typical section is also shown.

Two options exist for construction. One would be micro-tunneling and the other would be conventional well construction.

Once constructed, the water system (including the tunnel) would be dedicated to the Board of Water Supply.

An easement or access permitted designation would be required form the State of Hawaii Department of Transportation. Ongoing discussions exploring the easement/access permitted designation have been occurring.

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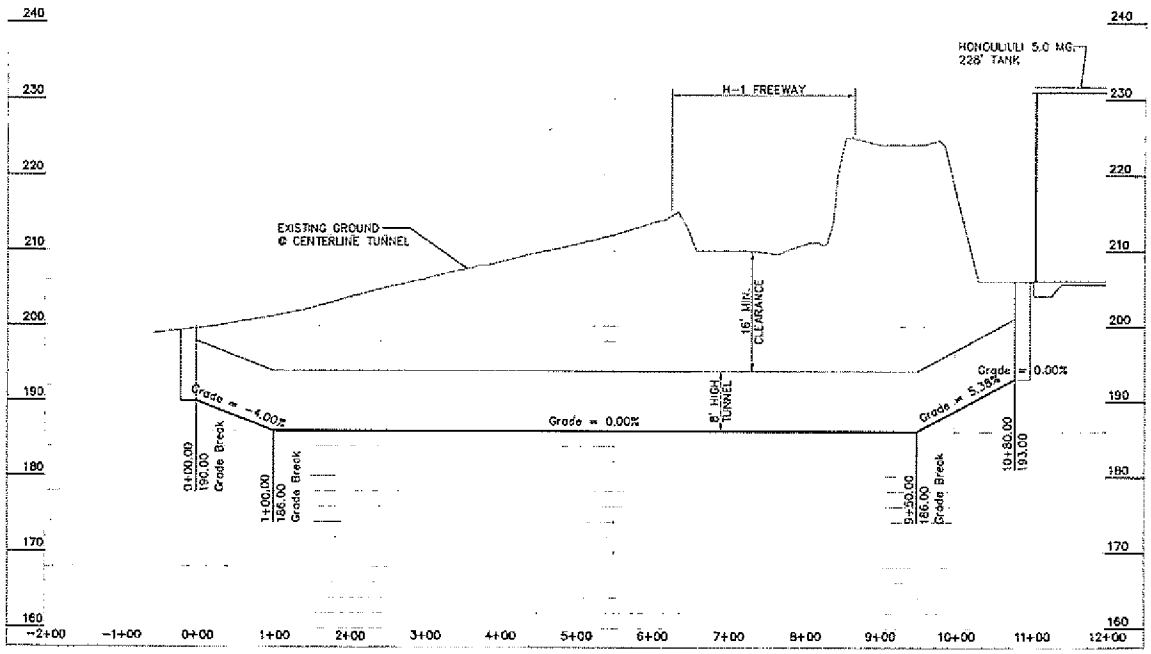
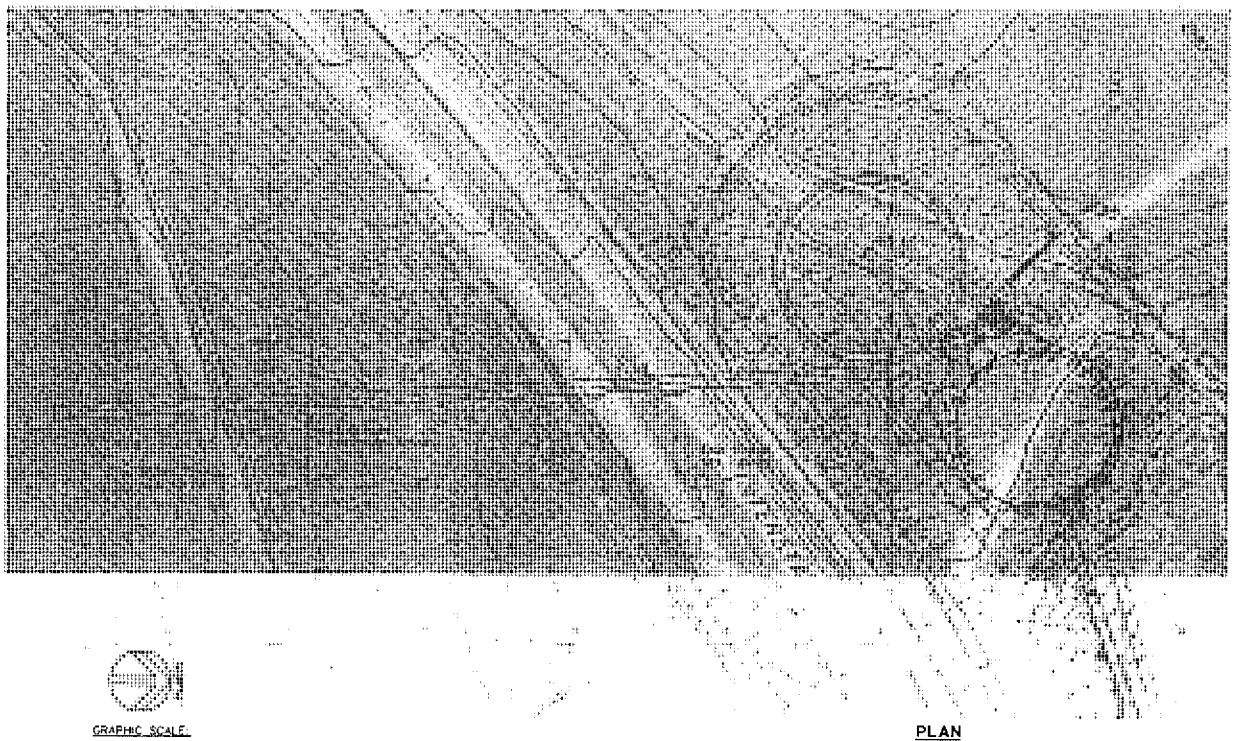
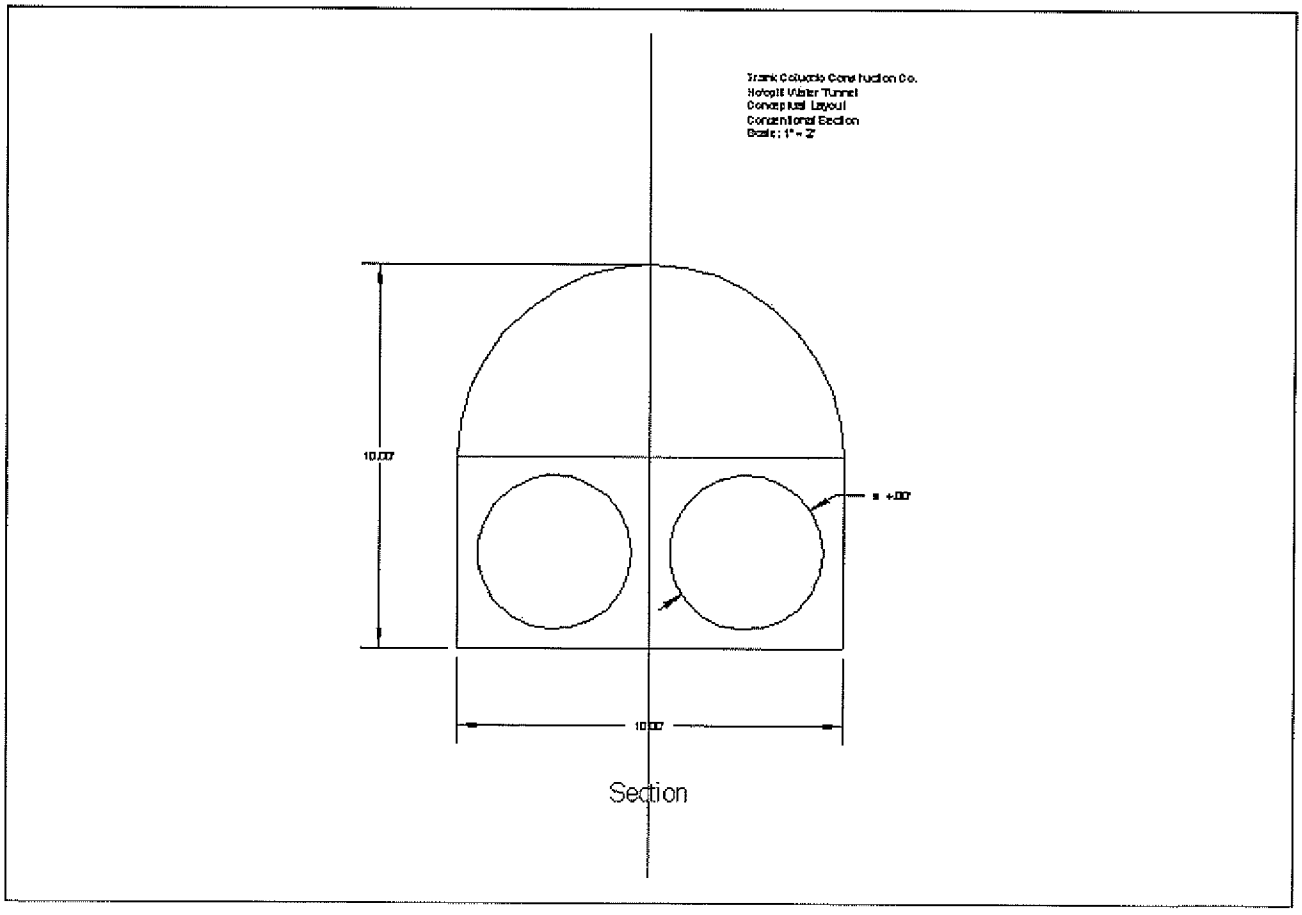




GRAPHIC SCALE
100' 50' 0 100' 200'

PLAN
POSSIBLE TUNNEL ALIGNMENT FROM HONOULIULI 228' TANK
BENEATH H-1 FREEWAY

AR00028336


Trans Columbia Construction Co.
Hetzgill Water Tunnel
Conceptual Layout
Conventional Section
Scale: 1" = 2'
10.00'
8 +.00'
10.00'
Section

APPENDIX N

Preliminary Wastewater Collection System Master Plan

PRELIMINARY WASTEWATER COLLECTION SYSTEM MASTER PLAN

FOR

HO'OPILI

HONOULIULI, 'EWA, O'AHU, HAWAI'I
TMK: (1)9-1-017: POR. 004, 059, 072;
(1)9-1-018: 001, 004

NOVEMBER 2007

BILLS ENGINEERING INC.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, Hawai'i 96813-2715
Telephone No: 808.792.2022
Fax No: 808.792.2033
General Email: info@BillsEngineering.com
www.BillsEngineering.com

PRELIMINARY WASTEWATER COLLECTION SYSTEM MASTER PLAN

FOR

HO'OPILI

TMK: (1) 9-1-017: POR. 004, 059, 072;
(1)9-1-018: 001, 004
HONOULIULI, 'EWA, O'AHU, HAWAI'I

NOVEMBER 2007

DAVID B. BILLS
LICENSED PROFESSIONAL ENGINEER
No. 4516-C
HAWAII, USA

THIS WORK WAS PREPARED
BY ME OR UNDER MY SUPERVISION.

SIGNATURE
Expiration Date: 4-30-08

PREPARED BY:

BILLS ENGINEERING INC.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, Hawai'i 96813

AR00028339

TABLE OF CONTENTS

		Page
SECTION 1.	BACKGROUND INFORMATION	1
SECTION 2.	EXISTING CONDITIONS	2
SECTION 3.	PROPOSED CONDITIONS	2
SECTION 4.	ULTIMATE TREATMENT AND DISPOSAL	3

LIST OF FIGURES

Figure 1 - Ho'opili Site Plan

Figure 2 - Existing Sewer System Plan

Figure 3 - DHHL Sewer System

Figure 4 - Sewer Corridor Typical Section

Figure 5 - Ho'opili Sewer Zones

APPENDICES

Appendix A Preliminary Wastewater Calculations

Appendix B Wastewater Calculations from "Wastewater Master Plan for East Kapolei" dated June 2006

SECTION 1. BACKGROUND INFORMATION

D. R. Horton-Schuler Division ("Schuler") intends to develop approximately 1,555 acres of land in 'Ewa over the next 25 to 30 years. The project will be called Ho'opili. The Ho'opili project is generally bound by the H-1 Freeway to the north, proposed North-South Road to the west, Ewa Villages to the south and Old Fort Weaver Road/Fort Weaver Road to the east. Figure 1 - Ho'opili Site Plan illustrates the project and how it is situated on the Ewa plain. The other notable projects being developed in the immediate vicinity are Department of Hawaiian Homeland ("DHHL") properties and the University of Hawai'i West Oahu ("UHWO") campus. Ho'opili and other neighboring projects in the area are shown on Figure 1.

The Ho'opili project is anticipated to provide housing and commercial space as listed below:

Housing Units:	11,750 (Single Family, Multi-Family and Apartment)
Commercial Space:	
Retail	2,240,000 Square Feet
Office	720,000 Square Feet
Industrial	800,000 Square Feet
Developable Acres (Minus Schools/Parks/ Roads/Open Space)	1,130 Acres

The Ho'opili project is at the beginning of the development path. The current State land use designation is agricultural and a petition will be processed with the State Land Use Commission to change the designation of the land from agricultural to urban. Subsequent steps in the development process will be the submittal and processing of a change of zone application with the City and County of Honolulu. Upon successful completion of the State Land Use petition process and change of zoning, actual development (subdivision work and physical improvements) could commence. A general time frame for the project is outlined below:

State Land Use Petition and City Change of Zone	3-5 years (Starting in 4th Quarter 2006 ending 2010)
Incremental Development initiated through subdivision actions	20-25 years (Starting 2010 and ending 2035)

This wastewater collection system master plan has been prepared for the Ho'opili project in order to support the development process and to assist reviewing technical agencies (Department of Planning and Permitting and the Department of Wastewater Management).

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SECTION 2. EXISTING CONDITIONS

The major municipal sewage system features that exist in the project area are the Honouliuli Wastewater Treatment Plant (WWTP) and trunk sewers transmitting sewage from points farther west to the Honouliuli WWTP. The existing treatment plant capacity is 35 MGD. The current average daily flows are approximately 27 MGD. The trunk sewer system is made up of the Makakilo Interceptor Sewer and the recently completed Kapolei Interceptor Sewer. Figure 2 - Existing Sewer System Plan shows these municipal sewage system features in relation to the project site and proposed development in the immediate vicinity.

It should be pointed out that development in the immediate project area has been contemplated in various forms over the past decade. This portion of the Ewa Plain has long been the designated site for the University of Hawai'i West Oahu campus as well as for DHHL property development. In the mid 1990's Schuler explored development of 660 acres of the Ho'opili property (East Kapolei Project) and prepared an EIS to support a Land Use petition.

Because of that earlier planning, the existing conditions plan, as shown on Figure 2, shows a sewer stub on the recently completed Kapolei Interceptor at the proposed North/South Road intersection. This stub was to accommodate future growth to the north and, particularly, DHHL and UHWO lands. The Kapolei Interceptor was designed to accept a "future" flow having an equivalent population of 38,975 people, encompassing an area of 1,409 acres and a peak flow of 9.45 million gallons per day (MGD).

There are other existing municipal sewage collection features in the area. These include trunk sewers in Fort Weaver Road/Geiger Road delivering sewage from properties to the east and south into the Honouliuli WWTP. However, since there are no planned connections to this part of the existing sewage collection infrastructure, these systems have been omitted from the existing conditions plan (Figure 2).

SECTION 3. PROPOSED CONDITIONS

Ho'opili, UHWO and DHHL plan to develop a sewer corridor extending from the existing sewer stub on the Kapolei Interceptor at North/South Road (see Figure 2) and extending the gravity sewer system in a northerly direction generally following North/South Road to collect sewage from all three projects and deliver the sewage to the Honouliuli WWTP. The proposed system is shown on Figure 3 - DHHL Sewer System.

Transmission to the Honouliuli WWTP will require one of two upgrades to the existing sewer corridor:

1. Construct a third interceptor, alongside the 30" Makakilo Interceptor and 42" Kapolei Interceptor. Figure 4 - Sewer Corridor Typical Section shows a preliminary location for the new interceptor. The three lines will be connected to create a manifold system capable of distributing flow between the lines. Size and actual location of the line will be determined as planning progresses.

2. Construct a third interceptor, alongside the 30" Makakilo Interceptor and 42" Kapolei Interceptor, with the intention of abandoning the 30" Makakilo Interceptor. This line would be larger than that proposed in option 1 above, and would be sized to accommodate the additional flows from DHHL, UHWO, Ho'opili and other future projects, such as Makaiwa Hills. Size of the line will be determined as planning progresses.

The Ho'opili project is made up of three sewer zones as shown on Figure 5 - Ho'opili Sewer Zones. Sewer Zone 1 is approximately 925 acres and is located on the site's west side. Zone 2 is approximately 375 acres and borders the east side of Zone 1 and Old Fort Weaver Road. Zone 3 is located on the project's northeastern corner, east of Honouliuli Stream and is approximately 205 acres. See Appendix A - Preliminary Wastewater Calculations for computed flows for each of the three zones.

Zone 1 will gravity flow to the Main Trunk Sewer to Honouliuli WWTP with a design peak flow of 9.2 MGD. This main trunk sewer is a part of the DHHL sewer system shown on Figure 3. See Appendix B - Wastewater Calculations from "Wastewater Master Plan for East Kapolei" dated June 2006.

Zone 2 sewage will gravity flow to the proposed Ho'opili SPS, where it will then be lifted to Zone 1. Peak design flow is approximately 2.0 MGD.

Zone 3 has a design peak flow of 1.6 MGD. This area will gravity flow to the Kunia SPS, eventually connecting to the Waipahu SPS. Adequacy of the existing infrastructure will be determined as planning progresses.

An alternative option to provide sewer service for Zone 3 is to install a sewage pump station and lift sewage to the mauka end of Zone 2. The Zone 2 gravity system would be sized to transport all sewage to the Zone 2 sewage pump station and subsequently lifted to the main trunk sewer in Zone 1.

SECTION 4. ULTIMATE TREATMENT AND DISPOSAL

The project area is within the service limits of the City's Honouliuli Wastewater Treatment Plant service (WWTP) area. The "West Mamala Bay Facilities Plan" prepared for the City and County of Honolulu (Wilson Okamoto and Associates, Inc. and Brown and Caldwell Consultants, 2001) identifies the future flows from the total service area identified in Figure 1. The 2020 capacity of the Honolulu is anticipated to be 51 MGD. The project will be contributing funds towards planned expansions to the treatment plant facilities by payment of Sewer Facility Charges.

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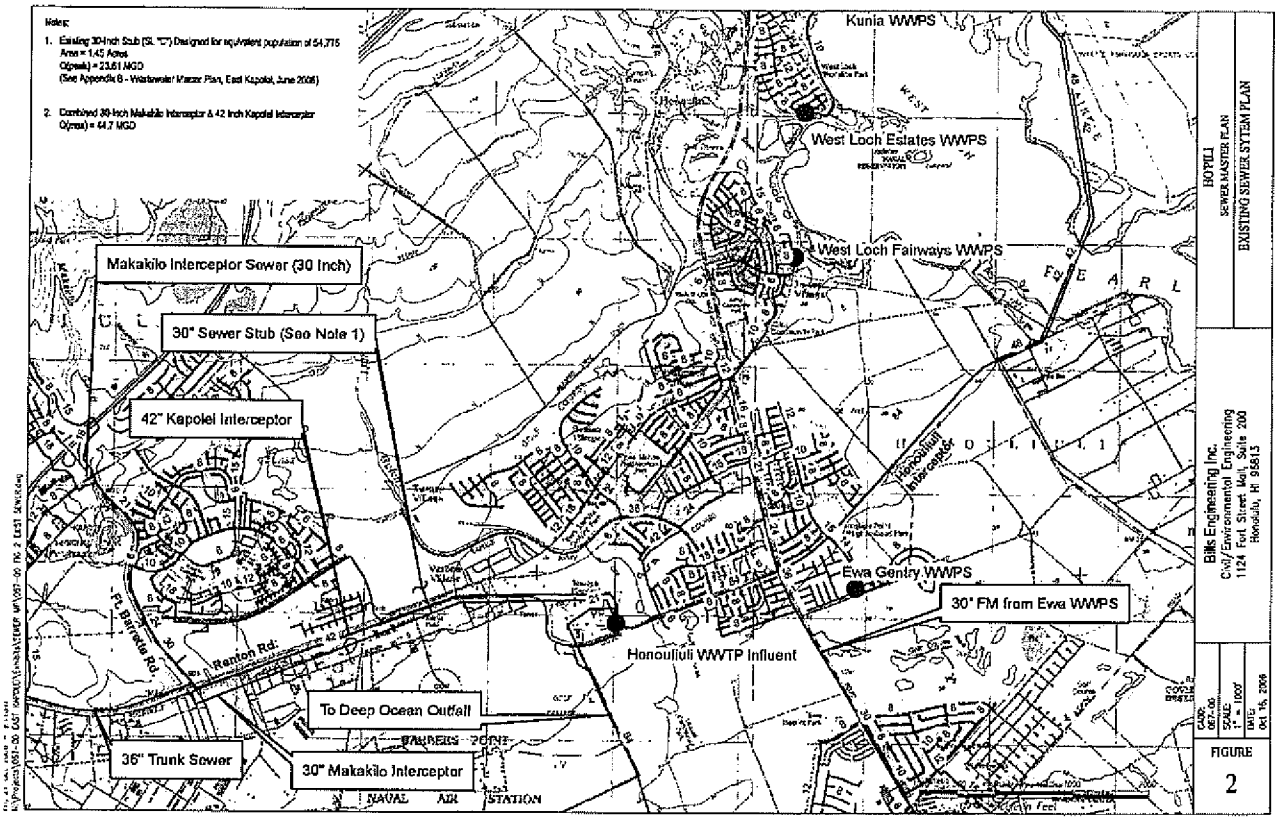
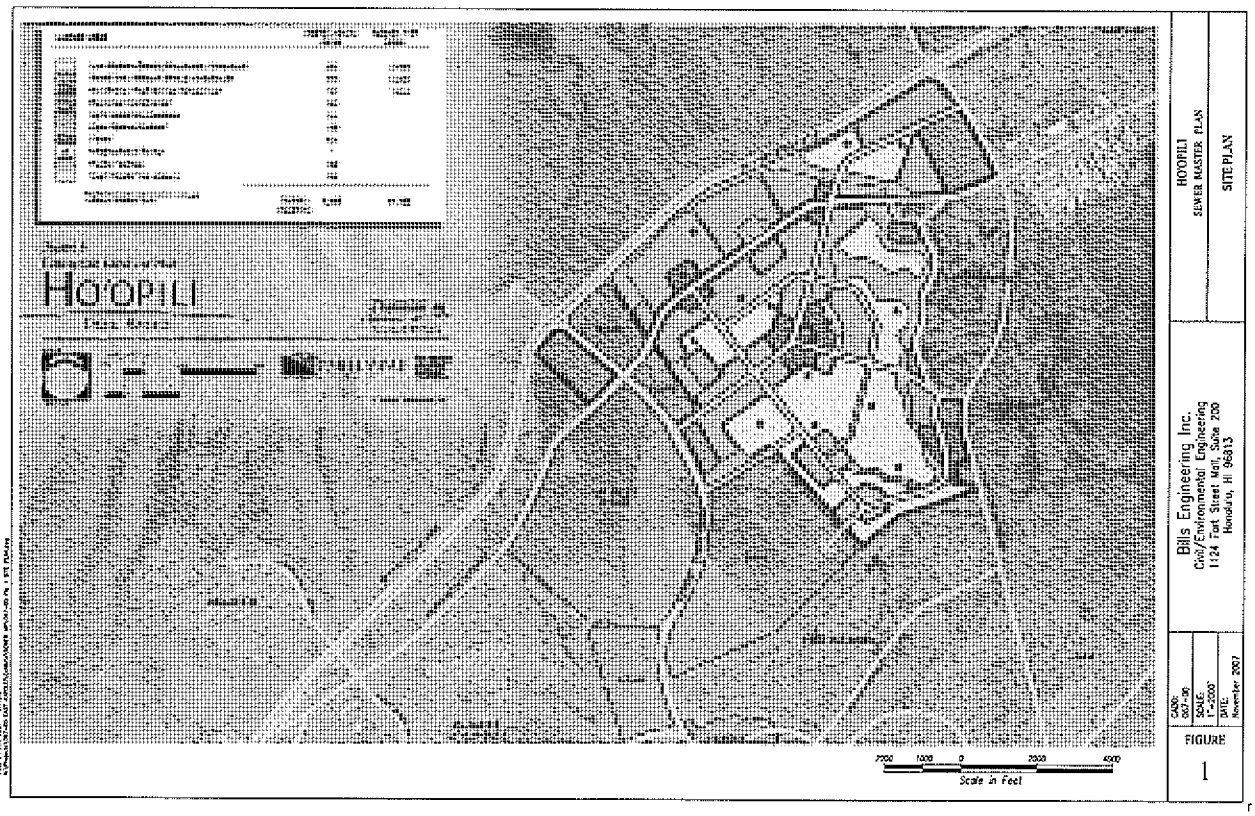
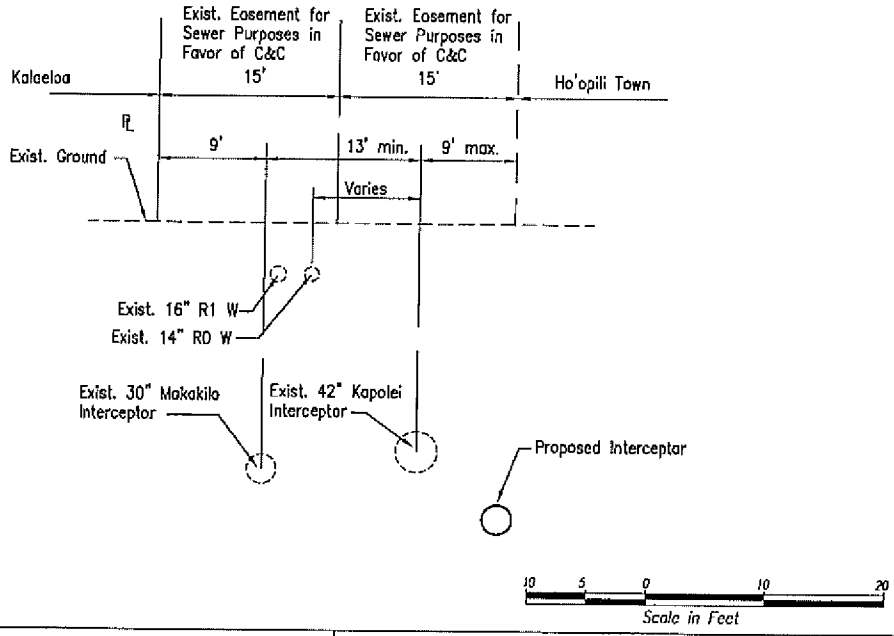
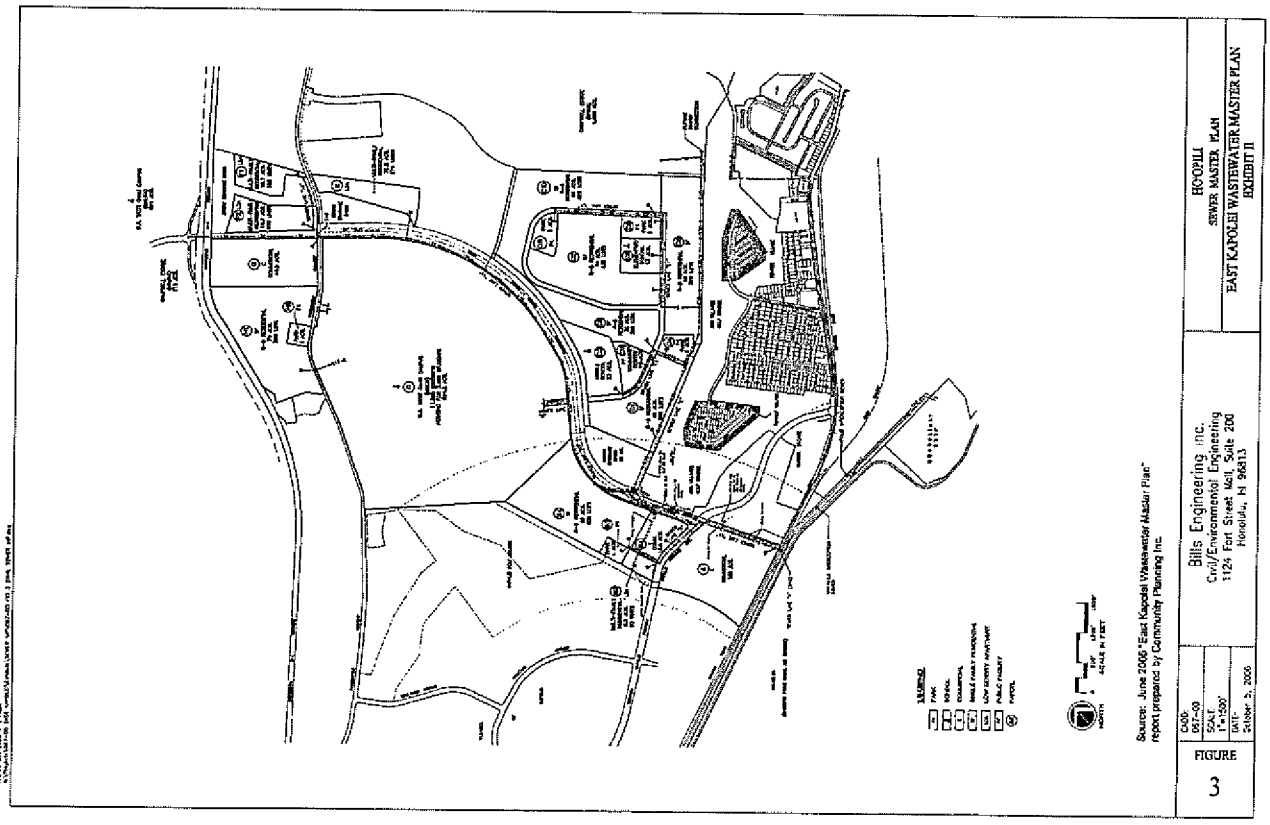

Notes:
1. Existing 30-Inch Stub (St. "C") Designed for equivalent population of 64,715
Area = 1.45 Acres
Q(peak) = 23.61 MGD
(See Appendix B - Wastewater Master Plan, East Kapolei, June 2006)
2. Combined 36-Inch Makakilo Interceptor & 42 Inch Kapolei Interceptor
Q(max) = 64.7 MGD
Kunia WWPS
West Loch Estates WWPS
West Loch Fairways WWPS
Makakilo Interceptor Sewer (30 Inch)
30" Sewer Stub (See Note 1)
42" Kapolei Interceptor
Ewa Gentry WWPS
30" FM from Ewa WWPS
Honouliuli WWTP Influent
To Deep Ocean Outfall
36" Trunk Sewer
30" Makakilo Interceptor
Renton Rd.
NAVAL AIR STATION
HOOPILI
SEWER MASTER PLAN
EXISTING SEWER SYSTEM PLAN
Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813
CADD: 067-00
SCALE: 1" = 1000'
DATE: Oct 15, 2008
FIGURE
2

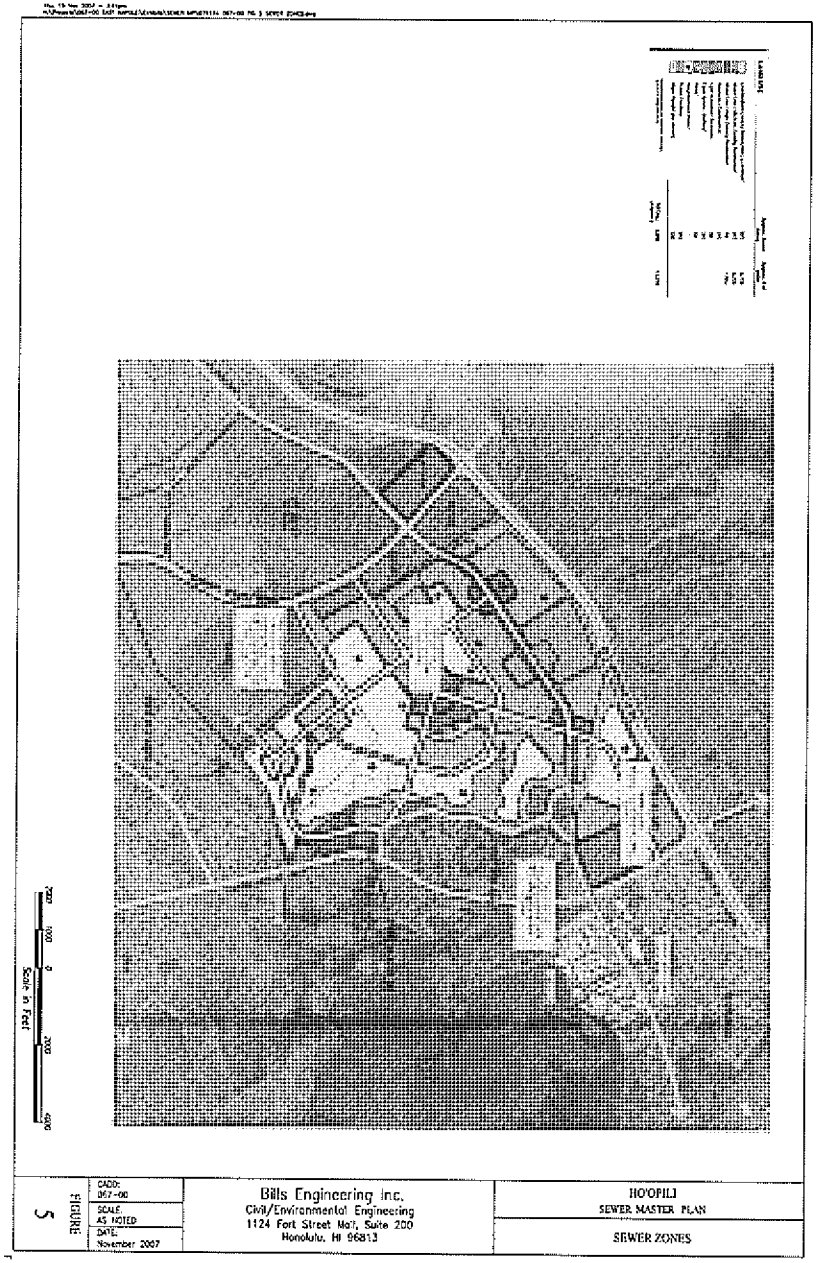

HOOPILI
Scale in Feet
HOOPILI
SEWER MASTER PLAN
SITE PLAN
Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813
CADD: 067-00
SCALE: 1" = 2000'
DATE: November 2007
FIGURE
1

Fri, 27 Oct 2006 - 9:21am
N:\Projects\057-00 EAST KAPOLEI\Exhibits\SEWER MP\057-00 FIG 4 SEWER CORRIDOR.dwg



CADD: 057-00 SCALE: 1"=10' DATE: Oct. 5, 2006	Bills Engineering Inc. Civil/Environmental Engineering 1124 Fort Street Mall, Suite 200 Honolulu, HI 96813	HO'OPILI SEWER MASTER PLAN SEWER CORRIDOR TYPICAL SECTION	FIGURE 4





APPENDIX A
Preliminary Wastewater Calculations

AR00028344

Sewer Location				Tributary Area (Acres)		Tributary Equivalent Population						Wastewater Flow Computation								
District Zone or Street	Point	Unit	Multiplier	Incr.	Total	Residential 1/ Incr.	Residential 1/ Total	Other 2/ 3/ Incr.	Other 2/ 3/ Total	Total Incr.	Total Total	Ave. WWF (MGD)	Maximum Flow Factor	Maximum Flow (mgd)	Dry Weather Infiltration (mgd)	Design Average Flow (mgd)	Design Maximum Flow (mgd)	Wet Weather Infiltration (mgd)	Design Peak Flow (mgd)	Design Peak Flow (cfs)
ZONE 2	RESIDENTIAL (1,243 UNITS)	1,243	4			4972	4,972					0.398								
	RETAIL (327,934 SF)	327,934	0.007					2,186				0.055								
	OFFICE (215,285 SF)	215,285	0.007					1,435				0.036								
	INDUSTRIAL (0 SF)	-	0.005					-				-								
				317.00	317.00	4,972	4,972	3,621	3,621	8,593	8,593	0.488	3.2519	1.5875	0.0430	0.5313	1.6306	0.3003	2.0271	3.1362
	1. RESIDENTIAL - 4 PN/UNIT * 80 GPCD																			
	2. RETAIL/OFFICE - 150 SF/PN 25 GPCD																			
	3. INDUSTRIAL - 200 SF/PN 25 GPCD																			

Sewer Location				Tributary Area (Acres)		Tributary Equivalent Population						Wastewater Flow Computation								
District Zone or Street	Point	Unit	Multiplier	Incr.	Total	Residential 1/ Incr.	Residential 1/ Total	Other 2/ 3/ Incr.	Other 2/ 3/ Total	Total Incr.	Total Total	Ave. WWF (MGD)	Maximum Flow Factor	Maximum Flow (mgd)	Dry Weather Infiltration (mgd)	Design Average Flow (mgd)	Design Maximum Flow (mgd)	Wet Weather Infiltration (mgd)	Design Peak Flow (mgd)	Design Peak Flow (cfs)
ZONE 1	RESIDENTIAL (9,747 UNITS)	9,747	4			38986	38,986					3.119								
	RETAIL (1,249,136 SF)	1,249,136	0.007					8,329				0.208								
	OFFICE (81,437 SF)	81,437	0.007					543				0.014								
	INDUSTRIAL (800,000 SF)	800,000	0.005					4,000				0.100								
				906.00	906.00	38,968	38,968	12,870	12,870	51,858	51,858	3.441	2.2693	7.8103	0.2593	3.7001	8.0695	1.1325	9.2021	14.2367
	1. RESIDENTIAL - 4 PN/UNIT * 80 GPCD																			
	2. RETAIL/OFFICE - 150 SF/PN 25 GPCD																			
	3. INDUSTRIAL - 200 SF/PN 25 GPCD																			

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APPENDIX B
Wastewater Calculations from
"Wastewater Master Plan for East Kapolei"
dated June 2006

Sewer Location				Tributary Area (Acres)		Tributary Equivalent Population						Wastewater Flow Computation								
District						Residential 1/		Other 2/ 3/		Total		Ave.			Dry	Design	Design	Wet	Design	Design
Zone or Sheet	Point	Unit	Multiplier	Incr.	Total	Incr.	Total	Incr.	Total	Incr.	Total	WWF (MGD)	Maximum Flow Factor	Maximum Flow (mgd)	Weather Infiltration (mgd)	Average Flow (mgd)	Maximum Flow (mgd)	Weather Infiltration (mgd)	Peak Flow (mgd)	Peak Flow (cfs)
ZONE 3	RESIDENTIAL (760 UNITS)	760	4			3040	3,040					0.243								
	RETAIL (642,936 SF)	642,936	0.007					4,266				0.107								
	OFFICE (423,276 SF)	423,276	0.007					2,822				0.071								
	INDUSTRIAL (0 SF)	-	0.005					-				-								
				187.00	187.00	3,040	3,040	7,108	7,108	10,148	10,148	0.421	3.1455	1.3240	0.0507	0.4716	1.3747	0.2338	1.6084	2.4885
	1. RESIDENTIAL - 4 PN/UNIT * 80 GPCD																			
	2. RETAIL/OFFICE - 150 SF/PN 25 GPCD																			
	3. INDUSTRIAL - 200 SF/PN 25 GPCD																			

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COMPUTATION OF WASTEWATER FLOW

SEWER: EAST KAPOLEI
DISTRICT: SEWERLINE "B" AND "C"
REFERENCE MAPS:

PAGE: 2 OF 3
COMPUTED BY: DHM
DATE: 5/18/2006

SEWER LOCATION		TRIBUTARY AREA (ACRES)		TRIBUTARY EQUIVALENT POPULATION						WASTEWATER FLOW COMPUTATION								AVERAGE FLOW			MAXIMUM FLOW		SEWER STUDY					
				RESIDENTIAL		OTHER		TOTAL															EXISTING		X ULTIMATE			
DISTRICT ZONE OR STREET	PARCEL	INCREMENT	TOTAL	INCREMENT	TOTAL	INCREMENT *	TOTAL	INCREMENT	TOTAL	AVERAGE WWF @ 80 GPCD (MGD)	MAXIMUM FLOW FACTOR	MAXIMUM FLOW (MGD)	DRY WEATHER INFIL (MGD)	DESIGN AVERAGE FLOW (MGD)	DESIGN MAXIMUM FLOW (MGD)	WET WEATHER INFIL (MGD)	DESIGN PEAK FLOW (MGD)	VELOCITY (FPS)	DEPTH (IN)	% FULL	VELOCITY (FPS)	DEPTH (IN)	PIPE DIA. (IN.)	ROUGHNESS	SLOPE (%)	VELOCITY (FPS)	CAPACITY (MGD)	PEAK FLOW CAPACITY (%)
SEWERLINE "B"																											
Single-Family Res.	B4	50	50	1,600	1,600			1,600	1,600	0.128	4.55	0.582	0.006	0.135	0.591	0.068	0.66	1.45	2.88	24%	2.16	0.36	12	0.015	0.28	2.1	1.06	64%
Park	B3	4	73		1,600	208		8	1,608	0.128	4.55	0.584	0.006	0.137	0.592	0.068	0.66	1.46	2.88	24%	2.14	0.42	12	0.015	0.28	2.1	1.06	65%
Low-Density Res.	B2	5.3	78.3	166	1,766			166	1,774	0.142	4.46	0.653	0.006	0.151	0.642	0.095	0.74	1.48	3.06	26%	2.19	0.72	12	0.015	0.28	2.1	1.06	70%
Community/Business	B1	13.8	92.1		1,766	1932		1,932	3,706	0.296	3.88	1.141	0.019	0.315	1.159	0.115	1.27	2.46	3.60	30%	3.38	7.68	12	0.015	0.81	3.1	1.58	82%
Sewer "B"			92.1		1,766				3,706	0.296	3.88	1.141	0.019	0.315	1.159	0.115	1.27	2.46	3.60	30%	3.38	7.68	12	0.015	0.81	3.1	1.58	82%
SEWERLINE "C"																											
Single-Family Res.	C6	38	38	1,450	1,450			1,450	1,450	0.116	4.62	0.547	0.007	0.123	0.555	0.075	0.63	1.43	2.76	23%	2.10	0.18	12	0.015	0.28	2.1	1.06	59%
21" carry over		167	225	3,400	4,850			3,787	5,287	0.421	3.55	1.515	0.026	0.445	1.537	0.331	1.62	1.75	4.98	38%	2.41	9.81	18	0.015	0.20	2.3	2.63	66%
24" carry over		73	298	400	5,850			1,341	6,628	0.522	3.44	1.794	0.033	0.556	1.827	0.373	2.20	1.84	5.59	31%	2.50	10.98	18	0.015	0.20	2.3	2.63	84%
Single-Family Res.	C1	45	343	1,120	6,903			1,120	7,648	0.612	3.33	2.037	0.035	0.680	2.072	0.429	2.50	2.06	5.40	30%	2.62	10.44	18	0.015	0.30	2.9	3.22	78%
Cancelled/Waived (FUTURE)		1485	1828	54,775	61,678			54,776	62,423	4.994	2.19	10.923	0.312	5.306	11.235	2.285	13.52	4.21	11.52	33%	5.11	17.46	36	0.013	0.30	5.0	23.81	57%
Sewer "C"			1828		61,678			-	62,423	4.994	2.19	10.923	0.312	5.306	11.235	2.285	13.52	4.21	11.52	32%	5.11	17.46	36	0.013	0.30	5.0	23.81	57%
Park	C11	8	8		-	208		8	8	0.000	5.00	0.002	0.000	0.001	0.002	0.010	0.01	0.33	0.20	3%	0.50	0.44	8	0.013	0.26	1.0	0.36	3%
Single-Family Res.	C10	69	77	1,656	1,656			1,656	1,656	0.133	4.50	0.597	0.008	0.143	0.610	0.099	0.71	1.49	2.94	25%	2.18	0.54	12	0.015	0.28	2.1	1.06	67%
Park	C9	9	86		1,656	208		8	1,672	0.135	4.50	0.609	0.008	0.144	0.618	0.106	0.73	1.48	2.94	25%	2.18	0.54	12	0.015	0.28	2.1	1.06	69%
Elementary School	C8	13	98		1,656	1200/375		375	2,047	0.165	4.32	0.715	0.010	0.176	0.725	0.123	0.85	1.56	3.30	28%	2.26	7.26	12	0.015	0.28	2.1	1.06	80%
Single-Family Res	C7	69	167	1,720	3,400			1,720	3,767	0.303	3.83	1.161	0.019	0.322	1.180	0.209	1.39	1.82	4.13	28%	2.56	9.48	15	0.015	0.28	2.4	1.91	73%
Sewer "C1"			167		3,400				3,767	0.303	3.83	1.161	0.019	0.322	1.180	0.209	1.39	1.82	4.13	28%	2.55	9.48	15	0.015	0.28	2.4	1.91	73%
Middle School	C2	23	23		-	1200/375		375	375	0.030	5.00	0.150	0.002	0.032	0.152	0.023	0.18	1.31	1.32	17%	2.04	2.83	8	0.015	0.60	2.3	0.52	34%
Community Center	C3	10	33		-	250/80		80	455	0.036	5.00	0.182	0.003	0.038	0.184	0.041	0.23	1.43	1.44	15%	5.13	3.36	8	0.015	0.60	2.3	0.52	43%
Single-Family Res.	C5	32	65	800	800			800	1,255	0.100	4.78	0.482	0.006	0.107	0.486	0.051	0.57	1.48	2.60	26%	2.14	5.15	10	0.015	0.32	2.0	0.69	82%
Park	C4	8	73		800	208		8	1,263	0.101	4.77	0.482	0.006	0.107	0.488	0.051	0.57	1.43	2.65	27%	2.14	5.15	10	0.015	0.32	2.0	0.69	83%
Sewer "C3"			73		800				1,263	0.101	4.77	0.482	0.006	0.107	0.488	0.051	0.57	1.43	2.65	27%	2.14	5.15	10	0.015	0.32	2.0	0.69	83%

REMARKS: * Design criteria population (generating 25 gpcd) converted to an equivalent population (generating 80 gpcd) by multiplying loo number in the column by 0.3125
(Example: 1200/375 => 1200 x 0.3125 = 375 equivalent population)

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APPENDIX O
Drainage Master Plan

DRAINAGE MASTER PLAN

FOR

HO'OPILI

HONOULIULI, 'EWA, O'AHU, HAWAI'I
TMK: (1)9-1-017: POR. 004, 059, 072;
9-1-018: 001, 004

NOVEMBER 2007

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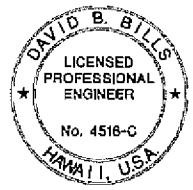
DRAINAGE MASTER PLAN

FOR

HO'OPILI

TMK: (1)9-1-017: POR. 004, 059, 072;
9-1-018: 001, 004
HONOULIULI, 'EWA, O'AHU, HAWAI'I

NOVEMBER 2007



THIS WORK WAS PREPARED
BY ME OR UNDER MY SUPERVISION.

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Figure 6 - Proposed West Loch Detention Area (Detention Basin Plan)

Figure 6A - Proposed West Loch Detention Area (Detention Basin Plan – Concrete Channel Alternative)

APPENDICES

Appendix A - Rational Method Tables and Plates

Appendix B - Preliminary TR-20 Calculations

SECTION 1. INTRODUCTION

1.1 Project Location

The Ho'opili project by D. R. Horton-Schuler Division ("Schuler") is located in Honouliuli, 'Ewa, O'ahu. The project site is between 'Ewa Villages and H-1 Freeway, west of Fort Weaver Road, and east of the proposed North-South Road. The development includes TMK: (1)9-1-017: por. 004, 059, 072 and 9-1-018: 001, 004, for a total area of approximately 1,586 acres. (See Figure 1 - Location Map & Project Site Plan.)

The proposed Ho'opili project is a master-planned community with approximately 11,750 residential units. The project will also include commercial and medical office space, parks, and schools.

1.2 Purpose

The purpose of this report is to present the existing and proposed hydrology affecting the project site and to develop a conceptual drainage plan that will demonstrate that storm water can adequately be accommodated to pass through the project site, in conformance with the City and County of Honolulu Drainage Standards.

The second purpose of this report is to present a conceptual plan for compliance with the Water Quality component of the City and County of Honolulu Drainage Standards. All projects in excess of 10 acres must demonstrate that it has reduced the discharge of pollutants to the "maximum extent practicable". Physical methods to demonstrate compliance (detention based water quality control) are proposed.

More detailed drainage studies will be done, as appropriate, to support the various stages of project planning and development.

SECTION 2. EXISTING CONDITIONS

2.1 Existing Topography

The project site is located within the 'Ewa Plain of Leeward O'ahu. The land is presently in agricultural production. The property is relatively flat with elevations ranging from 220 feet above Mean Sea Level (MSL) at the mauka boundary at H-1, to elevation 55 MSL at Fort Weaver Road. The site has an average slope of 1.6% from mauka to makai.

2.2 Flood Insurance Rate Map

The majority of the project site is located in an area designated as Zone D on the Flood Insurance Rate Map (Map No. 15003C220 & 310 F, effective September 30, 2004), where flood hazards are undetermined but possible. Portions of the site are subject to flooding from Honouliuli Stream and are within Zones A, AE and X. (See Figure 2 - Flood Insurance Rate Map.)

2.3 Existing Drainage

The Ho'opili project is within three drainage basins - West Loch, Kalo'i Gulch and Honouliuli. The "Ewa District Runoff Map - Drainage Areas and Peak Flows" prepared by Engineering Concepts, Inc. dated April 3, 1991, identifies the extent of each of these drainage basins. Figure 3 – Ho'opili/'Ewa District Runoff Map shows the map with the

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proposed Ho'opili project limits superimposed. Figure 4 – Project Drainage Areas, shows how the site is divided between these basins.

West Loch

Approximately 849 acres of the project area lies within the West Loch drainage basin, extending from H-1 Freeway, across Farrington Highway, and down toward the northeast boundary with 'Ewa Village. Runoff within the basin flows along the cane haul road, crossing under Fort Weaver Road, or over Fort Weaver Road in the vicinity just mauka of the Elderly Housing Project (see Figure 4).

The cane haul road is within Easement "2680" and runs through the Asing Park owned by the City and County of Honolulu (TMK: 9-1-17:66). A 54" inlet, located at the low-point takes water through the West Loch Fairways project (design area, A = 31 acres, design discharge, Q = 93 cfs) and discharges through an 84" outlet into the West Loch Fairways golf course (A = 80 acres, Q = 239 cfs). Runoff in excess of the 93 cfs is forced out toward West Loch along the cane haul road. The cane haul road terminates at an existing detention basin built in Schuler's 31-acre parcel (TMK: (1)9-1-010: 002).

The basin was built just southeast of the West Loch subdivision in conjunction with the 'Ewa by Gentry – East project. The basin collects runoff from the Elderly Housing site, a portion of 'Ewa Villages (via two- 54" pipe culverts under Fort Weaver Road), and the site of the future Ho'opili project. The basin is owned and maintained by the City and County of Honolulu. Overflow from the basin sheet-flows toward the West Loch basin of Pearl Harbor.

Onsite storm water basins have been defined from H-1 Freeway as the mauka extent and the basins have been drawn to the exit point of the proposed project (see Figure 4). Basins W1 and W2 represent the drainage areas contributing to West Loch via the Cane Haul Road. The City and County of Honolulu Drainage Standard (Plate 6) was used for this basin since it is over 100 acres. The basins listed as W1A and W1B represent subareas of basin W1 used in the analysis of developed conditions.

Kalo'i Gulch

The entire Kalo'i basin extends from the Wai'anae Range above H-1 Freeway and terminates at the coast in the vicinity of the Ocean Pointe marina. Approximately 102 acres of the project area (areas K8 and K9, on Figure 4) lie within the Kalo'i drainage basin. The areas are adjacent to the proposed North-South Road (TMK: (1)9-1-018: 004 and portion of TMK: (1)9-1-017: 004). Runoff flows in a mauka to makai direction from H-1 Freeway.

Honouliuli

The entire Honouliuli drainage basin is approximately 12.13 square miles in area. It extends from the south slopes of the Wai'anae Range above H-1 Freeway and drains into West Loch, Pearl Harbor. The Honouliuli Stream system is made up of two main branches, the East and West forks, with a confluence just above H-1 Freeway. Below H-1, the flow is confined to Honouliuli Stream.

The "Honouliuli Stream Flood Study for the West Loch Development" dated May 1992, prepared by the R. M. Towill Corporation, established flood boundaries and elevations along the lower Honouliuli Stream floodplain. The study mentioned that the area is prone to relatively frequent flooding due to an accumulation of debris along the stream's narrow and winding course. Channel improvements and clearing done in conjunction with the development of the golf course increased capacity of Honouliuli Stream to carry the 10-year flood. The Fort Weaver Road twin bridges have a 100-year design capacity. (See Figure 2 – Flood Insurance Rate Map.)

Approximately 632 acres of the Ho'opili project (portion of TMK: (1)9-1-018: 001 and portion of (1)9-1-017: 004) are within the Honouliuli drainage basin. The majority of the area is within Zone D, where flood hazards are undetermined but possible. Within TMK: (1)9-1-018: 001 (portions of areas H3 and H4), a strip along Honouliuli Stream is within Zone A and Zone X, areas where no base flood elevations have been determined, and areas of 0.2% annual chance of flood or with 1% annual chance of flood with average depths less than 1 foot, respectively.

The offsite drainage basin, mauka of H-1 Freeway, entering the site is approximately 6,896 acres with a Plate 6 design discharge of 11,200 cfs. The Flood Insurance Study lists a Q_{100} of 7,730 cfs at Farrington Highway.

The onsite basins are shown as H3 – H7 on Figure 4. Areas H5A, H5B, H7A and H7B are subareas used in the analysis of developed conditions.

2.4 Existing Hydrology

The following table summarizes the hydrologic calculations for each onsite basin shown on Figure 4.

TABLE 1. ONSITE DRAINAGE BASIN SUMMARY

Basin	*Area (acres)*	*Q (cfs)*	*Method/comments*
West Loch			
W1	809.5	2,400	Plate 6, Q_{peak}/A = 3 cfs/ac
W2	9.1	11.2	Rational Method Q_{50}/A = 1.2 cfs/ac
	30.8		Detention area (TMK: 9-1-10:02)
	849.4		
Honouliuli			
H3	94.8	83.4	Rational Method Q_{50}/A = 0.9 cfs/ac
H4	78.1	82.5	Rational Method Q_{50}/A = 1.1 cfs/ac
H5	137.8	750	Plate 6, Q_{peak}/A = 5.4 cfs/ac
H6	173.5	750	Plate 6, Q_{peak}/A = 4.3 cfs/ac
H7	148.2	700	Plate 6, Q_{peak}/A = 4.7 cfs/ac
	632.4		
Kalo'i			
K8	50.5	48	Rational Method Q_{50}/A = 0.92 cfs/ac
K9	52.0	48.9	Rational Method Q_{50}/A = 0.97 cfs/ac
	102.5		
Totals	1,584.3*	4,874	*Drainage area exceeds project area due to area contributed by Farrington Hwy.

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Rational Method
(See Appendix A – Rational Method, for Tables and Plates)

Basin W2 – 9.1 Acres

Q_{50} = CIA, where
C = 0.2 (Table 1, Band 4, flat farmlands)
I = TM_{50} x Correction Factor for Time of Concentration
TM_{50} = 2.2 in/hr (Plate 2)

Correction Factor = Use Plate 5 for Small Agricultural Basins, where:

Length (L) = 450 Feet
H (Height) = Elevation 62- Elevation 58 = 4 Feet
Slope (S) = 4/450 = 0.89 Ft/Ft

$K = L/S^{1/2}$ = $450/0.0089^{1/2}$ = 4,770

For K = 4,770 and Upper Curve Plate 5,
Time of Concentration = 5.3 Minutes
Correction Factor = 2.8 (Plate 4)

Q_{50} /A = (0.2)(2.8 In/Hr.)(2.2) = 1.2 cfs/ac
Q_{50} = (9.1 ac)(1.2) = 11 cfs

Basin H3 – 94.8 Acres

Q_{50} = CIA, where
C = 0.2 (Table 1, Band 4, flat farmlands)
I = TM_{50} x Correction Factor for Time of Concentration
TM_{50} = 2.2 in/hr (Plate 2)

Correction Factor = Use Plate 5 for Small Agricultural Basins, where:

Length (L) = 3,200 Feet
H (Height) = Elevation 212 - Elevation 107 = 105 Feet
Slope (S) = 105/3,200 = 3.28 Ft/Ft

$K = L/S^{1/2}$ = $3,200/0.0328^{1/2}$ = 17,669

For K = 17,669 and Upper Curve, Plate 5
Time of Concentration = 14.5 Minutes
Correction Factor = 2.0 (Plate 4)

Q_{50}/A = (0.2) (2.0 in/hr)(2.2)/(A) = 0.88 cfs/ac
Q_{50} = (94.8 ac)(0.88) = 83.4 cfs

Basin H4 – 78.1 Acres

Q_{50} = CIA, where
C = 0.2 (Table 1, Band 4, flat farmlands)
I = TM_{50} x Correction Factor for Time of Concentration
TM_{50} = 2.2 in/hr (Plate 2)

Correction Factor = Use Plate 5 for Small Agricultural Basins, where:

Length (L) = 2,100 Feet
H (Height) = Elevation 189.6 - Elevation 96 = 93.6 Feet
Slope (S) = 93.6/2,100 = 4.46 Ft/Ft

$K = L/S^{1/2}$ = $2,100/0.0446^{1/2}$ = 9,947

For K = 9,947 and Upper Curve, Plate 5
Time of Concentration = 9.3 Minutes
Correction Factor = 2.4 (Plate 4)

Q_{50}/A = (0.2) (2.2 in/hr)(2.4)/(A) = 1.06 cfs/ac
Q_{50} = (78.1 ac)(1.06) = 82.8 cfs

Basin K8 – 50.5 Acres

Q_{50} = CIA, where
C = 0.2 (Table 1, Band 4, flat farmlands)
I = TM_{50} x Correction Factor for Time of Concentration
TM_{50} = 2.2 in/hr (Plate 2)

Correction Factor = Use Plate 5 for Small Agricultural Basins, where:

Length (L) = 2,200 Feet
H (Height) = Elevation 200 - Elevation 150 = 50 Feet
Slope (S) = 50/2,200 = .0227 Ft/Ft

$K = L/S^{1/2}$ = $2,200/0.0227^{1/2}$ = 14,602

For K = 14,602 and Upper Curve, Plate 5
Time of Concentration = 12.6 Minutes
Correction Factor = 2.1 (Plate 4)

Q_{50}/A = (0.2) (2.2 in/hr)(2.1)/(A) = 0.92 cfs/ac
Q_{50} = (50.5 ac)(0.92) = 46.5 cfs

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SECTION 3. PROPOSED CONDITIONS

3.1 Increased Runoff from Development

The master plan for the proposed "Ho'opili" project is shown on Figure 5 – Ho'opili Master Plan. The individual basins and sub-basins that were analyzed to create the Master Plan are identified on Figure 4 - Project Drainage Areas. Figure 5 - Drainage Master Plan summarizes the total "after development" conditions. Increased runoff resulting from development has been determined for all areas using the NRCS Method TR-20. Existing and peak flows were calculated for each drainage basin assuming 24-hour rainfall. (See Table 2 - Runoff Increase Summary.)

Runoff will "be limited to predevelopment conditions", in accordance with Section 1-4.1B.3 of the City and County of Honolulu Drainage Standards. Individual developments will be required to provide detention/retention facilities to address both peak storm water runoff rates as well as water quality requirements of the Drainage Standards. The location of the retention/detention basin facilities will be determined during the site planning stage for each area. The one exception to this design criteria will be that runoff that can be directly routed to West Loch and not cause downstream aggravation to property will be allowed to pass at a "fully developed" discharge flow with detention for water quality requirements only. See Table 2 for comparison of runoff for existing and developed conditions. Figure 5 shows preliminary locations for detention/retention areas discussed below.

Kalo'i Basin

For Kalo'i drainage basins (Areas K8 and K9), any increase in runoff will be collected in retention/detention facilities within the two development areas. The retention/detention basin for the K-8 area will discharge to Farrington Highway and the UHWO campus areas at pre-development rates. The discharge from the retention/detention basin for the K9 area will be connected to the North-South Road drainage channel system.

Honouliuli Stream Basin

Area H5 at the corner of Farrington Highway and Fort Weaver Road presently drains to a low point at the southeast corner of TMK: (1)9-1-018: 001. It appears that the runoff ponds within this area until it rises and eventually crosses Fort Weaver Road towards West Loch, Pearl Harbor. Under developed conditions, portions of the Honouliuli drainage basin will be diverted to Honouliuli Stream to alleviate this potential problem, resulting in a decrease in runoff for area H5B. Area H5B is identified as the Waipahu Drainage Basin on the Master Plan (Figure 5).

Under existing and proposed conditions, runoff from Areas H3 and H4 drain towards Honouliuli Stream. Any increase in runoff will need to be addressed by providing onsite detention/retention facilities, with overflow going into Honouliuli Stream.

Runoff from area H6 flows along an existing gully and then sheet flows across existing lots along the West Loch Golf Course (Mauka Phase 1). The runoff gets into Honouliuli Stream once it reaches the golf course. It is proposed that a detention/retention area be created within the existing gully. Overflow will be released at a rate not to exceed the 10-year recurrence interval storm. (This is the recognized capacity of the Honouliuli Stream channel.)

Under existing conditions, the majority of the runoff from area H7 sheet flows across Fort Weaver Road, with a portion of the runoff allowed to pass under Fort Weaver Road via a 48-inch pipe culvert to West Loch Estates. Under developed conditions, runoff from Area H7A (approximately 148 acres) will be collected within the roadway drainage system and piped to the Cane Haul Road, eventually discharging into West Loch. Runoff from Area H7B (approximately 23 acres) will continue to sheet flow across Fort Weaver Road. The net result of drainage improvements proposed by Ho'opili will be a reduction in storm water flow (46 cfs) crossing Fort Weaver Road, passing through West Loch Estates and crossing the Golf Course before ultimately entering the West Loch.

West Loch

Runoff from the West Loch areas (Areas H7A, W1A and W1B) will flow from the project's onsite drainage system into the Cane Haul Road drainage ditch and then into an enlarged detention area near West Loch Fairways Subdivision. The existing detention basin will need to be expanded to cover the 31-acre site to accept flow from the "developed" Ho'opili project. Discharge from the detention basin facilities would then be routed across Navy property to ultimately discharge into the West Loch of Pearl Harbor. The stormwater routing from the detention basin to West Loch would consist of an earth lined trapezoidal channel approximately 80 to 100 feet wide. The channel (from the detention basin to West Loch) would have a maintenance roadway and security fencing.

A plan was developed by Gentry in the mid 1990's to allow a similar detention basin and overflow channel to West Loch. Gentry entered discussions with the Navy but no agreements were made. The Gentry 1990's plan is shown on Figure 6 – Proposed West Loch Detention Area as the background of the current plan. The current plan minimizes the amount of Navy land potentially impacted. A Figure 6A is also presented that provides for a concrete channel overflow. The concrete channel overflow is being considered as a "lowest maintenance" option that would be more attractive to the City for dedication purposes.

The plan presented in this drainage analysis shows storm water runoff from the West Loch drainage basin entering the makai detention area with an overflow to West Loch across Navy property. The concept can readily be expanded to also include Gentry properties to the west of Fort Weaver Road by adding detention on Gentry property adjacent to the 31 acre makai detention area and widening the overflow channel. Consultation with Gentry has confirmed this option may be explored. The current Gentry plan to meet City and County of Honolulu Drainage standards for their properties west of Fort Weaver Road is to excavate depressions capable of storing 100-year 24-hour rainfall events. This plan reduces the land Gentry's land area available for development and encumbers it with large depressions.

Crossing Navy property will require approval of the U. S. Navy. Resolving issues regarding security and maintenance (private vs. City and County) will be paramount. The alternative to the concept shown on Figure 6 is complete retention of a 100-year 24-hour storm on the Ho'opili project property. This would include the 31-acre detention site shown on Figure 6 as well as a portion of the project currently planned for residential housing. The volume required to retain a 100-year 24-hour storm is 34 acre-feet.

AR00028353

TABLE 2. RUNOFF INCREASE SUMMARY							
Basin	Area (acres)	Developed Area (acres)	Existing Peak Runoff (cfs)	Developed Peak Runoff (cfs)	Change (cfs)	Storm Water Quality Requirement WQDV = C(1")A(3,630) (Acre-ft)	Preliminary Basin Design Dimensions/ Peak flow /Vol (cfs/Acre-ft)
West Loch							
W1							
W1 (Exist.)	809.5		306.52				
W1A & W1B		809.5		1201.53	895.01	33.7	
W2	9.1	9.1	11.0	21.35	10.35	0.4	
TMK: 9-1-010:2	30.8	30.8	-	-	-	Detention area	700'x400'x8.4'/ 195 cfs/57 AF
Total (West Loch)	849.4	849.4	317.52	1222.88	905.36	35.4	
Honouliuli							
H3	94.8	94.8	83.81	217.59	133.78	4.0	140'x100'x9.3'/ 68 cfs/8 AF
H4							
H4 (Exist.)	78.1		91.12				
H4 & H5A		183.1		357.19	266.07	7.6	300'x300'x7.8'/ 74 cfs/18 AF
H5							
H5A & H5B (Exist.)	137.8		114.4				
H5B		32.8		75.48	-38.92	1.4	100'x100'x7.9'/ 36 cfs/3 AF
H6	173.5	173.5	144.92	217.07	72.15	7.2	250'x250'x7.8'/ 142 cfs/13 AF
H7							
H7 (Exist.)	148.2		99.05				
H7A		125.2		236.87		5.2	250'x250'x7.8'/ 71 cfs/11 AF
H7B		23		52.93	190.75	1.0	100'x100'x6.3'/ 23 cfs/2 AF
Total (Honouliuli)	632.4	632.4	533.3	1134.59	601.29	26.4	
Kalo'i							
K8	50.5	50.5	49.31	108.13	58.62	2.2	150'x150'x6.9'/ 45 cfs/4 AF
K9	52.0	52.0	48.36	110.32	61.96	2.1	150'x150'x6.7'/ 46 cfs/4 AF
Total (Kalo'i)	102.5	102.5			120.78	4.3	
Totals	1,584.3	1,584.3					

3.2 Onsite Drainage System

All runoff from the project lots and roadway system will be collected by swales and roadway catch basins. The drainage system will include catch basins, drain manholes and drain lines. All improvements will be designed and constructed in accordance with City and County of Honolulu "Rules Relating to Storm Drainage Standards" dated January 2000.

Hydraulic calculations for the onsite drainage system will be submitted with the construction plans.

3.3 Retention/Detention Facility

The project's detention/retention facilities have two purposes: to reduce the project's peak flow to predevelopment conditions and to provide water quality detention.

The size of the water quality detention facilities will be based on Section 1-5.1C of the Storm Drainage Standards the required volume of runoff to be detained through the water quality detention basin is calculated as follows:

WQDV = C x 1" x A x 3,630

Where, C = 0.05 + (0.009) x (IMP)

Where, IMP = Impervious Area of project expressed as percentage where little or no infiltration occurs. For the purpose of this study, a paved percentage factor of 50 has been used.

C = 0.05 + (0.009) x 50 = 0.50

WQVD = 0.5 x 1" x Area x 3,630 = 1,815 Cubic Feet/Acre (.0417 Acre-feet/Acre)
Table 2 - Runoff Increase Summary identifies the water quality storage requirement for each of the development areas shown of Figure 4.

In addition to the water quality aspect of the project's retention/detention facility, the facility utilizes storage to dampen the project's peak flow. Inflow and outflow hydrographs have been created to size both the basin and the basin's outflow structure, to demonstrate that the basin adequately dampens the peak flow to predevelopment conditions. (See Appendix B – Preliminary TR-20 Calculations.)

3.4 Maintenance of Drainage Facilities

Piped Systems

Piped systems (i.e., drain pipes, catch basins, concrete drainage structures, etc.) will be constructed to meet the requirements of the Drainage Standards and will be dedicated to the City and County oh Honolulu. Drainage features within roadways will be part of the dedicated roadway system. Piped drainage systems created outside the roadway area will be constructed to City and County standards and easements will be created for the piped systems as a part of dedication.

AR00028354

Retention/Detention Basins

Retention/detention basins will be constructed to meet hydraulic requirements of the Drainage Standards. It is the project's intention to dedicate the facilities to the City and County of Honolulu. However, it is recognized that the City may require maintenance of these facilities to be retained by the homeowners or property owner associations. Flowage easements will be created for the basins.

The West Loch drainage basin and the makai detention facility may require special consideration. The discharge from the basin is proposed to cross Navy property and the Navy will be particularly concerned about the entity responsible for maintenance. Maintenance by a private company or a property owner association may be unacceptable to the Navy.

Commercial lots, such as Areas K8 and K9, will most likely have their own property owner association(s) and these retention/detention basins will be privately maintained.

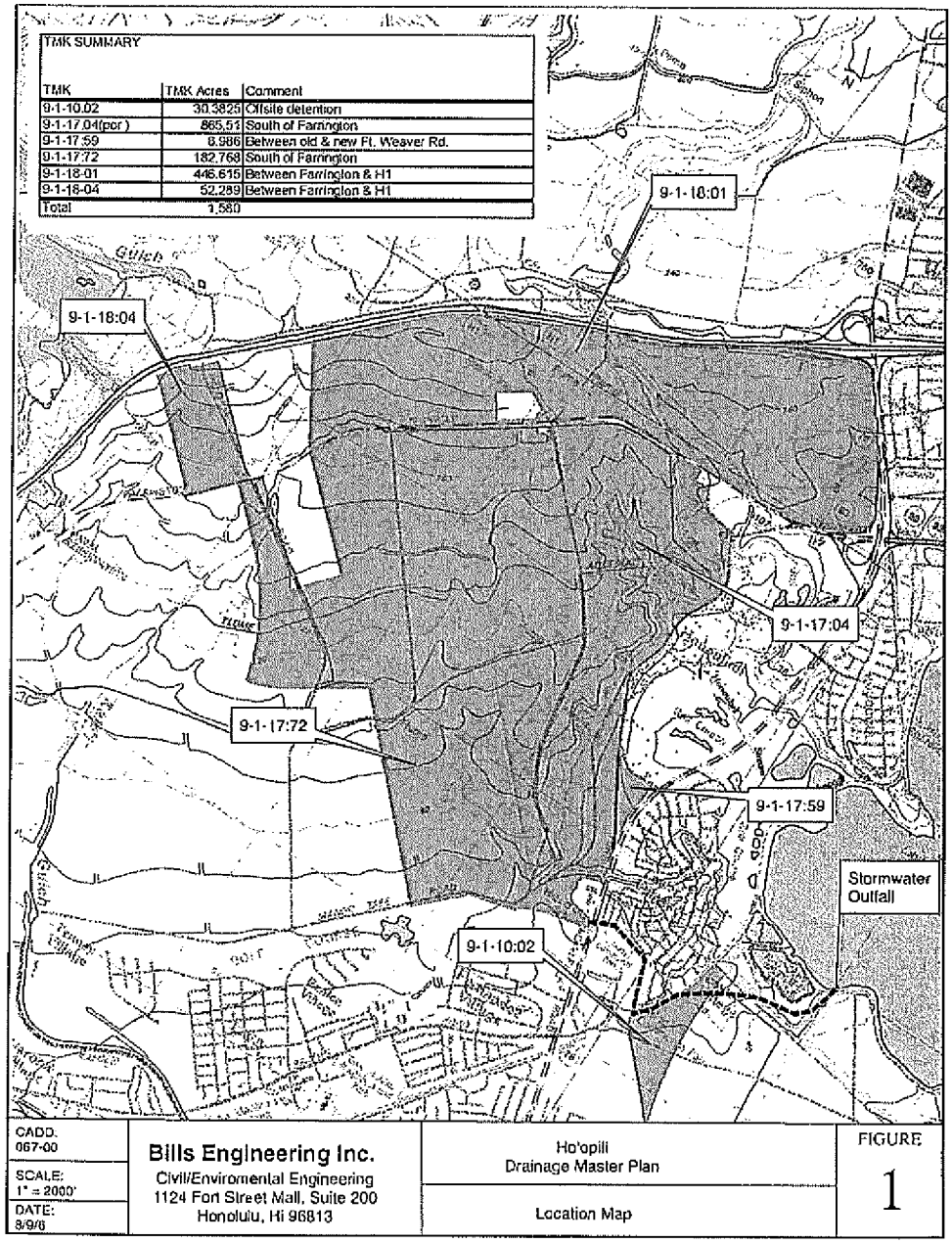
SECTION 4. SUMMARY & CONCLUSIONS

1. The Drainage Master Plan for the Ho'opili project demonstrates that proposed development will not adversely affect adjacent property owners and/or existing or proposed downstream development in accordance with the City and County of Honolulu Drainage Standards.

2. This Drainage Master Plan identifies the major components of the overall Ho'opili drainage system with emphasis on the methods and means to address downstream runoff created through urbanization. The master plan will evolve to add more detailed site specific analysis of on-site piping structures at a later date as the plan becomes more developed. However, the methods to address increased runoff will not change significantly.

3. There will be no adverse drainage impacts resulting from development if the principles in this Drainage Master Plan are followed.

4. The Navy has been consulted with respect to the preferred option of having the ultimate discharge enter West Loch. As of this date the Navy has rejected the plan. Therefore, unless the Navy's position can be altered, the primary ultimate drainage solution will be the creation of on-site retention basins capable of storing the 100-year, 24-hour rainfall event.



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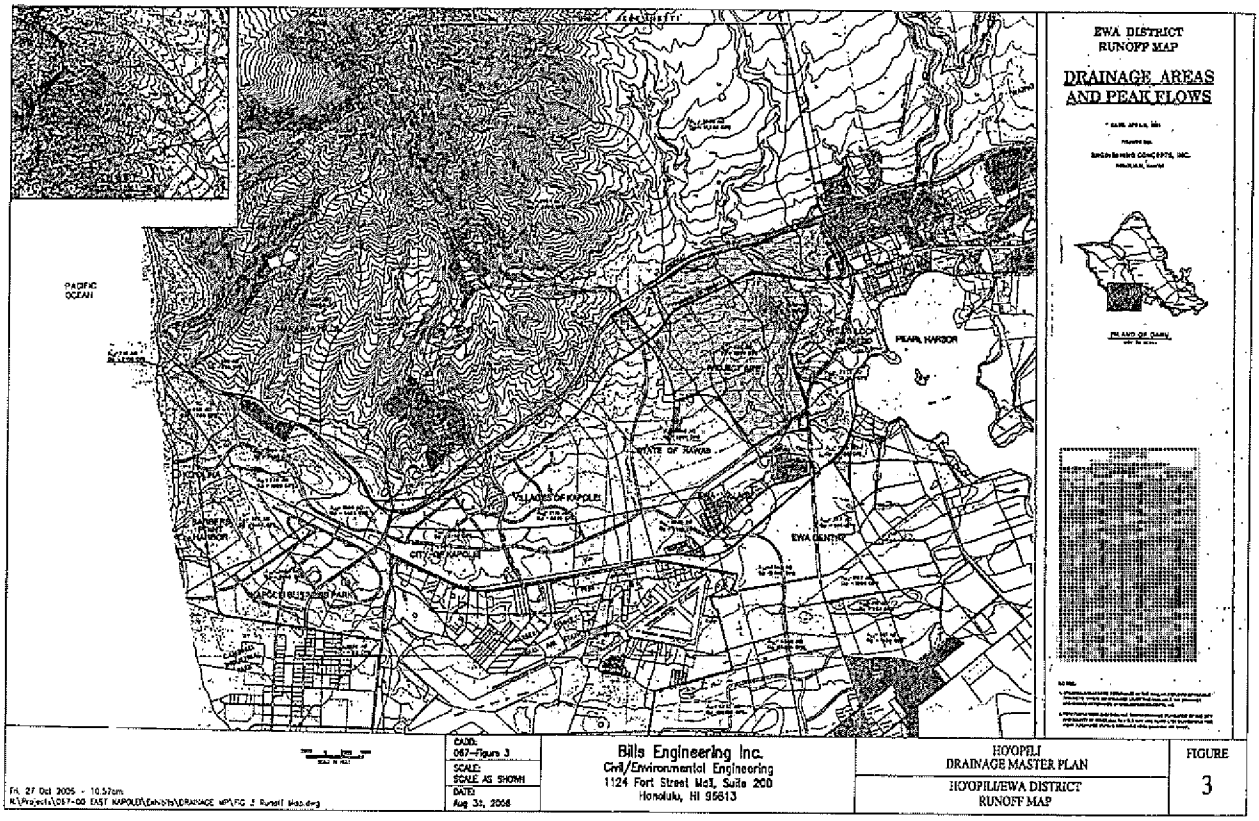
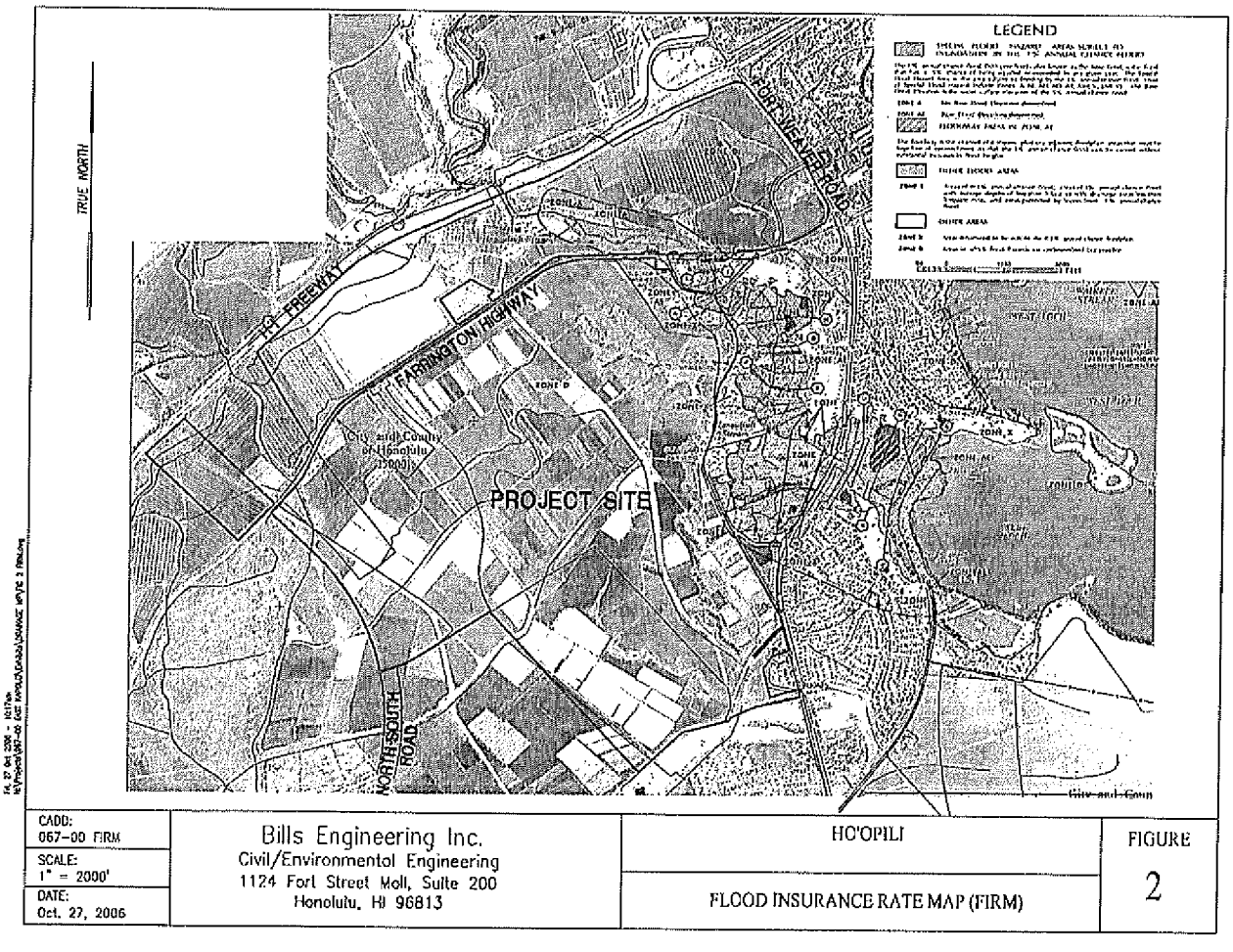
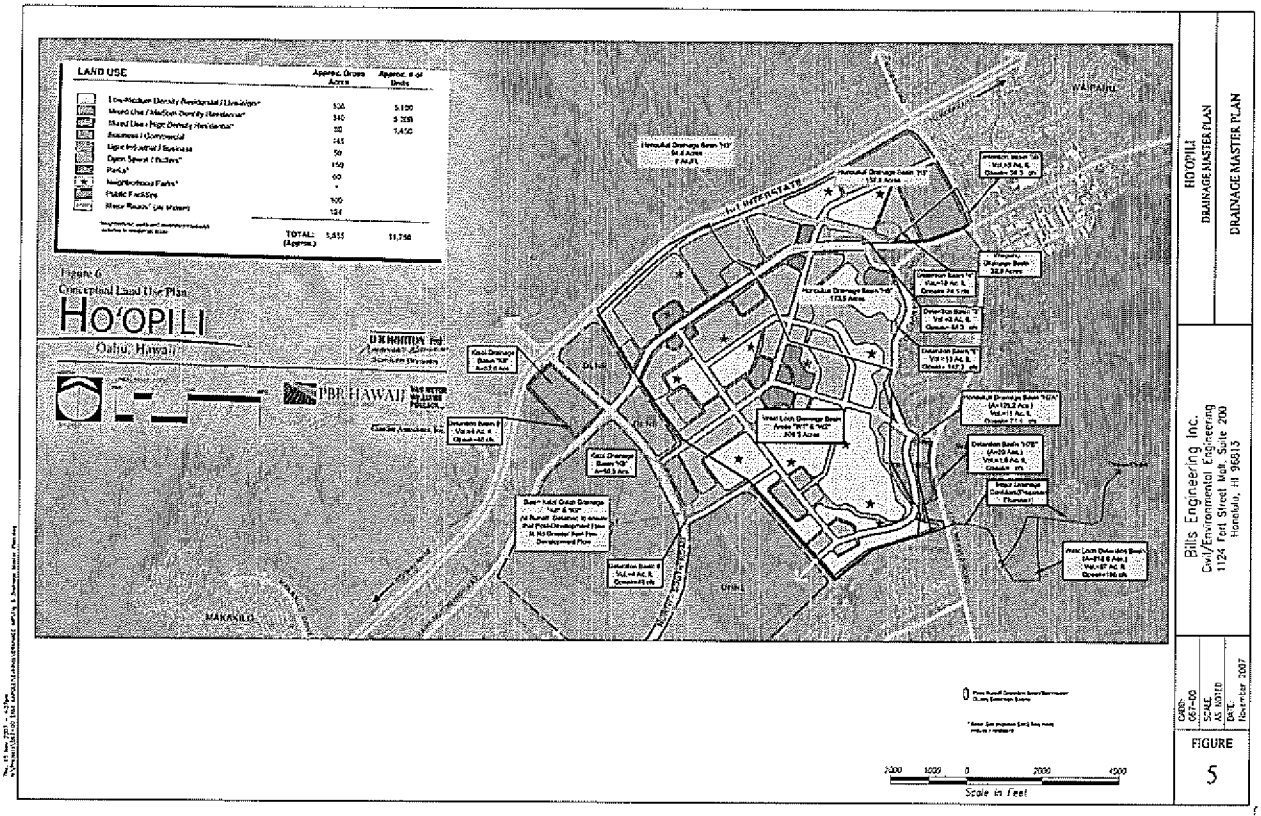

EWA DISTRICT
RUNOFF MAP
DRAINAGE AREAS
AND PEAK FLOWS
PACIFIC OCEAN
PEARL HARBOR
VILLAGES OF KAPOLEI
EWA CENTER
CADD:
067-Figure 3
SCALE:
SCALE AS SHOWN
DATE:
Aug 31, 2006
Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813
HO'OPILI
DRAINAGE MASTER PLAN
HO'OPILI/EWA DISTRICT
RUNOFF MAP
FIGURE
3


LEGEND
TRUE NORTH
H-1 FREEWAY
FARRINGTON HIGHWAY
FORT WEAVER ROAD
NORTH-SOUTH ROAD
PROJECT SITE
CADD:
067-00 FIRM
SCALE:
1" = 2000'
DATE:
Oct. 27, 2006
Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813
HO'OPILI
FLOOD INSURANCE RATE MAP (FIRM)
FIGURE
2


LAND USE
Figure 6
Conceptual Land Use Plan
HO'OPILI
Oahu, Hawaii
DR HORTON
DBR HAWAII
Kalo Drainage Basin "KB"
West Loch Drainage Basin "WB"
Honouliuli Drainage Basin "HB"
Detention Basin "A"
Detention Basin "B"
Detention Basin "C"
Detention Basin "D"
Detention Basin "E"
Detention Basin "F"
Detention Basin "G"
Detention Basin "H"
Detention Basin "I"
Detention Basin "J"
Detention Basin "K"
Detention Basin "L"
Detention Basin "M"
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Detention Basin "DD"
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Detention Basin "BBBBB"
Detention Basin "CCCCC"
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Detention Basin "VVVVVVVV"
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Detention Basin "ZZZZZZZZ"
Scale in Feet
HO'OPILI
DRAINAGE MASTER PLAN
Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
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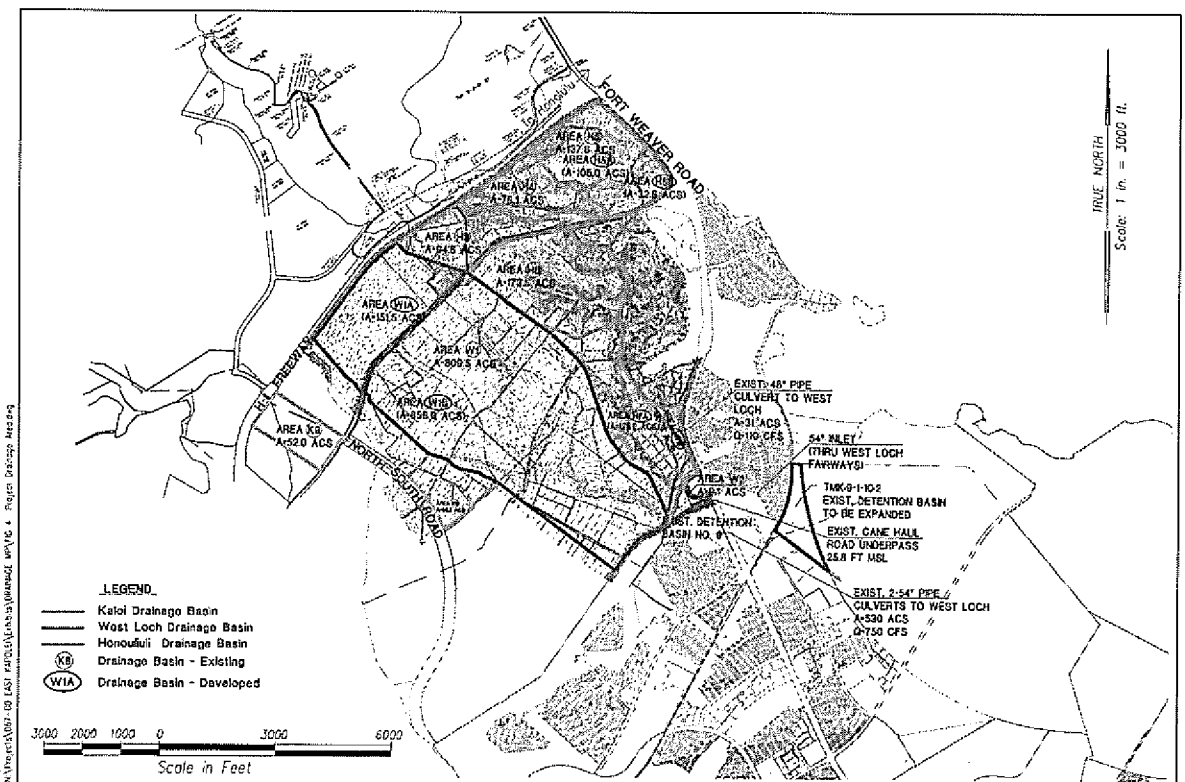
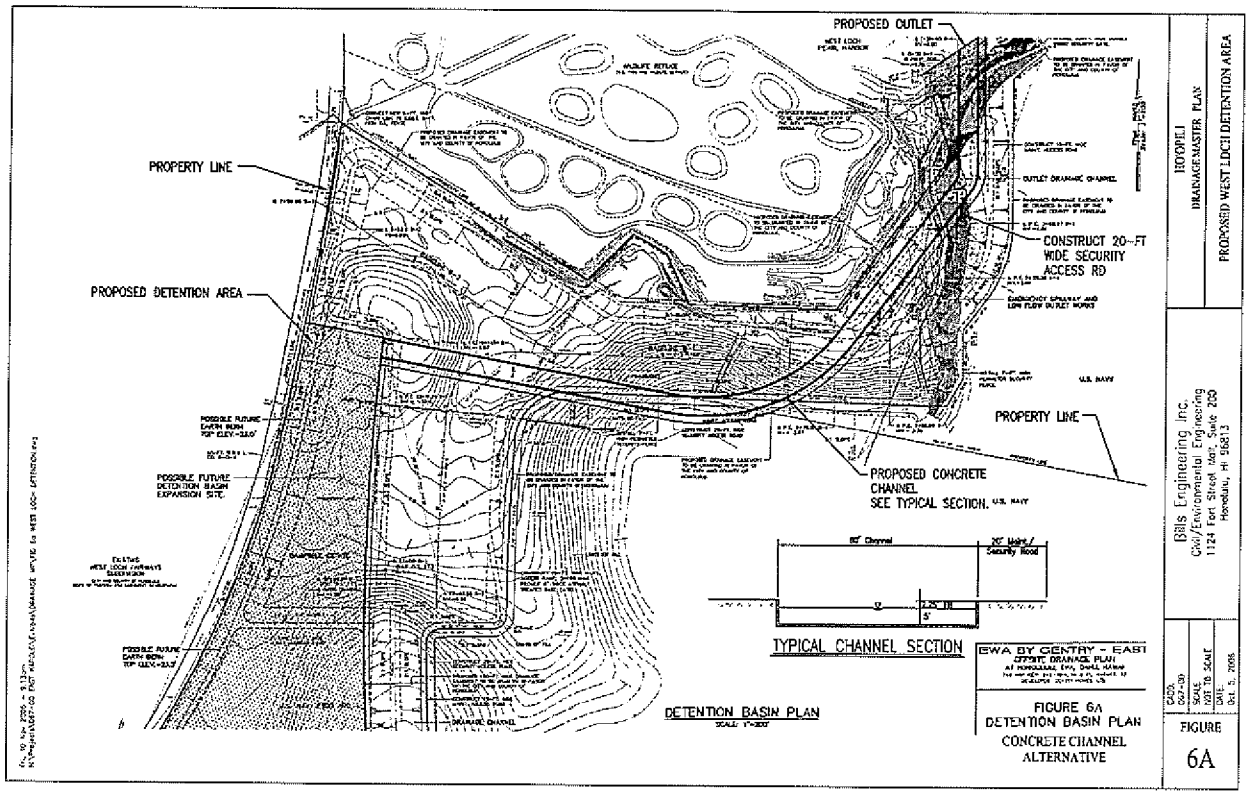
FIGURE
5


FORT WEAVER ROAD
H-1 FREEWAY
NORTH-SOUTH ROAD
AREA K3
A=52.0 ACS
AREA (K4)
A=84.8 ACS
AREA (K5)
A=177.5 ACS
AREA (K6)
A=856.8 ACS
AREA (K7)
A=106.0 ACS
AREA (K8)
A=12.6 ACS
AREA W1A
A=151.5 ACS
AREA W2
A=809.5 ACS
AREA W3
A=761 ACS
AREA W4
A=[illegible] ACS
EXIST. DETENTION BASIN NO. 6
EXIST. 48" PIPE CULVERT TO WEST LOCH
A=31 ACS
Q=110 CFS
54" RCP
(THRU WEST LOCH FAIRWAYS)
TMK:9-1-10:2
EXIST. DETENTION BASIN TO BE EXPANDED
EXIST. CANE HAUL ROAD UNDERPASS
25.8 FT MSL
EXIST. 2-54" RCP CULVERTS TO WEST LOCH
A=530 ACS
Q=750 CFS
LEGEND
Kaloi Drainage Basin
West Loch Drainage Basin
Honouliuli Drainage Basin
KB Drainage Basin - Existing
WIA Drainage Basin - Developed
3000 2000 1000 0 3000 6000
Scale in Feet
TRUE NORTH
Scale: 1 in. = 3000 ft.
CADD:
SCALE: 1" = 3000'
DATE: NOVEMBER 2007
Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813
HO'OPILI
DRAINAGE MASTER PLAN
PROJECT DRAINAGE AREAS
FIGURE
4


PROPOSED OUTLET
PROPERTY LINE
PROPOSED DETENTION AREA
CONSTRUCT 20-FT WIDE SECURITY ACCESS RD
PROPERTY LINE
PROPOSED CONCRETE CHANNEL SEE TYPICAL SECTION.
TYPICAL CHANNEL SECTION
DETENTION BASIN PLAN
EWA BY GENTRY - EAST
FIGURE 6A
DETENTION BASIN PLAN
CONCRETE CHANNEL ALTERNATIVE
HONOPILI
DRAINAGE MASTER PLAN
PROPOSED WEST LOCH DETENTION AREA
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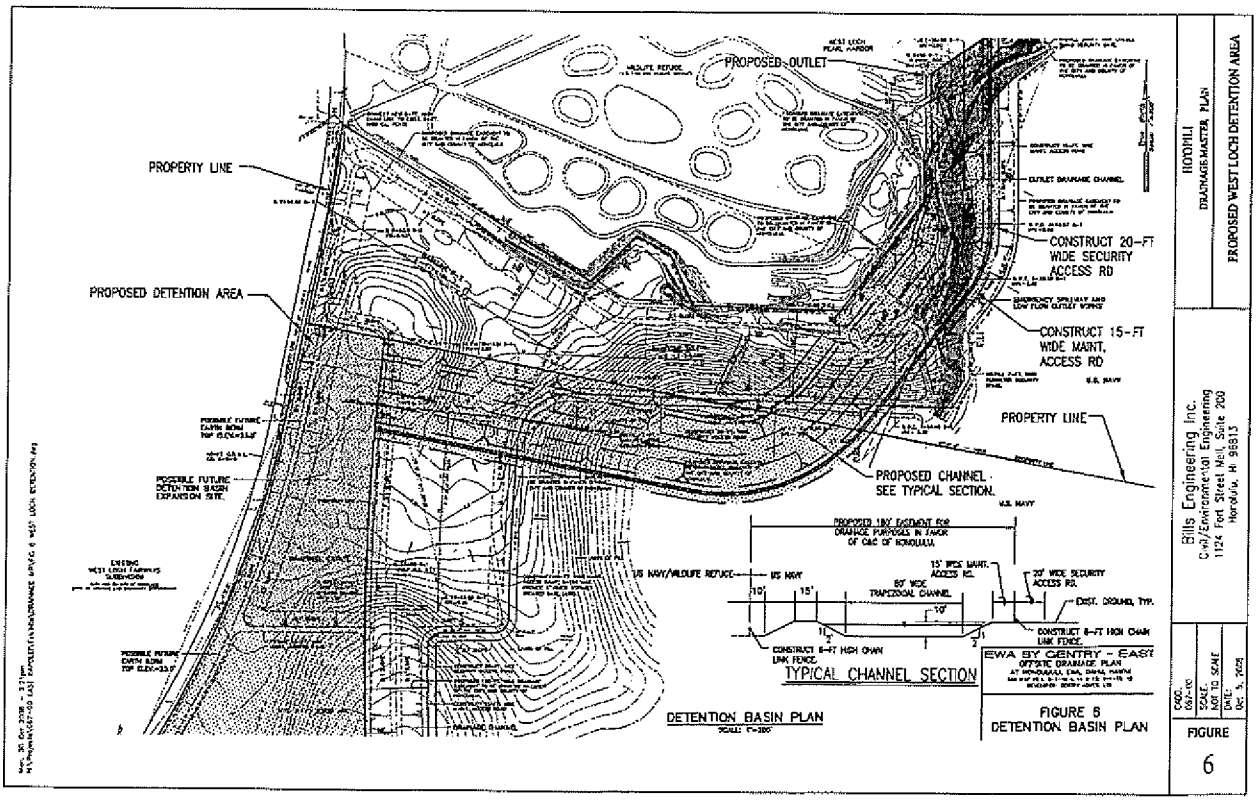
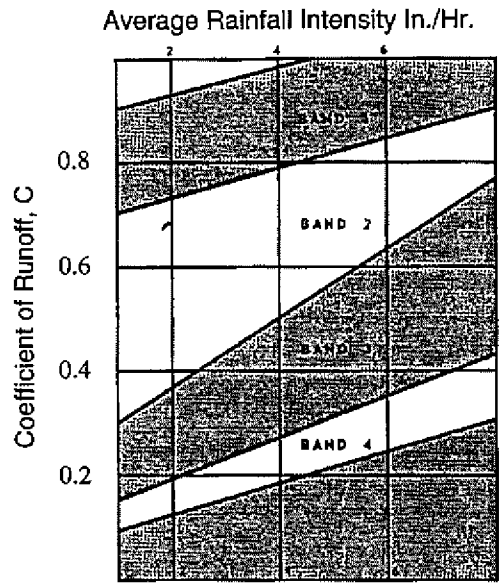
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813
FIGURE
6A


PROPOSED OUTLET
PROPERTY LINE
PROPOSED DETENTION AREA
CONSTRUCT 20-FT WIDE SECURITY ACCESS RD
CONSTRUCT 15-FT WIDE MAINT. ACCESS RD
PROPERTY LINE
PROPOSED CHANNEL SEE TYPICAL SECTION.
PROPOSED 18V EASEMENT FOR DRAINAGE PURPOSES IN FAVOR OF CITY OF HONOLULU
US NAVY/WILDLIFE REFUGE
US NAVY
15' WIDE MAINT. ACCESS RD.
20' WIDE SECURITY ACCESS RD.
80' WIDE TRAPEZOIDAL CHANNEL
EXIST. GROUND, TYP.
CONSTRUCT 6-FT HIGH CHAIN LINK FENCE.
CONSTRUCT 6-FT HIGH CHAIN LINK FENCE.
TYPICAL CHANNEL SECTION
DETENTION BASIN PLAN
EWA BY GENTRY - EAST
FIGURE 6
DETENTION BASIN PLAN
HONOPILI
DRAINAGE MASTER PLAN
PROPOSED WEST LOCH DETENTION AREA
Bills Engineering Inc.
Civil/Environmental Engineering
1124 Fort Street Mall, Suite 200
Honolulu, HI 96813
FIGURE
6

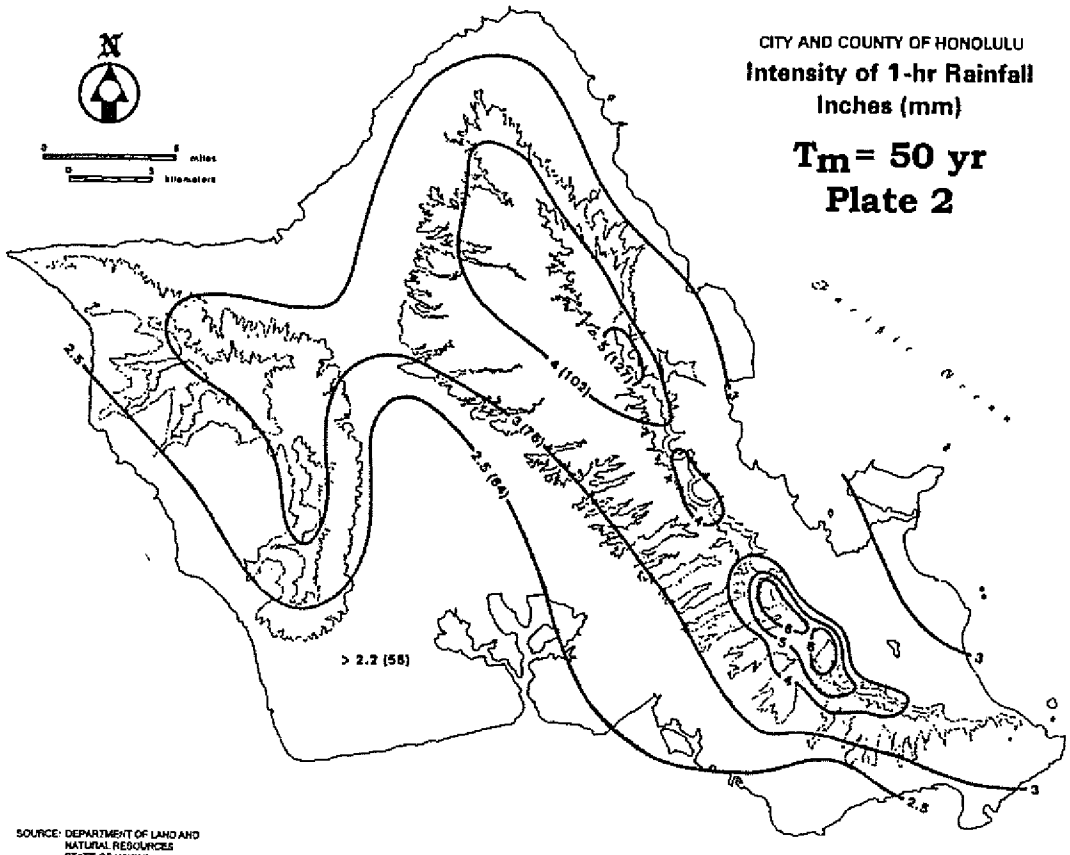
APPENDIX A
Rational Method Tables and Plates

Table 1
RUNOFF COEFFICIENT FOR AGRICULTRUAL AND OPEN AREAS

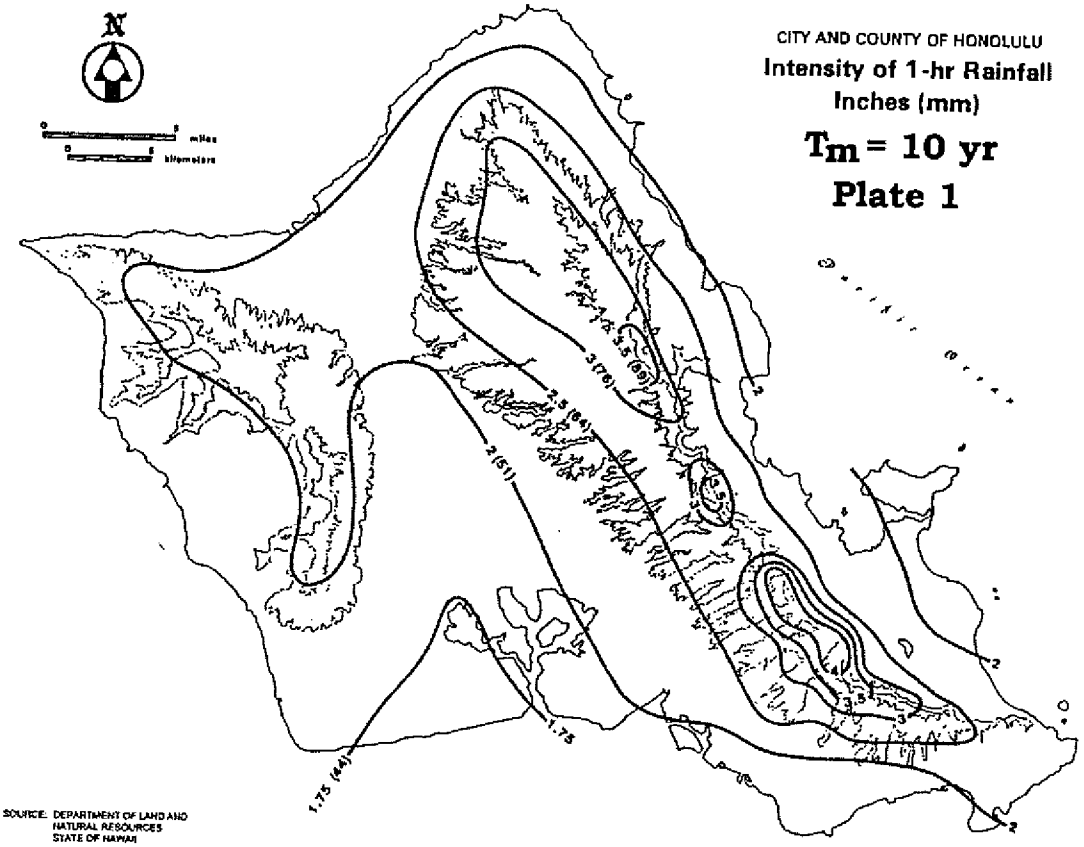


Band 1	Steep, barren, impervious surfaces
Band 2	Rolling barren in upper band values, flat barren in lower part of band, steep forested and steep grass meadows
Band 3	Timber lands of moderate to steep slopes, mountainous, farming
Band 4	Flat pervious surface, flat farmlands, wooded areas and meadows

AR00028359



SOURCE: DEPARTMENT OF LAND AND NATURAL RESOURCES STATE OF HAWAII

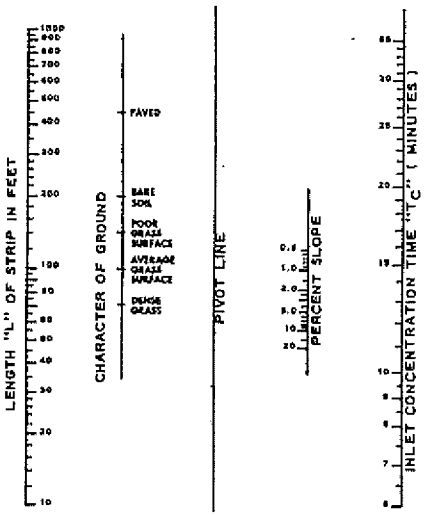


SOURCE: DEPARTMENT OF LAND AND NATURAL RESOURCES STATE OF HAWAII

AR00028360

Plate 3

Overland Flow Chart



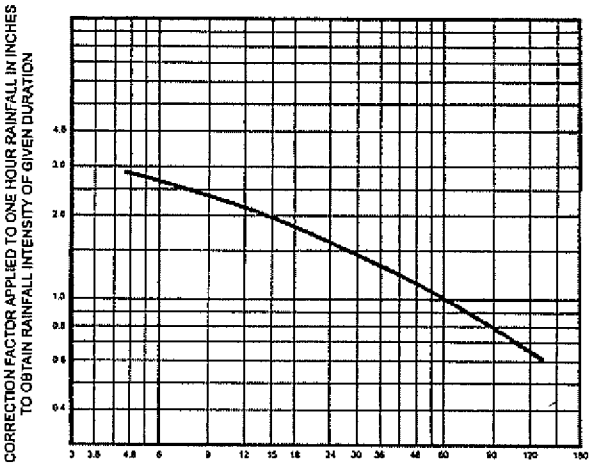
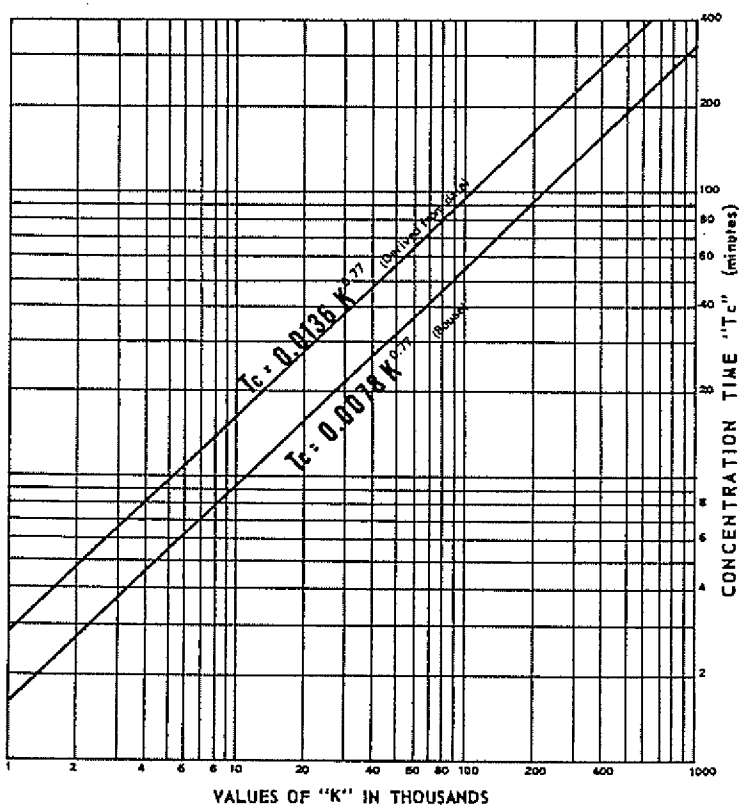


Plate 4

CORRECTION FACTOR
FOR CONVERTING 1 HR. RAINFALL TO RAINFALL INTENSITY OF VARIOUS DURATIONS

TO BE USED FOR AREA LESS THAN 100 ACRES

(See Plate 6 for area more than 100 acres)



L = Maximum length of travel in feet
H = Difference in elevation between most remote point and outlet in feet.
S = Slope H/L

$K = \frac{L}{\sqrt{S}} = \sqrt{\frac{L^3}{H}}$

Use upper curve for well forested areas
Use lower curve for areas with little or no cover.

SOURCE: CITY PLANNING COMMISSION
graph from Hunter Rouse "Engineering Hydraulics."

NOTE: Use 5 minutes if Tc is 5 minutes or less.

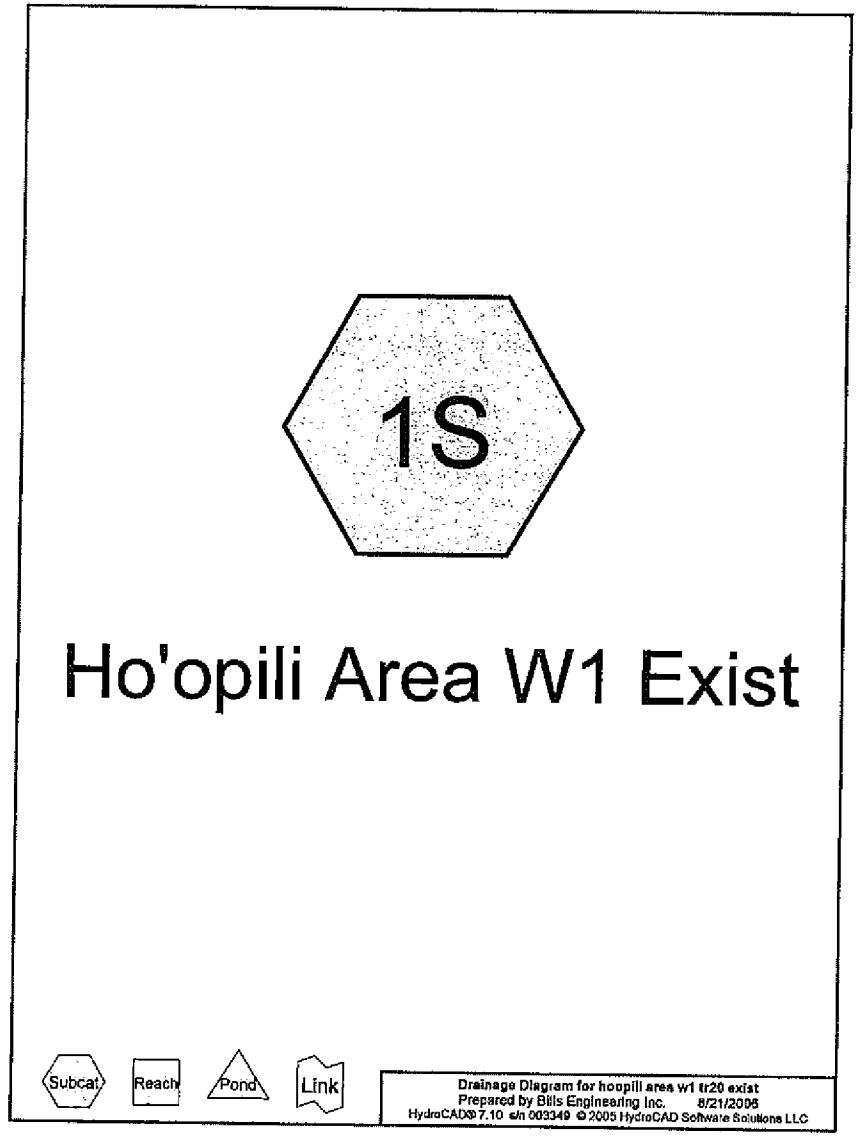
Plate 5

Time of Concentration

(OF SMALL AGRICULTURAL DRAINAGE BASIN)

AR00028361

APPENDIX B
Preliminary TR-20 Calculations



AR00028362

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area W1 Exist Runoff Area=809.500 ac Runoff Depth=2.46"
Flow Length=11,000' Tc=176.7 min CN=80 Runoff=306.52 cfs 166.051 af

Total Runoff Area = 809.500 ac Runoff Volume = 166.051 af Average Runoff Depth = 2.46"

Subcatchment 1S: Ho'opili Area W1 Exist

Subcatchment area W1 east of NS Rd

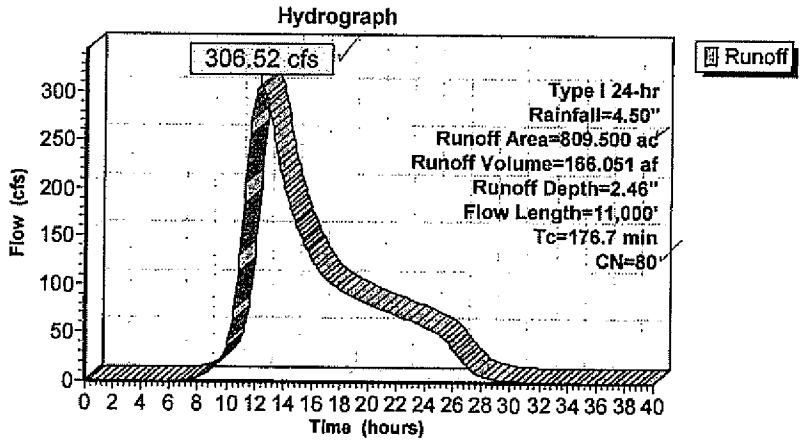
Runoff = 306.52 cfs @ 12.36 hrs, Volume= 166.051 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
809.500	80	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
176.7	11,000	0.0150	1.0		Lag/CN Method, Existing condition

Subcatchment 1S: Ho'opili Area W1 Exist



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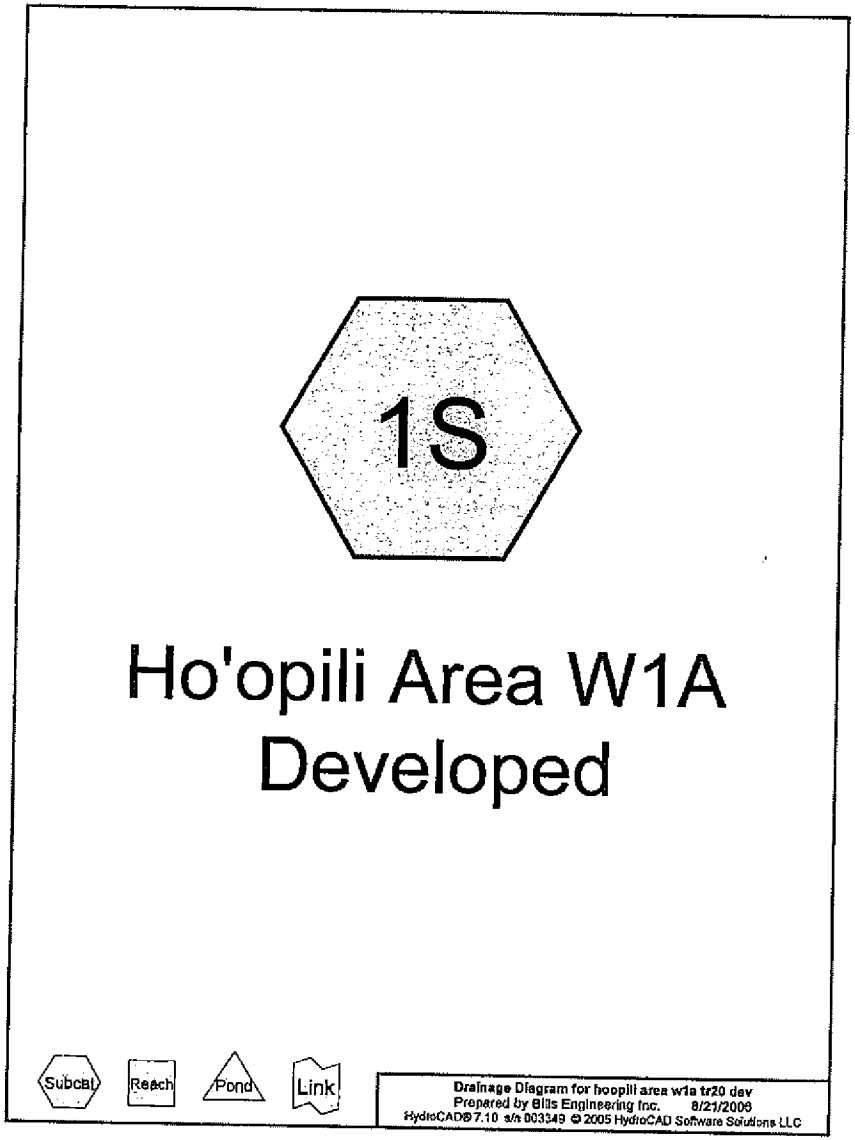

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area W1A Developed Runoff Area=151.500 ac Runoff Depth=3.10"
Flow Length=5,400' Tc=17.7 min CN=87 Runoff=281.85 cfs 39.124 af

Total Runoff Area = 151.500 ac Runoff Volume = 39.124 af Average Runoff Depth = 3.10"

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Subcatchment 1S: Ho'opili Area W1A Developed

Subcatchment area W1A east of NS Rd above Farrington

Runoff = 281.85 cfs @ 10.10 hrs, Volume= 39.124 af, Depth= 3.10"

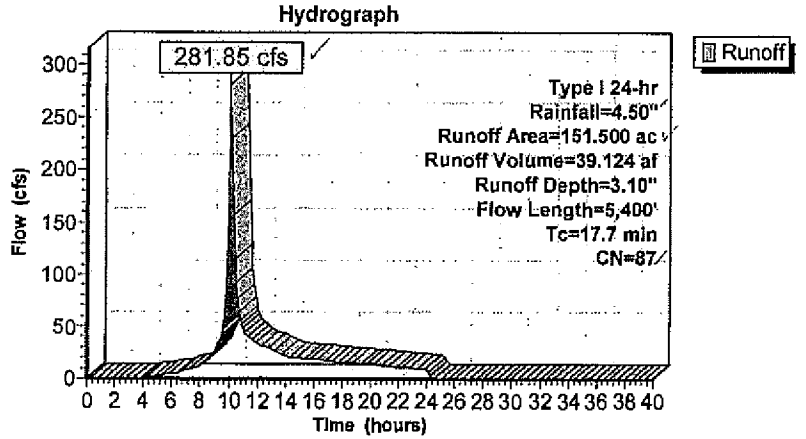
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

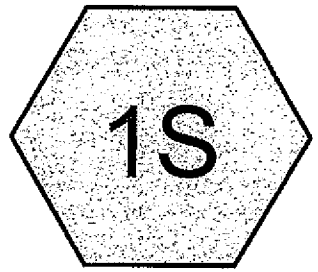
Area (ac)	CN	Description
151.500	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		**Lag/CN Method, Overland**
2.9	1,800	0.0200	10.2	31.99	**Circular Channel (pipe), Piped**
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
7.9	3,400	0.0100	7.2	22.62	**Circular Channel (pipe), Piped within Farrington**
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
17.7	5,400	Total			

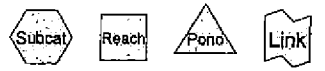
Subcatchment 1S: Ho'opili Area W1A Developed

Hydrograph





Ho'opili Area W1B Developed



Drainage Diagram for hoopili area w1b tr20 dev
Prepared by Bills Engineering Inc. 8/21/2006
HydroCAD® 7.10 s/n 003349 © 2005 HydroCAD Software Solutions LLC

AR00028365

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area W1B Developed Runoff Area=658.000 ac Runoff Depth=3.10"
Flow Length=12,000' Tc=31.4 min CN=87 Runoff=919.68 cfs 169.925 af

Total Runoff Area = 658.000 ac Runoff Volume = 169.925 af Average Runoff Depth = 3.10"

Subcatchment 1S: Ho'opili Area W1B Developed

Subcatchment area W1B east of NS Rd belowFarrington

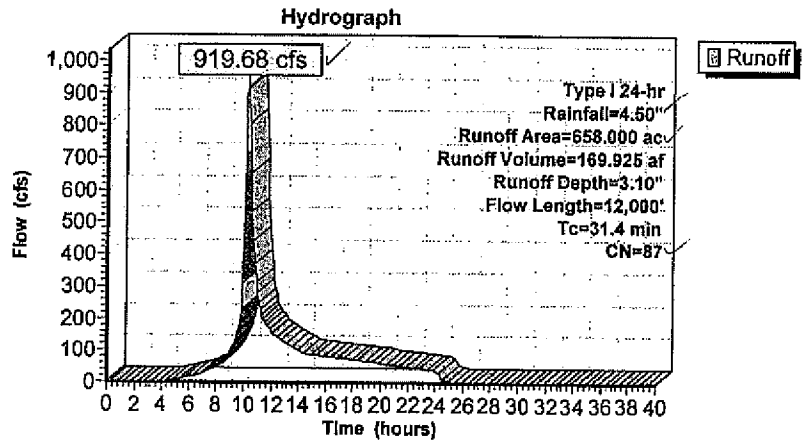
Runoff = 919.68 cfs @ 10.27 hrs, Volume= 169.925 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
658.000	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		**Lag/CN Method, Overland**
19.9	9,800	0.0130	6.2	25.79	**Circular Channel (pipe), Piped**
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
4.6	2,000	0.0100	7.2	22.62	**Circular Channel (pipe), Piped**
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
31.4	12,000	Total			

Subcatchment 1S: Ho'opili Area W1B Developed



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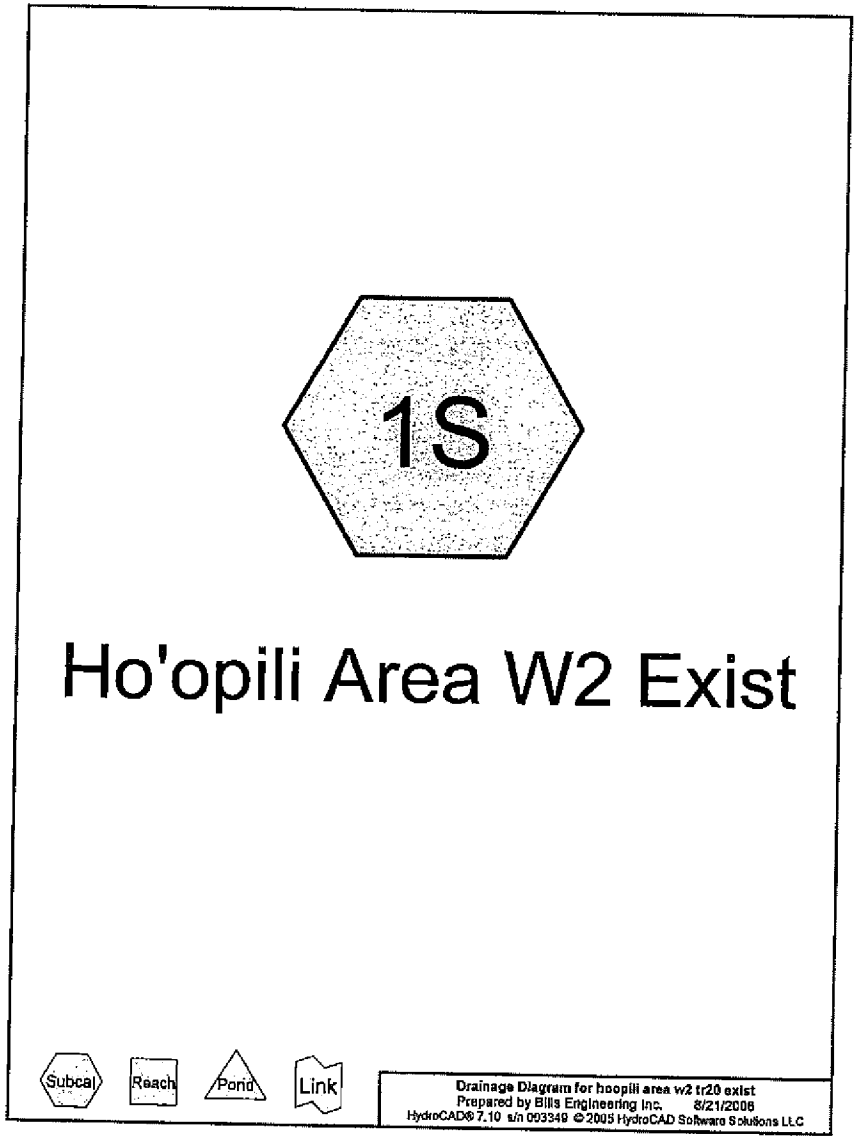

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area W2 Exist Runoff Area=9.100 ac Runoff Depth=2.46"
Flow Length=600' Tc=25.2 min CN=80 Runoff=11.00 cfs 1.867 af

Total Runoff Area = 9.100 ac Runoff Volume = 1.867 af Average Runoff Depth = 2.46"

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Subcatchment 1S: Ho'opili Area W2 Exist

Subcatchment area W2 north of Cane Haul Rd.

Runoff = 11.00 cfs @ 10.20 hrs, Volume= 1.867 af, Depth= 2.46"

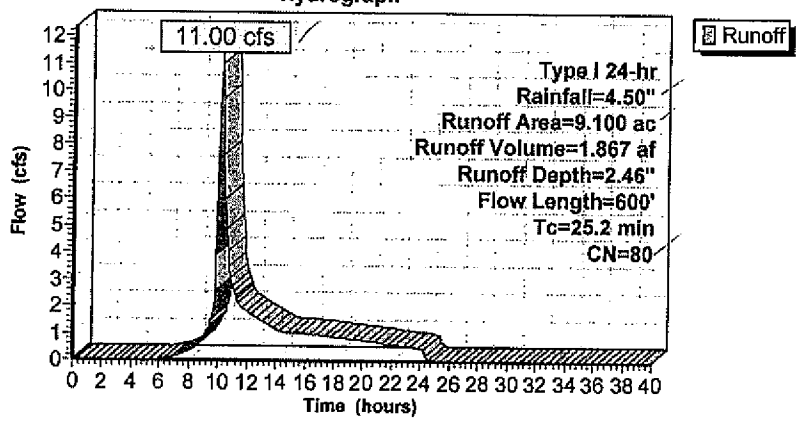
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

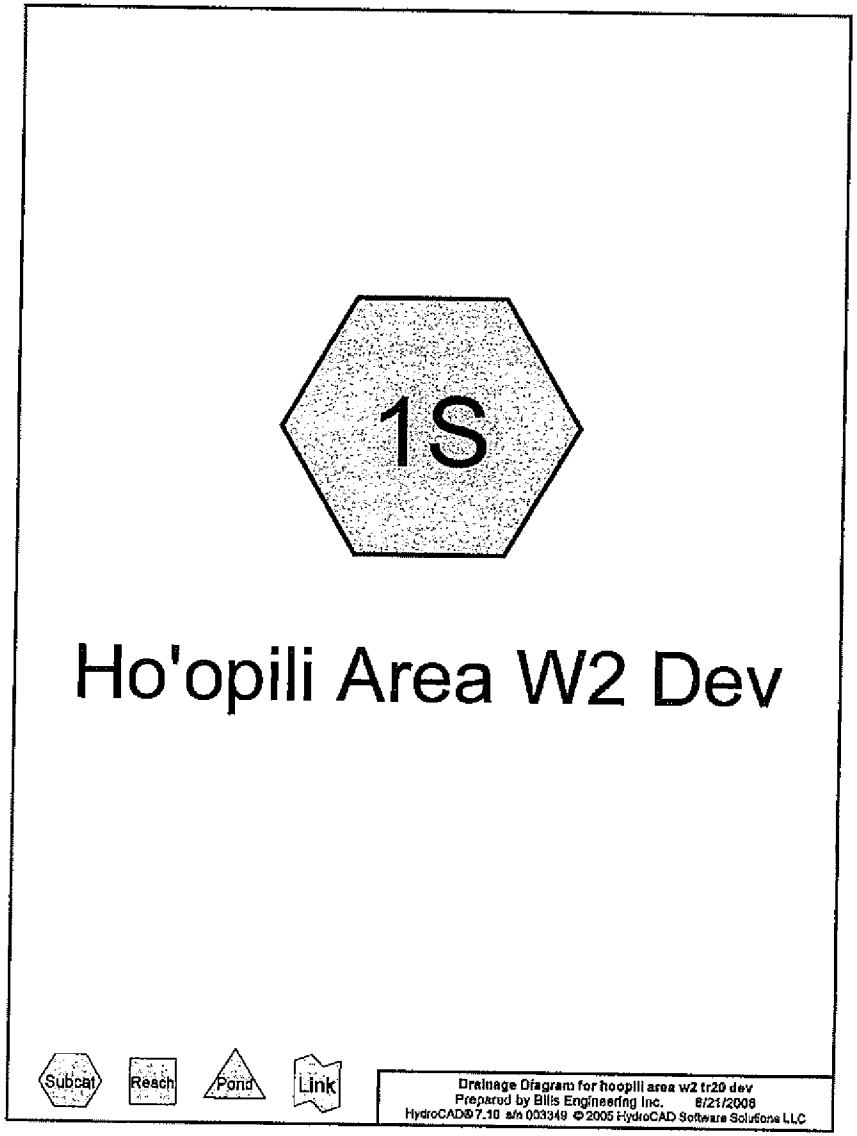
Area (ac)	CN	Description
9.100	80	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
25.2	600	0.0070	0.4		Lag/CN Method, Existing condition

Subcatchment 1S: Ho'opili Area W2 Exist

Hydrograph





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Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area W2 Dev Runoff Area=9.100 ac Runoff Depth=3.10"
Flow Length=800' Tc=8.3 min CN=87 Runoff=21.35 cfs 2.350 af

Total Runoff Area = 9.100 ac Runoff Volume = 2.350 af Average Runoff Depth = 3.10"

Subcatchment 1S: Ho'opili Area W2 Dev

Subcatchment area W2 north of Cane Haul Rd.

[49] Hint: Tc<2dt may require smaller dt

Runoff = 21.35 cfs @ 9.99 hrs, Volume= 2.350 af, Depth= 3.10"

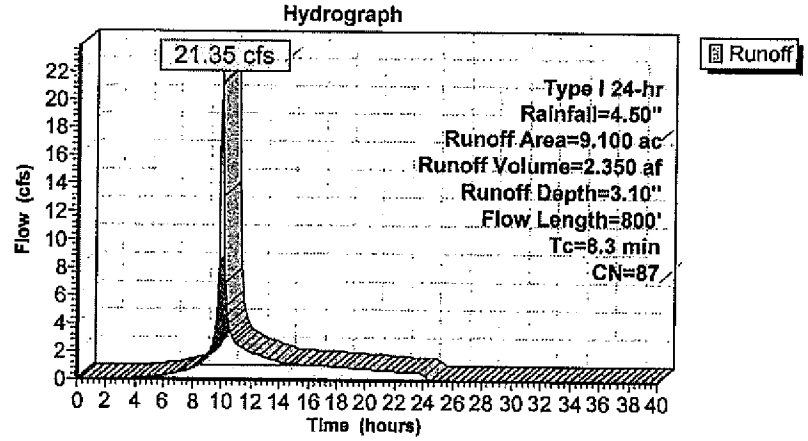
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
9.100	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		Lag/CN Method, Overland
1.4	600	0.0100	7.2	22.62	Circular Channel (pipe), Piped within rd
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
8.3	800	Total			

Subcatchment 1S: Ho'opili Area W2 Dev

Hydrograph



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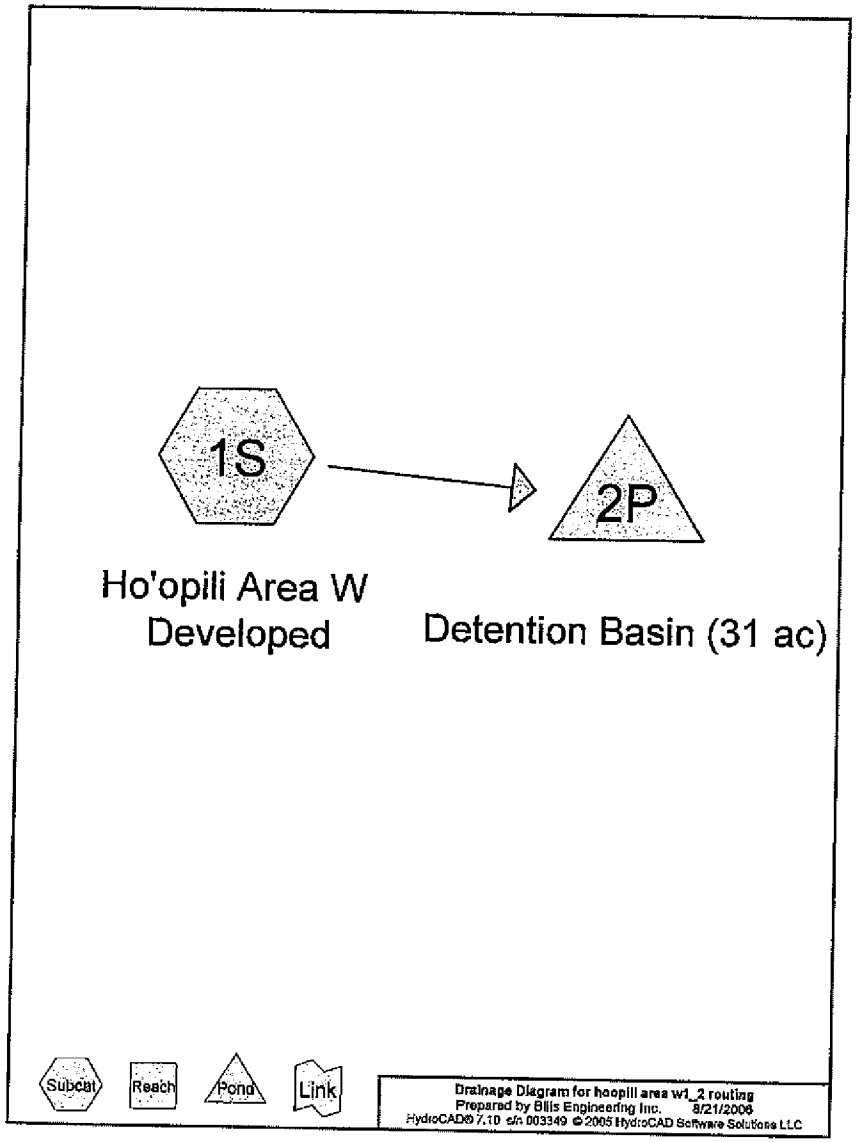

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area W Developed Runoff Area=818.600 ac Runoff Depth=2.18"
Flow Length=12,000' Tc=31.4 min CN=87 Runoff=796.88 cfs 148.878 af

Pond 2P: Detention Basin (31 ac) Peak Elev=8.35' Storage=57.243 af Inflow=796.88 cfs 148.878 af
46.0" x 20.0' Culvert Outflow=195.01 cfs 113.466 af

Total Runoff Area = 818.600 ac Runoff Volume = 148.878 af Average Runoff Depth = 2.18"

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Subcatchment 1S: Ho'opili Area W Developed

West Loch drainage basins W1 and W2

Runoff = 796.88 cfs @ 10.27 hrs, Volume= 148.878 af, Depth= 2.18"

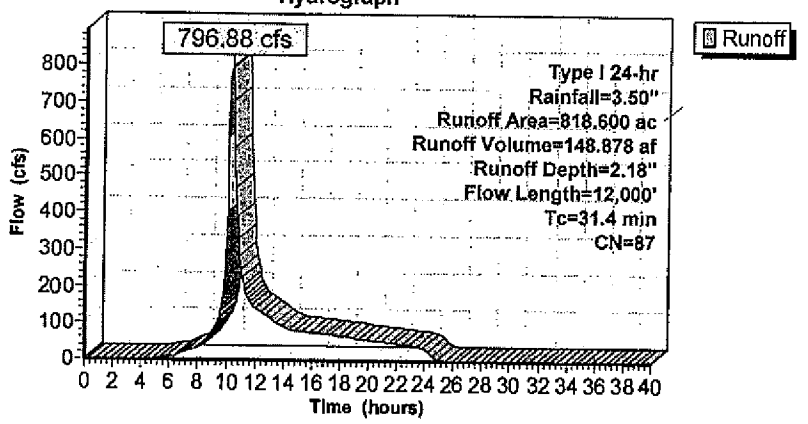
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=3.50"

Area (ac)	CN	Description
818.600	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		Lag/CN Method, Overland
19.9	9,800	0.0130	8.2	25.79	Circular Channel (pipe), Piped
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
4.6	2,000	0.0100	7.2	22.62	Circular Channel (pipe), Piped
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
31.4	12,000	Total			

Subcatchment 1S: Ho'opili Area W Developed

Hydrograph



Pond 2P: Detention Basin (31 ac)

Inflow Area = 818.600 ac, Inflow Depth = 2.18"
Inflow = 796.88 cfs @ 10.27 hrs, Volume= 148.878 af
Outflow = 195.01 cfs @ 11.26 hrs, Volume= 113.468 af, Atten= 76%, Lag= 59.6 min
Primary = 195.01 cfs @ 11.26 hrs, Volume= 113.468 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 8.35' @ 11.26 hrs Surf.Area= 7.297 ac Storage= 57.243 af
Plug-Flow detention time=307.1 min calculated for 113.185 af (76% of inflow)
Center-of-Mass det. time= 187.2 min (994.4 - 807.2)

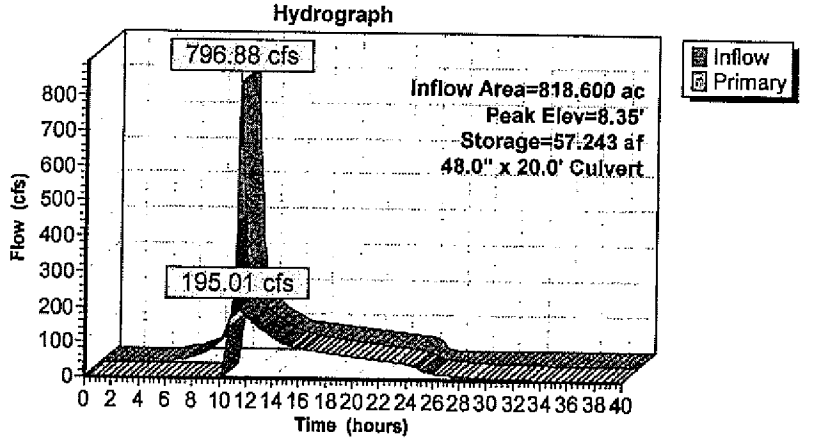
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	84.619 af	700.00'W x 400.00'L x 12.00'H Prismatoid Z=2.0

Device	Routing	Invert	Outlet Devices
#1	Primary	5.10'	48.0" x 20.0' long Culvert X 4.00 RCP, square edge headwall, Ke= 0.500
			Outlet Invert= 5.00' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=194.83 cfs @ 11.26 hrs HW=8.35' (Free Discharge)
↳1=Culvert (Barrel Controls 194.83 cfs @ 6.1 fps)

Pond 2P: Detention Basin (31 ac)

Hydrograph



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Stage-Discharge for Pond 2P: Detention Basin (31 ac)

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	3.18	0.00	6.36	35.81	9.54	314.43
0.06	0.00	3.24	0.00	6.42	39.06	9.60	320.11
0.12	0.00	3.30	0.00	6.48	42.43	9.66	325.70
0.18	0.00	3.36	0.00	6.54	45.92	9.72	331.21
0.24	0.00	3.42	0.00	6.60	49.52	9.78	336.61
0.30	0.00	3.48	0.00	6.66	53.24	9.84	341.89
0.36	0.00	3.54	0.00	6.72	57.08	9.90	347.04
0.42	0.00	3.60	0.00	6.78	61.02	9.96	352.04
0.48	0.00	3.66	0.00	6.84	65.08	10.02	356.88
0.54	0.00	3.72	0.00	6.90	69.23	10.08	361.53
0.60	0.00	3.78	0.00	6.96	73.50	10.14	365.96
0.66	0.00	3.84	0.00	7.02	77.86	10.20	370.14
0.72	0.00	3.90	0.00	7.08	82.33	10.26	374.01
0.78	0.00	3.96	0.00	7.14	86.89	10.32	377.51
0.84	0.00	4.02	0.00	7.20	91.54	10.38	380.46
0.90	0.00	4.08	0.00	7.26	96.29	10.44	382.61
0.96	0.00	4.14	0.00	7.32	101.12	10.50	390.70
1.02	0.00	4.20	0.00	7.38	106.04	10.56	398.44
1.08	0.00	4.26	0.00	7.44	111.05	10.62	406.03
1.14	0.00	4.32	0.00	7.50	116.13	10.68	413.48
1.20	0.00	4.38	0.00	7.56	121.30	10.74	420.80
1.26	0.00	4.44	0.00	7.62	126.54	10.80	427.99
1.32	0.00	4.50	0.00	7.68	131.86	10.86	435.06
1.38	0.00	4.56	0.00	7.74	137.24	10.92	442.03
1.44	0.00	4.62	0.00	7.80	142.70	10.98	448.88
1.50	0.00	4.68	0.00	7.86	148.21	11.04	455.63
1.56	0.00	4.74	0.00	7.92	153.79	11.10	462.28
1.62	0.00	4.80	0.00	7.98	159.43	11.16	468.84
1.68	0.00	4.86	0.00	8.04	165.13	11.22	475.31
1.74	0.00	4.92	0.00	8.10	170.87	11.28	481.69
1.80	0.00	4.98	0.00	8.16	176.67	11.34	487.98
1.86	0.00	5.04	0.00	8.22	182.51	11.40	494.20
1.92	0.00	5.10	0.00	8.28	188.39	11.46	500.34
1.98	0.00	5.16	0.08	8.34	194.31	11.52	506.40
2.04	0.00	5.22	0.34	8.40	200.27	11.58	512.27
2.10	0.00	5.28	0.80	8.46	206.26	11.64	515.69
2.16	0.00	5.34	1.44	8.52	212.26	11.70	519.09
2.22	0.00	5.40	2.25	8.58	218.32	11.76	522.46
2.28	0.00	5.46	3.23	8.64	224.38	11.82	525.82
2.34	0.00	5.52	4.38	8.70	230.45	11.88	529.15
2.40	0.00	5.58	5.68	8.76	236.54	11.94	532.46
2.46	0.00	5.64	7.14	8.82	242.64	12.00	535.75
2.52	0.00	5.70	8.76	8.88	248.73		
2.58	0.00	5.76	10.52	8.94	254.83		
2.64	0.00	5.82	12.43	9.00	260.91		
2.70	0.00	5.88	14.48	9.06	266.99		
2.76	0.00	5.94	16.67	9.12	273.05		
2.82	0.00	6.00	19.01	9.18	279.08		
2.88	0.00	6.06	21.48	9.24	285.08		
2.94	0.00	6.12	24.08	9.30	291.05		
3.00	0.00	6.18	26.82	9.36	296.98		
3.06	0.00	6.24	29.69	9.42	302.85		
3.12	0.00	6.30	32.69	9.48	308.67		

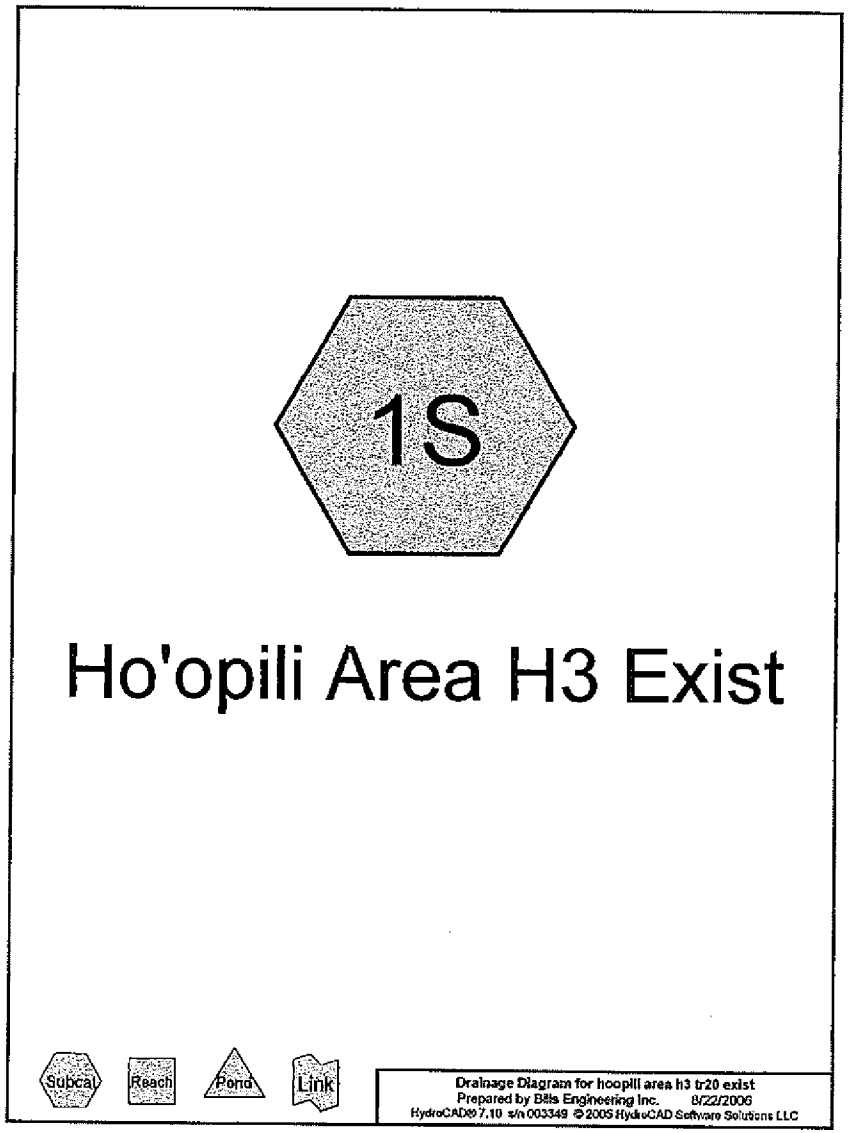
Stage-Area-Storage for Pond 2P: Detention Basin (31 ac)

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
0.00	0.000	3.18	20.955	6.36	42.956	9.54	66.025
0.06	0.386	3.24	21.361	6.42	43.381	9.60	66.471
0.12	0.772	3.30	21.767	6.48	43.807	9.66	66.917
0.18	1.159	3.36	22.173	6.54	44.233	9.72	67.363
0.24	1.546	3.42	22.579	6.60	44.659	9.78	67.810
0.30	1.933	3.48	22.988	6.66	45.086	9.84	68.258
0.36	2.321	3.54	23.393	6.72	45.513	9.90	68.705
0.42	2.709	3.60	23.801	6.78	45.941	9.96	69.153
0.48	3.097	3.66	24.209	6.84	46.369	10.02	69.602
0.54	3.486	3.72	24.617	6.90	46.797	10.08	70.050
0.60	3.875	3.78	25.026	6.96	47.228	10.14	70.500
0.66	4.264	3.84	25.436	7.02	47.655	10.20	70.949
0.72	4.654	3.90	25.844	7.08	48.085	10.26	71.399
0.78	5.045	3.96	26.254	7.14	48.515	10.32	71.850
0.84	5.435	4.02	26.664	7.20	48.945	10.38	72.300
0.90	5.826	4.08	27.075	7.26	49.376	10.44	72.751
0.96	6.217	4.14	27.486	7.32	49.807	10.50	73.203
1.02	6.609	4.20	27.897	7.38	50.238	10.56	73.655
1.08	7.001	4.26	28.309	7.44	50.670	10.62	74.107
1.14	7.394	4.32	28.721	7.50	51.102	10.68	74.560
1.20	7.786	4.38	29.133	7.56	51.534	10.74	75.013
1.26	8.180	4.44	29.546	7.62	51.967	10.80	75.467
1.32	8.573	4.50	29.960	7.68	52.401	10.86	75.921
1.38	8.967	4.56	30.373	7.74	52.834	10.92	76.375
1.44	9.361	4.62	30.787	7.80	53.269	10.98	76.829
1.50	9.756	4.68	31.201	7.86	53.703	11.04	77.285
1.56	10.151	4.74	31.616	7.92	54.138	11.10	77.740
1.62	10.546	4.80	32.031	7.98	54.573	11.16	78.196
1.68	10.942	4.86	32.447	8.04	55.009	11.22	78.652
1.74	11.338	4.92	32.862	8.10	55.445	11.28	79.109
1.80	11.735	4.98	33.279	8.16	55.881	11.34	79.566
1.86	12.131	5.04	33.695	8.22	56.318	11.40	80.023
1.92	12.529	5.10 ✓	34.112 ✓	8.28	56.755	11.46	80.481
1.98	12.926	5.16	34.530	8.34	57.193	11.52	80.939
2.04	13.324	5.22	34.947	8.40	57.631	11.58	81.398
2.10	13.722	5.28	35.365	8.46	58.069	11.64	81.857
2.16	14.121	5.34	35.784	8.52	58.508	11.70	82.316
2.22	14.520	5.40	36.203	8.58	58.947	11.76	82.776
2.28	14.920	5.46	36.622	8.64	59.386	11.82	83.236
2.34	15.319	5.52	37.042	8.70	59.826	11.88	83.697
2.40	15.720	5.58	37.462	8.76	60.266	11.94	84.158
2.46	16.120	5.64	37.882	8.82	60.707	12.00	84.619
2.52	16.521	5.70	38.303	8.88	61.148		
2.58	16.922	5.76	38.724	8.94	61.590		
2.64	17.324	5.82	39.145	9.00	62.031		
2.70	17.726	5.88	39.567	9.06	62.474		
2.76	18.128	5.94	39.989	9.12	62.916		
2.82	18.531	6.00	40.412	9.18	63.359		
2.88	18.934	6.06	40.835	9.24	63.803		
2.94	19.338	6.12	41.259	9.30	64.246		
3.00	19.742	6.18	41.682	9.36	64.690		
3.06	20.146	6.24	42.106	9.42	65.135		
3.12	20.550	6.30	42.531	9.48	65.580		

AR00028372

Q = 1.486 AR^2/3 S^1/2 N^(-1)

SECTION	Rectangular	Input width	30	Cane Haul Rd Channel
DESIRED Q	2600			
ASSUMED D	5.1	R =		3.81
INPUT S	0.005	Q =		2614.49
INPUT N	0.015			
A	153	TOTAL REQ'D DEPTH		7.84
P	40.2			
V	17.08818			
FB*	2.73535			



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Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H3 Exist Runoff Area=94.800 ac Runoff Depth=2.46"
Flow Length=3,200' Tc=44.4 min CN=80 Runoff=83.81 cfs 19.446 af

Total Runoff Area = 94.800 ac Runoff Volume = 19.446 af Average Runoff Depth = 2.46"

Subcatchment 1S: Ho'opili Area H3 Exist

Subcatchment area 3 west of Honouliuli Stream

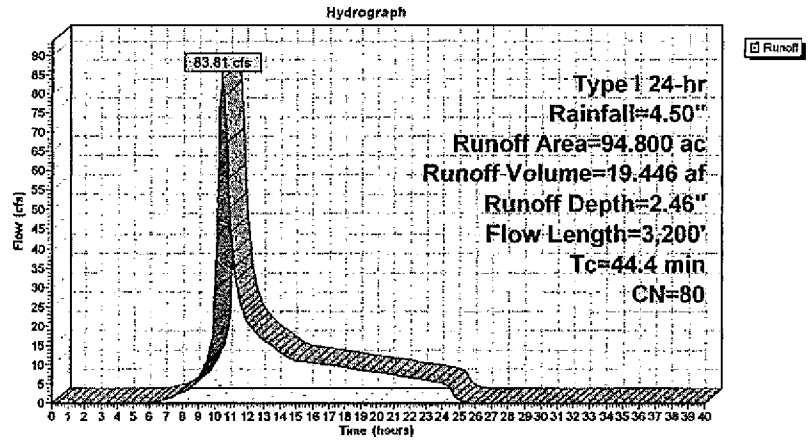
Runoff = 83.81 cfs @ 10.44 hrs, Volume= 19.446 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
94.800	80	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
44.4	3,200	0.0330	1.2		**Lag/CN Method, Existing condition**

Subcatchment 1S: Ho'opili Area H3 Exist



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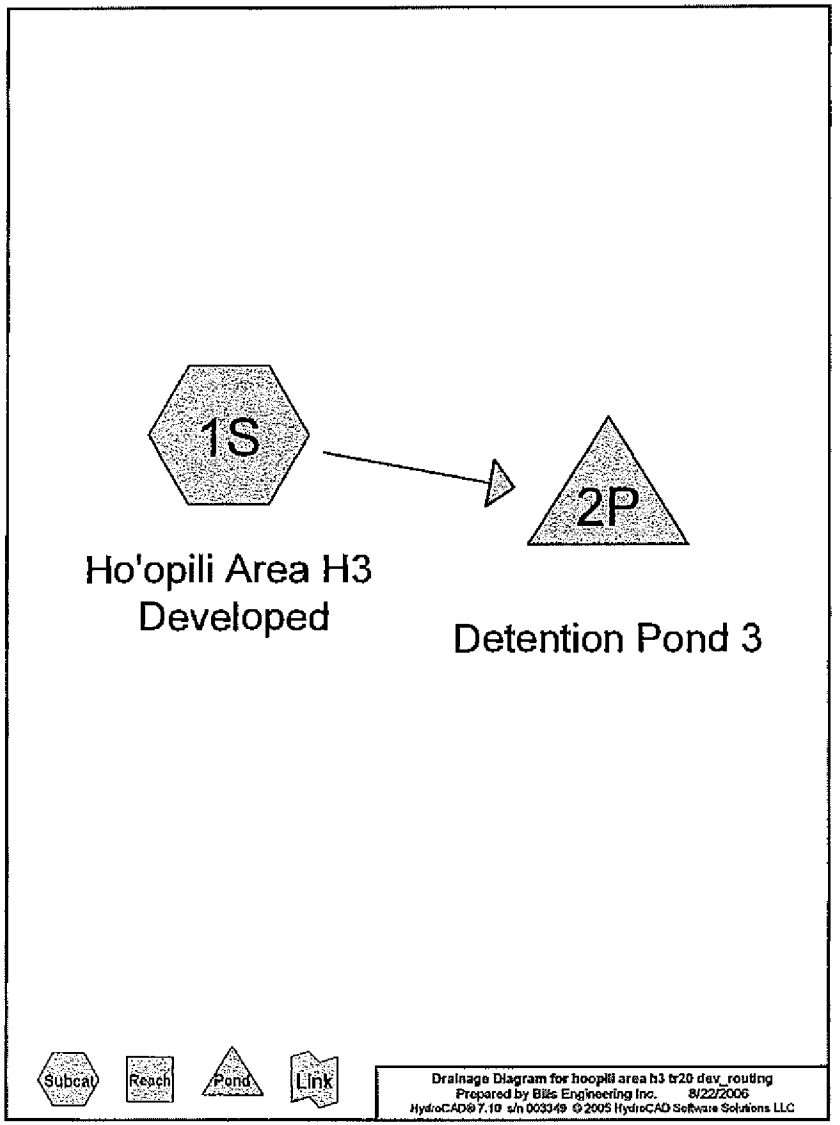

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H3 Developed Runoff Area=94.800 ac Runoff Depth=3.10"
Flow Length=2,000' Tc=9.3 min CN=87 Runoff=217.59 cfs 24.482 af

Pond 2P: Detention Pond 3 Peak Elev=90.32' Storage=8.108 af Inflow=217.59 cfs 24.482 af
30.0" x 100.0' Culvert Outflow=68.33 cfs 20.187 af

Total Runoff Area = 94.800 ac Runoff Volume = 24.482 af Average Runoff Depth = 3.10"

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Subcatchment 1S: Ho'opili Area H3 Developed

Subcatchment area 3 Honouliuli Stream

[49] Hint: Tc<2dt may require smaller dt

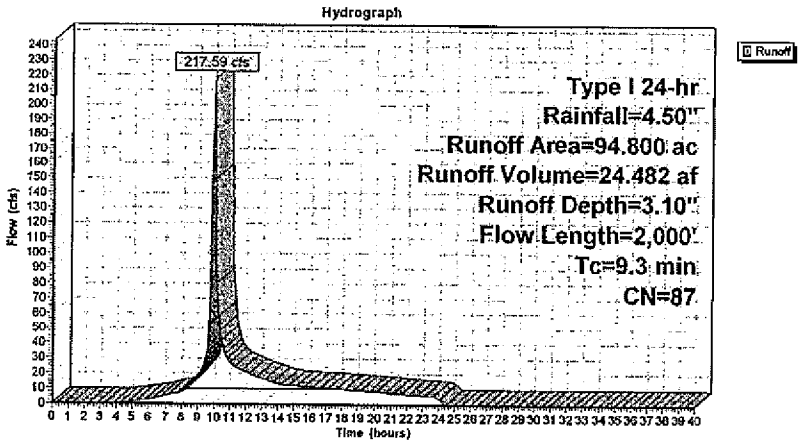
Runoff = 217.59 cfs @ 10.00 hrs, Volume= 24.482 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
94.800	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		Lag/CN Method, OVERLAND
2.4	1,800	0.0300	12.5	39.18	Circular Channel (pipe), PIPED DRAIN SYSTEM
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50'
					n= 0.013 Concrete pipe, bends & connections
9.3	2,000	Total			

Subcatchment 1S: Ho'opili Area H3 Developed



Pond 2P: Detention Pond 3

Inflow Area = 94.800 ac, Inflow Depth = 3.10"
Inflow = 217.59 cfs @ 10.00 hrs, Volume= 24.482 af
Outflow = 68.33 cfs @ 10.26 hrs, Volume= 20.187 af, Atten= 69%, Lag= 15.6 min
Primary = 68.33 cfs @ 10.26 hrs, Volume= 20.187 af

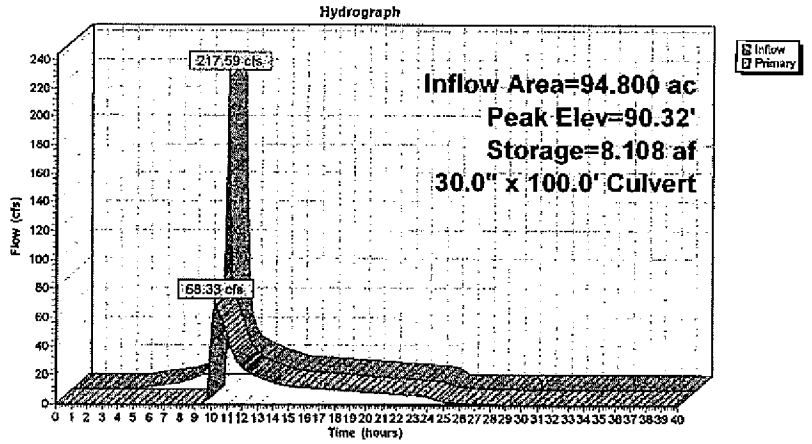
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 90.32' @ 10.26 hrs Surf.Area= 1.118 ac Storage= 8.108 af
Plug-Flow detention time= 204.9 min calculated for 20.137 af (82% of inflow)
Center-of-Mass det. time= 110.7 min (882.5 - 771.8)

Volume	Invert	Avail.Storage	Storage Description
#1	81.00'	8.677 af	**140.00'W x 100.00'L x 10.00'H Prismatoid Z=2.0 x 2**

Device	Routing	Invert	Outlet Devices
#1	Primary	86.50'	**30.0" x 100.0' long Culvert X 2.00**
			RCP, square edge headwall, Ke= 0.500
			Outlet Invert= 86.00' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=68.08 cfs @ 10.26 hrs HW=90.31' (Free Discharge)
↑—**1=Culvert** (Barrel Controls 68.08 cfs @ 6.9 fps)

Pond 2P: Detention Pond 3



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Stage-Discharge for Pond 2P: Detention Pond 3

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
81.00	0.00	86.40	0.00
81.10	0.00	86.50	0.00
81.20	0.00	86.60	0.09
81.30	0.00	86.70	0.40
81.40	0.00	86.80	0.94
81.50	0.00	86.90	1.68
81.60	0.00	87.00	2.63
81.70	0.00	87.10	3.76
81.80	0.00	87.20	5.06
81.90	0.00	87.30	6.53
82.00	0.00	87.40	8.13
82.10	0.00	87.50	9.88
82.20	0.00	87.60	11.75
82.30	0.00	87.70	13.74
82.40	0.00	87.80	15.82
82.50	0.00	87.90	18.01
82.60	0.00	88.00	20.28
82.70	0.00	88.10	22.62
82.80	0.00	88.20	25.02
82.90	0.00	88.30	27.48
83.00	0.00	88.40	29.98
83.10	0.00	88.50	32.51
83.20	0.00	88.60	35.06
83.30	0.00	88.70	37.60
83.40	0.00	88.80	40.14
83.50	0.00	88.90	42.65
83.60	0.00	89.00	45.11
83.70	0.00	89.10	47.51
83.80	0.00	89.20	49.82
83.90	0.00	89.30	52.01
84.00	0.00	89.40	54.05
84.10	0.00	89.50	55.89
84.20	0.00	89.60	57.45
84.30	0.00	89.70	58.63
84.40	0.00	89.80	59.06
84.50	0.00	89.90	59.85
84.60	0.00	90.00	61.95
84.70	0.00	90.10	63.99
84.80	0.00	90.20	65.96
84.90	0.00	90.30	67.87
85.00	0.00	90.40	69.73
85.10	0.00	90.50	71.54
85.20	0.00	90.60	73.31
85.30	0.00	90.70	75.03
85.40	0.00	90.80	76.72
85.50	0.00	90.90	78.37
85.60	0.00	91.00	79.98
85.70	0.00		
85.80	0.00		
85.90	0.00		
86.00	0.00		
86.10	0.00		
86.20	0.00		
86.30	0.00		

Stage-Area-Storage for Pond 2P: Detention Pond 3

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
81.00	0.000	86.40	4.152
81.10	0.064	86.50	4.243
81.20	0.129	86.60	4.334
81.30	0.195	86.70	4.425
81.40	0.261	86.80	4.517
81.50	0.327	86.90	4.610
81.60	0.394	87.00	4.703
81.70	0.461	87.10	4.797
81.80	0.528	87.20	4.891
81.90	0.597	87.30	4.986
82.00	0.665	87.40	5.081
82.10	0.734	87.50	5.177
82.20	0.804	87.60	5.273
82.30	0.873	87.70	5.370
82.40	0.944	87.80	5.467
82.50	1.015	87.90	5.565
82.60	1.086	88.00	5.663
82.70	1.158	88.10	5.762
82.80	1.230	88.20	5.862
82.90	1.303	88.30	5.962
83.00	1.376	88.40	6.063
83.10	1.449	88.50	6.164
83.20	1.523	88.60	6.266
83.30	1.598	88.70	6.368
83.40	1.673	88.80	6.471
83.50	1.749	88.90	6.574
83.60	1.825	89.00	6.678
83.70	1.901	89.10	6.783
83.80	1.978	89.20	6.888
83.90	2.055	89.30	6.993
84.00	2.133	89.40	7.100
84.10	2.212	89.50	7.206
84.20	2.291	89.60	7.314
84.30	2.370	89.70	7.422
84.40	2.450	89.80	7.530
84.50	2.530	89.90	7.639
84.60	2.611	90.00	7.749
84.70	2.692	90.10	7.859
84.80	2.774	90.20	7.970
84.90	2.857	90.30	8.081
85.00	2.939	90.40	8.193
85.10	3.023	90.50	8.305
85.20	3.107	90.60	8.419
85.30	3.191	90.70	8.532
85.40	3.276	90.80	8.646
85.50	3.361	90.90	8.761
85.60	3.447	91.00	8.877
85.70	3.533		
85.80	3.620		
85.90	3.708		
86.00	3.796		
86.10	3.884		
86.20	3.973		
86.30	4.062		

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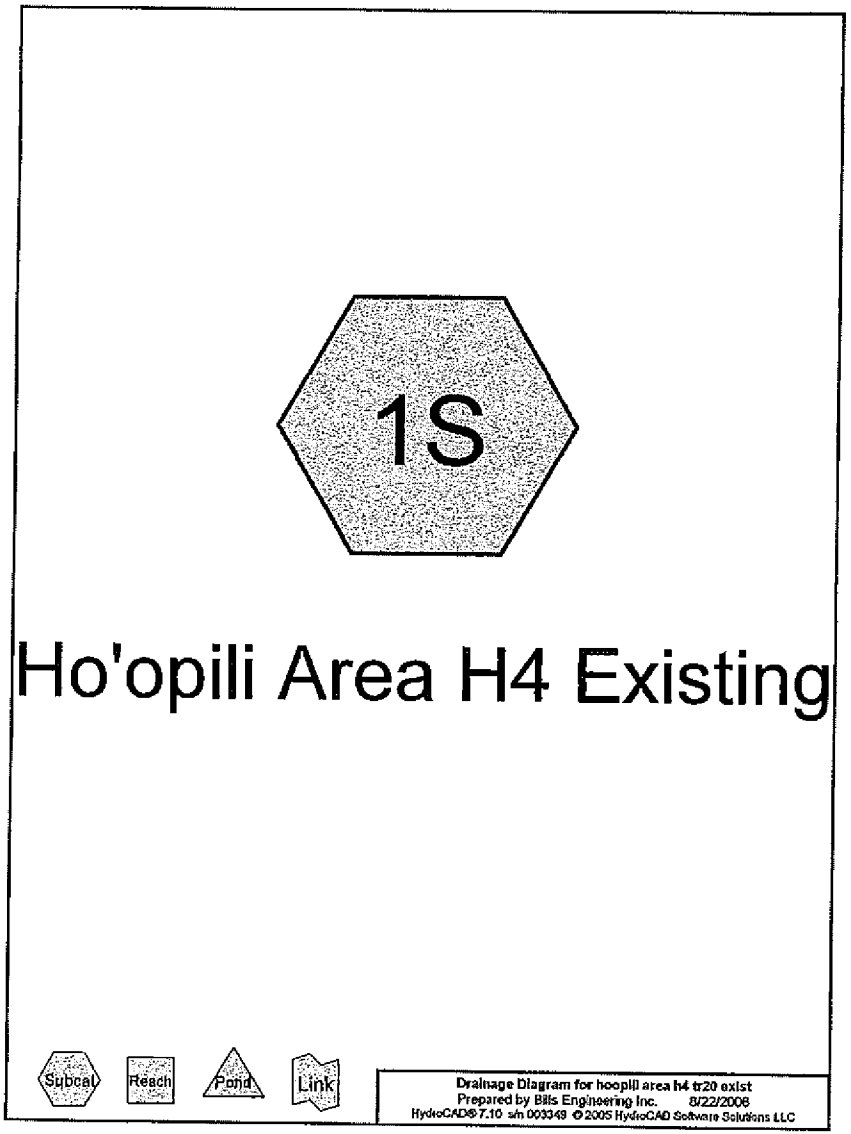

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H4 Existing Runoff Area=78.100 ac Runoff Depth=2.46"
Flow Length=2,100' Tc=27.1 min CN=80 Runoff=91.12 cfs 16.021 af

Total Runoff Area = 78.100 ac Runoff Volume = 16.021 af Average Runoff Depth = 2.46"

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Subcatchment 1S: Ho'opili Area H4 Existing

Subcatchment area 4 Honouliuli Stream

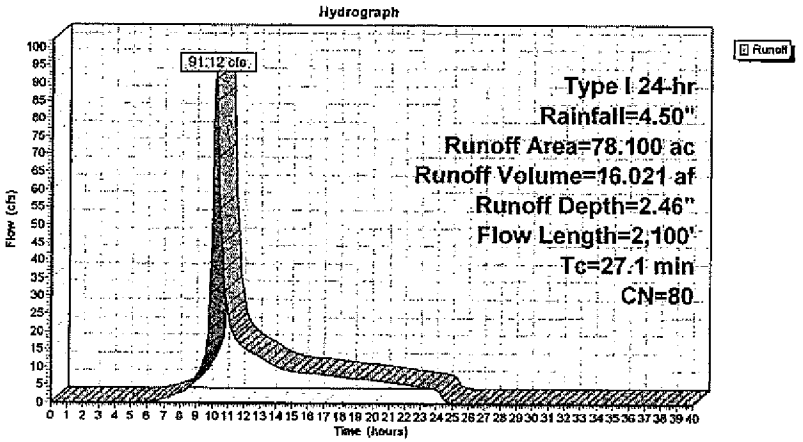
Runoff = 91.12 cfs @ 10.22 hrs, Volume= 16.021 af, Depth= 2.46"

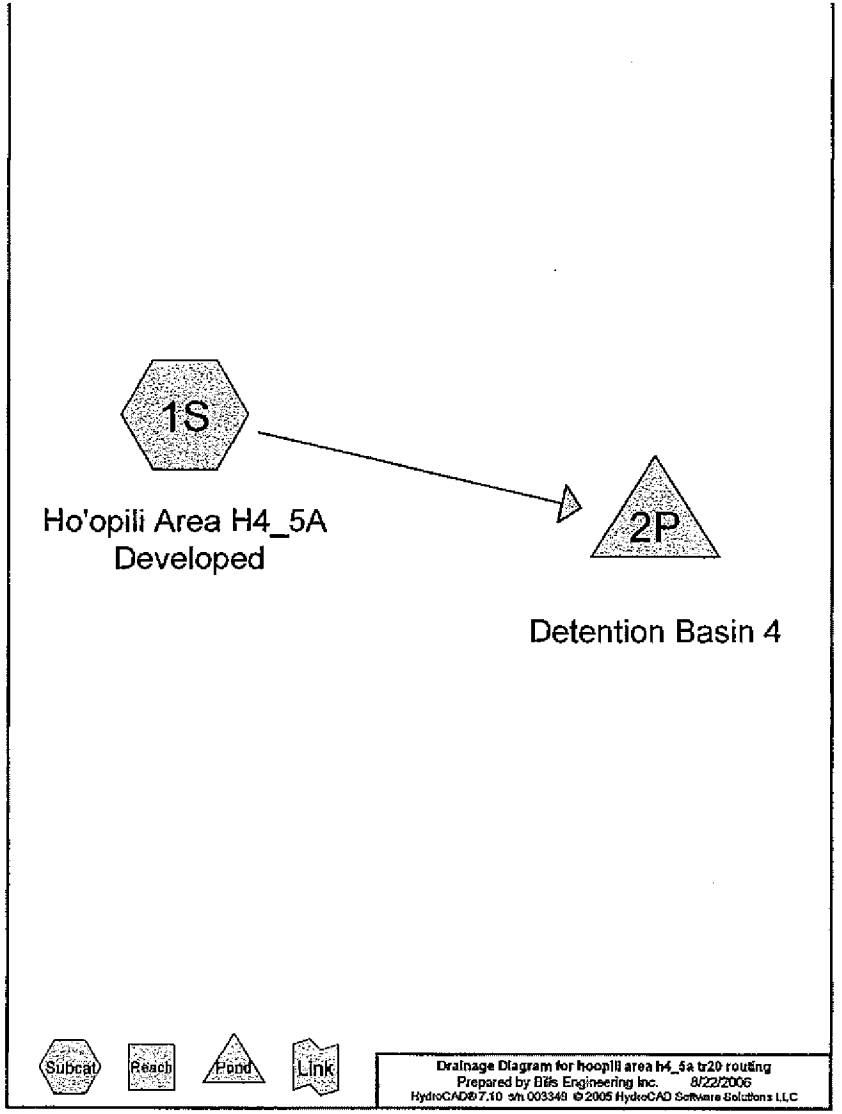
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
78.100	80	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
27.1	2,100	0.0450	1.3		Lag/CN Method, Existing condition

Subcatchment 1S: Ho'opili Area H4 Existing





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Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H4_5A Developed Runoff Area=183.100 ac Runoff Depth=3.10"
Flow Length=3,800' Tc=15.2 min CN=87 Runoff=357.19 cfs 47.285 af

Pond 2P: Detention Basin 4 Peak Elev=87.75' Storage=17.715 af Inflow=357.19 cfs 47.285 af
30.0" x 100.0' Culvert Outflow=74.10 cfs 39.155 af

Total Runoff Area = 183.100 ac Runoff Volume = 47.285 af Average Runoff Depth = 3.10"

Subcatchment 1S: Ho'opili Area H4_5A Developed

Subcatchment area 4 Honouliuli Stream, including area 5A (105 acs).

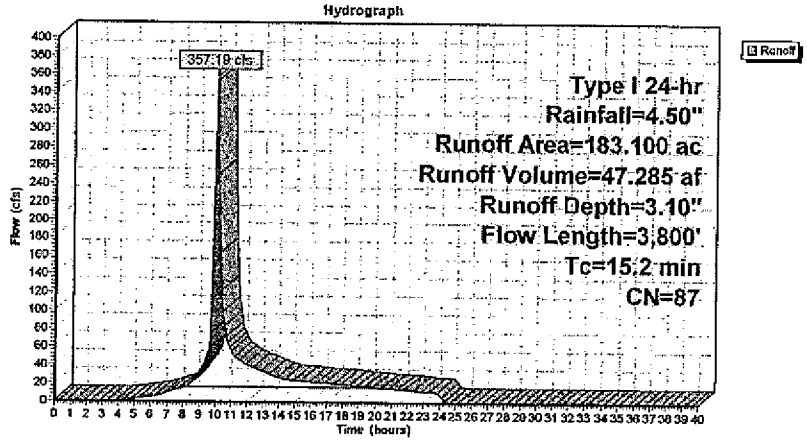
Runoff = 357.19 cfs @ 10.07 hrs, Volume= 47.285 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
183.100	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		**Lag/CN Method, Overland**
8.3	3,600	0.0100	7.2	22.62	**Circular Channel (pipe), Piped**
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
15.2	3,800	Total			

Subcatchment 1S: Ho'opili Area H4_5A Developed



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Pond 2P: Detention Basin 4

Inflow Area = 183.100 ac, Inflow Depth = 3.10"
Inflow = 357.19 cfs @ 10.07 hrs, Volume= 47.285 af
Outflow = 74.10 cfs @ 10.69 hrs, Volume= 39.155 af, Atten= 79%, Lag= 36.8 min
Primary = 74.10 cfs @ 10.69 hrs, Volume= 39.155 af

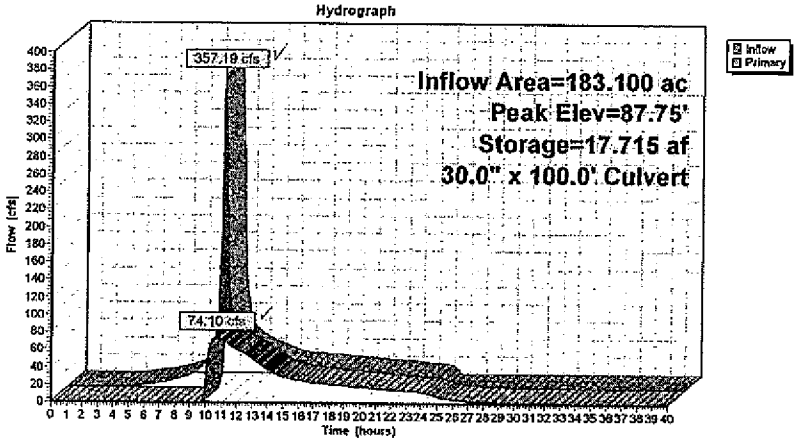
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 87.75' @ 10.69 hrs Surf.Area= 2.515 ac Storage= 17.715 af
Plug-Flow detention time= 255.5 min calculated for 39.155 af (83% of inflow)
Center-of-Mass det. time= 160.6 min (937.9 - 777.3)

Volume	Invert	Avail.Storage	Storage Description
#1	80.00'	23.538 af	300.00'W x 300.00'L x 10.00'H Prismatoid Z=2.0

Device	Routing	Invert	Outlet Devices
#1	Primary	83.60'	30.0" x 100.0' long Culvert X 2.00 RCP, square edge headwall, Ke= 0.500 Outlet Invert= 83.10' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=74.08 cfs @ 10.69 hrs HW=87.74' (Free Discharge)
↑1=Culvert (Barrel Controls 74.08 cfs @ 7.5 fps)

Pond 2P: Detention Basin 4



Stage-Discharge for Pond 2P: Detention Basin 4

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
80.00	0.00	85.40	27.48
80.10	0.00	85.50	29.98
80.20	0.00	85.60	32.51
80.30	0.00	85.70	35.06
80.40	0.00	85.80	37.60
80.50	0.00	85.90	40.14
80.60	0.00	86.00	42.65
80.70	0.00	86.10	45.11
80.80	0.00	86.20	47.51
80.90	0.00	86.30	49.82
81.00	0.00	86.40	52.01
81.10	0.00	86.50	54.05
81.20	0.00	86.60	55.89
81.30	0.00	86.70	57.45
81.40	0.00	86.80	58.63
81.50	0.00	86.90	59.06
81.60	0.00	87.00	59.85
81.70	0.00	87.10	61.95
81.80	0.00	87.20	63.99
81.90	0.00	87.30	65.96
82.00	0.00	87.40	67.87
82.10	0.00	87.50	69.73
82.20	0.00	87.60	71.54
82.30	0.00	87.70	73.31
82.40	0.00	87.80	75.03
82.50	0.00	87.90	76.72
82.60	0.00	88.00	78.37
82.70	0.00	88.10	79.98
82.80	0.00	88.20	81.57
82.90	0.00	88.30	83.12
83.00	0.00	88.40	84.65
83.10	0.00	88.50	86.14
83.20	0.00	88.60	87.62
83.30	0.00	88.70	89.07
83.40	0.00	88.80	90.49
83.50	0.00	88.90	91.89
83.60	0.00	89.00	93.26
83.70	0.09	89.10	94.64
83.80	0.40	89.20	95.98
83.90	0.94	89.30	97.30
84.00	1.68	89.40	98.61
84.10	2.63	89.50	99.90
84.20	3.76	89.60	101.17
84.30	5.06	89.70	102.43
84.40	6.53	89.80	103.67
84.50	8.13	89.90	104.90
84.60	9.88	90.00	106.11
84.70	11.75		
84.80	13.74		
84.90	15.82		
85.00	18.01		
85.10	20.28		
85.20	22.62		
85.30	25.02		

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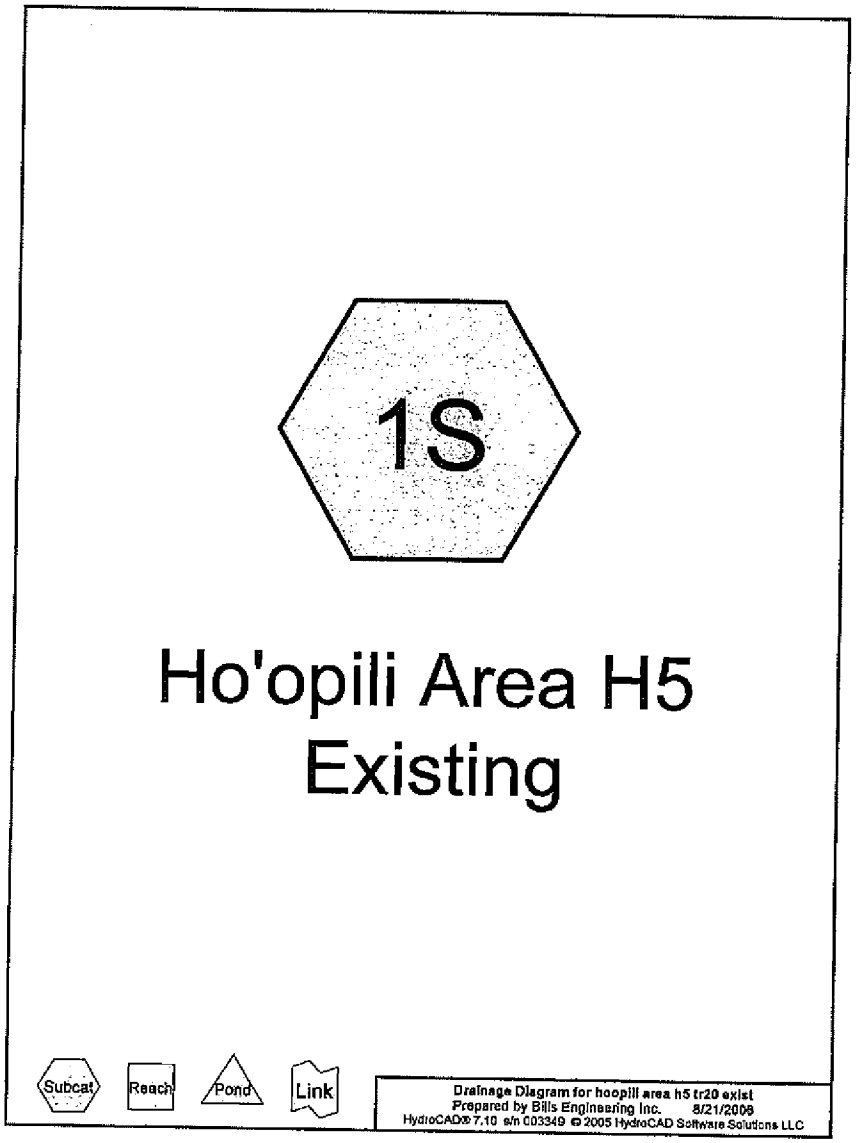
Stage-Area-Storage for Pond 2P: Detention Basin 4

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
80.00	0.000	85.40	11.980
80.10	0.207	85.50	12.217
80.20	0.414	85.60	12.458
80.30	0.622	85.70	12.695
80.40	0.831	85.80	12.934
80.50	1.040	85.90	13.174
80.60	1.250	86.00	13.415
80.70	1.460	86.10	13.656
80.80	1.671	86.20	13.898
80.90	1.882	86.30	14.141
81.00	2.094	86.40	14.384
81.10	2.306	86.50	14.627
81.20	2.519	86.60	14.872
81.30	2.733	86.70	15.116
81.40	2.947	86.80	15.362
81.50	3.162	86.90	15.608
81.60	3.377	87.00	15.855
81.70	3.593	87.10	16.102
81.80	3.809	87.20	16.350
81.90	4.026	87.30	16.598
82.00	4.243	87.40	16.847
82.10	4.461	87.50	17.097
82.20	4.680	87.60	17.347
82.30	4.899	87.70	17.598
82.40	5.119	87.80	17.850
82.50	5.339	87.90	18.102
82.60	5.560	88.00	18.355
82.70	5.782	88.10	18.608
82.80	6.004	88.20	18.862
82.90	6.226	88.30	19.117
83.00	6.450	88.40	19.372
83.10	6.673	88.50	19.628
83.20	6.898	88.60	19.884
83.30	7.123	88.70	20.141
83.40	7.348	88.80	20.399
83.50	7.574	88.90	20.657
83.60	7.801	89.00	20.916
83.70	8.028	89.10	21.175
83.80	8.256	89.20	21.435
83.90	8.484	89.30	21.696
84.00	8.713	89.40	21.957
84.10	8.943	89.50	22.219
84.20	9.173	89.60	22.482
84.30	9.403	89.70	22.745
84.40	9.635	89.80	23.009
84.50	9.867	89.90	23.273
84.60	10.099	90.00	23.538
84.70	10.332		
84.80	10.566		
84.90	10.800		
85.00	11.035		
85.10	11.270		
85.20	11.506		
85.30	11.742		



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Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H5 Existing Runoff Area=137.800 ac Runoff Depth=2.46"
Flow Length=3,800' Tc=49.4 min CN=80 Runoff=114.40 cfs 28.267 af

Total Runoff Area = 137.800 ac Runoff Volume = 28.267 af Average Runoff Depth = 2.46"

Subcatchment 1S: Ho'opili Area H5 Existing

Subcatchment area 5 Honouliuli Stream

Runoff = 114.40 cfs @ 10.51 hrs, Volume= 28.267 af, Depth= 2.46"

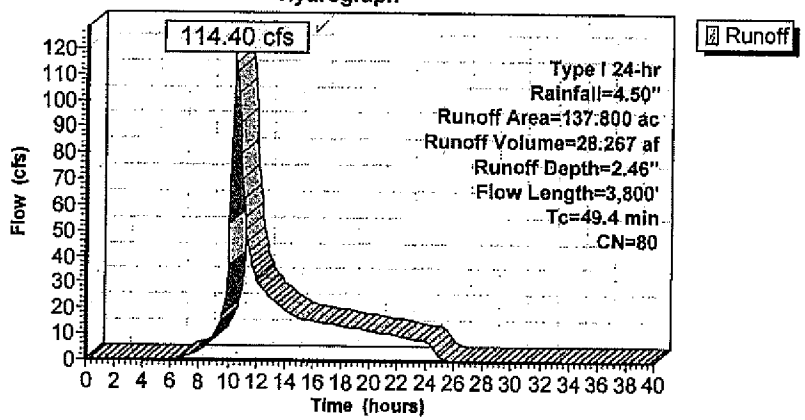
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
137.800	80	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
49.4	3,800	0.0350	1.3		Lag/CN Method, Existing condition

Subcatchment 1S: Ho'opili Area H5 Existing

Hydrograph



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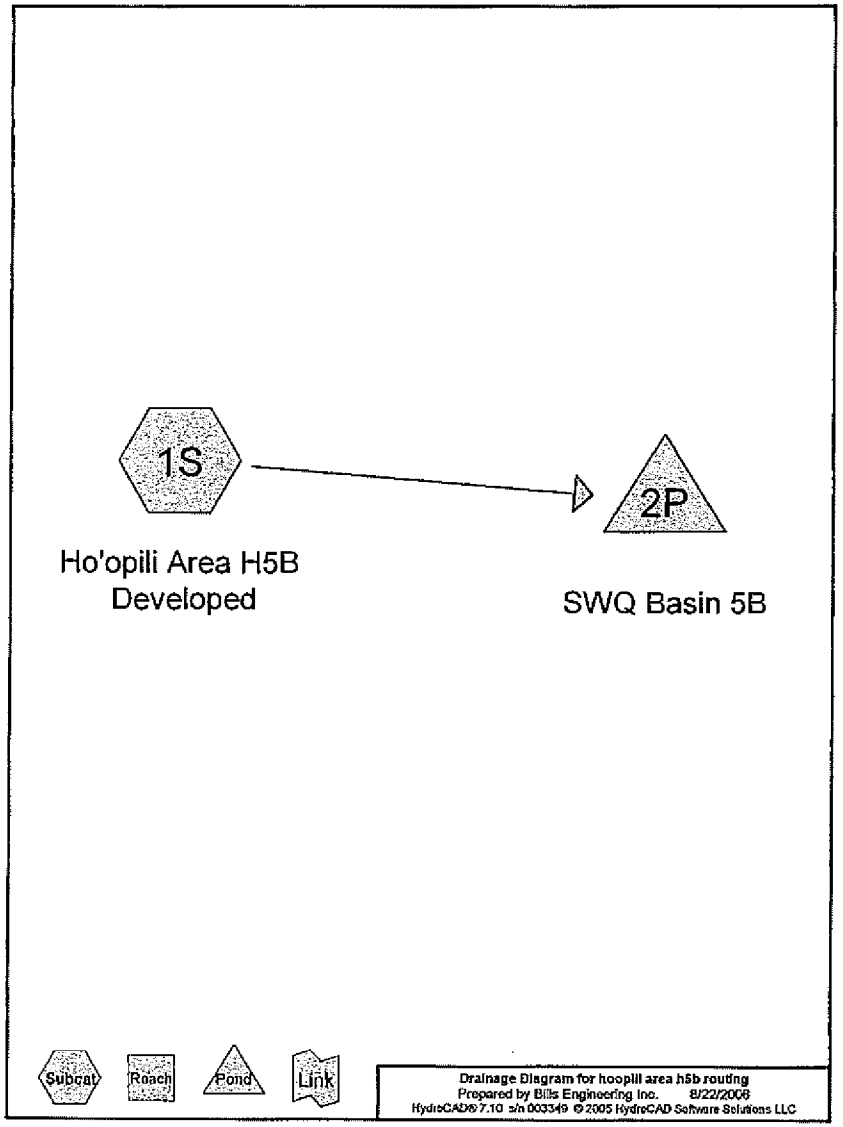

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H5B Developed Runoff Area=32.800 ac Runoff Depth=3.10"
Flow Length=1,200' Tc=9.2 min CN=87 Runoff=75.48 cfs 8.470 af

Pond 2P: SWQ Basin 5B Peak Elev=7.93' Storage=2.458 af Inflow=75.48 cfs 8.470 af
24.0" x 100.0' Culvert Outflow=36.33 cfs 7.075 af

Total Runoff Area = 32.800 ac Runoff Volume = 8.470 af Average Runoff Depth = 3.10"

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Subcatchment 1S: Ho'opili Area H5B Developed

Subcatchment area 5B Honouliuli Stream

[49] Hint: Tc<2dt may require smaller dt

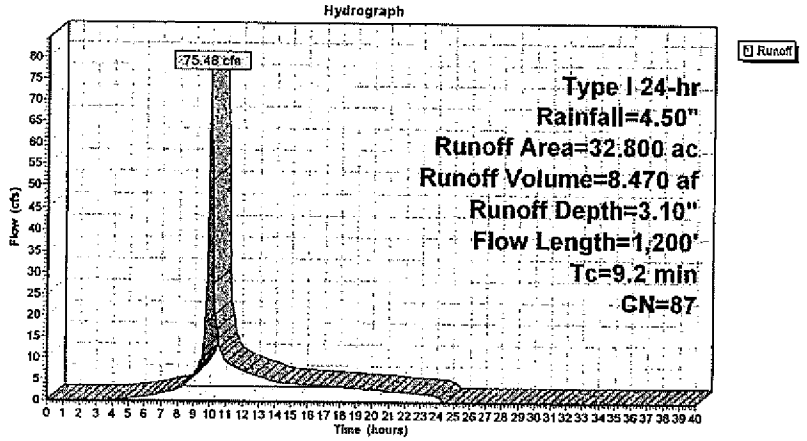
Runoff = 75.48 cfs @ 10.00 hrs, Volume= 8.470 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
32.800	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		Lag/CN Method, Overland
2.3	1,000	0.0100	7.2	22.62	Circular Channel (pipe), Piped
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
9.2	1,200	Total			

Subcatchment 1S: Ho'opili Area H5B Developed



Pond 2P: SWQ Basin 5B

Inflow Area = 32.800 ac, Inflow Depth = 3.10"
Inflow = 75.48 cfs @ 10.00 hrs, Volume= 8.470 af
Outflow = 36.33 cfs @ 10.18 hrs, Volume= 7.075 af, Atten= 52%, Lag= 10.7 min
Primary = 36.33 cfs @ 10.18 hrs, Volume= 7.075 af

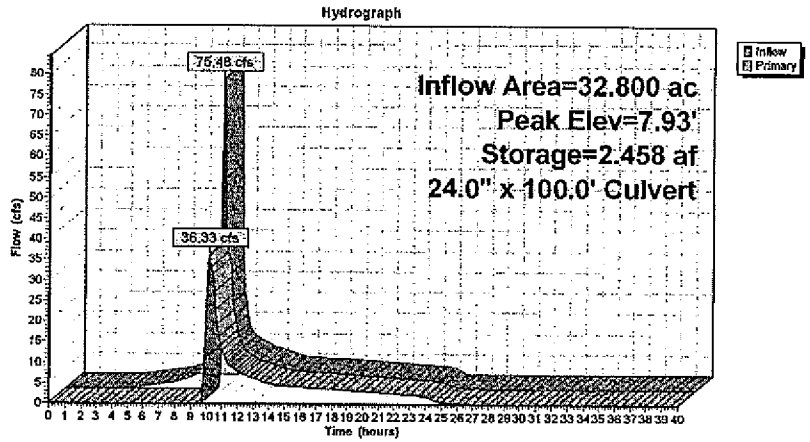
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 7.93' @ 10.18 hrs Surf.Area= 0.398 ac Storage= 2.458 af
Plug-Flow detention time= 179.0 min calculated for 7.075 af (84% of inflow)
Center-of-Mass det. time= 87.2 min (858.9 - 771.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	3.336 af	100.00'W x 100.00'L x 10.00'H Prismatoid Z=2.0

Device	Routing	Invert	Outlet Devices
#1	Primary	5.00'	24.0" x 100.0' long Culvert X 2.00
			RCP, square edge headwall, Ke= 0.500
			Outlet Invert= 4.50' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=35.98 cfs @ 10.18 hrs HW=7.90' (Free Discharge)
↳1=Culvert (Barrel Controls 35.98 cfs @ 5.7 fps)

Pond 2P: SWQ Basin 5B



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Stage-Discharge for Pond 2P: SWQ Basin 5B

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	5.40	1.48
0.10	0.00	5.50	2.30
0.20	0.00	5.60	3.28
0.30	0.00	5.70	4.39
0.40	0.00	5.80	5.63
0.50	0.00	5.90	6.99
0.60	0.00	6.00	8.45
0.70	0.00	6.10	10.00
0.80	0.00	6.20	11.62
0.90	0.00	6.30	13.31
1.00	0.00	6.40	15.05
1.10	0.00	6.50	16.84
1.20	0.00	6.60	18.64
1.30	0.00	6.70	20.46
1.40	0.00	6.80	22.27
1.50	0.00	6.90	24.06
1.60	0.00	7.00	25.81
1.70	0.00	7.10	27.49
1.80	0.00	7.20	29.07
1.90	0.00	7.30	30.53
2.00	0.00	7.40	31.79
2.10	0.00	7.50	32.80
2.20	0.00	7.60	33.37
2.30	0.00	7.70	33.33
2.40	0.00	7.80	34.69
2.50	0.00	7.90	36.09
2.60	0.00	8.00	37.26
2.70	0.00	8.10	38.49
2.80	0.00	8.20	39.67
2.90	0.00	8.30	40.82
3.00	0.00	8.40	41.94
3.10	0.00	8.50	43.03
3.20	0.00	8.60	44.09
3.30	0.00	8.70	45.13
3.40	0.00	8.80	46.14
3.50	0.00	8.90	47.14
3.60	0.00	9.00	48.11
3.70	0.00	9.10	49.06
3.80	0.00	9.20	50.00
3.90	0.00	9.30	50.91
4.00	0.00	9.40	51.81
4.10	0.00	9.50	52.70
4.20	0.00	9.60	53.57
4.30	0.00	9.70	54.43
4.40	0.00	9.80	55.27
4.50	0.00	9.90	56.10
4.60	0.00	10.00	56.92
4.70	0.00		
4.80	0.00		
4.90	0.00		
5.00	0.00		
5.10	0.08		
5.20	0.36		
5.30	0.83		

Stage-Area-Storage for Pond 2P: SWQ Basin 5B

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
0.00	0.000	5.40	1.527
0.10	0.023	5.50	1.561
0.20	0.046	5.60	1.595
0.30	0.070	5.70	1.630
0.40	0.093	5.80	1.664
0.50	0.117	5.90	1.699
0.60	0.141	6.00	1.734
0.70	0.165	6.10	1.770
0.80	0.190	6.20	1.805
0.90	0.214	6.30	1.841
1.00	0.239	6.40	1.877
1.10	0.264	6.50	1.914
1.20	0.289	6.60	1.950
1.30	0.314	6.70	1.987
1.40	0.340	6.80	2.024
1.50	0.365	6.90	2.061
1.60	0.391	7.00	2.099
1.70	0.417	7.10	2.137
1.80	0.444	7.20	2.175
1.90	0.470	7.30	2.213
2.00	0.497	7.40	2.251
2.10	0.524	7.50	2.290
2.20	0.551	7.60	2.329
2.30	0.578	7.70	2.368
2.40	0.606	7.80	2.407
2.50	0.633	7.90	2.447
2.60	0.661	8.00	2.487
2.70	0.689	8.10	2.527
2.80	0.717	8.20	2.567
2.90	0.746	8.30	2.608
3.00	0.775	8.40	2.649
3.10	0.804	8.50	2.690
3.20	0.833	8.60	2.731
3.30	0.862	8.70	2.773
3.40	0.891	8.80	2.815
3.50	0.921	8.90	2.857
3.60	0.951	9.00	2.899
3.70	0.981	9.10	2.942
3.80	1.012	9.20	2.985
3.90	1.042	9.30	3.028
4.00	1.073	9.40	3.071
4.10	1.104	9.50	3.115
4.20	1.135	9.60	3.158
4.30	1.167	9.70	3.203
4.40	1.198	9.80	3.247
4.50	1.230	9.90	3.292
4.60	1.262	10.00	3.336
4.70	1.295		
4.80	1.327		
4.90	1.360		
5.00	1.393		
5.10	1.426		
5.20	1.459		
5.30	1.493		

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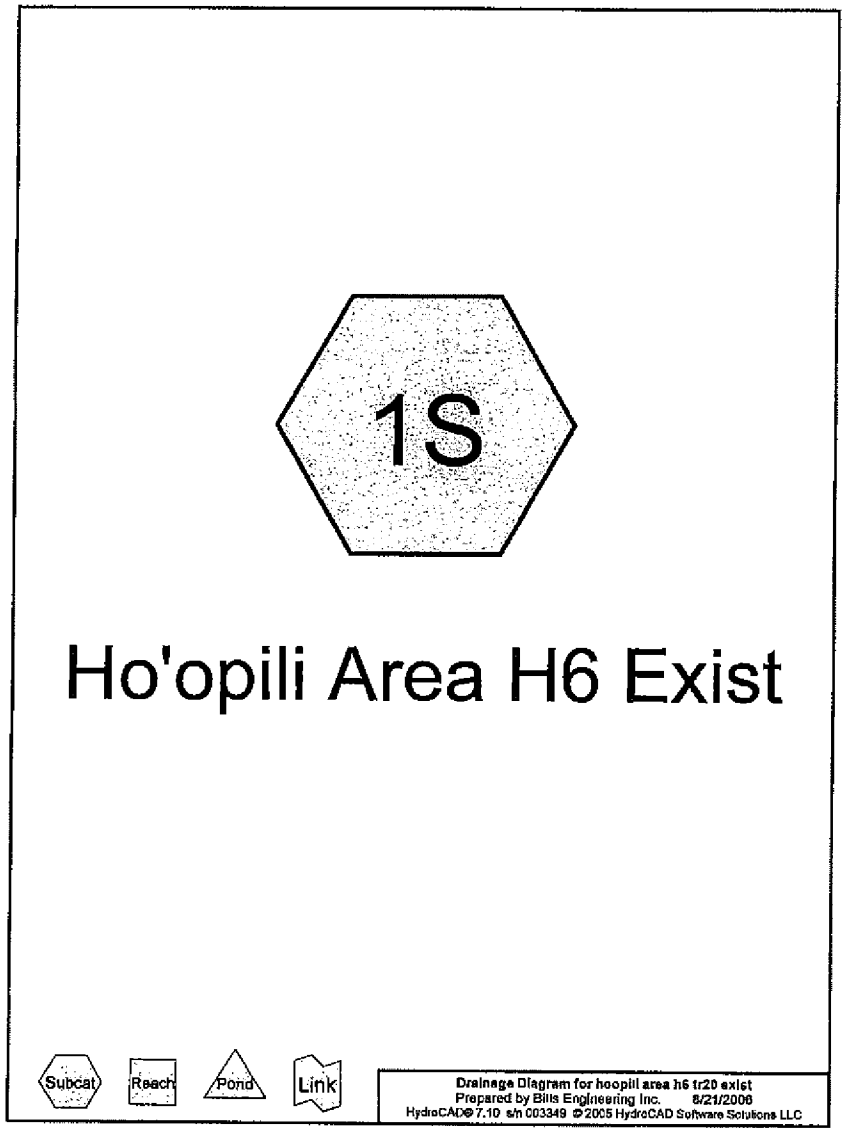

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H6 Exist Runoff Area=173.500 ac Runoff Depth=2.46"
Flow Length=3,800' Tc=48.7 min CN=80 Runoff=144.92 cfs 35.590 af

Total Runoff Area = 173.500 ac Runoff Volume = 35.590 af Average Runoff Depth = 2.46"

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Subcatchment 1S: Ho'opili Area H6 Exist

Subcatchment area 6 west of Honoulluli Stream

Runoff = 144.92 cfs @ 10.50 hrs, Volume= 35.590 af, Depth= 2.46"

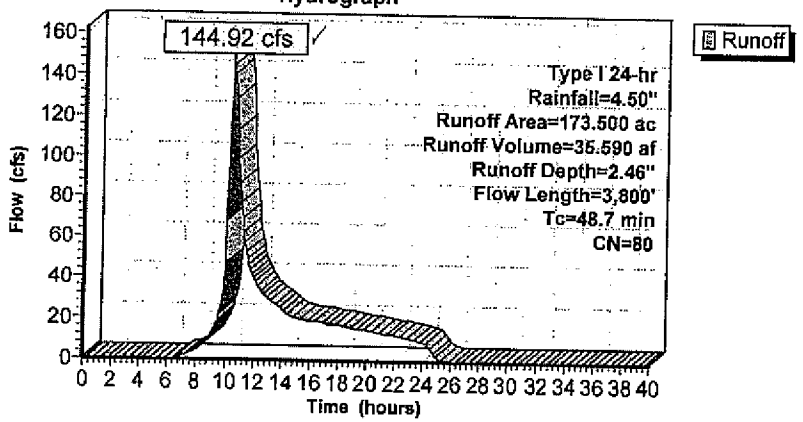
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

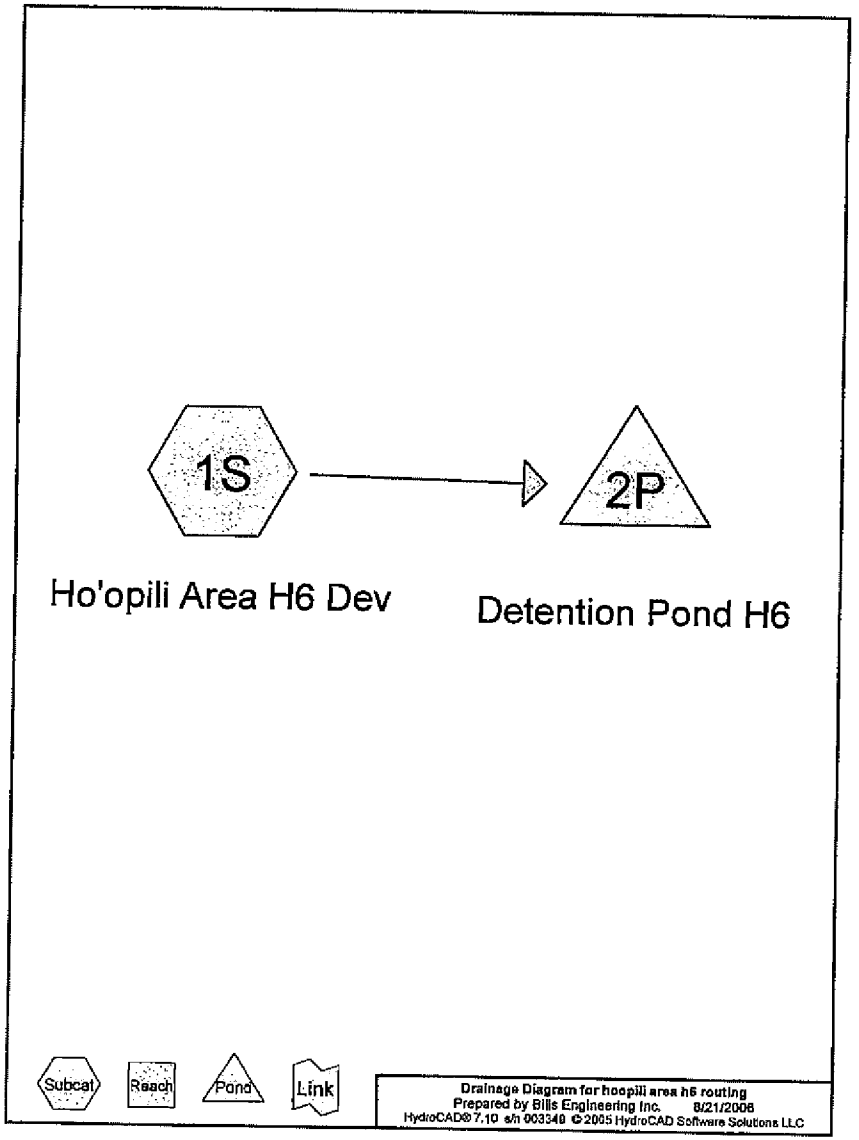
Area (ac)	CN	Description
173.500	80	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
48.7	3,800	0.0360	1.3		Lag/CN Method, Existing condition

Subcatchment 1S: Ho'opili Area H6 Exist

Hydrograph





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Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H6 Dev Runoff Area=173.500 ac Runoff Depth=3.10"
Flow Length=3,800' Tc=38.4 min CN=87 Runoff=217.07 cfs 44.805 af

Pond 2P: Detention Pond H6 Peak Elev=7.83' Storage=12.693 af Inflow=217.07 cfs 44.805 af
46.0" x 100.0' Culvert Outflow=142.28 cfs 37.285 af

Total Runoff Area = 173.500 ac Runoff Volume = 44.805 af Average Runoff Depth = 3.10"

Subcatchment 1S: Ho'opili Area H6 Dev

Subcatchment area 6 west of Honouliuli Stream

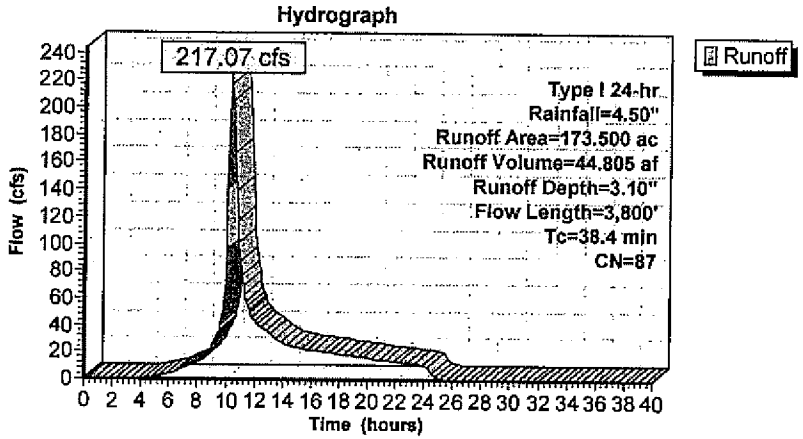
Runoff = 217.07 cfs @ 10.35 hrs, Volume= 44.805 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
173.500	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.4	3,800	0.0360	1.6		Lag/CN Method, Developed condition

Subcatchment 1S: Ho'opili Area H6 Dev



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Pond 2P: Detention Pond H6

Inflow Area = 173.500 ac, Inflow Depth = 3.10"
Inflow = 217.07 cfs @ 10.35 hrs, Volume= 44.805 af
Outflow = 142.26 cfs @ 10.70 hrs, Volume= 37.285 af, Atten= 34%, Lag= 20.9 min
Primary = 142.26 cfs @ 10.70 hrs, Volume= 37.285 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 7.83' @ 10.70 hrs Surf.Area= 1.817 ac Storage= 12,693 af
Plug-Flow detention time= 193.7 min calculated for 37.192 af (83% of inflow)
Center-of-Mass det. time= 102.7 min (901.5 - 798.8)

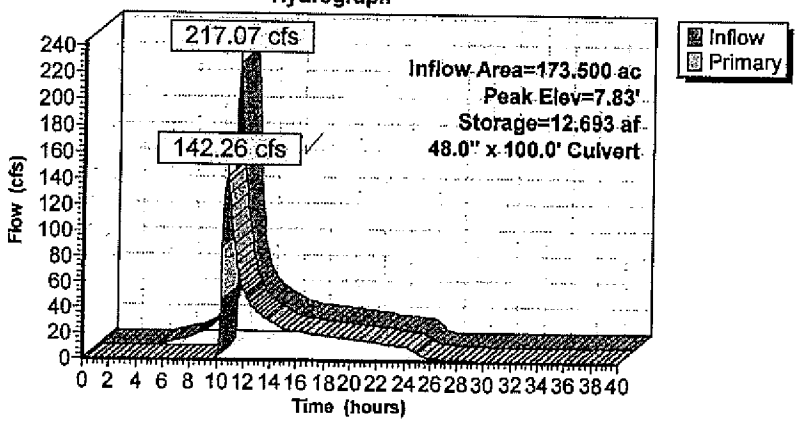
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	18.786 af	**250.00'W x 250.00'L x 10.00'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	4.60'	**48.0" x 100.0' long Culvert X 3.00** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 4.30' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=142.24 cfs @ 10.70 hrs HW=7.83' (Free Discharge)
↳1=**Culvert** (Barrel Controls 142.24 cfs @ 6.4 fps)

Pond 2P: Detention Pond H6

Hydrograph



Stage-Discharge for Pond 2P: Detention Pond H6

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	5.30	5.15
0.10	0.00	5.40	7.41
0.20	0.00	5.50	10.03
0.30	0.00	5.60	13.00
0.40	0.00	5.70	16.31
0.50	0.00	5.80	19.93
0.60	0.00	5.90	23.85
0.70	0.00	6.00	28.06
0.80	0.00	6.10	32.54
0.90	0.00	6.20	37.29
1.00	0.00	6.30	42.29
1.10	0.00	6.40	47.53
1.20	0.00	6.50	53.00
1.30	0.00	6.60	58.70
1.40	0.00	6.70	64.60
1.50	0.00	6.80	70.70
1.60	0.00	6.90	76.99
1.70	0.00	7.00	83.45
1.80	0.00	7.10	90.09
1.90	0.00	7.20	96.88
2.00	0.00	7.30	103.82
2.10	0.00	7.40	110.90
2.20	0.00	7.50	118.10
2.30	0.00	7.60	125.41
2.40	0.00	7.70	132.82
2.50	0.00	7.80	140.32
2.60	0.00	7.90	147.90
2.70	0.00	8.00	155.54
2.80	0.00	8.10	163.23
2.90	0.00	8.20	170.95
3.00	0.00	8.30	178.70
3.10	0.00	8.40	186.44
3.20	0.00	8.50	194.18
3.30	0.00	8.60	201.88
3.40	0.00	8.70	209.53
3.50	0.00	8.80	217.11
3.60	0.00	8.90	224.60
3.70	0.00	9.00	231.97
3.80	0.00	9.10	239.19
3.90	0.00	9.20	246.24
4.00	0.00	9.30	253.08
4.10	0.00	9.40	259.65
4.20	0.00	9.50	265.96
4.30	0.00	9.60	271.89
4.40	0.00	9.70	277.40
4.50	0.00	9.80	282.38
4.60	0.00	9.90	286.87
4.70	0.00	10.00	**289.99**
4.80	0.00		
4.90	0.18		
5.00	0.78		
5.10	1.81		
5.20	3.28		

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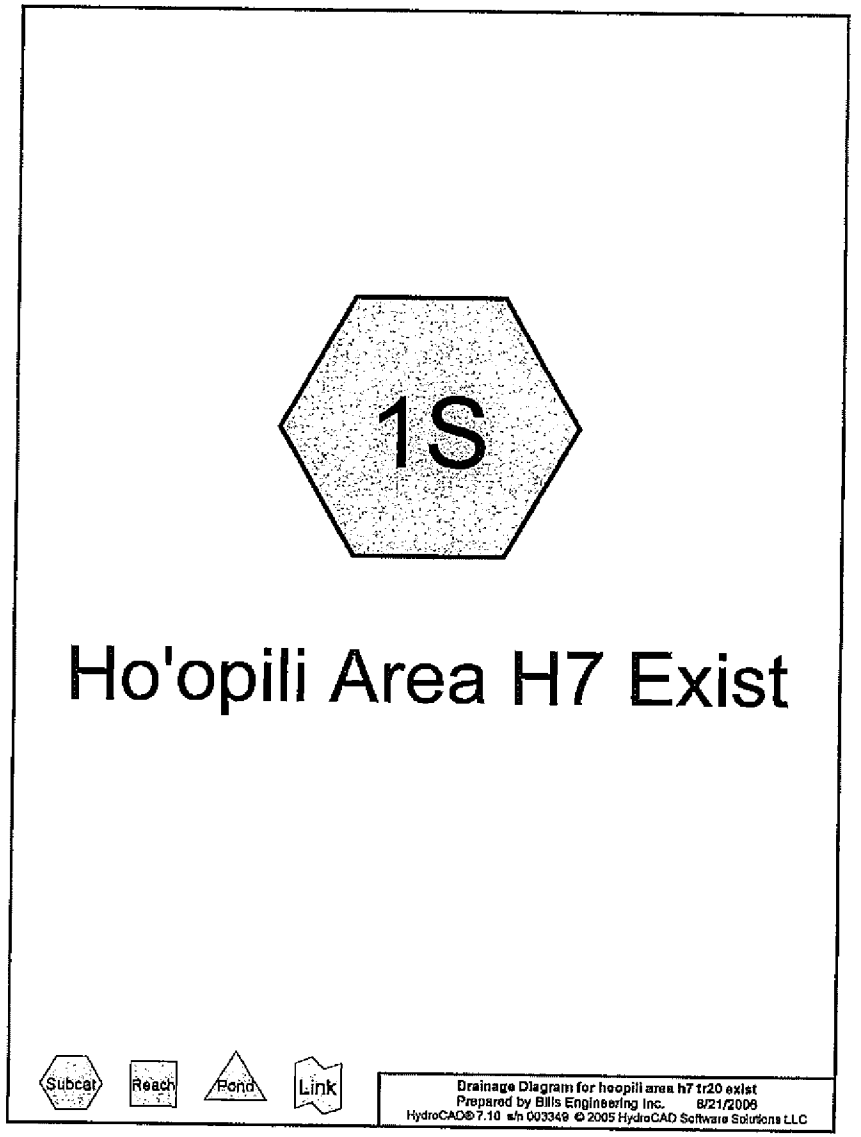
Stage-Area-Storage for Pond 2P: Detention Pond H6

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
0.00	0.000	5.30	8.268
0.10	0.144	5.40	8.437
0.20	0.288	5.50	8.606
0.30	0.433	5.60	8.776
0.40	0.578	5.70	8.947
0.50	0.723	5.80	9.118
0.60	0.869	5.90	9.290
0.70	1.016	6.00	9.462
0.80	1.163	6.10	9.634
0.90	1.310	6.20	9.807
1.00	1.458	6.30	9.981
1.10	1.606	6.40	10.155
1.20	1.755	6.50	10.330
1.30	1.904	6.60	10.505
1.40	2.054	6.70	10.681
1.50	2.204	6.80	10.857
1.60	2.355	6.90	11.033
1.70	2.506	7.00	11.210
1.80	2.658	7.10	11.388
1.90	2.810	7.20	11.566
2.00	2.962	7.30	11.745
2.10	3.115	7.40	11.924
2.20	3.269	7.50	12.104
2.30	3.423	7.60	12.284
2.40	3.577	7.70	12.466
2.50	3.732	7.80	12.646
2.60	3.888	7.90	12.828
2.70	4.044	8.00	13.010
2.80	4.200	8.10	13.193
2.90	4.357	8.20	13.377
3.00	4.514	8.30	13.560
3.10	4.672	8.40	13.745
3.20	4.830	8.50	13.930
3.30	4.989	8.60	14.115
3.40	5.149	8.70	14.301
3.50	5.308	8.80	14.487
3.60	5.469	8.90	14.674
3.70	5.629	9.00	14.862
3.80	5.790	9.10	15.050
3.90	5.952	9.20	15.239
4.00	6.114	9.30	15.428
4.10	6.277	9.40	15.617
4.20	6.440	9.50	15.807
4.30	6.604	9.60	15.998
4.40	6.768	9.70	16.189
4.50	6.933	9.80	16.381
4.60	7.098	9.90	16.573
4.70	7.263	10.00	16.766
4.80	7.430		
4.90	7.596		
5.00	7.763		
5.10	7.931		
5.20	8.099		



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Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H7 Exist Runoff Area=148.200 ac Runoff Depth=2.46"
Flow Length=4,800' Tc=70.5 min CN=80/Runoff=99.05 cfs 30.400 af

Total Runoff Area = 148.200 ac Runoff Volume = 30.400 af Average Runoff Depth = 2.46"

Subcatchment 1S: Ho'opili Area H7 Exist

Subcatchment area 7 west of Honouliuli Stream

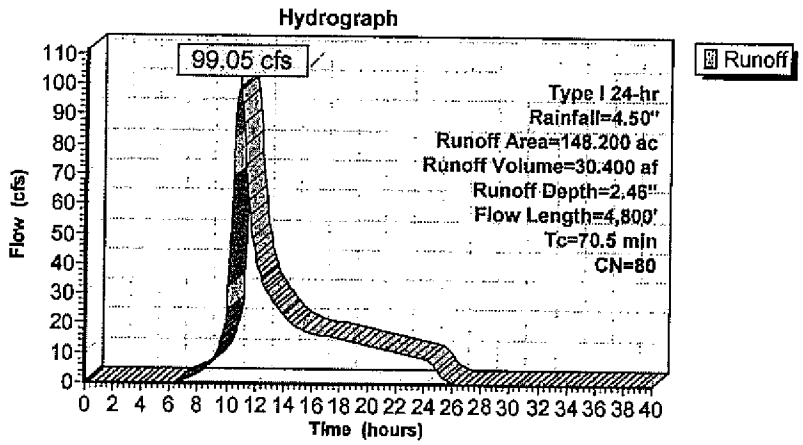
Runoff = 99.05 cfs @ 10.60 hrs, Volume= 30.400 af, Depth= 2.46"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
148.200	80	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
70.5	4,800	0.0250	1.1		Lag/CN Method, Existing condition

Subcatchment 1S: Ho'opili Area H7 Exist



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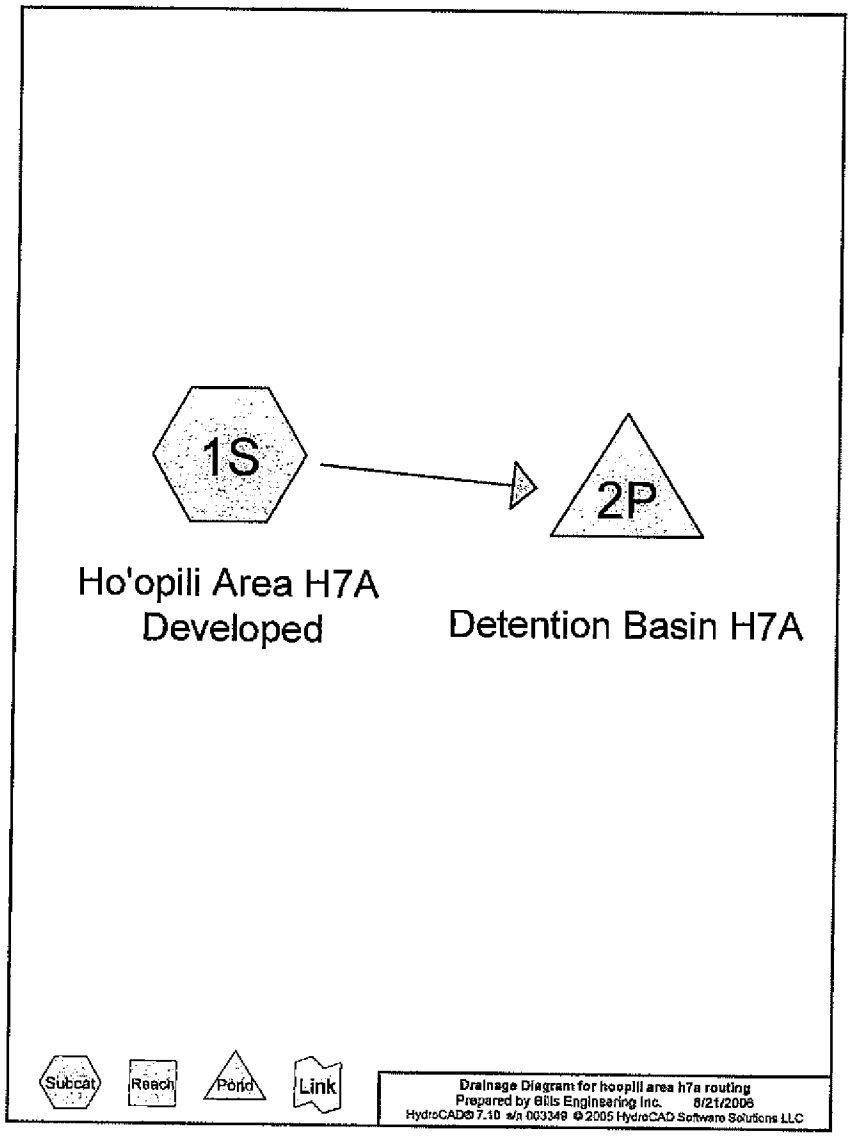

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H7A Developed Runoff Area=125.200 ac Runoff Depth=3.10"
Flow Length=4,000' Tc=16.9 min CN=87 Runoff=236.87 cfs 32.332 af

Pond 2P: Detention Basin H7A Peak Elev=7.78' Storage=11.157 af Inflow=236.87 cfs 32.332 af
30.0" x 100.0' Culvert Outflow=71.10 cfs 26.745 af

Total Runoff Area = 125.200 ac Runoff Volume = 32.332 af Average Runoff Depth = 3.10"

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Subcatchment 1S: Ho'opili Area H7A Developed

Subcatchment area 7 west of Honouliuli Stream

Runoff = 236.87 cfs @ 10.09 hrs, Volume= 32.332 af, Depth= 3.10"

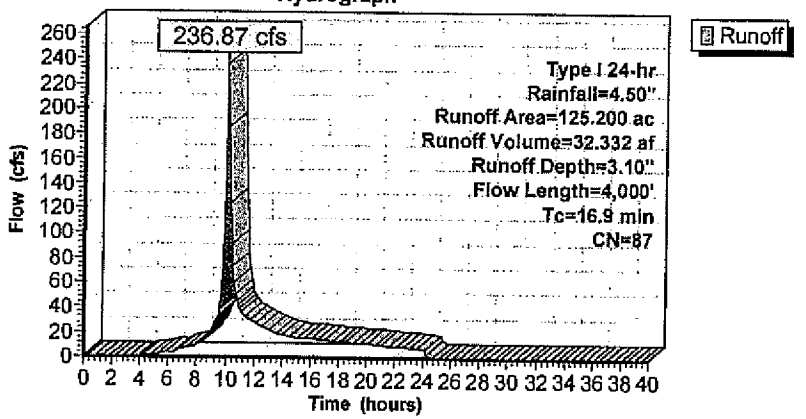
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
125.200	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		**Lag/CN Method, Overland**
2.5	1,500	0.0200	10.2	31.99	**Circular Channel (pipe), Piped**
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
7.5	2,300	0.0050	5.1	16.00	**Circular Channel (pipe), Piped-In road**
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
16.9	4,000	Total			

Subcatchment 1S: Ho'opili Area H7A Developed

Hydrograph



Pond 2P: Detention Basin H7A

Inflow Area = 125.200 ac, Inflow Depth = 3.10"
Inflow = 236.87 cfs @ 10.09 hrs, Volume= 32.332 af
Outflow = 71.10 cfs @ 10.52 hrs, Volume= 26.745 af, Atten= 70%, Lag= 25.9 min
Primary = 71.10 cfs @ 10.52 hrs, Volume= 26.745 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 7.78' @ 10.52 hrs Surf.Area= 1.435 ac Storage= 11.157 af
Plug-Flow detention time= 222.0 min calculated for 26.679 af (83% of inflow)
Center-of-Mass det. time= 129.0 min (907.9 - 778.9)

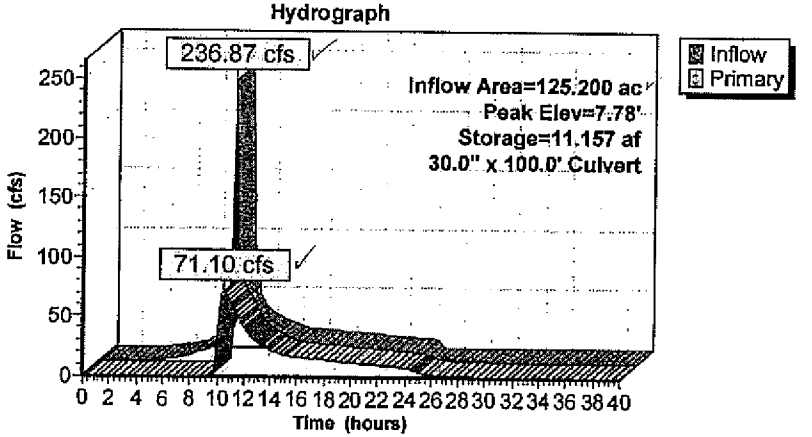
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	14.348 af	**250.00'W x 250.00'L x 10.00'H Prismatoid**

Device	Routing	Invert	Outlet Devices
#1	Primary	3.80'	**30.0" x 100.0' long Culvert X 2.00** RCP, square edge headwall, Ke= 0.500
			Outlet Invert= 3.30' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=70.95 cfs @ 10.52 hrs HW=7.77' (Free Discharge)
↳1=Culvert (Barrel Controls 70.95 cfs @ 7.2 fps)

Pond 2P: Detention Basin H7A

Hydrograph



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Stage-Discharge for Pond 2P: Detention Basin H7A

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	5.30	20.28
0.10	0.00	5.40	22.82
0.20	0.00	5.50	25.02
0.30	0.00	5.60	27.46
0.40	0.00	5.70	29.98
0.50	0.00	5.80	32.51
0.60	0.00	5.90	35.06
0.70	0.00	6.00	37.60
0.80	0.00	6.10	40.14
0.90	0.00	6.20	42.65
1.00	0.00	6.30	45.11
1.10	0.00	6.40	47.51
1.20	0.00	6.50	49.82
1.30	0.00	6.60	52.01
1.40	0.00	6.70	54.05
1.50	0.00	6.80	55.88
1.60	0.00	6.90	57.45
1.70	0.00	7.00	58.63
1.80	0.00	7.10	59.06
1.90	0.00	7.20	59.85
2.00	0.00	7.30	61.95
2.10	0.00	7.40	63.89
2.20	0.00	7.50	65.96
2.30	0.00	7.60	67.87
2.40	0.00	7.70	69.73
2.50	0.00	7.80	71.54
2.60	0.00	7.90	73.31
2.70	0.00	8.00	75.03
2.80	0.00	8.10	76.72
2.90	0.00	8.20	78.37
3.00	0.00	8.30	79.98
3.10	0.00	8.40	81.57
3.20	0.00	8.50	83.12
3.30	0.00	8.60	84.65
3.40	0.00	8.70	86.14
3.50	0.00	8.80	87.62
3.60	0.00	8.90	89.07
3.70	0.00	9.00	90.49
3.80	0.00	9.10	91.69
3.90	0.09	9.20	93.28
4.00	0.40	9.30	94.64
4.10	0.94	9.40	95.98
4.20	1.66	9.50	97.30
4.30	2.63	9.60	98.61
4.40	3.76	9.70	99.90
4.50	5.06	9.80	101.17
4.60	6.53	9.90	102.43
4.70	8.13	10.00	103.67
4.80	9.88		
4.90	11.76		
5.00	13.74		
5.10	15.82		
5.20	18.01		

Stage-Area-Storage for Pond 2P: Detention Basin H7A

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
0.00	0.000	5.30	7.604
0.10	0.143	5.40	7.748
0.20	0.287	5.50	7.891
0.30	0.430	5.60	8.035
0.40	0.574	5.70	8.178
0.50	0.717	5.80	8.322
0.60	0.861	5.90	8.465
0.70	1.004	6.00	8.609
0.80	1.148	6.10	8.752
0.90	1.291	6.20	8.896
1.00	1.435	6.30	9.039
1.10	1.578	6.40	9.183
1.20	1.722	6.50	9.326
1.30	1.865	6.60	9.470
1.40	2.009	6.70	9.613
1.50	2.152	6.80	9.757
1.60	2.296	6.90	9.900
1.70	2.439	7.00	10.044
1.80	2.583	7.10	10.187
1.90	2.726	7.20	10.331
2.00	2.870	7.30	10.474
2.10	3.013	7.40	10.618
2.20	3.157	7.50	10.761
2.30	3.300	7.60	10.904
2.40	3.444	7.70	11.048
2.50	3.587	7.80	11.191
2.60	3.730	7.90	11.335
2.70	3.874	8.00	11.478
2.80	4.017	8.10	11.622
2.90	4.161	8.20	11.765
3.00	4.304	8.30	11.909
3.10	4.448	8.40	12.052
3.20	4.591	8.50	12.196
3.30	4.735	8.60	12.339
3.40	4.878	8.70	12.483
3.50	5.022	8.80	12.626
3.60	5.165	8.90	12.770
3.70	5.309	9.00	12.913
3.80 ✓	5.452✓	9.10	13.057
3.90	5.596	9.20	13.200
4.00	5.739	9.30	13.344
4.10	5.883	9.40	13.487
4.20	6.026	9.50	13.631
4.30	6.170	9.60	13.774
4.40	6.313	9.70	13.918
4.50	6.457	9.80	14.061
4.60	6.600	9.90	14.205
4.70	6.744	10.00	14.348
4.80	6.887		
4.90	7.031		
5.00	7.174		
5.10	7.317		
5.20	7.461		

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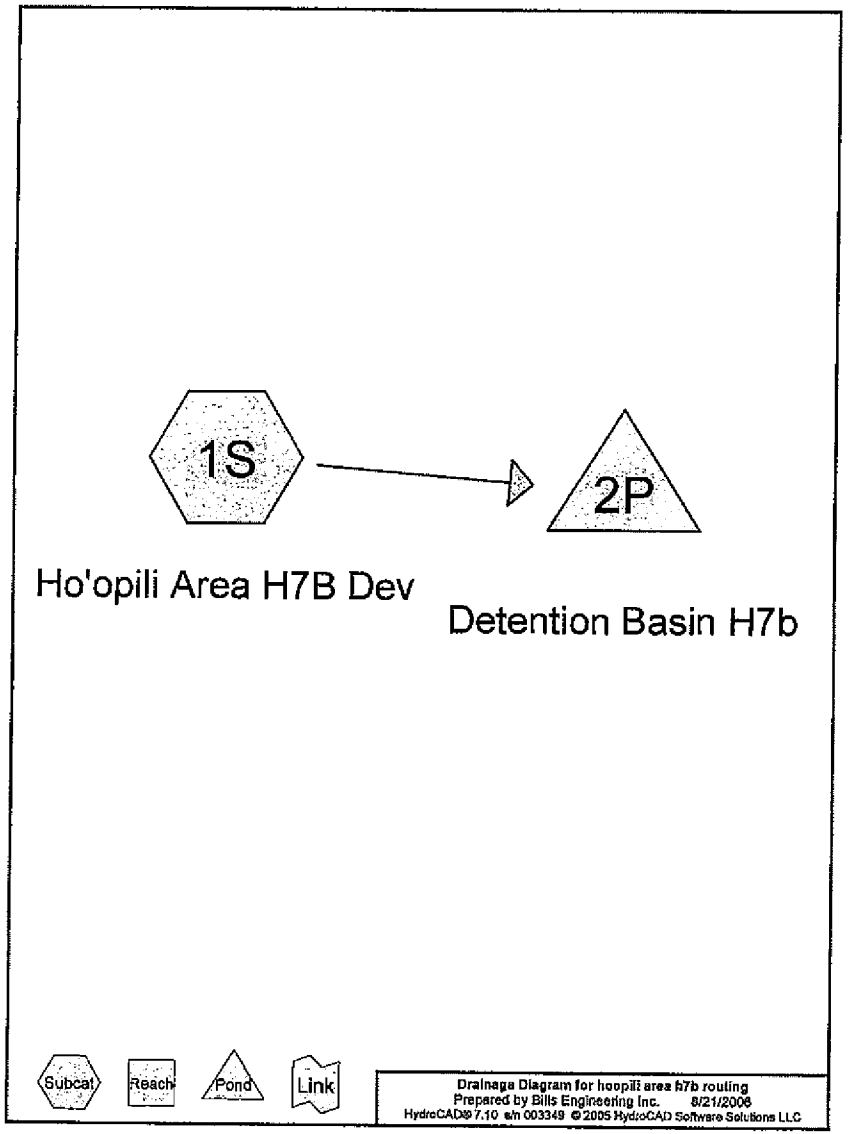

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area H7B Dev Runoff Area=23.000 ac Runoff Depth=3.10"
Flow Length=1,200' Tc=9.2 min CN=87 Runoff=52.93 cfs 5.940 af

Pond 2P: Detention Basin H7b Peak Elev=6.33' Storage=1.852 af Inflow=52.93 cfs 5.940 af
30.0" x 100.0' Culvert Outflow=22.91 cfs 4.919 af

Total Runoff Area = 23.000 ac Runoff Volume = 5.940 af Average Runoff Depth = 3.10"

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Subcatchment 1S: Ho'opili Area H7B Dev

Subcatchment area 7B west of Honouliuli Stream

[49] Hint: Tc<2dt may require smaller dt

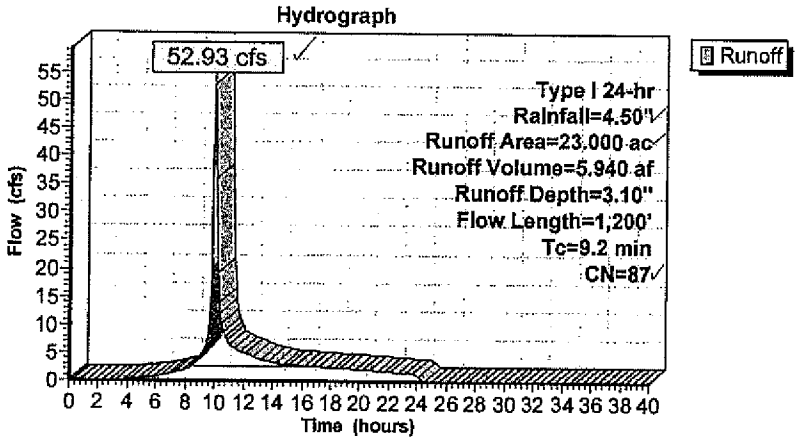
Runoff = 52.93 cfs @ 10.00 hrs, Volume= 5.940 af, Depth= 3.10"

Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
23.000	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		Lag/CN Method, Overland
2.3	1,000	0.0100	7.2	22.62	Circular Channel (pipe), Piped
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
9.2	1,200	Total			

Subcatchment 1S: Ho'opili Area H7B Dev



Pond 2P: Detention Basin H7b

Inflow Area = 23.000 ac, Inflow Depth = 3.10"
Inflow = 52.93 cfs @ 10.00 hrs, Volume= 5.940 af
Outflow = 22.91 cfs @ 10.20 hrs, Volume= 4.919 af, Atten= 57%, Lag= 12.2 min
Primary = 22.91 cfs @ 10.20 hrs, Volume= 4.919 af

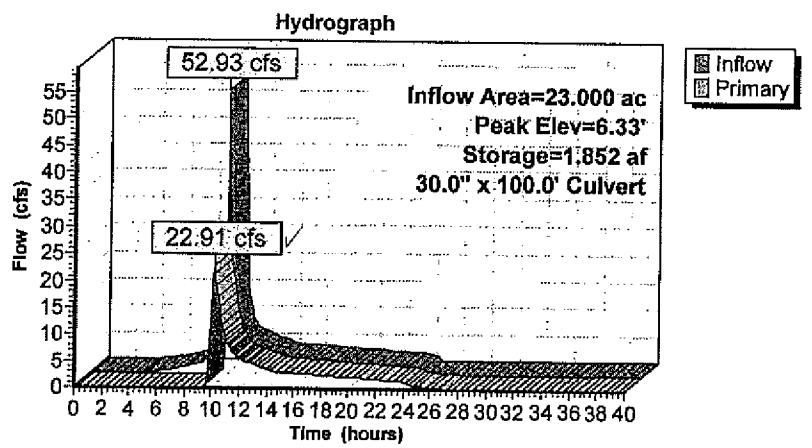
Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 6.33' @ 10.20 hrs Surf.Area= 0.361 ac Storage= 1.852 af
Plug-Flow detention time=199.3 min calculated for 4.919 af (83% of inflow)
Center-of-Mass det. time= 104.4 min (876.1 - 771.7)

Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	3.336 af	100.00'W x 100.00'L x 10.00'H Prismatoid Z=2.0

Device	Routing	Invert	Outlet Devices
#1	Primary	3.80'	30.0" x 100.0' long Culvert CPP, square edge headwall, Ke= 0.500
			Outlet Invert= 3.30' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=22.91 cfs @ 10.20 hrs HW=6.33' (Free Discharge)
↳1=Culvert (Barrel Controls 22.91 cfs @ 5.7 fps)

Pond 2P: Detention Basin H7b



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Stage-Discharge for Pond 2P: Detention Basin H7b

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	5.30	10.14
0.10	0.00	5.40	11.31
0.20	0.00	5.50	12.51
0.30	0.00	5.60	13.74
0.40	0.00	5.70	14.99
0.50	0.00	5.80	16.26
0.60	0.00	5.90	17.53
0.70	0.00	6.00	18.80
0.80	0.00	6.10	20.07
0.90	0.00	6.20	21.33
1.00	0.00	6.30	22.56
1.10	0.00	6.40	23.76
1.20	0.00	6.50	24.91
1.30	0.00	6.60	26.01
1.40	0.00	6.70	27.02
1.50	0.00	6.80	27.94
1.60	0.00	6.90	28.73
1.70	0.00	7.00	29.31
1.80	0.00	7.10	29.53
1.90	0.00	7.20	29.93
2.00	0.00	7.30	30.98
2.10	0.00	7.40	31.99
2.20	0.00	7.50	32.98
2.30	0.00	7.60	33.93
2.40	0.00	7.70	34.86
2.50	0.00	7.80	35.77
2.60	0.00	7.90	36.65
2.70	0.00	8.00	37.52
2.80	0.00	8.10	38.36
2.90	0.00	8.20	39.16
3.00	0.00	8.30	39.99
3.10	0.00	8.40	40.78
3.20	0.00	8.50	41.56
3.30	0.00	8.60	42.32
3.40	0.00	8.70	43.07
3.50	0.00	8.80	43.81
3.60	0.00	8.90	44.53
3.70	0.00	9.00	45.25
3.80	0.00	9.10	45.95
3.90	0.05	9.20	46.64
4.00	0.20	9.30	47.32
4.10	0.47	9.40	47.99
4.20	0.84	9.50	48.65
4.30	1.31	9.60	49.31
4.40	1.88	9.70	49.95
4.50	2.53	9.80	50.59
4.60	3.26	9.90	51.21
4.70	4.07	10.00	**51.84**
4.80	4.94		
4.90	5.87		
5.00	6.87		
5.10	7.91		
5.20	9.00		

Stage-Area-Storage for Pond 2P: Detention Basin H7b

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
0.00	0.000	5.30	1.493
0.10	0.023	5.40	1.527
0.20	0.046	5.50	1.561
0.30	0.070	5.60	1.595
0.40	0.093	5.70	1.630
0.50	0.117	5.80	1.664
0.60	0.141	5.90	1.699
0.70	0.165	6.00	1.734
0.80	0.190	6.10	1.770
0.90	0.214	6.20	1.805
1.00	0.239	6.30	1.841
1.10	0.264	6.40	1.877
1.20	0.289	6.50	1.914
1.30	0.314	6.60	1.950
1.40	0.340	6.70	1.987
1.50	0.365	6.80	2.024
1.60	0.391	6.90	2.061
1.70	0.417	7.00	2.099
1.80	0.444	7.10	2.137
1.90	0.470	7.20	2.175
2.00	0.497	7.30	2.213
2.10	0.524	7.40	2.251
2.20	0.551	7.50	2.290
2.30	0.578	7.60	2.329
2.40	0.606	7.70	2.368
2.50	0.633	7.80	2.407
2.60	0.661	7.90	2.447
2.70	0.689	8.00	2.487
2.80	0.717	8.10	2.527
2.90	0.746	8.20	2.567
3.00	0.775	8.30	2.608
3.10	0.804	8.40	2.649
3.20	0.833	8.50	2.690
3.30	0.862	8.60	2.731
3.40	0.891	8.70	2.773
3.50	0.921	8.80	2.815
3.60	0.951	8.90	2.857
3.70	0.981	9.00	2.899
3.80 ✓	1.012 ✓	9.10	2.942
3.90	1.042	9.20	2.985
4.00	1.073	9.30	3.028
4.10	1.104	9.40	3.071
4.20	1.135	9.50	3.115
4.30	1.167	9.60	3.158
4.40	1.198	9.70	3.203
4.50	1.230	9.80	3.247
4.60	1.262	9.90	3.292
4.70	1.295	10.00	**3.336**
4.80	1.327		
4.90	1.360		
5.00	1.393		
5.10	1.426		
5.20	1.459		

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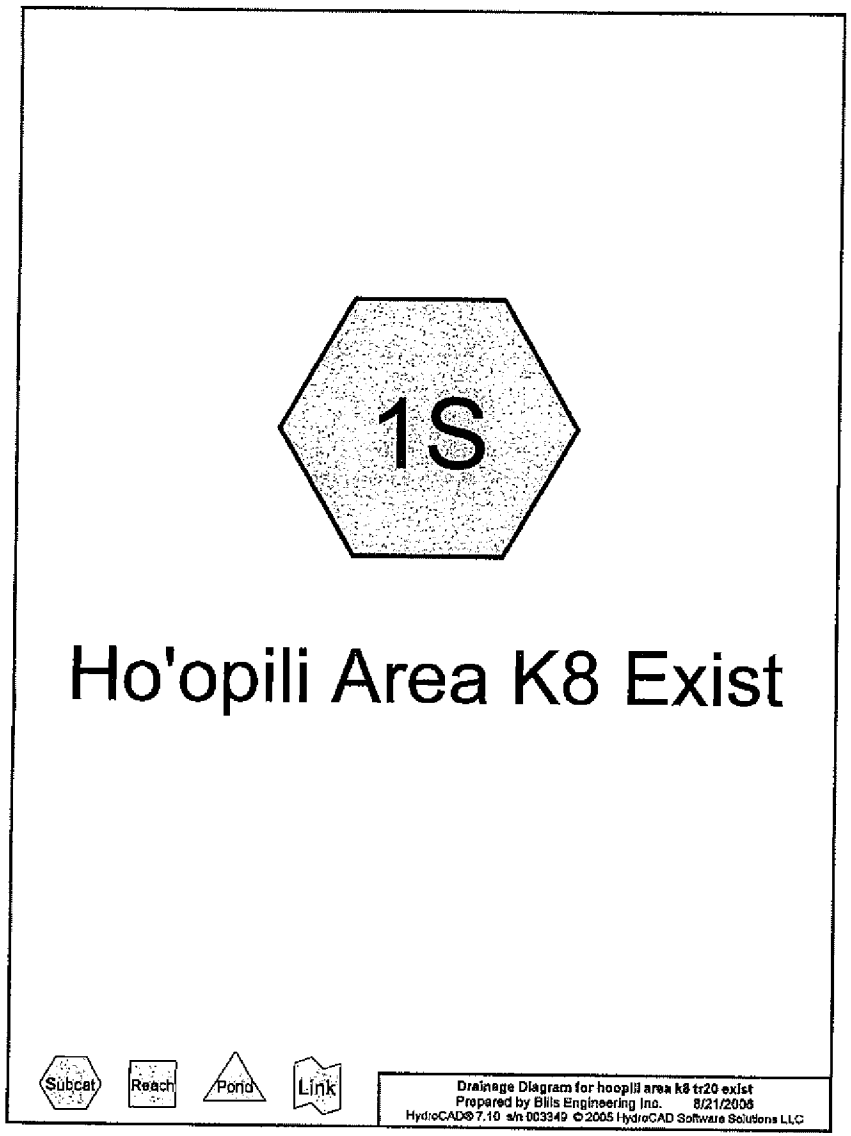


Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area K8 Exist Runoff Area=52.000 ac Runoff Depth=2.46"
Flow Length=2,000' Tc=39.1 min CN=80 Runoff=49.31 cfs 10.667 af

Total Runoff Area = 52.000 ac Runoff Volume = 10.667 af Average Runoff Depth = 2.46"

AR00028399

Subcatchment 1S: Ho'opili Area K8 Exist

Subcatchment area K8 west of NS Rd above Ferrington

Runoff = 49.31 cfs @ 10.38 hrs, Volume= 10.667 af, Depth= 2.46"

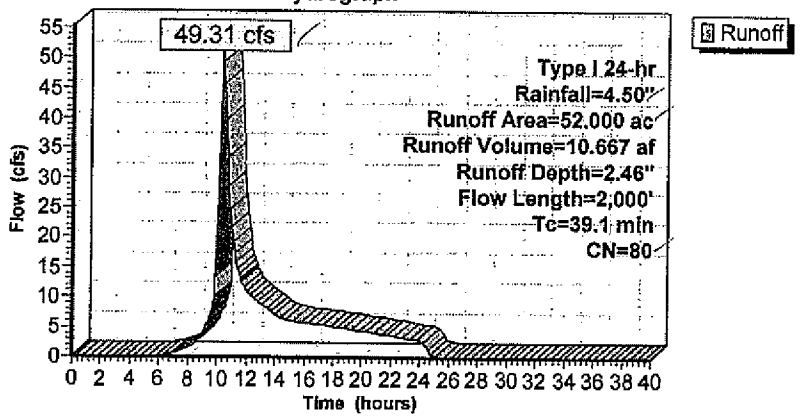
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

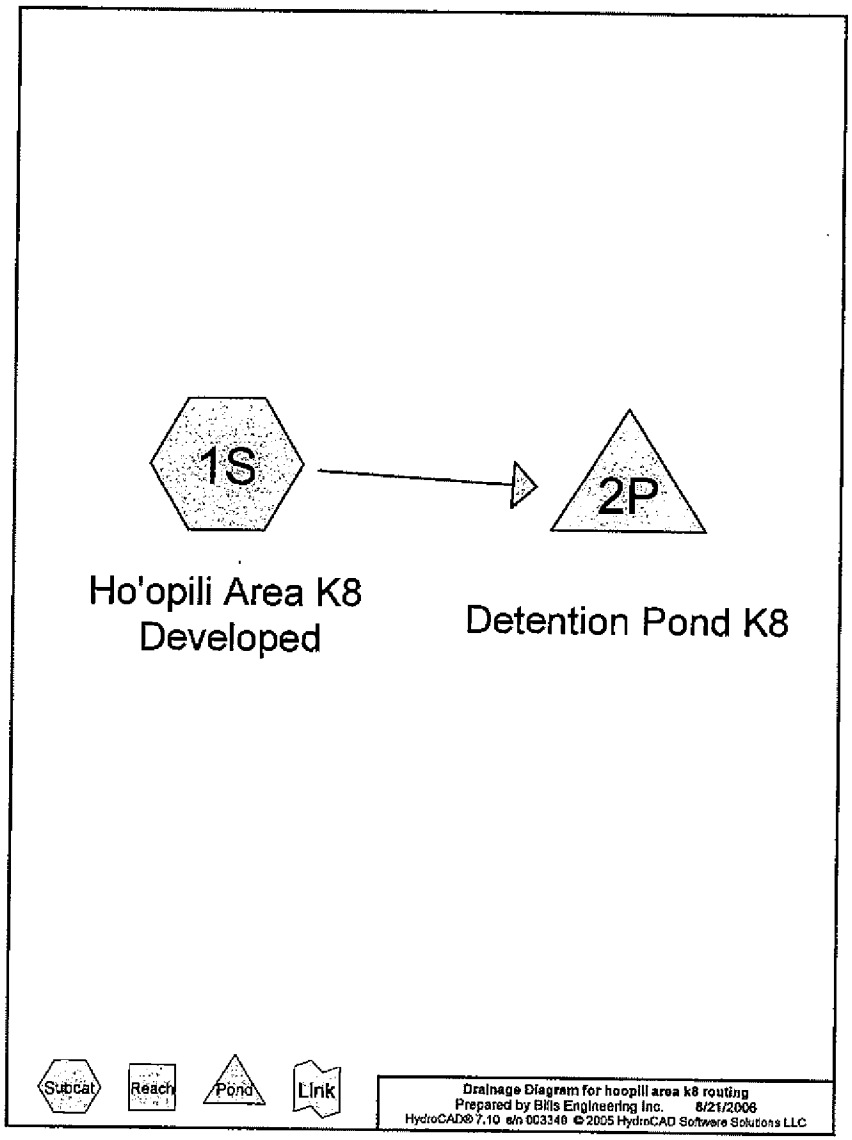
Area (ac)	CN	Description
52.000	80	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
39.1	2,000	0.0200	0.9		Lag/CN Method, Existing condition

Subcatchment 1S: Ho'opili Area K8 Exist

Hydrograph





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Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area K8 Developed Runoff Area=52.000 ac Runoff Depth=3.10"
Flow Length=3,200' Tc=12.5 min CN=87 Runoff=108.13 cfs 13.429 af

Pond 2P: Detention Pond K8 Peak Elev=6.94' Storage=4.291 af Inflow=108.13 cfs 13.429 af
48.0" x 100.0' Culvert Outflow=45.35 cfs 11.092 af

Total Runoff Area = 52.000 ac Runoff Volume = 13.429 af Average Runoff Depth = 3.10"

Subcatchment 1S: Ho'opili Area K8 Developed

Subcatchment area K8 west of NS Rd above Farrington

Runoff = 108.13 cfs @ 10.03 hrs, Volume= 13.429 af, Depth= 3.10"

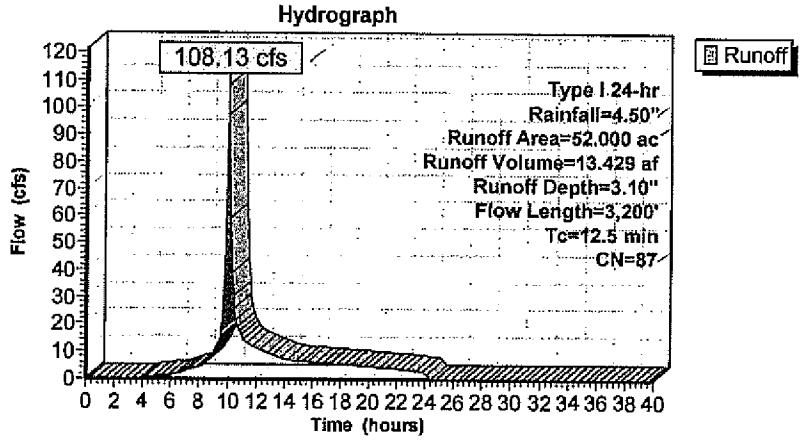
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
52.000	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.9	200	0.0100	0.5		Lag/CN Method, overland
2.3	1,000	0.0100	7.2	22.62	Circular Channel (pipe), Piped Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
3.3	2,000	0.0200	10.2	31.99	Circular Channel (pipe), Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
12.5	3,200	Total			

Subcatchment 1S: Ho'opili Area K8 Developed

Hydrograph



AR00028401

Pond 2P: Detention Pond K8

Inflow Area = 52.000 ac, Inflow Depth = 3.10"
Inflow = 108.13 cfs @ 10.03 hrs, Volume= 13.429 af
Outflow = 45.35 cfs @ 10.28 hrs, Volume= 11.092 af, Atten= 58%, Lag= 15.0 min
Primary = 45.35 cfs @ 10.28 hrs, Volume= 11.092 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 6.94' @ 10.28 hrs Surf.Area= 0.726 ac Storage= 4.291 af
Plug-Flow detention time= 209.7 min calculated for 11.092 af (83% of inflow)
Center-of-Mass det. time= 113.8 min (888.5 - 774.8)

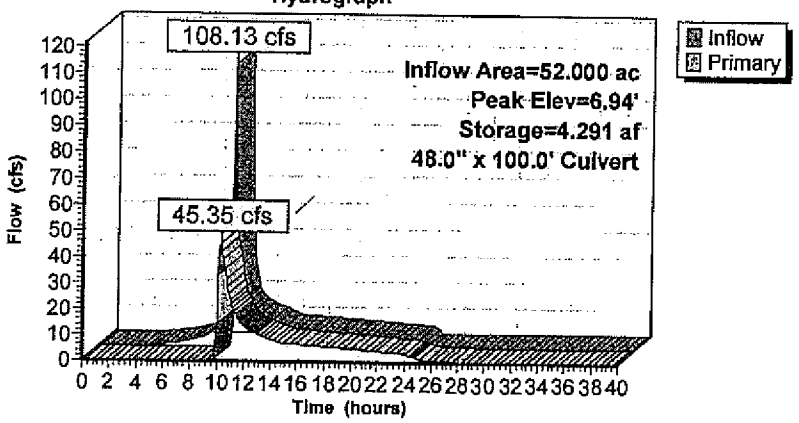
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	5.076 af	**150.00'W x 150.00'L x 8.00'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	4.00'	**48.0" x 100.0' long Culvert** RCP, square edge headwall, Ke= 0.500 Outlet Invert= 3.50' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=45.07 cfs @ 10.28 hrs HW=6.93' (Free Discharge)
└1=Culvert (Barrel Controls 45.07 cfs @ 6.4 fps)

Pond 2P: Detention Pond K8

Hydrograph



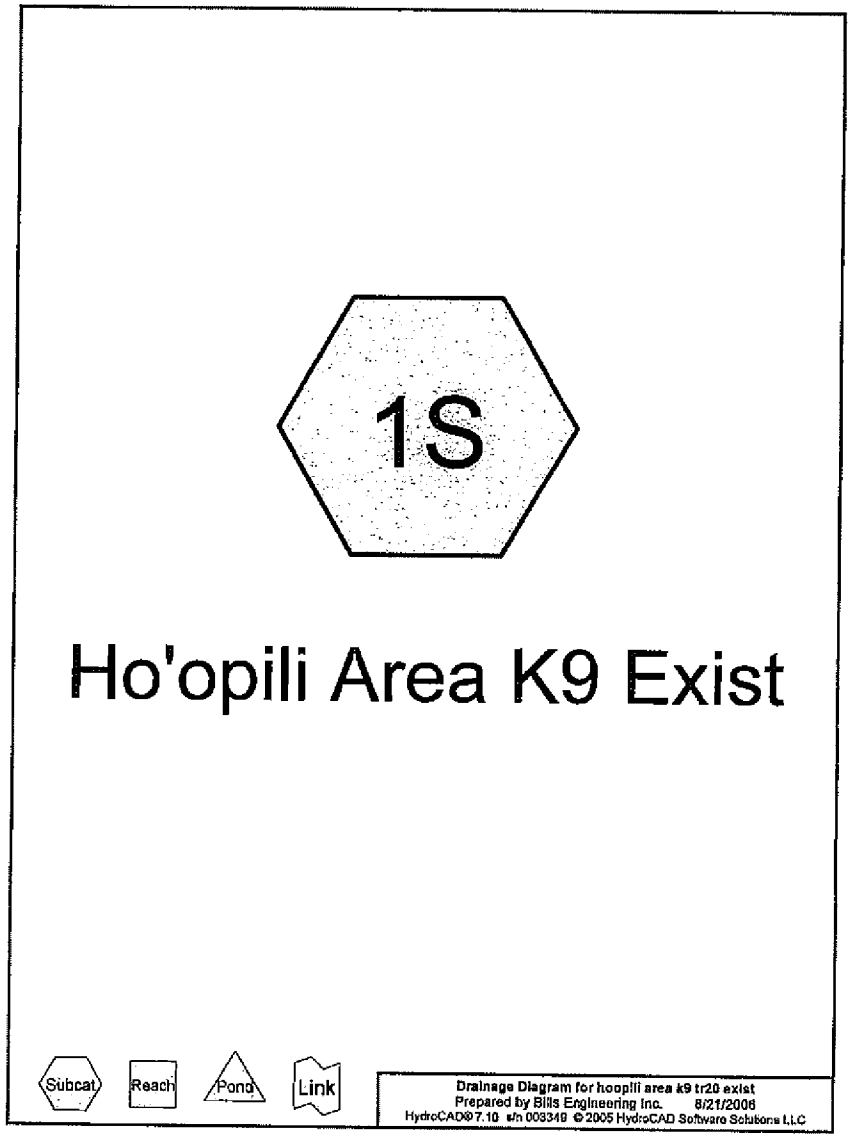
Stage-Discharge for Pond 2P: Detention Pond K8

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	2.12	0.00	4.24	0.38	8.36	31.38
0.04	0.00	2.16	0.00	4.28	0.52	8.40	32.29
0.08	0.00	2.20	0.00	4.32	0.69	8.44	33.21
0.12	0.00	2.24	0.00	4.36	0.88	8.48	34.14
0.16	0.00	2.28	0.00	4.40	1.09	8.52	35.08
0.20	0.00	2.32	0.00	4.44	1.33	8.56	36.02
0.24	0.00	2.36	0.00	4.48	1.58	8.60	36.97
0.28	0.00	2.40	0.00	4.52	1.86	8.64	37.92
0.32	0.00	2.44	0.00	4.56	2.15	8.68	38.88
0.36	0.00	2.48	0.00	4.60	2.47	8.72	39.85
0.40	0.00	2.52	0.00	4.64	2.80	8.76	40.82
0.44	0.00	2.56	0.00	4.68	3.18	8.80	41.80
0.48	0.00	2.60	0.00	4.72	3.53	8.84	42.79
0.52	0.00	2.64	0.00	4.76	3.92	8.88	43.78
0.56	0.00	2.68	0.00	4.80	4.33	8.92	44.77
0.60	0.00	2.72	0.00	4.84	4.76	8.96	45.77
0.64	0.00	2.76	0.00	4.88	5.21	7.00	46.77
0.68	0.00	2.80	0.00	4.92	5.67	7.04	47.78
0.72	0.00	2.84	0.00	4.96	6.15	7.08	48.79
0.76	0.00	2.88	0.00	5.00	6.64	7.12	49.81
0.80	0.00	2.92	0.00	5.04	7.15	7.16	50.83
0.84	0.00	2.96	0.00	5.08	7.68	7.20	51.85
0.88	0.00	3.00	0.00	5.12	8.22	7.24	52.87
0.92	0.00	3.04	0.00	5.16	8.78	7.28	53.90
0.96	0.00	3.08	0.00	5.20	9.35	7.32	54.92
1.00	0.00	3.12	0.00	5.24	9.94	7.36	55.95
1.04	0.00	3.16	0.00	5.28	10.54	7.40	56.98
1.08	0.00	3.20	0.00	5.32	11.16	7.44	58.02
1.12	0.00	3.24	0.00	5.36	11.79	7.48	59.05
1.16	0.00	3.28	0.00	5.40	12.43	7.52	60.08
1.20	0.00	3.32	0.00	5.44	13.09	7.56	61.12
1.24	0.00	3.36	0.00	5.48	13.76	7.60	62.15
1.28	0.00	3.40	0.00	5.52	14.44	7.64	63.18
1.32	0.00	3.44	0.00	5.56	15.14	7.68	64.21
1.36	0.00	3.48	0.00	5.60	15.84	7.72	65.24
1.40	0.00	3.52	0.00	5.64	16.58	7.76	66.27
1.44	0.00	3.56	0.00	5.68	17.30	7.80	67.29
1.48	0.00	3.60	0.00	5.72	18.04	7.84	68.32
1.52	0.00	3.64	0.00	5.76	18.80	7.88	69.33
1.56	0.00	3.68	0.00	5.80	19.57	7.92	70.35
1.60	0.00	3.72	0.00	5.84	20.34	7.96	71.36
1.64	0.00	3.76	0.00	5.88	21.13	8.00	72.37
1.68	0.00	3.80	0.00	5.92	21.93		
1.72	0.00	3.84	0.00	5.96	22.74		
1.76	0.00	3.88	0.00	6.00	23.57		
1.80	0.00	3.92	0.00	6.04	24.40		
1.84	0.00	3.96	0.00	6.08	25.24		
1.88	0.00	4.00	0.00	6.12	26.09		
1.92	0.00	4.04	0.01	6.16	26.95		
1.96	0.00	4.08	0.04	6.20	27.82		
2.00	0.00	4.12	0.09	6.24	28.70		
2.04	0.00	4.16	0.16	6.28	29.58		
2.08	0.00	4.20	0.26	6.32	30.48		

AR00028402

Stage-Area-Storage for Pond 2P: Detention Pond K8

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
0.00	0.000	2.12	1.158	4.24	2.447	6.36	3.874
0.04	0.021	2.16	1.181	4.28	2.473	6.40	3.902
0.08	0.041	2.20	1.204	4.32	2.498	6.44	3.930
0.12	0.062	2.24	1.228	4.36	2.524	6.48	3.959
0.16	0.083	2.28	1.251	4.40	2.550	6.52	3.987
0.20	0.104	2.32	1.274	4.44	2.576	6.56	4.016
0.24	0.125	2.36	1.297	4.48	2.602	6.60	4.044
0.28	0.146	2.40	1.321	4.52	2.627	6.64	4.073
0.32	0.167	2.44	1.344	4.56	2.653	6.68	4.102
0.36	0.188	2.48	1.368	4.60	2.679	6.72	4.130
0.40	0.209	2.52	1.391	4.64	2.705	6.76	4.159
0.44	0.230	2.56	1.415	4.68	2.732	6.80	4.188
0.48	0.251	2.60	1.438	4.72	2.758	6.84	4.217
0.52	0.272	2.64	1.462	4.76	2.784	6.88	4.246
0.56	0.294	2.68	1.486	4.80	2.810	6.92	4.275
0.60	0.315	2.72	1.509	4.84	2.837	6.96	4.304
0.64	0.336	2.76	1.533	4.88	2.863	7.00	4.333
0.68	0.358	2.80	1.557	4.92	2.889	7.04	4.362
0.72	0.379	2.84	1.581	4.96	2.916	7.08	4.391
0.76	0.401	2.88	1.605	5.00	2.942	7.12	4.420
0.80	0.422	2.92	1.629	5.04	2.969	7.16	4.449
0.84	0.444	2.96	1.653	5.08	2.995	7.20	4.479
0.88	0.465	3.00	1.677	5.12	3.022	7.24	4.508
0.92	0.487	3.04	1.701	5.16	3.049	7.28	4.538
0.96	0.509	3.08	1.725	5.20	3.076	7.32	4.567
1.00	0.530	3.12	1.749	5.24	3.102	7.36	4.597
1.04	0.552	3.16	1.774	5.28	3.129	7.40	4.626
1.08	0.574	3.20	1.798	5.32	3.156	7.44	4.656
1.12	0.596	3.24	1.822	5.36	3.183	7.48	4.686
1.16	0.618	3.28	1.847	5.40	3.210	7.52	4.715
1.20	0.640	3.32	1.871	5.44	3.237	7.56	4.745
1.24	0.662	3.36	1.896	5.48	3.264	7.60	4.775
1.28	0.684	3.40	1.920	5.52	3.292	7.64	4.805
1.32	0.706	3.44	1.945	5.56	3.319	7.68	4.835
1.36	0.728	3.48	1.969	5.60	3.346	7.72	4.865
1.40	0.750	3.52	1.994	5.64	3.373	7.76	4.895
1.44	0.773	3.56	2.019	5.68	3.401	7.80	4.925
1.48	0.795	3.60	2.044	5.72	3.428	7.84	4.955
1.52	0.817	3.64	2.069	5.76	3.456	7.88	4.985
1.56	0.840	3.68	2.093	5.80	3.483	7.92	5.016
1.60	0.862	3.72	2.118	5.84	3.511	7.96	5.046
1.64	0.885	3.76	2.143	5.88	3.538	8.00	5.076
1.68	0.907	3.80	2.168	5.92	3.566		
1.72	0.930	3.84	2.194	5.96	3.594		
1.76	0.952	3.88	2.219	6.00	3.621		
1.80	0.975	3.92	2.244	6.04	3.649		
1.84	0.998	3.96	2.269	6.08	3.677		
1.88	1.021	4.00	2.294	6.12	3.705		
1.92	1.043	4.04	2.320	6.16	3.733		
1.96	1.066	4.08	2.345	8.20	3.761		
2.00	1.089	4.12	2.370	8.24	3.789		
2.04	1.112	4.16	2.396	6.28	3.817		
2.08	1.135	4.20	2.421	6.32	3.846		



AR00028403

Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area K9 Exist Runoff Area=50.500 ac Runoff Depth=2.46"
Flow Length=1,700' Tc=38.4 min CN=80 Runoff=48.36 cfs 10.359 af

Total Runoff Area = 50.500 ac Runoff Volume = 10.359 af Average Runoff Depth = 2.46"

Subcatchment 1S: Ho'opili Area K9 Exist

Subcatchment area K9 east of NS Rd below Farrington

Runoff = 48.36 cfs @ 10.37 hrs, Volume= 10.359 af, Depth= 2.46"

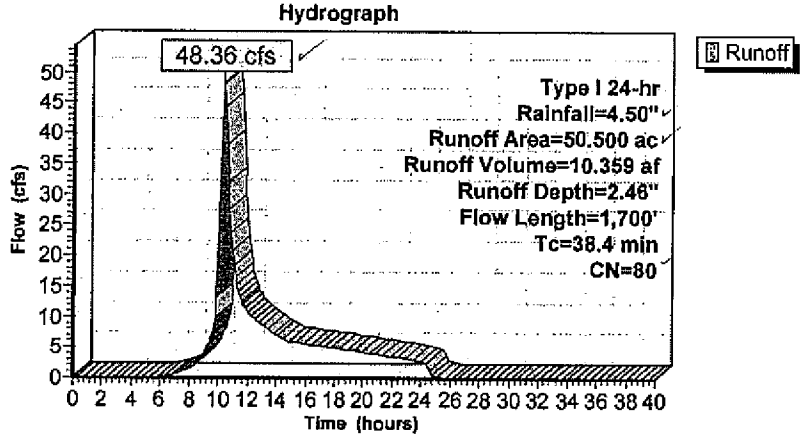
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
50.500	80	CN entered directly

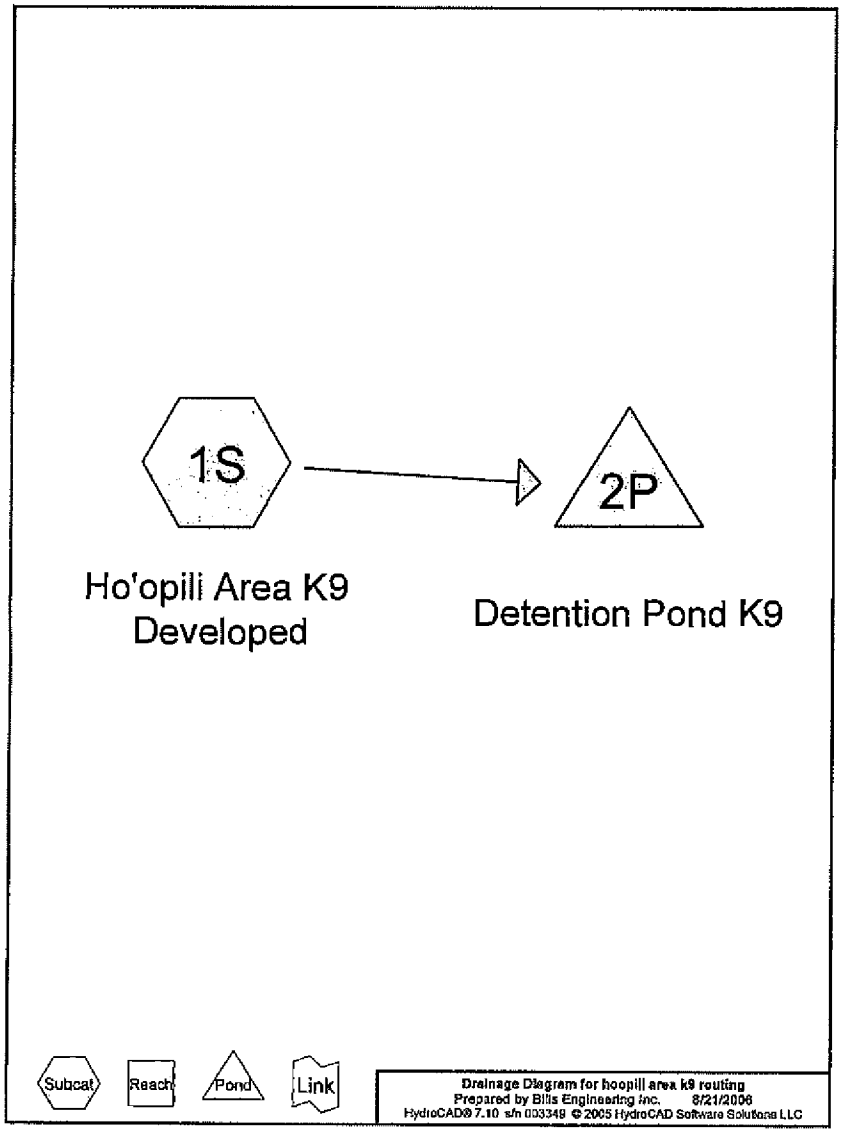
Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
38.4	1,700	0.0160	0.7		Lag/CN Method, Existing condition

Subcatchment 1S: Ho'opili Area K9 Exist

Hydrograph



AR00028404



Time span=0.00-40.00 hrs, dt=0.10 hrs, 401 points
Runoff by SCS TR-20 method, UH=SCS
Reach routing by Stor-Ind method - Pond routing by Stor-Ind method

Subcatchment 1S: Ho'opili Area K9 Developed Runoff Area=50.500 ac Runoff Depth=3.10"
Flow Length=2,300' Tc=11.0 min CN=87 Runoff=110.32 cfs 13.041 af

Pond 2P: Detention Pond K9 Peak Elev=6.66' Storage=4.084 af Inflow=110.32 cfs 13.041 af
46.0" x 100.0' Culvert Outflow=48.16 cfs 10.960 af

Total Runoff Area = 50.500 ac Runoff Volume = 13.041 af Average Runoff Depth = 3.10"

AR00028405

Subcatchment 1S: Ho'opili Area K9 Developed

Subcatchment area K9 east of NS Rd below Farrington

[49] Hint: Tc<2dt may require smaller dt

Runoff = 110.32 cfs @ 10.01 hrs, Volume= 13.041 af, Depth= 3.10"

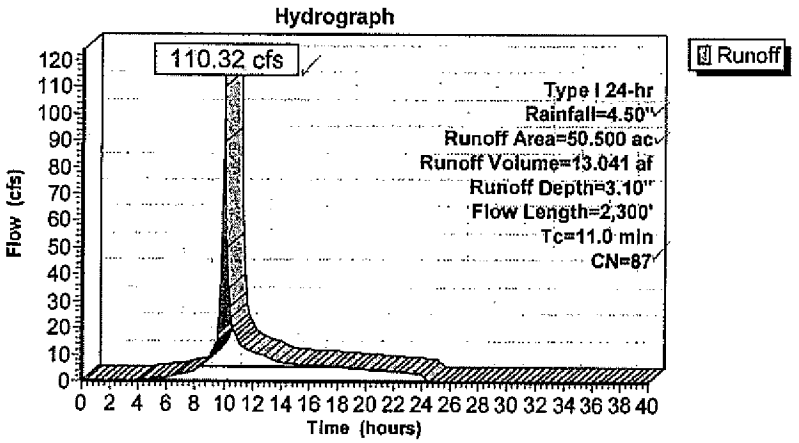
Runoff by SCS TR-20 method, UH=SCS, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Type I 24-hr Rainfall=4.50"

Area (ac)	CN	Description
50.500	87	CN entered directly

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
8.9	200	0.0100	0.5		Lag/CN Method, Overland
3.2	1,700	0.0150	8.8	27.71	Circular Channel (pipe), Piped in road
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
0.9	400	0.0100	7.2	22.62	Circular Channel (pipe), Piped
					Diam= 24.0" Area= 3.1 sf Perim= 6.3' r= 0.50' n= 0.013
11.0	2,300	Total			

Subcatchment 1S: Ho'opili Area K9 Developed

Hydrograph



Pond 2P: Detention Pond K9

Inflow Area = 50.500 ac, Inflow Depth = 3.10"
Inflow = 110.32 cfs @ 10.01 hrs, Volume= 13.041 af
Outflow = 48.16 cfs @ 10.23 hrs, Volume= 10.960 af, Atten= 56%, Lag= 13.2 min
Primary = 48.16 cfs @ 10.23 hrs, Volume= 10.960 af

Routing by Stor-Ind method, Time Span= 0.00-40.00 hrs, dt= 0.10 hrs
Peak Elev= 6.66' @ 10.23 hrs Surf.Area= 0.716 ac Storage= 4.084 af
Plug-Flow detention time= 196.0 min calculated for 10.933 af (84% of inflow)
Center-of-Mass det. time= 109.1 min (882.5 - 773.4)

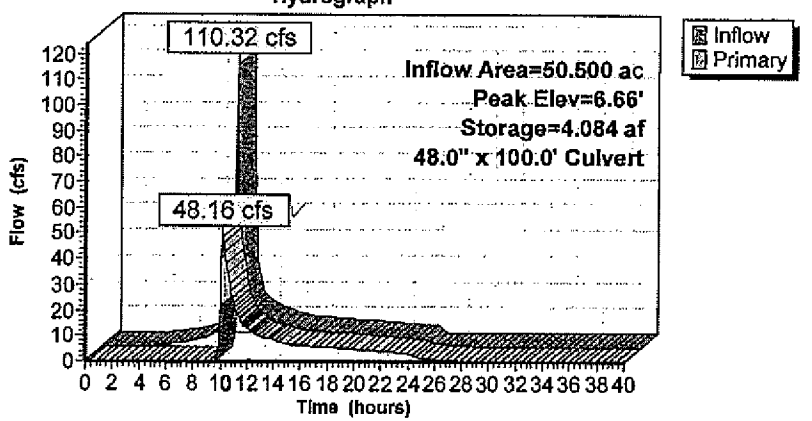
Volume	Invert	Avail.Storage	Storage Description
#1	0.00'	8.665 af	**150.00'W x 150.00'L x 10.00'H Prismatoid Z=2.0**

Device	Routing	Invert	Outlet Devices
#1	Primary	3.60'	**48.0" x 100.0' long Culvert** RCP, square edge headwall, Ke= 0.500
			Outlet Invert= 3.10' S= 0.0050 '/' Cc= 0.900 n= 0.013

Primary OutFlow Max=47.16 cfs @ 10.23 hrs HW=6.62' (Free Discharge)
↳1=Culvert (Barrel Controls 47.16 cfs @ 6.4 fps)

Pond 2P: Detention Pond K9

Hydrograph



AR00028406

Stage-Discharge for Pond 2P: Detention Pond K9

Elevation (feet)	Primary (cfs)	Elevation (feet)	Primary (cfs)
0.00	0.00	5.30	17.67
0.10	0.00	5.40	19.57
0.20	0.00	5.50	21.53
0.30	0.00	5.60	23.57
0.40	0.00	5.70	25.66
0.50	0.00	5.80	27.82
0.60	0.00	5.90	30.03
0.70	0.00	6.00	32.29
0.80	0.00	6.10	34.61
0.90	0.00	6.20	36.97
1.00	0.00	6.30	39.37
1.10	0.00	6.40	41.80
1.20	0.00	6.50	44.27
1.30	0.00	6.60	46.77
1.40	0.00	6.70	49.30
1.50	0.00	6.80	51.85
1.60	0.00	6.90	54.41
1.70	0.00	7.00	56.98
1.80	0.00	7.10	59.57
1.90	0.00	7.20	62.15
2.00	0.00	7.30	64.73
2.10	0.00	7.40	67.29
2.20	0.00	7.50	69.84
2.30	0.00	7.60	72.37
2.40	0.00	7.70	74.87
2.50	0.00	7.80	77.32
2.60	0.00	7.90	79.73
2.70	0.00	8.00	82.08
2.80	0.00	8.10	84.36
2.90	0.00	8.20	86.55
3.00	0.00	8.30	88.65
3.10	0.00	8.40	90.63
3.20	0.00	8.50	92.47
3.30	0.00	8.60	94.13
3.40	0.00	8.70	95.56
3.50	0.00	8.80	96.66
3.60	0.00	8.90	97.17
3.70	0.08	9.00	98.42
3.80	0.26	9.10	100.98
3.90	0.60	9.20	103.47
4.00	1.09	9.30	105.91
4.10	1.72	9.40	108.29
4.20	2.47	9.50	110.62
4.30	3.34	9.60	112.90
4.40	4.33	9.70	115.13
4.50	5.44	9.80	117.33
4.60	6.64	9.90	119.48
4.70	7.95	10.00	121.59
4.80	9.35		
4.90	10.85		
5.00	12.43		
5.10	14.10		
5.20	15.84		

Stage-Area-Storage for Pond 2P: Detention Pond K9

Elevation (feet)	Storage (acre-feet)	Elevation (feet)	Storage (acre-feet)
0.00	0.000	5.30	3.143
0.10	0.052	5.40	3.210
0.20	0.104	5.50	3.278
0.30	0.156	5.60	3.346
0.40	0.209	5.70	3.414
0.50	0.262	5.80	3.483
0.60	0.315	5.90	3.552
0.70	0.368	6.00	3.621
0.80	0.422	6.10	3.691
0.90	0.476	6.20	3.761
1.00	0.530	6.30	3.831
1.10	0.585	6.40	3.902
1.20	0.640	6.50	3.973
1.30	0.695	6.60	4.044
1.40	0.750	6.70	4.116
1.50	0.806	6.80	4.188
1.60	0.862	6.90	4.260
1.70	0.919	7.00	4.333
1.80	0.975	7.10	4.406
1.90	1.032	7.20	4.479
2.00	1.089	7.30	4.552
2.10	1.147	7.40	4.626
2.20	1.204	7.50	4.700
2.30	1.262	7.60	4.775
2.40	1.321	7.70	4.850
2.50	1.379	7.80	4.925
2.60	1.438	7.90	5.001
2.70	1.497	8.00	5.076
2.80	1.557	8.10	5.153
2.90	1.617	8.20	5.229
3.00	1.677	8.30	5.306
3.10	1.737	8.40	5.383
3.20	1.798	8.50	5.461
3.30	1.859	8.60	5.539
3.40	1.920	8.70	5.617
3.50	1.982	8.80	5.696
3.60	2.044	8.90	5.774
3.70	2.106	9.00	5.854
3.80	2.168	9.10	5.933
3.90	2.231	9.20	6.013
4.00	2.294	9.30	6.094
4.10	2.358	9.40	6.174
4.20	2.421	9.50	6.255
4.30	2.485	9.60	6.336
4.40	2.550	9.70	6.418
4.50	2.614	9.80	6.500
4.60	2.679	9.90	6.582
4.70	2.745	10.00	6.665
4.80	2.810		
4.90	2.876		
5.00	2.942		
5.10	3.009		
5.20	3.076		

AR00028407

APPENDIX P

Preliminary Electrical & Communications Master Plan

PRELIMINARY ELECTRICAL AND COMMUNICATIONS MASTER PLAN

FOR

HO'OPILI

EWA, OAHU, HAWAII

Prepared for:

D.R. Horton - Schuler Homes, LLC

Honolulu, Hawaii

Prepared by:

MK Engineers, Ltd.
286 Kalihi Street
Honolulu, Hawaii 96819

February, 2008

PRELIMINARY ELECTRICAL AND COMMUNICATIONS MASTER PLAN
Prepared by MK Engineers, Ltd. for
D.R. Horton – Schuler Homes, LLC
November, 2007

I. INTRODUCTION

D.R. Horton – Schuler Homes, LLC is preparing conceptual plans for the Ho'opili project that will provide residential homes, schools, parks, commercial, and light industrial facilities on about 1,555 acres in an area approximately bounded by the H-1 Freeway to the north, the new North-South Road to the west, Fort Weaver Road to the east, and Ewa Villages Golf Course to the south. This preliminary master plan document provides the results of meetings with the various electrical and communication utilities who have facilities being impacted by the development, what efforts will be required to relocate or remove the existing utilities, and what will be required to provide new electrical and communication services to the development.

II. HAWAIIAN ELECTRIC COMPANY (HECO)

A meeting was held with several HECO representatives on May 3, 2006 (see Attachment A for the meeting minutes). At the meeting and with follow-up correspondence, the following items were determined:

A. Existing Facilities (see Attachment B)

HECO's facilities currently consist of a major transmission steel pole line supporting two 138 kV circuits following the North-South Road alignment to Farrington Highway, then along the mauka side of Farrington Highway with a 12.47 kV circuit below to its Ewa Nui Transmission Substation. From the Ewa Nui Transmission Substation, two 138 kV circuits and a 46 kV circuit on a steel pole line, and a 12.47 kV circuit traverse the property mauka towards the H-1 Freeway on a perpetual easement with no relocation clause. From the Ewa Nui Transmission Substation, a 46 kV circuit on wood poles with 12.47 kV underbuild traverses east along Farrington Highway to the Waipahu Interchange and up Fort Weaver Road to the Kunia Interchange. The 46 kV and 12.47 kV lines also continue down the Old Fort Weaver Road to the intersection with the new Fort Weaver Road. Finally, a 12.47 kV line traverses the property in the makai direction on an easement to the Old Fort Weaver Road that serves the West Loch area as well as some irrigation wells that used to belong to the Oahu Sugar Company. This easement has a relocation clause. HECO also provided all the easement documents and maps for existing HECO facilities that currently encumber the properties within the project boundary.

AR00028409

Each of these easements will need to be researched during the preliminary engineering phase of the project to determine whether the existing facility can remain or must be relocated, and if so, to where, at what cost, at who's expense, and when required.

B. Proposed Substation Sites and 46 kV Subtransmission Lines

Three distribution substations will be required for the development at a minimum. The existing transmission substation is mainly for transmission and subtransmission switching, with expansion plans for only transmission and subtransmission. There is currently one distribution transformer in the transmission substation that serves as a backup to nearby distribution substations, as well as to provide station power for the transmission substation. The requirements for the new distribution substations are as follows:

1. The first new distribution substation will be located on the mauka side of Farrington Highway between the Ewa Nui Transmission Substation and Fort Weaver Road; the second new distribution substation will be located near the main road running through Ho'opili and perpendicular to the North-South Road; and the third new distribution substation will be located between the North-South Road and the Ewa Nui Transmission Substation. See Attachment C for tentative areas that these new distribution substations may be located. Other factors such as proximity to existing 46 kV subtransmission lines, use of open spaces, etc., should be taken into consideration in locating these substation sites.
2. The new substation sites will likely be low profile type and may be square or rectangular with a size of about 20,000 SF. This size lot will be suitable for a four-unit substation. See Attachment D (four sheets) for various substation layouts based on different lot configurations.
3. Substation land will be owned by HECO. HECO does not want the substations located in flood zone areas.
4. Each substation will require the 46 kV feeders to be underground. There will initially be two 46 kV feeders to each substation and one or two transformers, with a third 46 kV feeder required for full build-out of the substation (four transformers).
5. Since there is no ordinance mandating that the 46 kV lines within a subdivision be placed underground, any 46 kV underground lines within the subdivision will need to be paid for by the developer. The developer would be required to install the underground infrastructure at his cost and the developer's share of 46 kV line extension costs will be the difference between the underground cable installation cost and an equivalent overhead line cost.
6. HECO will have two 46 kV lines running overhead on the 138 kV steel poles along the new North-South Road. If substations are placed near North-South Road, the cost of the underground 46 kV line extensions may be minimized.

C. Proposed Distribution Lines

By City ordinance, all new primary and secondary distribution lines within Ho'opili must be placed underground.

1. The distribution system voltage will be 12.47 kV and the distribution system will include primary and secondary cables in a concrete-encased duct system within the streets and sidewalks and with handholes in the sidewalk area, primary padmounted switchgears, and padmounted transformers.
2. Easements will be required for the padmounted switchgears, padmounted transformers, and cables crossing private property to serve other customers.
3. Service tails will be provided at the property line for service to the individual property owners.
4. Each substation will require the 46 kV feeders to be underground. There will initially be two 46 kV feeders to each substation and one or two transformers, with a third 46 kV feeder required for full build-out of the substation (four transformers).

D. Miscellaneous

1. The new North-South Road will be constructed of concrete and any future trenching across the roadway will not be allowed. Accordingly, D.R. Horton – Schuler Homes, LLC is coordinating duct requirements with R.M. Towill along North-South Road.
2. The final alignment of the Honolulu High Capacity Transit Corridor (HHCTC) project has not yet been determined. An Environmental Impact Statement (EIS) will be prepared for the HHCTC project that will address impacts on existing and new electrical and communication facilities within the new Ho'opili project.
3. There is a 30-foot wide Energy Corridor along the mauka side of Farrington Highway that contains a 10-inch Hawaiian Independent Refinery, Inc. fuel oil pipeline and a 16-inch Gas Company gas pipeline. This Energy Corridor is currently under the jurisdiction of the State Department of Transportation (Harbors Division). Any utility lines crossing this Energy Corridor will require a permit from the Harbors Division and construction plans must satisfy the requirements of the Harbors Division and of its tenants.

III. HAWAIIAN TELCOM (HTCOM)

A meeting was held with several HTCOM representatives on April 25, 2006 (see Attachment E for the meeting minutes). At the meeting and with follow-up correspondence, the following items were determined:

A. Existing Facilities (see Attachment B)

AR00028410

HTCOM's facilities currently consist of a several major telephone cables on overhead wooden poles along Farrington Highway, Old Fort Weaver Road, and Kunia Road.

B. Proposed HTCOM Lines

1. One source of telephone service may be from Kapolei.
2. North-South Road design is underway and there are 6-way ducts on the mauka side and 8-way ducts on the makai side of the North-South Road. Service to Ho'opili could be routed along the North-South Road. Coordination should be done with Ron Ho and Associates, the electrical design consultant for the North-South Road.
3. HTCOM has not been contacted about the UH West Oahu Campus. They would like to know what the timing of that project is.
4. The size of the Ho'opili project suggests that multiple hubs may be required for telephone service. HTCOM would prefer to have a lot near the center of area served for the hub.
5. The telephone distribution system from the hubs will include copper or fiber optic cables in a concrete-encased duct system within the streets and sidewalks and with handholes in the sidewalk area.
6. Easements will be required for the cables crossing private property to serve other customers.
7. Service tails will be provided at the property line for service to the individual property owners.
8. HTCOM requested the electronic file of the subdivision plan so that they can begin planning and engineering.

IV. OCEANIC TIME WARNER CABLE (TW)

The following items were determined:

A. Existing Facilities (see Attachment B)

TW's facilities currently consist of fiber optic cables on overhead wooden poles along Farrington Highway, Old Fort Weaver Road, and Kunia Road.

B. Proposed TW Lines

1. The project will need to provide 6'x6' easements for TW's cable television (CATV) Power Supply Pedestal Equipment cabinets adjacent to HECO's padmounted switchgear (see Attachment F).
2. The CATV distribution system will include fiber optic cables in a concrete-encased duct system within the streets and sidewalks and with handholes in the

sidewalk area.
3. Easements will be required for the power supply cabinets and for cables crossing private property to serve other customers.
4. Service tails will be provided at the property line for service to the individual property owners.

V. OTHER COMMUNICATION FACILITIES

There may be other private or governmental communication facilities within the Ho'opili project such as Pacific LightNet, Inc., Sandwich Isles Communication, Inc, and Army Signal Corps. These entities will need to be contacted as part of the infrastructure design phase of the project to coordinate any relocation of existing facilities.

AR00028411

Attachment A

HECO Conference Memo

MK Engineers, Ltd.

Consulting Electrical Engineers
286 Kalihi St. $ Honolulu, Hawaii 96819
Telephone # (808) 848-8622 $ Fax # (808) 848-5574
e-mail address: ron@mkhawaii.com

CONFERENCE MEMORANDUM

Project:	Ho'opili Development (East Kapolei) for D. R. Horton, Schuler Division
Project No.:	06040
Location:	HECO Ward Avenue Conf Rm 300
Date of Conf:	5-3-06
Prepared By:	Ron Katahara
Attenders:	See attendance sheet

Items of Discussion

1. See Agenda. Mr. Hirakami described the project and displayed phasing drawings.
2. Discussion:
   a. The new development will have all-electric residential units (SF and MF), schools, medical facilities, commercial and light industrial facilities, and parks. Overall project development is expected to span 25 to 30 years. Developer needs to seek land rezoning and permitting from both the State and City governments. Construction of the first phase is expected to start within 4 to 5 years, with first home projected to be sold in 2012. The second, third and fourth phases of the project will be approximately 5 years each thereafter. A spreadsheet showing tentative zoning calculations of acreage and number of units within each Land Use Ordinance zone was provided.
   b. There are several other design projects that may impact this project.
      i. North South Road designs are underway. Ron Ho & Associates is doing the electrical design for the State DOT.
      ii. The UH West Oahu Campus will be on the western boundary of this project. HECO is working with the consultant on the location of a new substation to serve this development.
      iii. The Dept. of Hawaiian Home Lands is developing a parcel of land just below the UH West Oahu Campus. HECO is in contact with the DHHL, but haven't received definite plans to date.
      iv. The City's High-Capacity Transit project has two alternative routes that may impact this project: one along the North-South Road and Farrington Highway; and the other along Fort Weaver Road. MKE previously met with HECO engineers on the City's transit project and requested information on HECO's facilities along each of the alternative routes.
      v. The State DOT is widening Fort Weaver Road from about the Waipahu Interchange down to Geiger Road. MKE previously informed HECO on the DOT's project and requested information on HECO's existing facilities.
   c. There is an existing energy corridor along the mauka side of Farrington Highway.
   d. HECO's facilities currently consist of a major transmission steel pole line supporting two 138 kV circuits following the North-South Road alignment to Farrington Highway, then along the

AR00028412

mauka side of Farrington Highway to its Ewa Nui Transmission Snbstation. From the Ewa Nui Transmission Substation, two 138 kV circuits and a 46 kV circuit on a steel pole line traverses the property mauka towards the H-1 Freeway on an perpetual easement with no relocation clause. From the Ewa Nui Transmission Substation, a 46 kV circuit on wood poles with 12 kV underbuild traverses east along Farrington Highway to the Waipahu Interchange and up Kunia Road to the Kunia Interchange. The 46 kV and 12 kV lines also continue down the Old Fort Weaver Road to the intersection with the new Fort Weaver Road. Finally, a 12 kV line traverses the property in the makai direction on an easement to the Old Fort Weaver Road that serves the West Loch area as well as some irrigation wells that used to belong to the Oahu Sugar Company. This easement may have a relocation clause.

e. Two distribution substations will probably be required for the development as a minimum. The existing transmission substation is mainly for transmission and subtransmission switching, with expansion plans for only transmission and subtransmission. There is currently one distribution transformer in the transmission substation that serves as a backup to nearby distribution substations as well as to provide station power for the transmission substation.
    i. The new substation sites may be square or rectangular with size of about 20,000 SF. This size lot will be suitable for a four-unit substation.
    ii. Substation land will be owned by HECO. HECO does not want the substations located in flood zone areas.
    iii. The substation will likely be low profile type and will require 46 kV in-feed to be underground. There will initially be two 46 kV feeders to each substation and one or two transformers, with a third 46 kV feeder required for full build-out of the substation (four transformers).
    iv. Since there is no ordinance mandating that the 46 kV lines within a subdivision be placed underground, any 46 kV underground lines within the subdivision will need to be paid for by the developer. The developer would be required to install the underground infrastructure at his cost and the developer's share of 46 kV line extension costs will be the difference between the underground cable installation cost and an equivalent overhead line cost.
    v. HECO will have two 46 kV lines running overhead on the 138 kV steel poles along the new North-South Road. If substations are placed near North-South Road, the cost of the underground 46 kV line extensions may be minimized.
f. The distribution system voltage will be 12 kV and will be all underground.
g. The new North-South Road will be constructed of concrete and any future trenching across the roadway will not be allowed. Accordingly, HECO suggested that MKE contact D.R. Horton and ask them to see if the State would be willing to provide North-South Road duct crossings for HECO at the West Oahu UH main roadway that will extend into the Phase 1B portion of the Ho'opili Town Development. This will provide some flexibility in the event that the new substation in the UH West Oahu Campus might have some spare capacity to initially serve Phase 1B.
h. It is uncertain whether the High Capacity Transit project or the new Ho'opili Town Development project will provide for the widening of Farrington Highway. It is currently a two-lane highway, but there is room for widening on the makai side. Distribution duct requirements will need to be coordinated with whichever project initiates the widening of Farrington Highway.

3. MKE will provide a load estimate based on the planned uses of the land. This information will be used by HECO to determine the number of substations required for the development and their suggested locations.
4. ACTION ITEMS:
    a. HECO will request that MKE sign a waiver and hold harmless agreement form for copies of HECO documents (easement maps and documents, transmission and distribution line maps, and preliminary substation layout plans).
    b. Upon receipt of signed waiver and hold harmless agreement form, HECO will provide the requested documents.
    c. MKE will provide estimated loads for each of the planned zoning parcels so that the total number of substations and potential substation sites can be determined.
    d. Upon receipt of the estimated loads, HECO will provide the number of substations required to serve the development and potential substation sites within the development.

END

AR00028413

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Consulting Electrical Engineers
286 Kalihi St. • Honolulu, Hawaii 96819
Telephone # (808) 848-8622 • Fax # (808) 848-5574
e-mail address: info@mkhawaii.com

ATTENDANCE SHEET

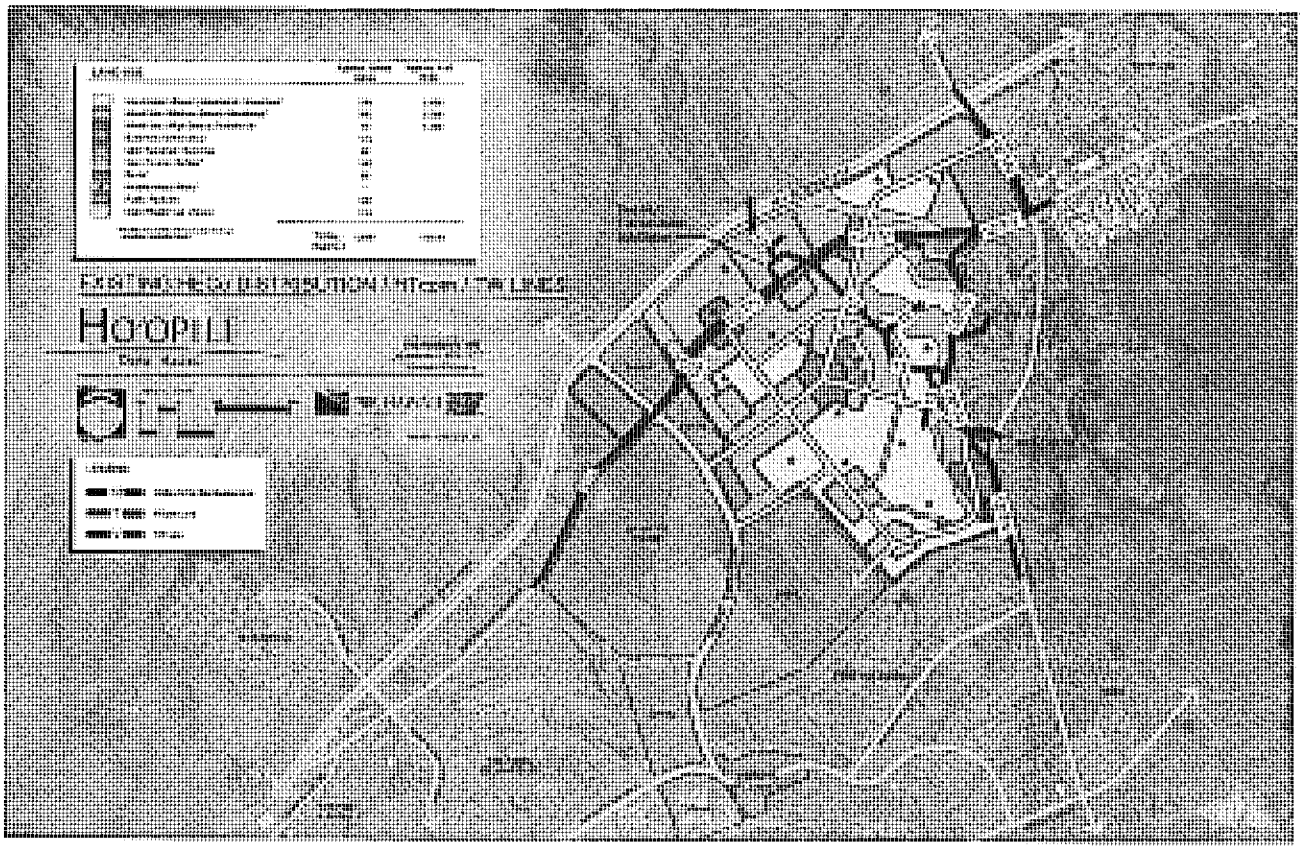
PROJECT: Ho'opili Town Development
DATE: 5/3/06
LOCATION OF CONFERENCE: HECO conf rm 300

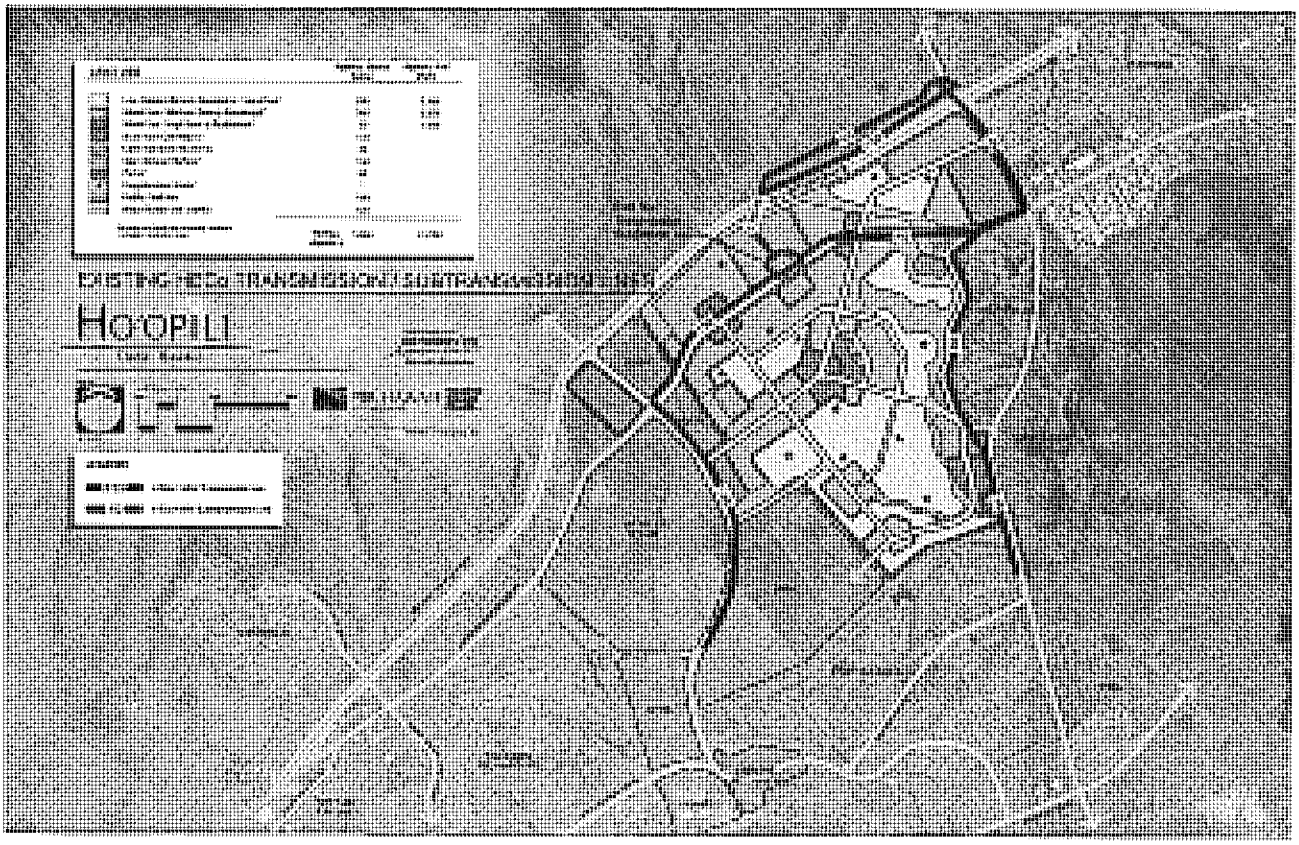
NAME	COMPANY/ACTIVITY	PHONE/FAX/E-MAIL
Francis Hirakami	MK Engineers, Ltd.	(808)848-8622/(808) 848-5574 francis@mkhawaii.com
Ron Katahara	"	Ron @ mkhawaii.com
Phil Hauret	HECO	543-4735/4726 phil.hauret@heco.com
Ruby Shimabukuro	"	543-4617 Ruby.Shimabukuro@heco.com
Jimmy Lum	✓	543-7553 jimmy.lum@heco.com
Susan Chow	HECO	543-7766 susan.chow@heco.com
Rudy Tamayo	HECO	543-7999 rudy.tamayo@heco.com
Nathan Liang	HECO	543-7970 NATHAN.LIANG@HECO.COM
Paul Nakagawa	HECO	543-7002 paul.nakagawa@heco.com

Attachment B

Maps of Existing Utility Lines

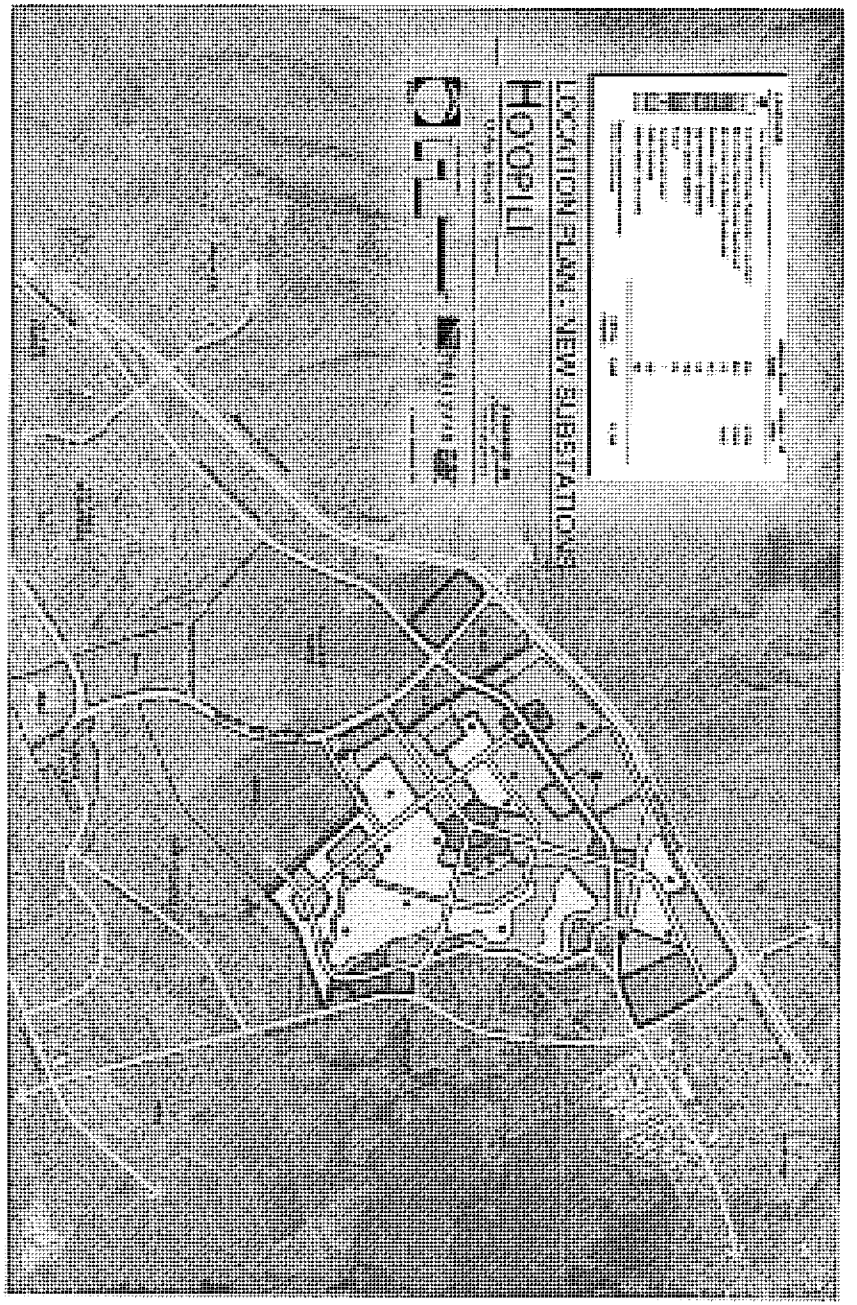
AR00028414


HOOPILI


HOOPILI

Attachment C

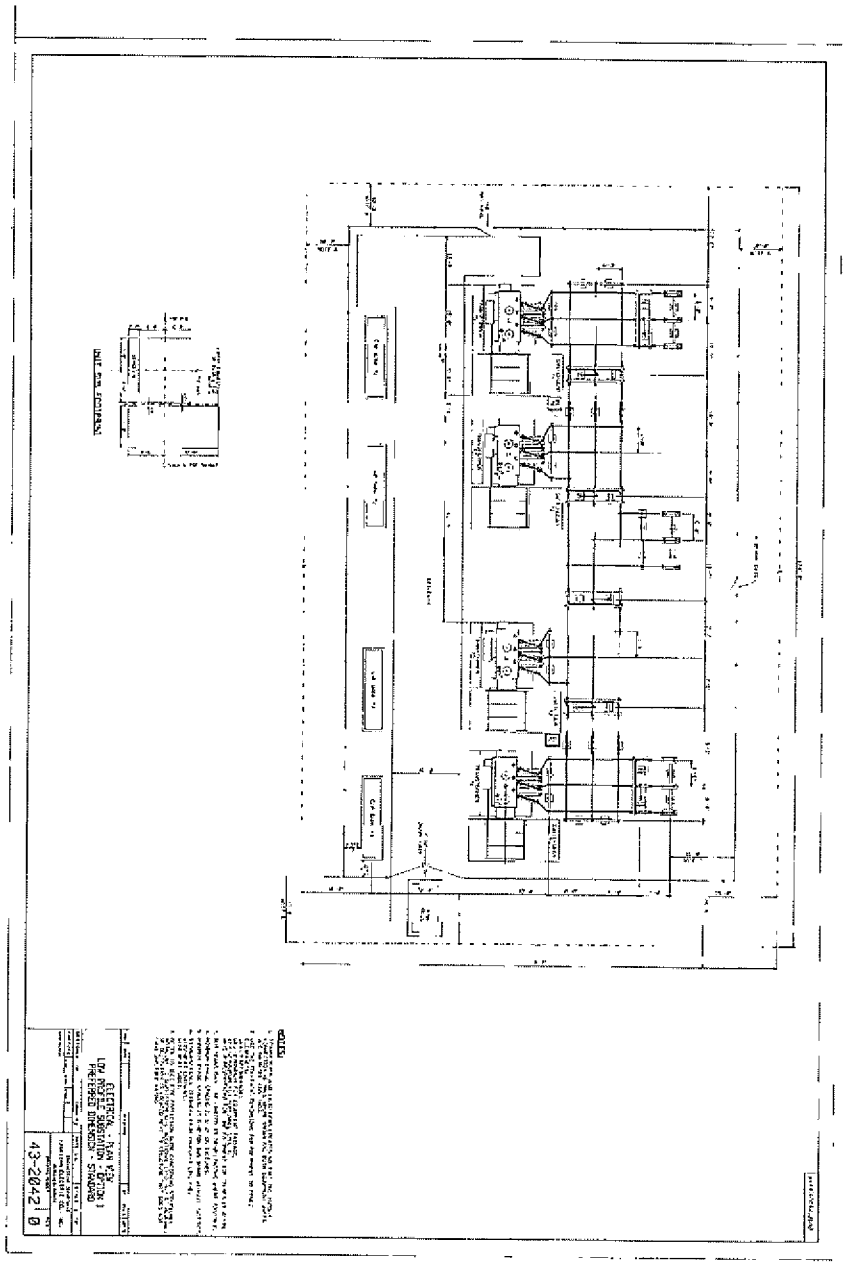
New Distribution Substation Sites



AR00028416

Attachment D

Distribution Substation Layouts



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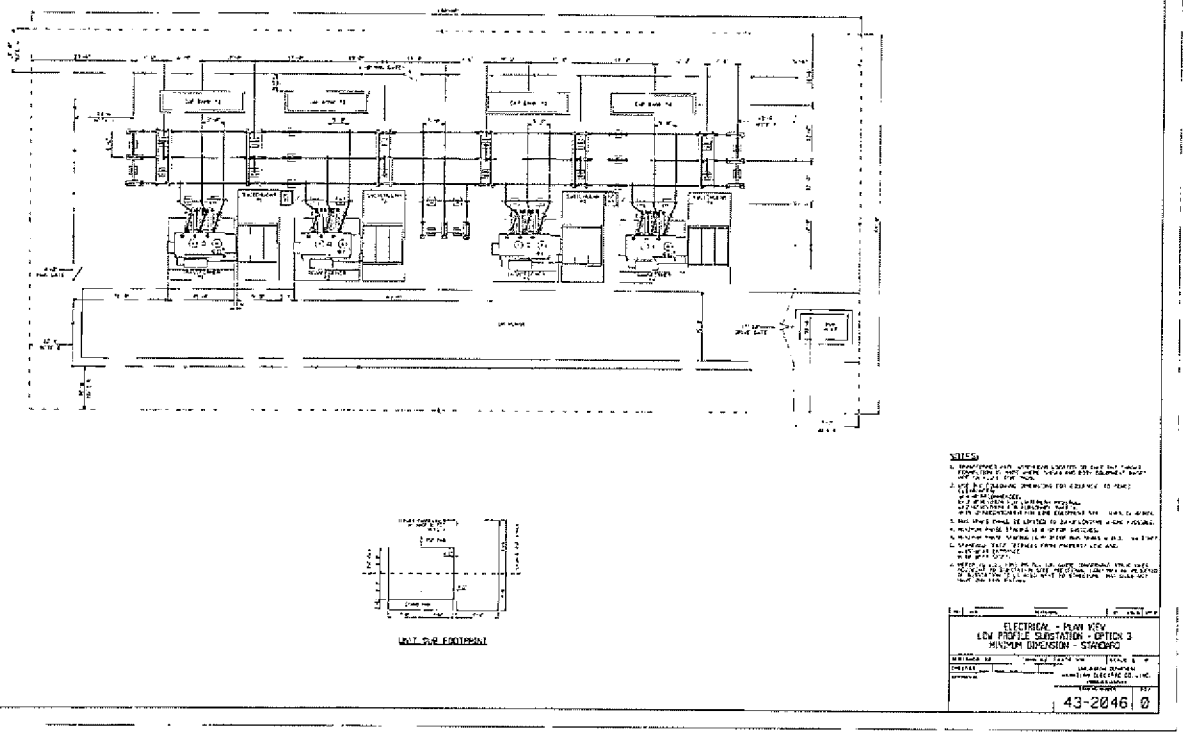
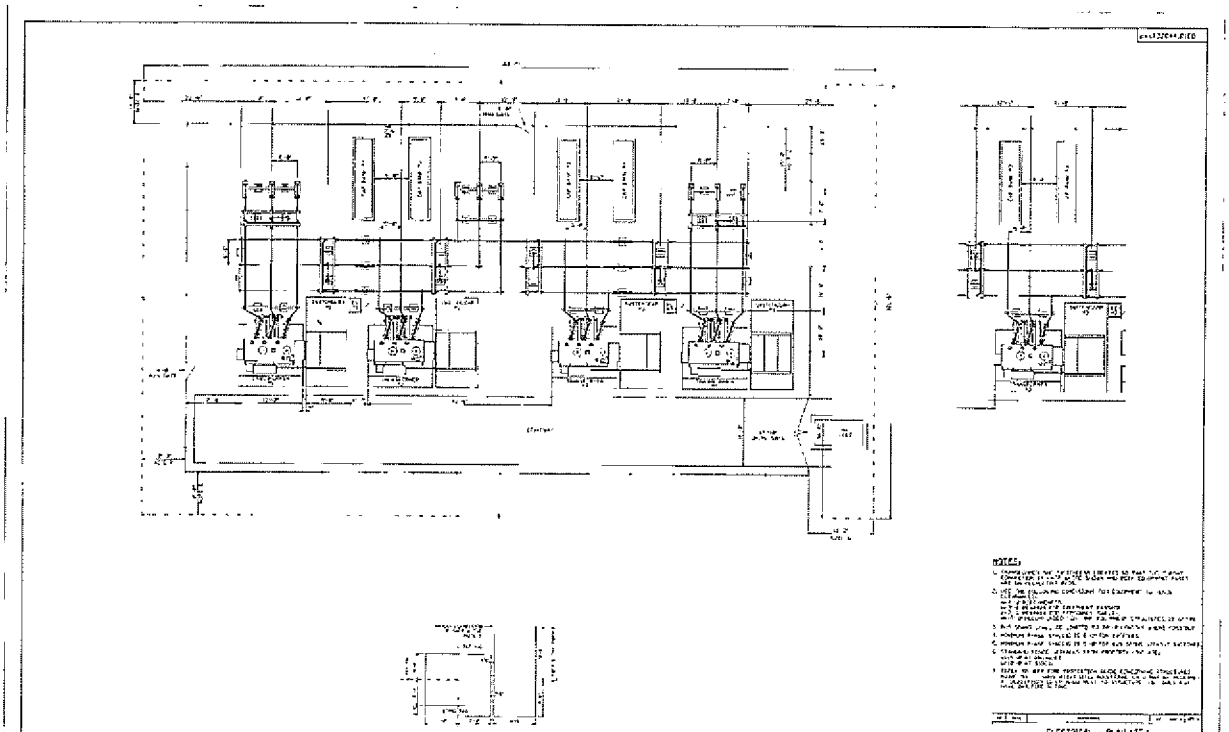


UNIT SUB FOOTPRINT

ELECTRICAL - PLAN VIEW
LOW PROFILE SUBSTATION - OPTION 3
MINIMUM DIMENSION - STANDARD

43-2046 | 0



UNIT SUB FOOTPRINT

ELECTRICAL - PLAN VIEW
LOW PROFILE SUBSTATION - OPTION 2
MINIMUM DIMENSION - STANDARD

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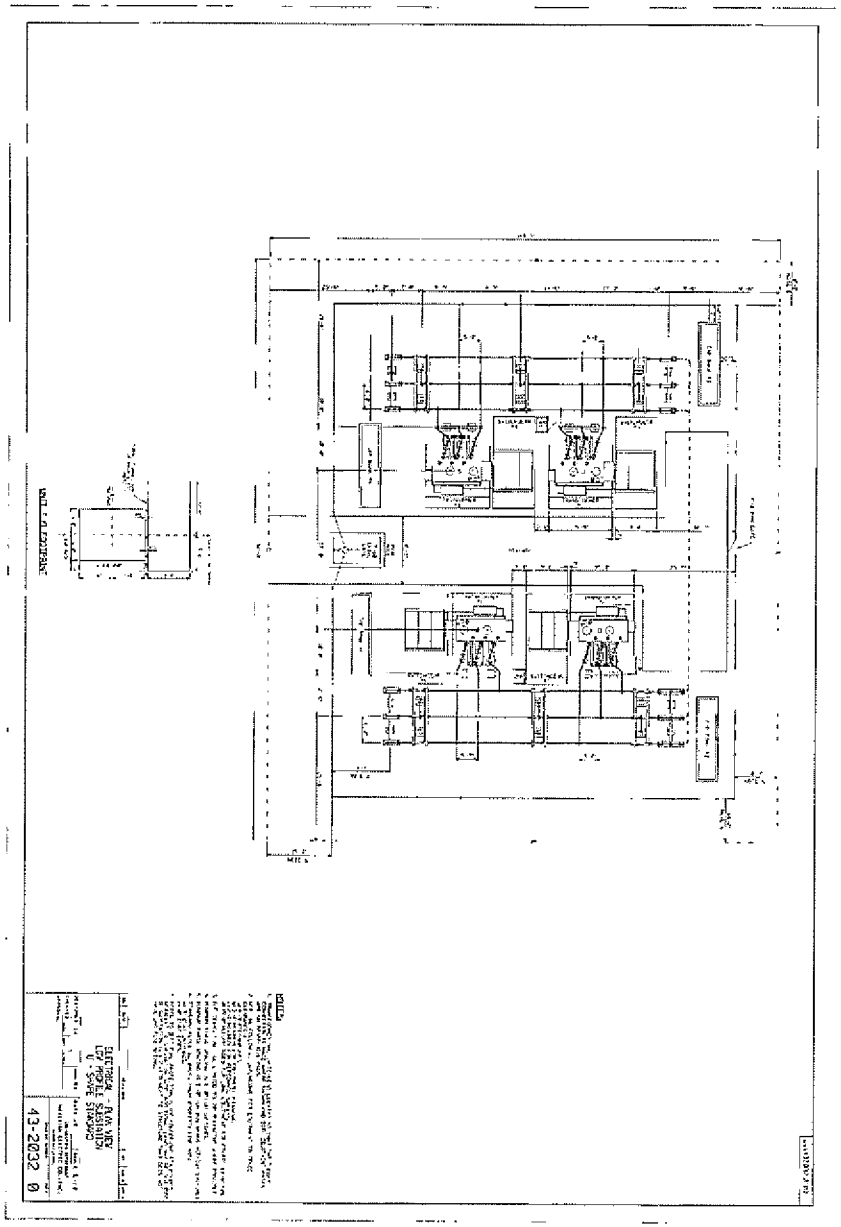
AR00028418



Attachment E

HTCOM
Conference Memo

AR00028419

MK Engineers, Ltd.

Consulting Electrical Engineers
286 Kalihi St. $ Honolulu, Hawaii 96819
Telephone # (808) 848-8622 $ Fax # (808) 848-5574
e-mail address: ron@mkhawaii.com

CONFERENCE MEMORANDUM

Project: Ho'opili Development, East Kapolei – D. R. Horton Schuler Division
Project No.: 06040
Location: Hawaiian Telcom Airport Baseyard
Date: 4-25-06
Prepared By: Ron Katahara
Attenders: Messrs. Les Loo, Gary Sumida, Paul Hanohano, Cliff Onguay, Clay Tang, Kevin Choan of HT and Ron Katahara of MKE

Items of Discussion

1. Katahara gave a brief overview of the project with reference to the overall colored map sent earlier with the letter to HT:
   a. 16000 single family homes
   b. Retail, commercial, industrial, schools
   c. HECO switching station/substation will stay in same location
   d. First home will be finished in 2012
   e. Development will span about 25 years and include 5 phases, each about 5 years in length
   f. Some data is available on the map – i.e.

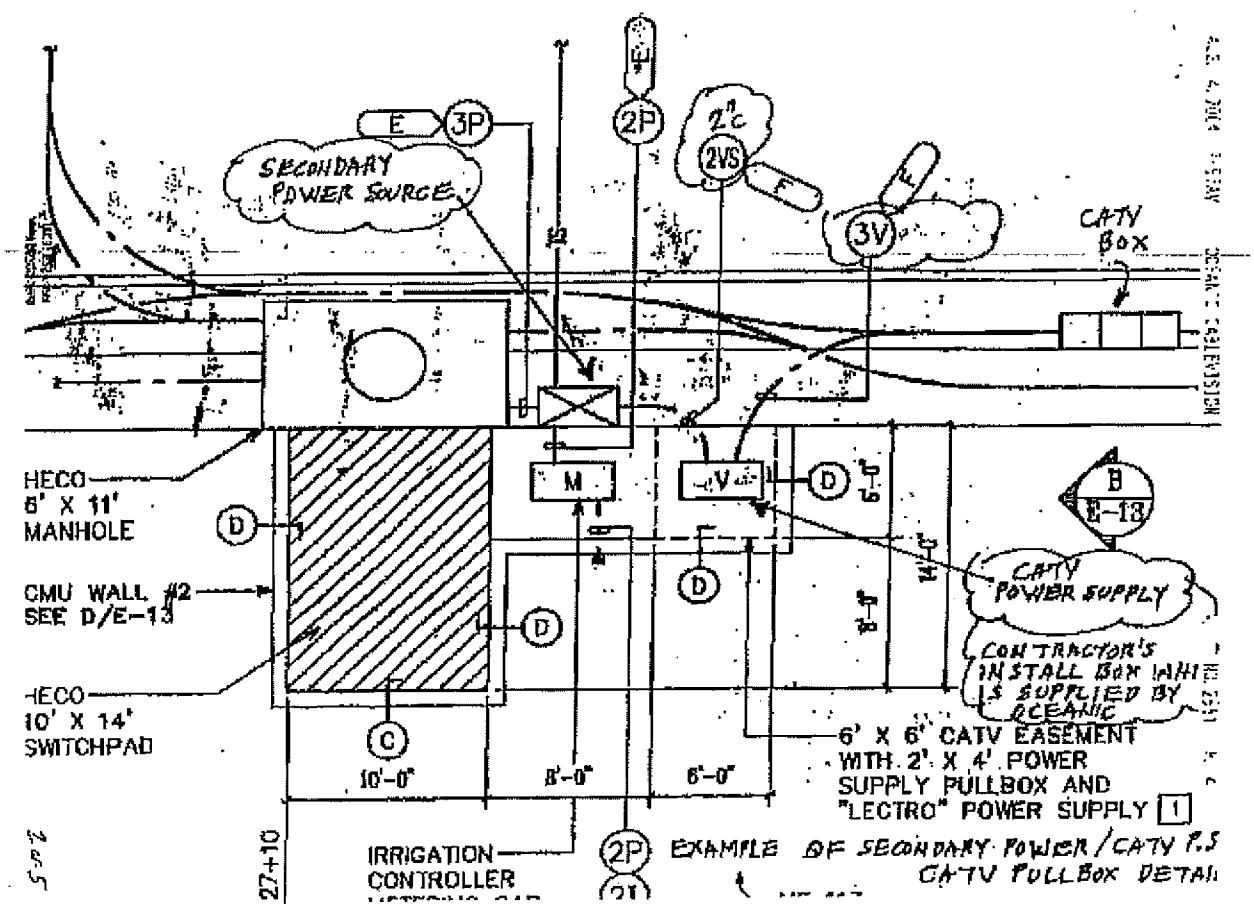
2. Katahara requested information on existing easements and facilities in the area, where HT will bring service from and what their infrastructure requirements will be. The telephone systems engineers will study the project and make recommendations. Katahara requested desired location of facilities (hnbs) and size of lot be provide while in this preliminary planning stage.
3. HT comments:
   a. Once source of service may be from Kapolei
   b. North South Road design is underway and there are 6 way ducts on the mauka side and 8 way ducts on the makai side. Service to Ho'opili might be from NS road. Ron Ho and Associates is doing the design of NS Road (Gary Funasaki).
   c. HT has not been contacted about the West Oahu Campus. They would like to know what the timing of that project is.
   d. The size of the Ho'opili development suggests that multiple hubs may be required for telephone service. Desire would be to have a lot near the center of area served for the hub.
   e. HT requested the electronic file of the subdivision plan so that they can begin planning and engineering.

END

Attachment F

CATV Power Supply Layout

AR00028420


E
3P
SECONDARY POWER SOURCE
2P
2"c
2VS
3V
CATV BOX
HECO 6' X 11' MANHOLE
CMU WALL #2 SEE D/E-13
HECO 10' X 14' SWITCHPAD
M
V
D
B
E-13
CATV POWER SUPPLY
CONTRACTOR'S INSTALL BOX WHI IS SUPPLIED BY OCEANIC
6' X 6' CATV EASEMENT WITH 2' X 4' POWER SUPPLY PULLBOX AND "LECTRO" POWER SUPPLY 1
10'-0"
8'-0"
6'-0"
IRRIGATION CONTROLLER
27+10
EXAMPLE OF SECONDARY POWER / CATV P.S
CATV PULLBOX DETAI

APPENDIX Q

Draft Project Master Plan

HO'OPILI

Draft Master Plan

February, 2008

Prepared by

PBR HAWAII
& ASSOCIATES INC.

CITY AND COUNTY OF HONOLULU
DEPARTMENT OF PLANNING AND PERMITTING'S
PROJECT MASTER PLAN
DETAILED REQUIREMENTS

The proposed Ho'opili project is located in the 'Ewa District and will require a zone change. According to the City and County of Honolulu, Department of Planning and Permitting (DPP) criteria, the proposed Ho'opili project would be considered a "significant" zone change. According to DPP, a Project Master Plan must be included as part of the Environmental Assessment (EA) or Environmental Impact Statement (EIS) for significant zone changes which are larger than a specified project size (any significant zone change involving 25 acres or more of land).

According to DPP, "the Project Master Plan is intended solely as a guide to help describe in words and illustrations how a project promotes the vision, policies, principles and guidelines for the Development Plan (DP) or Sustainable Communities Plan (SCP) area...The Project Master Plan should be based on the best information available to the applicant at the time the Environmental Assessment or Environmental Impact Statement is submitted [emphasis added]..."

The following is a Draft Master Plan for the proposed Ho'opili project, which will be finalized when resubmitted with the zone change application.

AR00028423

LIST OF FIGURES

Figure		Follows Page
1	Parcels Map	1
2	Natural Resources Conservation Services Soil Survey Map	2
3	Land Study Bureau Land Classification	3
4	Agricultural Lands of Importance to the State of Hawaii	3
5	Drainage Basins	5
6	Conceptual Land Use Plan	12
7	Proposed Circulation Plan	17

HO'OPILI
DRAFT MASTER PLAN
FEBRUARY 2008

(i) Statement of Consistency with the Development Plan or Sustainable Communities Plan

The Ho'opili Master Plan will be consistent with the vision, policies, and guidelines stated in the *Ewa Development Plan* (Ewa DP), as described in *Section 5.3.2 Ewa Development Plan* of the EIS.

(ii) Site Analysis

The following is a description of prominent site features and their relationship to the proposed development of the property.

Topography. The approximately 1,600.265-acre Project Area consists of 10 distinct parcels of land (5ee Figure 1: Parcels Map). Parcels A, B, C, D1, D2 and G are situated makai of the H-1 Freeway while Parcels E1, E2, E3, and F are situated mauka of the H-1 Freeway. The topography of each of the 10 parcels is described below.

The topography of Parcel A ranges from approximately 150 feet above mean sea level (MSL) at Farrington Highway to approximately 210 feet MSL at the H-1 Freeway. The slope of Parcel A is 3 percent.

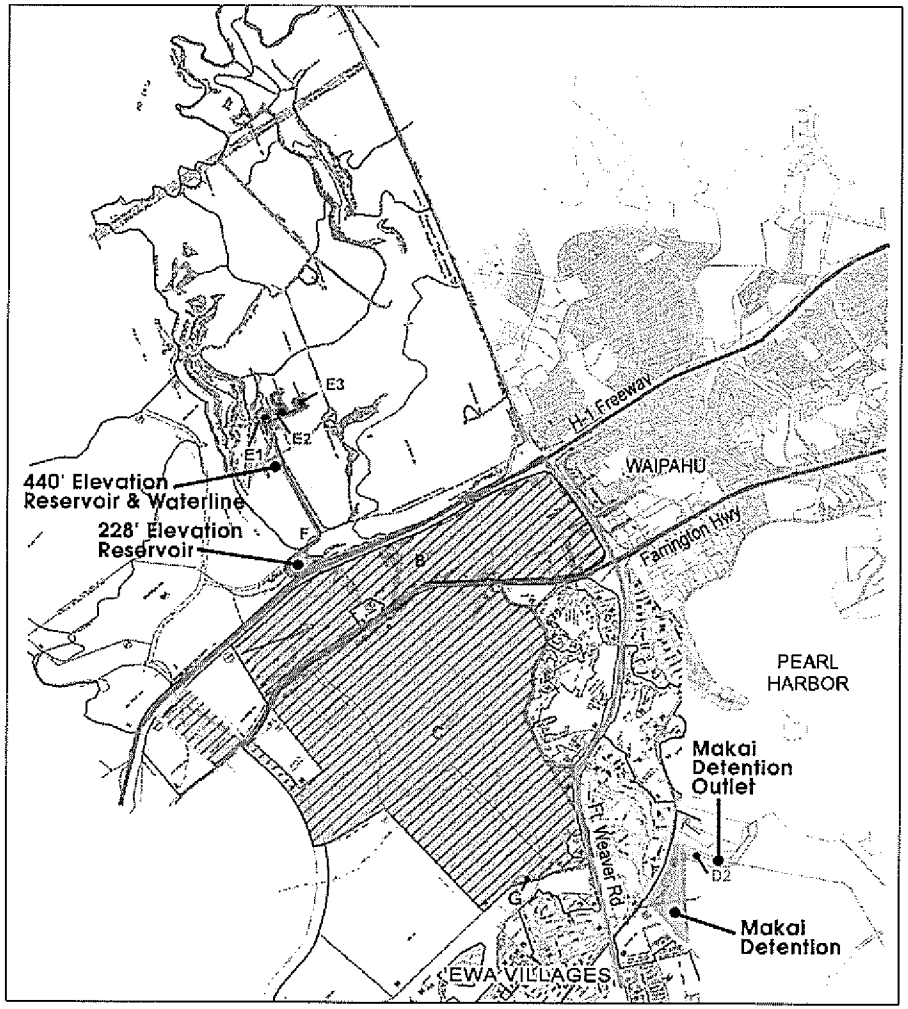
The topography of Parcel B ranges from approximately 170 feet MSL at the southwestern boundary (at Farrington Highway) to approximately 205 feet MSL at its northwestern boundary (at the H-1 Freeway). The topography of Parcel B at the southeastern boundary (at Farrington Highway) is approximately 75 feet MSL and approximately 175 feet MSL at the northeastern boundary (at the H-1 Freeway). The slope of Parcel B is between 1.9 percent and 3.2 percent.

The topography of Parcel C ranges from approximately 65 feet MSL at its southern boundary to approximately 175 feet MSL at Farrington Highway. The slope of Parcel C is 1.4 percent. A ravine and steep, east-facing slope are located on the eastern boundary of the Parcel C, along Old Fort Weaver Road.

The topography of Parcel D1 ranges from approximately 10 feet MSL at its northern boundary to approximately 40 feet MSL at its northern boundary. The central portion of Parcel D1 is 25 feet MSL. The slope of Parcel D1 is 1.2 percent. Parcel D2 ranges from 0 feet at its northern boundary to 35 feet MSL at its southern boundary with a slope of 1.1 percent.

The topography of Parcels E1, E2 and E3 ranges from approximately 410 feet MSL at their southern boundaries to 415, 430 and 415, respectively at their northern

AR00028424



LEGEND

Petition Area

- Parcel A: 52.289 Acres
- Parcel B: 447.592 Acres
- Parcel C: 1,053.983 Acres

Non-petition Area

- Parcel D1: 30.825 Acres
- Parcel D2: 4.5 Acres*
- Parcel E1: .635 Acres
- Parcel E2: 1.48 Acres*
- Parcel E3: .359 Acres
- Parcel F: 7.311 Acres
- Parcel G: 1.301 Acres

* Approx Acres

Source: Tax Maps Zone 9, Sec. 1, Plats 10, 15,17 & 18 and Zone 9, Sec. 2, Plats 1 and 2
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 1: Parcels Map

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

boundaries. The slope of parcel E1 is 2.8 percent, the slope of E2 is 3.5 percent, and the slope of E3 is 3.9 percent.

The topography of Parcel F runs with an east-west slope with an elevation of 240 feet MSL on the western boundary and an elevation of 205 on the eastern edge. The center of the parcel is at an elevation of 220 feet. Parcel F has a slope of 3.49 percent on the east-west axis.

Parcel G is very small and located along the makai edge of Parcel C, bordering the 'Ewa Villages Golf Course. The slope of Parcel G is approximately 1.4 percent.

The entire Project Area has been historically utilized for sugarcane cultivation and large portions are currently utilized for agricultural production. As such, the Project Area has been extensively modified with dirt roadways, various irrigation systems, and other appurtenant agricultural structures.

The topography of the Project Area is mostly gently sloping (and highly accessible) and provides adequate slope for drainage. The Project Area will be modified with infrastructure improvements and urban structures for residential, commercial, industrial, recreational and educational uses. The Project Area will include drainage detention basins, open space buffers, parks and some undeveloped areas. Most of the developed areas will be extensively landscaped, which will minimize the potential for soil erosion.

Soils. Three soil suitability studies have been prepared for lands in Hawai'i. The principal focus of these studies is to describe the physical attributes and relative productivity of different land types for agricultural production within the State of Hawai'i. The three studies are the U.S. Department of Agriculture (USDA) *Natural Resources Conservation Service Soil Survey*, the University of Hawai'i Land Study Bureau *Detailed Land Classification*, and the State of Hawai'i, Department of Agriculture's *Agricultural Lands of Importance to the State of Hawaii* (ALISH).

Natural Resources Conservation Service Soil Survey. The U.S. Department of Agriculture Natural Resources Conservation Service identified sixteen general soil types within the property (See Figure 2: Natural Resources Conservation Services Soil Survey Map). The soil types include:

- 'Ewa Silty Clay Loam, 3 to 6 percent slopes (EaB);
- Honouliuli Clay, 0 to 2 percent slopes (HxA);
- Honouliuli Clay, 2 to 6 percent slopes (HxB);
- Kaloko Clay, Noncalcareous Variant (Kfa);
- Kawaihāpai Clay Loam, 0 to 2 percent slopes (KlB);

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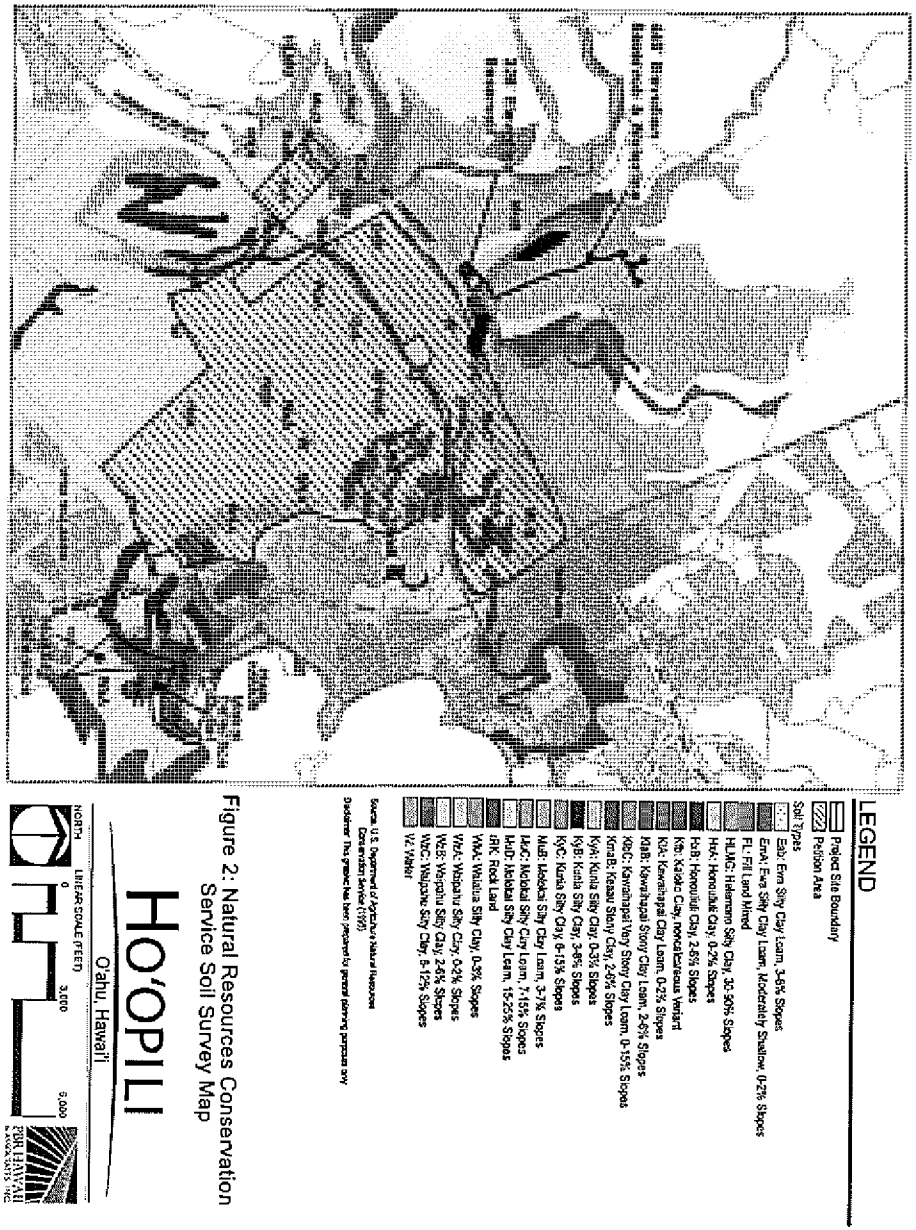

Figure 2: Natural Resources Conservation Service Soil Survey Map

HO'OPILI

O'ahu, Hawai'i

- Kolekole Silty Clay Loam, 6 to 12 percent slopes (KuC);
- Kolekole Silty Clay Loam, 12 to 25 percent slopes (KuD);
- Kunia Silty Clay, 0 to 3 percent slopes (KyA);
- Kunia Silty Clay, 3 to 8 percent slopes (KyB);
- Kunia Silty Clay, 8 to 15 percent slopes (KyC);
- Moloka'i Silty Clay Loam, 3 to 7 percent slopes (MuB);
- Moloka'i Silty Clay Loam, 7 to 15 percent slopes (MuC);
- Waialua Silty Clay, 0 to 3 percent slopes (WkA);
- Waipahu Silty Clay, 0 to 2 percent slopes (WzA);
- Waipahu Silty Clay, 2 to 6 percent slopes (WzB); and
- Wahiawā Silty Clay Loam, 0 to 3 percent slopes (WaA).

Land Study Bureau Detailed Land Classification. The *Detailed Land Classification* (1965 through 1972) series was produced for each island by the Land Study Bureau (LSB) of the University of Hawai'i. The intent of this series of reports was to develop a land inventory and productivity evaluation based on statewide standards of crop yields and levels of management.

A five-class productivity rating is applied using the letters A, B, C, D and E, with A representing the class of highest productivity and E the lowest. Most of the soils within the Project Area are rated B (See Figure 3: Land Study Bureau Land Classification). Other soils are rated A, with fewer soils rated C, D and E. These soil ratings reflect the Project Area's past and present use for agricultural production under irrigated conditions.

Agricultural Lands of Importance to the State of Hawaii. *The Agricultural Lands of Importance to the State of Hawaii* (ALISH) (1977) system classifies lands that are important to agriculture in Hawai'i as Prime, Unique, or Other Agricultural Land, with Prime Agricultural Land representing the class of greatest importance and Other Agricultural Land the least. Most of the Project Area includes soils identified as Prime Agricultural Land, which is defined as "land best suited for the production of food, feed, forage, and fiber crops." The remaining lands are identified as Other Agricultural Land (which is important to agriculture in Hawai'i but exhibits properties that exclude it from the Prime or Unique Agricultural Land classifications) or are not classified by the ALISH system (See Figure 4: Agricultural Lands of Importance to the State of Hawaii).

While the Project Area contains soil with good agricultural productivity, State and County land use policy has directed growth towards 'Ewa, makai of the H-1 Freeway.

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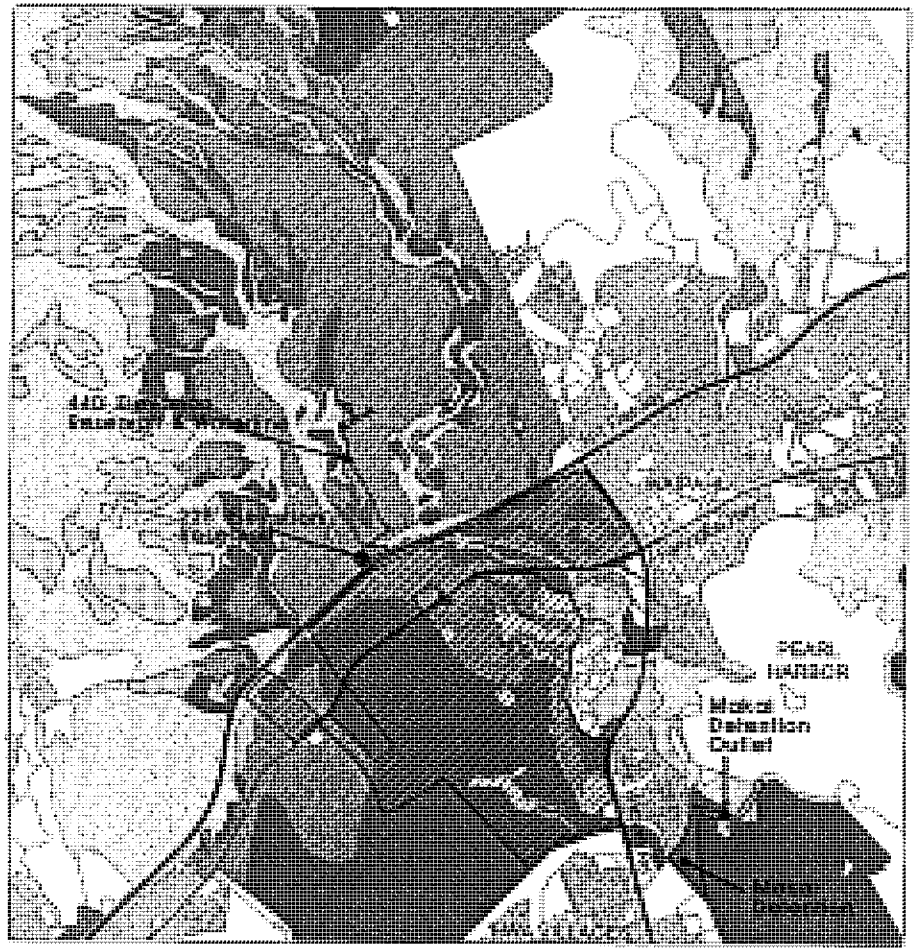

LEGEND

- Project Site Boundary
- Petition Area

Soil Classification

- A (Excellent)
- B (Good)
- C (Fair)
- D (Poor)
- E (Very Poor)
- Not Classified

Source: Land Study Bureau (1967)
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 3: Land Study Bureau Land Classification

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,500 7,000

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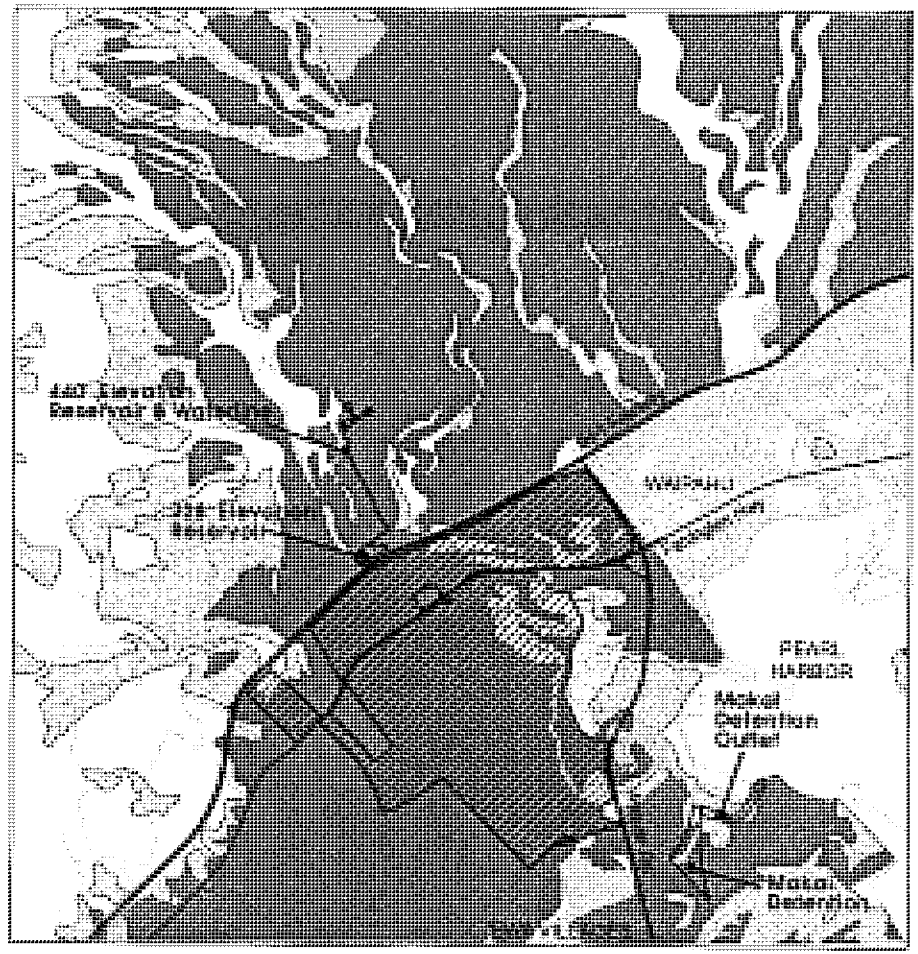

LEGEND

- Project Site Boundary
- Petition Area
- Prime Agricultural Lands
- Unique Agricultural Lands
- Other Agricultural Lands
- Unclassified Agricultural Lands

Source: State Dept. of Agriculture (1977).
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 4: Agricultural Lands of Importance to the State of Hawaii (ALISH)

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,500 7,000

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Drainage. The Project Area is within three distinct drainage basins. These are the Kalo'i drainage basin, the Honouliuli Stream drainage basin and the West Loch drainage basin.

Kalo'i Drainage Basin. The Kalo'i Basin stretches to the top of the eastern slopes of the Wai'anae mountain range and terminates near the ocean in the vicinity of Haseko's Ocean Pointe development. The drainage basin mauka of the H-1 Freeway is 3,000 acres and generates a peak flow of 5,000 cubic feet per second (CFS). The drainage basin size increases to 4,330 acres and carries a peak flow of 8,900 CFS at the entrance to 'Ewa Villages. Approximately 100 acres of the Ho'opili project are within this watershed.

With respect to the portion of the project within the Kalo'i drainage basin, the project will be creating on-site detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed pre-development conditions. The project will also be providing storage and detention to meet the City and County of Honolulu Drainage Standards with respect to water quality standards. The basin size could be decreased at some time in the future when the terminus of Kalo'i basin is finalized. All developed projects discharging to the Kalo'i basin currently have discharge restrictions and these restrictions will continue until the Kalo'i basin terminus is finalized. The portions of the project within the Kalo'i drainage basin are Parcels A and the western most part of Parcel C adjacent to the North-South Roadway alignment. The D.R. Horton - Schuler Division will continue to coordinate with County and State agencies to discuss issues within the Kalo'i Gulch Watershed.

Honouliuli Stream Drainage Basin. The Honouliuli Stream drainage basin also stretches to the top of the eastern slopes of the Wai'anae mountain range. This basin contains 6,600 acres (11,200 CFS – peak flow) of drainage area mauka of the H-1 Freeway and expands to 7,880 acres (12,300 CFS – peak flow) at its connection with the West Loch of Pearl Harbor. The terminus location is in the vicinity of the West Loch Golf Course. Approximately 635 acres of the Ho'opili project are in the Honouliuli Stream drainage basin. The portions of the project within the Honouliuli Stream drainage basin are Parcels B and the northeastern part of Parcel C adjacent to Old Fort Weaver Road.

With respect to the Honouliuli Stream drainage basin, the project will provide detention basins to collect all storm water runoff and discharge the flow at a rate that will not exceed the 10-year recurrence flow rate. This is the recognized capacity of the Honouliuli Stream channel.

West Loch Drainage Basin. The West Loch drainage basin is the smallest drainage basin affecting the project. The basin upper reaches begin at the makai side of the H-1 Freeway and generally terminates at two locations at the West Loch of Pearl Harbor. One terminus is through West Loch Estates and the other is an overflow from an existing detention basin located east of Fort Weaver Road and just south of the OR&L railroad tracks (See Parcel D1 on Figure 1: Parcels Map). This basin contains approximately 937 acres and generates a peak flow of 2,500 CFS. The total basin is within lands that are part of the Ho'opili project.

With respect to the West Loch drainage basin, the project intends to collect all storm water and route it to the existing detention basin located on the east side of Fort Weaver Road and south of the OR&L railroad tracks. The routing would require the installation of a concrete channel from the southeastern end of Parcel C, under Fort Weaver Road (using the existing cane haul underpass) and connecting to the existing detention basin. The basin would be expanded to ensure that the water quality storage component of the City and County of Honolulu Standards was achieved. An overflow from the detention basin would discharge to the West Loch of Pearl Harbor (See Parcel D2 on Figure 1: Parcels Map). The portion of the project within the West Loch drainage basin is the bulk of Parcel C (See Figure 5: Drainage Basins).

The overflow from the detention basin would have to cross Navy property. Permission of the Navy would be required. Initial inquiries have been made to the Navy to see if the overflow can be negotiated. Issues with the Navy include security and access in a post- "9/11" environment, Navy plans for development in the overflow corridor, and the acquisition of a maintenance commitment by the City and County of Honolulu. The concept of the overflow across Navy property is not new and was approved in concept back in the early- to mid- 1990's. Lack of action and the issues cited above are points that need to be resolved for the overflow option to move forward.

If permitted, the overflow option across Navy property will solve drainage problems occurring on Fort Weaver Road, within West Loch Estates and within portions of 'Ewa Villages by effectively collecting the storm water that currently is misdirected across these properties.

The alternative drainage solution if the overflow across Navy property cannot be resolved is to construct retention basins on site holding back the total volume of a 100 year- 24 hour storm. These basins would be located on the southern portion of Parcel C.

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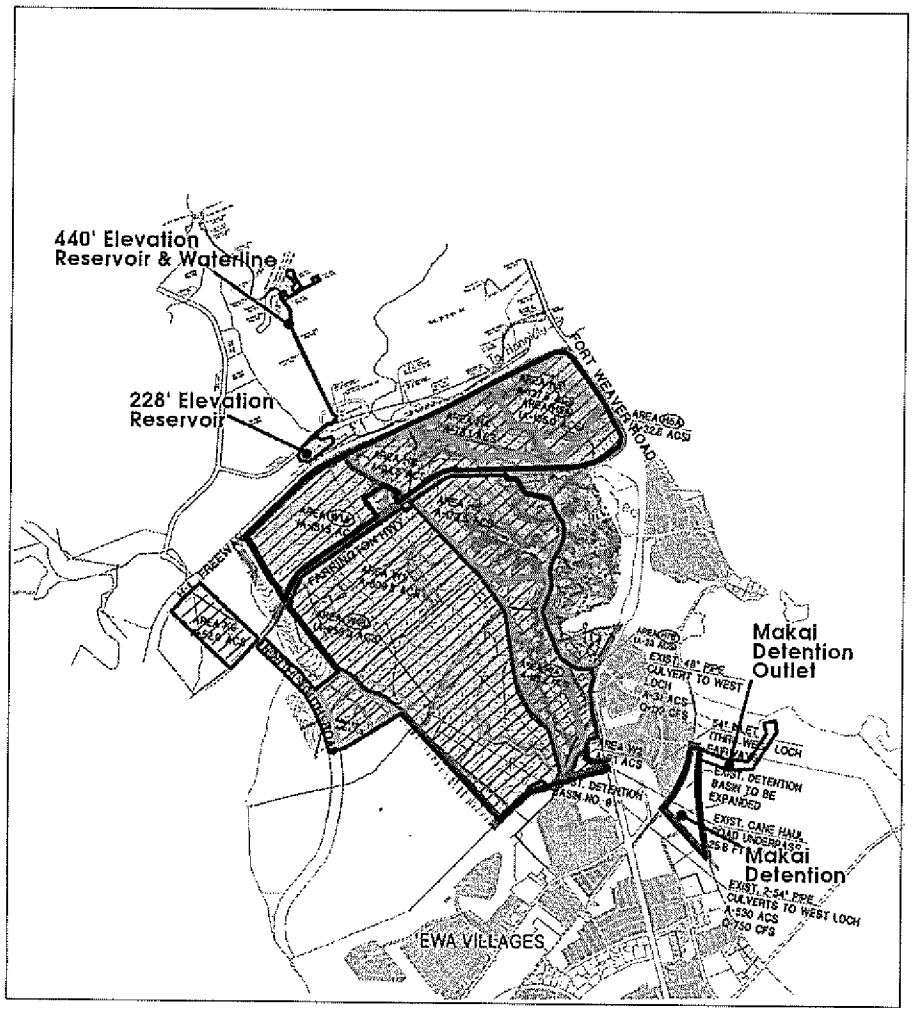

LEGEND

- Project Site Boundary
- Petition Area
- Kalol Drainage Basin
- West Loch Drainage Basin
- Honouliuli Drainage Basin
- (KA) Drainage Basin-Existing
- (W1A) Drainage Basin-Developed

Source: Bills Engineering, Inc.
Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 5: Drainage Basins

HO'OPILI
O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,000 6,000

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Grading. The Project Area will be modified with infrastructure improvements and urban structures for residential, commercial, industrial, recreational and educational uses. The Project Area will include drainage detention basins, open space buffers, parks and some undeveloped areas. Most of the developed areas will be extensively landscaped, which will minimize the potential for soil erosion.

Geotechnical Considerations. No significant geological and/or geotechnical constraints that would preclude the proposed development are expected to be encountered. The primary geotechnical considerations for the development of this property appear to be site drainage, abandoned agricultural infrastructure, (assumed to be) expansive soil conditions, and possible backfilled, undocumented ditches or reservoirs associated with past use of the land. Due to the relatively dry climatic conditions of the 'Ewa Plain, it is important that proper site drainage and landscaping, along with a permanent irrigation system, be developed to help control the (assumed) expansive soils and reduce the potential for significant erosion of soil materials.

Flora. According to the botanical survey reports, conducted by LeGrande Biological Surveys, Inc., in August 2006, most of the Project Area is currently plowed and devoid of trees and brush. Other lands within the Project Area are uncultivated brushland or pastureland. The vegetation is typical of agriculturally cultivated cropland or highly disturbed weedy areas. Little of the original native vegetation remains after over a century of intensive sugarcane agriculture and periodic burning. Native species have been replaced by aggressive non-native plant species. No federally listed endangered or threatened native plants, or candidate endangered species, were encountered on the property. Additionally, no wetlands occur on the property.

None of the plant species which occurred on the Project Area are considered a threatened and endangered species or a species of concern. Although a concerted effort was made in surveying for ko'oloa'ula (*Abutilon menziesii*), no plants were observed on the property. As such, the proposed project is not expected to have a significant negative impact on the botanical resources in this part of O'ahu.

Fauna. According to the biological survey reports prepared by Rana Productions, Ltd., in February 2008, the mammalian and avian species currently found within the Project Area are by and large alien species. All of the mammalian species identified are alien and only three of the avian species present are indigenous. A variety of rats and mice are present in some locations, and are strongly suspected to be present in other areas. Although presence of the endangered Hawaiian Hoary bat (*Lasiurus cinereus semotus*) was suspected, none were observed during the surveys.

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The majority of the sites surveyed within the Project Area are lands formerly cultivated in sugarcane or pineapple, having led to high degrees of disturbance or destruction of native habitat. Current habitats are deemed "depauperate" (severely diminished) by the biological consultant. Some of the sites are currently under partial cultivation, but those habitats likewise have been severely degraded.

The notable exceptions to the above are the four endangered waterbird species which currently inhabit the National Wildlife Refuge located north of Parcels D1 and D2 (See Figure 1: Parcels Map). The Pearl Harbor National Wildlife Refuge was established in 1972 as mitigation for construction of the Honolulu International Airport Reef Runway. The refuge is primarily devoted to the recovery of four endemic and endangered waterbirds [Hawaiian Duck x Mallard hybrids (*Anas wyvilliana x platyrhynchos*), Common Moorhen (*Gallinula choropus sandvicensis*), Hawaiian Coot (*Fulica alai*) and Black-necked Stilt (*Himantopus mexicanus knudseni*)]. The refuge is composed of two units, the 37-acre Honouliuli Unit bordering West Loch and the 25-acre Waiawa Unit bordering Middle Loch.

These waterbirds are likely to utilize the detention basin once sufficient water collects to allow ponding. There may be periodic disturbance to the waterbird species if temporary construction occurs within the detention basin (to enlarge it) or if an outlet is allowed. As previously noted, the waterbirds breed in the Honouliuli Unit of the National Wildlife Refuge, less than a sixth of a mile (250 meters) north of Parcels D1 and D2.

Impacts to the other existing mammalian and avian species and their habitats are expected to be minimal. Displacement of alien species is likely to occur as construction and development infill takes place, but these species will re-inhabit any un- or underutilized locations once development is complete. No other mitigation measures are planned for the remaining faunal species.

Historic Sites. An archaeological inventory survey report for the Project Area was conducted in February 2006 by Cultural Surveys Hawai'i Inc. This report is included in Appendix D of the EIS. Five historic properties (SIHP Nos. 50-80-12-4344, 4345, 4346, 4347, and 4348) were documented during Cultural Surveys Hawai'i's (CSH) archaeological inventory survey of the Petition Area. All five historic properties have been assessed as eligible for the State Register of Historic Places under Criteria C and D, except for Site 4344, which is only eligible under criterion D. The State of Hawai'i, Department of Land and Natural Resources, Historic Preservation Division (SHPD) concurs with these significance assessments. All five historic properties are located in the vicinity of Old Fort Weaver Road).

SIHP Nos. 50-80-12-4344. A survey conducted by CSH in 1990 identified three iron pipe features, including a tall metal post and two welded pipe constructions, located in the vicinity of the Drivers/Stable Villages. The age and function of these features elucidate out record of plantation life in 'Ewa. A more recent inventory study conducted by CSH in 2005 could not locate the previously identified features as the area had been bulldozed and the features destroyed. However, four additional plantation infrastructure features adjacent to Honouliuli Gulch were identified. These features were added to the site description, and will not affect the significance and recommendation for this site ("no preservation").

SIHP Nos. 50-80-12-4345 ('Ewa Plantation Railroad Berm). The 'Ewa Plantation Company operated an approximately 30-mile private railroad from 1890 – 1947 for the primary purpose of the transport of sugar cane. While the railroad runs throughout the Petition Area, a particularly good section of railroad can be found in the northeastern portion of the Petition Area in the mouth of a dry stream valley. A railroad berm runs on both sides of the valley access road with well-preserved facings approximately 2 meters in height. The archaeological consultant recommended that the railroad berm be preserved through incorporating the feature into the development of the project where feasible.

SIHP Nos. 50-80-12-4346 (Northern Pumping Station). A survey conducted by CSH in 1990 previously determined the site's significance under Criteria C and D. The site consists of a pumping station with a deep rectangular basalt block, faced wall. The site is believed to pre-date 1928. An adjacent single pump house, which has an exterior or corrugated sheet metal panel construction, is located nearby. The archaeological consultant recommended that the well be preserved and that issues of significance and proper historic documentation be resolved with the SHPD office in advance of any development in the area to avoid adverse impacts. A preservation plan has been drafted and will be submitted to SHPD for review and comments.

SIHP Nos. 50-80-12-4347 (Central Pumping Station). A survey conducted by CSH in 1990 previously determined the site's significance under Criteria C and D. The site consists of a pumping station with a deep rectangular basalt block, faced wall. The site is believed to pre-date 1928. Eight features related to and in the immediate vicinity of the well include a number of small architectural and/or industrial features. The archaeological consultant recommended that the well and portions of the site be preserved. The significance of the site would be evaluated after an assessment of the significance of the architectural features and the assessment of the significance of the 'Ewa Village area. A preservation plan has been drafted and will be submitted to SHPD for review and comments.

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SIHP Nos. 50-80-12-4348 (Southern Pumping Station). A survey conducted by CSH in 1990 previously determined the site's significance under Criteria C and D. The site consists of a pumping station with a deep rectangular basalt block, faced wall. The site is believed to be constructed shortly after 1928. An adjacent single pump house, which has an exterior or corrugated sheet metal panel construction, is located nearby. The archaeological consultant recommended that the well be preserved and that issues of significance and proper historic documentation be resolved with SHPD in advance of any development in the area to avoid adverse impacts. A preservation plan has been drafted and will be submitted to SHPD for review and comments.

Research of earlier maps indicates four areas of interest: the Honouliuli taro lands, Kapalani Church, Pipe Line Village and Drivers/Stable Villages. All are located in the vicinity of Old Fort Weaver Road, well below from the main development area.

The Honouliuli taro lands were probably nineteenth century (and earlier) Hawaiian habitation and agricultural area. However, no surface or subsurface remains were found during the 2005 inventory survey. CSH has determined that no additional testing is necessary. However, CSH is recommending on-call/on-site archaeological monitoring during any future development in this area. SHPD concurs with this recommendation.

The Kapalani Church was a nineteenth century Hawaiian Catholic Church, schoolhouse and possible cemetery area. Pipeline Village and the Drivers/Stable Villages were early twentieth century immigrant plantation habitation camps. No surface or subsurface remains were found during the 2005 inventory survey. CSH has determined that no additional inventory survey is necessary. However, CSH is recommending on-call/on-site archaeological monitoring during any future development in this area. SHPD concurs with this recommendation.

SHPD concurs with the consulting archaeologist's (Cultural Surveys Hawai'i) mitigation recommendations, which include: (1) no further archaeological work at Site 4344, (2) preservation of Sites 4345, 4346, 4347, and 4348, and (3) archaeological monitoring in the vicinity of the four areas of historic habitation (Honouliuli taro lands, Kapalani Catholic Church, Pipeline Village, and Drivers/Stable Village).

According to SHPD, the archaeological inventory survey report is now accepted in fulfillment of *Hawaii Administrative Rules* 13-284 and 13-276 (See EIS Appendix E). A preservation plan and archaeological monitoring plan will be prepared and submitted to SHPD for their review and approval. All five sites are located near

Old Fort Weaver Road and well away (and below the bluff) from the main Petition Area. Should any archaeologically significant artifacts, bones, or other indicators of previous on-site activity be uncovered during construction, work will stop immediately and the will be notified in accordance with applicable regulations.

View Analysis. The Petition Area is located in 'Ewa (the area roughly bounded by the H-1 Freeway to the north, Kapolei Golf Course, Kapolei Middle School and the Villages of Kapolei to the west, 'Ewa Villages to the south, and Honouliuli and Fort Weaver Road to the east). Most of 'Ewa is mostly open and is being cultivated. The major man-made features in 'Ewa besides roads (such as Farrington Highway and the North-South Road – under construction) are HECO's transformer station along Farrington Highway and its overhead 138kV powerlines and supporting tower structures crossing the H-1 Freeway, and running along Farrington Highway and North-South Road.

As is the case with the rest of 'Ewa, Parcels A, B and C of the Petition Area are presently undergoing various forms of diversified agriculture. A portion of the Petition Area is being developed during the construction of North-South Road (construction on-going). Views of the Wai'anae Mountains and Diamond Head are offered from certain locations of the project site. However, since most of the Petition Area is being actively cultivated, the public does not have the opportunity to experience these views. The most heavily traveled roadways in the vicinity of the site are the H-1 Freeway and Fort Weaver Road. In fact, as DPP noted in their comments on the EISPN, the *Ewa Development Plan* Open Space Map shows that "panoramic views" of the property are available from these roadways. While nearly all of the Petition Area is lower in elevation than the H-1 Freeway, views makai from H-1 Freeway are infrequent along the stretch of the Freeway between where Kunia Road and Palehua Road cross the Freeway. In some sections of the H-1 Freeway, it appears that the Freeway was cut across slopes and/or the makai shoulder of the Freeway was graded with berms. At posted Freeway speeds of 60 miles per hour, viewing the Petition Area while driving is hazardous.

Most of the Petition Area is higher in elevation than Fort Weaver Road, but lower in elevation than the H-1 Freeway.

The most visible portion of the Petition Area from either the H-1 Freeway and/or Kunia Road/Fort Weaver Road is located near the intersection of the H-1 Freeway and Kunia Road or from Farrington Highway.

The visual appearance of the Petition Area as well as the rest of 'Ewa (including the Kroc Center, UHWO and DHHL East Kapolei Development Parcel 2) will change from vacant scrub and cultivated vegetation to a landscaped mixed-use community with parks and

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open space. The HHCTC project, a possible transit maintenance and storage facility, transit-oriented development, project landscaping, and the project's architectural design will set the visual character of the Petition Area. .

Analysis of Surrounding Uses. The Project Area consists of 1,553.844 acres of the 1,600.265 acres in the Project Area. The Project Area consists of 10 distinct parcels of land situated within the Agricultural District. For purposes of this EIS, the parcels have been labeled as A, B, C, D1, D2, E1, E2, E3, F and G (See Figure 1: Parcels Map). The Project Area parcels are A, B and C. The remaining Project Area parcels, D1, D2, E1, E2, E3, F and G, do not need to be reclassified to urban.

Parcel A is located west of Parcels B and C, and north of the UHWO. It is bordered by State land to the west, Farrington Highway to the south, the proposed North-South Road (under construction) to the east, and the H-1 Freeway to the north.

Parcel B is located north (mauka) of Parcel C and Farrington Highway. It is the second largest of the 10 parcels. Parcel B is bordered to the west by land proposed for multi-family residential use by the Housing and Community Development Corporation of Hawai'i (HCDCH), to the south by Farrington Highway, to the east by Kunia Road, and to the north by the H-1 Freeway. An out-parcel along Farrington Highway is used by HECO.

Parcel C is located south (makai) of Farrington Highway. It is the largest of the 10 parcels. Parcel C is bordered by the proposed North-South Road to the west; State of Hawai'i, Department of Hawaiian Home Lands (DHHL) landholdings, 'Ewa Villages, and the 'Ewa Villages Golf Course to the south; Old Fort Weaver Road and (new) Fort Weaver Road to the east; and Farrington Highway to the north. There are two out-parcels along Farrington Highway. One out-parcel of land near the planned University of Hawai'i West O'ahu (UHWO) campus and North-South Road is proposed for multi-family residential use by HCDCH. The other out-parcel of land is used by the City and County of Honolulu, Board of Water Supply (BWS).

Parcel D1 is located east of the other four parcels and Fort Weaver Road. Pearl Harbor National Wildlife Refuge is located to the north, West Loch Estates is located to the northwest, 'Ewa by Gentry is located to the south and southwest, and Waipahu and Pearl Harbor are located to the east.

Parcel D2 functions as an outlet, connecting Parcel D1 to Pearl Harbor and its use would require approval from the United States Navy.

Parcels E1, E2 and E3 are located north (mauka) of the H-1 Freeway. The parcels are numbered from west to east, with E1 on the west and E3 on the east. All are surrounded by open space, and are connected to Parcel F via narrow parcel of land which will serve as a waterline.

Parcel F is located north (mauka) near to the H-1 Freeway. It is linked to Parcels E1, E2 and E3 by a narrow band of land. It is bordered by the H-1 Freeway on the southern boundary and by open space on its north, east and western sides.

Parcel G is adjacent to the makai boundary of Parcel C and is located north (mauka) of the 'Ewa Villages Golf Course, and is already located within the State Urban Land Use District boundaries.

(iii)Land Use

The Proposed Action involves the reclassification of approximately 1,553.844 acres from the Agricultural District to the Urban District. Urbanization of the Project Area will enable The D.R. Horton - Schuler Division to develop its proposed Conceptual Land Use Plan (See Figure 6: Conceptual Land Use Plan). The proposed Ho'opili Conceptual Land Use Plan will be a community where residents can live, work, learn, play, and shop.

To achieve the communities' vision for Ho'opili, a Conceptual Land Use Plan has been formulated that illustrates a mixed-use community that would complete and connect 'Ewa with the surrounding communities. Originating from the common vision and values of a community-driven planning effort, the conceptual plan contains a series of neighborhoods with a mix of uses including residential, retail, office and light industrial. Included in this mix are a series of parks, schools, public buildings and community centers which act as a focus and help define the identity of each neighborhood.

Ho'opili will be connected to the surrounding 'Ewa District by a network of streets and bicycle paths which allow a variety of circulation options for residents and visitors. Wider tree-lined boulevards create a distinct axis running north-south and east-west across the site. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the

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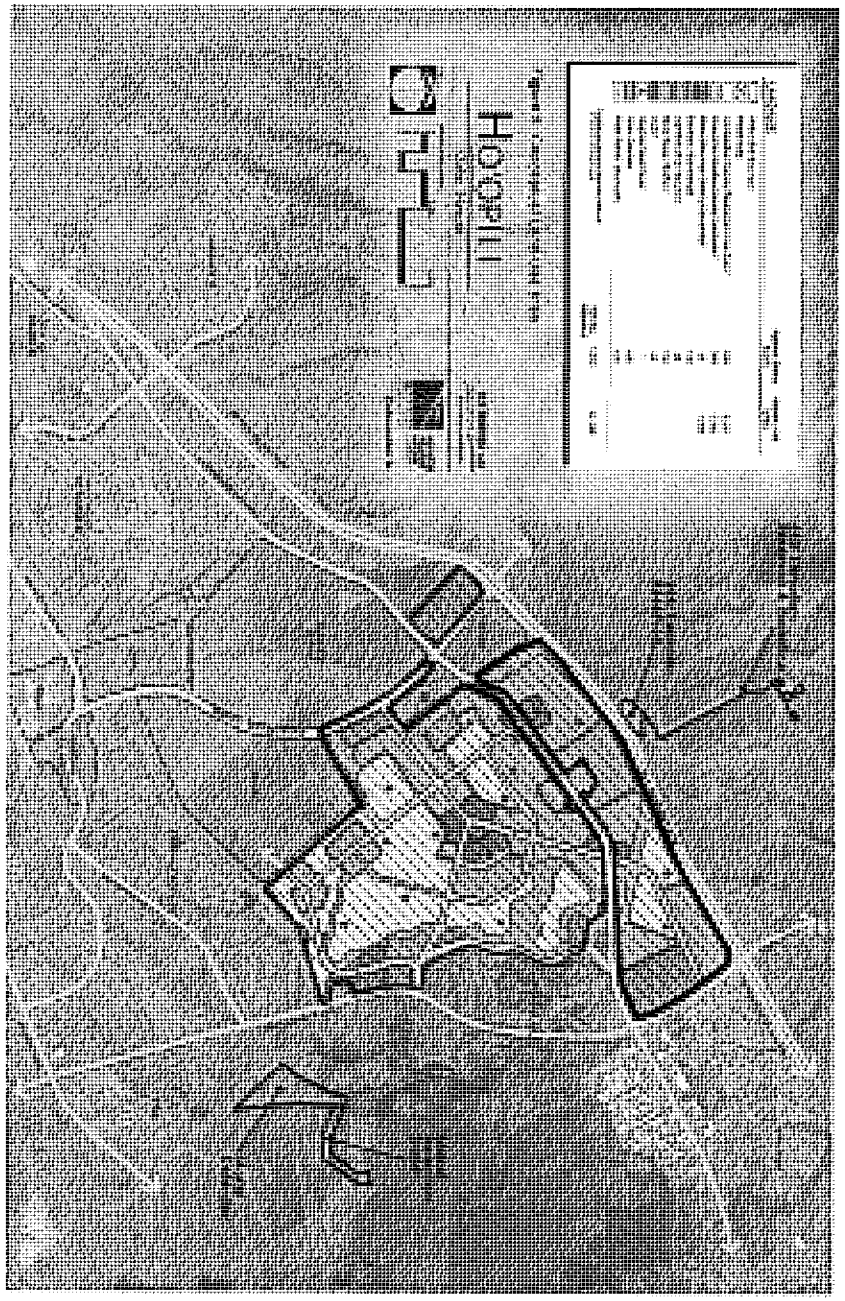

alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will probably be concentrated around the transit station(s). Also possible is a site for a transit maintenance and storage facility.

In the geographical center of the site there is a public square or Civic Plaza that is surrounded by higher density housing development and mixed-use buildings. Housing intensity transitions to lower-density small-lot single family homes along the eastern and southern peripheries of the site. A significant open space and pedestrian/bicycle trail network provides a wide variety of recreational opportunities for residents and other members of the 'Ewa community. Ho'opili will incorporate traditional Hawaiian building styles with a modern, contemporary aesthetic and will reflect the landscape and climate.

The general land use allocation illustrated on the Conceptual Land Use Plan is summarized in Table 3 of the EIS and described below:

Low-Medium Density Residential/Live-Work
Ranging from traditional single family detached homes on varying lot sizes to multifamily dwellings with a variety of live-work opportunities, there are approximately 535 gross acres (which includes secondary roads and mini-"neighborhood" parks) planned to accommodate approximately 5,100 residential units at densities of 5 to 14 units per acre. These areas would include mini-parks located as focal points and activity centers of the community.

Mixed-Use/Medium Density Residential
Planned to be oriented along future high-capacity transit and major roadway alignments, these medium density mixed use districts would include live-work residential units or residential uses over ground floor commercial and office uses. Within these districts that comprise approximately 340 acres (all of which will not be developed for housing because the acreage includes secondary roads, off-street parking and mini-"neighborhood" parks), there are approximately 5,200 dwelling units planned at densities of 15 to 29 units per acre along with retail and office use.

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Mixed-Use/High Density Residential
Planned to be located near major transportation junctions, these higher density mixed use districts would include commercial, office space, and higher density live-work residential units or residential uses above ground floor businesses. Within these districts that comprise approximately 50 gross acres (which includes secondary roads, off-street parking and mini-"neighborhood" parks) would be approximately 40 net developable acres that would accommodate approximately 1,450 dwelling units planned at densities of 30 to 50 units per acre along with retail and office use.

Business / Commercial
To serve the neighborhoods and surrounding communities and to provide a variety of employment opportunities within Ho'opili, the business/commercial uses are located to be conveniently accessed from the major transportation corridors of the region. The approximately 145 gross acres illustrated (which includes secondary roads and off-street parking) are estimated to yield a net development area of approximately 130 acres that are projected to accommodate retail and office use. These areas would be significant employment generators for Ho'opili and the region.

Light Industrial / Business Mixed-Use
To meet regional demands and to provide for an additional employment center for Ho'opili, approximately 50 gross acres (which includes secondary roads and off-street parking) are planned to provide an area for larger light industrial type users and businesses. It is estimated that there would be a net development area of approximately 40 acres industrial mixed-use.

Open Spaces / Buffers
Integral to the connectivity of Ho'opili to the surrounding neighborhoods, a variety of open space buffers and drainage detention areas are planned. Some of the key open space buffers include along the H-1 Freeway, Honouliuli Gulch and along Old Fort Weaver Road.

Parks
Some of the key parks being planned include a district park along Fort Weaver Road and a downtown civic square to serve as the community gathering area.

Mini-Parks
Integral to the establishment and identity of neighborhoods, a variety of smaller parks of approximately one to two acres in size are planned. Properly planned and located, most residents will be within walking distance of one of these mini-parks.

Public Facilities
The proposed project could include as many as five public school sites. The Conceptual Land Use Plan shows the possible locations for five State of Hawai'i, Department of Education (DOE) school sites planned to be as accessible to the neighborhoods of Ho'opili as the community is developed; one high school, one middle school and three elementary schools. The plan can also accommodate private schools as the need is determined. In addition, area is set aside along the western end of Farrington Highway fronting the Project Area for either a fire station or a police substation. In total, approximately 100 acres are allocated to meet public facility needs.

Major Roads and the Honolulu High-Capacity Transit Corridor (HHCTC) Project
To provide for improved regional circulation and to define and serve the various neighborhoods of Ho'opili, the major boulevards planned within the community are illustrated. In addition, there will be a well planned network of local streets to provide connectivity and alternate routes throughout the community in a safe and pedestrian friendly manner. This land use category includes the portion of the property that will be utilized for 1) the widening of Farrington Highway fronting the Project Area, 2) a portion of North-South Road between Farrington Highway and Kapolei Parkway, 3) portions of the intersections of North-South Road with Farrington Highway and the H-1 Freeway, and 4) the segment of the East-West Connector through the Project Area. As previously mentioned, a significant portion of the project site will be taken for a segment of the HHCTC project, including a possible transit maintenance and storage facility.

Proposed land uses are shown in the Conceptual Land Use Plan (See Figure 6: Conceptual Land Use Plan) and generally described below. The approximate land use areas may be adjusted as the proposed Ho'opili Conceptual Land Use Plan is refined through the land use review and approval process, as well as when the HHCTC alignment is finalized within Ho'opili. During the EISPN public review period, the City and County of Honolulu, Department of Design and Construction recommended that "the developer meet with City officials from the Department of Planning and Permitting, Department of Design and Construction, and Department of Parks and Recreation (DPR) at an early stage in the development's planning process to develop a conceptual plan for overall development which is acceptable and appropriate." As such, D.R. Horton - Schuler Division will continue to coordinate with City and County of Honolulu agencies to develop a conceptual plan for overall development which is acceptable and appropriate.

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Conceptual Land Use Plan – Land Use Summary for Project Area

LAND USE	APPROX. GROSS ACREAGE	APPROX. DEVELOPABLE NET ACRES	APPROX. NUMBER OF UNITS	GENERAL LAND USE DENSITY RANGE (DWELLINGS/UNITS PER ACRE)	PROPOSED ZONING DISTRICT****
PROJECT AREA					
Low-Medium Density Residential/Live-Work*	535	400-475	5,100	5-14	R-5/AMX-2
Mixed Use/Medium Density Residential*	340	250-300	5,200	15-29	AMX-3
Mixed Use/High Density Residential*	50	40	1,450	30-50	BMX-3
Business/Commercial	145	130	-	-	B1
Light Industrial/Business Mixed Use	50	40	-	-	IMX-1
Open Space/Buffers*,**	150	N/A	-	-	P-2
Parks*	60	N/A	-	-	P-2
Mini-"Neighborhood" Parks*	*	N/A	-	-	P-2
Public Facilities	100	N/A	-	-	AMX-3
Major Roads (as shown)**	124	N/A	-	-	Varies
TOTAL (approx.)	1,554***	-	11,750	-	-

* - Mini-"Neighborhood" parks and secondary roadways included in residential areas
** - May increase as developable areas decrease in residential and commercial categories
*** - Total acreage to be rezoned is approximately 1,555.145 acres
**** - Zoning designation may vary depending whether a Transit-Oriented Development overlay district is adopted

(iv) Open Space

Assuming an average of three residents per each of the proposed 11,750 households (estimated 35,250 future residents), and the Ewa DP's minimum requirement of two acres of park space per 1,000 residents, the proposed project, would require 70.5 acres of park space. The Ho'opili project is consistent with the Ewa DP's objectives and policies to protect and preserve open space. As many as 210 acres of parks and open space will be provided within the Project Area. An additional 30 acres will be maintained as open space and will be used for off-site drainage. Open space buffers are proposed to be located along the H-1 Freeway and Old Fort Weaver Road. In addition, linear parks and open space will encircle the Ho'opili project with walking/biking paths to create a separate but welcoming identity for the Ho'opili community.

(v) Circulation

Prior to rezoning, a Circulation Plan delineating the hierarchy of streets within the Ho'opili project and its relationship to the surrounding transportation network will be developed. Ho'opili is being designed to maximize connectivity within and to/from surrounding properties. To provide multiple routes for traveling through Ho'opili, a fine grid of closely-spaced blocks is envisioned over most of the site and where topography allows. Major planned and proposed regional connectors have been considered in the planning of the proposed project. These include: setting aside additional right-of-way for the City and County of Honolulu's widening of Farrington Highway; multiple connections to Farrington Highway; setting aside land for the proposed East-West Road; connection to the proposed North-South Road (under construction); and construction of a mauka-makai "North-South Bypass" road.

As shown on Figure 7: Proposed Circulation Plan, the Circulation Plan will also indicate:

- The currently proposed HHCTC alignment; existing and proposed bus routes; and specific measures, such as a "circulator shuttle" (local bus route connecting Ho'opili and UHWO) to accommodate efficient transit service for as many households as possible.
- Any principal pedestrian and bicycle paths that are physically separated from roadways. Within the proposed fine network of gridded streets, it is envisioned that most streets will include on-street parking and sidewalks and/or grade-separated multi-modal bike/pedestrian paths. This will allow experienced bicyclists to travel on most roadways and inexperienced bicyclists to stay off roads, except at intersections.

Not shown on Figure 7: Proposed Circulation Plan, but will be addressed in the Circulation Plan are:

- That street intersections along principal pedestrian and bicycle paths should have a narrow curb radius and include special signage and paving to encourage safe and convenient pedestrian and bicycle crossings; and
- A five-minute walking radius from proposed bus and transit routes (unless localized topographic conditions make such a requirement impractical).

(vi) Design Theme and Character

Ho'opili will be highly consistent with the goals and objectives of two primary recognized long-range development plans for the area, the City and County of Honolulu's directed growth policy for the area, the *Ewa Development Plan* and the *Kapolei Area Long Range Master Plan*, which was adopted by the City and County

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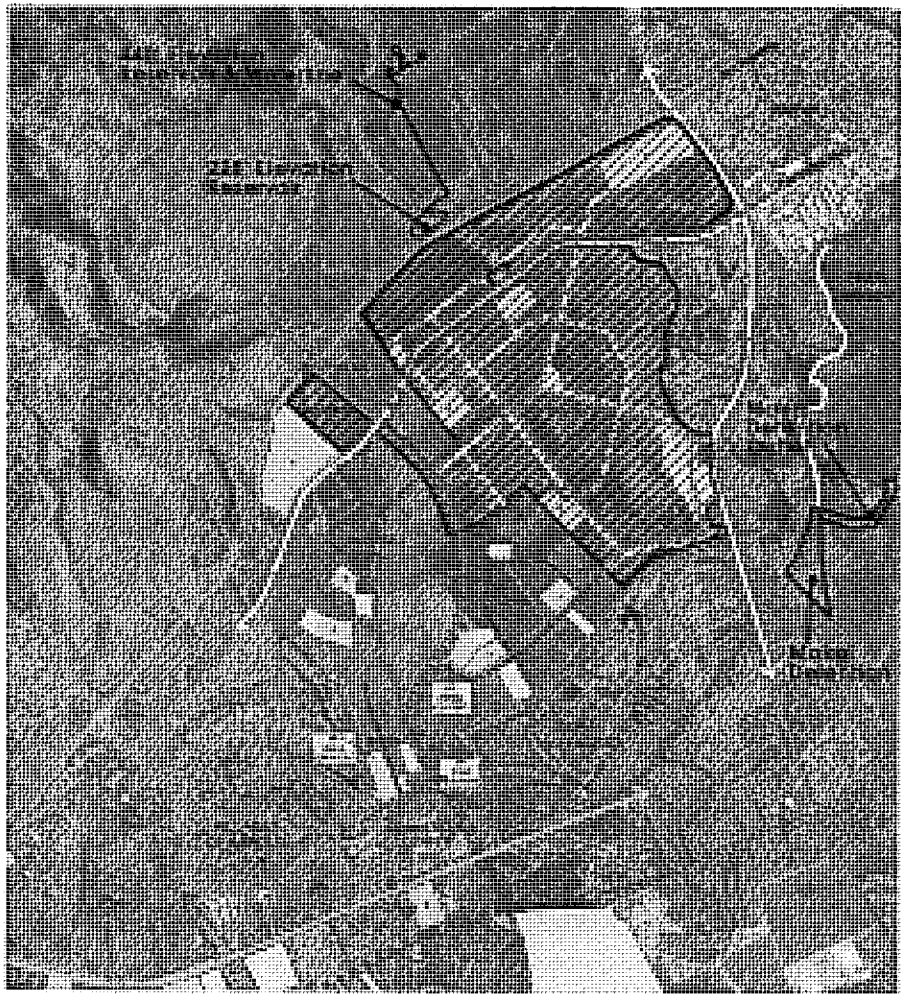

LEGEND

- Project Site Boundary
- Petition Area
- Proposed UH West O'ahu Bikeway
- Proposed Ho'opili Bikeway
- Proposed DHHL Bikeway
- Proposed Bikeway by Others
- Existing State Bike Plan
- Pearl Harbor Historic Trail and Leeward Bikeway
- Express and Local Bus Routes
- Proposed HHCTC Corridor
- Circulator Shuttle
- Proposed Parks
- Proposed Schools
- Proposed Public Facility
- Right-in / Right-out
- Right-in / Right-out

Source: State of Hawaii Department of Transportation Bicycle Plan 2000; Draft Ewa Connectivity Study 2007.

Disclaimer: This graphic has been prepared for general planning purposes only.

Figure 7: Proposed Circulation Plan

HO'OPILI

O'ahu, Hawai'i

NORTH LINEAR SCALE (FEET) 0 3,000 6,000

PBR HAWAII & ASSOCIATES, INC.

of Honolulu as part of Resolution 91-34. The Ewa DP states that growth in the area will include community building, not just project development, with communities designed to enhance lives, reduce automobile dependency, and be connected via a network of greenways ('Ewa will be built around a regional system of open space and greenways so that it has the feel of a network of communities "within a garden").

Ho'opili will adhere to the best intentions of the area's long-range master plans and the possibilities for a better 'Ewa with its proposed:

- concentrated mixed-use development pattern;
- embrace of "Traditional Neighborhood Design" and "Transit-Oriented Development" principles so that the entire project is walkable, connected and transit-ready; and
- earmarking of large areas for community gathering places, schools, parks and open space and a comprehensive bicycle/pedestrian network.

Ho'opili can play a key role in actualizing the community's vision for 'Ewa and enhancing the desirability of living on the 'Ewa Plain. Ho'opili, or "coming together," is part of the bridge where Honolulu's existing central corridor that reaches to Waipahu meets the urban core of the 'Ewa Plain, the City of Kapolei. It is where neighboring towns from Waipahu to Ko 'Olina and from Makakilo to 'Ewa Beach will be welcome and can gather.

Ho'opili will be connected to the surrounding 'Ewa District by a network of streets and bicycle paths which allow a variety of circulation options for residents and visitors. Wider tree-lined boulevards create a distinct axis running north-south and east-west across the site. Ho'opili is being designed to be transit-ready, and the land use plan, while subject to change, has been designed to accommodate a high-capacity transit corridor either along Farrington Highway or diagonally through the project site, with either one or two transit station locations. While the proposed residential unit count will not change, the land use plan will need to be adjusted depending on the final alignment of the high-capacity transit corridor, as the potential for noise impact from an elevated high-capacity transit alignment would likely require taller, higher density residential or industrial uses along the alignment. The final siting of the transit station location(s) will also provide transit-oriented development potentials, which will also cause the plan to be refined, as higher intensity development (and density) will probably be concentrated around the transit station(s). Also possible is a site for a transit maintenance and storage facility.

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Residents should celebrate the benefits of this connected community for generations to come. Ho'opili will be a community that will:

- Be innovative, incorporating principles of "transit-oriented development" and "Traditional Neighborhood Design";
- Be highly liveable with a range of housing options – including affordable, workforce, and senior housing – plus parks, community facilities, schools, and a diversity of jobs and retail options;
- Be based on a healthy, walkable, live-work environment;
- Enhance living in 'Ewa: fewer vehicle trips to for commuting to work or school outside of the District, more time spent with families, less auto emissions, and greater community gathering opportunities; and
- Be sustainable, "green" requiring fewer car trips with its bicycle and pedestrian paths, and using renewable resources for energy consumption and recycling other resources, such as wastewater and solid waste.

Sustainability options are being considered for the Ho'opili project. Where feasible, project buildings, activities, and site grounds are intended to be designed with energy-saving considerations. Given the natural climate, the project may be suited for the use of renewable energy technologies including photovoltaics.

(vii) Telecommunications

Hawaiian Telcom, which provides telephone service to the area, owns and maintains a pole line along Farrington Highway, Old Fort Weaver Road and Kunia Road. This pole line is substandard; however, Oceanic Time Warner Cable and Pacific Lightnet have an agreement with Hawaiian Telcom for use of its poles and have attached cables to extend their facilities to Kapolei. AT&T has a fiber cable buried within the southern shoulder of the existing Farrington Highway right-of-way. In addition, the Federal government owns a buried joint tactical support cable within the Farrington Highway right-of-way.

Due to the substandard location of the existing telephone pole line along Farrington Highway; Hawaiian Telcom, Oceanic Time Warner Cable, and Pacific Lightnet will have to relocate their lines to new poles along Farrington Highway in the future. These telephone and communication lines will require easements within and the use of State and County road right-of-ways.

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APPENDIX R
Arthropod Survey and Assessment

ARTHROPOD SURVEY AND ASSESSMENT

HO'OPILI PROJECT

'EWA DISTRICT, O'AHU, HAWAI'I

May 2008

Prepared for

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INTRODUCTION

A survey of arthropods on the Ho'opili Project Site was conducted on May 09, 2008 by Dr. Gregory Brenner of Pacific Analytics, LLC. The primary objectives of the survey were to provide a general description of the arthropod fauna of the Ho'opili Project Site, evaluate the habitats, and search and assess the potential for threatened and endangered arthropod species as well as species of concern (DLNR 1997, Federal Register 1999, 2005).

GENERAL SITE DESCRIPTION

The approximately 1,550 acre (627 hectares) Ho'opili Project Site in the 'Ewa District on the Island of O'ahu includes three main parcels, Parcels A, B, and C, and seven smaller parcels, Parcels D1, D2, E1, E2, E3, F, and G (see Figure 1.5, DEIS page 4). The Ho'opili Project Site ranges in elevation from near sea level to about 430 ft (131 m). The Ho'opili Project Site was cultivated in sugarcane from the late 1800s to 1995, and currently contains cultivated fields for diversified agriculture, pasturage, and agricultural research, and some small gulches and cliffs. The edges of the fields and the small gulches and cliffs on the site are weedy areas dominated by alien plant species (LeGrande 2006).

There are neither unique floral habitats nor unique avian and mammalian faunal habitats on the Ho'opili Project Site and a survey for botanical, avian, and mammalian resources found no threatened endangered, or species endemic to Hawai'i at the site (LeGrande 2006, David 2008).

SURVEY METHODS

Prior to the site visit a search of literature pertaining to arthropods found in the 'Ewa District was conducted. Maps and aerial photographs of the Ho'opili Project Site were examined to familiarize the principal investigator with the general area and locate potential arthropod habitats. After examining the maps and aerial photographs it was determined that special attention should be given to the gulch and the cliff areas where the botanical survey identified scrub vegetation with native plant elements (LeGrande 2006). These areas were determined to have the best potential as native arthropod habitats.

The areas selected as requiring special attention include Honouliuli Gulch running through Parcel B, two flumes that run east-west through Parcel C, and the cliffs along the eastern boundary of Parcel C.

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The arthropod survey was conducted on May 9, 2008. Roads were driven on the Ho'opili Project Site to locate potential arthropod habitats previously identified from maps and aerial photographs. A Staged Random-Walk survey method was used in these areas. Vegetation was sampled on foot along roads and between cultivated fields where arthropods would likely be found using the following methods.

Aerial Netting - Flying insects were captured in aerial nets and placed into vials for immediate identification in the field. Species present were recorded in a field notebook with annotations about relative abundance and other ecological information. Specimens were released after identification.

Sweep Netting - Grasses, small shrubs and other low-lying vegetation was sampled with a sweep net. An insect net was brushed along the top of the vegetation or grass to capture insects. Specimens were released after identification.

Foliage Beating -Foliage was sampled using a beating sheet. An insect net was placed under a branch and the stem was struck with a short stick. Arthropods on the foliage were dislodged and fell onto the sheet where they were collected with an aspirator into vials for identification. Specimens were released after identification.

Visual Inspection – Plants were visually inspected for arthropods that were not collected by other methods. Time was also spent observing larger flying insects that could be identified on the wing. The Honouliuli Gulch was also visually inspected for aquatic insects after water began flowing, apparently released from the state flood control detention pond upstream of the site.

Sampling Transects – The length of sampling transects varied with location. Staged Random-Walk sampling transects were used to survey each area. Sampling transects were selected at random to represent at least twenty percent of the vegetation on each Parcel. Sampling intensity was increased to at least fifty percent in those areas identified from maps and aerial photographs as requiring special attention.

DESCRIPTION OF THE ARTHROPOD FAUNA

Twenty-seven species of insects representing eight orders and at eighteen families were observed at the site. In additional three species of spiders were also recognized.

The entire site is disturbed by agriculture and related activities, and the vegetation is composed of non-indigenous, weedy species. This is reflective of the overall arthropod community which is almost entirely non-indigenous. Only one indigenous species, *Pantala flavescens*, a common dragonfly, was observed. No endemic native Hawaiian arthropods were detected.

Plants that were in bloom attracted pollen and nectar feeders, especially bees and butterflies. Other insects were found feeding on plant juices, under leaves and on stems. Ants were the most abundant insect on the ground.

There have been no previous arthropod surveys at the Ho'opili Project Site and a search of literature revealed only one reference of an arthropod study in the Barbers Point vicinity. The nearest and most complete comparative survey was one conducted in 2006 by the principal investigator for the proposed development of the Kapolei Harborside Center (Pacific Analytics 2006). In that study one hundred and ninety-five species of insects representing sixteen orders and at least seventy-five families were collected with an additional nineteen species of spiders, three species of other arthropods, and five species of fossilized snail.

More than ninety percent of the species collected in the Kapolei Harborside Center Project Site survey were non-indigenous. Many are cosmopolitan, weedy species found throughout the Pacific and the World. The few indigenous and endemic species observed at the Project Site are common and no rare, endangered, threatened, or species of concern were detected. The large proportion of non-indigenous species was an indication of the amount of habitat degradation that resulted from the various agricultural and mining operations that have occurred at the site.

Similar degradation has occurred at the Ho'opili Project Site as a result of the more than one hundred years of agricultural use. The vegetation at the Ho'opili Project Site is similar to but less diverse than that at Kapolei Harborside Center Project Site. In my judgment, the arthropod fauna at the Ho'opili Project Site is not substantially different from that found at the Kapolei Harborside Center Project Site and it is unlikely that an intensive inventory of the site would yield significantly different findings from the 2006 study.

Despite particular attention to gulches, flumes, and water detention areas, no native Hawaiian damselflies of other endemic aquatic arthropod species were detected. Given the intermittent nature of the water flow in these some of these areas it is unlikely that aquatic species would persist there. Only one species of native Hawaiian damselfly is historically known from this area, *Megalagrion xanthomelas*, and that species is nearly extirpated from Oahu, known recently from only one locality above Honolulu (BPBM 2008).

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SUMMARY OF THE ARTHROPOD FAUNA

The arthropods species that were collected during this study would be considered typical of what would be found in lowland sites with little or no native vegetation and disturbed by agricultural operations. No species were found that are locally unique to the site. Nor were any species found whose habitat would be threatened by the proposed development at the site.

The results of this arthropod survey at the Ho'opili Project Site indicate there are no special concerns or legal constraints related to invertebrate resources in the project area. Although several species of Hawaiian endemic arthropods may occur on the 'Ewa plain, these species are not likely to be abundant in the highly disturbed agriculture lands that comprise the Ho'opili site. No invertebrate species listed as endangered, threatened, or that are currently proposed for listing under either federal or State of Hawai'i endangered species statutes are known to exist at the Project Site (DLNR 1997, Federal Register 1999, 2005).

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