Revised DRAFT Archaeological Inventory Survey of Construction Phase I for the Honolulu High-Capacity Transit Corridor Project, Honouliuli, Hōʻaeʻae, Waikele, Waipiʻo, Waiawa, and Manana Ahupuaʻa, ʻEwa District, Island of Oʻahu

TMK: [1] 9-1, 9-4, 9-6, 9-7 (Various Plats and Parcels)

Prepared for

Parsons Brinkerhoff

and

The City & County of Honolulu

Prepared by

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Kailua, Hawaiʻi

(Job Code: HONOULIULI 18)

April 2010

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Management Summary

Reference	Archaeological Inventory Survey of Construction Phase I for the Honolulu High-Capacity Transit Corridor Project, Honouliuli, Hōʻaeʻae, Waikele, Waipiʻo, Waiawa, and Manana Ahupuaʻa, ʻEwa District, Island of Oʻahu {TMK: [1] 9-1, 9-4, 9-6, 9-7 (Various Plats and Parcels)} (Hammatt 2010)
Date	April 2010
Project Number (s)	Cultural Surveys Hawaiʻi, Inc. Job Code: HONOULIULI 18
Investigation Permit Number	The fieldwork component of the archaeological inventory survey (AIS) investigation was carried out under archaeological permit number 09-20, issued by the Hawaiʻi State Historic Preservation Division/Department of Land and Natural Resources (SHPD / DLNR), per Hawaiʻi Administrative Rules (HAR) Chapter 13-282.
Project Location and AIS Study Area	The proposed Honolulu High-Capacity Transit Corridor Project (HHCTCP) extends approximately 23 miles from Kapolei in the west to the University of Hawaiʻi at Mānoa and Waikīkī in the east. The focus of this AIS investigation is the western-most 7.4 miles of the overall project area. This AIS study area includes all of Construction Phase I of the HHCTCP, which consists of an approximately 6.8-mile segment of the HHCTCP extending from North-South Road in East Kapolei to the Pearl Highlands Station, and the western portion of Construction Phase II, extending approximately 0.6 miles from the Pearl Highlands Station to Waimano Home Road in Pearl City. The AIS study area is depicted on the U.S. Geological Survey 7.5-Minute Series Topographic Map, Ewa (1998), Schofield Barracks (1998), and Waipahu (1998) Quadrangles. The western-most portion of Construction Phase II was included in this AIS study so that the historic preservation review process of at least a portion of the project's Construction Phase II would be concluded well ahead of actual construction. **For the purposes of this investigation, the project area (7.4 linear miles) includes all of Construction Phase I (6.8 linear miles) and the western-most portion of Construction Phase II (0.6 linear miles).**
Land Jurisdiction	The AIS study area (all of Construction Phase I and the western portion of Construction Phase II) is primarily located within existing or planned road rights-of-way owned by the State of Hawaiʻi or the City & County of Honolulu, including North-South Road, Farrington Highway, and Kamehameha Highway. The project corridor also traverses: agricultural lands privately owned by D.R. Horton; the Ewa Drum Filling and Fuel Storage Area, formerly owned by the U.S. Navy and now under State of Hawaiʻi (Department of Hawaiian Home Lands) jurisdiction; and Leeward Community College, owned by the State of Hawaiʻi. The support facilities along the project corridor are located on privately-owned lands.

Agencies	City & County of Honolulu (City); SHPD; Federal Transit Administration (FTA)
Project Description and Related Ground Disturbance	The purpose of the proposed HHCTCP is to provide high-capacity rapid transit in the highly congested east-west transportation corridor between Kapolei and the University of Hawai‘i at Mānoa via a fixed guideway rail transit system. In addition to the guideway, the project will require construction of transit stations and support facilities, including a vehicle maintenance and storage facility and park and ride lots. Seven proposed transit stations are within the AIS study area, including: East Kapolei Station; University of Hawai‘i at West O‘ahu Station; Ho‘opili Station; West Loch Station; Waipahu Transit Center Station; Leeward Community College Station; and Pearl Highlands Station. Project construction will also require relocation of existing utility lines within the project corridor that conflict with the proposed project design. Minimally, land-disturbing activities would include grading of facility locations and excavations for guideway column foundations, subsurface utility relocation and installation, and facility construction.
Project Acreage	The approximately 156-acre Construction Phase I project area (which includes the western-most portion of Construction Phase II) consists of: the approximately 7 mile long transit corridor; seven transit stations (approximately 5 acres); four park-and-ride facilities (approximately 25 acres); and a vehicle maintenance and storage facility (approximately 44 acres).
Area of Potential Effect (APE) and Survey Acreage	The survey area for this AIS investigation included the entire approximately 156-acre project area. The Construction Phase I project's area of potential effect (APE) for archaeological cultural resources is defined as all areas of direct ground disturbance. Although the extent of ancillary subsurface impacts, for example those related to the relocation of existing utilities, is still to be determined, it is estimated that the project's area of direct ground disturbance / APE is approximately 75 acres.
Historic Preservation Regulatory Context	This document was prepared to support the proposed project's historic preservation review under Hawai‘i Revised Statutes (HRS) Chapter 6E-8 and Hawai‘i Administrative Rules (HAR) Chapter 13-275. Due to federal (FTA) funding, this project is a federal undertaking, requiring compliance with Section 106 of the National Historic Preservation Act (NHPA), the National Environmental Policy Act (NEPA), and Section 4(f) of the Department of Transportation Act. In consultation with SHPD, an AIS plan was prepared prior to conducting the current AIS investigation. The *Archaeological Inventory Survey Plan For Construction Phase I of the Honolulu High-Capacity Transit Corridor Project Station 392+00 (near East Kapolei Station) to Station 776+00 (near Waimano Home Road), Honouliuli, Hō‘ae‘ae, Waikele, Waipi‘o, and Waiawa Ahupua‘a, ‘Ewa District, O‘ahu* (Hammatt and Shideler 2009) was reviewed and accepted by SHPD in March 2009 (LOG NO: 2009.1325, DOC NO: 0903WT115).

Document Purpose	This AIS investigation was prepared in consideration of the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation, and was conducted to identify, document, and make National Register of Historic Places (National Register) and Hawai'i Register of Historic Places (Hawai'i Register) eligibility recommendations for the project area's archaeological cultural resources[1]. Identification and National/Hawai'i Register eligibility recommendations for the project area's architectural cultural resources, including historic roads, bridges, and structures, was conducted by historic architectural firm Mason Architects, Inc., in association with the project's Environmental Impact Statement (EIS) (USDOT/FTA and C&C/DTS 2008). In consultation with the Hawai'i State Historic Preservation Division (SHPD), this investigation was also designed to fulfill the State requirements for an AIS per Hawai'i Administrative Rules (HAR) Chapter 13-13-276. The investigation includes an undertaking-specific effect recommendation and treatment/mitigation recommendations for the cultural resources recommended National/Hawai'i Register eligible. This document is intended to support project-related historic preservation consultation among stake-holding federal and state agencies, interested Native Hawaiian groups and individuals, and community groups.
Fieldwork Effort	The CSH field crew included: Jeff Fong, M.A.; Matt McDermott, M.A.; David Shideler, M.A.; Jane Drengson, B.S.; Michelle Pammer, B.A.; Peter Moser-Samson, B.A.; Ena Sroat, B.A.; Douglas Thurman, B.A.; Jon Tulchin, B.A.; and Todd Tulchin, B.S.; under the general direction of Hallett H. Hammatt, Ph.D (principal investigator). Fieldwork was conducted between August 5 and October 14, 2009, and required approximately 125 person-days to complete.
Cultural Resources/Historic Properties[2] Identified and Recommended Eligibility to the National/Hawai'i Registers[3]	SIHP # 50-80-09-7751, subsurface cultural deposit (*lo'i* sediments), recommended National/Hawai'i Register-eligible under Criterion D
Effect Recommendation	This AIS investigation identified one cultural resource (SIHP # 50-80-09-7751) in the project area that may be affected by the proposed project. Under Hawaii State historic preservation review legislation, CSH's project-specific effect recommendation is "effect, with proposed mitigation commitments." Under federal historic preservation review legislation a project effect recommendation of "no adverse effect" is warranted, with the understanding that the proposed mitigation measures (described below) are carried out to mitigate the undertaking's potential effect to National register-eligible cultural resources.

Mitigation Recommendations[4]	SIHP # 50-80-09-7751, subsurface cultural deposit (*lo‘i* sediments): an archaeological data recovery program is recommended prior to project-related construction activities within the footprint of the *makai* (seaward) entrance building of the Waipahu Transit Center Station. In accordance with Hawai‘i Administrative Rules (HAR) 13-278 (governing archaeological data recovery programs), an archaeological data recovery plan should be prepared for review and approval of the SHPD. Once approved, the plan should be implemented prior to project-related construction activities in the vicinity. Based on the results of this AIS, other archaeological mitigation measures for the remainder of the HHCTCP Construction Phase I project area are unwarranted. If, in the unlikely event that subsurface cultural deposits or human skeletal remains are encountered during the course of project-related construction activities, all work in the immediate area should stop and the SHPD should be promptly notified.

[1]In historic preservation parlance, cultural resources are the physical remains and/or geographic locations that reflect the activity, heritage, and/or beliefs of ethnic groups, local communities, states, and/or nations. Generally, they are at least 50 years old, although there are exceptions, and include: buildings and structures; groupings of buildings or structures (historic districts); certain objects; archaeological artifacts, features, sites, and/or deposits; groupings of archaeological sites (archaeological districts); and, in some instances, natural landscape features and/or geographic locations of cultural significance.

[2]Historic properties, as defined under federal historic preservation legislation, are cultural resources that are at least 50 years old (with exceptions) and have been determined eligible for inclusion in the National Register of Historic Places based on their integrity and historic/cultural significance in terms of established significance criteria. Determinations of eligibility are generally made by a federal agency official in consultation with SHPD. Under federal legislation, a project's (undertaking's) potential effect on historic properties must be evaluated and potentially mitigated. Under Hawai‘i State historic preservation legislation, historic properties are defined as any cultural resources that are 50 years old, regardless of their historic/cultural significance under state law, and a project's effect and potential mitigation measures are evaluated based on the project's potential impact to "significant" historic properties (those historic properties determined eligible, based on their integrity and historic/cultural significance in terms of established significance criteria, for inclusion in the Hawai‘i Register of Historic Places). Determinations of eligibility to the Hawai‘i Register result when a state agency official's historic property "significance assessment" is approved by SHPD, or when SHPD itself makes an eligibility determination for a historic property.

[3]Cultural resource significance is evaluated and expressed as eligibility for listing on the National and/or Hawai‘i Register. To be considered eligible for listing on the National and/or Hawai‘i Register a cultural resource should possess integrity of location, design, setting, materials, workmanship, feeling, and association, and meet one or more of the following broad cultural/historic significance criteria: "A" reflects major trends or events in the history of the state or nation; "B" is associated with the lives of persons significant in our past; "C" is an excellent example of a site type/work of a master; "D" has yielded or may be likely to yield information important in prehistory or history; and, "E" (Hawaii Register only) has traditional cultural significance to an ethnic group, includes religious structures and/or burials.

[4]Under Hawai‘i State historic preservation review legislation, there are five potential forms of historic preservation mitigation: A) Preservation; B) Architectural Recordation; C) Archaeological Data Recovery; D) Historical Data Recovery; and E) Ethnographic Documentation (HAR Chapter 13-275-8).

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Section 1 Introduction

1.1 Project Background

At the request of Parsons Brinkerhoff (PB) and the City & County of Honolulu (C&C), Cultural Surveys Hawai‘i Inc. (CSH) completed an archaeological inventory survey (AIS) for Construction Phase I of the Honolulu High-Capacity Transit Corridor Project, Honouliuli, Hō‘ae‘ae, Waikele, Waipi‘o, Waiawa and Manana Ahupua‘a, ‘Ewa District, Island of O‘ahu (TMK: [1] 9-1, 9-4, 9-6, 9-7 various plats and parcels). The proposed Honolulu High-Capacity Transit Corridor Project (HHCTCP) extends approximately 23 miles from Kapolei in the west to the University of Hawai‘i at Mānoa and Waikīkī in the east. The focus of this AIS investigation is the western-most 7.4 miles of the overall project area (Figures 1-6).

This AIS study area includes all of Construction Phase I of the HHCTCP, which consists of an approximately 6.8-mile segment extending from North-South Road in East Kapolei to the Pearl Highlands Station, and the western portion of Construction Phase II, extending approximately 0.6 miles from the Pearl Highlands Station to Waimano Home Road in Pearl City. The AIS study area is depicted on the U.S. Geological Survey 7.5-Minute Series Topographic Map, Ewa (1998), Schofield Barracks (1998), and Waipahu (1998) Quadrangles. The western-most portion of Construction Phase II was included in this AIS study so that the historic preservation review process of at least a portion of the project’s Construction Phase II would be concluded well ahead of actual construction. **For the purposes of this investigation, the project area (7.4 linear miles) includes all of Construction Phase I (6.8 linear miles) and the western-most portion of Construction Phase II (0.6 linear miles).**

The AIS study area (all of Construction Phase I and the western portion of Construction Phase II) is primarily located within existing or planned road rights-of-way owned by the State of Hawai‘i or the City & County of Honolulu, including North-South Road, Farrington Highway, and Kamehameha Highway. The project corridor also traverses: agricultural lands privately owned by D.R. Horton; the Ewa Drum Filling and Fuel Storage Area, formerly owned by the U.S. Navy and now under State of Hawai‘i (Department of Hawaiian Home Lands) jurisdiction; and Leeward Community College, owned by the State of Hawai‘i. The support facilities along the project corridor are located on lands owned by various private land owners. Project related agencies include the City and County of Honolulu, the State Historic Preservation Division / Department of Land and Natural Resources (SHPD / DLNR), and the Federal Transit Administration (FTA).

The purpose of the proposed HHCTCP is to provide high-capacity rapid transit in the highly congested east-west transportation corridor between Kapolei and the University of Hawai‘i at Mānoa via a fixed guideway rail transit system. In addition to the guideway, the project will require construction of transit stations and support facilities, including a vehicle maintenance and storage facility and park and ride lots. Seven proposed transit stations are within the AIS study area, including: East Kapolei Station; University of Hawai‘i at West O‘ahu Station; Ho‘opili Station; West Loch Station; Waipahu Transit Center Station; Leeward Community College Station; and Pearl Highlands Station. Project construction will also require relocation of existing utility lines within the project corridor that conflict with the proposed project design. Minimally, land-disturbing activities would include grading of facility locations and excavations for guideway column foundations, subsurface utility relocation and installation, and facility construction.

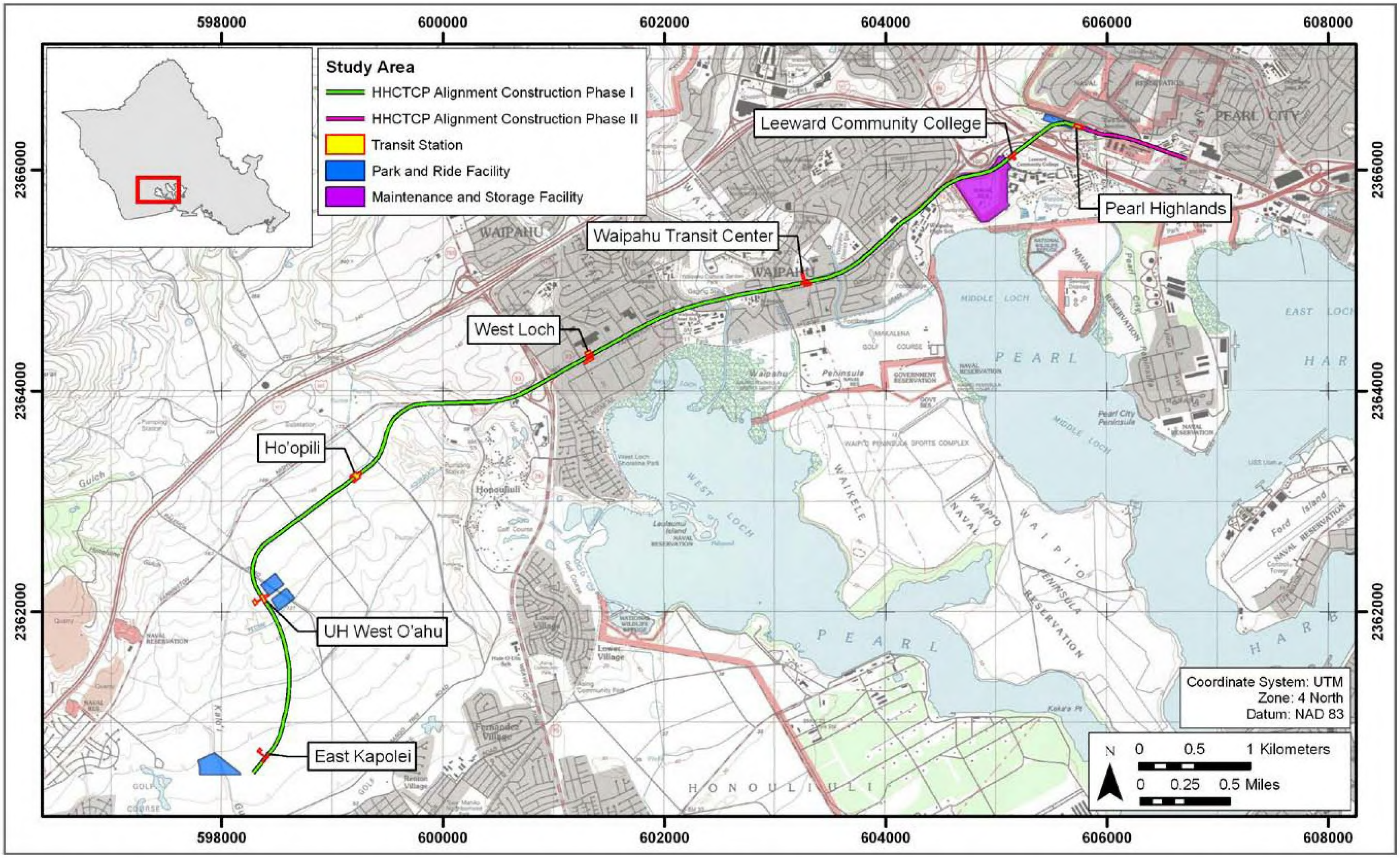

Figure 1. U.S. Geological Survey 7.5-Minute Series Topographic Map, Ewa (1998), Pearl Harbor (1999), Schofield Barracks (1998), and Waipahu (1998) Quadrangles, showing the locations of the project corridor and support facilities

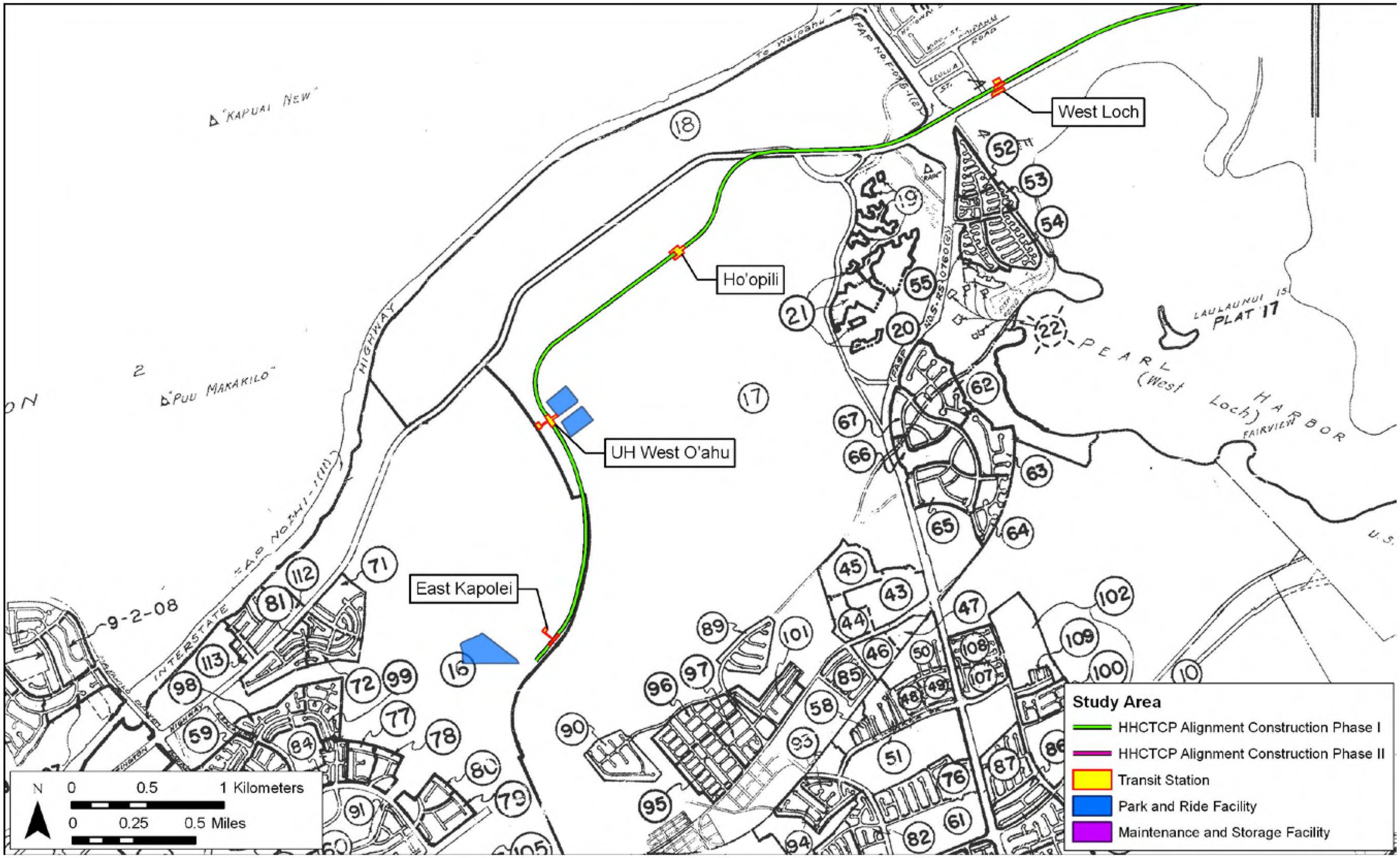

Figure 2. Portion of Tax Map Key 9-1, showing the locations of the project corridor and support facilities

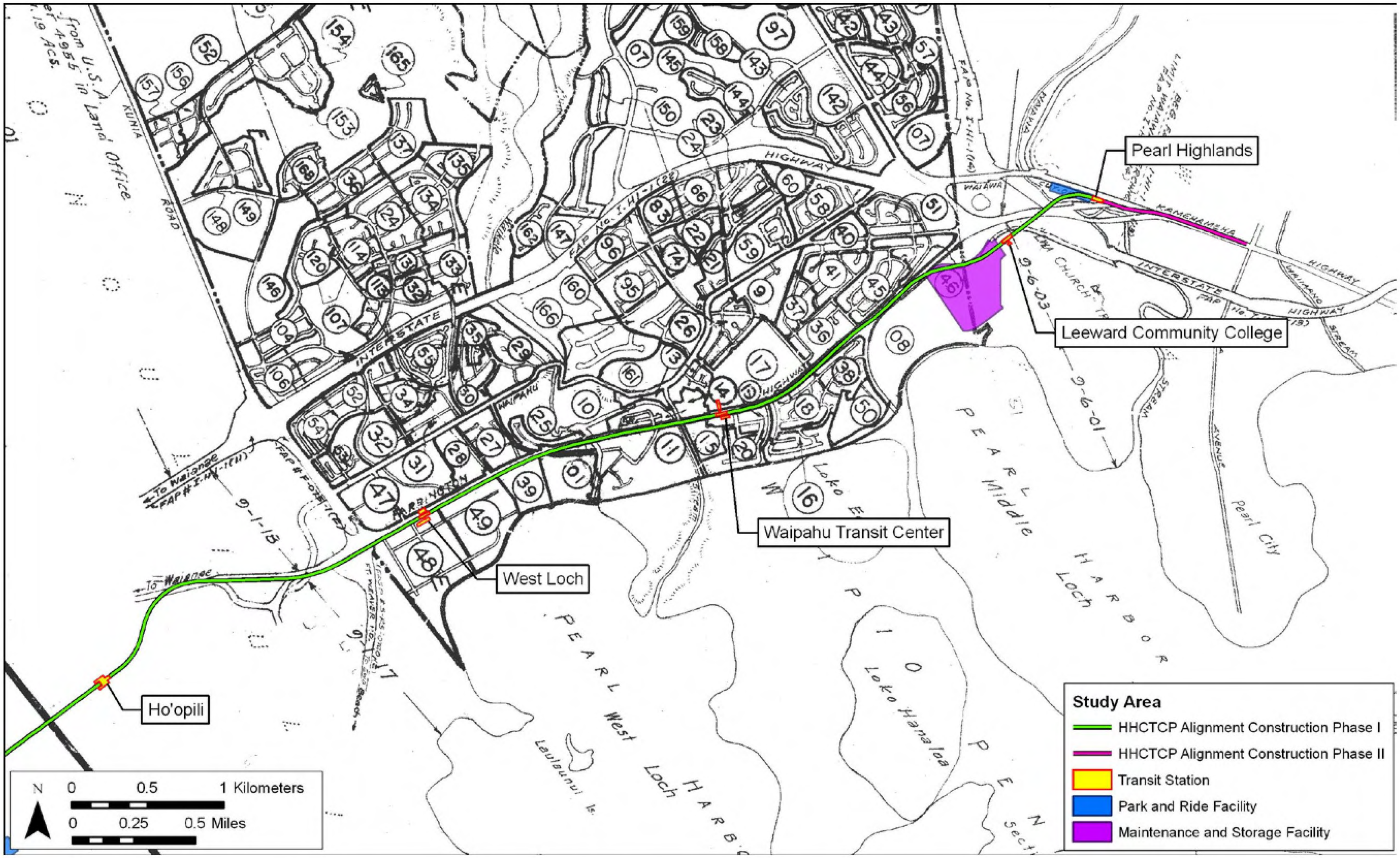

Figure 3. Portion of Tax Map Key 9-4, showing the locations of the project corridor and support facilities

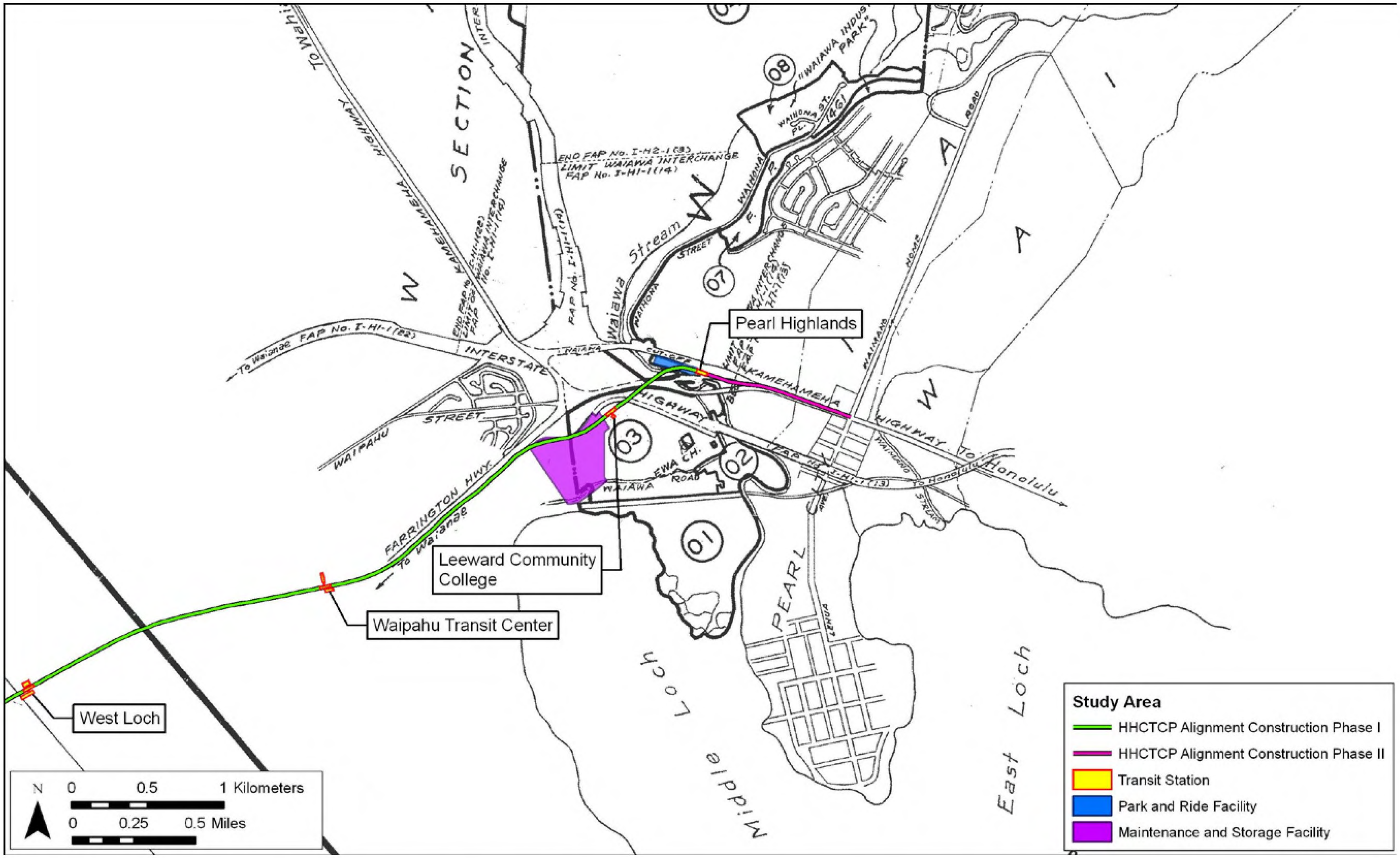

Figure 4. Portion of Tax Map Key 9-6, showing the locations of the project corridor and support facilities

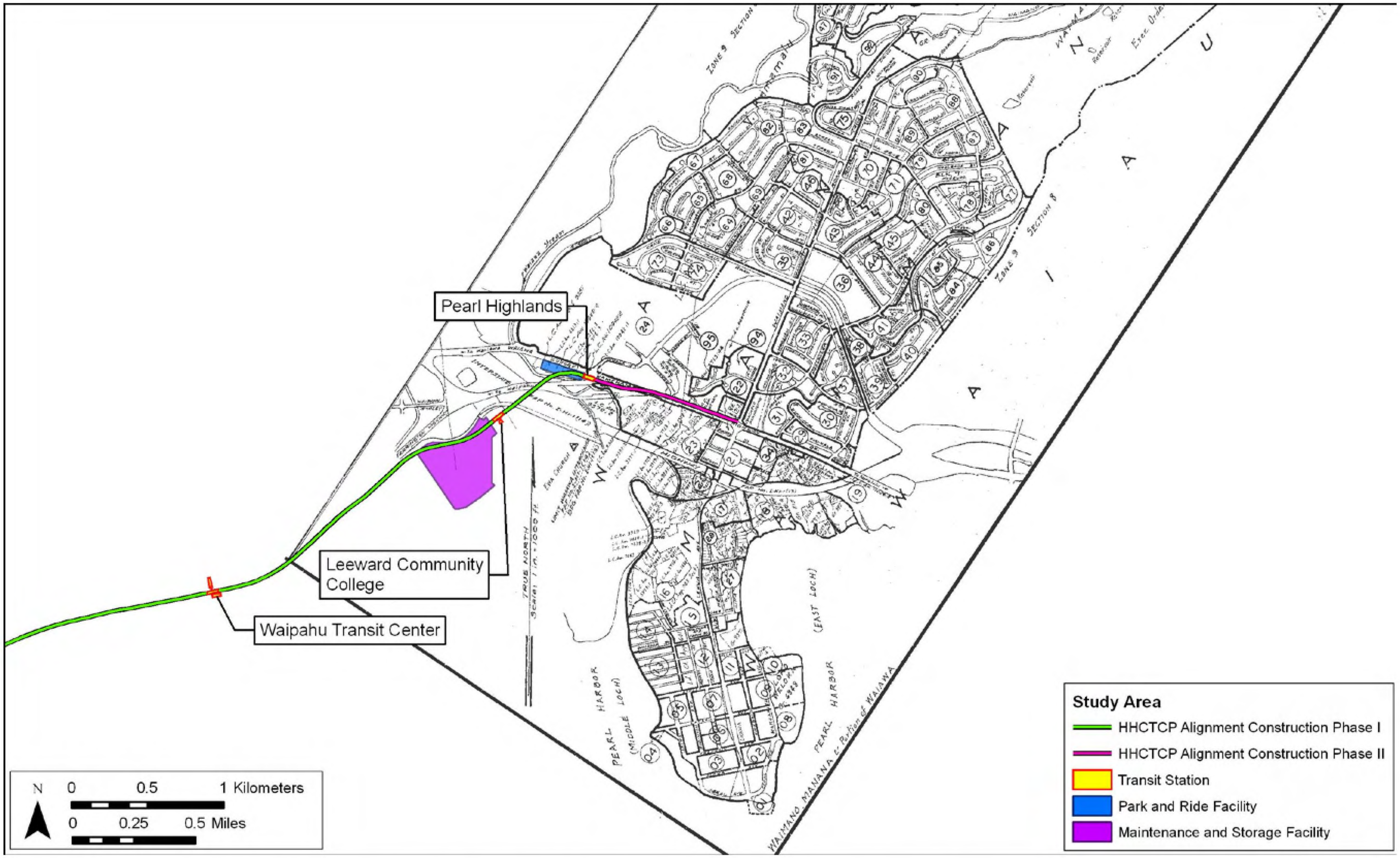

Figure 5. Portion of Tax Map Key 9-7, showing the locations of the project corridor and support facilities

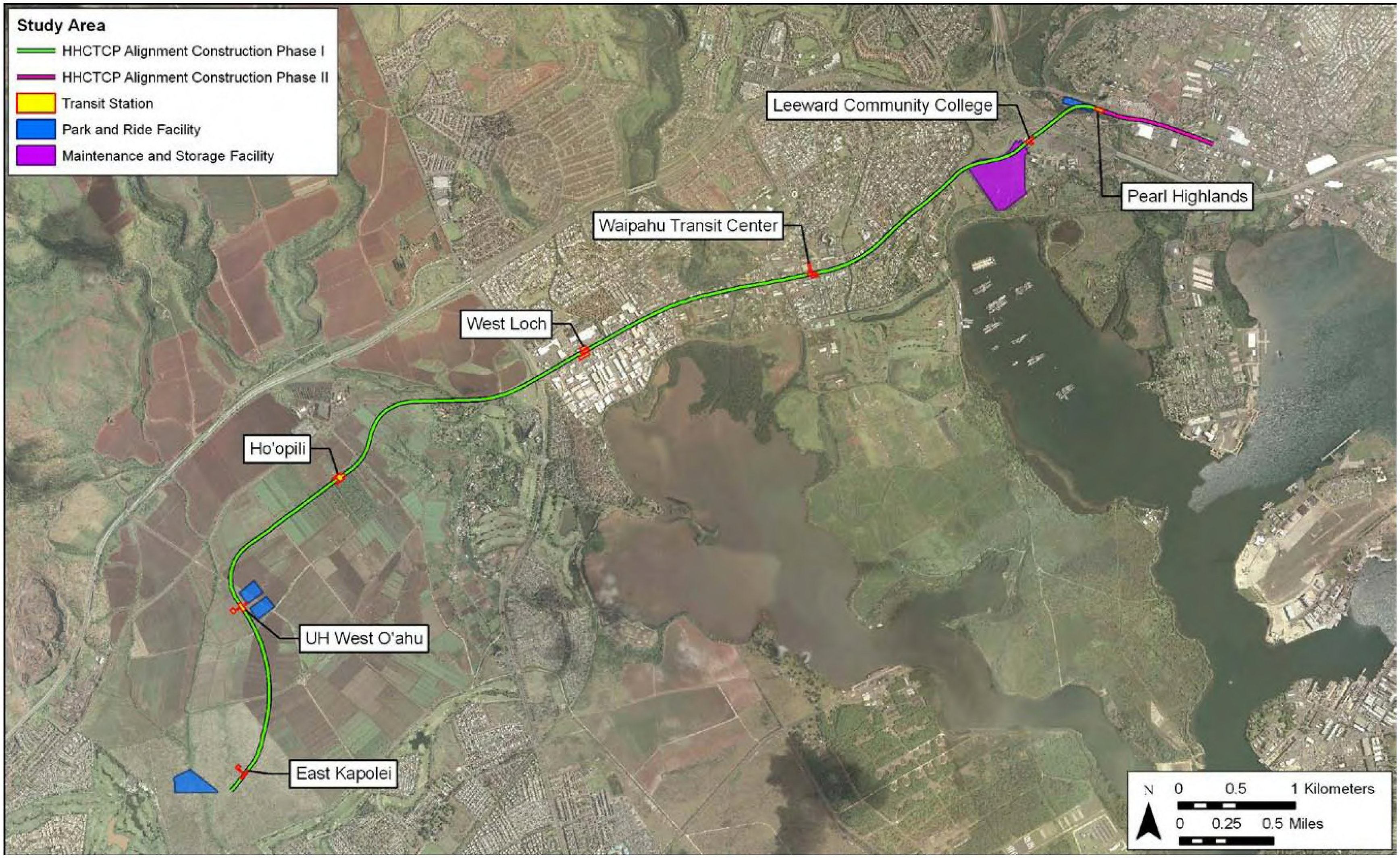

Figure 6. Aerial photograph (source: U.S. Geological Survey Orthoimagery 2005), showing the locations of the project corridor and support facilities

The approximately 156-acre Construction Phase I project area (which includes the western most portion of Construction Phase II) consists of: the approximately 7 mile long transit corridor; seven transit stations (approximately 5 acres); four park-and-ride facilities (approximately 25 acres); and a vehicle maintenance and storage facility (approximately 44 acres). The survey area for this AIS investigation included the entire approximately 156-acre project area. The Construction Phase I project's area of potential effect (APE) for subsurface cultural resources is defined as all areas of direct ground disturbance. Although the extent of ancillary subsurface impacts, for example those related to the relocation of existing utilities, is still to be determined, it is estimated that the project's area of direct ground disturbance / APE is approximately 75 acres.

This document was prepared to support the proposed project's historic preservation review under Hawai'i Revised Statutes (HRS) Chapter 6E-8 and Hawai'i Administrative Rules (HAR) Chapter 13-275. Due to federal (FTA) funding, this project is a federal undertaking, requiring compliance with Section 106 of the National Historic Preservation Act (NHPA), the National Environmental Policy Act (NEPA), and Section 4(f) of the Department of Transportation Act. In consultation with SHPD, an AIS plan was prepared prior to conducting the current AIS investigation. The *Archaeological Inventory Survey Plan For Construction Phase I of the Honolulu High-Capacity Transit Corridor Project Station 392+00 (near East Kapolei Station) to Station 776+00 (near Waimano Home Road), Honouliuli, Hō'ae'ae, Waikele, Waipi'o, and Waiawa Ahupua'a, 'Ewa District, O'ahu* (Hammatt and Shideler 2009) was reviewed and accepted by SHPD in March 2009 (LOG NO: 2009.1325, DOC NO: 0903WT115)—refer to Appendix A).

This AIS investigation was prepared in consideration of the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation, and was conducted to identify, document, and make National Register of Historic Places (National Register) and Hawai'i Register of Historic Places (Hawai'i Register) eligibility recommendations for the project area's archaeological cultural resources1. Identification and National/Hawai'i Register eligibility recommendations for the project area's architectural cultural resources, including historic roads, bridges, and structures, was conducted by historic architectural firm Mason Architects, Inc., in association with the project's Environmental Impact Statement (EIS) (USDOT/FTA and C&C/DTS 2008).

In consultation with the Hawai'i State Historic Preservation Division (SHPD), this investigation was also designed to fulfill the State requirements for an AIS per Hawai'i Administrative Rules (HAR) Chapter 13-13-276. The investigation includes an undertaking-specific effect recommendation and treatment/mitigation recommendations for the cultural resources recommended National/Hawai'i Register eligible. This document is intended to support project-related historic preservation consultation among stake-holding federal and state agencies, interested Native Hawaiian groups and individuals, and community groups.

This archaeological inventory survey investigation is designed to comply with both federal and Hawai'i state historic preservation legislation. Generally, under both Hawai'i state and federal historic preservation legislation, archaeological inventory surveys are designed to identify, document, and make significance recommendations for "historic properties." As discussed in the paragraphs below, there are important distinctions between the federal and Hawai'i State definitions of "historic property." To alleviate any confusion these different definitions might cause, CSH has opted in this document to use the more generic term "cultural resources," as defined below, in its discussion of the cultural remains within the current project area.

In historic preservation parlance, cultural resources are the physical remains and/or geographic locations that reflect the activity, heritage, and/or beliefs of ethnic groups, local communities, states, and/or nations. Generally, they are at least 50 years old, although there are exceptions, and include: buildings and structures; groupings of buildings or structures (historic districts); certain objects; archaeological artifacts, features, sites, and/or deposits; groupings of archaeological sites (archaeological districts); and, in some instances, natural landscape features and/or geographic locations of cultural significance.

Historic properties, as defined under federal historic preservation legislation, are cultural resources that are at least 50 years old (with exceptions) and have been determined eligible for inclusion in the National Register based on established significance criteria. Determinations of eligibility are generally made by a federal agency official in consultation with SHPD. Under federal legislation, a project's (undertaking's) potential effect on historic properties must be evaluated and potentially mitigated.

Under Hawai'i State historic preservation legislation, historic properties are defined as any cultural resources that are 50 years old, regardless of their significance under state law, and a project's effect and potential mitigation measures are evaluated based on the project's potential impact to "significant" historic properties (those historic properties determined eligible, based on established significance criteria, for inclusion in the Hawai'i Register). Determinations of eligibility to the Hawai'i Register result when a state agency official's historic property "significance assessment" is approved by SHPD, or when SHPD itself makes an eligibility determination for a historic property.

1.2 Overview of Proposed Project Construction

The design, method of construction, and timeline of the Honolulu High-Capacity Transit Corridor Project (HHCTCP) continue to be refined. This overview of proposed project construction is a synopsis of the information provided in Appendix E - Construction Approach of the HHCTCP Environmental Impact Statement (EIS).

1.2.1 Fixed Guideway and Transit Stations

The HHCTCP involves construction of a fixed guideway rail transit system that would consist primarily of elevated structures. The main components of the fixed guideway system are: the elevated guideway structure, guideway foundation columns, and transit stations. The guideway foundation columns generally consist of a single 6-foot diameter column spaced every 150 feet, with shorter or longer spans used where needed. The HHCTCP Construction Phase 1 includes approximately 250 guideway foundation columns. Transit stations generally consist of elevated platform structures with ground-level entrance buildings. The subsurface impacts associated with the fixed guideway and transit stations would be primarily associated with excavations for the guideway foundation columns and excavations associated with the construction of ground-level station buildings, including subsurface utilities, elevator shafts, etc.

Two methods would be used to construct the guideway foundations, dictated by structural demands and existing subsurface conditions. Drilled shafts are the preferred foundation excavation method, which involves: drilling with a 6- to 10-foot diameter auger to depths of 50 to 150 feet; installation of a rebar cage in the shaft; and filling the shaft with concrete. Driven-pile foundations would be constructed where lateral loads, geotechnical, or other site conditions prohibit the use of drilled shafts. Construction of driven-pile foundations involves: excavations to accommodate the pile cap; pile driving by striking the pile with a heavy weight, vibrating the pile or jacking the pile into the ground; and forming and casting the pile cap with concrete.

1.2.2 Support Facilities

Support facilities for the transit system include park-and-ride lots, a vehicle maintenance and storage facility, and traction power substations. These facilities would be constructed at ground-level, adjacent to the transit corridor. Subsurface impacts would include: grading of the facility locations and excavations for building foundations, subsurface utility installation, and landscaping.

1.2.3 Ancillary Impacts

Project construction will require relocation of existing utility lines within the project corridor that conflict with the proposed project design. The nature and extent of utility relocations in the Construction Phase I project area are still being determined.

Guideway foundation excavations will extend below the water table, creating significant need for the management of displaced water and/or drilling slurry. It is unclear at this time how wastewater and drilling slurry will be managed. De-watering pits may be excavated to temporarily collect and treat wastewater and drilling slurry prior to reuse or disposal.

Construction staging areas would be needed throughout the Construction Phase I project area to provide adequate space for construction equipment, stockpiling and transfer of construction materials, parking, and other construction-related activities. While the use of the proposed park and ride lots and the vehicle maintenance and storage facility areas have been identified as potential staging areas, additional locations would be needed. The locations of additional construction staging areas have not yet been determined. Grading of the construction staging areas may be necessary.

1.3 Scope of Work

The following scope of work satisfies State and County requirements for an archaeological inventory survey [per HAR 13-13-276]. The scope of work included:

1. Historic and archaeological background research, including a search of historic maps, written records, Land. Commission Award documents, and the reports from prior archaeological investigations. This research focused on the specific project area's past land use, with general background on the pre-contact and historic settlement patterns of the *ahupua'a* and district. The background information was used to compile a predictive model for the types and locations of historic properties that could be expected within the project area.
2. A complete (100%) systematic pedestrian inspection of the project area (with the exception of areas previously addressed in SHPD-accepted inventory surveys) for the

purpose of cultural resource identification and documentation. Surface cultural resources would be recorded with an evaluation of age, function, interrelationships, and significance. Documentation would include photographs, scale drawings, and limited controlled excavation of select features. Each cultural resource was assigned a Hawai‘i State Inventory of Historic Properties (SIHP) number.

3. Based on the project area's environment and the results of the background research, substantial subsurface testing with a combination of hand and backhoe excavation was conducted to identify and document subsurface cultural resources that would not be located by surface pedestrian inspection. Appropriate samples from these excavations were analyzed for cultural and chronological information. All subsurface cultural resources identified were documented to the degree possible, including geographic extent, cultural content, function/derivation, age, interrelationships, and significance.
4. Appropriate consultation with knowledgeable individuals regarding the project area's history, past land use, and the function and age of the cultural resources identified in the project area.
5. Appropriate laboratory work to process and gather relevant environmental and/or archaeological information from collected samples.
6. Preparation of this archaeological inventory survey report, including the following:
   a. A project description;
   b. A section of a U.S. Geological Survey topographic map showing the project area boundaries and the location of all recorded cultural resources;
   c. Historical and archaeological background sections summarizing pre-contact and post-contact land use of the Project area and its vicinity;
   d. Descriptions of all historic properties, including selected photographs, scale drawings, and discussions of age, function, laboratory results, and significance;
   e. If appropriate, a section concerning cultural consultations [per the requirements of HAR 13-276-5(g) and HAR 13-275/284-8(a)(2)];
   f. A summary of cultural resource categories, integrity, and significance based upon the National and Hawai‘i Registers of Historic Places evaluation criteria;
   g. A project effect recommendation;
   h. Treatment recommendations to mitigate the project's potential effect on any cultural resources identified in the project area that are recommended eligible to the National/Hawaii Registers of Historic Places.

This scope of work also included full coordination with the State Historic Preservation Division (SHPD), and City and County of Honolulu (C&C) relating to archaeological matters. This coordination took place after consent of Parsons Brinkerhoff (PB) and the C&C Rapid Transit Division (RTD).

1.4 Environmental Setting

Construction Phase I of the HHCTCP traverses two distinct geographic areas. This discussion of the project area's environmental setting includes the inland southwestern Honouliuli lands that were, as a generalization, relatively barren and little used prior to being placed under a century of sugar cane cultivation, and the lands on the margins of Pearl Harbor that were much more intensively used in traditional Hawaiian times and that have continued under fairly intensive habitation to the present time. For the purposes of this discussion, the east/west division between these geographic areas is defined as Kunia Road.

1.4.1 Construction Phase I West of Kunia Road

1.4.1.1 Natural Environment

The western portion of the Construction Phase I project area extends through the ‘Ewa Plain, seaward (*makai)* of the Wai‘anae Mountains. The ‘Ewa Plain is a Pleistocene (>38,000 years old) reef platform overlain by alluvium. The terrain consists of limestone and alluvial deposits, which overlie flows of the Wai‘anae volcanic series (MacDonald et al. 1983:423). In pre-contact Hawai‘i, the project area would have been covered by lowland dry shrub and grassland. However, the area has been extensively disturbed and transformed by human activity, and is now dominated by a variety of exotic grasses, weeds, and shrubs.

In the late 19th and early 20th centuries, the Ewa Plantation Company installed ditches running from the lower slopes of the Wai‘anae Mountains to the lowlands and then plowed the slopes vertically just before the rainy season to induce erosion (Frierson 1972:17). These activities relocated sediments from the higher, soil-rich slopes of the Wai‘anae Mountains down to the soil-poor Pleistocene limestone plains of the Kalaeloa area. Portions of the agricultural lands in Honouliuli were developed from this arable land expansion program. In traditional Hawaiian times, the areas of exposed coral outcrop were undoubtedly more extensive.

The western portion of the Construction Phase I project area receives an average of 24 inches of annual rainfall (Giambelluca et al. 1986). Honouliuli Stream is the only major stream traversed by the western portion of the Construction Phase I project area. Elevations within western portion of the Construction Phase I project area range from approximately 80 to 160 feet above mean sea level.

According to U.S. Department of Agriculture (USDA) soil survey data (Foote et al. 1972), sediments in western portion of the Construction Phase I project area include: Honouliuli Clay (HxA, HxB); Kawaihapai Clay Loam (KlA); Kunia Silty Clay (KyA); and Waipahu Silty Clay (WzA, WzB, WzC) (Figure 7).

Soils of Honouliuli Series are described as follows:

> This series consists of well-drained soils on coastal plains on the island of O‘ahu in the ‘Ewa area. These soils developed in alluvium derived from basic igneous material. They are nearly level and gently sloping. Elevations range from 15 to 125 feet. The annual rainfall amounts to 18 to 30 inches and occurs mainly between November and April. The mean annual soil temperature is 74° F.

> Honouliuli soils are geographically associated with 'Ewa, Lualualei, Mamala, and Waialua soils.
>
> These soils are used for sugar cane, truck crops, orchards, and pasture. The natural vegetation consists of kiawe, koa haole, fingergrass, bristly foxtail, and bermudagrass. [Foote et al. 1972]

Soils of the Kawaihapai Series are described as follows:

> This series consists of well-drained soils in drainage ways and on alluvial fans on the coastal plains on the islands of O'ahu and Moloka'i. These soils formed in alluvium derived from basic igneous rock in humid uplands.
>
> They are nearly level to moderately sloping. Elevations range from nearly sea level to 300 feet. The annual rainfall amounts to 30 to 50 inches. The mean annual soil temperature is 73° F. Kawaihapai soils are geographically associated with Haleiwa, Waialua, and Jaucas soils.
>
> These soils are used for sugar cane, truck crops, and pasture. The natural vegetation consists of *kiawe*, *koa haole*, lantana, and bermudagrass. [Foote et al. 1972]

Soils of the Kunia Series are described as follows:

> This series consists of well-drained soils on upland terraces and fans on the island of Oahu. These soils developed in old alluvium. They are nearly level to moderately sloping. Elevations range from 700 to 1,000 feet. The mean annual rainfall amounts to 30 to 40 inches, most of which occurs from November to April. The mean annual soil temperature is 71° F. Kunia soils occur on the foot slopes of the Waianae Range, near Schofield Barracks. They are geographically associated with Kolekole, Lahaina, and Wahiawa soils.
>
> These soils are used for sugarcane, pineapple, home sites, and military reservations. Most areas are cultivated, and the natural vegetation is not significant.

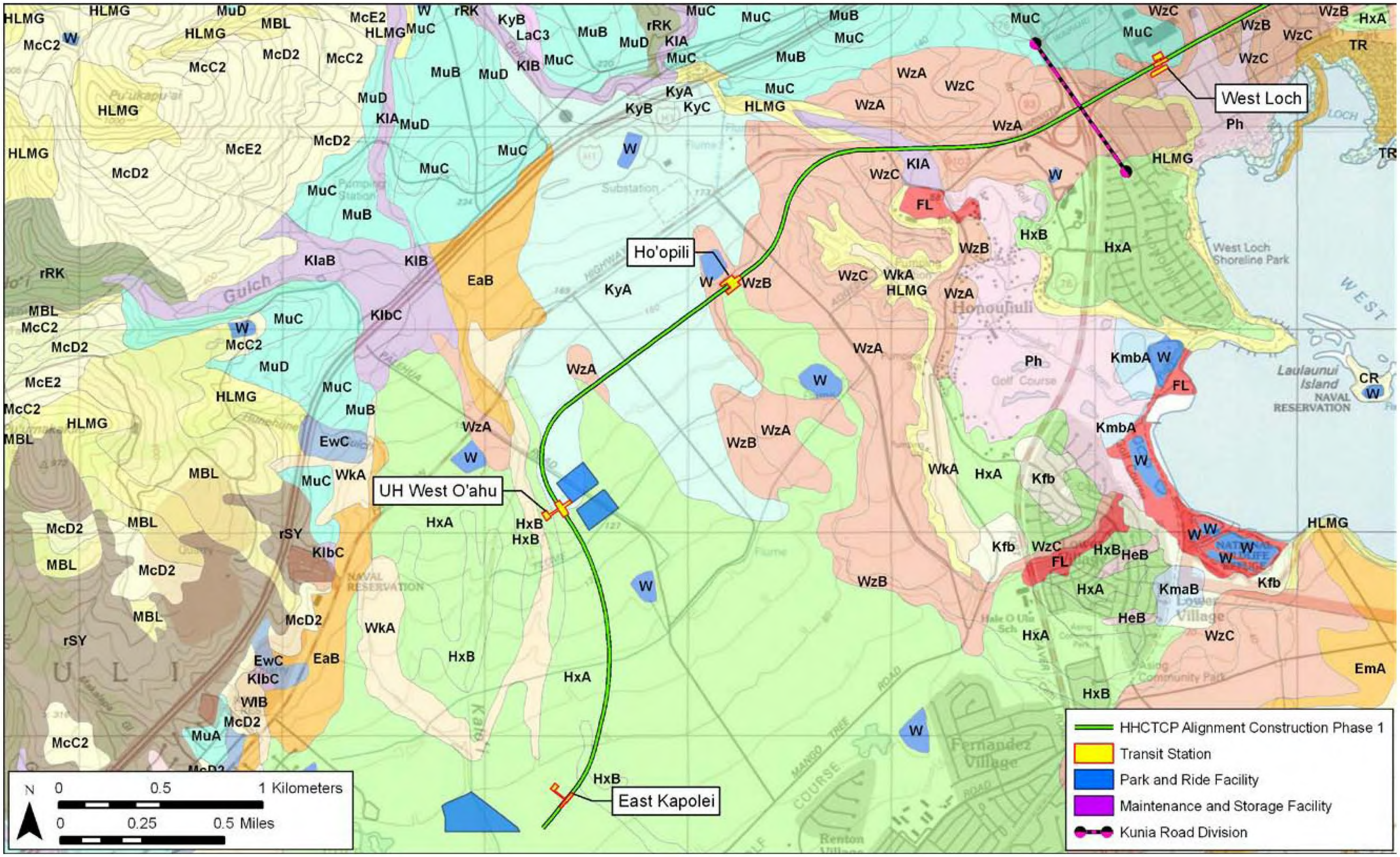

Figure 7. U.S. Geological Survey 7.5-Minute Series Topographic Map, Ewa (1998), Pearl Harbor (1999), Schofield Barracks (1998), and Waipahu (1998) Quadrangles, with overlay of the Soil Survey of Hawai'i (Foote et al. 1972), showing sediment types in the western portion of the Construction Phase I project area

Soils of the Waipahu Series are described as follows:

> This series consists of well-drained soils on marine terraces on the island of O'ahu. These soils developed in old alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevations range from nearly sea level to 125 feet. Rainfall amounts to 25 to 35 inches annually; most of it occurs between November and April. The mean annual soil temperature is 75° F. Waipahu soils are geographically associated with Hanalei, Honouliuli, and Waialua soils. [Foote et al. 1972]

The western portion of the Construction Phase I project area extends through a number of active agricultural fields. Vegetation outside of the cultivated fields consists predominantly of introduced perennial grasses and weeds, along with *kiawe* (*Prosopis pallida*) and *koa haole* (*Leucaena leucocephala*).

1.4.1.2 Built Environment

The western portion of the Construction Phase I project area has been drastically altered by historic and modern land use, including in particular intensive commercial sugar cane cultivation. In recent years, the western portion of the Construction Phase I project area has also been drastically altered by the construction of the North-South Road project and related infrastructure improvement projects. Aside from North-South Road project, the vicinity of the western portion of the Construction Phase I project area are generally consists of rural agricultural lands.

1.4.2 Construction Phase I East of Kunia Road

1.4.2.1 Natural Environment

The eastern portion of the Construction Phase I project area is generally located between 0.5 and 1 mile inland of the West and Middle Lochs of Pearl Harbor. Elevations within the eastern portion of the Construction Phase I project area range from 10 to 100 feet above mean sea level. The eastern portion of the Construction Phase I project area receives an average of 24 to 32 inches of annual rainfall (Giambelluca et al. 1986).

The largest stream traversed by the eastern portion of the Construction Phase I project area is Waikele Stream in Waikele Ahupua'a. The name Waikele translates as "muddy water" (Pukui et al. 1983), likely referring to the two permanent streams in the *ahupua'a*, Waikakalaua Stream and Kīpapa Stream, which flow through the Schofield Plateau and converge to form Waikele Stream in the lowland portion of the *ahupua'a*. These streams drain a "large expanse of lateritic soils of fine particle size [and therefore] the water would have appeared muddy in prehistoric times even during periods of normal flow" (Hammatt and Borthwick 1988). In addition to Waikele Stream, four smaller streams are traversed by the eastern portion of the Construction Phase I project area, including: Hō'ae'ae Stream, Kapakahi Stream, Makalena Stream, and Waiawa Stream.

According to USDA soil survey data (Foote et al. 1972), sediments in the eastern portion of the Construction Phase I project area include: Fill Land, mixed (FL); Helemano silty clay (HLMG); Honouliuli Clay (HxA); Kawaihapai Clay Loam (KlA); Molokai Silty Clay Loam

(MuB, MuC); Pearl Harbor Clay (Ph); Tropaquepts (TR); and Waipahu Silty Clay (WzA, WzB, WzC) (Figure 8).

Soils of the Honouliuli, Kawaihapai, and Waipahu Series are described in Section 1.4.1.1, above. Fill Land is described as follows:

> This land type occurs mostly near Pearl Harbor and in Honolulu, adjacent to the ocean. It consists of areas filled with material dredged from the ocean or hauled from nearby areas, garbage, and general material from other sources. Included in mapping were a few areas that have been excavated.
>
> This land type is used for urban development including airports, housing areas, and industrial facilities. [Foote et al. 1972]

Soils of the Helemano Series are described as follows:

> This series consists of well-drained soils on alluvial fans and colluvial slopes on the sides of gulches. These soils are on the island of Oahu. They developed in alluvium and colluvium derived from basic igneous rock. They are steep to extremely steep. Elevations range from 500 to 1,200 feet. The annual rainfall dominantly amounts to 30 to 60 inches but ranges to 75 inches at the highest elevations. The mean annual soil temperature is 72° F. Helemano soils are geographically associated with Lahaina, Leilehua, Manana, Molokai, and Wahiawa soils.
>
> These soils are used for pasture, woodland, and wildlife habitat. The natural vegetation consists of bermudagrass, Christmas berry, eucalyptus, Formosa koa, guava, Japanese tea, Java plum, and koa haole. [Foote et al. 1972]

Soils of the Molokai Series are described as follows:

> This series consists of well-drained soils on uplands on the islands of Maui, Lanai, Molokai, and Oahu. These soils formed in material weathered from basic igneous rock. They are nearly level to moderately steep. Elevations range mainly from nearly sea level to 1,000 feet but are as much as 1,500 feet on Lanai. The annual rainfall amounts to 20 to 25 inches, most of which occurs between November and April. The summers are hot and dry. The mean annual soil temperature is 73° F. Molokai soils are geographically associated with Holomua, Keahua, Lahaina, and Uwala soils.
>
> In this survey area a shallow variant of the Molokai series was mapped. This soil, Molokai silty clay loam, shallow variant, 15 to 25 percent slopes, severely eroded, is described in alphabetical order, along with other mapping units of this series.
>
> These soils are used for sugarcane, pineapple, pasture, wildlife habitat, and home sites. The natural vegetation consists of *kiawe*, *'ilima*, *uhaloa*, feather fingergrass, and buffalo grass. [Foote et al. 1972]

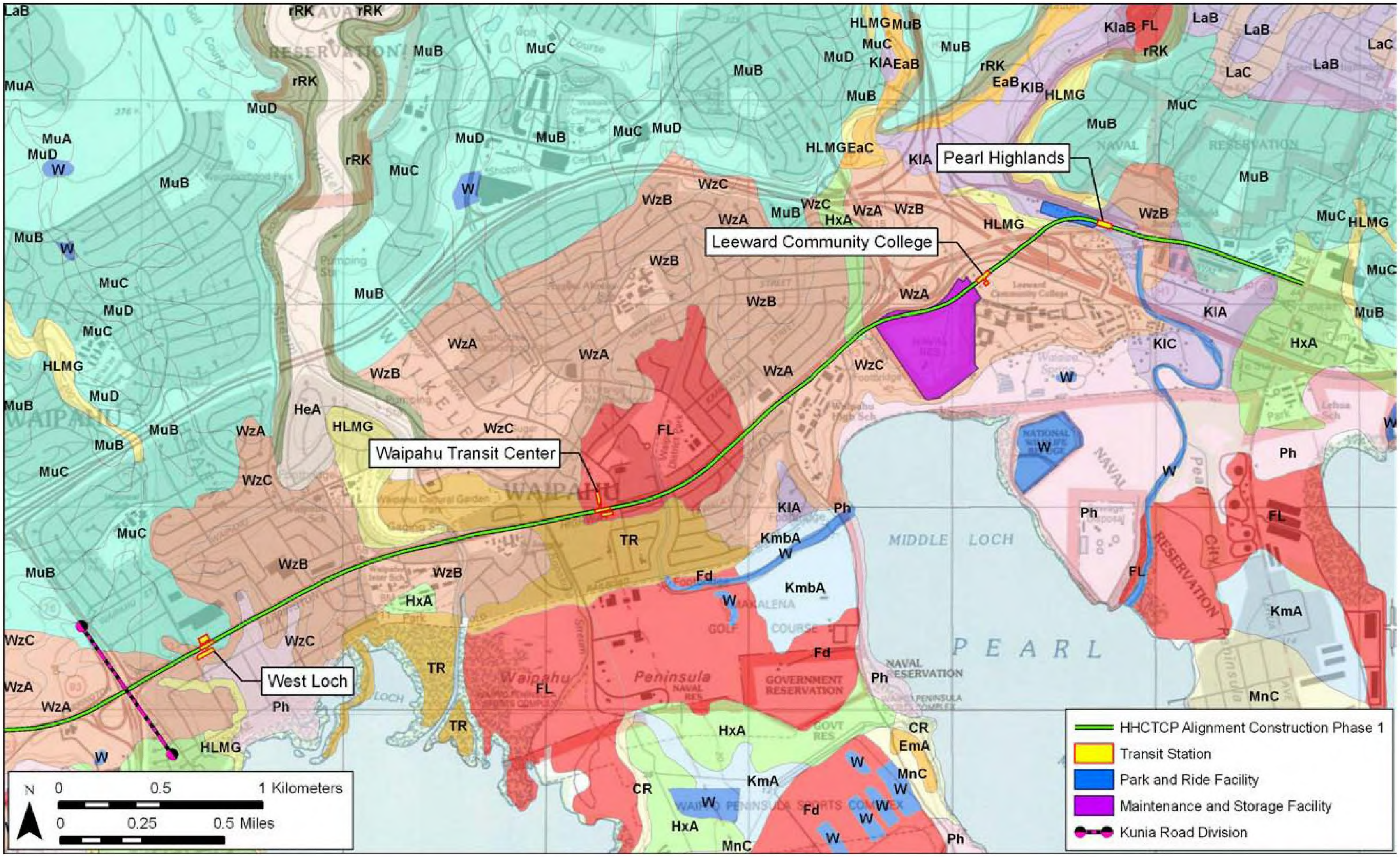

Figure 8. U.S. Geological Survey 7.5-Minute Series Topographic Map, Ewa (1998), Pearl Harbor (1999), Schofield Barracks (1998), and Waipahu (1998) Quadrangles, with overlay of the Soil Survey of Hawai'i (Foote et al. 1972), showing sediment types in the eastern portion of the Construction Phase I project area

Soils of the Pearl Harbor Series are described as follows:

> This series consists of very poorly drained soils on nearly level coastal plains on the island of Oahu. These soils developed in alluvium overlying organic material. Elevations range from nearly sea level to 5 feet. The annual rainfall amounts to 18 to 40 inches. The mean annual soil temperature is 74° F. Pearl Harbor soils are geographically associated with Hanalei, Kaloko, and Keaau soils.
>
> These soils are used for taro, sugarcane, and pasture. The natural vegetation consists of cattails, mangrove trees, California grass, and sedges. [Foote et al. 1972]

Soils of the Tropaquepts Series are described as follows:

> Tropaquepts (TR) are poorly drained soils that are periodically flooded by irrigation in order to grow crops that thrive in water. They occur as nearly level flood plains on the islands of Oahu and Maui. Elevations range from sea level to 200 feet. The annual rainfall amounts to 20 to 150 inches.
>
> These soils have been flooded for varying lengths of time, and soil development differs in degree from place to place. Generally, the surface layer, about 10 inches thick, consists of dark-gray, soft, mucky silt loam. This layer overlies firm to compact silty clay loam, 5 to 10 inches thick, that is mottled with gray, yellow, and brown. The mottled layer overlies friable alluvium.
>
> Tropaquepts are used for production of taro, rice, and watercress on flooded paddies. [Foote et al. 1972]

Vegetation in the eastern portion of the Construction Phase I project area consists primarily of grasses, shrubs, and introduced, non-native plants and trees used for landscaping.

1.4.2.2 Built Environment

The immediate vicinity of the intersection of Kunia Road and Farrington Highway, marks a distinct change in the built environment of the Construction Phase I project area, as the landscape abruptly transitions from rural and agricultural to an urban environment. East of Kunia Road, the project area continues through the towns of Waipahu and Pearl City, with the guideway centerline generally located within the median of Farrington Highway and Kamehameha Highway. Properties bordering the highways include a mix of commercial, industrial, and residential developments. Between Leeward Community College and the proposed Pearl Highlands Station, the project area traverses the H-1 Interstate Highway alignment. The immediate vicinity of the proposed Pearl Highlands Station is an exception to the predominantly urban environment. Lands bordering Waiawa Stream include the "banana patch" residential community that retains a rural character.

Section 2 Methods

2.1 Field Methods

The fieldwork component of the archaeological inventory survey investigation was carried out under archaeological permit number 09-20, issued by the Hawai'i State Historic Preservation Division/Department of Land and Natural Resources, per Hawai'i Administrative Rules Chapter 13-282. The CSH field crew included: Jeff Fong, M.A.; Matt McDermott, M.A.; David Shideler, M.A.; Jane Drengson, B.S.; Michelle Pammer, B.A.; Peter Moser-Samson, B.A.; Ena Sroat, B.A.; Douglas Thurman, B.A.; Jon Tulchin, B.A.; and Todd Tulchin, B.S.; under the general direction of Hallett H. Hammatt, Ph.D. Fieldwork was conducted between August 5 and October 14, 2009, and required approximately 125 person-days to complete.

2.1.1 Fieldwork Tasks

Fieldwork for this archaeological inventory survey investigation included the following:

1. Pedestrian survey of the Construction Phase I project area, including: the fixed guideway alignment; the East Kapolei, UH West O'ahu, Ho'opili, West Loch, Waipahu Transit Center, Leeward Community College, and Pearl Highlands stations; the East Kapolei, UH West O'ahu, and Pearl Highlands park and ride facilities.
2. Backhoe-assisted testing within the Construction Phase I project area, including: select guideway column foundation locations; the East Kapolei, UH West O'ahu, Ho'opili, West Loch, Waipahu Transit Center, Leeward Community College, and Pearl Highlands stations; the East Kapolei, UH West O'ahu, and Pearl Highlands park and ride facilities; and the vehicle maintenance and storage facility at the former U.S. Navy Ewa Drum Filling and Fuel Storage Area.
3. Ground penetrating radar (GPR) survey prior to backhoe-assisted testing within the Construction Phase I project area.

2.1.2 Pedestrian Survey

The pedestrian inspection of the Construction Phase I project area was accomplished through systematic sweeps. The interval between the archaeologists was generally 5 to 10 m. Along the major roads of the project area, archaeologists traversed the sidewalks and medians of the active thoroughfares. As previously discussed, identification and documentation of the project area's architectural cultural resources, including historic roads, bridges, and structures, was conducted by historic architectural firm Mason Architects, Inc., in association with the project's Environmental Impact Statement (EIS) (USDOT/FTA and C&C/DTS 2008).

2.1.3 Backhoe-Assisted Subsurface Testing

The backhoe-assisted subsurface testing program consisted of the excavation of 57 backhoe trenches and 35 column location test pits. In general, linear trenches measuring approximately 6 to 8 m long and 0.8 m wide were excavated at proposed station locations and rectangular test pits measuring approximately 2 by 2 m were excavated at guideway column foundation locations. Excavations were generally made to a depth of 2 m.

In general, test excavations were distributed throughout the project area to provide representative coverage and assess the stratigraphy and potential for subsurface cultural resources for the entire Construction Phase I project area. The reader is referred to the *Archaeological Inventory Survey Plan For Construction Phase I of the Honolulu High-Capacity Transit Corridor Project Station 392+00 (near East Kapolei Station) to Station 776+00 (near Waimano Home Road), Honouliuli, Hō'ae'ae, Waikele, Waipi'o, and Waiawa Ahupua'a, 'Ewa District, O'ahu* (Hammatt and Shideler 2009) for the details of the excavation sampling strategy employed by this archaeological inventory survey. The sampling strategy was developed in consideration of soil types, natural geographic features, historic records (particularly Land Commission Award data), the results of previous archaeological studies in the vicinity, the results of consultation with the Native Hawaiian community, an assessment of the impact of prior land development, and a consideration of safety concerns for actually carrying out the archaeological work. Selection of the sample of guideway column foundations to undergo subsurface testing was primarily based on the relationship to commoner (*kuleana*) Land Commission Awards as indicators of areas of intensive traditional Hawaiian activity. A secondary factor in selection was consideration of the proximity of landscape features, particularly streams. Subsurface testing was also focused on the station locations due to the relatively high density of subsurface impacts related to the stations' construction, and also because the stations would be problematic to re-locate owing to geographical and engineering constraints.

Each test excavation was documented with a scale section profile, photographs, and sediment descriptions. Sediment descriptions, using standard USDA soil description observations/terminology, included: Munsell color designations; texture; consistency; structure; plasticity; cementation; origin of sediments; descriptions of any inclusions, such as cultural material and/or roots and rootlets; lower boundary distinctiveness and topography; and other general observations. Cultural features were represented on the trench profile. Feature documentation included profiles and/or plan views, collected samples, stratigraphic descriptions, and photographs. The location of each test excavation was recorded using a Trimble ProXH GPS unit (sub-foot horizontal accuracy). Following appropriate documentation and sampling, each test excavation was backfilled, compacted, and restored to its original state.

2.1.4 Ground Penetrating Radar Survey

The ground penetrating radar (GPR) survey was performed using a Geophysical Survey Systems, Inc. (GSSI) SIR-3000 system equipped with 400 MHz antenna. This is a bistatic system, in which electromagnetic energy in the radar frequency range is transmitted into the ground via a sending antenna. Radar energy is reflected off of the subsurface matrix and is then received by another, paired antenna. Reflected energy is sampled and the travel time (in nanoseconds) of the individual reflection waves is recorded. Wave propagation speed varies depending on the nature of the subsurface medium. Any changes in density or electromagnetic properties within the stratigraphic column may cause observable variations in reflection intensity. Reflection features may include discrete objects, stratigraphic layering, or other subsurface anomalies.

The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits within the Construction Phase I project area. The effectiveness of GPR is highly dependent on local soil conditions. The high signal attenuation rate of many soil types restricts the depth of radar penetration and therefore limits the effectiveness of GPR surveys. The National Resource Conservation Service produced maps indicating the relative suitability of GPR applications throughout the U.S. The GPR suitability data was generated based on U.S. Department of Agriculture (USDA) soil survey data. Figure 9 shows the Construction Phase I project area on the NRCS GPR Suitability Map for Hawaiʻi. The project area is shown to traverse lands in the moderate to low suitability categories.

GPR survey for this project was conducted using single-run transects to generate two-dimensional (2D) depth profiles. GPR was conducted at locations selected for subsurface testing to prospect for subsurface anomalies and stratigraphic interfaces prior to excavation, as these could correspond to isolated archaeological features or sediments that are more likely to contain cultural deposits (i.e. buried A-horizons). Following the completion of subsurface testing, the documented stratigraphy was referenced against the GPR profiles to establish if there were patterns in the GPR data that may be associated with stratigraphic interfaces, sediment types, and subsurface features (i.e. trash pits, construction debris, etc.).

GPR data collection parameters (Table 1) were held constant throughout the survey under the assumption that soil conditions were relatively consistent across the study area. A dielectric constant[1] of 8 was utilized in anticipation of the presence of alluvial sediments (silts and clays) within the project area based on the USGS soil survey of the area (Foote et al. 1972). Estimated depth of view is 2 m.

All collected radar data was post-processed using RADAN 6.6 software. Position correction was utilized to remove unwanted surface "noise" from GPR profiles. Horizontal stretching was utilized in order to obtain greater detail for comparison with stratigraphic trench profiles. A Horizontal High Pass Finite Impulse Response "Boxcar" (Background Removal) filter was not utilized in order to retain the image of recorded stratigraphic layers.

Table 1. GPR Data Collection Parameters

Parameter	Settings
Antenna	400 MHz
Samples per Scan	512
Format	16-bit
Depth	2 meters
Dielectric	8
Soil	Type 2
Scans per Unit	50/m

[1] The measure of the ability of a material to store a charge from an applied electromagnetic field and then transmit that energy. In general, the greater the dielectric constant of a material, the slower radar energy will move through it. The dielectric constant is a measurement of how well radar energy will be transmitted to depth.

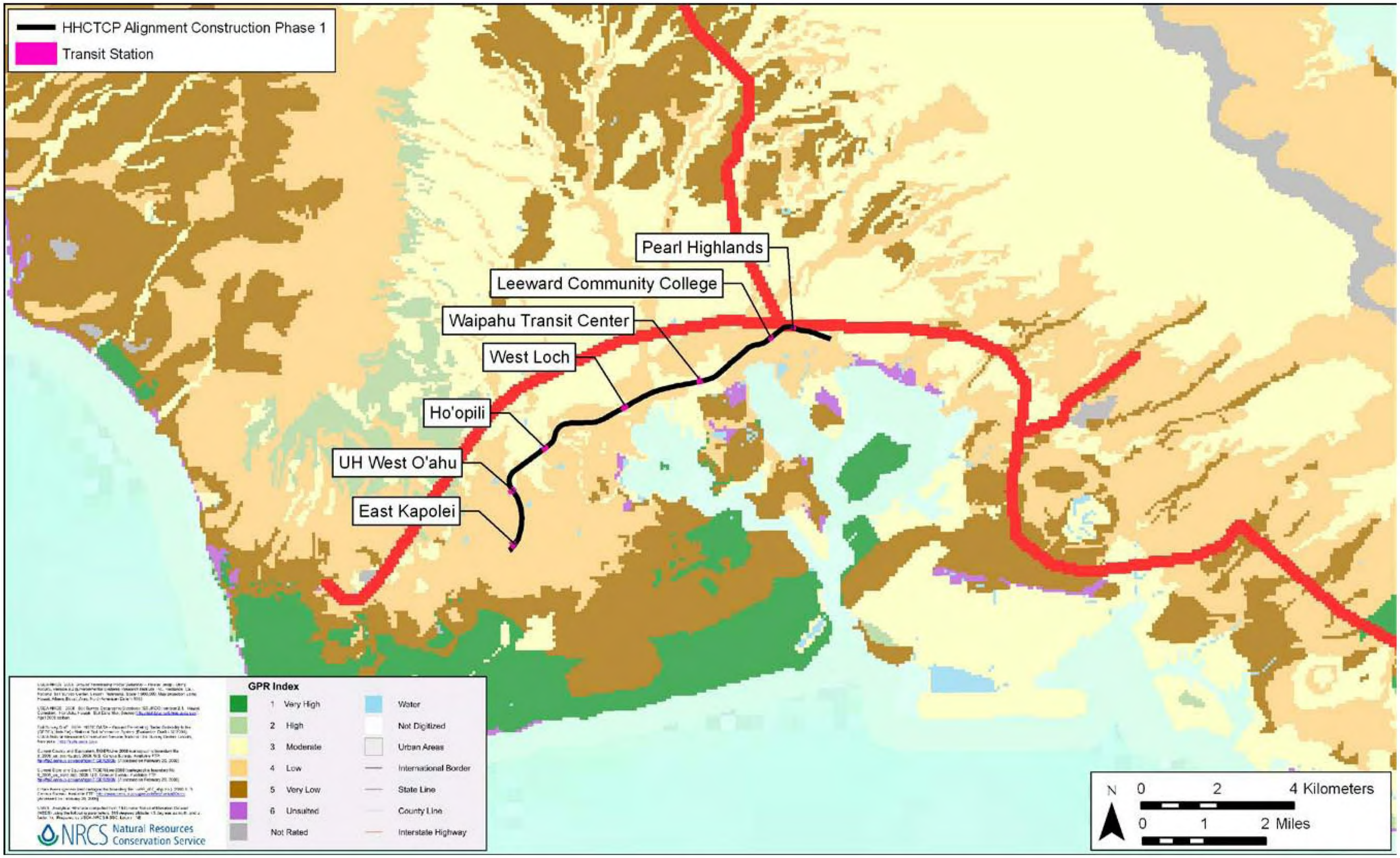

Figure 9. Ground penetrating radar (GPR) suitability map (source: National Resource Conservation Service) showing the project area

2.2 Document Review

Historic and archival research included information obtained from the UH Mānoa Hamilton Library, the State Historic Preservation Division Library, the Hawai‘i State Archives, the State Land Survey Division, and the Archives of the Bishop Museum. Previous archaeological reports for the area were reviewed, as were historic maps and primary and secondary historical sources. Information on Land Commission Awards was accessed through Waihona ‘Āina Corporation's Māhele Data Base (www.waihona.com).

2.3 Laboratory Methods

Following the completion of fieldwork, all collected materials were analyzed using current standard archaeological laboratory techniques. Three samples of organically enriched sediment were sent to Beta Analytic, Inc. of Miami, Florida for radiocarbon dating analysis. All samples were analyzed using the Accelerator Mass Spectrometer (AMS) method. The conventional radiocarbon ages determined by Beta Analytic, Inc. were calibrated to calendar ages using the OxCal calibration program, Version 3.10, developed by the University of Oxford Radiocarbon Accelerator Unit (ORAU), and available as share-ware over the Internet (http://c14.arch.ox.ac.uk/**oxcal**.html). The results of the radiocarbon dating analysis are presented in Section 5: Results of Laboratory Analyses of this report.

Upon conclusion of the project all materials collected will remain curated at the Cultural Surveys Hawai‘i, Inc. office in Waimānalo, Oahu until a permanent curation facility is determined by the project proponents and SHPD/DLNR.

Section 3 Background Research

Construction Phase I of the HHCTCP traverses two distinct geographic areas. This discussion of the project area's cultural history includes the inland southwestern Honouliuli Ahupua'a lands that were, as a generalization, relatively barren and little used prior to being placed under a century of sugar cane cultivation, and the Hō'ae'ae, Waikele, Waipi'o, and Waiawa Ahupua'a lands on the margins of Pearl Harbor that were much more intensively used in traditional Hawaiian times and that have continued under fairly intensive habitation to the present time. Figure 10 shows the boundaries of the *ahupua'a* traversed by the project area.

3.1 Mythological and Traditional Accounts

3.1.1 Honouliuli Ahupua'a

3.1.1.1 Traditions of Hawaiian Gods and Demi-gods

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 whom have strong connections with Kahiki (Kamakau 1991a:111; Pukui et al. 1974:200). The collection of myths and traditions presented in this section focus on the central portion of Honouliuli Ahupua'a, in areas near the HHCTCP Construction Phase I project area, and areas near Pearl Harbor.

3.1.1.2 The Naming of 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]

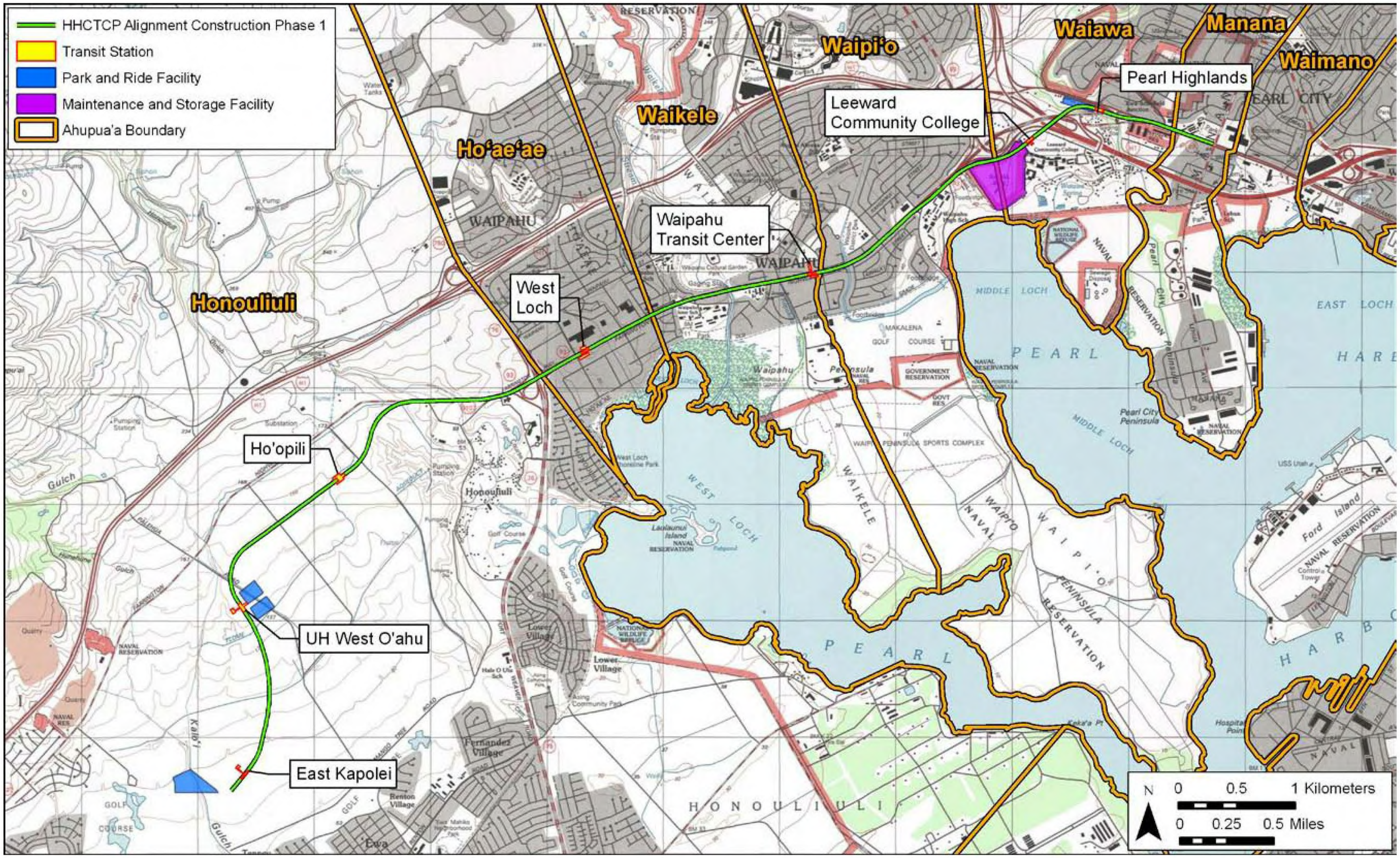

Figure 10. U.S. Geological Survey 7.5-Minute Series Topographic Map, Ewa (1998), Pearl Harbor (1999), Schofield Barracks (1998), and Waipahu (1998) Quadrangles, showing the boundaries of the *ahupuaʻa* traversed by the project area

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. The land of Honouliuli was named for the grandfather of Lepeamoa (Westervelt 1923:164-184).

It is likely that the boundaries of the western-most *ahupua‘a* of ‘Ewa were often contested with people of the neighboring Wai‘anae District. The ‘Ewa people could cite divine sanction that the dividing point was between two hills at Pili o Kahe:

> This is a spot where two small hills of the Waianae range come down parallel on the boundary between Honouliuli and Nanakuli (Ewa and Waianae). The ancient Hawaiians said the hill on the Ewa side was the male and the hill on the Waianae side was female. The stone was found on the Waianae side hill and the place is known as Pili o Kahe (Pili = to cling to, Kahe = to 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]

Honouliuli has a number of topographic features, peaks, streams, gulches, coastal points, and a number of ancient villages, as shown on Figure 11. A list of the names shown on Figure 11 and their meaning is presented in Table 2. All place names meanings are from Pukui et al. (1974) *Place Names of Hawai‘i*, unless otherwise noted.

3.1.1.3 Trails through Honouliuli

There were several pre-contact/early historic trails across ‘Ewa: a cross-*ahupua‘a* trail that traversed ‘Ewa and connected Honolulu to Wai‘anae; a *mauka-makai* trail that branched off from the cross-*ahupua‘a* trail and followed the boundary between Honouliuli and Hō‘ae‘ae to the Pōhākea Pass and Kolekole Pass to Wai‘anae; and a second branching *mauka-makai* trail that generally followed the path of Waikele Stream in Waikele Ahupua‘a to Wahiawā in central O‘ahu (Figure 12). Of the first *mauka-makai* trail, ‘Ī‘ī (1959:97) noted “from Kunia the trail went to the plain of Keahumoa, on to Maunauna, and along Paupauwela, which met with the trails from Wahiawā and Waialua.” ‘Ī‘ī places the area called Kunia east of Pōhākea Pass in the *ahupua‘a* of Honouliuli and Hō‘ae‘ae, *makai* of the modern town of Kunia, and places the plain of Keahumoa between Kunia and Paupauwela, in the most *mauka* portion of Honouliuli. The trail passed near the peak called Maunauna in upper Honouliuli.

The HHCTCP Construction Phase I project area generally follows or parallels the cross-*ahupua‘a* trail across the Honouliuli plain. To the east of Honouliuli, this trail was just *mauka* of the floodplains near Pearl Harbor, skirting the inland edges of the productive taro fields. In western Honouliuli, the trail dipped down toward the coast in the direction of a prominent hill and landmark, Pu‘uokapolei. The trail then crossed into Wai‘anae at the coast near Pili o Kahe, the stone that marked the boundary between the ‘Ewa and Wai‘anae districts (Figure 12).

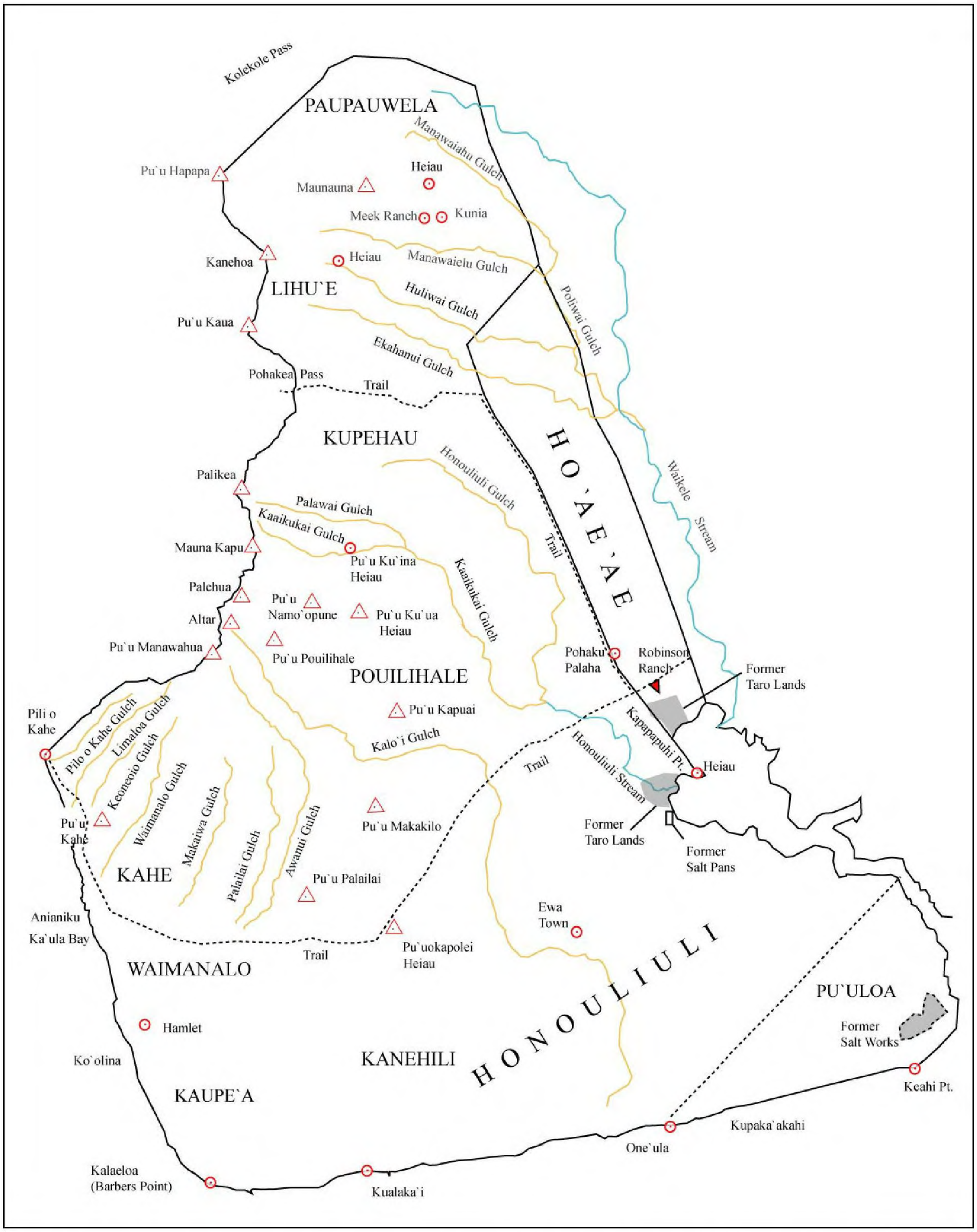

Figure 11. Place Names of Honouliuli (base map 1998 U.S.G.S. map). Note the modern Farrington Highway generally follows the ancient cross-*ahupua'a* trail

Table 2. Honouliuli Place Names

Place Name	Meaning
Akupu Spring	--
Anianikū Cove	--
Awanui Gulch	---
‘Ēkahanui Gulch	Large bird's nest fern
Hāpapa, Pu‘u	Rock stratum hill; a shallow soil (Thrum 1922:643)
Honouliuli Stream/Gulch	Dark bay; blue harbor (Thrum 1922:643)
Huliwai Gulch	--
Ka‘aikukui Gulch	The candlenut root
Ka‘aumakua (peak)	The family god
Kahe Point	Flow
Kahe, Pu‘u	Flow
Kaihuopala‘ai (West Loch)	The nose of Pala‘ai
Kalaeloa Point	The long point
Kalo‘i Gulch	The taro patch
Kānehili Plain	--
Kānehoa, Pu‘u	Named for native shrubs; Kāne's friend (Thrum 1922:643)
Kapapapuhi (Kapapuhi) Point	The numerous eels (Thrum 1922:645)
Kapolei, Pu‘u o (hill, *heiau*)	Beloved Kapo, a sister of Pele
Kapuai (peak)	Footstep (Thrum 1922:645)
Kaua, Pu‘u	War hill or fort hill
Kaula Bay	--
Kaupe‘a Plain	--
Keon‘ō‘io Gulch	The sandy place with bone *(‘ō‘io*) fish
Kolekole Pass	Raw, scarred
Ko‘olina (village)	--
Kualaka‘i (village)	*Tethys* (a sea creature)
Ku‘ina, Pu‘u (peak; *heiau*)	--
Kupaka‘akahi (beach)	--
Ku‘ua, Pu‘u (peak; *heiau*)	Relinquished hill
Laulaunui Island	Large leaf package

Place Name	Meaning
Limaloa Gulch	Long arm
Makaīwa Gulch	Mother of pearl eyes
Makakilo, Pu'u	Observing eyes
Manawahua, Pu'u	Great grief hill or nausea hill
Manawaiahu Gulch	--
Manawaielu Gulch	--
Maunakapu (peak)	Sacred mountain
Maunauna (peak)	Mountain sent on errands
Mo'opune, Pu'u	Grandchild hill
One'ula (village)	Red sand
Pālailai Gulch	Young *lai* fish
Pālailai, Pu'u	Young *lai* fish hill
Pālehua (peak)	*Lehua* flower enclosure
Palikea (peak)	White cliff
Pili o Kahe Point	Clinging to Kahe
Pōhākea Pass	White stone
Pōhaku Palaha	Broad rock (Thrum 1922:666)
Poliwai Gulch	Water bosom
Pouilihale, Pu'u	Dark house hill
Wai'eli Gulch	Dug water
Waimānalo Gulch	Potable water

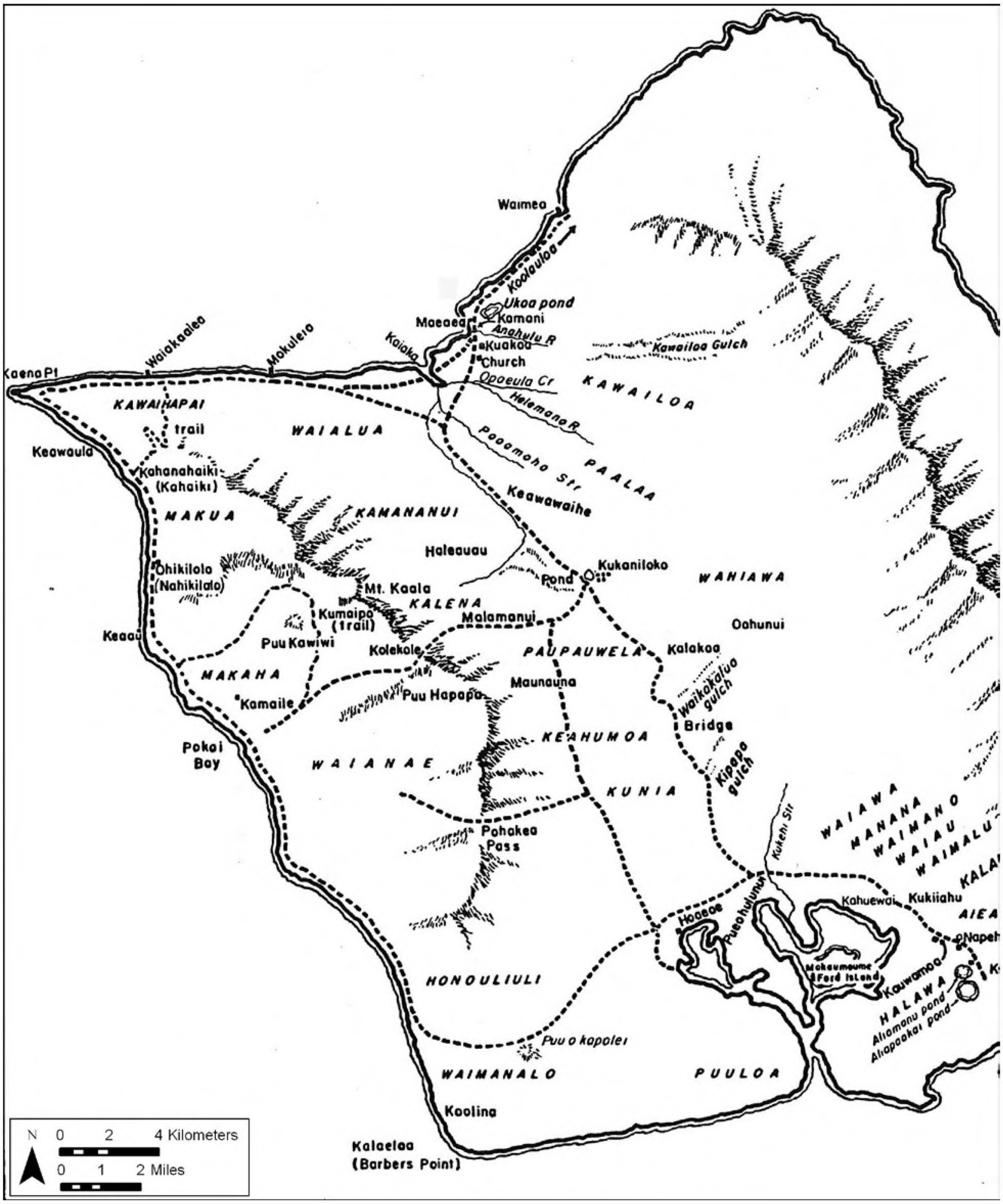

Figure 12. Trails of Leeward O'ahu, map by Paul Rockwood ('Ī'ī 1959:96)

3.1.1.4 Pu'uokapolei and the Plains of Kaupe'a

Pu'uokapolei was the primary landmark for travelers on the cross-*ahupua'a* trail that ran from Pearl Harbor in the east to Wai'anae in the west ('Ī'ī 1959:27, 29; Nakuina 1992:54; E.M. Nakuina 1904, in Sterling and Summers 1978:34). The plain southwest of the hill was called Kaupe'a.

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'uokapolei as an astronomical marker to designate the seasons.

> …the O'ahu people who reckoned the time (*Oahu pō'e helu*) called the season Kau for the setting of the sun from Pu'uokapolei, a hill in Honouliuli, 'Ewa, to the opening of Mahinaona (*i ke kawaha o Mahinaona*). When the sun moved south from Pu'uokapolei—and during the season of the sun in the south—for the coming of coolness and for the sprouting of new buds on growing things—the season was called Ho'oilo [winter, rainy season].

A *heiau* was once on Pu'uokapolei, but had been destroyed by the time of 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 making astronomical observations (Fornander 1919, *A Lamentation for Kahahana*, Vol. VI, Part II: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 1993:41). 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 (1919, *A Lamentation for Kahahana*, Vol. VI, Part II: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 Kānehili, *makai* of the hill.

Pu'uokapolei and Kamapua'a

Pu'uokapolei was the home of Kamapua'a's grandmother, Kamaunuaniho, one of the three migrants from Kahiki that were ancestors to the people of O'ahu (Fornander 1919, *Legend of Kamapuaa*, Vol. V, Part II:318; Kahiolo 1978:81, 107). Kamapua'a, the Hawaiian pig god, once lived in Kaluanui on the windward side of O'ahu, but he 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 Kekeleaiku, the older brother of Kamapua‘a, who also lived on Pu‘uokapolei.

Pu‘uokapolei and the Plains of Kaupe‘a and Kānehili

Hi‘iaka sang this bitter chant addressed to Lohiau and Wahine-‘ōma‘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,	We meet at Ewa’s leaf-shaped lagoon, friends;
Mai ke kula o Pe‘e-kaua, ke noho oe,	Let us sit, if you will on this lea
E noho kaua e kui, e lei i ka pua o ke kauno‘a,	And bedeck us with wreaths of Kauno‘a,
I ka pua o ke akuli-kuli, o ka wili-wili;	Of akuli-kuli and wili-wili,
O ka iho‘na o Kau-pe‘e i Kane-hili,	My soul went astray in this solitude;
Ua hili au; akahi no ka hili o ka la pomaika‘i;	It lost the track for once, in spite of luck,
E Lohiau ipo, e Wahine-oma‘o,	As I came down the road to Kau-pe‘a.
Hoe ‘a mai ka wa‘a i a‘e aku au.	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 1993:162-163].

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 1993:162). In the chant, Hi‘iaka is moving downhill from Kaupe‘a, probably the plains adjacent to Pu‘uokapolei, toward the coast to the plain of Kānehili.

The Plains of Kaupe‘a, 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 ream 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 Hālawa, ‘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 ‘ole 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 1991a: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 1991a:49]

The breadfruit tree Leilono was said to have been located on the ‘Ewa-Honolulu border, above Āliamanu. In another section of his account of the dead, Kamakau (1991a:29) 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‘uokapolei 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 foster father, the Maui chief Kahekili, after Kahahana became treacherous and killed the high priest Ka‘opulupulu.

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	*E hanehane mai ana ka la i na*
women of Kamao,	*wahine o Kamao,*
A hiding god, blossoming	*Akua pee,*
ohai of the banks,	*pua ohai o ke kaha,*
Contented among the stones-	*I walea wale i ke a-*
Among the breadfruit	*I ka ulu*
planted by Kahai.	*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, *A Lamentation for Kahahana*, Vol. VI, Part II:297]

Fornander provides some notes on this lament. The god dwelling at Kapolei is 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 Kaha‘i at Pu‘uloa (Fornander 1919, *A Lamentation for Kahahana*, Vol. VI, Part II:304).

Pukui (1983:180) offers this Hawaiian saying, which places the wandering souls in a *wiliwili* grove at Kaupe'a.

Ka wiliwili o Kaupe'a. The *wiliwili* grove of Kaupe'a.

In 'Ewa, O'ahu. Said to be where homeless ghosts wander among the trees.

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 where they wandered were avoided.

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'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-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 Puʻuokapolei, she also greeted two old women who lived at an *ʻohai* grove on the hill. These women were named Puʻuokapolei and Nāwaineokamaʻomaʻo (*Ka Hōkū o Hawaiʻi*, February 22, 1927, translated in Maly 1997:19). As she continued her travels, she looked to the ocean and saw the canoe carrying Lohiʻau.

My man on the many harbored sea of Puʻuloa	*Kuʻu kāne i ke awa lau o Puʻuloa*
As seen from the plain of Peʻekāua	*Mai ke kula o Peʻekāua ke noho*
Let us dwell upon the *ʻōhai* covered shore	*E noho kāua i ke kaha o ka ʻōhai*
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 hoʻi au-e*

[*Ka Hōkū o Hawaiʻi*, February 22, 1927, translated in Maly 1997:20]

3.1.1.5 The Caves of Honouliuli

ʻEwa was famous for the many limestone caves formed in the uplifted coral, called the "Ewa Karst." This Pleistocene limestone outcrop, where not covered by alluvium or stockpiled material, has characteristic dissolution "pit caves" (Mylroie and Carew 1995), which are nearly universally, but erroneously, referred to as "sink holes" (Halliday 2005). These pit caves, or sinkholes, vary widely in areal extent and depth, with some of the more modest features comparable in volume to five-gallon buckets, while some of the larger features, although usually irregularly shaped, are several meters wide and several meters deep. In traditional Hawaiian times, the areas of exposed coral outcrop were undoubtedly more extensive.

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. One famous cannibal king, Kaupe, lived in Līhuʻe in upland Honouliuli, was an *ōlohe*.

The caves of Puʻuloa were sometimes also used as burial caves. In 1849, Kealiʻiahonui, son of Kauaʻi's last king, Kaumualiʻi, died. He had once been married to the chiefess Kekauʻōnohi, 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 Kealiʻiahonui, the body was removed from the outer coffin, the rest was sunk, and the coffin was later buried somewhere in Puʻuloa.

3.1.1.6 Pearl Harbor (Puʻuloa) and West Loch (Kaihuopalaʻai)

<u>The "Silent Fish" of Pearl Harbor</u>

Pearl Harbor was called Pu'uloa or *Keawalau-o-Pu'uloa*, "the many harbored-sea of Pu'uloa" (Pukui 1983:182) by the Hawaiians. An alternate name was Awawalei, or "garland (*lei*) of harbors" (Handy and Handy 1972:469). Pukui (1983:120) uses the name Awalau 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 (1993:167) interpreted Awalau as "leaf-shaped lagoon."

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 Kānekua'ana (Handy and Handy 1972:470).

Kānekua'ana was the *kia'i* (food guardian) for 'Ewa. When food was scarce, the descendants of Kua'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 (*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 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). The *pipi* collectors were supposed to stay quiet while harvesting the shells, as in the sayings:

> *Ka i'a hāmau leo o 'Ewa.* — The fish of 'Ewa that silences the voice.
>
> The pearl oyster, which has to be gathered in silence. [Pukui 1983:144]
>
> *Haunāele 'Ewa i ka Moa'e.* — 'Ewa is disturbed by the Moa'e wind.
>
> 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 1983:59]
>
> *E hāmau o makani mai auane'i.* — Hush, lest the wind rise.
>
> 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 1983:34].

Ka i'a kuhi lima o 'Ewa. The gesturing fish of 'Ewa.

The *pipi*, or pearl oyster. Fishermen did not speak when fishing for them but gestured to each other like deaf-mutes. [Pukui 1983:148]

Sereno Bishop, an early resident of O'ahu, wrote of his time in the area around 1836, and 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 Kānekua'ana became displeased at the greed of some *konohiki* (overseers).

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, cited in Sterling and Summer 1978:50]

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 Kānekua'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 of the year so that their numbers 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:]

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 (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 an 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; one day she 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'ahupāhau 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].

In a second version of this story, the shark gods Kānehunamoku and Kamohoali'i were the ones that had placed a *kanawai* (decree) against the attack of men by all sharks around O'ahu. As a 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.

> 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 Ewa. 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 sharks 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 shark 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 Kaʻū, never to bother Kaʻahupāhau again.

In one version (Webb 1923:307-308) version, Mikololou went back to his home island of Hawaiʻi and organized an army of sharks to return to Pearl Harbor, but he was again defeated by the fishermen of ʻEwa under the command of Kaʻahupāhau, who slaughtered so many of the sharks that from then on "the sea of Puʻuloa 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" (Webb 1923:308). The watchful eye of Kaʻahupāhau led to these Hawaiian sayings:

Alahula Puʻuloa, he alahele na Kaʻahupāhau	Everywhere in Puʻuloa is the trail of Kaʻahupāhau

> Said of a person who goes everywhere, looking, peering, seeing all, or of a person familiar with every nook and corner of a place. Kaʻahupāhau is the shark goddess of Puʻuloa (Pearl Harbor) who guarded the people from being molested by sharks. She moved about, constantly watching. [Pukui 1983:14]

Hoʻahewa na niuhi ia. Kaʻahupāhau	The man-eating sharks blamed Kaʻahupāhau.

> Evil-doers blame the person who safeguards the rights of others. Kaʻahupāhau was the guardian shark goddess of Puʻuloa (Pearl Harbor) who drove out or destroyed all the man-eating sharks. [Pukui 1983:108]

Mehameha wale no o Puʻuloa, i ka hele a Kaʻahupāhau.	Puʻuloa became lonely when Kaʻahupāhau went away.

> The home is lonely when a loved one has gone. Kaʻahupāhau, guardian shark of Puʻuloa (Pearl Harbor), was dearly loved by the people. [Pukui 1983:234]

Make o Mikololou a ola i ke ale lo	Mikololou died and came to life again through his tongue.

> Said of one who talks himself out of a predicament. [Pukui 1983:229]

There were other guardian sharks in Pearl Harbor, including a brother of Kaʻahupāhau's named Kahiʻukā (the smiting tail), and a son named Kūpīpī (Pukui 1943:57), or, in some versions, twin sons, named Kūpīpī and Kūmaninini (Pukui and Green 1995:41). In one version of the Story of Pāpio, recounted above, it is said the Kaʻahupāhau later turned into a stone, although the people of Puʻuloa continued to feed her (Sterling and Summers 1978:56).

> Kahiʻukā was the brother of Kaʻahupahau. 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 Kahiʻuka, 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 Kahiʻukā 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 Kaʻahupāhau. Mary Pukui says Kahiʻukā lived in a cavern underwater off Mokuʻumeʻume (Ford Island) near Keanapuaʻa 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 (1892:11) wrote in the late 19th century that Kahiʻukā's keeper, Kimona, would often find fish nets missing and knew that Kahiʻukā had carried them up shore 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.

<u>Kaʻehu-iki-manō-o-Puʻuloa, the Little Yellow Shark</u>

One of the shark *ʻaumakua* associated with Pearl Harbor was the little yellow shark called Kaʻehu, who was born on the Big Island, but later traveled to Oʻahu and settled at Puʻuloa. His ancestor was Kamaʻiliʻili, the Hawaiian shark god, brother of the Hawaiian volcano goddess, Pele. Kaʻehu 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 translation of this legend, the shark's name is Ka-ehu-iki-manō-o-Puʻuloa, meaning "the small, blonde shark of Puʻuloa." He was born in Puna, Hawaiʻi, 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 Hawaiʻi.

> …Puuloa, Oahu, was the next objective. Reaching its entrance they visited the pit of Komoawa, where Kaahupahau'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 water…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 1986:164). In another version of this story, the shark watcher himself is named Komoawa and the cave that he lives in is called Keaʻaliʻi. Keaʻaliʻi guards the entrance to Pearl Harbor, while the home of Kaʻahupāhau is deeper into Honouliuli lagoon (Sheldon 1883).

In 1823, the missionary Hiram Bingham accompanied Liholiho (King Kamehameha II) and his company to the royal compound at Puʻuloa, 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 ʻEwa. 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 dry-dock 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 Kūpīpī the shark son of Kaʻahupāhau's, who lived in a cavern near the harbor entrance at Puʻuloa. "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 practitioners.

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 (*ʻehu*) hair of Kaʻehu. In this version, the cave of Kaʻehu is called Pānau, and the human mother and father of the little shark are Kapukapu and Holei of Pānau, in Puna, Hawaiʻi (Emory et al. 1959:63).

Kāne and Kanaloa and the Fish Ponds of West Loch

According to an account in the Hawaiian newspaper *Ka Loea Kālaiʻāina* (June 10, 1899), several of the fishponds in the Puʻuloa area were made by the brother gods, Kāne and Kanaloa. A fisherman living in Puʻuloa, 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 Keʻanapuaʻa, but were not satisfied. Then they built the fishpond, Kepoʻokala, 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 Kālaiʻāina*, 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 Hawaiʻi, 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 Kuʻula, 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 20th 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 the pond was used to catch the larger *akule (*goggler*)*, *opelu* (mackerel 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 Puʻuloa. The chief Kauhiwawaeono was known to murder people and use their bodies as shark bait (Kamakau 1992:182, 232).

Samuel Kamakau adds more information on the pond Kapākule, and a second one called Kepoʻokala.

> At Puʻuloa 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 *ʻeʻepa* 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 (*ʻomuku 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]

The Story of Kaihuopalaʻai

In the Legend of Maikohā (Fornander 1919, *Legend of Maikoha*, Vol. V, Part II:270-271), a sister of Maikohā, a deified hairy man who became the god of *tapa* makers, named Kaihuopalaʻai, journeys to Oʻahu:

> *ʻIke aku la o Kaihuopalaʻai i ka maikai o Kapapaapūhi, he kāne e noho ana ma Honouliuli ma ʻEwa. Moe iho la lāua, a noho iho la o Kaihuopalaʻai i laila a hiki i kēia lā. ʻOia kēlā loko kai e hoʻopuni ia nei i ka ʻanae, nona nā iʻa he nui loa, a hiki i kēia kākau ana.*
>
> Kaihuopalaʻai saw a goodly man by the name of Kapapaapūhi who was living at Honouliuli, ʻEwa; she fell in love with him and they were united, so Kaihuopalaʻai has remained in ʻEwa 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 [Fornander 1919, *Legend of Maikoha*, Vol. V, Part II:270].

The name of Maikohā's sister, Kaihuopalaʻai, which means "the nose of Palaʻai" (Pukui et al. 1974:68) is also the name the Hawaiians used for the west loch of Pearl Harbor. McAllister (1933) recorded that other Hawaiians say there never was a fishpond by that name. Beckwith

(1918) says that Kaihuopalaʻai changed into the fishpond near the place called Kapapapūhi, which means "the eel flats." This is identified on old maps as the peninsula that juts into the west side of West Loch (sometimes spelled Kapapaʻapūhi); 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 Kūʻokoʻa*, Oct. 2, 1908, from Sterling and Summers 1978:53]

<u>The Traveling Mullet of Honouliuli</u>

The story of Kaihuopalaʻai, or Ihuopalaʻai, is also associated with the tradition of the *anae-holo,* the traveling mullet of Pearl Harbor (Nakuina 1998:270-272):

> The home of the ʻ*anae-holo* is at Honouliuli, Pearl Harbor, at a place called Ihuopalaʻai. They make periodical journeys around to the opposite side of the island, starting from Puʻuloa and going to windward, passing successively Kumumanu, Kalihi, Kou, Kālia, Waikīkī, Kaʻalāwai, and so on, around to the Koʻolau side, ending at Lāʻie, and then returning by the same course to their starting point. [Nakuina 1998:271]

In Nakuina's account, Ihupalaʻai is a male who possesses a Kūʻula or fish god that supplied the large mullet known as *anae*. His sister lived in Lāʻie, and there came a time when there were no fish to be had. She sent her husband to visit Ihupalaʻai, who was kind enough to send the fish following his brother-in-law on his trip back to Lāʻie.

This story is associated with a proverb or poetical saying identified with Honouliuli:

> The fish fetched by the wind. *Ka iʻa hali a ka makani*
>
> The ʻ*anaeholo*, a fish that travels from Honouliuli, where it breeds, to Kaipāpaʻu, on the windward side of Oʻahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong. [Pukui 1983:145]

Pukui et al. (1974:68) give the name of the husband in this story as Lāʻie and the name of the wife as Palaʻai, which ties into the name of the west loch of Pearl Harbor, called Kaihu o Palaʻai, "the nose of Palaʻai." 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 Lāʻie 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 Papapūhi, which relates to the name of the fishpond in the tale called Kapapapūhi (*Ka Loea Kālaiʻāina*, Oct. 21, 1899).

3.1.2 Hōʻaeʻae, Waikele, Waipiʻo and Waiawa Ahupuaʻa

Place names or *wahi pana* ("legendary place" Pukui and Elbert 1986: 376) are an integral part of Hawaiian culture. "In Hawaiian culture, if a particular spot is given a name, it is because an event occurred there which has meaning for the people of that time (McGuire 2000:23)." The *wahi pana* were then passed on through language and the oral tradition, thus preserving the unique significance of the place. Hawaiians named all sorts of objects and places, points of interest which may have gone unnoticed by persons of other cultural backgrounds. Hawaiians named taro patches, rocks, and trees that represented deities and ancestors, sites of houses and *heiau* (places of worship), canoe landings, fishing stations in the sea, resting places in the forests, and the tiniest spots where miraculous or interesting events are believed to have taken place.

Place Names of Hawai'i (Pukui et al. 1974) was used as the primary source for all place name translations. In some cases, where there were no known translations, a literal translation of the place name was made using the *Hawaiian Dictionary* (Pukui and Elbert 1986) or from another source. The intent of the author is to merely present the available information and let the readers come to their own conclusions.

3.1.2.1 Hō'ae'ae Place Names

Hō'ae'ae is bound by the on the *makai* side by the north shore of Pearl Harbor's West Loch, by a trail running along the eastern edge of Honouliuli Gulch on the west side, and by the western side of Waikele Gulch and a trail on the east side (see Figure 11). The *mauka* edge of the ahupua'a does not extend to the Ko'olau Mountains, but is "cut off" by Honouliuli to the west and Waikele to the east. There are references to a Hō'ae'ae Stream in traditional literature. Pre-contact and early post-contact agriculture focused on the spring-fed floodplains adjacent to West Loch. Hō'ae'ae means "to make soft or fine" according to *Place Names of Hawai'i* (Pukui et al. 1974:47). Pukui et al. do not explain why the *ahupua'a* is called this name, but do mention that there was a famous *pōhaku* (stone) called Pōhaku-Pili on the boundary between Hō'ae'ae and Waikele. Another source (Thrum 1922:632) says Hō'ae'ae s means "to pulverize."

3.1.2.2 Waikele Place Names

The next *ahupua'a* to the east is Waikele Ahupua'a, which extends from the north and eastern shore of West Loch to a boundary point between the District of Wahiawā and the *ahupua'a* of Waipi'o on the *mauka* side. It is at this boundary point that Sterling and Summers (1978:137), believe was the *former* location of a famous *pōhaku* called O'ahunui, a stone shaped like the island of O'ahu. Waikele is watered by Waikele Stream; the ridge on the east side of the stream marks the boundary with Waipi'o. In upper Waikele, the stream is fed by two tributary streams, from the west Wai'eli (possibly "dug water") and from the east Waikakalaua ("water [rough] in rain"). Waikele means "muddy water," probably a reference to this long stream. There were other names for the lower part of the stream, shown as Kapakahi ("crooked") Stream on some maps, and referred to as Poniohua (possibly, "anointed on the night of Hua; Thrum 1922:667) Stream in some legends (Mauricio 1997:9).

The most famous location in Waikele is Waipahu Spring ("bursting water"). The waters of this spring were used to irrigate many of the ancient taro patches on the Waikele flood plain and later the rice and sugar cane crops. As a town and sugar mill expanded around it, the entire *makai* area of Hō'ae'ae and Waikele became known as Waipahu, and the older names were no longer used. A resident clarified this change in names:

> …"Waipahu"…is not a tract of land, but only a spring located in Waikele. The Oahu Railway Company is the culprit responsible for misuse and confusion, when

> it built its station at Kaohai and called [it] "Waipahu Station" The Oahu [Sugar Plantation] Mill is situated on the plateau of "Keonekuilimalaulaoewa" (the arm-in-arm-plateau of ewa), Waikele. [Simeon Nawaa, in *Honolulu Star Bulletin* Oct. 16, 1956, cited in Sterling and Summers 1978:1]

Above the spring was a rock face called Pōhaku-pili (clinging stone), which was said to have been placed there by the Hawaiian pig-god, Kamapua'a (Mauricio 1997:7). There were four *heiau* in Waikele, two in the lowland area, just north of the present H-1 Interstate Highway, and two in the uplands, near the head of Kīpapa Gulch. The two lower *heiau*, Mokoula and Hapupu, had been completely destroyed by or in the early 20th century, but McAllister found (or was told of) remnants of the two upper *heiau*, Moaula, and the Heiau of 'Umi, during his survey of prominent O'ahu archaeological sites in the early 1930s.

3.1.2.3 Waipi'o Place Names

To the east of Waikele is Waipi'o, which means "curved, winding water" (Sterling and Summers 1978:1), probably a reference to the curving shorelines of the Middle Loch of Pearl Harbor, with its many adjacent fishponds. The loch waters were extensively used for gathering limu (seaweed), shellfish and other invertebrates, and fish. After Honouliuli, Waipi'o is the largest next largest *ahupua'a* in 'Ewa, extending all the way from the tip of Waipi'o Peninsula, between the West and Middle Lochs of Pearl Harbor, up to the boundary with the Ko'olau Mountains. The major stream/gulch of Waipio is called Kīpapa ("placed prone"), but there are two other gulches in the upland area, Panahakea, and Pānakauahi ("touched by the smoke"). Keakua'ōlelo was the name of a *heiau* in Pānakauahi Gulch. Pu'u Ka'aumakua is the highest peak, marking the boundary point between Waipi'o, the Wahiawā District, and the Ko'olaupoko District. At the *mauka* western corner of the *ahupua'a*, a secondary peak on the Waipi'o/Waiawa border was called Pu'u Kamana ("hill [of] the supernatural power"). There was once a *heiau* in the area between Farrington Highway and the coast, called Ahu'ena ("red hot heap"). When Thrum (1907:46) listed it in 1907, he noted that only the foundations remained. John Papa 'Ī'ī was once the custodian of the idols in the *heiau*. There were several fishponds on the Waipi'o coast. Two of the largest were Loko ('pond") 'Eo and Loko Hanaloa ("kong bay").

3.1.2.4 Waiawa Place Names

The easternmost *ahupua'a* traversed by the Construction Phase I project area is Waiawa Ahupua'a, which like Waipi'o extends from Pearl Harbor (Middle Loch) to the Ko'olau Mountains. In the lower section, the *ahupua'a* is watered by Waiawa Stream, which in the upper portion splits into Waiawa and Mānana Streams. Near this junction was a long ridge called Lae Pōhaku ("stone point"), the boundary line between Waiawa and Mānana. At this junction, McAllister recorded a *heiau* called Puoiki. Some historic maps also have a peak called Pu'u Pōhaku ("stone hill") at the same elevation as Lae Pōhaku, but on the Waiawa/Waipi'o boundary.

The meaning and correct pronunciation of Waiawa is in dispute. It is variously spelled Waiawa or Wai'awa, which leads to different interpretations. *Awa* is the word for milk fish, while *'awa* is the word to the native *'awa* (*Piper methysticum*) plant, which was used to make a mild narcotic drink by the Hawaiians.

In a portion of a chant for Kūali'i (Fornander 1917, *History of Kualii*, Vol. IV, Part II:394-400), Waiawa is noted for its *awa* fish, *E ku'u kaua i ka loko awa—o Waiawa*, translated as "Let us cast the net in the awa-pond—of Waiawa." This would be no surprise as the fish ponds of Waiawa, such as Kuhialoko, were well known for their productivity.

Other traditional accounts suggest that Waiawa may have been acknowledged in early times as the site of a special variety of the 'awa

> *I ka wa i hiki mai ai ua eueu nei a ku ma ka puka o kahi e komo ai i loko o ua kuahiwi nei o Konahuanui, aia noi na makana a pau ma ka lima o Keanuenue, oia hoi ka puaa-pukoa, he puaa ehu keia o ka hulu, a he pu awa popolo, aole i laha nui keia awa ma keia pae aina, aia nae keia awa e ulu nei i keai wa ma uka o Waiawa ma Ewa ae nei.*
>
> …When the wondrous maiden [Keaomelemele] arrived at the entrance to the mountain of Konahuanui, all the offerings were in charge of Ke-anuenue, a puko'a or reddish brown pig, a clump of dark 'awa [*pu 'awa pōpolo]* which was not common in these islands. This variety of 'awa now grows in the upland of Waiawa, down here in 'Ewa. [Manu 2002:50, 138; originally published in *Ka Nūpepa Kū'oko'a*, Jan. 17, 1885]

A *kupuna* who grew up in Waiawa and lives there still, Tin Hu Young, suggested a different origin of the name Waiawa. During his interview, he gave this explanation:

> …In fact, the name 'Wai'awa' means water and 'awa. You know the meaning of 'awa? 'Awa is that kava root that you drink, Hawaiians call it 'awa. I kind of didn't like the idea they called it 'bitter water'. Because 'awa is a little bitter when you drink it, so Wai'awa—Wai'awa Valley was an area known in the ancient days of harvesting 'awa root. It was a ceremonial drink that they had. Of course in the old days only the royalty used that root, until later on, and then the commoners would use it. Then you could sell it in the market and go buy it, like other things. So, Wai'awa was a source of that. But, I like to think that the meaning of 'bitter water' for the name Wai'awa, to me, could come from—because the area is the farther lot, the bottom on the lowland, mauka of Pearl Harbor. And when I used to watch the water, the rivulets would come twisting and turning like little 'awa roots, twisted. If you ever harvest that 'awa root, you got to see, its like a big root coral. It's all tangled into each other. And it reminds me, when it flooded down in the lowland, all these little rivulets, twisting and turning, like the 'awa root. But it's just my romantic— it's just because I live there. I don't want them to say, Ehh you live in bitter water? [Interview with T. H. Young, October 9, 2002, in Bushnell et al. 2003:9-10]

In addition to the milkfish (*Chanos chanos*), *awa* and the '*awa* root (*Piper methysticum*), the Hawaiian word *awa* has a third meaning: of harbor, cove or channel or passage (Pukui and Elbert 1986:33). This suggests there may be some link between the rivulets described by Mr. Young and the *awa* or channels which reach the sea.

3.1.2.5 Legends of the Lowlands and Pearl Harbor

John Papa ‘Ī‘ī noted that the trail in ‘Ewa skirted the upper margin of the taro lands in central ‘Ewa. Coming from Honolulu (see Figure 12):

> The trail went down to the stream and up again, then went above the taro patches of Waiau, up to a *maika* field, to Waimano, to Manana, and to Waiawa; then to the stream of Kukehi and up to two other maika fields, Pueohulunui and Haupuu [in Waiawa]. At Pueohulunui [on the border of Waiawa and Waikele] was the place where a trail branched off to go to Waialua and down to Honouliuli and on to Waianae…
>
> From Kunia [upland of Hō‘ae‘ae and Honouliuli] the trail went to the plain of Keahumoa [upland area for several *ahupua‘a*], on to Maunauna [a peak in upper Honouliuli] and along Paupauewla [extreme *mauka* ‘*ili* of Honouliuli], which met with the trails from Wahiawā and Waialua. [‘Ī‘ī 1959:97]

Along this trail were several stone markers, called Nāpōhaku-luahine. These are described as old women who were changed into stones:

> The names of these royal stones were Kahoaiai (also the name of an ‘*ili* in Waiawa), Waiawakalea, Piliaumoa, Kahe‘ekuluaikamoku, all chiefesses. Their four servants were Nohoana, Kikaeleke, Piliamo‘o, Nohoanakalai. These were the guardians of the trail. [*Ka Loea Kālai‘āina,* June 3, 1899; p. 18]

The writer describes the location of the stones:

> Here is how the traveler can locate them. When you leave the bridge of Waiawa, for Honolulu, go up and then down an incline. The hill standing on the seaward side is Nuku-o-ka-manu. The next incline is Waiawa. Go up the ascent till you reach the top and above that, about two chains from the road you will find the stones. [*Ka Loea Kālai‘āina,* June 3, 1899; p. 18]

There was a cave named Kapuna on Waipi‘o Peninsula that was associated with a famous riddle. *No Kapuna ka 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 Ka‘opulupulu, thus angering the high chief of Maui, Kahekili.

In Waipi'o, 'Ewa, 'Ai'ai, the son of the fishing god, Kū'ula, was said to have established a *pōhaku i'a* (fish stone) at Hanapouli and a *ku'ula* (stone god used to attract fish) named Ahu'ena (Manu 1902:127).

Kamaika'ahui was a man who could take the form of a shark. In his human form, he had the mouth and teeth of a shark on his back. Whenever he got the chance at his home in Hāna, Maui or his home in Waikele, O'ahu, he would secretly change into his shark form, kill, and eat unsuspecting swimmers. Ahapau, the king of O'ahu, had promised to make king anyone who could drive Kamaika'ahui away from O'ahu. When Palila got to Waikele, he found Kamaika'ahui. At one look of Palila's war club, the shark-man ran away and tried to jump into the sea. But every time he tried to escape, Palila threw his war club, again and again, until finally he killed Kamaika'ahui (Fornander 1919, *Story of Palila*, Vol. V, Part II:373-374).

In the story of Ka'ehuikimanō-o-Pu'uloa (Thrum 1923:301) the shark from Puna, Hawai'i Island goes to visit the famous Ka'ahupāhau, chiefess of the shark gods of Pu'uloa (Pearl Harbor) and finds her and her entourage at Waiawa. Again, no details are given. Other references associating the Ka'ahupāhau shark royal court with Waiawa include the naming of a fishpond at Pearl Harbor "Kuhialoko" after the name of a butler or purveyor to the shark queen (*Saturday Press,* January 12, 1884). Ka'ahupāhau's brother, Kahi'uka was said to have a cave in Waiawa below the former home of the Reverend Bishop, who was the pastor in 'Ewa (*Ke Au Hou* Dec. 14, 1910, translation in Sterling and Summers 1978:18).

> *Pukana wai o Kahuku.* The water outlet of Kahuku.
>
> Refers to the outlet of an underground stream that once flowed from Kahuku to Waipahu, O'ahu [Pukui 1983:299].

The most famous *wahi pana* ("legendary place) in Waikele was the Waipahu Spring. Tapa was placed on a wooden board (also called an anvil), and beaten by women with tapa sticks to smooth out the fibers. This pounding made a resonant sound, and women could often identify the owner of the board by the sound that was made. One day a woman in Kahuku on O'ahu took her favorite tapa board to a pool to clean it and left it at the side of the pool. The next day the board was missing. The woman first searched the windward districts of the island, but never heard the distinctive ringing sound of her own favorite board. After several months without finding her board, she traveled to the leeward side of O'ahu.

> She went from Kahuku on the Koolau side to Kaneohe where she spent the night. There was no sign of the anvil in Koolau, because the sign she sought was the sound it made…She went on and spent the night at Wailupe but did not find hers. She heard other anvils but they were not hers. The night turned into day and she went on to Kapalama where she slept but did not hear what she sought till she came to Waipahu. [*Ka Loea Kalaiaina*, June 10, 1899; English translation in Sterling and Summers 1978:25]

At Waipahu Spring in the 'Ewa District, she finally heard the sound of her own board. She followed the sound to the uplands of Waikele and found a woman beating tapa on her board. The woman claimed that she had found the board one day floating on the water at a spring near her house. This legend illustrates the belief by the ancient Hawaiians that there were underground streams and passages that led from one side of the island to the other. In one version of this story, the people of 'Ewa followed the woman back to Kahuku so that she could prove that the board was the same one she had lost. They wrapped a bundle of ti leaves and cast them into the pool near the house of the Kahuku woman. Then returning to 'Ewa, they saw the same bundle of ti leaves a few days later in Waipahu at the spring. Because of this, the Waipahu spring was called Ka-puka-na-wai-o-Kahuku, which means "Outlet of water from Kahuku."

3.1.2.6 Legends of the Inland Plain called Keahumoa

In several legends of 'Ewa, mention is made of the "plain of Keahumoa." John Papa 'Ī'ī shows this plain opposite the trail to Pohakea Pass, stretching across the *ahupua'a* of Honouliuli and Hō'ae'ae (see Figure 12). McAllister (1933) states that the plain was west of Kīpapa Gulch in Waikele. It is also mentioned in legends of Waipi'o. Thus, this is probably a general name for the flat plain *mauka* of the productive floodplain area directly adjacent to Pearl Harbor.

Legend of Nāmakaokapao'o

Nāmakaokapao'o was a Hawaiian hero of legendary strength. Nāmakaokapao'o's mother was Pokai and his father was Kaulukahai, a great chief of Kahiki, the ancestral home of the Hawaiians. The two met in Hō'ae'ae and conceived their child there. The father returned to his home in Kahiki before the birth of his son, leaving his O'ahu family destitute. A man named Puali'i saw Pokai and married her. The couple then resided on the plains of Keahumoa, planting sweet potatoes. Nāmakaokapao'o was a small, brave child who took a dislike to his stepfather, and pulled up the sweet potatoes Puali'i had planted at their home in Keahumoa. When Puali'i came after Nāmakaokapao'o with an axe, Nāmakaokapao'o delivered a death prayer against him, and slew Puali'i, hurling his head into a cave in Waipouli, near the beach at Honouliuli (Fornander 1919, *Legend of Namakaokapaoo*, Vol. V, II:274-276).

Legend of Pikoi

Pikoi was a legendary hero, the son of a crow (*'alalā*) and brother to five god-sisters in the form of rats. He was famous for his ability to shoot arrows, and often made bets that he could hit rats from a long distance (Fornander 1917, *Story of Pikoiakaalala,* Vol. IV, Part III:450-463). Pikoi's skill was commemorated in a saying (Pukui 1983:200):

Ku aku la i ka pana a	Shot by the arrow of Pikoi-[son]
Pikoi-a-ka-'alalā, keiki pana	of-the-crow, the expert rat-shooter
'iole o ke kula o Keahumoa.	Of the plain of Keahumoa.

Story of Palila

In the legend of the hero Palila, the famous warrior had a supernatural war club. He could throw the club a long distance, hang on to the end of it, and fly along the club's path. Using this power, he touched down in several places in Honouliuli, Waipi'o, and Waikele. One day he used his supernatural war club to carry himself to Ka'ena Point in Wai'anae, and from there east across the district of 'Ewa.

> *Ha'alele keia ia Ka'ena, hele mai la a Kalena, a Pōhākea, Maunauna, Kānehoa, a ke kula o Keahumoa, nana ia 'Ewa. Kū kēia i laila nānā i ke kū a ka ea o ka*

> *lepo i nā kānaka, e pahu aku ana kēia i ka la'au palau aia nei i kai o Honouliuli, kū ka ea o ka lepo, nu lalo o ka honua, me he olai la, makau nā kānaka holo a hiki i Waikele. A hiki o Palila, i laila, e pa'apu ana nā kānaka i ka nānā lealea a ke 'li'i o O'ahu nei, oai o Ahuapau.*
>
> After leaving Ka'ena, he came to Kalena, then on to Pōhākea, then to Manuauna [a peak in Honouliuli], then to Kānehoa [a peak in Honouliuli], then to the plain of Keahumoa [upland plain from Honouliuli to Waipi'o] and looked 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. When the people heard something roar like an earthquake they were afraid and they all ran to Waikele. When Palila arrived at Waikele he saw the people gathered there to witness the athletic games that were being given by the king of O'ahu, Ahupau by name. [Fornander 1918, *Legend of Palila*, Vol. V, Part I:142-143]

<u>The Demi-god Maui</u>

In the stories of the demi-god Maui, Keahumoa is the home of Maui's grandfather, Kuolokele (Kū-honeycreeper). One day, Maui's wife, Kumulama, was stolen by the chief Peapeamakawalu, called eight-eyed-Pea-Pea, who is identified in the creation chant *Kumulipo*, as the octopus god (Beckwith 1951:136). The chief disappeared with Kumulama in the sky beyond the sea, and escaped so quickly that Maui could not catch him. To recover his wife, Maui's mother advised him to visit the hut of his grandfather at Keahumoa:

> Maui went as directed until he arrived at the hut; he peeped in but there was no one inside. He looked at the potato field on the other side of Poha-kea, toward Hono-uli-uli, but could see no one. He then ascended a hill, and while he stood there looking, he saw a man coming toward Waipahu with a load of potato leaves, one pack of which, it is said, would cover the whole land of Keahumoa. [Thrum 1923:253-254]

Kuolokele made a *moku-manu* ("bird-ship") for Maui, who entered the body of the bird and flew to Moanaliha, the land of the chief Peapeamakawalu. This chief claimed the bird as his own when it landed on a sacred box, and took it with him into the house he shared with Maui's wife. When Peapeamakawalu fell asleep, Maui killed him, cut off his head, and flew away back to O'ahu with his wife and the chief's head (Thrum 1923:252-259).

A man named Kaopele, born in Waipi'o, had a tendency to fall into deep trances for months at a time. While awake, he would create plantations of supernatural proportions. However, he was never able to enjoy the fruits of his labors because he would always fall into another deep sleep. During one profound slumber, Kaopele was believed to be dead; he taken to Wailua, Kaua'i to be offered as a sacrifice. Upon awakening, he married a woman named Makalani and stayed on Kaua'i. They had a son named Kalelealuaka, who was also blessed with supernatural powers. Kaopele instructed the boy in the arts of war and combat, which Kalelealuaka exhibited during two challenges with kings of Kaua'i. One day, Kalelealuaka decided to travel to O'ahu. A boy, Kaluhe, accompanied him and they paddled to Wai'anae. There, he met another companion who he later named Keinohoʻomanawanui, the sloven. The three traveled toward the old plantation called Keahumoe (Keahumoa), in the *mauka* regions of Waipiʻo, that were formerly planted by Kaopele.

> …the three turned inland and journeyed till they reached a plain of soft, whitish rock, where they all refreshed themselves with food. They kept on ascending, until Keahumoe lay before them, dripping with hoary moisture from the mist of the mountain, yet as if smiling through its tears. Here were standing bananas with ripened, yellow fruit, upland *kalo*, and sugar cane, rusty and crooked with age, while the sweet potatoes had crawled out of the earth and were cracked and dry. [Emerson 1998:86-87]

To determine the best settlement location, Kalelealuaka shot an arrow to see where it would land. He then built a mountain house and called it "Lelepua" (meaning "arrow flight"), after his magic arrows. One night, Kalelealuaka makes known his wish:

> The beautiful daughters of Kakuhihewa to be my wives; his fatted pigs and dogs to be baked for us; his choice *kalo*, sugar cane, and bananas to be served up for us; that Kakuhihewa himself send and get timber and build a house for us; that he pull the famous *awa* of Kahuone; that the King send and fetch us to him; that he chew the *awa* for us in his own mouth, strain and pour it for us, and give us to drink until we are happy, and then take us to our house. [Emerson 1998:89]

Upon hearing such a request, the *mōʻī* Kākuhihewa confers with his priests and instead of killing Kalelealuaka, decides to test him in battle with Kūaliʻi. Kalelealuaka proves worthy in battle and is given charge of Kākuhihewa's kingdom.

<u>Hiʻiaka, sister to the Hawaiian volcano goddess, Pele</u>

The goddess, Hiʻiaka, sister of the volcano goddess Pele, passed through ʻEwa and met women stringing *maʻo* flowers to make *lei*. Hiʻiaka offered a chant, making known her wish for a lei around her own neck.

E lei ana ke kula o Keʻahumoa i ka maʻo	The plains of Keahumoa are garlanded with *maʻo*
ʻOhuʻohu wale nā wāhine kui lei o ka nahele	The lei-stringing women of the forest are festively adorned

[Hoʻoumāhiehiemalie 2006a:287; 2006b:268]

3.1.2.7 Legends of the Uplands

<u>Ke akua ʻōlelo</u>

Ke akua ʻōlelo is described as a local god of Pānakauahi Gulch, who from his *heiau* in Pānakauahi spotted a woman of high rank from Hawaiʻi hide her *lei niho palaoa* in a hole of a rock, a rock named *pōhaku huna palaoa,* located on the plain of Punahawele. Ke akua ʻōlelo assured the woman that when the time came for her descendants to find the necklace, he would guide them (*Ka Loea Kālaiʻāina*, July 22, 1899, translation in Sterling and Summers 1978:22).

Ke akua ʻōlelo also appears in another *moʻolelo*, the legend of the children and the secret eating place, Kaʻaimalu. Pūpūkanioe, a boy and Nāuluahōkū, a girl who grew up with Panaʻiahakea, a tributary gulch located on the boundary of Waipiʻo and Waiawa, travel frequently to Kualakaʻi to fish. The usually caught plenty of fish. However, on one particular day, they only caught one fish, a *palani* which was considered a woman's fish. As they were on their long journey home, they were both caught up in hunger and the girl insisted they both eat the *palani* secretly. However, Ke akua ʻōlelo was watching and announced their sharing of the woman's fish. This was considered the first time the eating *kapu* was broken, and the spot where they ate is called Kaʻaimalu, the secret eating place (*Ka Loea Kālaiʻāina*, July 22, 1899: p.15, translation in Sterling and Summers, 1978:7).

Legend of Maihea

One story that suggests that Waiawa was named for the *ʻawa* plant is the legend of Maihea.

> …it was here in ʻEwa that Kāne and Kanaloa were invoked by a planter of sweet potatoes, taros, and *ʻawa* named Maihea. This man, living in the upland of Waiʻawa, [Handy and Handy use the glottal stop] when he had prepared his meal and his ʻawa, would pray:
>
> O unknown gods of mine,
> Here are *ʻawa*, taro greens and sweet potatoes
> Raised by me, Maihea, the great farmer.
> Grant health to me, to my wife and to my son.
> Grant us *mana*, knowledge and skill.
> *Amama*. It is freed.
> [Handy and Handy 1972:472]

Another more complete version of the story of Maihea is shared in the June 3, 1899 edition of *Ka Loea Kālaiʻāina*. In this version, Maihea lived at Waimalu, cultivating sweet potatoes and taro. However, it was on a hill in the upland of Waiawa where he planted his *ʻawa*. He prayed daily to the unknown gods with his offering of *ʻawa*, taro greens and sweet potatoes. In answer to his prayer, Kāne and Kanaloa sent a whale to Waimalu. All the people of the area came to marvel at the sight. The beached whale waited almost four weeks until the son of Maihea, Ula-a-Maihea could resist no longer, and against the wishes of his parents, he went down to the shore to see the spectacle. Once there, he followed the children climbing on to the whale. The whale began to move and Ula-a-Maihea was taken to Kahiki where he was trained in the *kahuna* arts under Kāne and Kanaloa.

The parents grieved for the boy, until two strangers came to the door. Maihea invited them to his house and offered them *ʻawa*, saying his usual prayer to the unknown gods. At this time, Kāne and Kanaloa revealed that they were the unknown gods and that they had answered his prayer by sending their son to Kahiki to learn the arts of the *kahuna*.

> This was the beginning of the travels of these gods on earth and this was also the time when the boundaries of Ewa were made as I told you when I mentioned Pohaku-pili. On their return after dividing the land, they came to the top of Haupuu, (that is the present site of the Kahikuonuolani Church at Waiawa) they

> turned to look at ʻEwa and when they saw the fish ponds at Waiawa, they said, "May the fish ponds down at Waiawa be as the stars in the sky above. May there be mullets at Kuhia-loko, fine sea weed at Kuhia-waho, salt at Ninauele, the single fruited coconut at Hapenui, the taro greens at Mokaalika and the water of Kaaimalu, to remove the bitterness of the ʻawa of Kalahikuola. [*Ka Loea Kālaiʻāina,* June 3, 1899:9, English summary in Sterling and Summers 1978:5]

3.1.2.8 Traditional Accounts of Pre-Contact and Early Post-Contact Hawaiian Battles

The rich resources of the Pearl Harbor lochs, the shoreline fishponds, the numerous springs, and the irrigated lands along the streams made central ʻEwa a prize for competing chiefs. Battles were fought for and on ʻEwa lands, sometimes from competing Oʻahu chiefs, and sometimes by invading chiefs from other islands.

Māʻilikūkahi and the Invasion of the Hawaiian Chiefs (16th Century)

Born *aliʻi kapu* at the birthing stones of Kūkaniloko (Kamakau 1991a:53), Māʻilikūkahi became *mōʻī* of Oʻahu around A.D. 1520 to 1540 (Cordy 2002:19). Māʻilikūkahi was popular during his reign and was remembered for initiating land reforms, which brought about peace, and for encouraging agricultural production, which brought about prosperity. He also prohibited the chiefs from plundering the *makaʻāinana*, with punishment of death (Kamakau 1991a:55).

Māʻilikūkahi's peaceful reign was interrupted by an invasion which would change Waipiʻo ʻUka forever. The following is a description of the Battle of Kīpapa by Fornander:

> I have before referred to the expedition by some Hawaii chiefs, *Hilo-a-Lakapu*, *Hilo-a-Hilo-Kapuhi*, and *Punaluu*, joined by *Luakoa* of Maui, which invaded Oahu during the reign of *Mailikukahi*. It cannot be considered as a war between the two islands, but rather as a raid by some restless and turbulent Hawaii chiefs…The invading force landed at first at Waikiki, but for reasons not stated in the legend, altered their mind, and proceeded up the Ewa lagoon and marched inland. At Waikakalaua they met *Mailikukahi* with his forces, and a sanguinary battle ensued. The fight continued from there to the Kīpapa gulch. The invaders were thoroughly defeated, and the gulch is said to have been literally paved with the corpses of the slain, and received its name "Kīpapa," from this circumstance. *Punaluu* was slain on the plain which bears his name, the fugitives were pursued as far as Waimano, and the head of *Hilo* was cut off and carried in triumph to Honouliuli, and stuck up at a place still called *Poo-Hilo*. [Fornander 1996:89-90]

Apparently, Kīpapa Gulch in Waipiʻo was named after this particular battle, or more likely renamed. In old Hawaiʻi, places were often given names based on historic events. The literal translation of the word *kīpapa* is "to be paved," as in "paved with the corpses of the slain."

The Rivalry of the Waikīkī and Waikele Chiefs (17th Century)

Around A.D. 1600-1620, the entire island of Oʻahu was united under the rule of one woman, an *aliʻi* named Kalaʻimanuia (Cordy 2002:30). Before her death, she divided her kingdom between four of her children, giving the districts of Kona and Koʻolaupoko to Kū, the *ahupuaʻa* of Kalauao, ʻAiea, Moanalua, and Hālawa to Ka'ihikapu, the districts of ʻEwa and Waiʻanae to Haʻo, and the districts of Waialua and Koʻolauloa to her daughter Kekela. To Kū, she passed on her title of *mōʻī*, or king, so that the other three were still subject to their eldest brother. Kū, however, was greedy and began to try to take the lands allotted to his siblings away from them. Haʻo joined with this brother Kaʻihikapu in a battle defending against an attack by Kū, a battle in which Kū was slain. Kaʻihikapu then became *mōʻī* and was a good king, taking care of his subjects and making frequent tours around the island to observe the people. On one of these circuits, he visited his brother Haʻo at his court in Waikele and grew jealous of the riches at his brother's home. Kaʻihikapu sent a large man-eating shark that had been caught near his court in Waikīkī to his brother as a gift so that Haʻo could use it as a sacrifice to dedicate to the gods at his *heiau* in Waikele. Kaʻihikapu's forces attacked Haʻo and his priests at the temple as they were unarmed and busy with the dedication ceremonies (Fornander 1996:270-271).

There are other versions of this story that describe the shark as similar to the gift of the Trojan Horse, but Fornander (1996:271) believes that these "embellishments" may have been made in the post-contact period. Two versions of this more elaborate story are presented below.

There is a saying concerning this rivalry between the two brothers: "*Ke one kuilima laula o ʻEwa.* The sand on which there was a linking of arms [*kuilima*] on the breadth of ʻEwa." This saying is in reference to how Kaʻihikapu took Haʻo's lands from him.

> The chiefs of Waikīkī and Waikele were brothers. The former wished to destroy the latter and laid his plot. He went fishing and caught a large *niuhi* [man-eating shark], whose skin he stretched over a framework. Then he sent a messenger to ask his brother if he would keep a fish for him. Having gained his consent, the chief left Waikīkī hidden with his best warriors in the "fish." Other warriors joined them along the way until there was a large army. They surrounded the residence of the chief of Waikele and linked arms [*kuilima*] to form a wall, while the Waikīkī warriors poured out of the "fish" and destroyed those of Waikele. [Pukui 1983:191]

In a different version of this story (Kamakau 1991a:61-67), Kaʻihikapu, cut open the shark captured from the Waikīkī waters, removed all the meat, but left the skin and bones. He sent a messenger to his brother, Haʻo, chief of Waikele, offering the shark to him. Haʻo quickly agreed, and waited for the shark to be delivered to Waikele, where he planned to place it at his *heiau* as an offering to the gods. When the shark was placed on the altar, Kaʻihikapu and his men jumped out and slaughtered his brother and all of the priests. The slain men were then put into the shark and offered as a sacrifice at the former *heiau* of Waikele. Kamakau (1991a:67) says that the name of this place of slaughter in Waikele was called Paumakua. Thrum (1922:665) translates this place name as "all fiery eyed." McAllister (1933:106) located this destroyed *heiau*, called Hapupu, at the site then occupied by the Waipahu plantation stables.

The Overthrow of Kahahana and his Escape to ʻEwa (18th Century)

Thomas Thrum (1998:203-214) translates the legend of the *kahuna*, or priest, Kaʻōpulupulu, who lived in Waimea. Kahekili, the king of Maui sent his foster son, Kahahana to rule Oʻahu, around the year A. D. 1779 (Cordy 2002:42). Kahahana set up his royal compound in Waikīkī, and commanded the priest Ka'ōpulupulu to attend him there. At first Kahahana valued the wisdom of this wise priest, but after several years, Kahahana began to be cruel to the people, and in protest Ka'ōpulupulu left Waikīkī to return to his home in Waimea. This angered the king, who sent messengers to order Ka'ōpulupulu and his son Kahulupue, to come to Wai'anae, where Kahahana then resided.

At Wai'anae, the two men were placed into a special grass hut, one tied to the end post and one tied to the corner post of the house. The next day, Kahahana ordered his men to torture the son, stabbing his eyes and stoning him while his father watched. When Ka'ōpulupulu saw this, he commanded his son to flee into the sea, saying these words (Pukui 1983:44), which contained a prophecy.

E nui ke aho, e ku'u keiki,	Take a deep breath, my son, and lay
a moe i ke kai, no ke kai la	yourself in the sea, for then the land
ho'i ka 'āina.	shall belong to the sea.

When Kahekili heard of this outrage, he sent an army to O'ahu to depose Kahahana. The O'ahu force was defeated around the year 1795 (Cordy 2002:19), and Kahahana, his wife, Kekuapoi, and his friend Alapai, fled westward, hiding at many places in 'Ewa.

> 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 [upper plain of Honouliuli, Ho'ae'ae, and Waipi'o]; 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 Pō'ohilo, Honouliuli and was killed on the plains of Hō'ae'ae [Thrum 1998:213-214]. While hiding in Pō'ohilo, and *'ili* of Honouliuli:

> …report thereof was made to Kahekili, the king, who thereupon sent Kekuamanoha, elder brother of Kekuapoi, the wife of Kahahana, with men in double canoes from Waikiki, landing first at Kupahu, Hanapouli, Waipio, and had instructions to capture and. put to death Kahahana, as also his friend Alapai, but to save alive Kekuapoi. When the canoes touched at Hanapouli, they proceeded thence to Waikele and Hoaeae, and from there to Poohilo, Honouliuli, where they met with Kahahana and party in conference. At the close of the day Kekuamanoha sought by enticing words to induce his brother-in-law to go un with him and see the father king and be assured of no death condemnation, and by skilled flattery he induced Kahahana to consent to his proposition, whereupon preparation was made for the return. On the following morning, coming along and reaching the plains of Hoaeae, they fell upon and slew Kahahana and Alapai there, and bore their lifeless bodies to Halaulani, Waipio, where they were placed in the canoes and brought up to Waikiki and placed up in the coconut trees by King Kahekili and his priests from Maui, as Kaopulupulu had been. Thus was fulfilled the famous saying of the Oahu priest in "all its truthfulness." According to the

> writings of S. M. Kamakau and David Malo, recognized authorities, the thought of Kaopulupulu as expressed to his son Kahulupue, "This land is the sea's," was in keeping with the famous prophetic vision of Kekiopilo that "the foreigners possess the land," as the people of Hawaii now realize. [Manu 1904:112-113]

Kūali'i's Defeat of the 'Ewa chiefs (19th Century)

In the first half of the 18th century, the island of O'ahu was ruled by a chief named Kūali'i, who consolidated his supreme power over the entire island by defeating the chiefs of 'Ewa (Cordy 2002:32). Kūali'i met the competing army on the plains of Keahumoa, but the 'Ewa chiefs surrendered when they saw Kūali'i's overwhelming forces, and they ceded the lands of Ko'olauloa, Ko'olaupoko, Waialua, and Wai'anae to him (Fornander 1917, *History of Kualii*, Volume IV, Part II:366, 400).

During the second half of the 18th century, Waipi'o again became a focus of political intrigue and warfare. In 1783, the forces of the Maui chief Kahekili gained control of the island of O'ahu by defeating the *mō'ī*, Kahahana, "from the powerful 'Ewa chiefs' line" (Cordy 1981:207). Kahekii set up his friend Hu'eu over the districts of 'Ewa, Waianae, and Ko'olauloa. The defeated O'ahu chiefs plotted to kill the Maui chiefs, and succeeded in killing Hu'eu, but Kahekili escaped.

The murderers of Hu'eu were found in Waipi'o, "therefore Ewa became famed as a land of deadly plots" (*Ka Nūpepa Kū'okok'a* Dec. 5, 1868; HEN Vol. I, p. 2734, cited in Sterling and Summers 1978:3). Waipi'o was given the name "Waipi'o *kīmopō*," or "Waipi'o of secret rebellion" (Pukui 1983:319) due to all the covert planning (Kamakau 1961:138). Following the plan's failure, Kahekili took revenge on the 'Ewa and Kona districts:

> …and when Ka-hekili learned that Elani of 'Ewa was one of the plotters, the districts of Kona and 'Ewa were attacked and men, women, and children were massacred, until the streams of Makaho and Niuhelewai in Kona and of Kahoa'ai'ai in 'Ewa were choked with the bodies of the dead, and their waters became bitter to the taste, as eyewitnesses say, from the brains that turned the water bitter. All the O'ahu chiefs were killed and the chiefesses tortured. [Kamakau 1992:138]

If Kamakau is correct, the population of Waipi'o would have been decimated during the 1780s. Kahekili and the Maui chiefs retained control of O'ahu until the 1790s. In 1794, Kahekili died at Waikīkī. His son, Kalanikūpule, was defeated the following year at the battle of Nu'uanu by Kamehameha, who distributed the O'ahu lands - including Waipi'o Ahupua'a - among his favorite followers which resulted in the displacement of many families. "Land belonging to the old chiefs was given to strange chiefs and that of old residents on the land to their companies of soldiers, leaving the old settled families destitute" (Kamakau 1992:376-377).

3.2 Historical Background

3.2.1 'Ewa as a Political Center

There are many documented references that chiefs resided in 'Ewa and that it was a political center in the past. Oral accounts of chiefs and chiefesses recorded by noted Hawaiian historian Samuel Kamakau date back to at least the 12th century. He tells us that:

> The chiefs of Līhu'e, Wahiawā, and Halemano on O'ahu were called *lō ali'i*. Because the chiefs at these places lived there continually and guarded their *kapu*, they were called *lō ali'i* [from whom a "guaranteed" chief might be obtained, *loa'a*]. They were like gods, unseen, resembling men. [Kamakau 1991a:40]

By ca. A.D. 1320, 'Ewa, along with Kona, and Ko'olaupoko, were the dominant political districts, 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 1996:48). 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; Fornander 1996:88). 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).

A 14th century account speaks of the reign of Mā'ilikūkahi, an *ali'i kapu* who was born at Kūkaniloko in Wahiawā around the 14th century A.D. (Pukui et al. 1974:113). Upon consenting to become *mō'ī* (king) at the age of 29, he was taken to Kapukapuākea Heiau (temple) at Pa'la'akai in Waialua to be consecrated. Soon after becoming king, Mā'ilikūkahi was taken by the chiefs to live at Waikīkī. The story tells us that he was probably one of the first chiefs to live there. Up until this time the chiefs had always lived at Waialua and 'Ewa. Under his reign, the land divisions were reorganized and redefined.

In reference to the productivity of the land and the population during Mā'ilikūkahi's reign, Kamakau writes:

> In the time of Mā'ili-kūkahi, the land was full of people. From the brow, *lae*, of Kulihemo to the brow of Maunauna in 'Ewa, from the brow of Maunauna to the brow of Pu'ukea [Pu'u Ku'ua] the land was full of chiefs and people. From Kānewai to Halemano in Wai'alua, from Halemano to Paupali, from Paupali to Hālawa in 'Ewa the land was filled with chiefs and people. [Kamakau 1991a:55]

The picture presented here is that the whole *moku* (district) of 'Ewa was one of prosperity and productivity and the land was heavily populated. 'Ewa continued to be a political center until the 18th century when Kahahana, a Maui chief, was chosen by the O'ahu chiefs to rule over the whole island. Somewhere between 1883 and 1885, Kahahana was killed by Kahekili of Maui.

Kahahana's father, 'Elani, along with other O'ahu chiefs, plotted to kill Kahekili and his chiefs who were residing at Kailua, O'ahu, as well as his chiefs residing at 'Ewa and Waialua. The plot was discovered by Kahekili and a messenger was sent to warn Hū'eu at Waialua. For some reason, the messenger never reached Hū'eu and he and his retinue were killed. This slaughter became known as the *Waipi'o Kīmopō* or the Waipi'o assassination because it originated there. Kahekili avenged the death of Hū'eu by pillaging and destroying the districts of Kona and 'Ewa. It is said that the streams of Makaho and Niuhelewai in Kona, as well as Hō'ae'ae in 'Ewa were choked with the bodies of the slain. It was during this time that the O'ahu chiefly lines were nearly exterminated. It is said that one of the Maui chiefs, Kalaikoa, used the bones of the slain to build a wall around his house at Lapakea in Moanalua. The house was known as Kauwalua and could be seen as one passed by the "old upper road to 'Ewa" (Fornander 1996:290).

Even though Waikīkī was a favorite playground for the chiefs of Kona, as with 'Ewa chiefs, there were no deep harbors where large ships could enter port. With the introduction of trade and foreign goods, along with Kamehameha's unification of the islands, attention shifted to Kou (old name for Honolulu, used until about 1800) (Pukui et al. 1974:117), which had a deep enough harbor for ships to pull in and anchor. Kou became the center of activity as royalty moved away from the outer districts toward the center of commerce. The general populace also moved away from the rural areas, as they too became dependent on a cash economy. Archibald Campbell writes about O'ahu in 1809:

> Although only of secondary size, it [O'ahu] has become the most important island in the group, both on account of its superior fertility, and because it possesses the only secure harbour to be met with in the Sandwich Islands.
>
> In consequence of this, and of the facility with which fresh provisions can be procured, almost every vessel that navigates the North Pacific puts in here to refit. This is probably the principal reason why the king has chosen it as his place of residence. [Campbell1967:109-110]

'Ewa is depicted as an abundant and populated land where chiefs of distinguished lineages were born and resided. The land was fertile and well fed by mountain streams that helped sustain the agricultural lifestyle needed to support the chiefs, their households and their people. An examination of the place names reveals that water was a very important factor in this district. Six of the twelve *ahupua'a* names begin with *wai*, the Hawaiian word for water (Waikele, Waipi'o, Waiawa, Waimano, Waiau, and Waimalu). The fact that there were so many fishponds in the 'Ewa District and in the Pu'uloa area, more than any other district on O'ahu, indicates that agricultural/aquacultural intensification was a direct link to the chiefs who resided there, and also to the increasing needs of the population. 'Ewa's part in the politics and history of O'ahu is of noteworthy importance.

3.2.2 Honouliuli Ahupua'a

3.2.2.1 Early Post-Contact Period – Late 18th to Mid-19th Centuries

In A.D. 1795, seventeen years after Captain James Cook made the first Western contact with the Hawaiian Islands, the great Hawaiian warrior Kamehameha completed his conquest of the island of O'ahu and then went on to consolidate his rule over all of the Hawaiian Islands. He gave the *ahupua'a* of Honouliuli to Kalanimōkū, an early supporter, 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 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,* used to make *kapa* for clothing), bananas, *olonā* (*Touchardia latifoli*, used to make cordage), 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 *māmaki* (*Pipterus* spp.; used to make *kapa* for clothing). It was also famous for a rare taro called the *kāī 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:

Ua 'ai i ke kāī-koi o 'Ewa. He has eaten the Kāī-koi taro of '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 1983:305]

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 (Hammatt et al. 1990).

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]

Subsequent to western contact in the area, the landscape of the ʻEwa plains and Waiʻanae 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 were allowed to graze freely about the land for some time after. It is unclear when the domesticated animals were brought to Oʻahu. However, L.A. Henke reports the existence of a longhorn cattle ranch in Waiʻanae 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.

At contact, the most populous *ahupuaʻa* 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 ʻEwa and Waiʻanae combined was 2,451 people. In 1872, it was 1,671 (Schmitt 1968:71). The inland area of ʻEwa was probably abandoned by the mid-19th century, due to population decline and consolidation of the remaining people in the town of Honouliuli, near Kapapapūhi Point.

3.2.2.2 Mid-19th 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, the Hawaiian government, and the *aliʻi* (royalty) received their land titles. The common people (*makaʻāinana*) received their *kuleana* awards (individual land parcels) in 1850. It is through records for Land Commission Awards (LCA) generated during the Māhele that the first specific documentation of life in ʻEwa, as it had evolved up to the mid-19th century, come to light.

In 1855 the Land Commission awarded all of the unclaimed lands in Honouliuli, 43,250 acres, to Miriam Keʻahikuni Kekauʻōnohi (Royal Patent 6971 in 1877; Parcel 1069 in the Land Court office; Land Commission Award 11218), a granddaughter of Kamehameha I, and the heir of Kalanimōkū, who had been given the land by Kamehameha after the conquest of Oʻahu (Indices of Awards 1929; Kameʻeleihiwa 1992). Kekauʻōnohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanuʻu Kahalaiʻa, governor of Kauaʻi (Kelly 1985:21). Subsequently, Kekauʻōnohi ran away with Queen Kaʻahumanu's stepson, Keliʻiahonui, and then became the wife of Chief Levi Haʻalelea. Upon her death on June 2, 1851, all her property was passed on to her husband and his heirs. 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.

During the *Māhele* of 1848, 96 individual land claims were made in the *ahupua‘a* of Honouliuli, with 72 claims being registered and awarded by King Kamehameha III to commoners (Table 3; 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.

Table 3. 72 *Kuleana* Land Commission Awards in Honouliuli Ahupua'a

LCA	Awardee	*'Ili*		LCA	Awardee	*'Ili*
748	Kalauhala	Panahaha, Kaaumakua		906	Kanoho	Kamoku
749	Mahina	Kaulaula		907	Luana	Kamaipipipi, Niukee
751	Kalauli	Kamoku, Polapola, Kalihikahi		910	Nunu	Kaaumakua
752	Haae	Kailikahi, Kailihai		911	Kauhailepa	Poohilo
753	Manuwa	Kamoku		914	Kamaala	Niukee, Kapapahi
754	Kaunahi	Niukee		916	Kama	Loloulu, Makau
755	Keinohana-nui	Niukee, Kailikahi, Kaakau		917	Kaulu	Kamilomilo, Kaaumakua
756	Kauouo	Kaaumakua		947	Kaopala	Loloulu, Kaulaula
758	Nihua	Niukee		960	Poopuu	Loloulu
760	Kuhemu	Kamaipipipi, Niukee, Naopala, Kailikahi		1565	Kaalauahi	Niukee, Kapapahi
761	Kinolua	Niukee, Kailikahi, Ilikahi, Palahemo		1570	Kekua	Poohilo
762	Kalama	Kaaumakua		1570-B	Paekane	Kaaumakua
763	Keliiaa, Solomona	Hiwa, Poohilo, Mauakapuoa, Uani / Maui, Polapola		1570-C	Naholowaa	Kaaumakua
765	Kamalae	Niukee, Kailikahi, Palahemo		1573	Kawahamana	Niukee, Kapapapuhi
766	Paele	Niukee, Kaluamooiki, Kailikahi		1580	Kanahuna	Kamilomilo
767	Hapauea	Niukee, Kapapahi		1580-B	Kapioho	Polapola, Kahiwapalaai
768	Pio	Kahaumakua, Niukee, Waioha		1598	Kekua	Loloulu, Kapapahi
827	Kauakahilau	Poohilo		1605-B	Nakai	Mahuna, Niukee
828	Kawahaea	Poohilo		1666	Mauwele	Poohilo
831	Kaekuna	Poohilo		1666-B	Kuahilo	Poohilo
832	Opiopio	Poohilo		1670	Moano	Loloulu, Kaaumakua
834	Oni	Poohilo, Kailikahi		1672	Makue	Kamoku, Kapapapuhi

LCA	Awardee	*'Ili*		LCA	Awardee	*'Ili*
839	Kaaiawaawa	Kamilomilo, Kailikahi, Haole, Poohilo		1699	Leleiaupa	Maui, Poaiwaikele
845	Kekukahiko	Kapapahi, Niukee		1701	Alaluka	Pohilo
847	Hinaa	Poohilo		1703	Aimaikai	Kamilomilo
848	Kapule	Poohilo		1713	Healani	Niukee, Kapapuhi
869	Pue	Maui		1719	Hilea	Kaaumakua
872	Kahakuliilii	Loloulu, Paakai, Papaioua		1720	Hilinae	Polapola
874	Laamaikahiki	Polapola, Hiwa		5204	Kalama 2	Polapola
876	Nohunohu	Niukee, Nukee		5653	Kua	Maui, Polapola, Kahui
881	Kikala	Polapola		5654	Kuhiena	Maui, Poohilo
886	Kahalewai	Kamoku, Manuwa		5653-B	Kanehikili	Poohilo
892	Aoao, Samuela	Kapapahi, Niukee		5670-B	Kaohai	Kaihuopalaai, Polapola
898	Kaneaola	Polapola		5670-C	Kumupopo	Poohili, Kepoe, Loloulu, Puaaluu
901	Kuahine	Nukee / Niukee,		5950	Pihana	Kamoku
902	Haakue	Waimanalo		10933	Uia	Niukee
905	Kaimuena	Kaaumakua				

An 1873 map of Honouliuli (Figure 13) shows the project area north of the dense cluster of LCA parcels in lower Honouliuli Gulch, known as the "Honouliuli Taro Lands." An 1878 map of the Honouliuli Taro Lands (Figure 14) shows the *mauka* (inland) extent of the cluster of LCA parcels approximately 200 m *makai* (seaward) of the current project area. The five LCAs located nearest to the project area included multiple *lo'i* (taro fields), *kula* (pasture or dry field), house lots (Table 4).

Table 4. Honouliuli Land Commission Awards in the Vicinity of the Project Area

LCA	Contents of Award
831:3	No data
847:1 and 847:2	14 *lo'i*, 1 *kula*, and 1 guard house for the *lo'i*
848:5	5 *lo'i* and 1 *kula*
911:1	1 house, 1 *kula*, 5 *lo'i*
1570:1	Several *lo'i* and 1 *kula*

3.2.2.3 Late 19th Century to Present

Early Ranching in on the 'Ewa Plain

In 1871, John Coney rented the lands of Honouliuli to James Dowsett and John Meek, who used the land for cattle grazing. In 1877, James Campbell purchased most of Honouliuli Ahupua'a for a total of $95,000. He then drove off 32,347 head of cattle belonging to Dowsett, Meek, and 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 5,500 head after a few years (Dillingham 1885, cited in Frierson 1972:14).

In 1881, a medical student touring the island to provide smallpox vaccinations to the population, viewed Campbell's property, called Honouliuli Ranch:

> I took a ride over the Honouliuli Ranch which is quite romantic. The soil is a deep, reddish loam, up to the highest peaks, and the country is well-grassed. Springs of water abound. The '*ilima*, which grows in endless quantities on the plains of this ranch, is considered excellent for feeding cattle; beside it grows the indigo plant, whose young shoots are also good fodder, of which the cattle are fond. Beneath these grows the manieizie grass, and Spanish clover and native grasses grow in the open; so there is abundant pasturage of various kinds here. As I rode, to the left were towering mountains and gaping gorges; ahead, undulating plains, and to the right, creeks and indentations from the sea. A wide valley of fertile land extends between the Nuuanu Range and the Waianae Mountains and

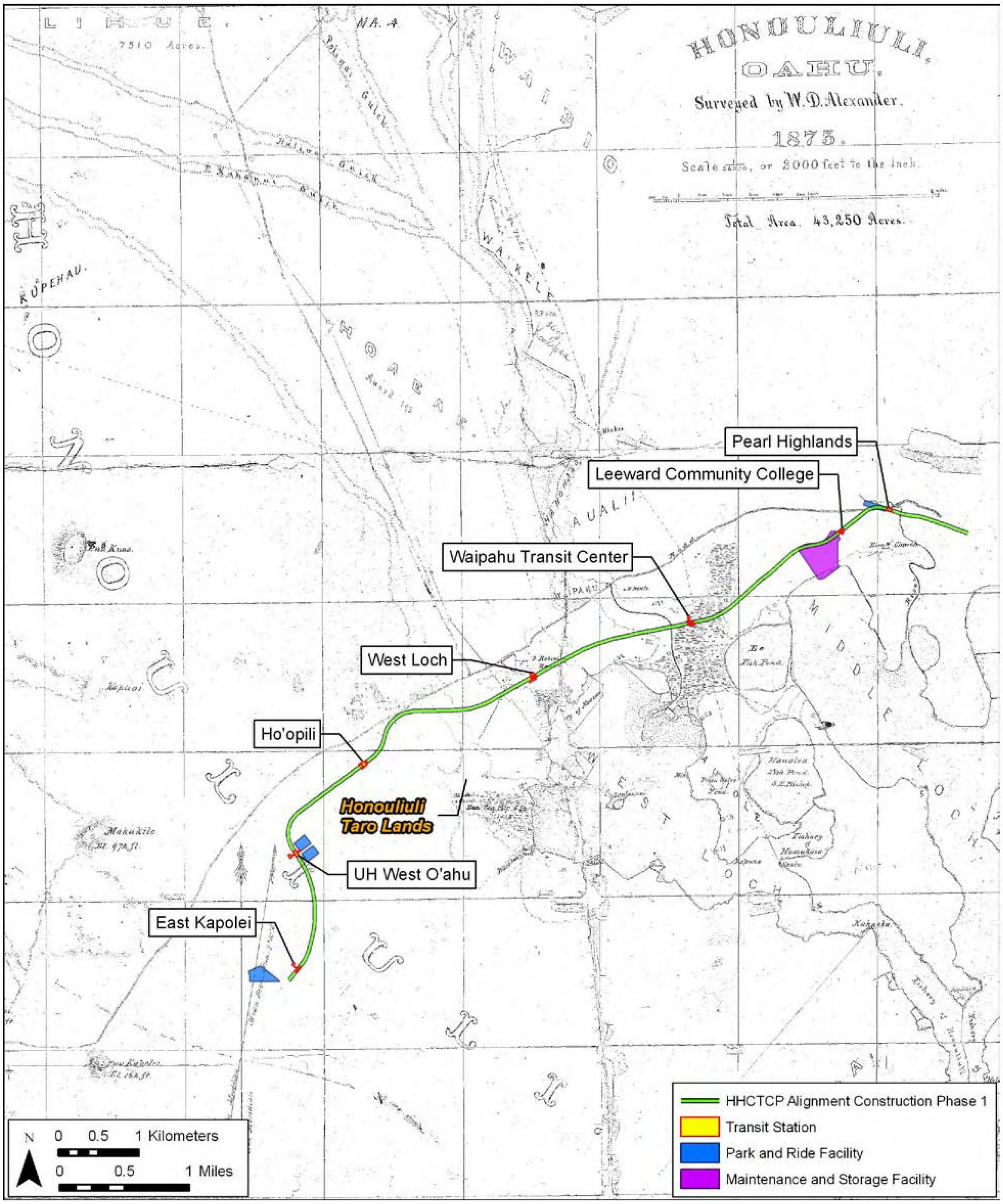

Figure 13. 1873 Map of Honouliuli (Registered Map No. 405, Hawai'i Land Survey Division), W.D. Alexander Surveyor, showing the location of the project area in relation to the "Honouliuli Taro Lands"

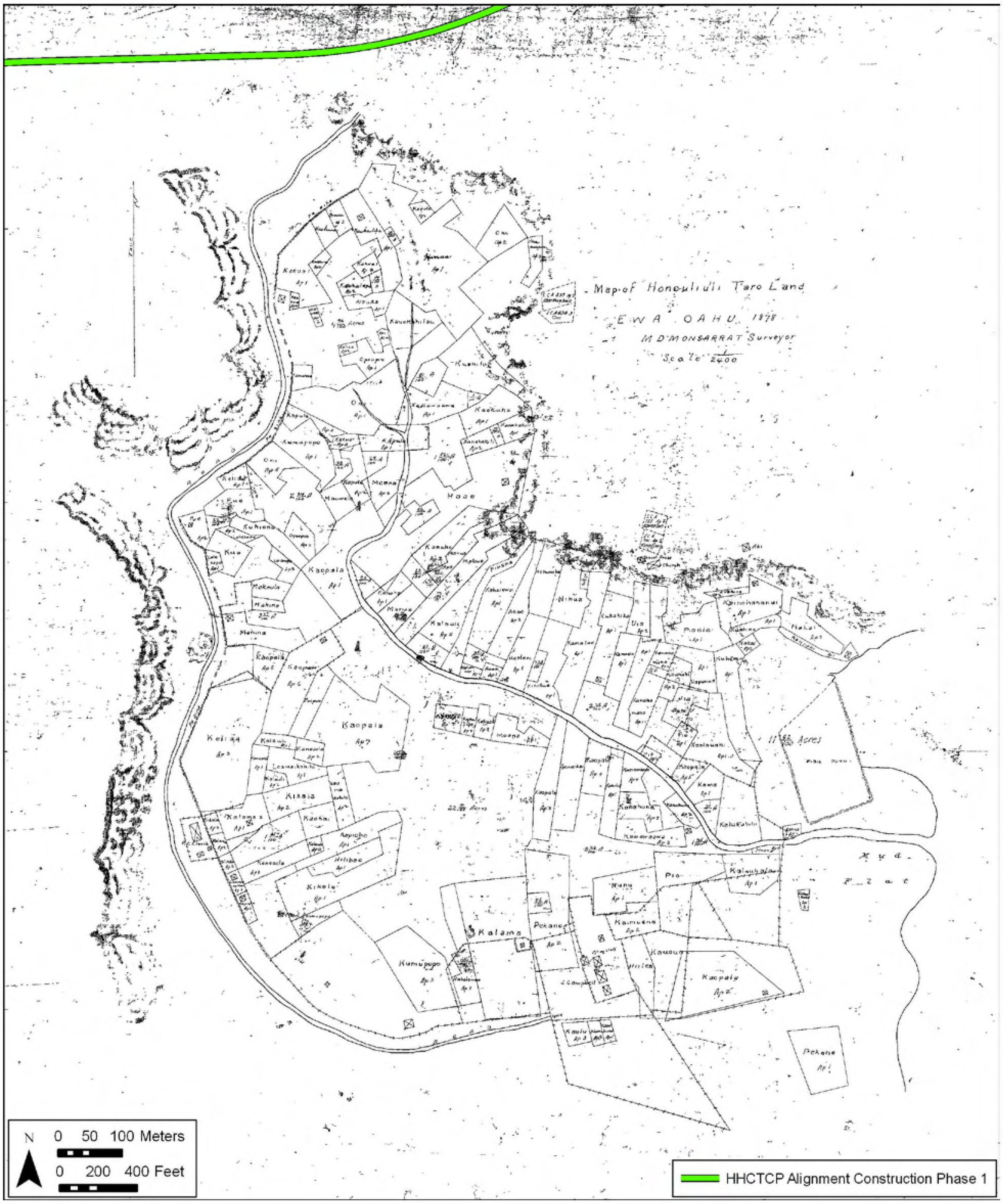

Figure 14. 1878 Map of Honouliuli Taro Lands (Registered Map No. 630, Hawai'i Land Survey Division), M.D. Monsarrat Surveyor, showing the location of the project area

thence to the coast of Waialua. There are many wild goats in this valley, which are left more or less undisturbed because they kill the growth of mimosa bushes, which would otherwise overrun the country and destroy the pasturage for cattle. [Briggs 1926:62-63]

In 1880-81, 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. A 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.

<u>Other Enterprises in Campbell Lands</u>

Parts of 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). The rice fields were planted in former taro fields or in undeveloped swamps, such as those near 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 Honouliuli lands below 200 feet to William Castle, who used most of the land for sugar cane cultivation, but also sub-leased some lands for rice cultivation, pasture, wood lots, bee-keeping, garden crops, and quarries. Some land above 650 feet 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 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]

Into the early 20th century, some Hawaiian families continued to live in Honouliuli, including the fishing village of Kualaka‘i, and preserve the traditional lifestyle. 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]

History of the Oahu Railway and Land Company (O.R. & L.)

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 1887:74). This homestead idea failed. Two factors influencing the failure were the lack of water and the distance from ‘Ewa to Honolulu. The water problem was solved by the drilling of artesian wells, and Dillingham decided that the area could be used instead for large-scale agricultural cultivation (Pagliaro 1987:4). The transportation problem was to be solved by the construction of a railroad, which Dillingham soon began to finance under the company name of the Oahu Railway and Land Company (O.R. & L.).

During the last decade of the 19th 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, generally running along the *makai* (seaward) boundary of the sugar cane fields. To attract business to the new railroad, Dillingham sub-leased all Honouliuli lands below 200 feet 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 feet that were suitable for sugar cane cultivation were sublet to the Oahu Sugar Company. Throughout this time, and continuing into modern times, cattle ranching continued in the area, and Honouliuli Ranch was the “fattening” area for the other ranches (Frierson 1972:15).

Operations at the O.R. & L. began to slow down in the 1920s, when electric streetcars were built for public transportation within the city of Honolulu and automobiles began to be used by families for transportation outside the city (Chiddix and Simpson (2004:185). The build-up to World War II turned this decline around, as the U.S. military utilized the O.R. & L. lines to transport materials to build defense projects around the island. Historians have noted that one of the most serious mistakes made by the Japanese in their 1941 attack on Pearl Harbor was their decision not to bomb the railway infrastructure. Soon after the attack, the O.R. & L. operated 24 hours a day, transporting war materials and troops from Honolulu to the new and expanded army, naval, and air bases. The huge naval base at Pearl Harbor had its own rail lines that connected to the O.R. & L. rail lines.

In August of 1945, the war ended, and so did the O.R. &. L’s heyday as a military transport line:

> She had served her country well and proudly during the war, but operating round-the-clock on what little maintenance could be squeezed in, had taken a prodigious hit on the locomotives and track. Traffic stayed steady for a short time, but soon dropped precipitously as soldiers and sailors went home, military posts were shrunk or razed, and civilians could again get tires, gasoline and new cars. [Chiddix and Simpson 2004:257]

There was no choice but to abandon the O.R. & L. main line, and in 1946 Water F. Dillingham, son of B.F. Dillingham, wrote:

> The sudden termination of the war with Japan changed not only the character of our transportation, but cut the freight tonnage to a third and the passenger business to a little above the pre-war level. With the increased cost of labor and material and the shrinkage in freight tonnage and passenger travel, it was definite that the road could not be operated as a common carrier. With no prospect of increased tonnage, and the impossibility of increasing rates against truck competition, your management has applied to the Interstate Commerce for authority to abandon its mainline. [Walter Dillingham, cited in Chiddix and Simpson 2004:257]

After the war, most of the over 150 miles of O.R. & L. track was pried up, locomotives were sold to businesses on the U.S. mainland, and railway cars were scrapped. In 1947, the U.S. Navy took over a section of the O.R. & L. track for their own use: to transport bombs, ammunition, and torpedoes from the ammunition magazines at Lualualei, West Loch, and Waikele, on O.R. & L.’s Wahiawā Branch line to Pearl Harbor Naval Base (Treiber 2005:25-26). The track to Waipahu was abandoned in the 1950s, but the line from the magazines in Lualualei to the wharves in West Loch at Peal Harbor remained open until 1968.

History of the Ewa Plantation Company

The Ewa Plantation Company was incorporated in 1890 for sugar cane cultivation. The first crop, 2,849 tons of sugar, was harvested in 1892. Ewa Plantation Company 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:III, 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 on to 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 Company was generating large profits and was the “richest sugar plantation in the world” (*Paradise of the Pacific,* December 1902:19-22, cited in Kelly 1985:171).

During the 20th century, the Ewa Plantation Company 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. 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, and Filipino) labor force that had characterized most of the early history of the plantation. The Oahu Sugar Company took control of the Ewa Plantation Company lands in 1970 and continued operations until 1995, when they decided to shut down sugar cane production in the combined plantation areas (Dorrance and Morgan 2000:45, 50).

The Military Development at Pearl Harbor

In 1891, Russian explorer Otto Von Kotzebue tried to observe Pearl River, but his group could not obtain a canoe. What he was told 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 harbor of Hana-rura; 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. [Kotzebue 1821:338-348]

The early missionary Levi Chamberlain was able to take an outrigger canoe trip to Pearl River:

> 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, but the 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 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 Hawaiian Islands to the United States in 1899, development began to create 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 U.S. 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 airships. 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. government bought 3,500 acres of land in this area, to build several other military camps and installations, including Barbers Point Naval Air Station (Landrum et al 1997:62-67).

On December 7, 1941, the Japanese Navy launched a devastating surprise attack on the U.S. Naval base at Pearl Harbor and other military facilities. Although the major battle damage to the U.S. 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 or 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]

West Loch was later used as the major staging area for U.S. Navy vessels for the Pacific Fleet, especially for ships called Tank Landing Ships (LST), those capable of landing on shore to disembark vehicles and marines. On Sunday morning, May 21, 1944, 29 LSTs, slated to sail to the Mariana Islands for the invasion of Saipan, were in West Loch. Each LST carried a crew of 119 men, 200 marines with ammunition, and vehicles with gas. An explosion at 3:08 blasted one LST, quickly leading to fires on the other ships. In addition, 20 buildings on shore at the West Loch facility were damaged. In all, six of the LSTs sank, 163 men died, and 396 people, including civilians, were injured (Leniham 1989: Chap. II). Today, Naval Magazine (NAVMAG) -West Loch is used for the storage of ammunition, and the five wharfs at West Loch provide marine terminal services for ocean-transported ordnance (Landrum et al. 1997:68).

3.2.2.4 Residential and Commercial Development in Honouliuli

A series of historic topographic maps shows the gradual residential and commercial development of Honouliuli. On the 1919 War Department map (Figure 15), residential areas were limited to a cluster at Honouliuli near the old taro lands adjacent to West Loch, and the Ewa Plantation Village *makai* of Honouliuli. On the 1927 U.S.G.S. map (Figure 16), both Honouliuli and the ʻEwa Plantation Villages were expanding with new and improved roads. On the 1943 War Department map (Figure 17), ʻEwa Villages had expanded with additional "ethnic camps," while Honouliuli had become a smaller residential area, rather than a separate "village." On the 1953 Army Mapping Service map (Figure 18), residential subdivisions were spreading to the shore of Pearl Harbor. However, the Honouliuli lands of the Construction Phase I project area, remained almost exclusively under commercial sugar cane cultivation until the end of the 20th century (Figure 19).

3.2.3 Hōʻaeʻae, Waikele, Waipiʻo, and Waiawa Ahupuaʻa

3.2.3.1 Pre-Contact and Early Post-Contact Agriculture and Habitation

In a study of the resources and population of the *ahupuaʻa* in ʻEwa, Ross Cordy (1996:12) wrote a correlation study of three factors: floodplain size, fishery size, and population size. Hōʻaeʻae had a small floodplain area, directly adjacent to the north shore of Pearl Harbor's West Loch, and a fairly small fishery, which took up only a small portion of West Loch. Waiawa had a medium-sized floodplain, shared with the neighboring *ahupuaʻa* of Mānana, and a small fishery, again shared with Mānana, on the north shore of Middle Loch. Waikele had a large floodplain and had irrigated fields along the lower Waikele Stream and the inland Waikakalaua Stream, but only a medium-sized fishery along the west shore of West Loch. Waipiʻo had a large floodplain, irrigated fields along Kīpapa Stream, and a large fishery, encompassing most of Middle Loch and the fringes of West Loch along Waipiʻo Peninsula. Cordy found that the first two factors were good predictors for pre-contact and early post-contact population. Waipiʻo had the largest population, Waikele and Waiawa had medium-sized populations, and Hōʻaeʻae had the smallest population of the four.

Of the four *ahupuaʻa* in central ʻEwa, Waipiʻo was the main focus of Hawaiian settlement and activity during the centuries preceding western contact. "The populous dwelling place of the *aliʻi* (chiefly class) was formerly located on an east point of Waipiʻo Peninsula known as Lēpau" (McAllister 1933:106). The *aliʻi* at Waipiʻo were no doubt attracted to the great abundance of resources the region offered.

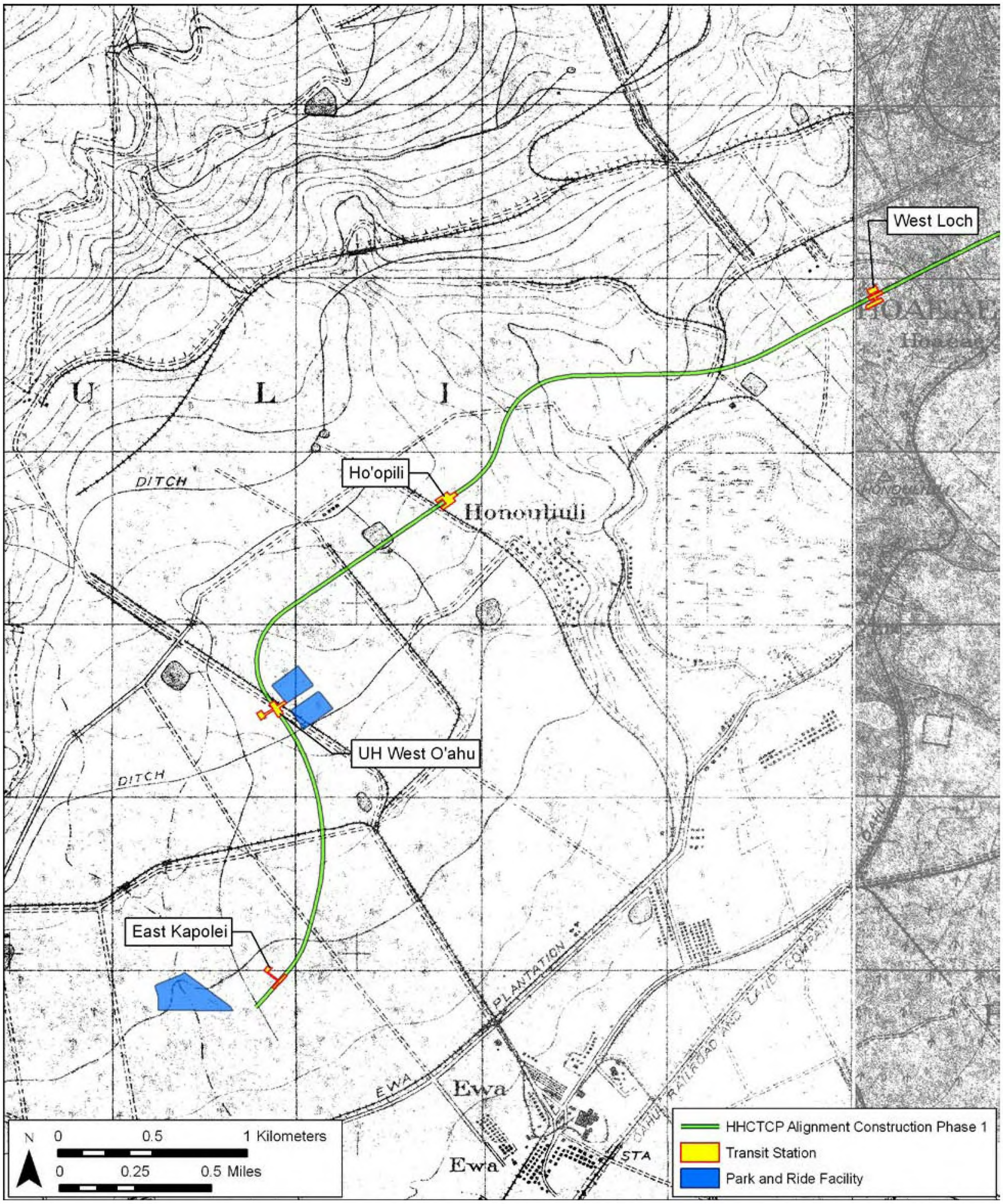

Figure 15. 1919 War Department Fire Control Map, Nanakuli and Pearl Harbor Quadrangles, showing the location of the Honouliuli portion of the Construction Phase I project area

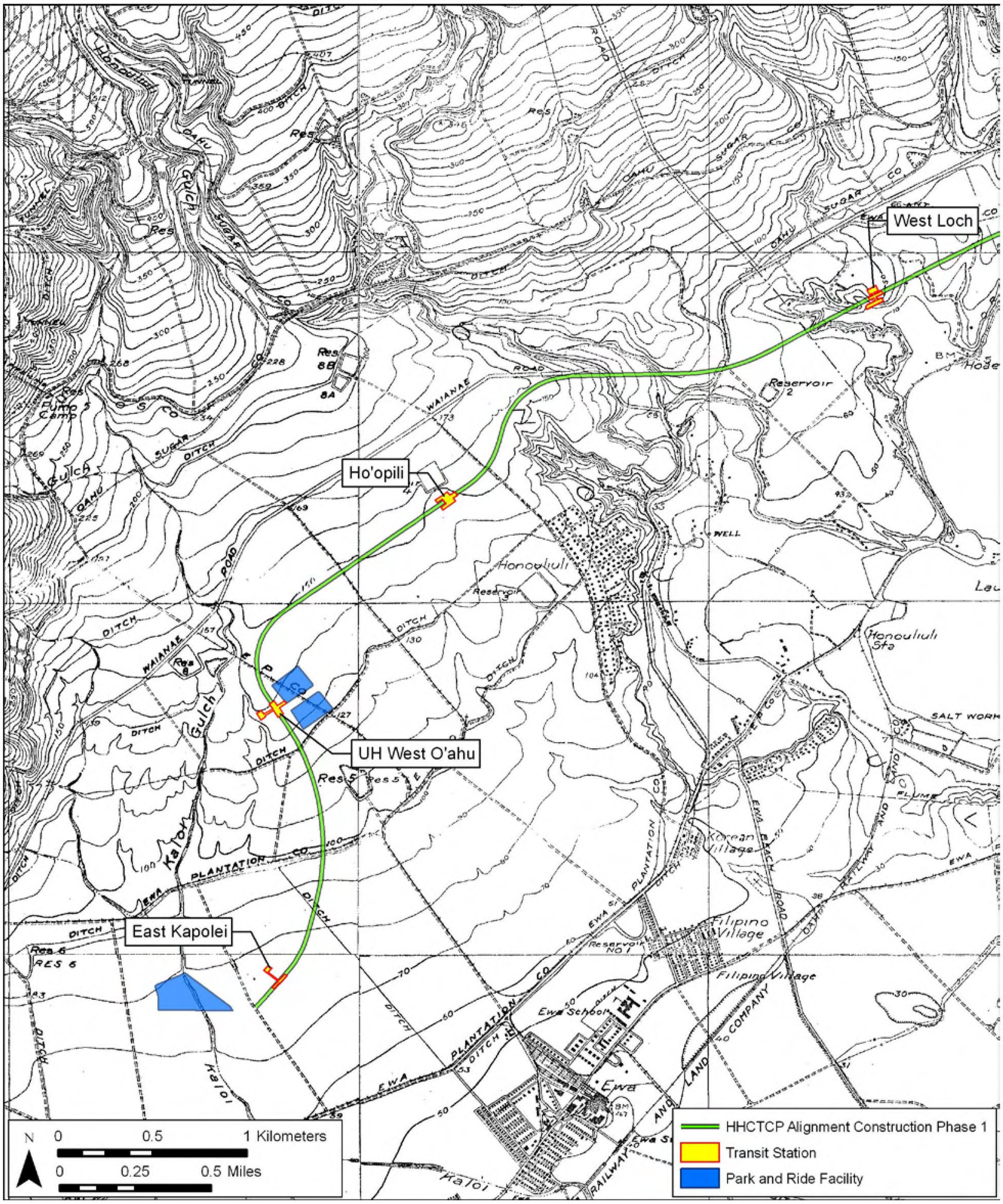

Figure 16. 1927-1928 U.S. Geological Survey Topographic Map, Barbers Point, Waipahu, and Waianae Quadrangles, showing the location of the Honouliuli portion of the Construction Phase I project area

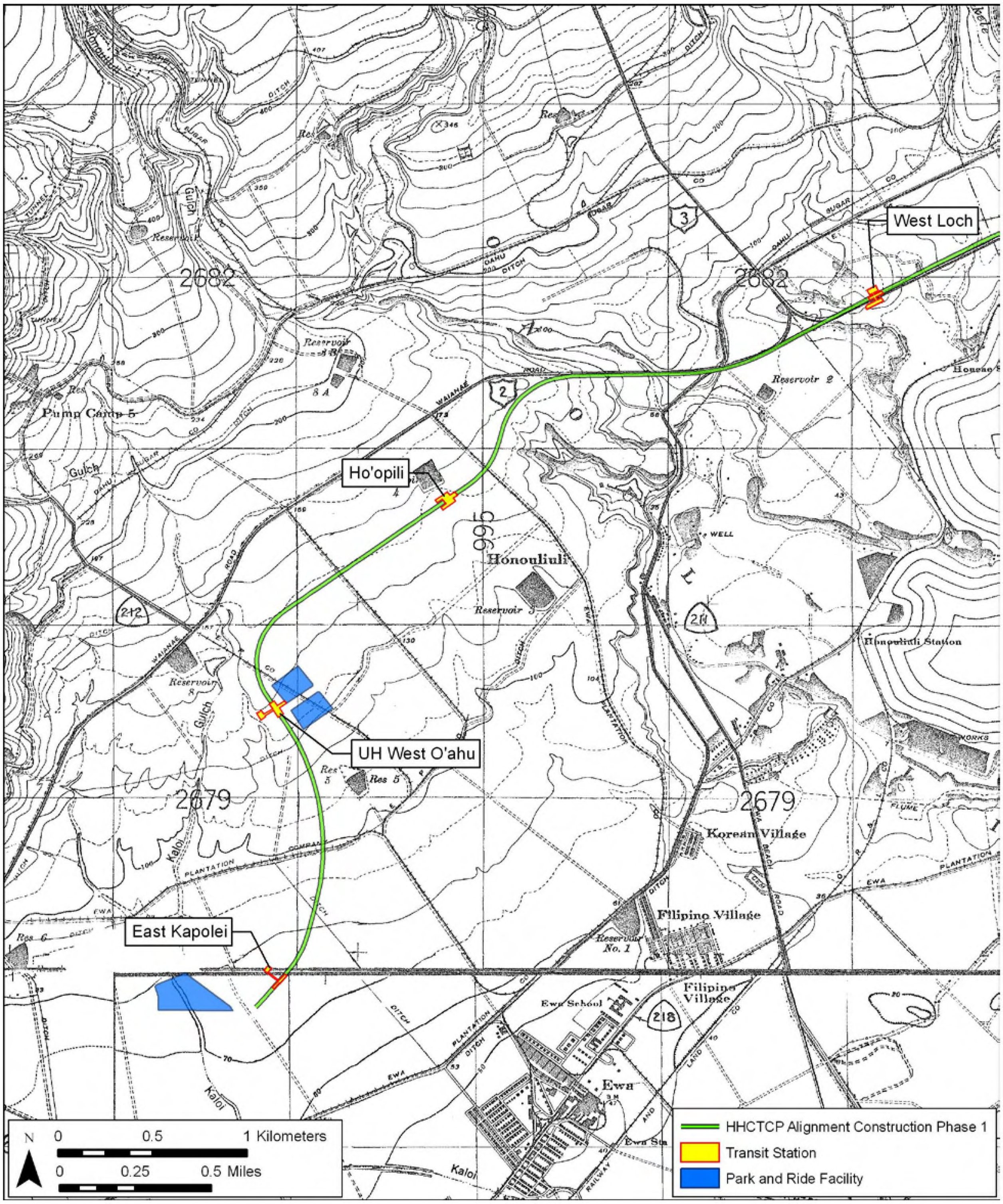

Figure 17. 1943 War Department Topographic Map, Ewa and Waipahu Quadrangles, showing the location of the Honouliuli portion of the Construction Phase I project area

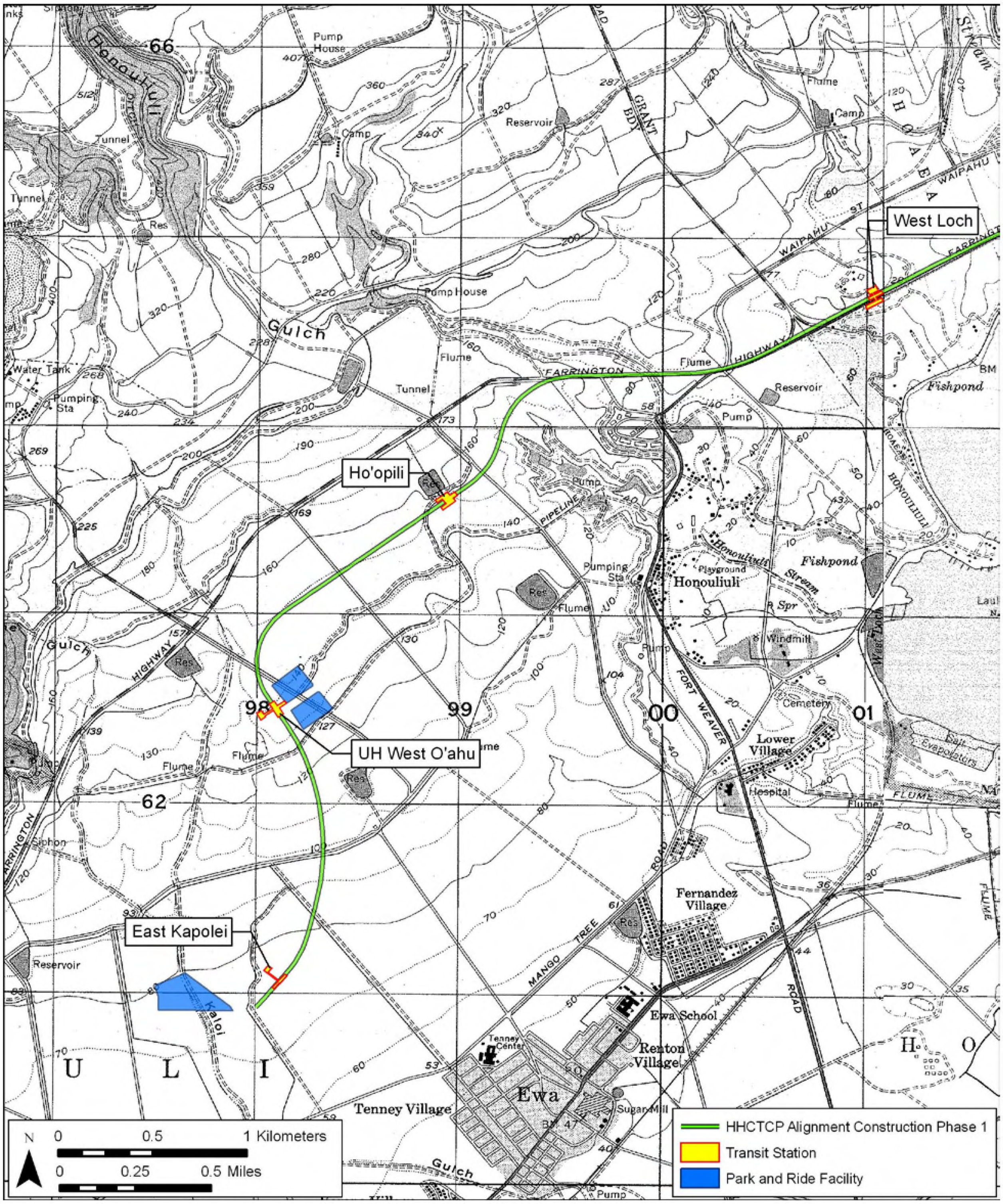

Figure 18. 1953 Army Mapping Service Topographic Map, Ewa and Schofield Barracks Quadrangles, showing the location of the Honouliuli portion of the Construction Phase I project area

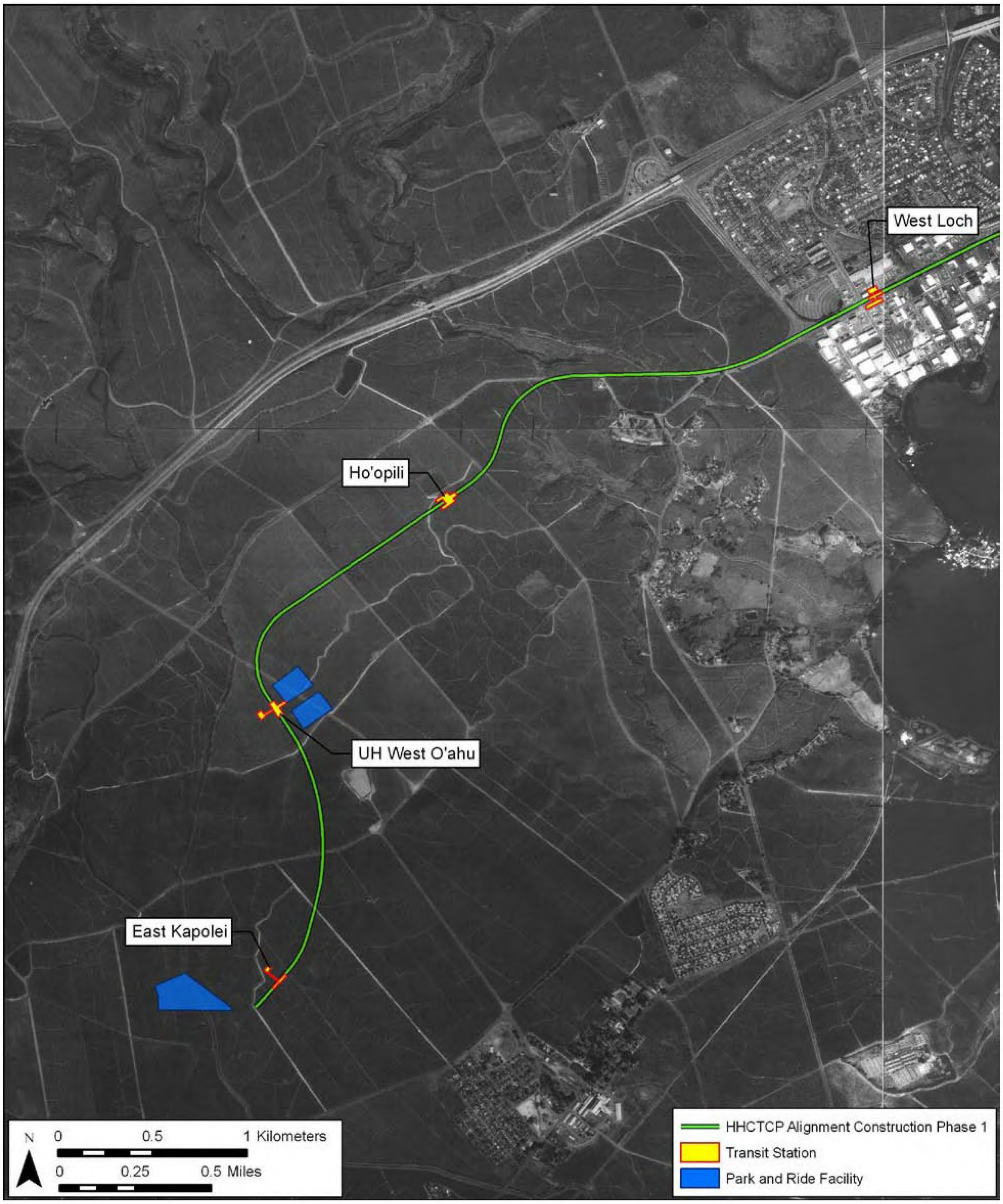

Figure 19. 1977 U.S. Geological Survey Orthophotograph, Ewa and Schofield Barracks Quadrangles, showing the location of the Honouliuli portion of the Construction Phase I project area

In the early 1940s, E. Craighill Handy made a survey of existing and remnant agricultural areas of the Hawaiian Islands. Of the Waiawa/Mānana floodplain, he says only that "there were a few terraces seaward, irrigated by Waiawa Stream" (Handy 1940:81). For Waikele, he states:

> In the flatland, where the Kamehameha Highway crosses the lower valley of Waikele Stream, there are the remains of terraces on both sides of the road, now planted to bananas, beans, cane, and small gardens. For at least 2 miles upstream there were small terrace areas. [Handy 1940:82]

Handy (1940:82) noted that Hōʻaeʻae had "a moderate-sized area of terraces watered by springs inland from West Loch of Pearl Harbor." Handy (1940:82) was most impressed by the resources of Waipiʻo:

> Between West Loch of Pearl Harbor and Loko Eo, the lowlands were filled with terraces which extended for over a mile up into the flats along Waikele Stream. The lower terraces were formerly irrigated partly from Waipahu Spring…It is said that terraces formerly existed on the flats in Kipapa Gulch at least 2 miles upstream above its junction with Waikele. Wild taros grow in abundance in upper Kipapa Gulch.

The second great resource for central ʻEwa was the fisheries of Pearl Harbor, including the man-made fish traps and fish ponds. Handy and Handy (1972:240) noted that:

> The primary reason for ʻEwa's prominence in history and as an *aliʻi* stronghold was undoubtedly the existence of the great number of fishponds at different points around Pearl Harbor, which was ʻEwa territory. Two of the largest [Loko ʻEo and Loko Hanaloa] were on Waipiʻo Peninsula…

The 1873 map of Honouliuli (see Figure 13) shows the locations of numerous *loko* (fishponds) adjacent to the West and Middle Lochs of Pearl Harbor, within the *ahupuaʻa* of Waikele, Waipiʻo, and Waiawa. Apple and Kikuchi (1975:2) discuss the impact that fishponds had on the general population of an area:

> Accessibility to these ponds and their products was limited to the elite minority of the native population - the chiefs and priests. Prehistoric ponds and pond products appear to have been taboo to the vast majority of Hawaiians and to have yielded them no direct benefit. However, indirect public benefit came from ownership by the chiefs of exclusive food sources. Royal fishponds…insured less demand on the commoners' food production resources. Every fish taken from a royal fishpond left its counterpart in the natural habitat available to lesser chiefs and commoners.

The fishponds of ʻEwa, although not necessarily representing beneficial resources for the commoners, can be seen as evidence for a thriving chiefly class in the *ahupuaʻa*. One of the largest was Loko (pond) ʻEo; *ʻeo* is translated as "full of food" (Pukui and Elbert 1986:42). A 19th century visitor to Loko ʻEo provided testimony on the abundant marine resources found in the area:

> We rode and reached Waipio. Saw Halaulani House; only the house stood there for the inhabitants had gone to Mana. The bubbling water of the pond Eo rippled

> on the left. There a recollection came of the bundles of fat eel from that place and the delicious mullet of Makahanaloa. It was delicious clean and that is why the very juice in the ti leaves was sucked up by Kohala's son. [*Ka Nūpepa Kū'oko'a* Aug. 11, 1899, cited in Sterling and Summers 1978:20]

3.2.3.2 Protestant Missionaries and Roman Catholic Priests

The first company of Protestant missionaries from America, part of the American Board of Commissioners of Foreign Missions (ABCFM), arrived in Honolulu in 1820. They quickly established churches in Kona, Hawai'i, Waimea, Kauai, and Honolulu, O'ahu. Although the missionaries were based in Honolulu, they traveled around the islands intermittently to preach to the rural Hawaiians and to check on the progress of English and Bible instruction schools set up by local converts.

In 1828, the missionary Levi Chamberlain (1956:39-40) made a circuit of O'ahu Island, stopping wherever there was a large enough population to warrant a sermon or to visit a school. In his trek though the 'Ewa District, coming from Wai'anae, he stopped at Waimanalo 'Ili in Honouliuli, on the western border of 'Ewa. At around 11 o'clock the next day, on a Saturday, Chamberlain and his companions set out towards the east, reaching Waikele at 3 or 4 o'clock. The group did not stop in Hō'ae'ae, suggesting that the population was too small for a school, but Waikele had two schools, an obviously a larger population than Hō'ae'ae. Chamberlain decided to stay in Waikele until the next day, on the Sabbath, and preach to the Hawaiians who lived there. A crowd of 150 to 200 gathered for the sermon. The next day at 6 o'clock they set out for the village of Waipi'o, which had one school. They left Waipi'o at about 8:30 and walked to Waiawa, where there were two schools. Around ten o'clock, they began their circuit again, stopping only in the *ahupua'*a of Kalauao in the 'Ewa District before they reached Moanalua Ahupua'a in the Kona District. The account does not give much information on the surroundings, but does indicate the relatively populated areas of 'Ewa, in western Honouliuli, Waikele, Waipi'o, Waiawa, and Kalauao, and the time it took to travel by foot along the trail across the 'Ewa District.

In the next years, the Protestant missionaries established smaller churches in outlying areas, sometimes presided over by a foreign missionary or led by a Hawaiian convert, with periodical visits by a visiting pastor from one of the main churches. The first mission in 'Ewa was established in 1834 in Waiawa, near Pearl Harbor. Two missionaries, Lowell and Abigail Smith, were assigned to the station, and were in charge of building a church and a house for themselves near the church (Hawaiian Mission Children's Society1969:3-9). The *ali'i,* Kīna'u, daughter of Kamehameha I and an early Christian convert, offered the missionaries to "settle upon her land, will build us a house and do anything to promote our happiness" (letter from Lowell Smith, June 24th, 1833, cited in Frear 1934:69). Citing his wife's poor health, the Smiths went to Moloka'i instead. But at the General Meeting of the missionaries in June and July of 1834, the board decided that the Smith's should be transferred to 'Ewa, to a place three miles from the king's favorite country seat (Frear 1934:93).

Because of her health, Abigail at first stayed in Honolulu, as her husband began to build their new home. But in November, he brought his wife home to their new station:

> November 15th, 1834…This morning at half past twelve o‘clock Abba and myself left the mission families at Honolulu and took up our anchor—and on a double canoe we came to this place, Waiawa, in four hours…She finds the climate, the water, taro, etc. to agree with her much better than at Honolulu…Nov. 25th…We have been favored with considerable many presents since her arrival viz: some seven or eight fowls, four turkeys, one hog, fish, oysters, potatoes, taro, cabbage, wood, etc. [letters of Lowell Smith, cited in Frear 1934:95-96]

The Smith’s congregation was spread out over an area of 20 miles, and Lowell Smith traveled to different areas to preach to crowds usually several hundred strong. He also established two schools, one for boys and one for girls, and treated the sick, especially inoculating his parishioners against smallpox. In 1836, Abigail’s health deteriorated, and the mission decided that the two should live in Honolulu instead. To carry on the work at the mission, the Rev. Artemas Bishop and his family were transferred to ‘Ewa. Sereno Bishop (1916:41-42), the son of Artemas Bishop, remembered the move:

> Our predecessors at Ewa were Rev. and Mrs. Lowell Smith, specially capable and devoted missionaries who had been only two years in the field. Mr. Smith had built a comfortable house of adobe bricks, thatched with grass and well plastered inside and out. He had also erected the adobe walls of a church, capable of holding an audience of about one thousand people. I think the roof also was on…The adobe walls fifteen feet high were covered by a steeply pitched roof, which extended out in a verandah on all four sides, in order to protect the base of the mud walls from being destroyed by raindrip. The timbers of the roof were long beams dragged from the mountains entirely by human strength, the labor being secured by volunteering, under the leadership of the chiefs.
>
> The mission house was located on the west bank of the Waiawa creek, about one-fourth mile northwest of the present railway station at Pearl City. There was nearly an acre of ground enclosed in an adobe wall. Some distance seaward was a glebe of a couple of acres of taro swamp, a little below where the railway bridge now crosses the creek. A small cattle pen was enclosed about twenty rods north. An old wall of the natives separated the upland from the planted lands and kept out the pigs and afterward the cattle. Copious springs of most delicious water abounded throughout the district of Ewa, a small one being in our own grounds.

In 1837, a new church was completed (Frear 1934:137) on a lot now part of the Leeward Community College. The church was described as:

> An elegant church building, ninety feet long, forty two feet wide with a veranda all around it,--plastered inside and out, a good pulpit, etc., etc. The house will contain from ten to twelve hundred people. [letter from Lowell Smith Feb. 4th, 1857, cited in Frear 1934:115]

The Bishops had their main residence in Honolulu, as he assisted the minister of Kawaiaha‘o Church, although he made monthly visits to ‘Ewa. Bishop’s official assignment at ‘Ewa was from 1836 to 1856, but he continued to preach in ‘Ewa until 1860.

Smaller churches were also established in neighboring *ahupua‘a* of ‘Ewa. In 1898, Hō‘ae‘ae was still considered a remote location. It did not merit its own church, but only a mission, with a missionary visiting irregularly. In 1898, there were branch churches at Pearl Harbor and at the Ewa Plantation (Hosmer 1898:148).

One of the main contributions by the missionaries was their establishment of a census of the population. In ca. 1832, the population of ‘Ewa was about 4,015 (Ewa Station Report 1836:4). At the end of 1835 it was 3,423, “a decrease of 592 in 4 years” (Ewa Station Report 1836:4). Population stabilized in the 1830s and early 1840s. In the 1840s, depopulation increased with a measles epidemic in October of 1849. In January 1849, the population was 2,386 people. The pastor of the ‘Ewa church noted that some of the depopulation was due to emigration, mainly to Honolulu. Sereno Bishop (1916:44) noted that many taro patches had been abandoned when his family lived in Waiawa. The smallpox epidemic of 1853-1854 shattered the remaining population:

> The people of Ewa are a dying people. I have not been able to obtain an exact count of all the deaths & births since the last general meeting. But my impression is that there have been as many as 8 or 10 deaths to one birth. I have heard of but 4 births on Waiawa during the year, & all of these children are dead. I have attended about 20 funerals on that one land, & 16 of these were adults [Rev. L. Smith 1835. Ewa Station Report, p. 8-9].

In 1860, Artemas Bishop reported:

> The people of the district are rapidly diminishing, and whole neighborhoods where in former years were numerous families and cultivated lands, there are now no inhabitants, and the land is left to run to waste. The fathers have died off, and the children wander into other parts, and there are none to fill their places [Bishop1860, Ewa Station Report:1].

3.2.3.3 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, the Hawaiian government, and the *ali‘i* (royalty) received their land titles. The common people (*maka‘āinana*) received their *kuleana* awards (individual land parcels) in 1850.

<u>Hō‘ae‘ae</u>

A total of 23 land claims were made in Hō‘ae‘ae Ahupua‘a, with 19 claims awarded to commoners. All unclaimed lands in the *ahupua‘a* were awarded to Nueku Nāmau‘u as Māhele Award 63 (LCA 10474). Nāmau‘u was a descendant of Hawai‘i Island chieftains and a cousin (or nephew) to Mataio Kekūanao‘a, the father of two Hawaiian monarchs, Alexander Liholiho (Kamehameha IV) and Lot Kapuāiwa (Kamehameha V) (Day 1984:69). The *kuleana* awards were clustered around the floodplain on the north shore of Pearl Harbor’s West Loch, along Hō‘ae‘ae Stream, and along a large irrigation ditch, as shown on a 1905 map (Figure 20). The claimants were awarded *kula* lands (for dry land agriculture or pasture), *lo‘i* (irrigated patches for taro), and house lots (Table 5).

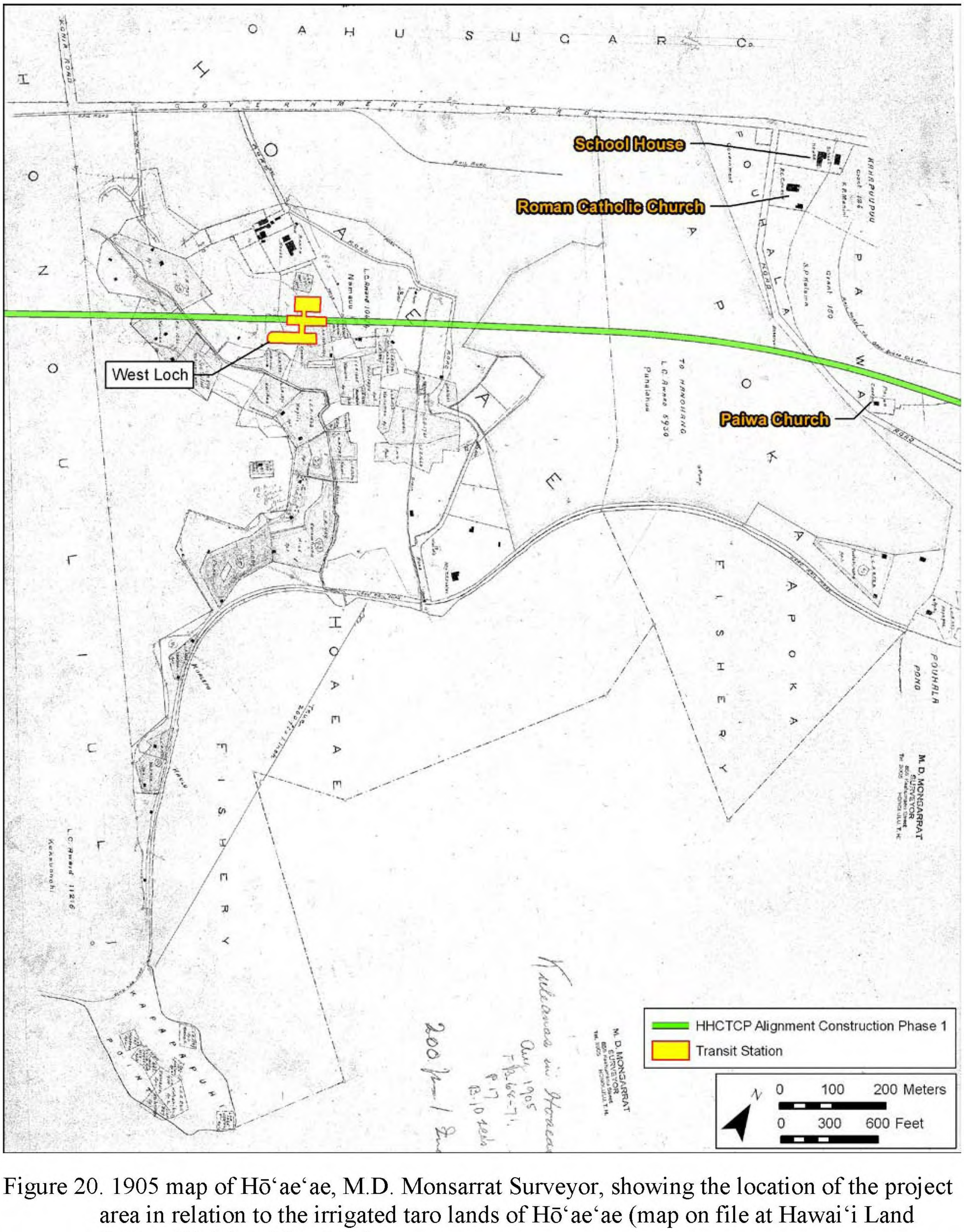

Figure 20. 1905 map of Hōʻaeʻae, M.D. Monsarrat Surveyor, showing the location of the project area in relation to the irrigated taro lands of Hōʻaeʻae (map on file at Hawaiʻi Land Survey Division, Honolulu)

Table 5. Land Commission Awards in Hō‘ae‘ae Ahupua‘a

LCA	Awardee	*‘Ili*
193	Rees, Lewis	
750	Mokumakuaole	Koipu, Kalokoloa
887	Kaihikapu	Kalaikea, Kapapapuhi, Kuainihi, Kalokoeli, Pakai
889	Puko	Waiihi
899	Kahooweliweli	Amakeahilalo
909	Kaneiahuea	Paniu, Kalahale, Lihue, Kumuhau
1533	Kealaiki	Muki, Waihi, Kalokoeli
1561	Kaumanu	Amakeahiluna, Kamalokala
1562	Kapili	Kaaiiole, Koipuu
1571	Kalihue	Kamalokala
1578	Kaihumai	Laekea
1582	Kukahoe	Koipu
1583	Kekapa	Waihi
1601	Kekoamiki	Keahupuaa, Kaaiiiole, Holokoeli
1605	Kaualei	Koipuiki, Koipu
1660	Ewa	Kahuu
1707	I	Kalokoeli
1721	Hinawale	Kuainiho, Kaaiiole
5634	Kaiwi	Kalokoeli, Koipuu
10474	Namauu	Ahupua‘a

Waikele

In the Māhele, the *ahupua'a* of Waikele was awarded to the *ali'i* Nahuina. He returned it to the government as a commutation fee to pay for the lands he kept for himself. Much of the most productive lands of the *ahupua'a* were awarded to several *ali'i* as *'ili* awards, such as: the 199-acre award of Auiole 'Ili to Nāmāhana and Maawe; the 252-acre award of Koalipea 'Ili to Nāmakehā; and the 2829-acre award of Pouhala 'Ili to Lūlūhiwalani. In all, 119 land claims were made in Waikele Ahupua'a, with 73 claims awarded (Table 6).

Taro lands were found at the floodplains along Pearl Harbor, and at inland areas adjacent to the lower section of Kīpapa Stream, along both sides of Waikele Stream, and along Waikakalaua Stream near the upper boundary of Waikele. The taro was irrigated by the water of the streams and by springs at the base of the bluffs, including the famous Waipahu Spring. The lower portion of the floodplain was used for fishponds. *Kula* lands were used for the cultivation of coconut, breadfruit, and pandanus, and for pasture. In a review of a sample of the *kuleana* awards, Cordy (1997:7) noted that approximately 50% mentioned a house lot as part of their claims.

The *'ili* and Land Commission Awards of Waikele are shown on three maps: the 1905 map of Hō'ae'ae (see Figure 20), which shows portions of the *'ili* of Apoka, Pouhala, and Pā'iwa in Waikele; an 1875 map (Figure 21), which shows the *'ili* names and boundaries; and an 1889 map (Figure 22), which shows the Land Commission Awards. Of particular interest on these maps is the relationship of the project area to two churches, one labeled "Paiwa Church," located approximately 50 meters south of the project area (Figure 22), and a Roman Catholic Church and school house located 300 meters north of the project area (see Figure 20).

The Roman Catholic diocese, based in Honolulu, began to send priests to convert native Hawaiians to Catholicism in the 'Ewa region as early as the 1840s. A small chapel had been built in Waipahu (Waikele Ahupua'a) in the late 1860s by Father Delelande, but as the population grew the Catholic Mission decided to build a church, and acquired a lot adjacent to a school built in 1899 (site of today's Waipahu Elementary School, on the *mauka* side of Farrington Highway) (see Figure 20). The church, called St. Joseph's, was completed in 1902 (Schoofs 1978:88). The church had an adjacent cemetery, on the east side of Waikele Street. This is shown as a small block on the west side of Waipahu Elementary School on modern maps. However, the cemetery area once stretched from the elementary school grounds makai, to the vicinity of Farrington Highway (Mauricio 1997:9), as shown on an 1898 map (Figure 23). According to a *Honolulu Star Bulletin* article (Adamski 1999), this cemetery was used by the Catholic Portuguese and Filipino workers of the Oahu Sugar Company. The last interment at the cemetery was in 1941 and the cemetery was subsequently abandoned. Residential apartments were later built on a portion of the site, and many of the burials were moved to Mililani Memorial Park. It is possible that some burials were overlooked during this operation, and that there may still be burials in the vicinity.

In 1939, St. Joseph Church had become termite-infested, and a new site (east of the area marked "Paiwa Church" on the *makai* side of Farrington Highway) for the church was chosen. In 1946, St. Joseph School was established adjacent to the west side of the church.

Table 6. Land Commission Awards in Waikele Ahupua'a

LCA	Awardee	*'Ili*		LCA	Awardee	*'Ili*
4 MA	Luluhiwalani	Pouhala		1614	Kekualiilii	Kahakuohia
39 MA	Kauliokamoa	Kapakahi		1675	Mahoe	Kamohai
61B MA	Namakeha			1675-B	Koniho	Papaa
60	Hunt, Thomas			1675-D	Makalolohe	Kapakahi
130	Kuapanio	Papaa Komohana		1675-E	Kaneolei	Ulumoku
851	Hiwauli, Salai	Papa		1675-F	Kaneiakama	Koheoo, Kahakuohia, Keahupuaa, Manooelua (Waipio, Waikele)
857	Kapepee	Pouhala		1679	Pala	Hopenui, Ulumanu
858	Kanealoha	Waipahu, Pouhala		1680	Pauoa	Lihue
858-B	Puolohinana	Pouhala		1682	Puhi	Kapakahi, Keahupuaa, Kaohai
858-C	Pokini	Pouhala, Paahao		1682-B	Kualii	Kapakahi
859	Kalauao	Lihue, Pouhala, Ohua		1712-B	Hopu	Kaokai
860	Kaaihee	Paahao		1712-C	Nuuanu	Kapuna, Keahupuaa
880	Niulii	Kahapuupuu		1716	Hauna	Kanupo
888	Ilikealani	Waipahu		1812	Ka'u	Kahakuohia
890	Kuhano	Ohua		2944	Marini, P.F. & Marini, Akoni	Kapuukolo, Puiwa, Kekupanio, Lihue
891	Kaakiakiaho	Kahapuupuu		3848	Puhalahua	Apokaa (Waikele, Honuakaha)
896	Nalii	Pouhala		5531	Keawe	Kapakahi
898	Kaneaola	Polapola, Kahawai, Hiwa (Honouliuli, Waikele)		5595-B	Kapahu	Kapakahi
908	Kaniu	Ohua		5595-C	Napupu	Ulumoku
913	Napihe	Kahakuohia		5602	Koliola	Halehalekaiwi, Kaohai, Kapuna
1005	Kahiki	Pouhala		5603	Kookoo	Kapakahi
1008	Ku	Papaa		5663	Kahonu	Pahoa, Paahoa

LCA	Awardee	*'Ili*		LCA	Awardee	*'Ili*
1009	Kahanu	Napuakalo		5762	Kuaihelani	Papaa, Kapakahi, Ohua
1010	Kahookohu	Papaa		5811	Kumumu	Hanaloa (Waipio, Waikele)
1011	Kakualopa	Papaa		5846	Kalou	Kapakahi, Kapuna
1013	Muhu	Ulumalu		5848	Kaupuaa	Kapakahi
1015	Kuheleloa	Paahao		5930	Puhalahua	Hanohano
1016	Haole	Ulumalu		5989	Makole	Kapakahi
1018	Palaualelo, wahine	Pouhala		6025	Kahaekaua	Ulumanu
1020	Akaakaa	Waipahu		6545	Haalilio, Hana Hupa	Ohua
1021	Maawe	Auiole		7260	Namakeha, B	Kaalaaluna, Kaolipea
1022	Piimahina	Paiwa		7442	Kuauli	Kahakuohia
1576	Kamole	Kahapuupuu		8597	Kamoana	Paiwa
1597	Kaihumua	Kapuna, Kamapuna, Auiole		9384-B	Kahula 2	Papaa
1613	Kaihunana	Kahakuohia		9384-C	Kahula 1	Papaa
1613-B	Huailua	Paiwa		10184	Namahana	Auiole
1614-B	Hookaamom i	Ahualii, Mikiokai, Keahupuaa		10831	Puniwai	Kanupoo

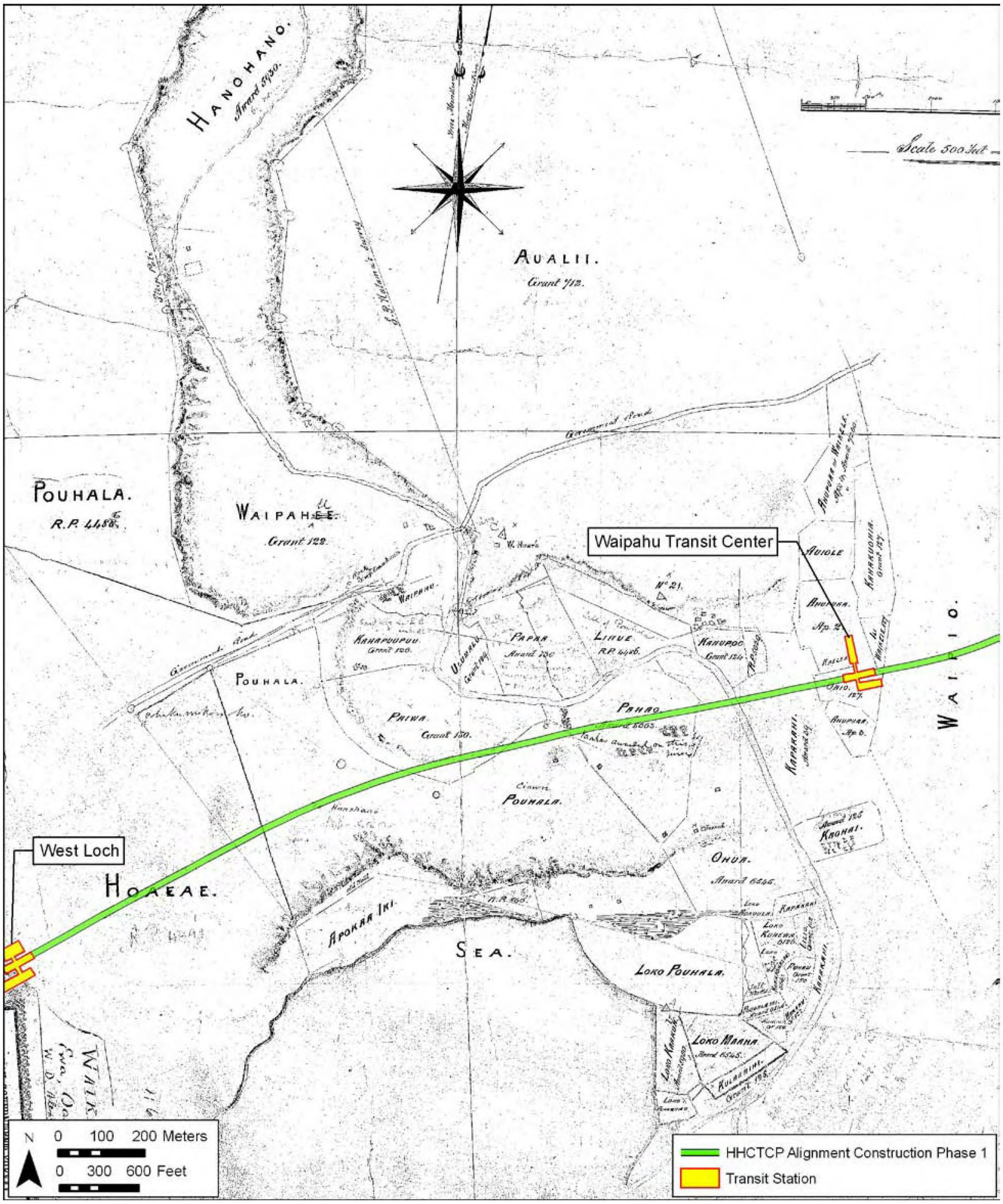

Figure 21. 1875 Map of Waikele, W.D. Alexander Surveyor, showing *'ili* in the vicinity of the project area (Registered Map No. 120, Hawai'i Land Survey Division)

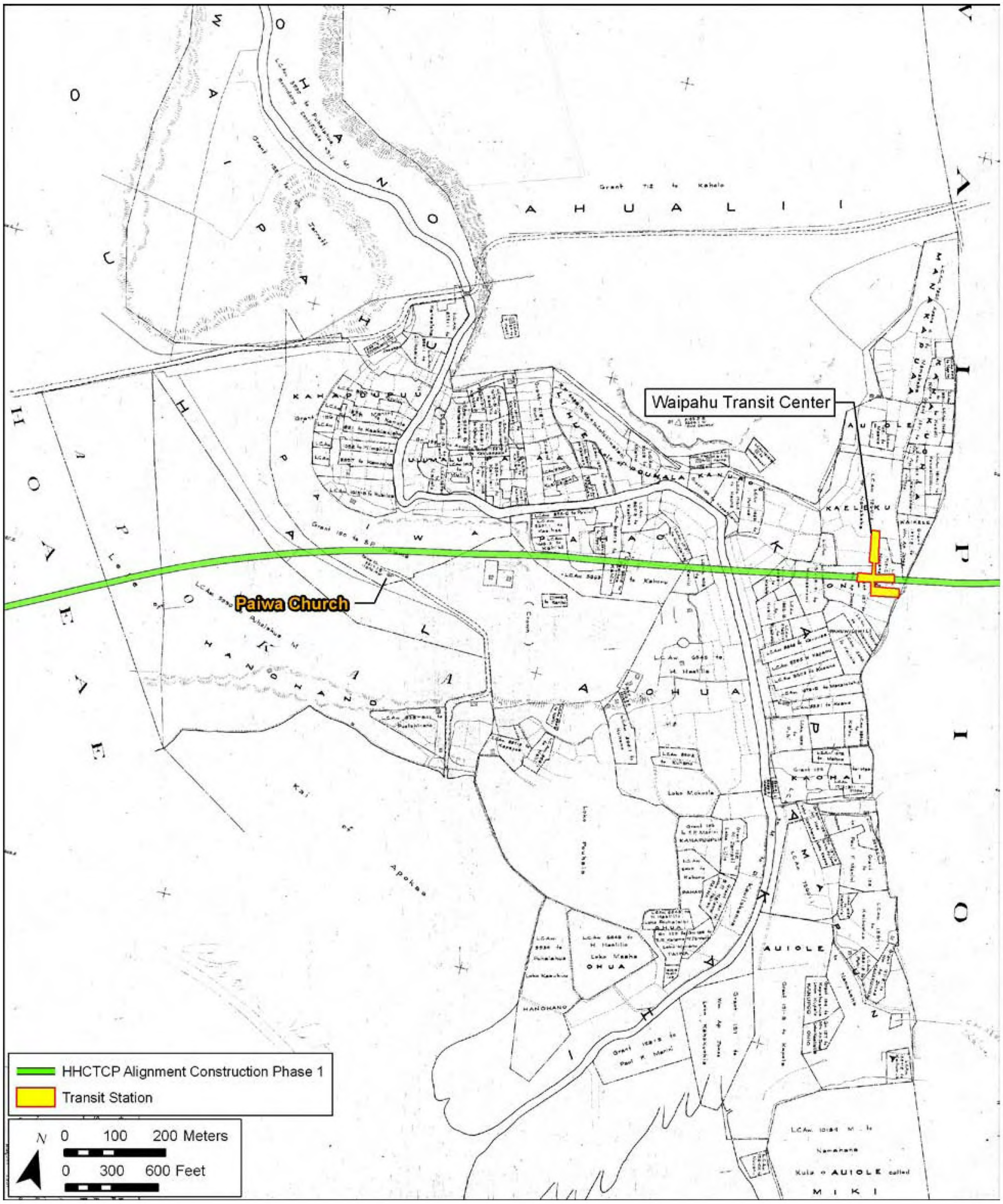

Figure 22. 1889 Map of Waikele, showing the location of the project area in relation to the irrigated taro lands of Waikele (Registered Map No. 1498, Hawai‘i Land Survey Division)

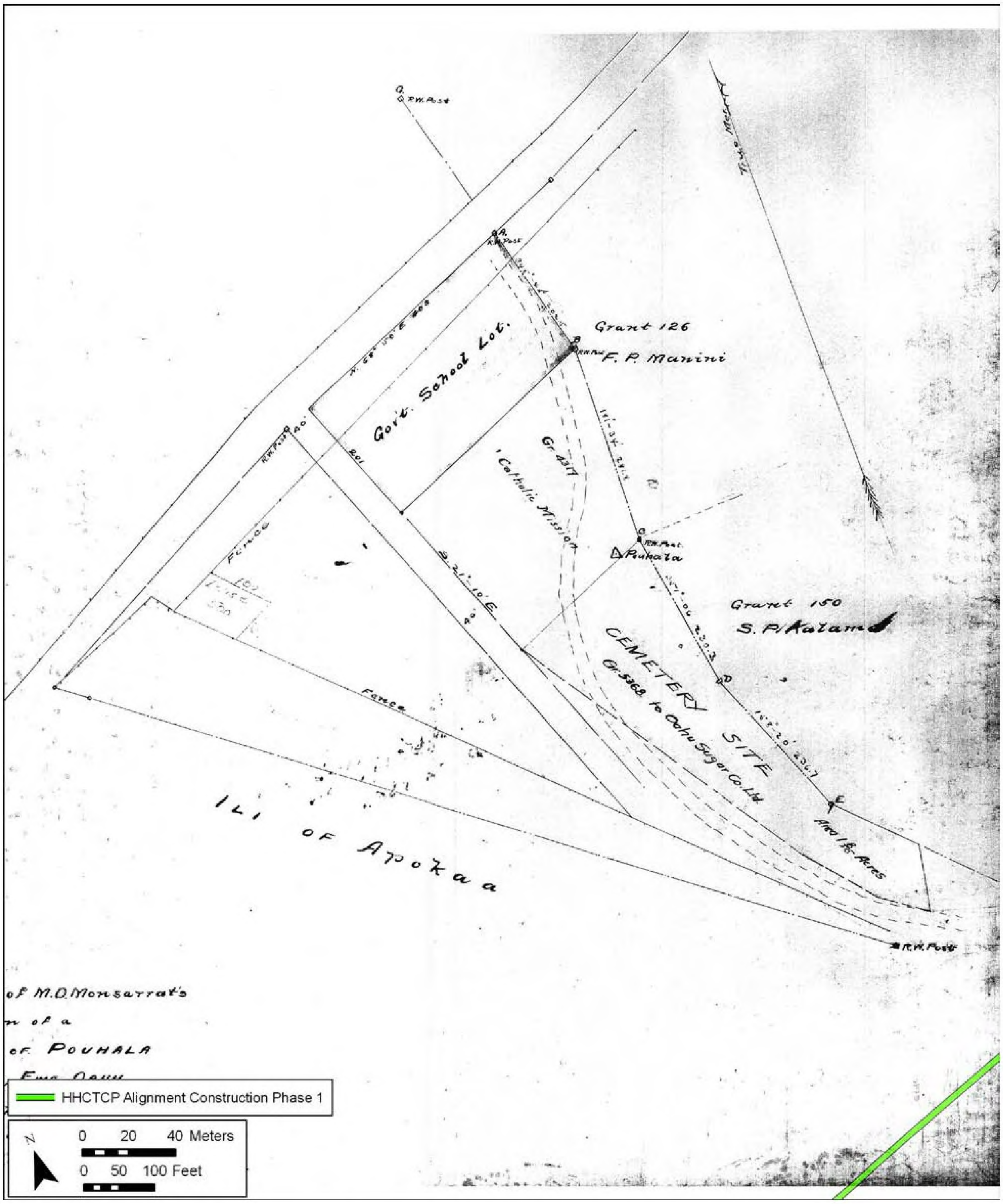

Figure 23. 1898 Map of the Pouhala 'Ili School Lot in Waikele Ahupua'a, showing the extent of the Catholic Cemetery, which once extended *makai* (seaward) to the vicinity of Farrington Highway (Registered Map No. 1950, Hawai'i Land Survey Division)

An extensive search was made on any information regarding "Paiwa Church." The church was located in the '*ili* of Pā'iwa, thus its name. The church is labeled as "Paiwa Church on the 1889 map of Waikele (see Figure 22) and on the 1905 map of Hō'ae'ae (see Figure 20). Paiwa Church was likely a Christian church for native Hawaiians, as Christian churches for the Japanese, Chinese, and Korean plantation workers were not established in the 'Ewa area until ca. 1905 (Chang 2003:38). It may have been related to the St. Joseph Catholic Church or it could have been a small branch church of the 'Ewa Protestant Mission Station at Waiawa. The proximity of this church to the project area is important as churches established before 1900 often have undocumented graves in adjacent cemeteries.

Waipi'o

John Papa 'Ī'ī was awarded most of the *ahupua'a* of Waipi'o in LCA 8241, comprising approximately 20,540 acres including Loko 'Eo, seen on an 1851 map (Figure 24). Included in the documentation for 'Ī'ī's award is a list of "the people living on the land of Waipi'o 'Ewa in 1848" (Barrere 1994:73). A substantial grant within the *ahupua'a* was awarded to Abenera Pākī, Bernice Pauahi Bishop's father. Part of LCA 10613 given to Pākī comprised the 350 acres of the *'ili* of Hanaloa. William Harbottle also received a land award (LCA 2937) in Waipi'o; he claimed two acres at Hanapouli 'Ili.

119 additional land claims were documented in Waipi'o, with 78 claims being awarded (Table 7). The majority of awarded land parcels were located in the *makai* portions of Waipi'o, at or just above Waipi'o Peninsula. Predominant among the claimed land usages in Waipi'o are: 312 *lo'i* (irrigated taro patches) of various sizes; and 43 *mo'o*, or fields, comprising indeterminate numbers of *lo'i*. Wetland taro cultivation was the primary agricultural pursuit within the *ahupua'a* in the mid-19th century, and likely reflects a long history of taro farming. At the coast, four fishponds were claimed. In the *mauka* reaches of Waipi'o, 53 claims were made for portions of *kula* (pasture land) and 25 for "*okipu*" or *'okipu'u* (forest clearings). The fact that several claims were made in the *mauka* regions suggests that Waipi'o residents had particular locales that they traveled to repeatedly. *Kula* land is a general term for open fields, pastures, uncultivated fields, or fields for cultivation, and upland (drier), which is distinct from meadow or wetland (Lucas 1995:60). *Kula* lands were often used for opportunistic plantings such as bananas, sugar cane, sweet potatoes, dry land taro, and others that did not depend heavily on a consistent source of water. *Okipu'u* is defined as a forest clearing (Lucas 1995:82), a place that was presumably used to gather forest products and medicinal herbs and or for pasturage.

In contrast to the well-populated *makai* lands of Waipi'o, the *mauka* regions were often described in 19th century accounts as virtually uninhabited. The missionary William Ellis described the interior regions of 'Ewa in 1823-24:

> The plain of Eva is nearly twenty miles in length, from the Pearl River to Waialua, and in some parts nine or ten miles across. The soil is fertile, and watered by a number of rivulets, which wind their way along the deep water-courses that intersect its surface, and empty themselves into the sea. Though capable of a high state of improvement, a very small portion of it is enclosed or under any kind of culture, and in traveling across it, scarce a habitation is to be seen. [Ellis 1963:7]

Table 7. Land Commission Awards in Waipi‘o

LCA	Awardee	*‘Ili*		LCA	Awardee	*‘Ili*
21 MA	Honu	Ulu		8241-K	Kuhiwahiwa	Homaikaia, Hanaloa
26 MA	Kailakamoa	Honopue		8241-KK	Kaiki	Pakikakika
1616	Kaluahinenui	Homaikaia		8241-L	Mokunui	Kamalo, Kauhola
1675-F	Kaneiakama	Koheoo, Kahakuohia, Keahupuaa, Manooelua		8241-LK	Kaholohana	Hanaupouli
1685	Peke	Kapaia, Waikaka		8241-LM	Ai	Hanaloa, Holoamana, Homaikaia
1712	Hinaakala	Hanaloa		8241-LN	Nahua	Kaakaualani, Kanonoukuono, Nakumei, Waihaka
3043	Kapiipo			8241-M	Kupokii	Eo
3794	Luheluhe	Kaalakea, Hanapouli		8241-MM	Puhipaka	Aimauino, Himauona, Waihaka
3972	Hinaumai	Hopenui		8241-N	Ukeke	Lelepua
5371	Ehu	Hanaloa, Keahupuaa		8241-NN	Luaka	Kionaole, Kaahukaua, Hanaloa
5604	Kaahuewalu	Hanaloa		8241-O	Manuwa	Halaula, Waihaka
5606	Kapela	Homaikaia, Hanaloa		8241-P	Uma	Halaula, Waihaka
5647	Kaia	Kalualaea, Eo, Hanaloa		8241-PN	Kahea	Mauoha
5811	Kumumu	Hanaloa (Waipio or Waikele)		8241-PP	Ulakaipo	Hopenui
5972	Manoha	Mohoa		8241-PW	Kupehe	Keahupuaa
5998-B	Puou	Homaikaia		8241-Q	Kamakahi	Kuana, Waianeki
6076	Humehume	Puopae		8241-R	Meahale	Waiakapuaa
8241	Ii, Ioane / Ii, John	Pawaa, Kalawahine (probably Honolulu)		8241-RR	Poikeo	Halaula
8241-AB	Palekaluhi	Kamuku, Lapili		8241-RS	Keliikuhoe	Kahema, Waihaka, Pakikakika

LCA	Awardee	*'Ili*		LCA	Awardee	*'Ili*
8241-BB	Koleaka	Homaikaia		8241-S	Niau	Eo, Waihaka
8241-BP	Kalauili	Kaahukahua, Kumupali		8241-SM	Ohilau	Hopenui, Laauli
8241-BS	Kahuailana	Kukina, Waihaka		8241-SS	Kauhiohewa	Hanapouli, Kahaole
8241-CB	Keawekolohe	Homaikaia, Hanaloa		8241-T	Kailio	
8241-CC	Poupou	Papa, Leoiki		8241-U	Kailihao	Kapoipuka
8241-CM	Manoha	Mohoa		8241-US	Nahola	Homaikaia
8241-CO	Paakiki	Halaula, Waihaka		8241-UU	Kalaiku	Waipio uka, Lelepua
8241-CW	Leoiki	Hopenui		8241-V	Kauluoaiwi	Honauaka, Waipio uka
8241-D	Makaaloha	Halaula, Waihaka		8241-W	Kaneakauhi	Kaohai
8241-DD	Kalili	Aimalino, Eo, Waihaka		8241-WW	Pi	Papohaki
8241-DO	Hana	Pakikakika, Puopae, Eo		8241-X	Halelaau	Kopilau, Hokapiele
8241-E	Kapule	Eo, Puuopae, Kalualaea		8241-Y	Hepa	
8241-F	Kaumiumi	Hoomaikaia, Lepau, Keakiula		8241-Z	Kaioe	Moakea, Puulu, Palikea
8241-G	Ope	Homaikaia, Lepau		10512	Nahuina	Kauaka
8241-GG	Kauhi	Kahaole, Hanaupouli		10613	Paki, Abner	
8241-GH	Moku	Kalualaea		11190	Kanae, S.	Keahupuaa
8241-GO	Kawahine-lawaia	Keio		11193	Kailianu	Lepau, Kanakahiloko]
8241-H	Kamaka	Lepau, Kauakahiki		11195	Kini	Waihaka
8241-HH	Paumano	Eo, Kamalua		11199	Kauaila	Kalualaau, Puuopae
8241-I	Puakea	Halaula, Puualaea		11200	Kihewa	Eoiki, Puuopae
				11205	Kalaiku	Lelepua

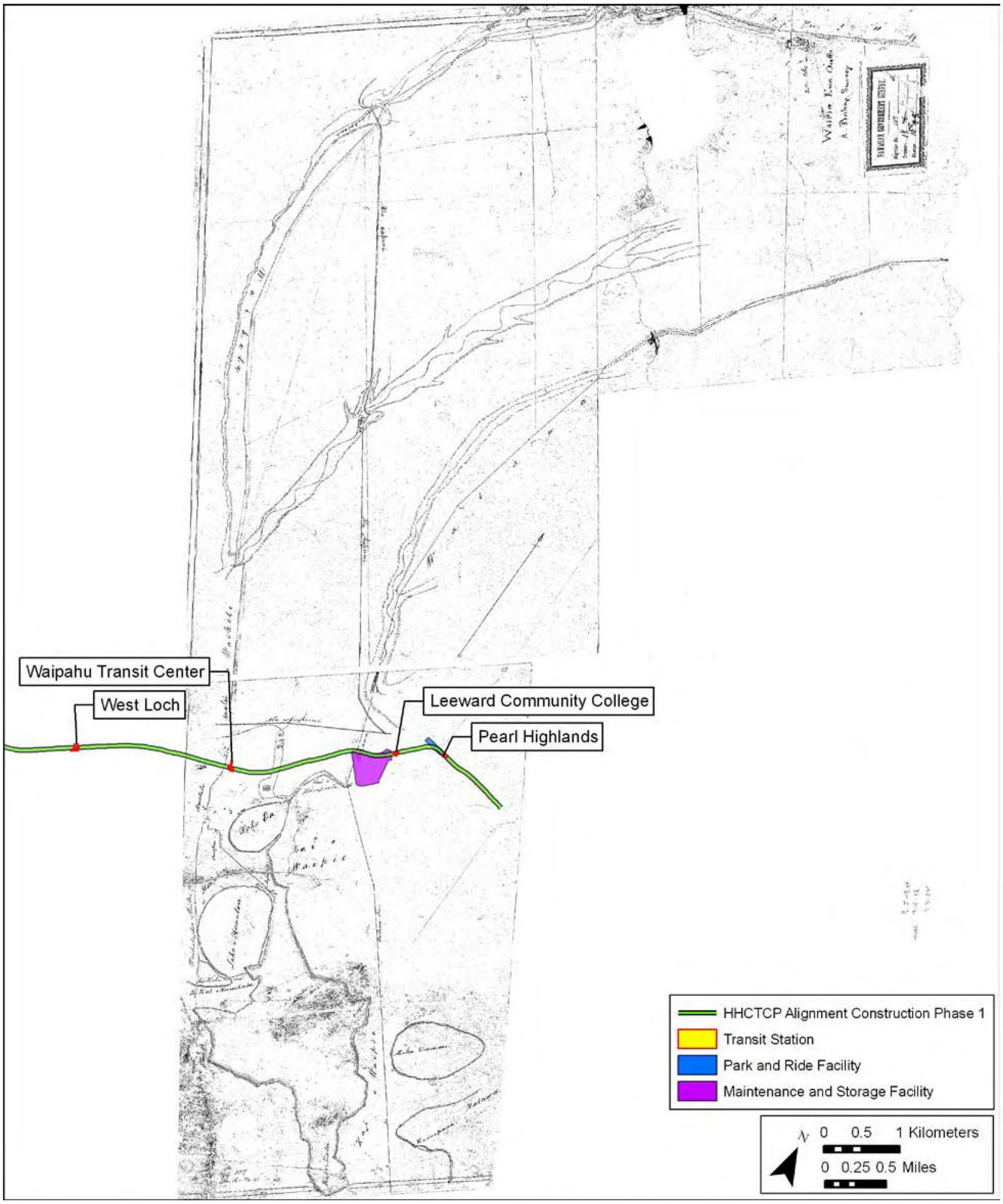

Figure 24. 1851 Map of Waipi‘o by Rev. Artemas Bishop, showing the Waipi‘o lands of John Papa ‘Ī‘ī (Registered Map No. 107, Hawai‘i Land Survey Division)

Despite Ellis' impressions, there is evidence that during the early 19th century, the Waipi'o population was not solely focused on the fertile coast. In an inventory of advances in education during the reign of Kamehameha III (from 1825 to 1854), "schools were built in the mountains and in the crowded settlements. Waipi'o had school houses near the coast and in the uplands" (Kamakau 1992:424). The placement of a school "in the uplands" of Waipi'o suggests that some portion of the *ahupua'a* population had settled there.

During the 1830s, cattle grazing began in the *mauka* regions of Waipi'o (Bishop 1901:87). In 1847, residents of more *makai* land petitioned the Minister of the Interior, John Young, to resolve the problem of stray animals. These stray animals may have been from herds of cattle and goats grazing on Waipi'o's *kula* lands. In addition to damage from stray animals on the lands of Waipi'o, the impact of grazing animals was noted several kilometers away at Pearl Harbor. Stray cattle continued to be a problem until large-scale agriculture was introduced just prior to the beginning of the 20th century. The occupation of the uplands by cattle denuded the countryside of ground cover, and caused vast quantities of earth to be washed down by storms into the lagoons, shoaling the water for a long distance seaward (Bishop 1901:87).

John Papa 'Ī'ī was born in Waipi'o Ahupua'a at the beginning of the 19th century, and was placed in the household of Liholiho (Kamehameha II) when he was ten years old. He became Liholiho's personal attendant and also maintained records of life in the Hawaiian Kingdom. An account of 'Ī'ī's birth details the establishment of his family at Waipi'o after the ascendancy of Kamehameha on O'ahu:

> John Papa 'Ī'ī was born in Kūmelewai, Waipi'o, in 'Ewa, O'ahu , on the third day of August (*Hilinehu* in the Hawaiian calendar) in 1800, on the land of Papa 'Ī'ī , whose namesake he was. Papa ['Ī'ī's uncle] was the owner of the pond of Hanaloa and two other pieces of property, all of which he had received from Kamehameha, as did others who lived on that *ahupua'a*, or land division, after the battle of Nu'uanu. He gave the property to his *kaikuahine*, or cousin, who was the mother of the aforementioned boy. Her names were Wanaoa, Pahulemu, and Kalaikane. ['Ī'ī 1959:20]

'Ī'ī's writings provide glimpses of life within Waipi'o Ahupua'a during his lifetime. 'Ī'ī mentions the "family [going] to Kīpapa from Kūmelewai by way of upper Waipi'o to make ditches for the farms" ('Ī'ī 1959:28) and recalls that, during the visit to O'ahu by the Kaua'i chief Kaumuali'i and his entourage, the chief's attendants were provided with gifts: "From Waipi'o in 'Ewa and from some lands of Hawai'i came *tapa* made of *mamaki* bark" ('Ī'ī 1959:83). 'Ī'ī notes how a period of famine was managed in Waipi'o and what resources were available during the famine:

> Here is a wonderful thing about the land of Waipi'o. After a famine had raged in that land, the removal of new crops from the taro patches and gardens was prohibited until all of the people had gathered and the farmers had joined in thanks to the gods. This prohibition was called "*kapu 'ohi'a*" because, while the famine was upon the land, the people had lived on mountain apples [*'ohi'a 'ai*], *ti*, yams, and other upland foods. On the morning of Kane, an offering of taro greens and other things was made to remove the *'ohi'a* prohibition, after which each farmer took of his own crops for the needs of his family. ['Ī'ī 1959:77]

The end of the 18th century and beginning of the 19th century marked Hawai‘i's entry into world trade networks. One of the chief exports at this time was sandalwood (*Santalum* sp.) or *‘iliahi*, which was prized in China for its unique fragrance and used in the manufacture of household items, as incense, as perfume, and as medicine (St. John 1947:13). The central plains of ‘Ewa supplied the Hawaiian Kingdom with *‘iliahi*. One of the first generation missionaries, Sereno Bishop (1901), described his memories of the central O‘ahu region in the 1830s:

> Our family made repeated trips to the home of Rev. John S. Emerson at Waialua during those years. There was then no road save a foot path across the generally smooth upland. We forded the streams. Beyond Kipapa Gulch the upland was dotted with occasional groves of Koa trees. On the high plains the *ti* plant abounded, often so high as to intercept the view. No cattle then existed to destroy its succulent foliage. According to the statements of the natives, a forest formerly covered the whole of the then nearly naked plains. It was burned off by the natives in search of sandalwood, which they detected by its odor burning. [cited in Sterling and Summers 1978:89]

After John Papa ‘Ī‘ī's death in 1870, his estate--including the Waipi‘o lands-- was inherited by his daughter Irene ‘Ī‘ī Brown. Shortly after, small parcels within the *ahupua‘a* were sold off (Barrere 1994:75).

Waiawa

During the Māhele, Waiawa Ahupua‘a was awarded to Princess Victoria Kamāmalu (sister of Kamehameha IV and V) as part of LCA 7713. During the second half of the 19th century, Waiawa was passed on to successive members of the *ali‘i*. Victoria Kamāmalu died in 1866 at the age of twenty-seven. Her entire estate was inherited by her father, Mataio Kekūanao‘a. Kekūanao‘a died two years later and the estate went to Kekūanao‘a's son Lot Kapuāiwa, who by that time reigned as Kamehameha V. Kapuāiwa died intestate in 1872, whereupon Ruta Ke‘elikōlani, Kapuāiwa's half-sister, petitioned for and received in 1873 the entire estate. By 1883, Ruta Ke‘elikōlani died, leaving her estate to her cousin Bernice Pauahi Bishop (Kame‘eleihiwa 1992:309-310). The Kamehameha Schools (Bernice Pauahi Bishop Estate) presently retains ownership of most of the *ahupua‘a*.

57 *kuleana* land claims were made in Waiawa, with 31 claims awarded (Table 8). One of these was an award to the American Board of Commissioners for Foreign Missions (ABCFM). LCA 387 to the ABCFM comprised 4.13 acres in the *makai* portion of Waiawa, and included a salt pond, a *mo‘o* (land strip) for the church, and a house lot. Making the application was Artemis Bishop, the Protestant missionary stationed at ‘Ewa from 1836-1856, drew a map of the Waiawa *kuleana* awards in 1887 (Figure 25). Another claim by a non-Hawaiian was made by William Wallace in LCA 10942, which comprised 3.2 acres, including a house lot, 2 *mo‘o*, and 6 *lo‘i*. The remaining 50 claims (for individual *‘āpana*) by 29 claimants in Waiawa were for *kuleana*. The claims included 28 house lots, 176 taro *lo‘i*, 20 fishponds, 23 *kula* or pasture, 8 p*aukū ‘auwai* [length of ditch], and 7 banana *kula*. The 31 awarded claims were all located in the *makai* portion of the *ahupua‘a*. While the uplands of Waiawa were probably used for the procurement of resources, there is no evidence of permanent habitation in traditional Hawaiian times.

Table 8. *Kuleana* Land Commission Awards in Waikele Ahupua‘a

LCA	Awardee	*‘Ili*		LCA	Awardee	*‘Ili*
879	Puakai	Panaio, Kapuaihalulu, Kainalu		5644	Kamalii	Kuhia
882	Poonui	Mooiki		5646	Kaionio	Panaio
904	Naheana, Noa	Panio, Kahoaiai, Kuhia, Panaio		5847	Kapaa	Hanakehau
1594	Keawe	Honokehau		6086	Makanui	Hanakehau, Ananakehau
1604	Kakoo	Kuhiawaho		9294	Kekeni	Piliaumoa
1683	Peahi	Panaio		9320	Keoho	Kapaloa
1696	Namomoku			9357B	Opunui	Panaio
1711	Hanamaulu	Kuhiawaho		9358	Kaanuu	Kapuaihalulu
1715	Haa	Kuhuoloko		9362-B	Naone	Kapuaihalulu
2146	Paahana	Kapuaihalulu		9376	Kupihea	Kapaloa
2448	Kikane	Panio, Kapuaihalulu		9377	Lio	Kapaloa,Haleaha
2685	Ohia	Holoipiapia, Kapuaihalulu		9384	Nahalepili	Kapoupou
4213	Kauhi	Holoipiapia, Kahoaiai, Kapuaihalulu, Kalona		9409	Puhiki	Kaakauwaihau
4529	Ohia	Holoipiapia, Kapuaihalulu		10567	Ohulenui	Kapuaihalulu, Kolona
5591	Kekua	Kahoaeae		10942	Wallace	Kahoaiai

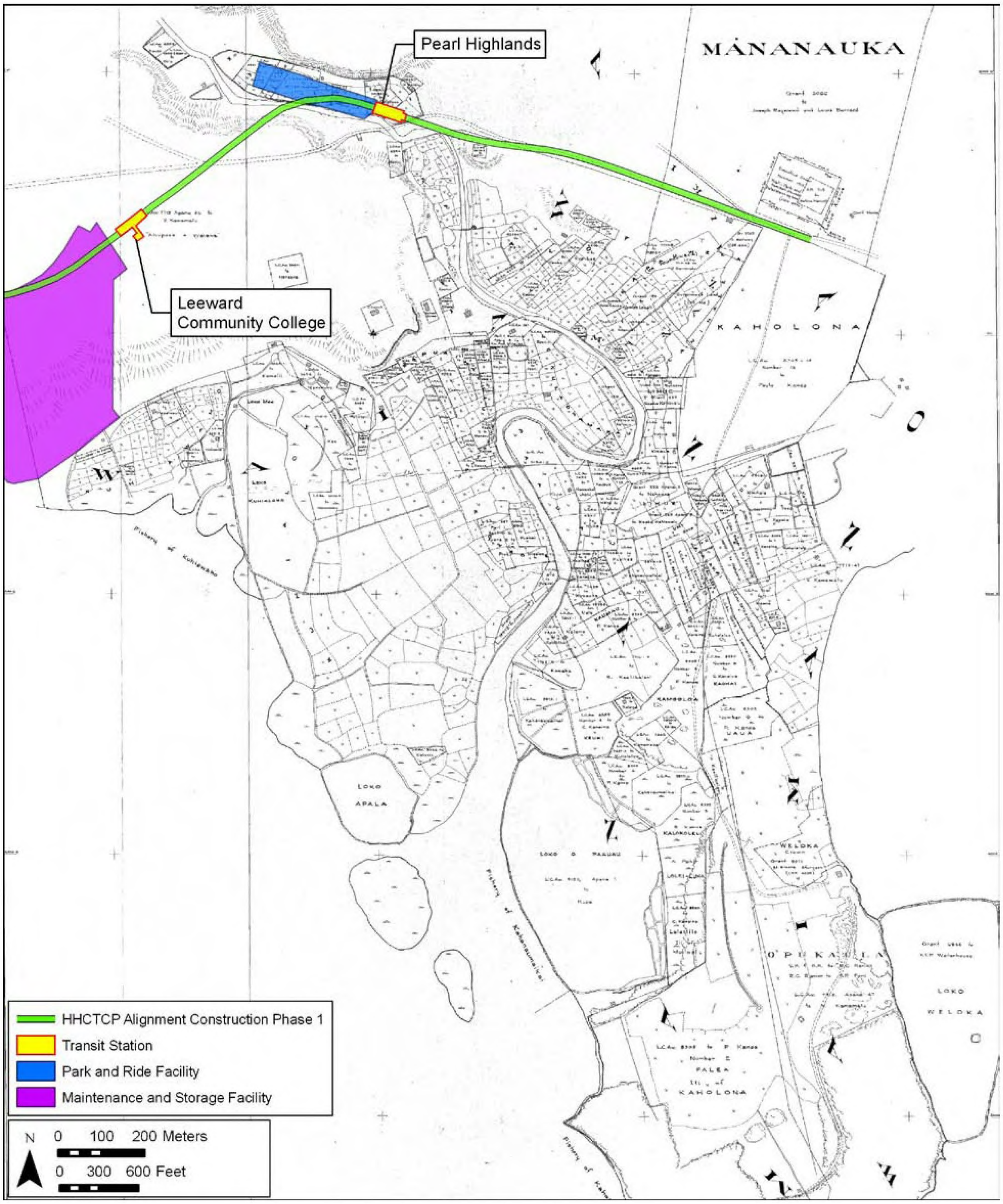

Figure 25. 1887 Map of Waiawa, Mānana, and Waimano by Rev. Artimas Bishop, showing the location of the project area in relation to the irrigated taro lands of Waiawa (Registered Map Mo. 1258, Hawai'i Land Survey Division)

Land Commission Awards in the Vicinity of the Hōʻaeʻae, Waikele, Waipiʻo and Waiawa Ahupuaʻa Portions of the Project Area

The distribution of LCA parcels generally reflects the distribution of the population in these four *ahupuaʻa* in the mid-19th century. In all four cases, the bulk of the *ahupuaʻa* was awarded to one or more *aliʻi*, government officials, or foreign residents favored by the throne. Nearly all *kuleana* awards were granted for small land claims on the low floodplains near Pearl Harbor.

Thirty-seven LCA claims were awarded in the vicinity of the project area. Four of these were large awards to *aliʻi* (Table 9). The remaining LCA claims reflect the agricultural nature of the region: nearly all of the 33 *kuleana* awards included *loʻi* (irrigated pond fields – an average of two *loʻi* per award); half of the awards included *kula*; and a third of the awards included house lots. Many of the LCA claims were clustered near the Government Road, which ran *mauka* of the floodplains.

In summary, the project area in Central ʻEwa traverses the former irrigated taro fields of Hōʻaeʻae and Waikele, near Pearl Harbor. The project area also passes through former taro lands in Waipiʻo, though this area was primarily owned by one man, John Papa ʻĪʻī. In Waiawa, the project area extends through a cluster of LCA parcels adjacent to Waiawa Stream.

3.2.3.4 The Oahu Sugar Company and the Waiahole Ditch System

In 1889, Benjamin Dillingham organized the Oahu Railway and Land Company (O.R. & L.). The railroad connected the outlying areas of Oʻahu to Honolulu. By 1890, the railroad reached from Honolulu to Pearl City and continued on to Waianae in 1895, to Waialua in 1898, and to Kahuku in 1899 (Kuykendall 1967:100).

In 1897, B.F. Dillingham established the Oahu Sugar Company on 12,000 acres of land leased from the estates of John Papa ʻĪʻī, Bishop, and Robinson. The Oahu Sugar Company had over 900 field workers, composed of 44 Hawaiians, 473 Japanese, 399 Chinese, and 57 Portuguese. The first sugar crop was harvested in 1899, ushering in the sugar plantation era in Waipahu (Ohira 1997).

Prior to commercial sugar cultivation, the Oahu Sugar Company 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). In 1890, Dillingham had successfully promoted the Ewa Plantation Company, the sprawling sugar company just south of the Oahu Sugar Company. Artesian wells had converted those arid ʻEwa lands into a thriving plantation, and Dillingham recognized the same potential in the Oahu Sugar Company lands.

Water to irrigate the *mauka* (upland) cane fields was initially pumped to elevations of 500 feet by some of the "largest steam pumps ever manufactured" (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 Koʻolau Mountains. 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 original system, when completed, included: 27

Table 9. Hō‘ae‘ae, Waikele, Waipi‘o and Waiawa Ahupua‘a Land Commission Awards in the Vicinity of the Project Area

LCA	Ahupua‘a	*‘Ili* (listed west to east)	Contents of Award
1707:2	Hō‘ae‘ae	Kalokoeli	3 *lo‘i* and 1 *kula*
1561	Hō‘ae‘ae	Amakeahiluna, Kamalokala	2 *lo‘i* and 1 *kula*
899	Hō‘ae‘ae	Amakeahilalo	1 house lot (1 house), 5 *lo‘i*, and 1 *kula*
750	Hō‘ae‘ae	Koipu, Kalokoloa	5 lo‘i
1571	Hō‘ae‘ae	Kamalokala	1 house lot (1 house), 1 *lo‘i*, and 1 *kula*
1533 and 1696	Hō‘ae‘ae; Waiawa	Muki, Waihi, Kalokoeli	1 house lot (1 house), 4 *lo‘i*, 1 *kula*
887:1	Hō‘ae‘ae	Kalaikea, Kapapapuhi, Kuainihi, Kalokoeli, Pakai	1 house, 1 *kula*, and 5 *lo‘i*
1578:2	Hō‘ae‘ae	Laekea	1 *lo‘i* and 1 *kula*
5930	Waikele	Hanohano	*‘ili* of Hanohano to Puhalahua
858:2	Waikele	Pouhala, Waipahu	5 *lo‘i* and 1 fishpond
857:1	Waikele	Pouhala	I house lot (2 houses)
1018	Waikele	Pouhala	I house lot (1 house) and 1 *kula*
860:1 and 860:2	Waikele	Paahao	1 house lot (1 house), 6 *lo‘i*, and 2 salt lands
1005:1, 2 and 3	Waikele	Pouhala	4 lo‘i and 1 kula
858-C:2	Waikele	Pouhala, Paahao	5 lo‘i
1015:1	Waikele	Paahao	1 house lot (1 house), 3 *lo‘i*, and 1 *kula*
5663:1	Waikele	Pahoa, Paahoa	*‘ili* of Pahao (14.37 acres) to Kahonu
908	Waikele	Ohua	1 lo‘i
6545:1	Waikele	Ohua	*‘ili* of Ohua (30.32 acres) to Hana Hupa Haalilio
5989:1	Waikele	Kapakahi	3 taro patches (*lo‘i*) and 1 pasture (*kula*)
1682-B:	Waikele	Kapakahi	2 lo‘i
1614-B:2	Waikele	Ahualii, Mikiokai, Keahupuaa	1 house lot

LCA	Ahupua'a	*'Ili* (listed west to east)	Contents of Award
7260:2	Waikele	Kaolipea	*'ili* of Waikele and Kaolipea (291.58 acres) to Bennett Namakeha
1712-C:2	Waikele	Kapuna, Keahupuaa°	1 house lot and garden
10512	Waipi'o	Kauaka	3 lo'i
1685:1	Waipi'o	Kapaia, Waikaka	3 taro patches (*lo'i*) and 1 pasture (*kula*)
8241 L.K.:2	Waipi'o	Hanaupouli	5 lo'i
8241 S.S.:2	Waipi'o	Hanapouli, Kahaole	(0.73-acre) lot
10613:4	Waipi'o		Lands to Abner Pākī (*Ali'i* Award)
4213:1 and 4213:2	Waiawa	Holoipiapia, Kahoaiai, Kapuaihalulu, Kalona	3 *lo'i* and 1 *kula*, ½ house lot
4529 and 2685	Waiawa	Holoipiapia, Kapuaihalulu	I house lot, 6 *lo'i*, 1 *'auwai*, and 1 steep banana plantation
904:3	Waiawa	Panio, Kahoaiai, Kuhia	1 house lot (3 houses), 1 *lo'i*, and 2 fishponds
5591 and 9357:1	Waiawa	Kahoaeae; Panaio	5 *lo'i* and 1 *kula*
9294	Waiawa	Piliaumoa	1 house lot
9368:1; 1604	Waiawa	Kuhiawaho	3 taro patches (*lo'i*) and 1 pasture (*kula*)
10942:1, 10942:2, 10942:3, and 10942:4	Waiawa	Kahoaiai	1 house lot (1 house) and 8 *lo'i* to William Wallace

tunnels connecting with 37 stream intakes on the north side of the Koʻolau; the main bore through Waiāhole Valley; 14 tunnels on the southern side of the Koʻolau at Waiawa; and a ditch extending westward to Honouliuli (Condé and Best 1973:37). Upon its completion in 1916, the Waiahole Ditch was 21.9 miles long (35 kilometers) and cost $2.3 million to construct. The 32 million gallons of daily water enabled the Oahu 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). The ditch system, with some modifications, remains in use.

The Waiahole Ditch passed through Hōʻaeʻae, bringing much needed water to the area:

> West of Waikakalaua Gulch, through Hoaeae and to the upper boundary of Oahu Plantation in Honouliuli, the conduit consists of 12,650 feet of cement-lined ditches, and three redwood pipes 5 feet in diameter, having an aggregate length of 2,830 feet. [Kluegel 1917:96]
>
> The Waiahole Water Co. has taken over from the Oahu Sugar Co. the Ahrens Ditch in Waiawa, the Kipapa Ditch, the Waikakalaua Ditch in Waipio, and the Hoaeae Ditch. Two redwood pipes having a total length of 1,223 feet have been laid across two gulches on the line of Hoaeae Ditch, cutting out 2 ¼ miles of ditch. The water delivered by the Waiahole System is chiefly used on newly planted cane on land above the lift of the pumps. [Kluegel 1917:107]

3.2.3.5 Other Agricultural Enterprises

As the sugar industry throughout the Hawaiian kingdom expanded in the second half of the 19th century, the need for increased numbers of field laborers prompted passage of contract labor laws. In 1852, the first Chinese contract laborers arrived in the islands. Contracts were for five years, and pay was $3 a month plus room and board. Upon completion of their contracts, a number of the immigrants remained in the islands, many becoming merchants or rice farmers. As was happening in other locales in the 1880s, groups of Chinese began leasing and buying — from the Hawaiians of Waikele and Waipiʻo *ahupuaʻa* — former taro lands for conversion to rice farming. The taro lands' availability throughout the islands in the late 1800s reflected the declining demand for taro as the native Hawaiian population diminished.

The Hawaiian Islands were well-positioned for rice cultivation. A market for rice in California had developed as increasing numbers of Chinese laborers immigrated there since the mid-19th century. Similarly, as Chinese immigration to the islands also accelerated, a domestic market opened. During the late 1800s, the taro fields of central ʻEwa were converted to rice fields as Chinese immigrants began to lease and purchase ʻEwa lands. By 1892, there were 333 acres of land devoted to rice farming in Waikele and Waipiʻo *ahupuaʻa* (Coulter and Chun 1937: 21).

By the early decades of the 20th century, rice farming in the Hawaiian Islands was in decline, beset by crop diseases and cheaper prices for mainland-grown rice. Commercial agriculture in Waikele became dominated by sugar with the development of the Oahu Sugar Company. The company imposed a new name on the area of its focus when, in 1897, its board of directors decided that "the name of the mill site and office of the company should be 'Waipahu'" (Nedbalek 1984:13).

As in Honouliuli, the cultivation of sisal was attempted on arid lands. Thrum's *Hawaiian Almanac and Annual* speaks of the prospect of sisal cultivation glowingly from 1904 to 1913, but the greater profits to be made from sugar cane cultivation eventually led to the decline of this industry. Upper Hōʻaeʻae seems to have been the focus of sisal cultivation in central ʻEwa, as shown in excerpts from the 1909 and 1913 annuals:

> The Hawaiian Fiber Co. increases its capital stock to $150,000, over 500 acres of new planting having been set out on their recently acquired Hoaeae land, and work being pushed to cover the entire tract of some 1,800 acres. [Thrum 1909:167]
>
> New and enlarged machinery for the sisal decorticating mill has been installed at the Pouhala station of the company on the upper Hoaeae lands, with which to care for the fibre product from their enlarging area. Some 1,750 acres are now planted out, including the fields of Sisal. [Thrum 1913:170-171]

An attempt to grow cotton was made on "the semiarid uplands at Kunia and Waipahu" in the early 20th century, but the enterprise was not profitable (Krause 1911:66).

John Papa ʻĪʻī associated Waiawa with the brewing of intoxicants in the early 1800s, and gives an account of the making of *ʻōkolehao,* an alcoholic drink made from brewing the roots of the *ti* plant (*Codyline fruticosa*):

> It was interesting to see how ti root was converted into a strong liquor. When the root was boiled on a stove, the liquid came forth like the flowing of sweat from a bud. The hand was wetted with the first drippings and then waved over the flames, when the drippings burned brightly. The first brew was called *lolo*, the second *kawai*, and the last *kawai hemo*. [ʻĪʻī 1959:85]

Between the years of 1861 and 1873, parcels in Waiawa were leased to Valdemar Knudsen for use as grazing lands for livestock. A fifty-year lease and leaseholds were granted to James Robinson in 1868. After James Robinson's death in 1890, his son, Mark P. Robinson, acquired a twenty-five year lease. Overwritten on the lease was the "permission granted to assign the lease to the Oahu Railway and Land Company" (Bureau of Land Conveyances 115:496). This lease was subleased from Oahu Railway and Land Company to the Oahu Sugar Company for forty-three years on January 1st, 1897. It is probable that much of the upper grasslands of Hōʻaeʻae, Waikele, Waipiʻo and Waiawa were used for cattle pasture.

In the early decades of the 20th century, lands in *mauka* Waipiʻo and Waiawa were being acquired for pineapple cultivation. There is a record of attempted pineapple irrigation utilizing water from shallow wells in Waiawa Gulch in 1893. Prior to 1913, most of the plateaus in Waiawa were planted in pineapple (Goodman and Nees 1991: 59). In 1901, the Hawaiian Pineapple Company obtained 61 acres in Waiawa through public auction. Initially, most pineapple was shipped to California for packing. In an attempt to speed up processing, save money, and produce a fresher product, a pineapple cannery was constructed in Waiawa. This cannery was constructed by the Pearl City Fruit Company, but became a part of the Hawaiian Pineapple Company operations after the Pearl City Fruit Company went bankrupt. The cannery was in operation from 1905 to 1935.

A 1908 lease from the John ʻĪʻī Estate, Ltd. to Yoshisuke Tanimoto and Kintaro Izumi led to the formation of the Waipiʻo Pineapple Company, which cleared and cultivated approximately 223 acres in portions of Kīpapa Gulch. In 1909, the government appropriated Waipiʻo Peninsula from the ʻĪʻī estate. The land was valued at $10,000 for purposes of fair compensation (Dept. of Land and Natural Resources Land Record Books 1909:228-235). In 1915, Libby, McNeill & Libby took over Waipiʻo Pineapple Company's leases and continued to cultivate pineapple in the area. By the late 1920s, James Dole's Hawaiian Pineapple Company, incorporated in 1901, was cultivating pineapple on thousands of acres leased from the ʻĪʻī estate in the *mauka* area of Waipiʻo.

Besides sisal, cotton, and pineapple, other crops were grown in central ʻEwa, such as macadamia nuts:

> At Hoaeae, in the Ewa district, is another tract of about six acres on the Robinson estate, reported to be in fine condition…Mr. Grant Bailey, manager of the Hoaeae Ranch, kindly furnishes the following data on the infant industry…"Our planting is about six acres. Apparently one would have to wait about ten years before expecting commercial results on the planting. Our oldest trees are seven years old and they are just now beginning to bear." [Thrum 1927:96]

3.2.3.6 The Military in Central ʻEwa

Early in the 20th century, the U.S. Government began acquiring the coastal lands of ʻEwa for the development of a naval base at Pearl Harbor. In 1901, the U.S. Congress formally ratified the annexation of the Territory of Hawaiʻi, and the first 1,356 acres of Pearl Harbor land were transferred to U.S. ownership. The U.S. Navy began a preliminary dredging program, which created a 30-foot deep entrance channel, measuring 200 feet wide and 3,085 feet long. In 1908, money was appropriated for five miles of entrance channel dredged to an additional 35 feet down (Downes 1953). In 1909, the government appropriated the entire Waipiʻo Peninsula from the ʻĪʻī estate.

By 1941, Pacific Naval Air Bases expenditures for new construction at Pearl Harbor were in the hundreds of millions of dollars. The Japanese attack on Pearl Harbor, December 7, 1941, damaged or destroyed much of the new construction. Reconstruction was instituted to double Pearl Harbor's war capacity. Military planners approved a new ammunition depot in the mountainside of Waipahu, a large new hospital in ʻAiea, and thousands of additional changes to the Navy Yard to accommodate the new aircraft carrier task forces (Woodbury 1946). During World War II, the military used the sugar cane rail system to "haul large quantities of ammunition" (Condé and Best 1973:315). Loko ʻEo was completely drained, filled in, and converted into a "naval reservation."

After entering World War II, a military reservation was established in the upland regions of Waiawa. The reservation was 650 acres consisting of both gulch and plateau lands. From 1941 to 1945, the reservation was used as a training area for tanks and personnel, and as an artillery impact area. The area was also used for the storage of munitions and supplies. The primary structure built by the military was a communications center. This center consisted of four buildings and a tunnel system. The communications center is currently being used by the State of Hawaiʻi as a minimum security prison (Waiawa Correctional Facility).

3.2.3.7 From Rural Farms to Modern Urban Development

During the second half of the 20th century, growth in central 'Ewa focused on the development of residential and military expansion, especially near Pearl Harbor. A series of U.S. Geographic Survey maps (taken over by the military during wartime), shows the increasing urban development surrounding the corridor from 1917 to 1970. On a 1919 map (Figure 26), the area was still rural, crossed only by the tracks of the OR&L railway and plantation rail lines. The main population center was around the mill town of Waipahu in Waikele Ahupua'a. On the 1927 (Figure 27) and 1943 maps (Figure 28), Waipahu had expanded; marshy areas (former taro lands) were still indicated in the *ahupua'a* of Waiawa. On the 1943 map (Figure 29), Waipahu town had expanded from Waikele into Waipi'o. A 1970 aerial photograph (Figure 30) indicates urban development along the complete extent of the HHCTCP alignment.

3.3 Previous Archaeological Research

While the southwest corner of the Island of O'ahu is arguably one of the most studied areas in Polynesia, the HHCTCP Construction Phase I project area is environmentally distant from the focus of most of this previous work (particularly the Barbers Point or Kalaeloa area). It is suggested that an in-depth analysis of the results of the previous archaeology of the Honouliuli *ahupua'a* would do little to elucidate the present project lands. The following discussion focuses on previous archaeological projects that are directly relevant to the lands under study.

Construction Phase I of the HHCTCP traverses two distinct geographic areas. This discussion of previous archaeological research in the vicinity of the project area includes the inland southwestern Honouliuli Ahupua'a lands that were, as a generalization, relatively barren and little used prior to being placed under a century of sugar cane cultivation, and the lands on the margins of Pearl Harbor that were much more intensively used in traditional Hawaiian times and that have continued under fairly intensive habitation to the present time. For the purposes of this discussion, the east/west division between these geographic areas is defined as Kunia Road.

3.3.1 Previous Archaeological Studies West of Kunia Road

The previous archaeological studies in the vicinity of the Construction Phase I project area west of Kunia Road predominantly cover relatively large parcels of land (often hundreds of acres) (Figure 31). It is noteworthy that nearly 100 percent of this western portion of the project area has been studied in prior archaeological studies. The following discussion of previous archaeological studies generally proceeds from west to east along the project corridor.

Spear 1996

In 1996, Scientific Consultant Services, Inc. conducted an archaeological reconnaissance and assessment of the East Kapolei Development Project, *makai* (seaward) of the H-1 Freeway, in the vicinity of the North-South Road corridor, and including portions of Kalo'i and Hunehune Gulches. This brief letter report addresses approximately 1,300 acres, including: approximately 1.4 miles of the project corridor; the East Kapolei Station and park and ride facility; and the U.H. West O'ahu Station and northern park and ride facility. The study cites a 1994 SHPD letter (Doc

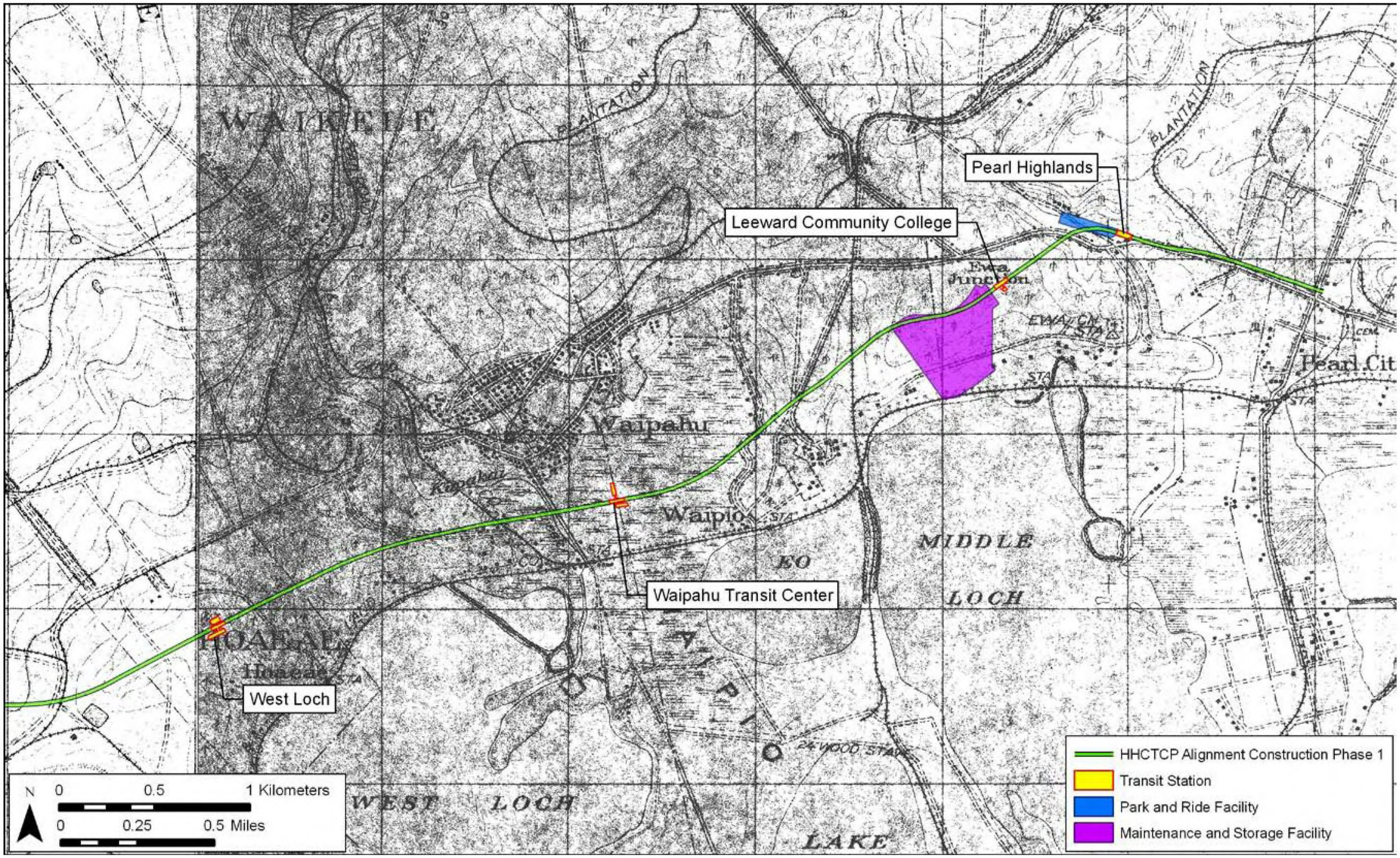

Figure 26. 1919 War Department Fire Control Map, Nanakuli and Pearl Harbor Quadrangles, showing the location of the eastern portion of the Construction Phase I project area

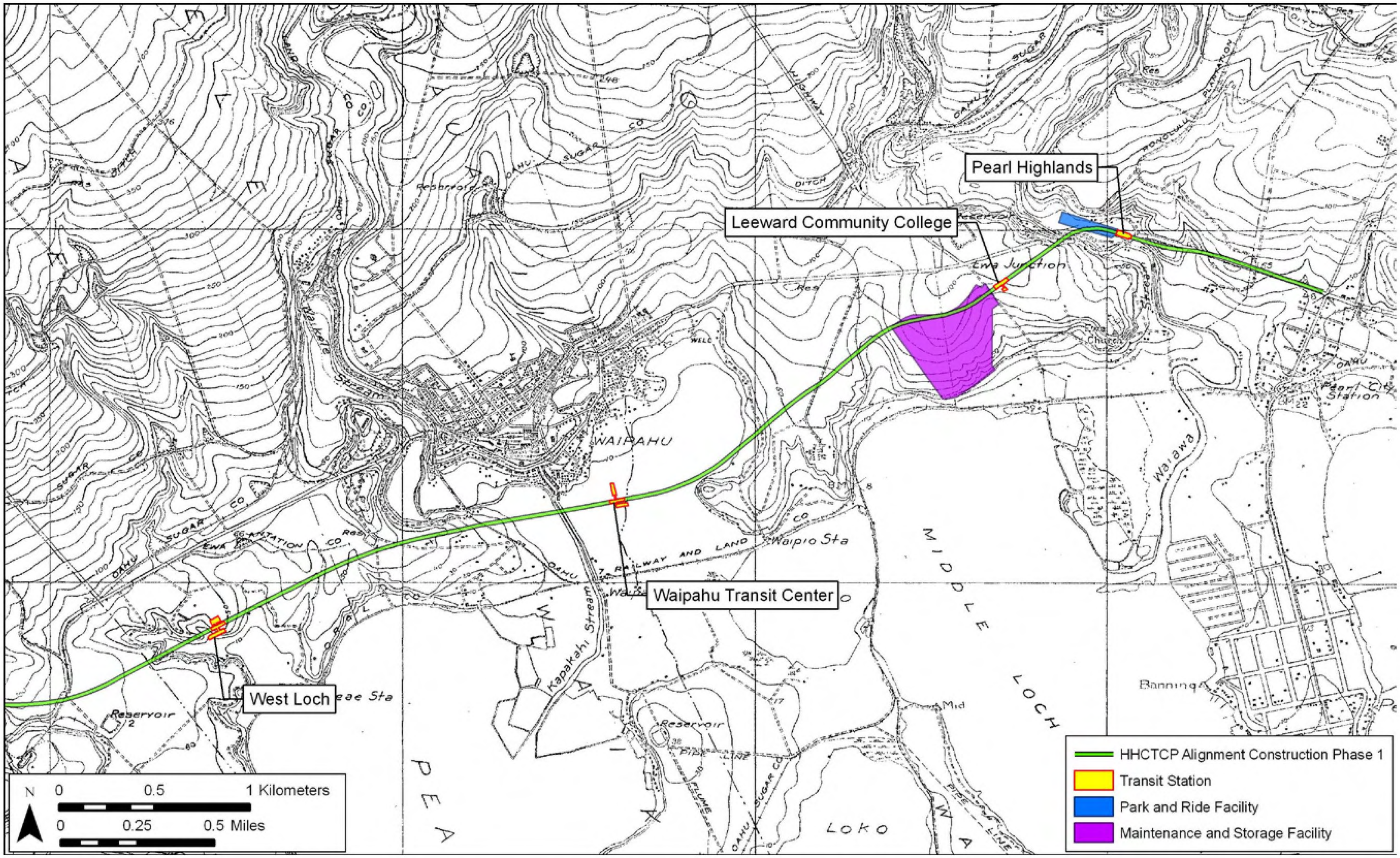

Figure 27. 1927-1928 U.S. Geological Survey Topographic Map, Waipahu Quadrangle, showing the location of the eastern portion of the Construction Phase I project area

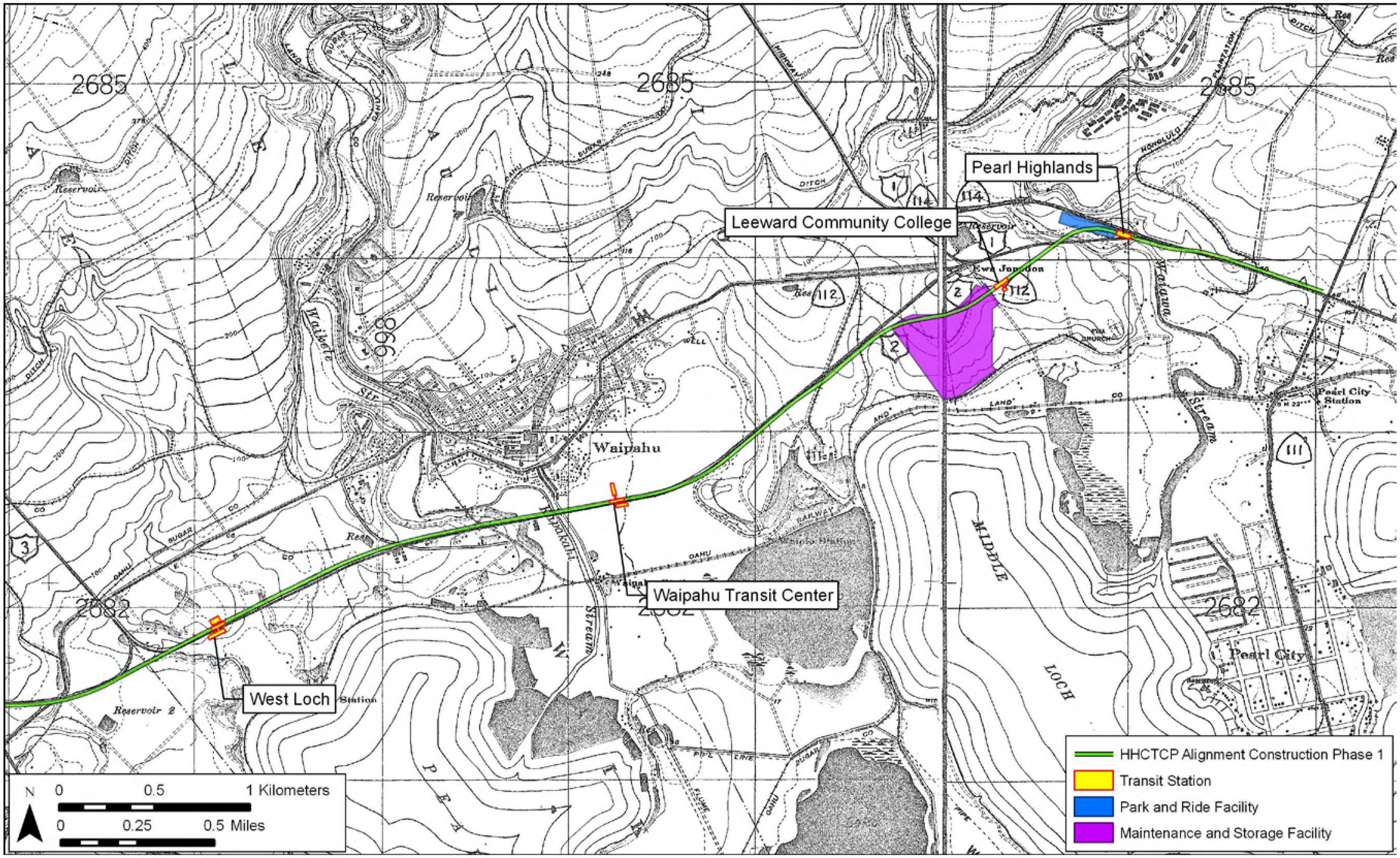

Figure 28. 1943 War Department Topographic Map, Aiea and Waipahu Quadrangles, showing the location of the eastern portion of the Construction Phase I project area

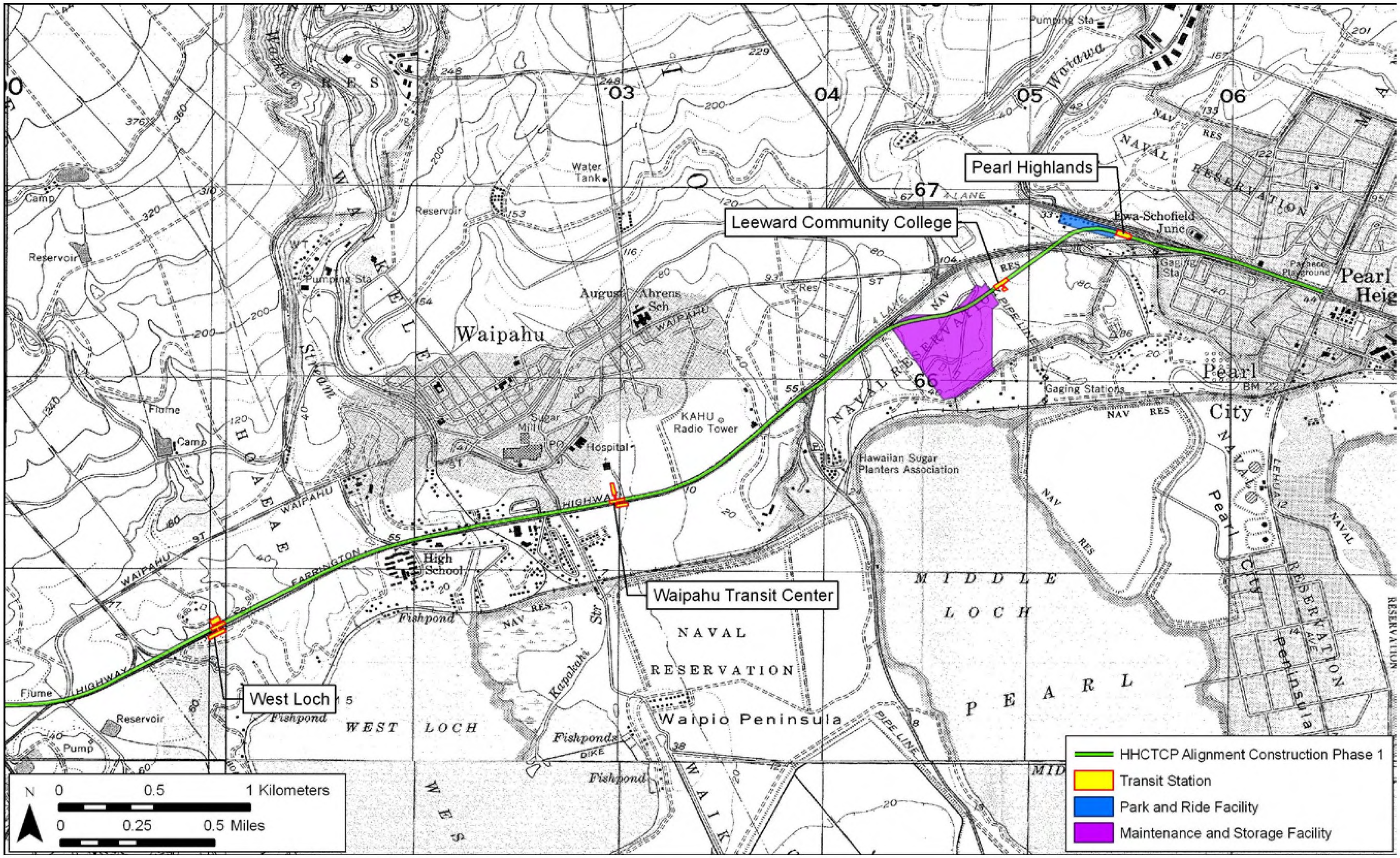

Figure 29. 1953 Army Mapping Service Topographic Map, Schofield Barracks and Waipahu Quadrangles, showing the location of the eastern portion of the Construction Phase I project area

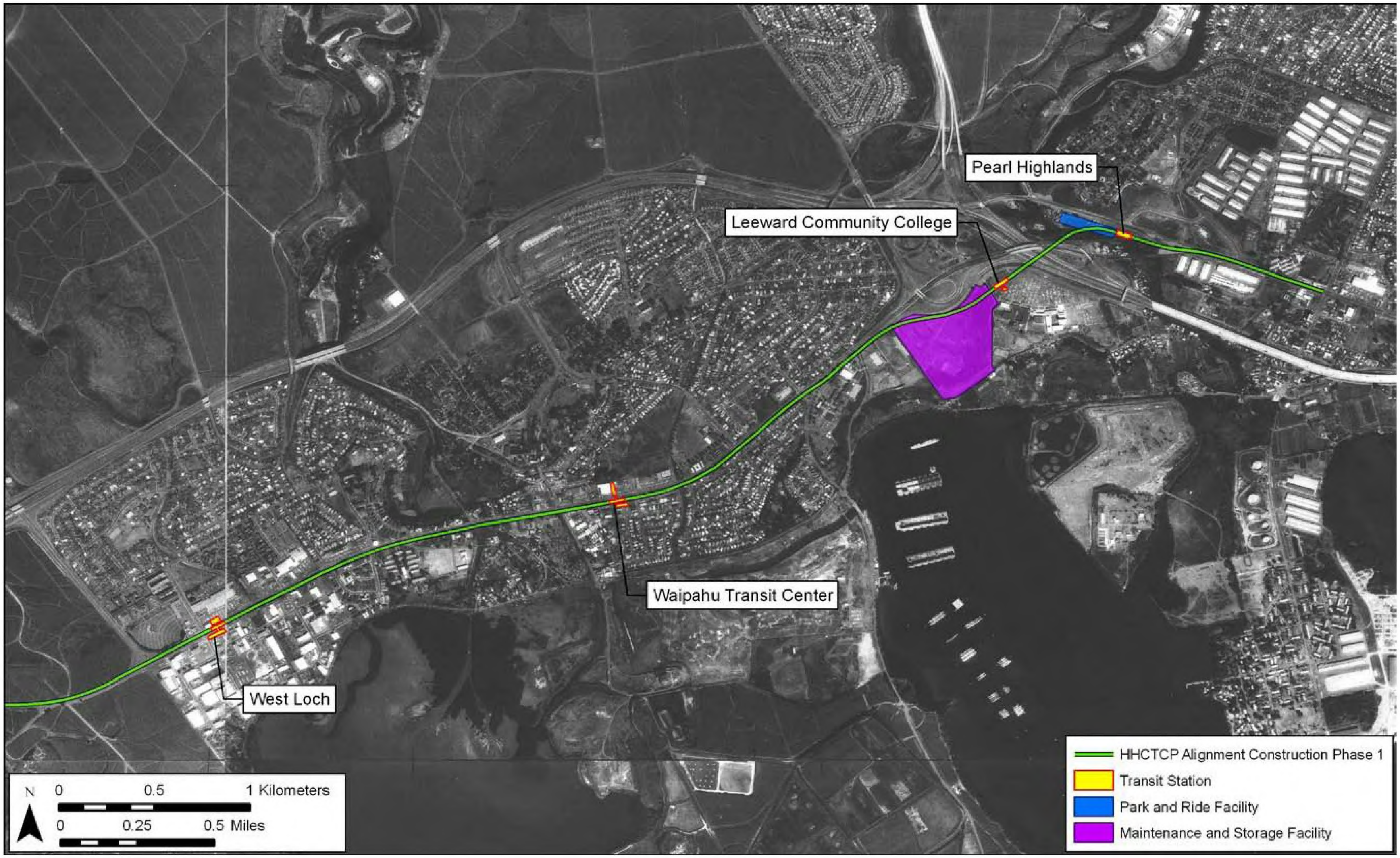

Figure 30. 1977 U.S. Geological Survey Orthophotograph, Schofield Barracks and Waipahu Quadrangles, showing the location of the eastern portion of the Construction Phase I project area

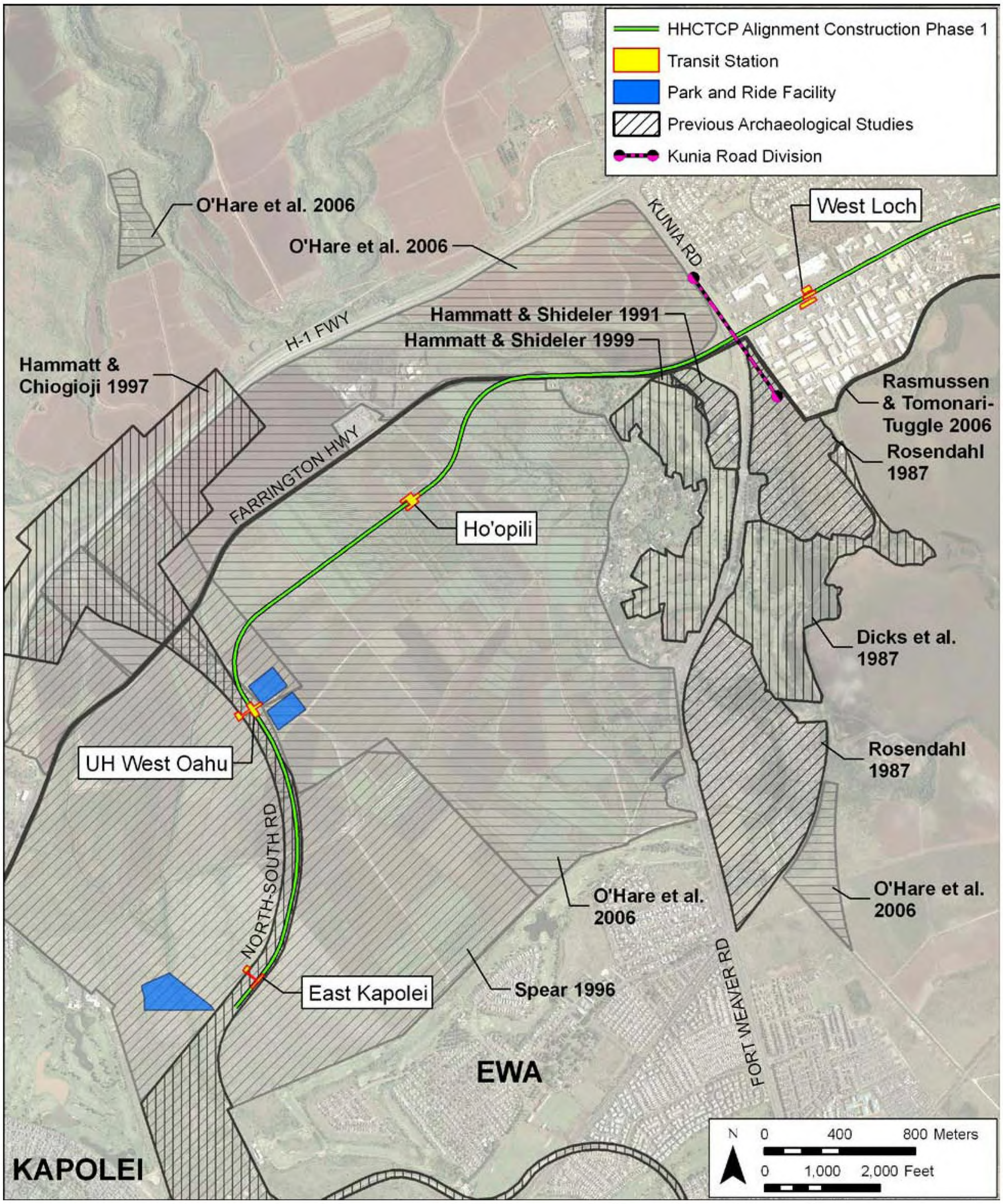

Figure 31. Aerial photograph (source: U.S. Geological Survey Orthoimagery 2005) showing the locations of previous archaeological studies in the vicinity of the western portion of the Construction Phase I project area

No 9408TD01) that “clearly indicates that most of the present [Spear 1996] project area has been declared to have “no effect” on historic sites due to the many years of commercial sugarcane production on these lands.”

A limited field inspection documented in the Spear (1996) letter report did not identify any historic properties, but noted that the 4 m wide and 4 m deep Kalo‘i and Hunehune Gulches had been modified for cane irrigation. The study concluded that, on the basis of the SHPD letter and the field inspection, “that future development on these land parcels will have ‘no effect’ on historic sites, and that no further cultural resource work is required” (Spear 1996:1). While it is unclear whether there was a formal SHPD response to the Spear (1996) letter report, the conclusions seem reasonable.

Hammatt and Chiogioji 1997a and 1997b

In 1997, Cultural Surveys Hawai‘i, Inc. conducted two similar archaeological reconnaissance surveys of a corridor that would become the “North-South Road” project, extending south from the H-1 Freeway. The earlier study (Hammatt and Chiogioji 1997a) extended south to approximately 5,300 feet inland of the ‘Ewa Beach shoreline. The later study (Hammatt and Chiogioji 1997b) was shorter in length, not extending south of the Oahu Railway and Land Company (O.R. & L.) right-of-way. For the purposes of the this discussion relating to the Construction Phase I project area, the two Hammatt and Chiogioji 1997 studies are essentially identical, with both studies addressing approximately 1.2 miles of the project corridor, including the East Kapolei and U.H. West O‘ahu Stations. It is unclear whether either of these studies was commented on by the SHPD. A letter signed by Dr. Don Hibbard, SHPD Administrator, dated March 8, 1996 (Log No 16697, Doc No 9603NN03) on the subject of the “North-South Road Corridor Project” only expresses concern for appropriate mitigation of impact to the O.R. & L. right-of-way.

Background research and a pedestrian survey for the Hammatt and Chiogioji 1997 studies revealed that the entire area had been extensively graded in association with sugar cane cultivation and the construction of plantation infrastructure. The Hammatt and Chiogioji 1997a study corridor crossed two previously identified areas of archaeological concern (both well south of the current project area): SIHP # 50-80-12-9786, consisting of the ‘Ewa Villages Historic District; and SIHP # 50-80-12-9714, the Oahu Railway and Land Company (O.R. & L.) right-of-way. These historic properties were not located in the vicinity of the Hammatt and Chiogioji 1997b study area. The Hammatt and Chiogioji 1997b study concluded: “No further archaeological investigation is recommended for the entire project area corridor and on-site or on-call monitoring is not justified during future construction activities” (Hammatt and Chiogioji 1997b:22).

Despite the recommendation cited above, the construction of the North-South Road project has been subjected to on-call archaeological monitoring programs by Cultural Surveys Hawai‘i Inc. There have been no significant finds to date.

O'Hare et al. 2006

In 2006, Cultural Surveys Hawai‘i, Inc. conducted an archaeological inventory survey of approximately 1,600 acres for the East Kapolei Project (subsequently known as the Ho‘opili Project) (O'Hare et al. 2006). The study was accepted by SHPD in a letter dated November 3, 2006 (Log No. 2006.3670, Doc. No. 0611amj01). The Ho‘opili project area was bounded on the east by Fort Weaver Road, *makai* (seaward) by Mango Tree Road, and *mauka* (inland) by the H-1 Freeway. The study area was configured by the owner/developer interests to dove-tail with the Spear (1996) study, with the western boundary of O'Hare et al. (2006) study area following the general configuration of the east side of the Spear (1996) study. A non-contiguous portion of the O'Hare et al. (2006) study area was *mauka* of the H-1 Freeway.

The O'Hare et al. (2006) study area covers approximately 1.2 miles of the Construction Phase I project area, between North-South Road and Farrington Highway, including the Ho‘opili Station. The southern of the two U.H. West O‘ahu Station park and ride facilities was also covered by the O'Hare et al. (2006) study area. The O'Hare et al. (2006) study area then borders an additional 0.8 miles of the project area from Farrington Highway to Kunia Road.

Several historic properties within the O'Hare et al. (2006) study area were previously identified during an archaeological survey in 1990 (Hammatt and Shideler 1990). These previously identified historic properties included: SIHP # 50-80-12-4344, plantation infrastructure; 50-80-12-4345, railroad berm; 50-80-12-4346, northern pumping station; 50-80-12-4347, central pumping station; and 50-80-12-4348, southern pumping station. Four additional archaeological features were documented by the O'Hare et al. (2006) study. These additional features, grouped under SIHP # 50-80-14-4344, include: Feature D, a linear wall along the east bank of Honouliuli Stream; Feature E, a linear wall along the east bank of Honouliuli Stream; Feature F, a stone-faced berm constructed perpendicular to the orientation of the stream; and Feature G, a concrete ditch and concrete masonry catchment basement on the west bank of Honouliuli Gulch.

No areas of concern were documented in the vicinity of the Construction Phase I project area by the O'Hare et al. (2006) study. While plantation irrigation features of SIHP # 50-80-14-4344 (i.e. Features D through G) were documented north of the Construction Phase I project area, within Honouliuli Gulch, no further work was recommended and there are no preservation concerns (O'Hare et al. 2006:116-117).

Rasmussen and Tomonari-Tuggle 2006

In 2004, archaeological monitoring was conducted along the Waiau Fuel Pipeline corridor, extending from the Hawaiian Electric Company's Barbers Point Tank Farm to the Waiau Generating Station. The Waiau Fuel Pipeline corridor follows Farrington Highway to Kunia Road, angles *makai* (seaward) near Kunia Road, then continues east along the O.R. & L. right of way near the Pearl Harbor coast. It appears that no archaeological monitoring was conducted west of Waipi‘o Peninsula, as the corridor to the west had been determined to not be archaeologically sensitive. The eastern portion of the Rasmussen and Tomonari-Tuggle (2006) study area, east of Kunia Road, is discussed further below.

Dicks et al. 1987

In 1987, Paul H. Rosendahl, Inc. conducted an archaeological reconnaissance survey for the West Loch Estates Golf Course and Parks (Dicks et al 1987). The study addressed an approximately 220 acre project area bisected by Fort Weaver Road, extending from the coast of the West Loch of Pearl Harbor to Farrington Highway. The project area included only a very narrow frontage along Farrington Highway near the intersection of old Fort Weaver Road. Given the preparation of the study for inclusion in an EIS, it is assumed that the Dicks et al (1987) study was reviewed and found to be acceptable to allow development to proceed.

While a wealth of archaeological finds were indicated east of Fort Weaver Road, at some remove from Farrington Highway, only one historic property (SIHP # 50-80-13-3321) was documented west of Fort Weaver Road, approximately 140 m south of the Construction Phase I project area. The subsurface cultural layer included a human burial, artifacts, midden, subsurface features, and structural remains. This cultural layer was determined to be of pre-contact origin and may have been occupied as early as the mid-6th to mid-9th centuries, with subsequent occupations occurring up to the early 1800s (Dicks et al. 1987:45-51). SIHP # 50-80-13-3321 relates to a complex of Land Commission Awards that lies in the Honouliuli Stream bottomlands, approximately 80 vertical feet below the Construction Phase I project area at Farrington Highway. Thus, although the historic property is only approximately 140 m south of the transit corridor it is ecologically distant.

Hammatt and Shideler 1999

In 1999, Cultural Surveys Hawaiʻi, Inc. conducted an archaeological assessment for the proposed expansion of St. Francis Medical Center West, located *makai* of Farrington Highway and west of Fort Weaver Road (Hammatt and Shideler 1999). This study lies adjacent to the Construction Phase I project area along Farrington Highway for approximately 300 feet. The study included a limited field inspection of the study area. No historic properties were identified in the study area. Due to the presence of a subsurface cultural layer (SIHP # 50-80-13-3321) east of the study area, an archaeological inventory survey, with a focus on subsurface testing, was recommended for a portion of the study area prior to any development involving ground disturbance (Hammatt and Shideler 1999).

Hammatt and Shideler 1991

In 1991, Cultural Surveys Hawaiʻi, Inc. conducted an archaeological inventory survey for a proposed expansion of Saint Francis Medical Center West on an approximately 24-acre parcel *makai* of Farrington Highway and west of Fort Weaver Road (Hammatt and Shideler 1991). This study lies adjacent to the Construction Phase I project area along Farrington Highway for approximately 400 feet. A pedestrian survey and background research revealed that the entire study area, located on a bluff northeast of the flood plain of Honouliuli Stream, had been extensively disturbed, contained no surface structures or other remains, and was unlikely to contain any subsurface historic properties. It is understood that the SHPD rendered a "no effect" letter for this project.

Rosendahl 1987

In 1987, Paul H. Rosendahl, Inc. conducted a combined surface and sub-surface survey of approximately 260 acres in two discontinuous parcels east of Fort Weaver Road. The northern of the two parcels extended *mauka* to the intersection of Fort Weaver Road and Farrington Highway. The main relevance of this study is in documentation of the virtual absence of finds in the vicinity. In the northern parcel, there was one heavily disturbed surface artifact collection area (designated "T-2") relating to a pre-1900 historic habitation, consisting of a scatter of glass and ceramic vessel fragments. This artifact scatter was located approximately 900 m south of the Construction Phase I project area. Given the preparation of the study for inclusion in an EIS, it is assumed that the study was reviewed and found to be acceptable to allow development to proceed.

3.3.2 Previous Archaeological Studies East of Kunia Road

The eastern portion of the Construction Phase I project area primarily consists of the Farrington Highway corridor. The highway, along with much of the built environment around it, was constructed during the 1960s (Voss 2008). Although the highway was built over existing roadways (including the previously mentioned Government Road), the improvements to the roadway led to residential and commercial growth, which occurred before archaeological investigations became standard in the late 1970s. This may explain why there are so few archaeological investigations within the area.

Near Farrington Highway, previous archaeological investigations show varied types of archaeological resources, including traditional Hawaiian remains, plantation infrastructure, and World War II historic infrastructure. Three of the previous archaeological investigations are in the vicinity of the project's vehicle maintenance and storage facility, near the Leeward Community College Station. The discussion of previous archaeological investigations in the vicinity of the eastern portion of the Construction Phase I project area proceeds from west to east. The locations of the previous archaeological studies are shown on Figure 32.

Hammatt and Chiogioji 2000

In 2000, Cultural Surveys Hawai'i, Inc. prepared an archaeological assessment of an approximately 2,600-foot-long portion of Farrington Highway for proposed improvements between Anini Place and Waipahu Depot Road (Hammatt and Chiogioji 2000). Background research indicated that the study area ran along land that was, until the mid-19th century, *lo'i* (irrigated taro fields). Many of the *lo'i* were replaced by rice fields in the 20th century. During the 20th century, the Oahu Sugar Company had been established and Waipahu Town developed around the sugar mill and plantation. The Oahu Railway and Land Company (O.R. & L.) tracks ran perpendicular across Hammatt and Chiogioji's (2000) study area. Background research also indicated the study area includes historic buildings and constructions more than 50 years old. The historic features mentioned in the report include: a railway overpass on the *makai* side of Farrington Highway with a drainage canal bridge constructed in the late 1930s (which had no markings or relation to the O.R. & L.); and the St. Joseph Church and School, also on the *makai* side of Farrington Highway, built in 1940s. St. Joseph Church and School are in-use today, and are not currently listed on either the Hawai'i or National Registers of Historic Places, and do not

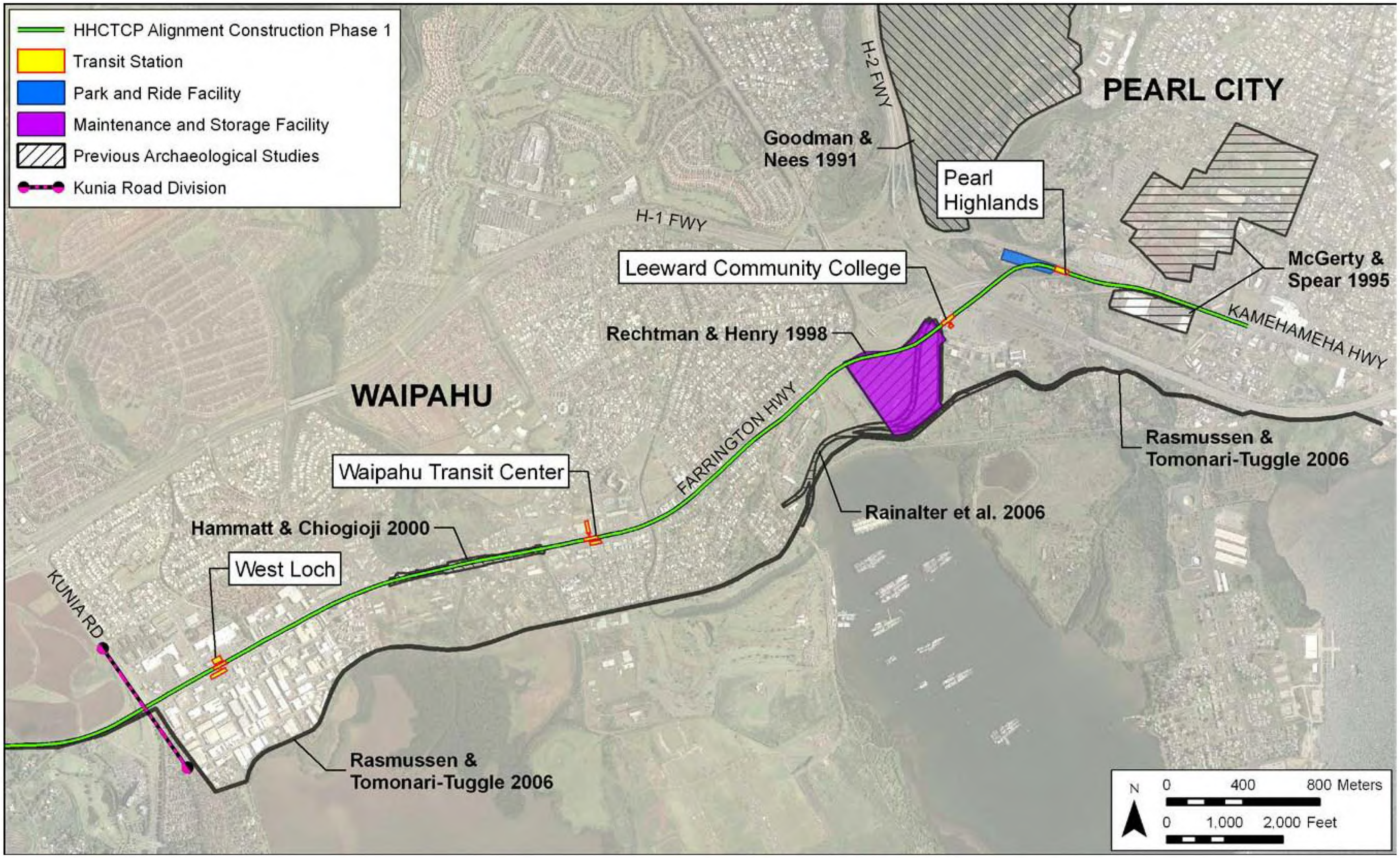

Figure 32. Aerial photograph (source: U.S. Geological Survey Orthoimagery 2005) showing the locations of previous archaeological studies in the vicinity of the eastern portion of the Construction Phase I project area

appear to have been evaluated for Hawai‘i or National Register eligibility. Background research also indicated that no archaeological inventory surveys had been conducted in the vicinity. In addition, no surface historic properties were observed, indicating little likelihood of finding pre-contact surface or subsurface archaeological remains, since all areas along the study area had been subjected to decades of urban development that would have removed any surface remnants related to traditional Hawaiian activities.

Rasmussen and Tomonari-Tuggle 2006

In 2004, archaeological monitoring was conducted along the Waiau Fuel Pipeline corridor from the HECO Barbers Point Tank Farm to the Waiau Generating Station (Rasmussen and Tomonari-Tuggle 2006). The portion of this corridor west of Kunia Road (addressed above) appears not to have been monitored because that portion of the corridor had been determined to not be archaeologically sensitive. East of Kunia Road, the Waiau Fuel Pipeline corridor generally paralleled the O.R. & L. right-of-way, approximately 1,000 feet *makai* (seaward) of the Construction Phase I project area. The Waiau Fuel Pipeline corridor did skirt the south edge of the project’s vehicle maintenance and storage facility, located immediately west of Leeward Community College, and did develop stratigraphic data in that area. The Waiau Fuel Pipeline corridor monitoring south and southeast of Leeward Community College occurred in the vicinity of previously identified traditional Hawaiian burials (SIHP # 50-80-09-3761 and SIHP # 50-80-09-5302) and the fishponds Loko Kuhialoko (SIHP # 50-80-09-0119) and Loko Mo‘o (SIHP # 50-80-09-0120). No new historic properties were discovered however.

Rechtman and Henry 1998

In 1998, PHRI completed an archaeological reconnaissance survey of the ‘Ewa Junction Drum Filling and Fuel Storage Area, *makai* (seaward) of Farrington Highway and immediately west of Leeward Community College (Rechtman and Henry 1998). The ‘Ewa Junction Drum Filling and Fuel Storage Area is the location of the current project’s vehicle maintenance and storage facility. The study was undertaken in compliance with Section 110 of the National Historic Preservation Act (NHPA). “The ‘Ewa Drum Filling and Fuel Storage Area received a 100% surface survey” (Rechtman and Henry 1998:6). No archaeological historic properties were identified in the study area in the course of the fieldwork and it was concluded that: “Due to the amount of prior disturbance and development at both of these facilities it is highly unlikely that any such resources, if they once existed, would have been preserved” (Rechtman and Henry 1998:ii). The study concluded that: “NHPA Section 110 responsibilities with respect to the identification and evaluation of archaeological resources located within these facilities” had been fulfilled.

Rainalter et al. 2006

In 2006, Cultural Surveys Hawai‘i, Inc. conducted an archaeological field inspection and literature search for the construction of a proposed second access road for Leeward Community College (Rainalter et al. 2006). The study area consisted of two corridors extending from Waipi‘o Point Access road, just *mauka* (inland) of the Middle Loch of Pearl Harbor, to the western and southern ends of Leeward Community College. One of the study corridors crossed through the ‘Ewa Drum Filling and Fuel Storage Area, the current project’s vehicle maintenance and storage facility. Two historic properties were identified within the Rainalter et al. (2006) study area: SIHP # 50-80-09-5302, a burial site containing both coffin and pit burials, located well south of the Construction Phase I project area; and SIHP # 50-80-09-6764, the 'Ewa Junction Drum Filling and Fuel Storage Area, a former U.S. Navy fuel storage facility designed to store automobile gasoline and aviation kerosene in underground storage tanks. The study developed fairly detailed data on the 'Ewa Junction Drum Filling and Fuel Storage Area, and following consultation with the U.S. Navy, concluded: "based on this initial evaluation by the Navy, it is likely that the site would be considered eligible by the Navy for listing on the National Register…" (Rainalter et al. 2006:81).

Goodman and Nees 1991

In 1991, the Bishop Museum conducted an archaeological reconnaissance survey of 3,600 acres in Waiawa Ahupua'a, east of the H-2 Freeway (Goodman and Nees 1991). The southern tip of the Goodman and Nees (1991) study area lies just north (across Kamehameha Highway) of the current project's Pearl Highlands park and ride facility. Seventeen historic properties were documented in the study area (SIHP #s 50-80-09-1469 to 1472 and 2261 to 2273). Four pre-contact historic properties were recorded: a rock-shelter complex, a mound complex, a trail, and a lithic scatter. Post-contact features, including irrigation ditches, a railroad system, and a cannery, and four features associated with World War II military training were also identified. None of these recorded archaeological resources are within or in the vicinity of the Construction Phase I project area.

McGerty and Spear 1995

In 1995, Scientific Consultant Services completed an archaeological assessment for the Department of Housing and Community Project (McGerty and Spear 1995). The study area consisted of 138.5 acres on two parcels in Pearl City, bisected by Kamehameha Highway, west of Waimano Home Road. The southern parcel, of particular interest to the current project, is located immediately *makai* (seaward) of Kamehameha Highway. Background research indicated intensive post-contact agricultural and military use of the study area. Thus, the potential of locating intact archaeological resources has been significantly decreased. No archaeological resources were encountered during this investigation.

3.4 Background Summary and Predictive Model

It has been useful to discuss the Construction Phase I project area as falling into two discrete sections, only slightly arbitrarily divided at Kunia Road, on the basis of the very different pre-contact and post-contact land-use history.

3.4.1 Predictive Model West of Kunia Road

West of Kunia Road there are no commoner Land Commission Awards in the vicinity of the project area, and previous archaeological studies have indicated no concerns in the immediate vicinity of the project area. The distance from the coast (and generally from fresh water) made vicinity of the western portion of the project area a little used area in pre-contact times. The intensive land disturbance of a century of commercial sugar cane cultivation probably removed most of what little evidence of pre-contact land-use there was. The archaeological sensitivity of this area is generally regarded as low. As the Construction Phase I project area crosses Honouliuli Stream and passes within 300 m of the northern-most extent of the “Honouliuli Taro Lands” the sensitivity is believed to increase somewhat, but is still regarded as low. Even though the distance to the former taro lands is not that far, the bottom lands that were preferred for pre-contact agriculture and habitation near the mouth of Honouliuli Stream seem, in terms of environmental attributes, to have been a world away. Archaeological deposits associated with pre-contact Hawaiian habitation and burial are a remote possibility. Post-contact archaeological deposits are not anticipated in any abundance on the basis of the historic record and the results reported in previous archaeological studies.

3.4.2 Predictive Model East of Kunia Road

East of Kunia Road, the environment changes rather abruptly, a fact that was mirrored in pre-contact settlement patterns and has continued to the present day. The margins of the lochs of Pearl Harbor were proverbially “fat,” “fertile,” and “sweet” (*momona*) lands owing to the availability of marine resources, riparian resources, well-watered bottom lands for *kalo* cultivation and other forms of agriculture, and the generally sheltered conditions. These lands responded rapidly to human endeavor, and the many fish ponds, fish traps, irrigation ditches and ponded fields of the margins of Pearl Harbor undoubtedly supported a relatively large and dense Hawaiian population for a thousand years. As such, the prospect of subsurface deposits relating to traditional Hawaiian habitation, burial, and agriculture having been present in the eastern portion of the Construction Phase I project area is regarded as high. Furthermore, the richness of the margins of Pearl Harbor attracted Hawaiian settlement and later settlement by other ethnic groups throughout the early historic period. The prospect of subsurface deposits relating to post-contact habitation, burial, and agriculture having been present in the eastern portion of the Construction Phase I project area is also regarded as high.

Weighing against this is the absence of reports of significant finds of cultural resources and/or burials in the historic and archaeological record. Undoubtedly this in part reflects the very substantial history of land alteration for transportation, commercial, and residential land uses in the 20th century. It appears likely that the acidity and moisture content of the soil has not been conducive to preservation.

Cultural resources and/or burials relating to both pre-contact and post-contact habitation, and agriculture may be encountered almost anywhere in the eastern portion of the Construction Phase I project area. The likelihood of such finds is suggested to be higher in the vicinity of known Land Commission Awards, streams, and the coast.

Section 4 Results of Fieldwork

Due to the size of the survey area, which spans 7.4 miles (12.3 km) and crosses through varying geographic areas, the fieldwork results will be presented in arbitrary segments, previously delineated during project planning. Phase I of the HHCTC Project has been divided into 17 construction sheets (Figure 33 & Figure 34). Below are the results of fieldwork as it relates to each construction sheet.

4.1 Construction Sheet RW001

Construction Sheet RW001 includes a 2,600 ft (0.8 km) segment of the proposed transit corridor, and includes the proposed East Kapolei Station and Park and Ride (P&R) (Figure 35). Two test trenches were excavated at both the station and park and ride (Figure 36). Additionally, one column test pit (C-1) was also excavated (see Figure 35), totaling 5 test excavations within Construction Sheet RW001.

4.1.1 Pedestrian Inspection

The site for the park and ride facility is located at the current construction baseyard for the North-South Road construction endeavor (Figure 37). The location for the East Kapolei Station as well as this section of the rail route was situated along the same route as North-South Road (transit line is proposed to run along its western side) (Figure 38). A newly created drainage canal is also located along the new roadway. All areas were heavily impacted by the road construction endeavor as well as the previous intensive agricultural activity. No cultural resources were observed during the pedestrian survey of this portion of the project area.

4.1.2 GPR Survey

Prior to excavation, each test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, each test area was excavated to compare the results of the GPR survey with the observed stratigraphy. Figure 39 through Figure 53 consist of a stratigraphic profile, a photograph, and a GPR profile for each of the 5 test areas excavated within Construction Sheet RW001.

In general, the results of the GPR survey were inconclusive. No clear stratigraphic interfaces could be defined, and subsurface utilities observed during test excavations at the East Kapolei P&R were not located (see Figure 39 & Figure 42). The maximum “visibility” within the study area ranged from 75 to 100 cm below the surface. It is believed that the environmental conditions present within Construction Sheet RW001 are not conducive for an accurate GPR survey. Based on a review of USDA soil data, the National Resources Conservation Service (NRCS) has indicated that GPR suitability in this area is moderate to low (Figure 9).

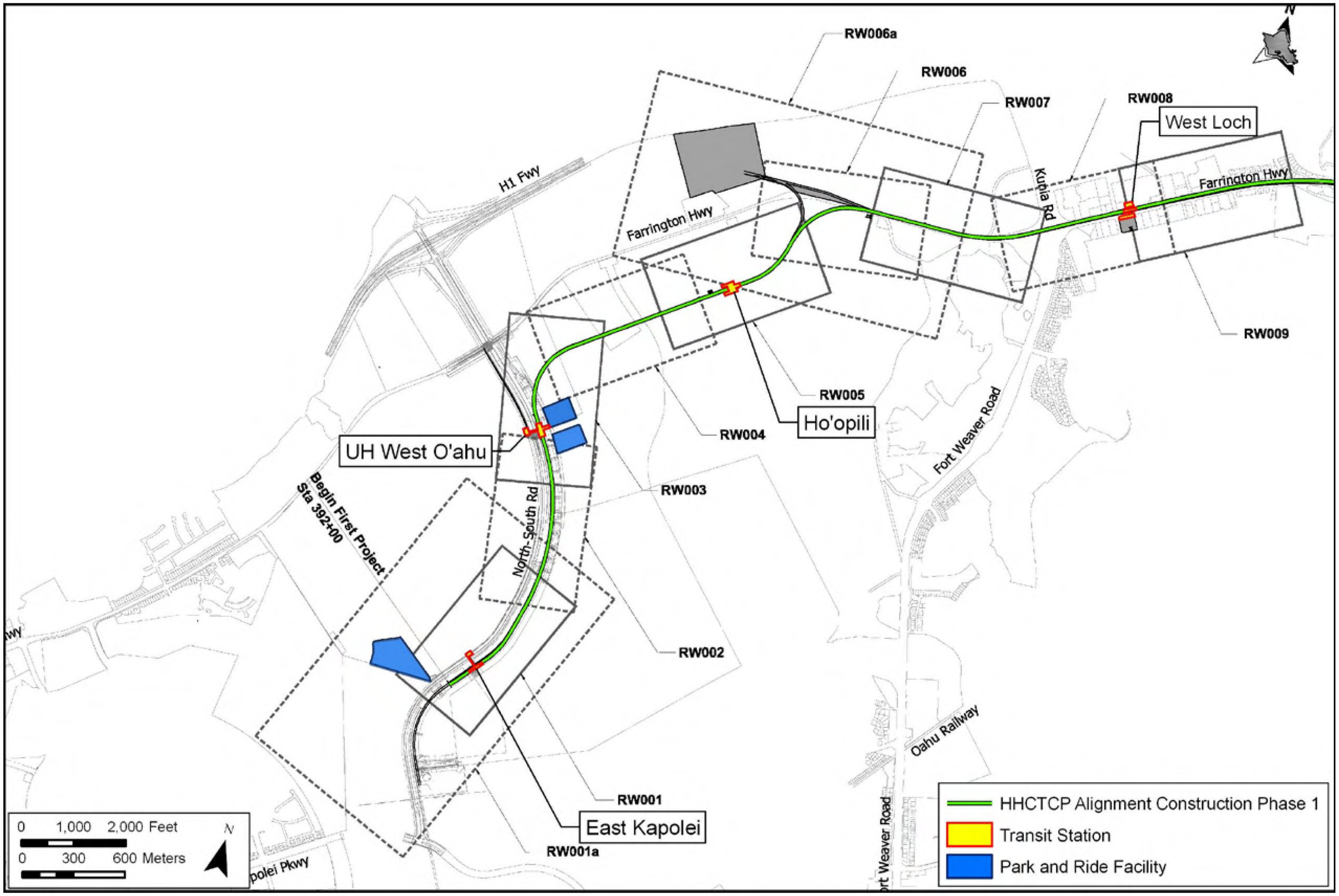

Figure 33. HHCTC Project Right of Way Map Index 1

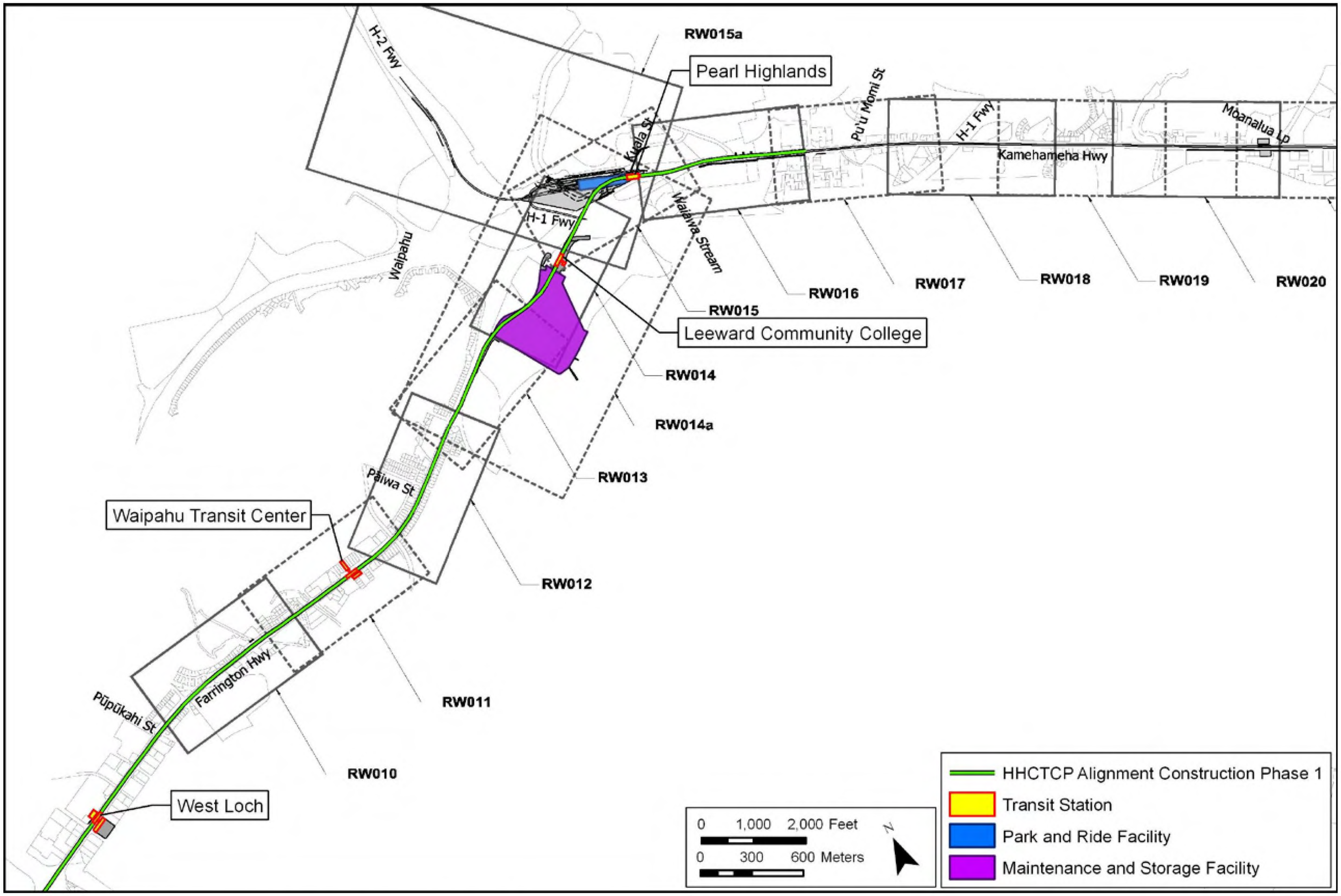

Figure 34. HHCTC Project Right of Way Map Index 2

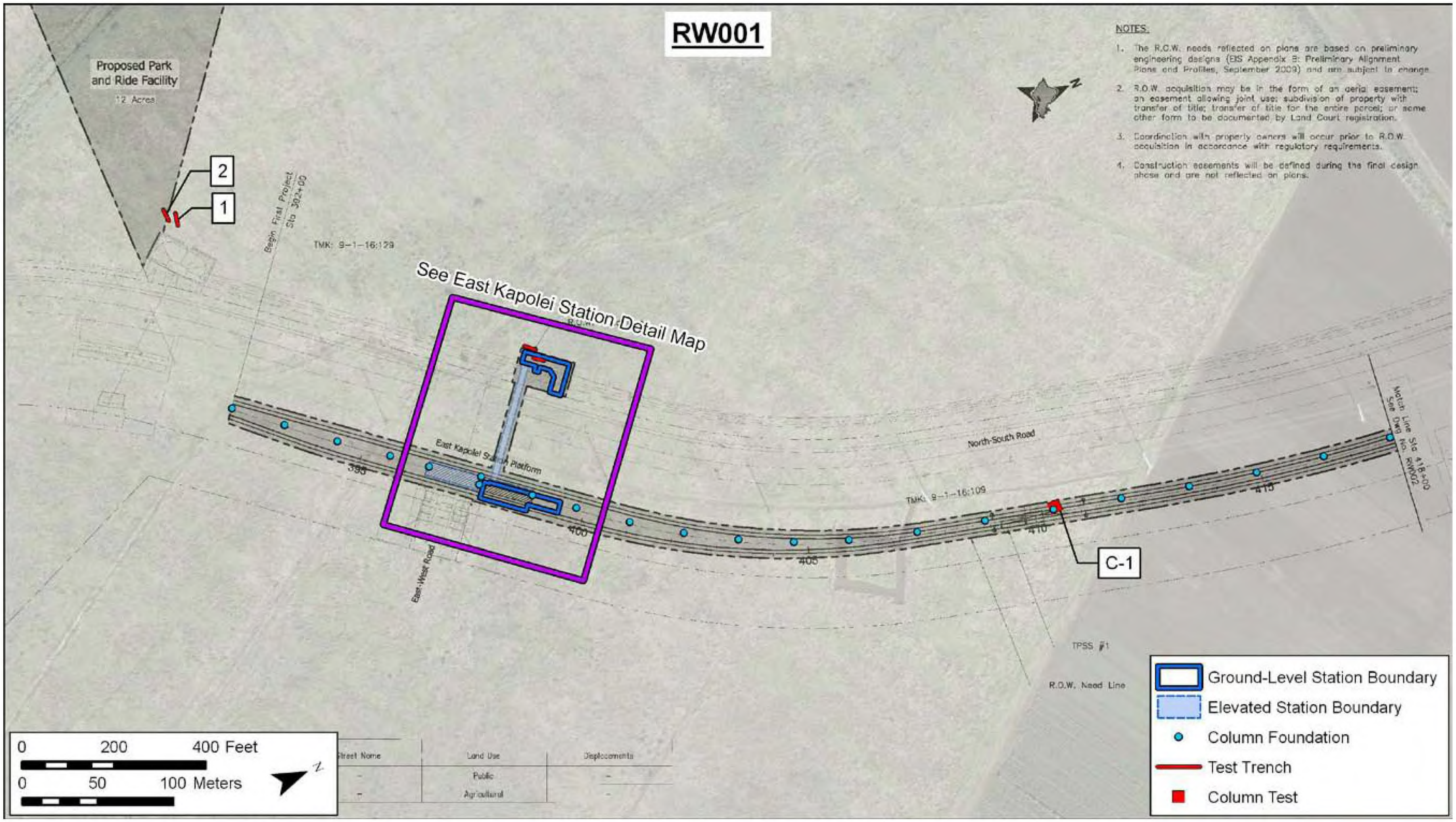

Figure 35. Construction Sheet RW001 showing location of test excavations

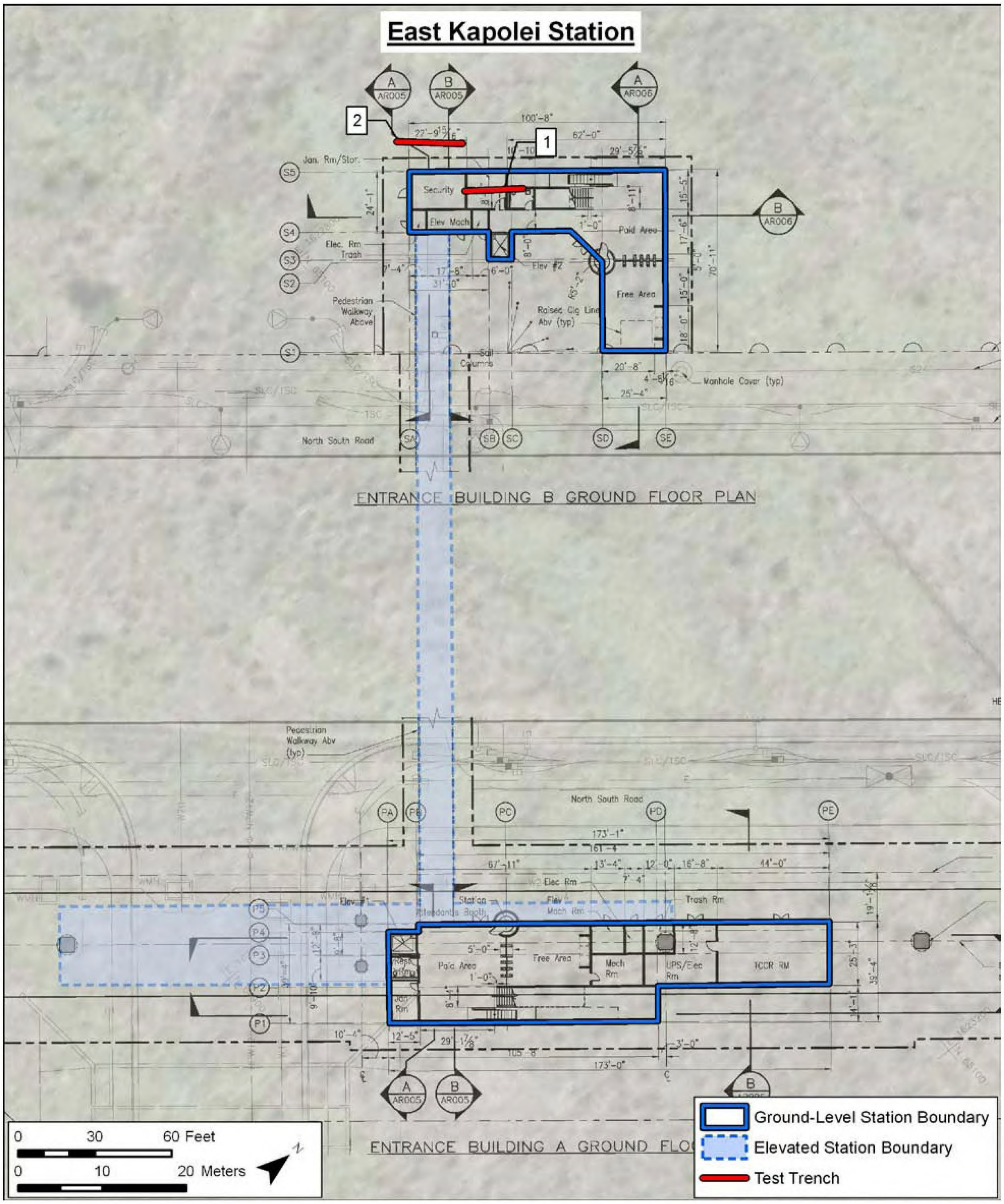

Figure 36. Floor Plan of East Kapolei Station showing location of test trenches

Figure 37.Photo of proposed East Kapolei Park and Ride Facility located at the current baseyard for construction of North-South Road

Figure 38. Photo of projected route of transit between East Kapolei Station and UH West O'ahu Station, which follows along North-South Road (under current construction)

4.1.3 Subsurface Testing

4.1.3.1 Stratigraphic Summary

Five (5) test excavations were placed within the area delineated by Construction Sheet RW001 (see Figure 35 & Figure 36). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 39 to Figure 53).

In general the observed and documented stratigraphy consisted of a single stratum of naturally deposited alluvial sediment utilized for agriculture. Of note was an area of disturbance ranging from 0 to 100 cmbs within most of the test excavations. This disturbance was determined to be associated with modern agriculture (i.e. tilling of the soil and irrigation line installation) as this portion of the project area is situated within actively cultivated fields. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.1.3.2 Excavation Documentation

East Kapolei P&R Test Trench 1

Orientation	284° TN
Length	8 m
Width	0.7 m
Maximum Depth	150 m

Stratum	Depth (cmbs)	Description
I	0-150	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil and instillation of water lines).

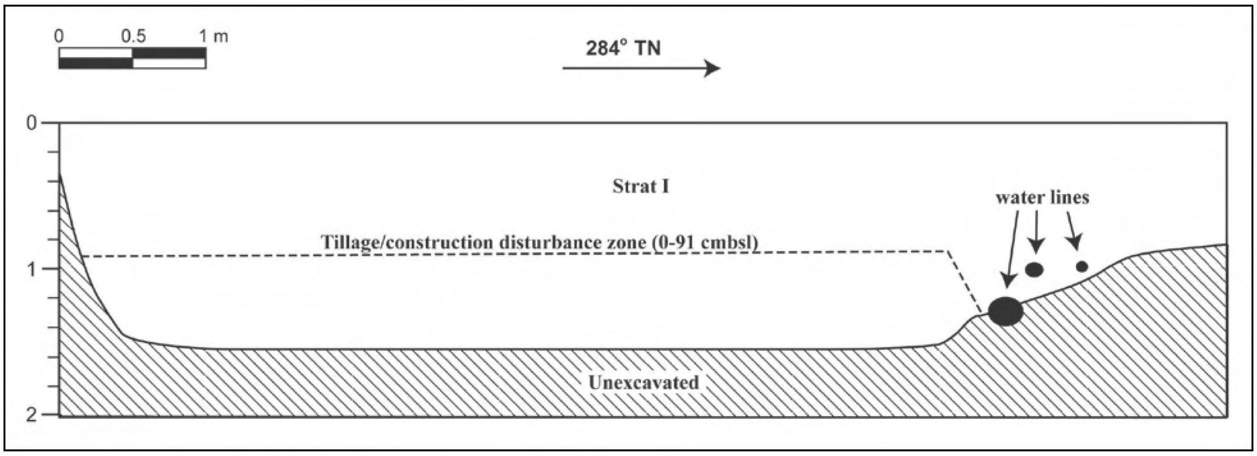

Figure 39. Profile of East Kapolei P&R Test Trench 1

Figure 40. Photograph of East Kapolei P&R Test Trench 1, view to south

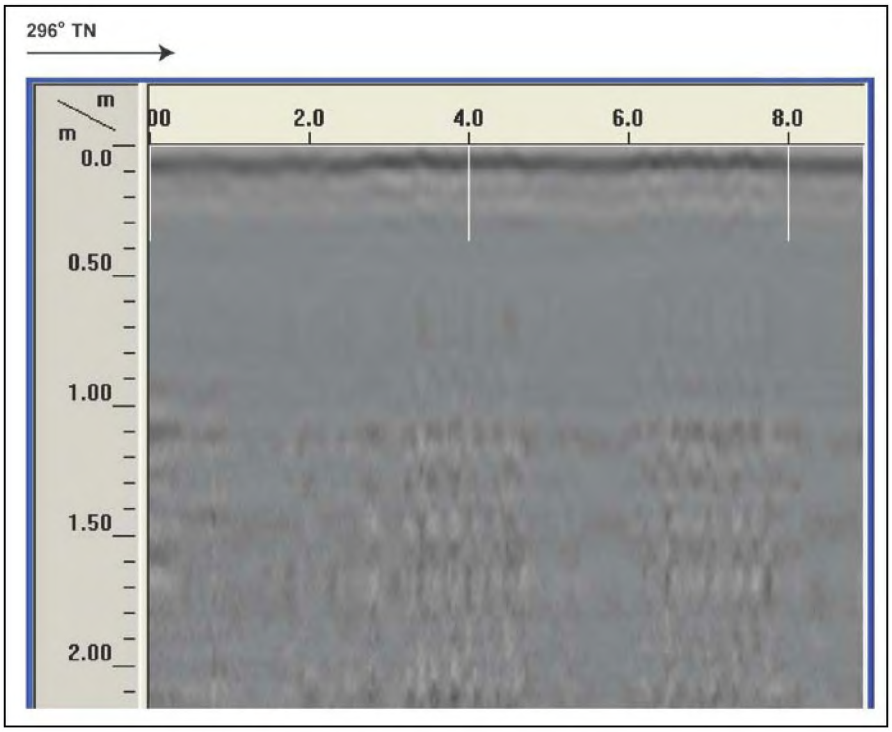

Figure 41. GPR Profile of East Kapolei P&R Test Trench 1

East Kapolei P&R Test Trench 2

Orientation	295° TN
Length	8m
Width	0.7 m
Maximum Depth	1.5m

Stratum	Depth (cmbs)	Description
I	0-150	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil and instillation of water lines).

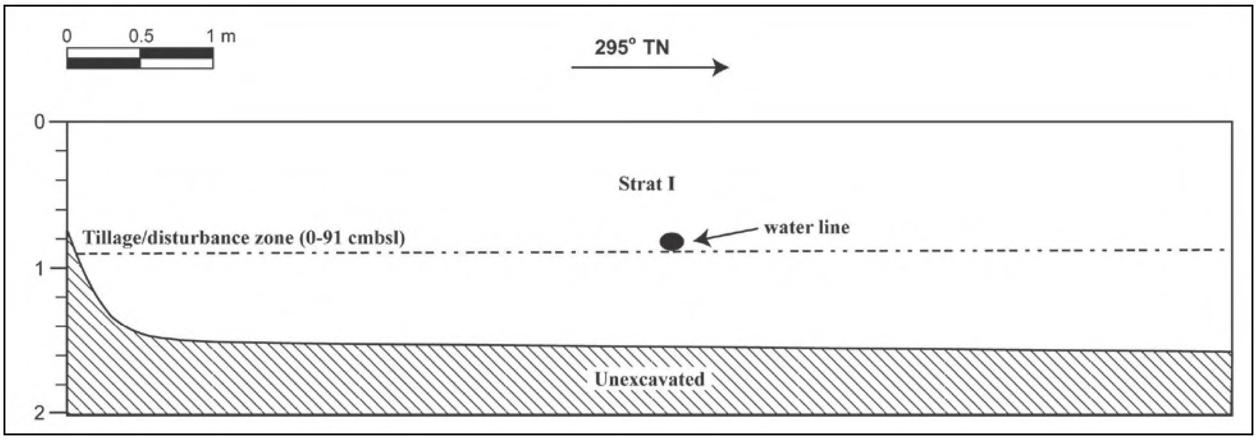

Figure 42. Profile of East Kapolei P&R Test Trench 2

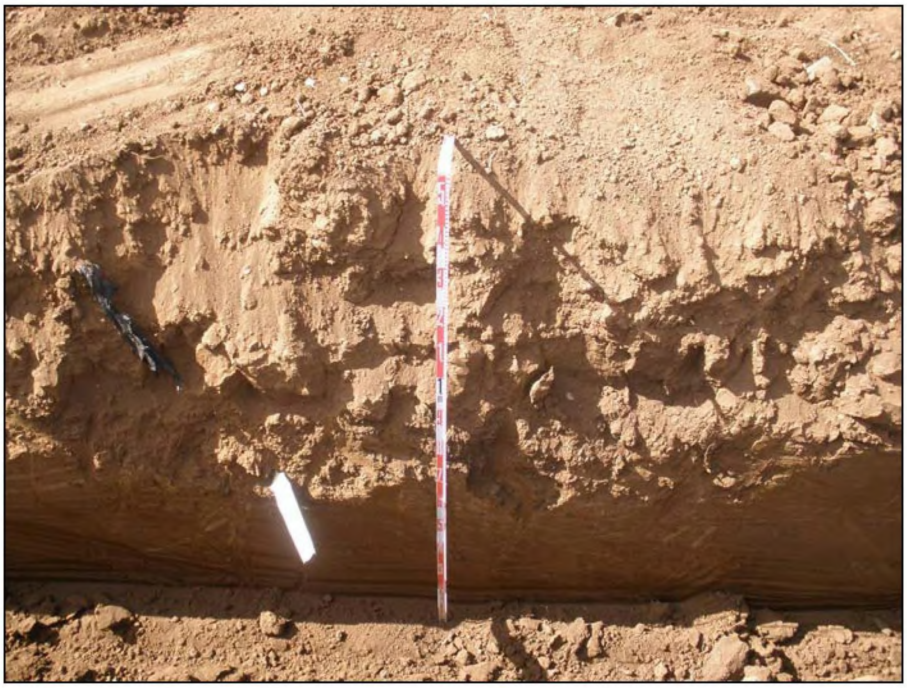

Figure 43. Photograph of East Kapolei P&R Test Trench 2, view to south

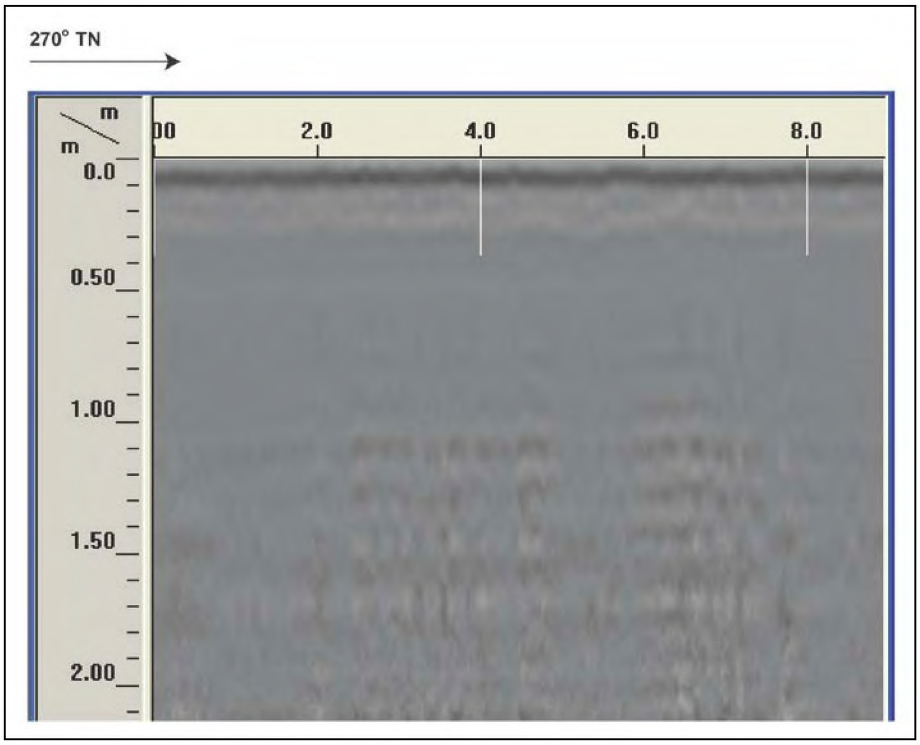

Figure 44. GPR Profile of East Kapolei P&R Test Trench 2

East Kapolei Station Test Trench 1

Orientation	226° TN
Length	8m
Width	0.7m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
I	0-160	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

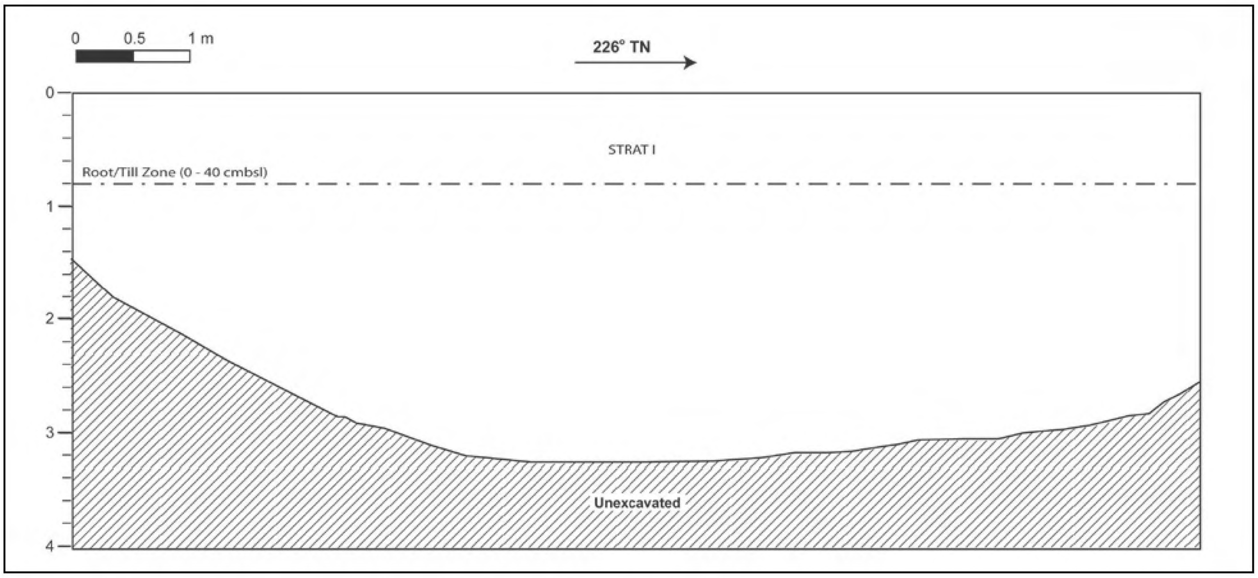

Figure 45. Profile of East Kapolei Station Test Trench 1

Figure 46. Photograph of East Kapolei Station Test Trench 1, view to east

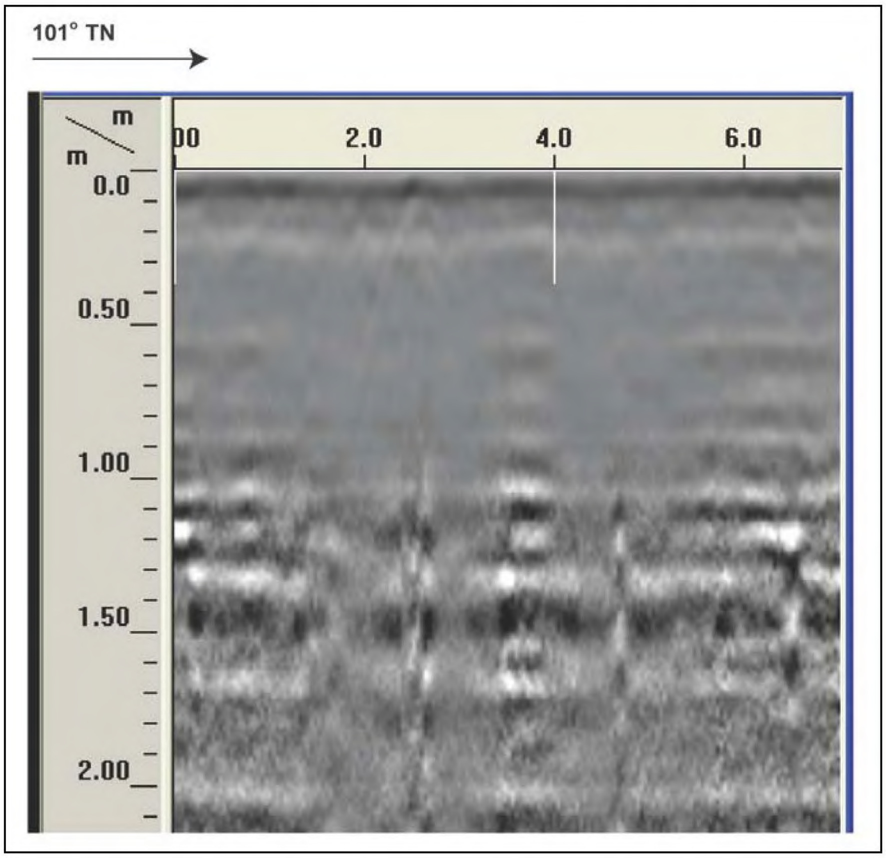

Figure 47. GPR Profile of East Kapolei Station Test Trench 1

East Kapolei Station Test Trench 2

Orientation	210° TN
Length	8m
Width	0.7m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
I	0-160	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

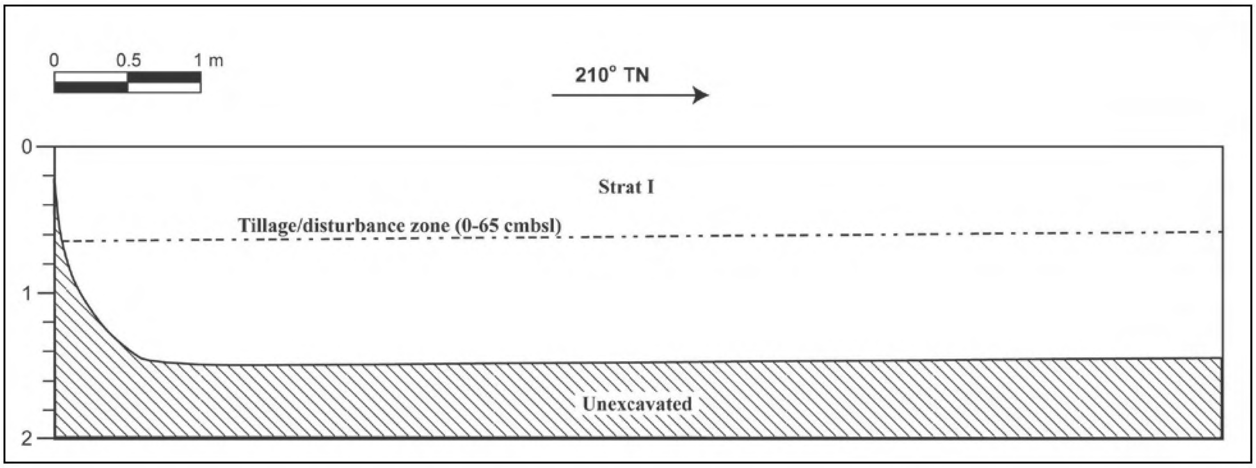

Figure 48. Profile of East Kapolei Station Test Trench 2

Figure 49. Photograph of East Kapolei Station Test Trench 2, view to east

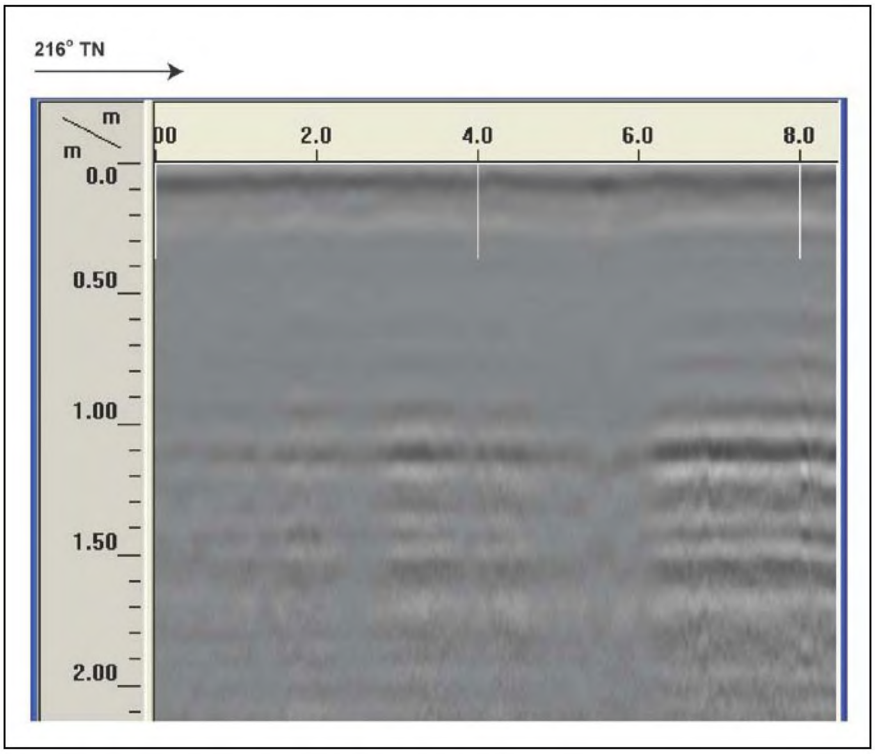

Figure 50. GPR Profile of East Kapolei Station Test Trench 2

Column Test 1 (C-1)

Orientation	11° TN
Length	3 m
Width	2 m
Maximum Depth	1.7 m

Stratum	Depth (cmbs)	Description
I	0-170	Fill; 7.5 YR 4/3, brown; silty clay loam; weak, coarse or thick, blocky structure; weakly coherant dry consistency; slightly plastic; no cementation; Previously disturbed naturally deposited alluvial sediment. Contains limestone and basalt cobbles, construction debris.

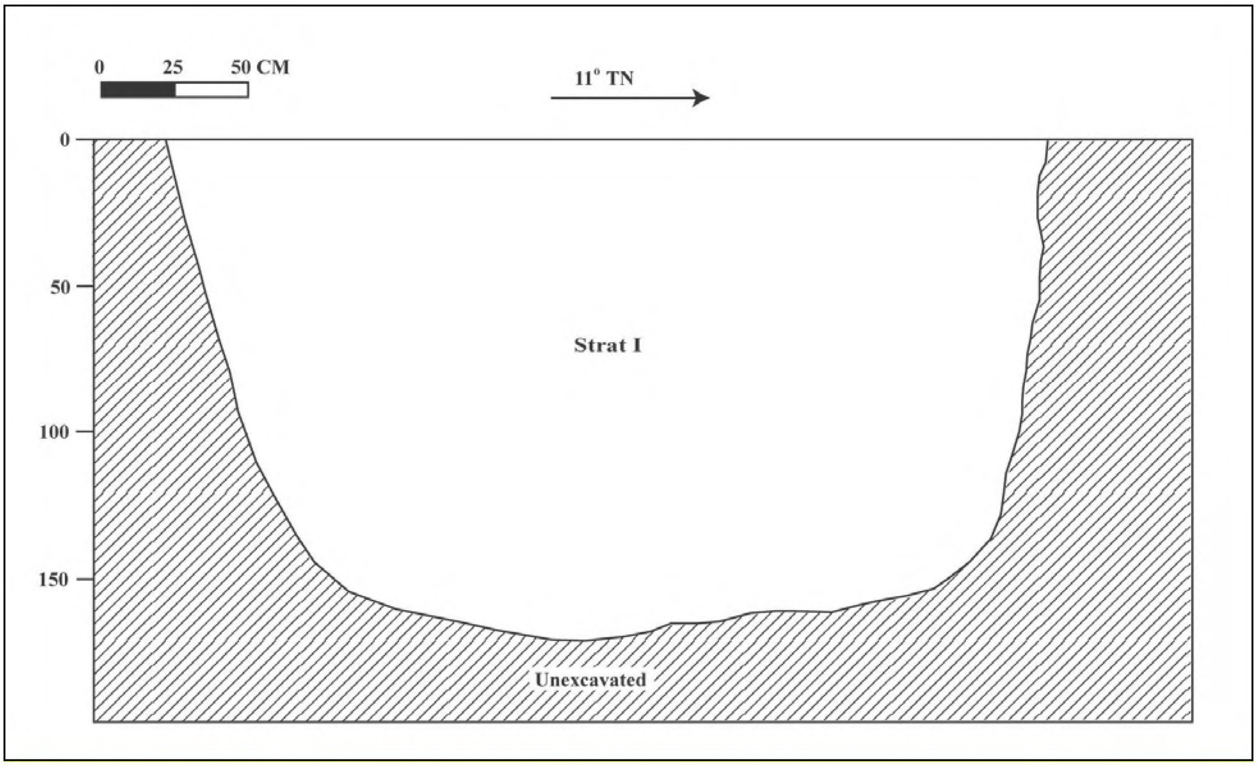

Figure 51. Profile of Column Test 1 (C-1)

Figure 52. Photograph of Column Test 1 (C-1), view to west

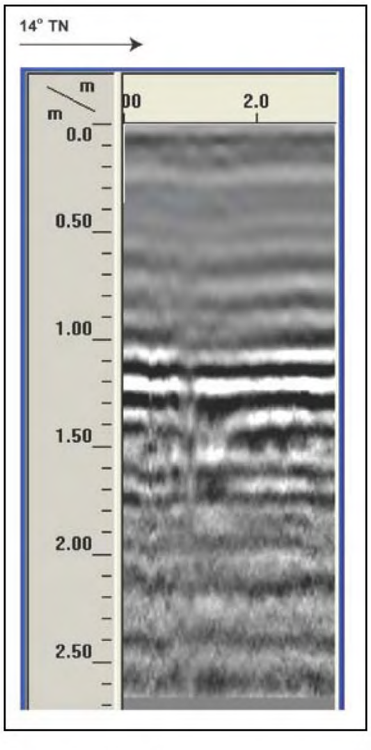

Figure 53. GPR profile of Column Test 1 (C-1)

4.2 Construction Sheet RW002

Construction Sheet RW002 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor, which is completely situated within actively cultivated agricultural land (Figure 54). One column test pit (C-2) was excavated within the area delineated by Construction Sheet RW002.

4.2.1 Pedestrian Inspection

As with the previous segment, this section of the project area has undergone extensive construction work for the new roadway (North-South Road) as well as a large drainage ditch (Figure 55). It was observed that road construction had altered the previous land surface elevation with the road surface being situated higher than the ground surface of the surrounding area. No cultural resources were observed.

4.2.2 GPR Survey

Prior to the excavation of column test pit 2 (C-2), the test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

In general, the results of the GPR survey were inconclusive. This is due to the fact that the stratigraphy of C-2 consisted of a single uniform stratum containing no features or foreign objects (Figure 56 & Figure 57). As a result the coinciding GPR data was also fairly uniform, indicating no subsurface anomalies or stratigraphic layers present in the test area (Figure 58).

4.2.3 Subsurface Testing

4.2.3.1 Stratigraphic Summary

One (1) backhoe column test excavation was placed within the area delineated by Construction Sheet RW002 (see Figure 54). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding the excavated trench, please refer to the trench profile, sediment description, and photograph, which follow this more general summary discussion (Figure 56 to Figure 58).

In general the observed and documented stratigraphy consisted of a single stratum of previously disturbed naturally deposited alluvial sediment. The observed disturbance was associated with filling and grading actuivities of recent North - South Road construction. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al.* 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

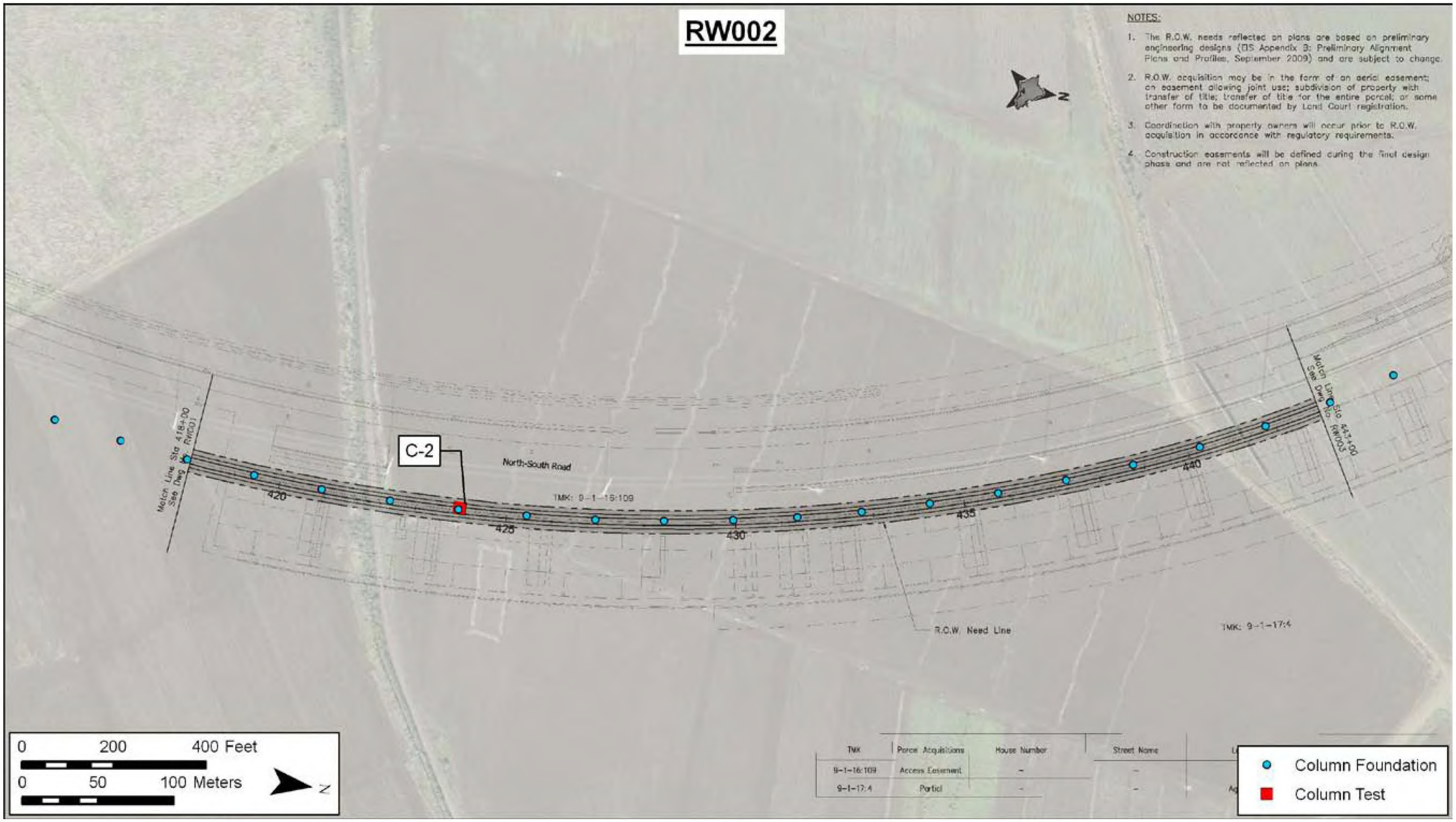

Figure 54. Construction Sheet RW002

Figure 55. Photo of current conditions along proposed rail route within Construction Sheet RW002, along side North-South Road

4.2.3.2 Excavation Documentation

Column Test 2 (C-2)

Orientation	177° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.7 m

Stratum	Depth (cmbs)	Description
I	0-170	Fill; 7.5 YR 4/3, brown; silty clay loam; weak, coarse or thick, blocky structure; weakly coherant dry consistency; slightly plastic; no cementation; Previously disturbed naturally deposited alluvial sediment. Disturbance associated with filling and grading actuivities of recent North - South Road construction.

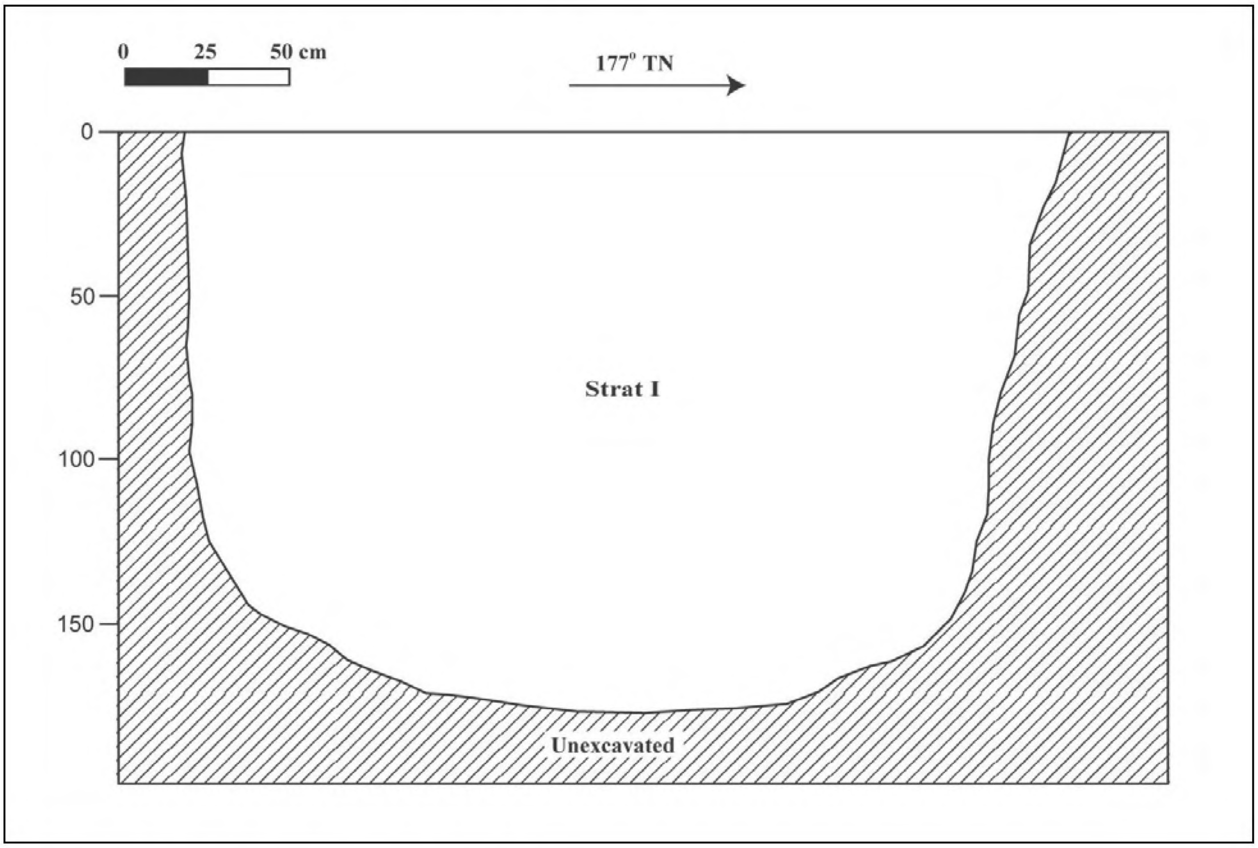

Figure 56. Profile of Column Test 2 (C-2)

Figure 57. Photograph of Column Test 2 (C-2), view to east

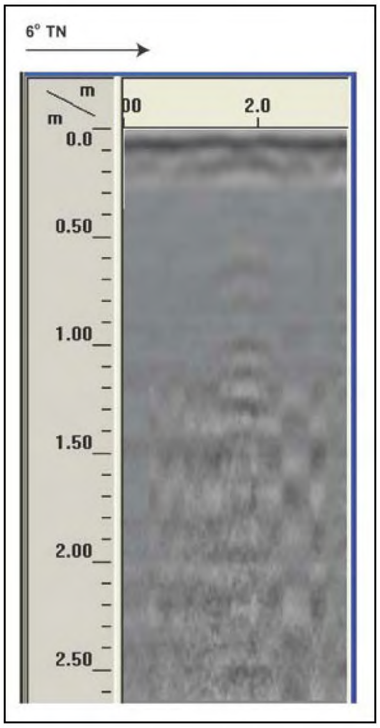

Figure 58. GPR profile of Column Test 2 (C-2)

4.3 Construction Sheet RW003

Construction Sheet RW003 consists of a 2,300 ft (0.7 km) segment of the proposed transit corridor and includes the proposed UH West O'ahu Station and Park and Ride (P&R) (Figure 59 & Figure 60). Two test trenches were excavated at both the station and park and ride (see Figure 60). Additionally, one column test pit (C-3) was also excavated (see Figure 59), totaling 5 test excavations within Construction Sheet RW003.

4.3.1 Pedestrian Inspection

The UH West O'ahu Station is located within the construction zone for North-South Road, while its two park and ride facilities are situated in agricultural fields currently cultivated by Aloun Farms (Figure 61). Both activities would have generated significant land disturbance to have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.3.2 GPR Survey

Prior to excavation, each test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, each test area was excavated to compare the results of the GPR survey with the observed stratigraphy. Figure 62 through Figure 75 consist of a stratigraphic profile, a photograph, and a GPR profile for each of the 5 test areas excavated within Construction Sheet RW003.

In general, the results of the GPR survey were inconclusive. This is due to the fact that the stratigraphy of all 5 test areas consisted of a single uniform stratum containing no features or foreign objects (Figure 62, Figure 65, Figure 67, Figure 70, & Figure 73). As a result the coinciding GPR data was also fairly uniform, indicating no subsurface anomalies or stratigraphic layers present in the test areas (Figure 64, Figure 69, Figure 72, & Figure 75).

4.3.3 Subsurface Testing

4.3.3.1 Stratigraphic Summary

Five (5) backhoe test units were placed within the area delineated by Construction Sheet RW003 (see Figure 59 & Figure 60). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated units, please refer to the excavation profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 39 to Figure 53).

In general the observed and documented stratigraphy consisted of a single stratum of naturally deposited alluvial sediment utilized for agriculture. Of note was an area of disturbance ranging from 0 to 120 cmbs within all of the test excavations. This disturbance was determined to be associated with modern agriculture (i.e. tilling of the soil and irrigation line installation) as this

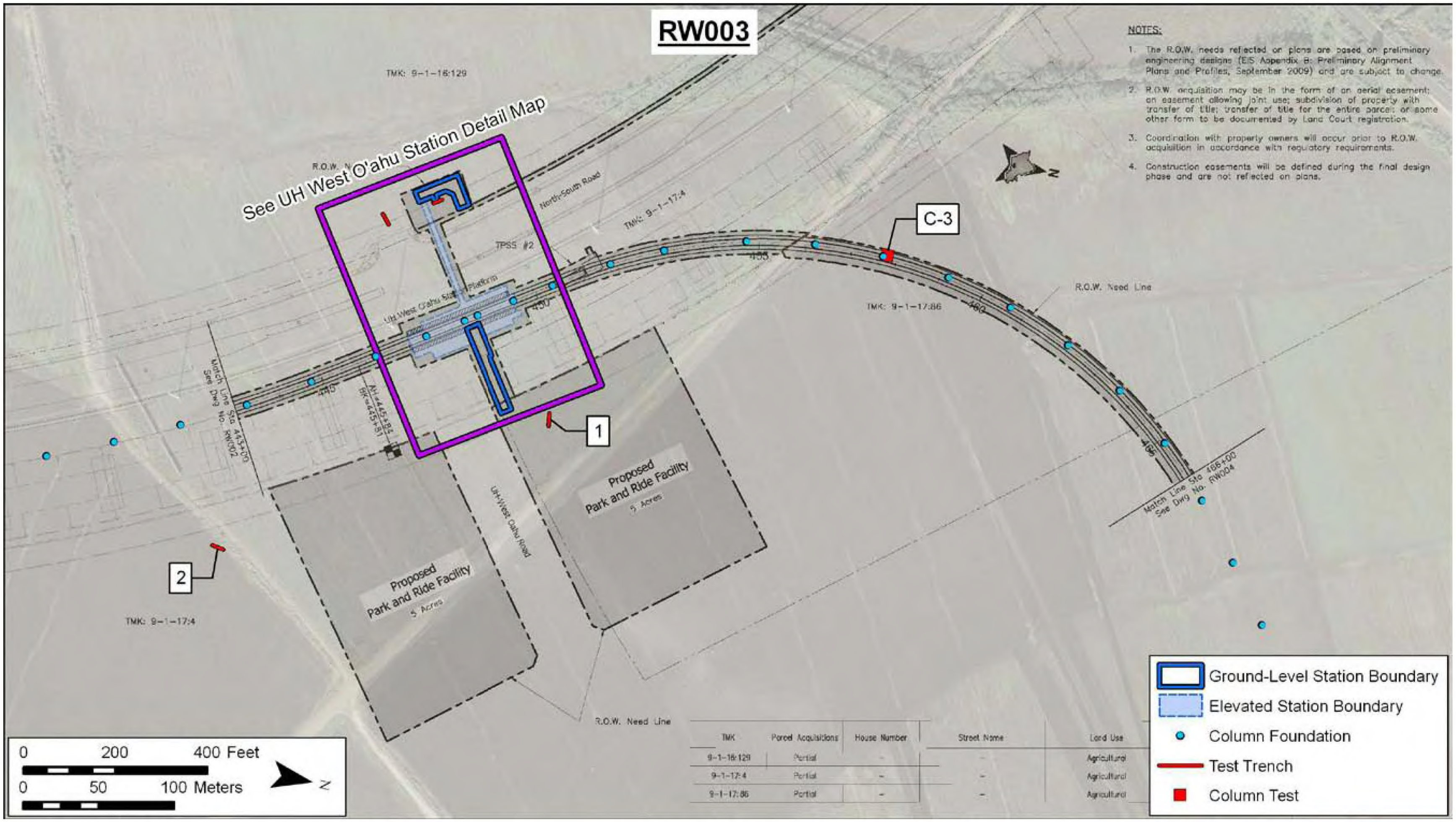

Figure 59. Construction Sheet RW003

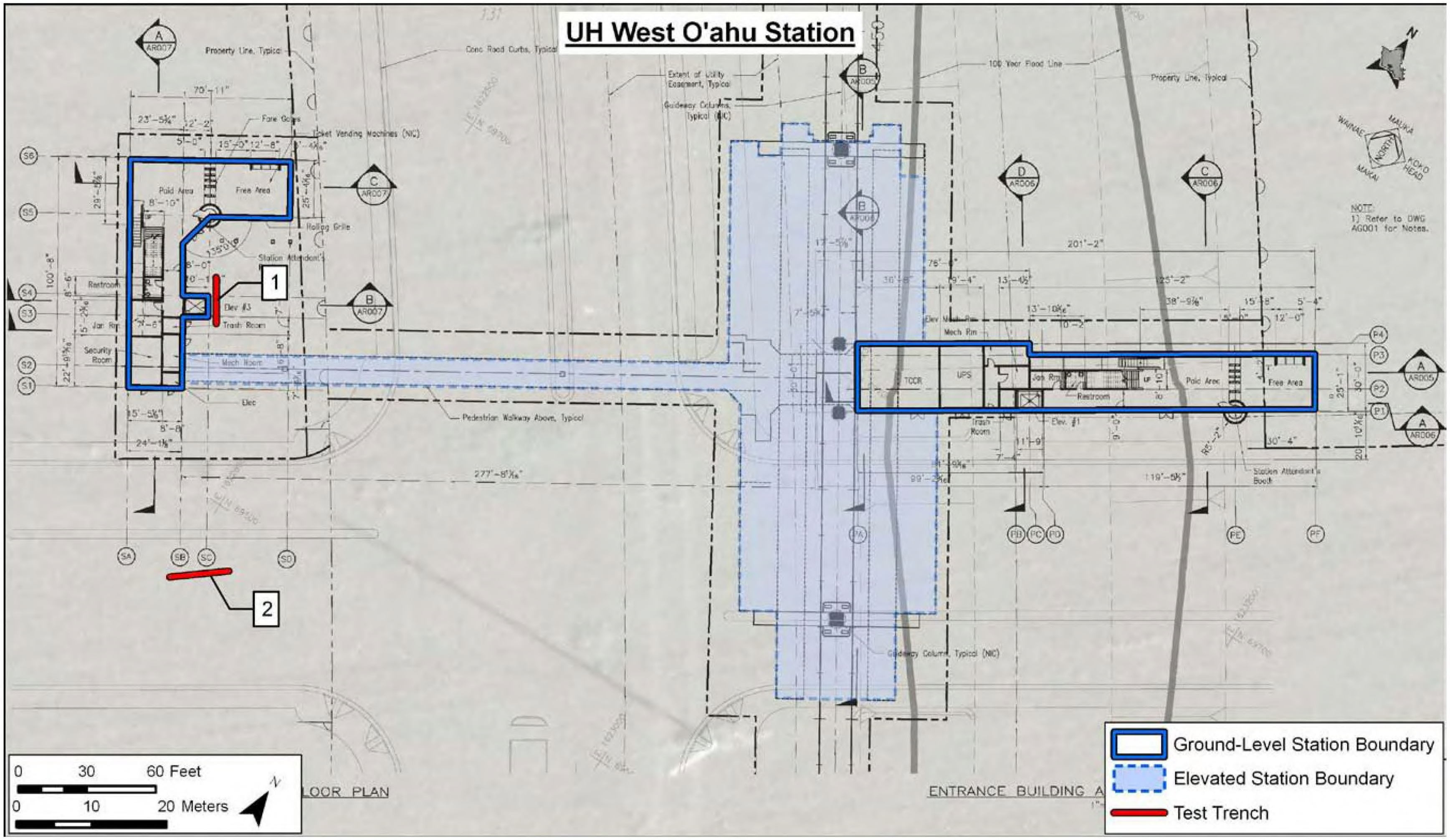

Figure 60. Floor Plan of UH West O'ahu Station showing location of test trenches

Figure 61.Photo of current conditions at location for the UH West Oahu Park and Ride Facility along the west side of Aloun Farms showing active agricultural fields and access (dirt) roads

portion of the project area is situated within actively cultivated fields. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.3.3.2 Excavation Documentation

UH West Oahu Station Test Trench 1

Orientation	337° TN
Length	8m
Width	0.7m
Maximum Depth	1.7m

Stratum	Depth (cmbs)	Description
I	0-170	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

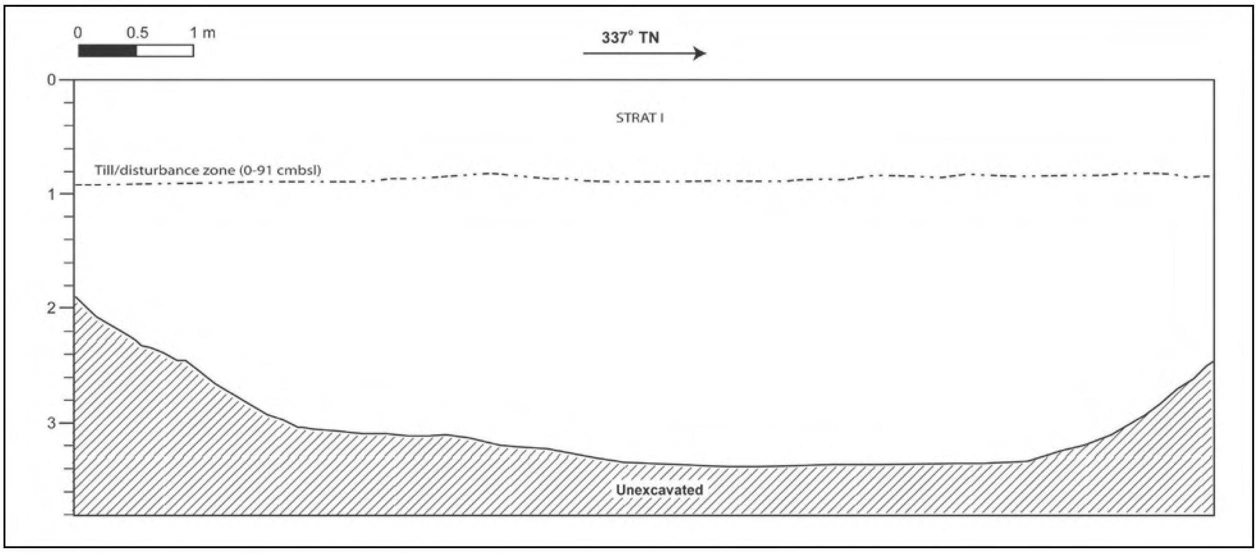

Figure 62. Profile of UH West Oahu Station Test Trench 1

Figure 63. Photograph of UH West Oahu Station Test Trench 1, view to west

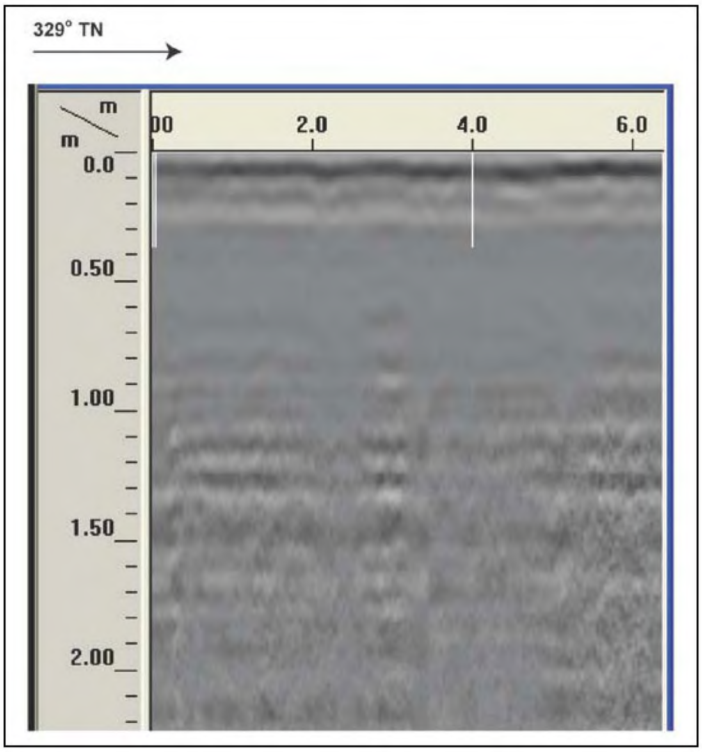

Figure 64. GPR profile of UH West Oahu Station Test Trench 1

UH West Oahu Station Test Trench 2

Orientation	239° TN
Length	8m
Width	0.7m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
I	0-150	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 105 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

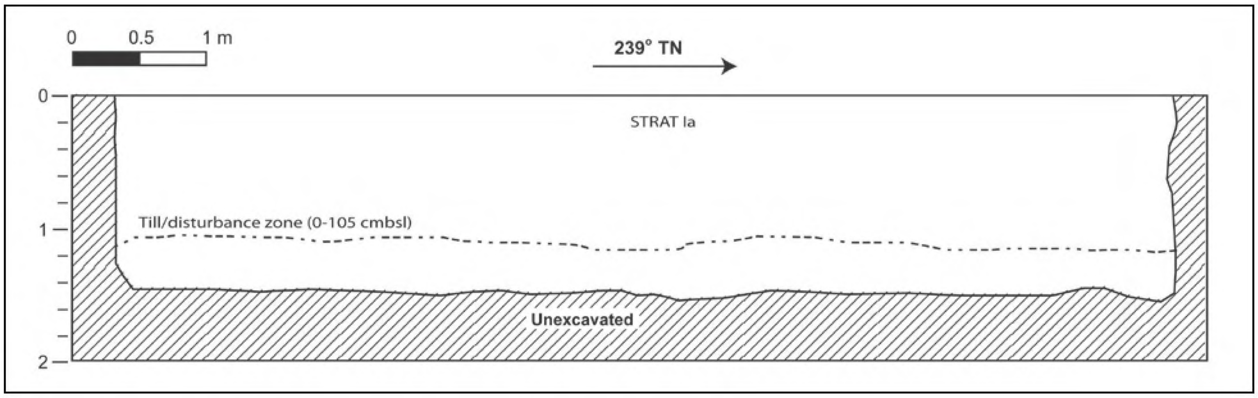

Figure 65. Profile of UH West Oahu Station Test Trench 2

Figure 66. Photograph of UH West Oahu Station Test Trench 2, view to south

UH West Oahu P&R Test Trench 1

Orientation	265° TN
Length	8m
Width	0.7m
Maximum Depth	1.4 m

Stratum	Depth (cmbs)	Description
I	0-140	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 80 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

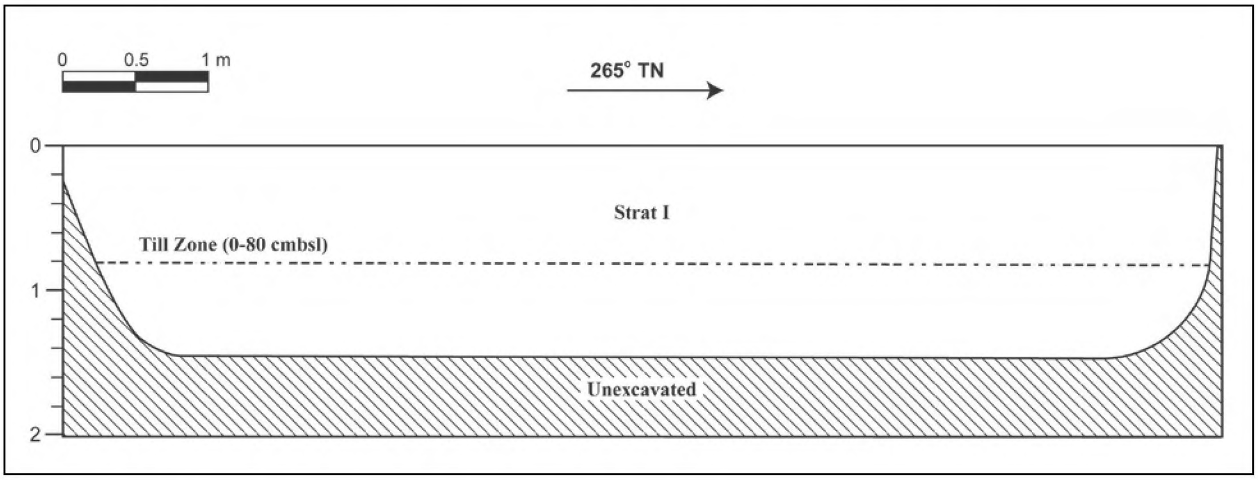

Figure 67. Profile of UH West Oahu P&R Test Trench 1

Figure 68. Photograph of UH West Oahu P&R Test Trench 1, view to south

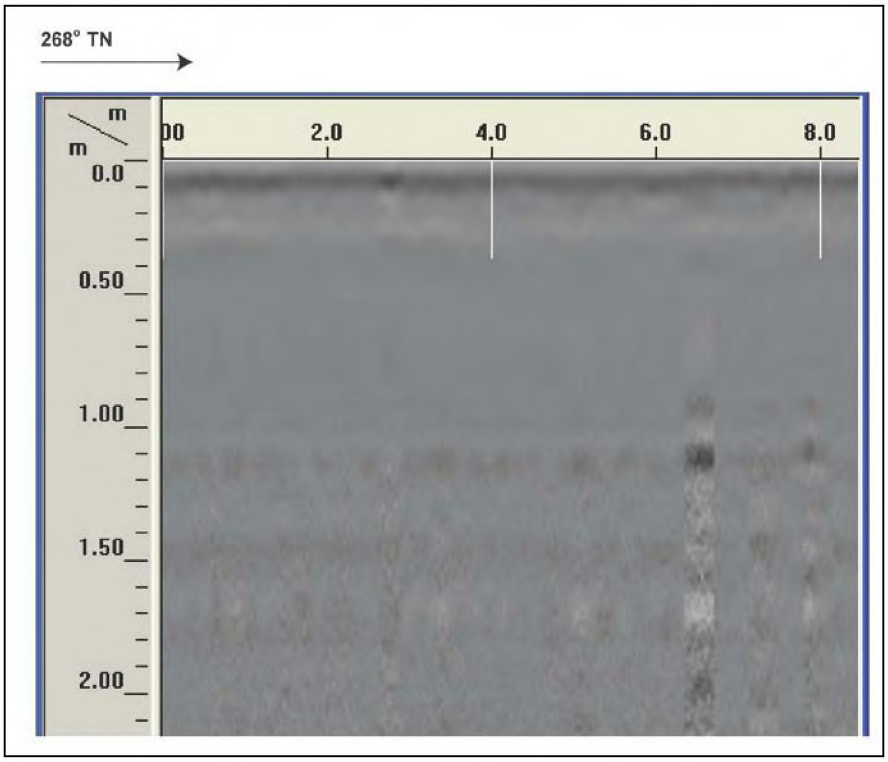

Figure 69. GPR profile of UH West Oahu P&R Test Trench 1

UH West Oahu P&R Test Trench 2

Orientation	009° TN
Length	8 m
Width	0.7 m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
I	0-160	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 120 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

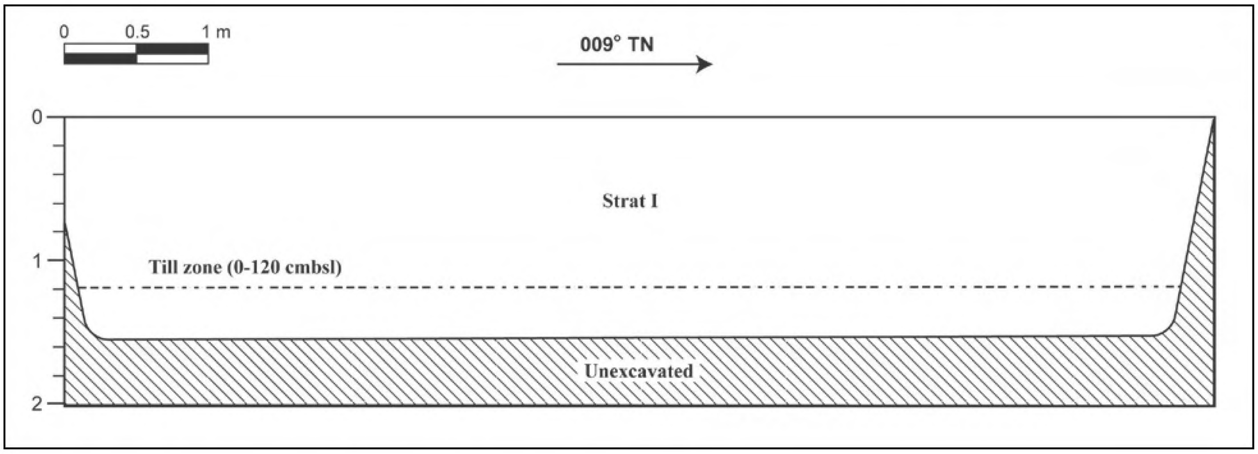

Figure 70. Profile of UH West Oahu P&R Test Trench 2

Figure 71. Photograph of UH West Oahu P&R Test Trench 2, view to west

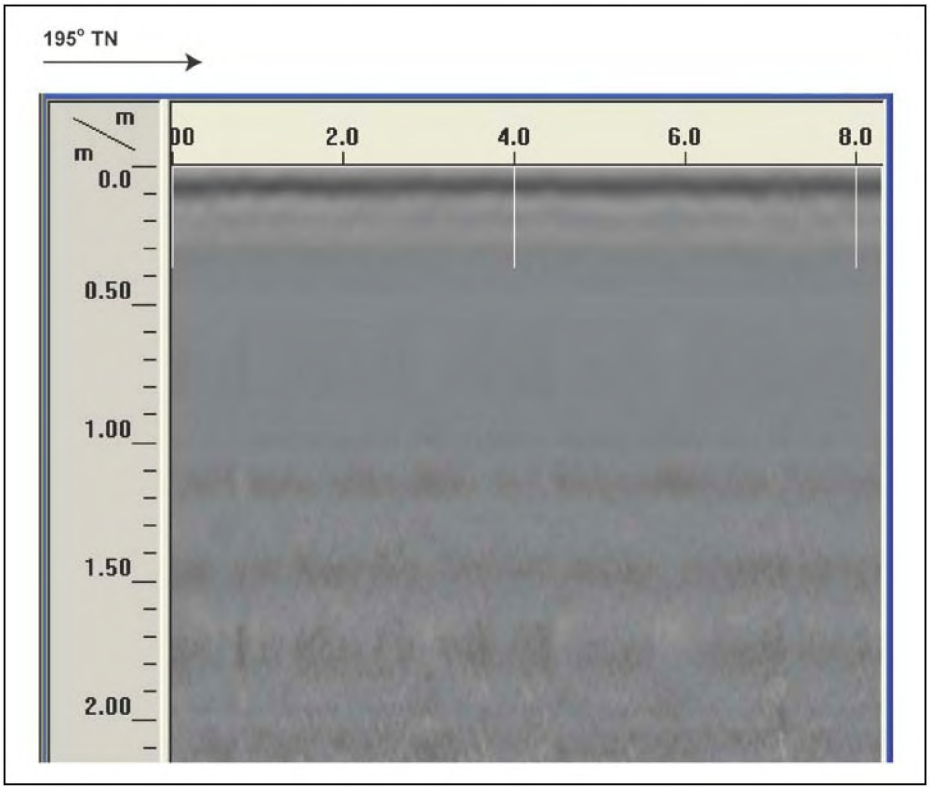

Figure 72. GPR profile of UH West Oahu P&R Test Trench 2

Column Test 3 (C-3)

Orientation	236° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.45 m

Stratum	Depth (cmbs)	Description
I	0-145	7.5 YR 3/3, dark brown; clay loam; moderate, coarse or thick, blocky structure; weakly coherant dry consistency; plastic; no cementation; Alluvial sediments utilized for agricultural fields - till zone 40 cmbs.

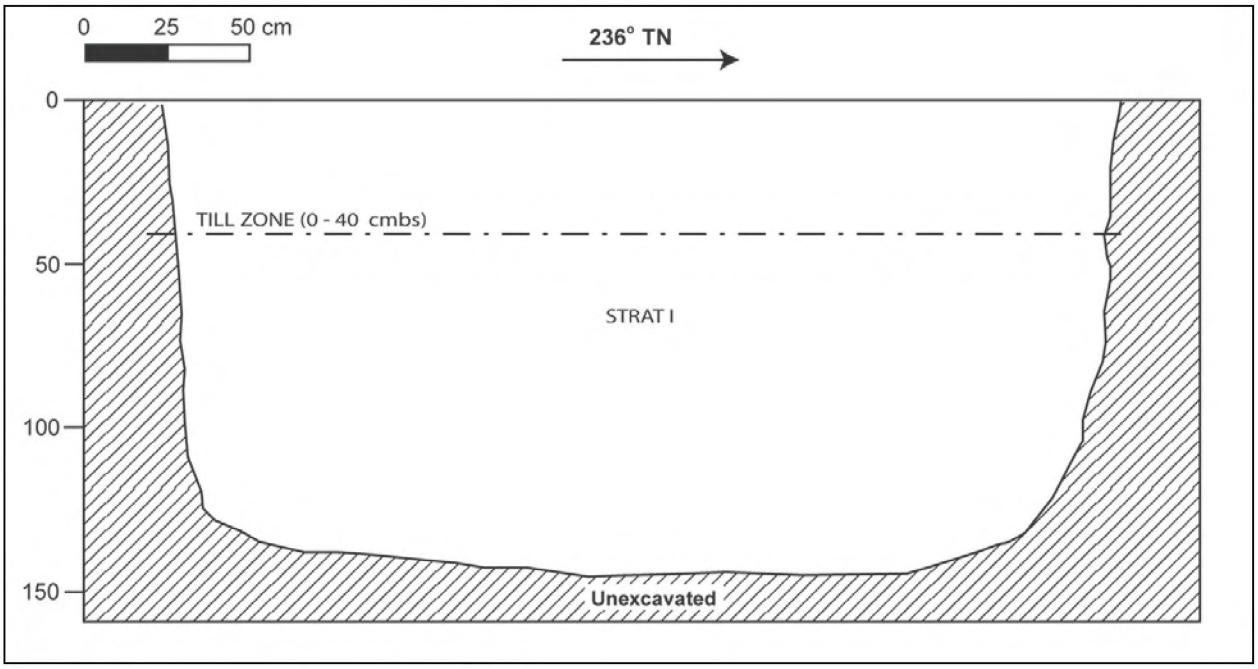

Figure 73. Profile of Column Test 3 (C-3)

Figure 74. Photograph of Column Test 3 (C-3), view to southeast

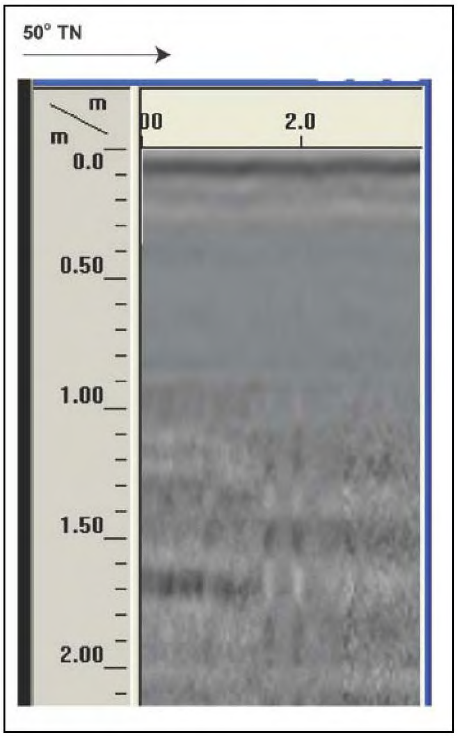

Figure 75. GPR profile of Column Test 3 (C-3)

4.4 Construction Sheet RW004

Construction Sheet RW004 consists of a 2,300 ft (0.7 km) segment of the proposed transit corridor (Figure 76). One column test pit (C-16) was excavated within Construction Sheet RW004.

4.4.1 Pedestrian Inspection

This section of the project area is actively being used for intensified agriculture by Aloun Farms (Figure 77). The proposed transit route crosses three fields within Construction Sheet RW004. A wide assortment of cultigens was planted in each field with each type switched after crops were harvested and the field re-tilled. No cultural resources were observed within this section of the project area.

4.4.2 GPR Survey

Prior to the excavation of column test pit 16 (C-16), the test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey appears to have identified the stratigraphic interface between Stratum I and Stratum II within column test pit 16 (C-16) (Figure 78). The horizontal banding shown from 0 to 30 cmbs in the GPR profile seems to correspond to the crushed coral fill layer (Stratum I) observed during excavation (Figure 80). It is believed that the drastic variance in consistency and compaction between the coral fill and the underlying clay loam allowed the GPR to delineate the stratigraphic interface between them.

4.4.3 Subsurface Testing

4.4.3.1 Stratigraphic Summary

One (1) backhoe test excavation was placed within the area delineated by Construction Sheet RW004 (see Figure 76). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding the excavated trench, please refer to the trench profile, sediment description, and photograph, which follow this more general summary discussion (Figure 78 to Figure 80).

In general the observed and documented stratigraphy consisted of a crushed coral road surface overlying a single stratum of naturally deposited alluvial sediment utilized for agriculture. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al.* 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

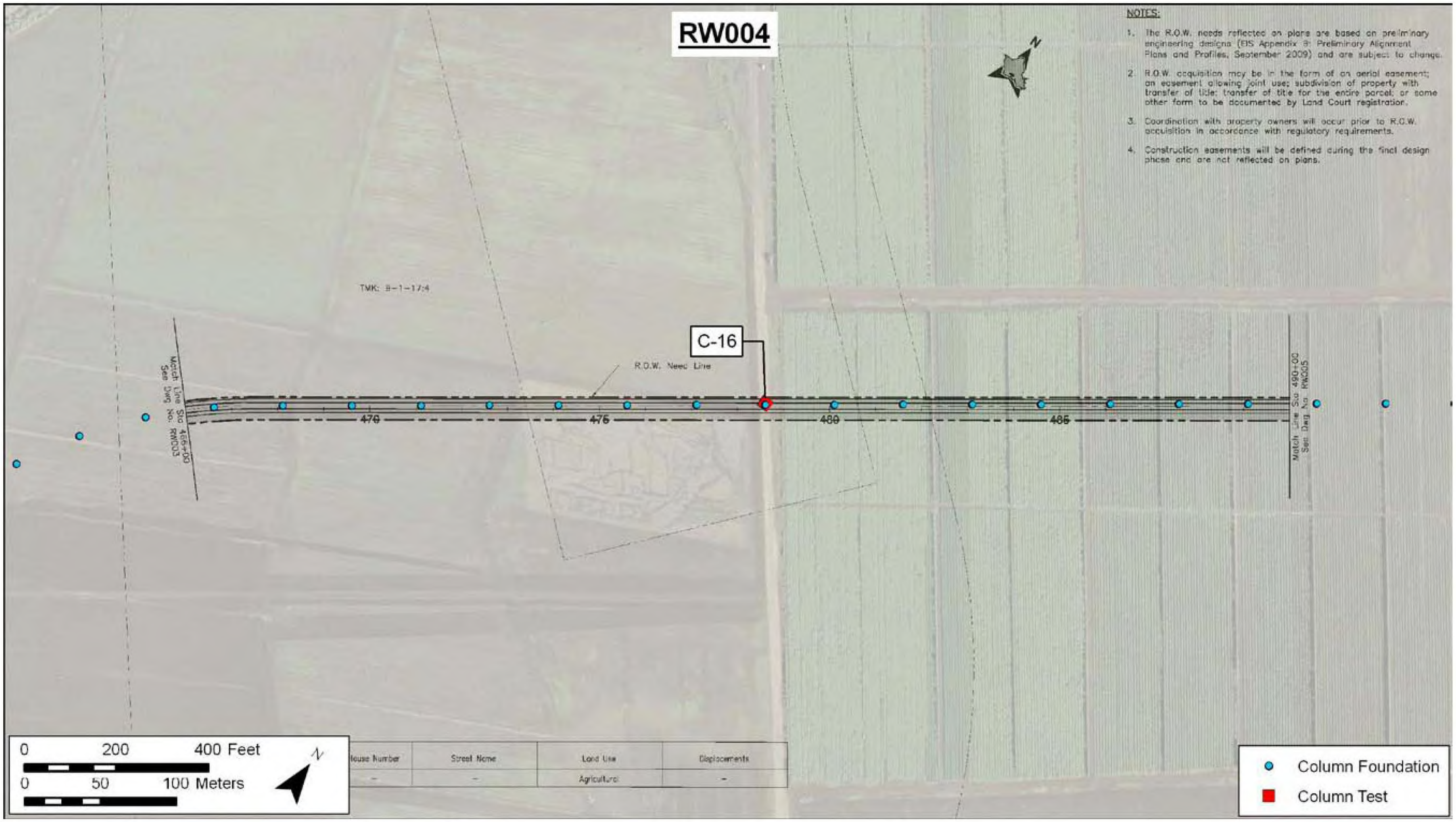

Figure 76. Construction Sheet RW004 showing the location of test excavations

Figure 77. Photo of active agricultural fields and access roads within Aloun Farms where transit route is projected to extend

4.4.3.2 Excavation Documentation

Column Test 16 (C-16)

Orientation	220° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.45 m

Stratum	Depth (cmbs)	Description
I	0-30	Crushed coral road surface
II	30-145	7.5 YR 3/3, dark brown; clay loam; moderate, coarse or thick, blocky structure; weakly coherant dry consistency; plastic; no cementation; Naturally deposited alluvial sediment.

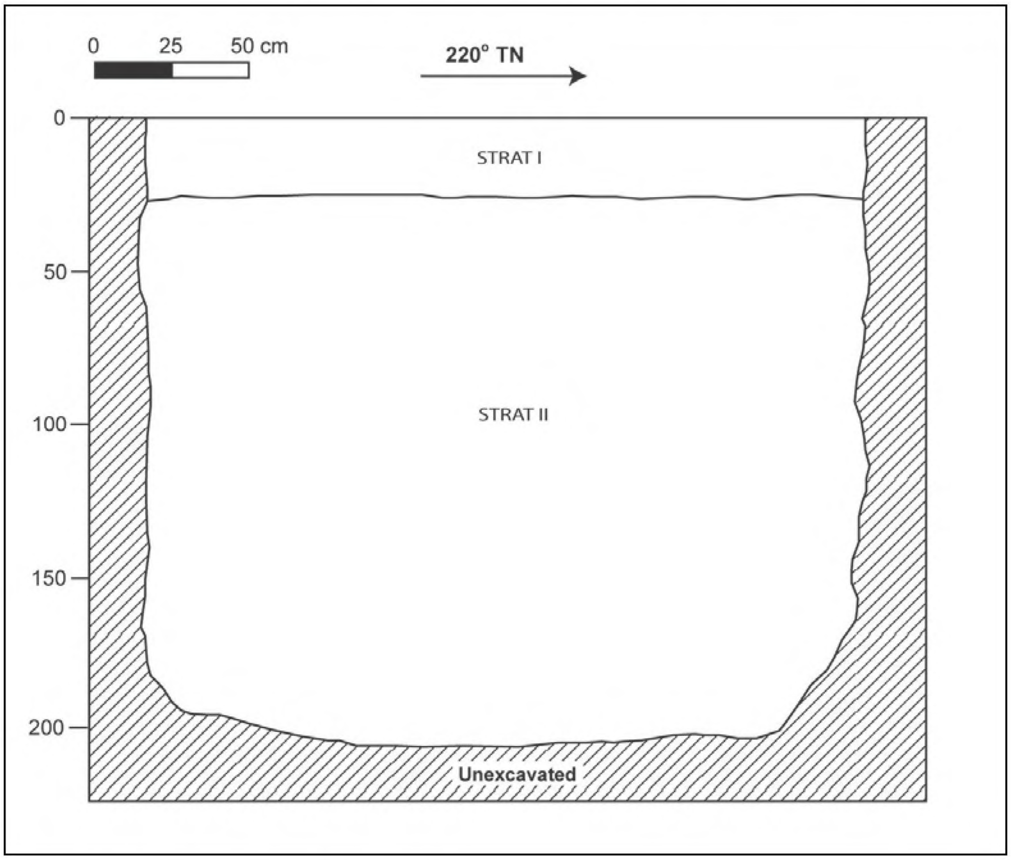

Figure 78. Profile of Column Test 16 (C-16)

Figure 79. Photograph of Column Test 16 (C-16), view to southeast

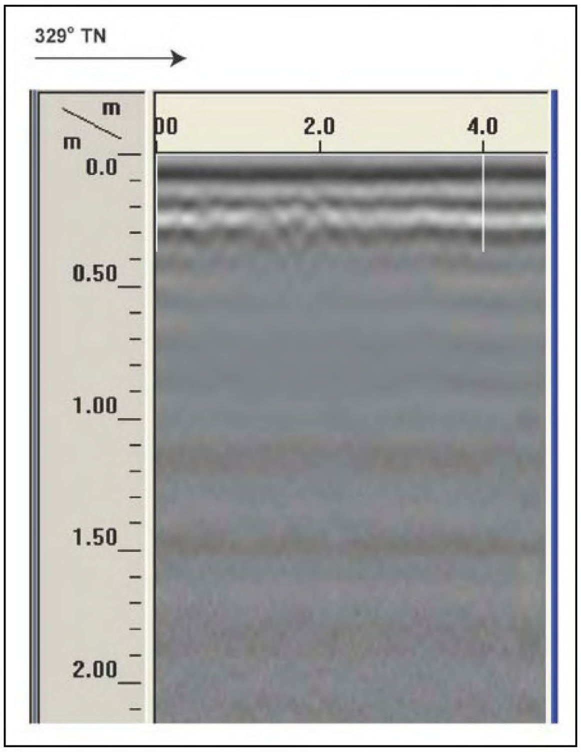

Figure 80. GPR profile of Column Test 16 (C-16)

4.5 Construction Sheet RW005

Construction Sheet RW005 consists of a 2,300 ft (0.7 km) segment of the proposed transit corridor and includes the proposed Ho`opili Station (Figure 81). Two test trenches were excavated at the station, as well as two column test pits (C-15 and C-19), totaling 4 test excavations within Construction Sheet RW005.

4.5.1 Pedestrian Inspection

This segment of the project area lies entirely within the actively cultivated fields and dirt access roads of Aloun Farms (Figure 82). Modern and historic agricultural activities in this area would have removed any surface cultural resources that may have been present. No cultural resources were observed within this section of the project area.

4.5.2 GPR Survey

Prior to the excavation, each test area was surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, each test area was excavated to compare the results of the GPR survey with the observed stratigraphy. Figure 83 through Figure 94 consist of a stratigraphic profile, a photograph, and a GPR profile for each of the 4 test areas excavated within Construction Sheet RW005.

The GPR survey of this area had mixed results. The GPR survey of Ho`opili Station Test Trench 1 was unable to identify a concentration of basalt boulders which were located approximately 30 cm below the surface (Figure 83 & Figure 85). However, during the GPR survey of Column Test 19, a water main and associated subsurface disturbance (i.e. prior trenching) were identified through the presence of subsurface anomalies within the GPR profile. Thus the question arises: What could cause such varying results in this area, given what appears to be fairly uniform environmental conditions? Upon further investigation, two major varying factors arise: 1.) topography and 2.) soil chemistry.

Uneven surface topography (both at ground level and buried) can cause a phenomenon known as radar scatter. Radar reflections off of surfaces "that contain ridges or troughs, or any other irregular features, can either focus or scatter radar energy, depending on the surface's orientation and the location of the antenna on the ground surface" (Conyers 2004: 73). The ground surface at Ho`opili Station Test Trench 1 is slightly sloped and was recently tilled prior to the GPR survey, causing an uneven surface with ridges and troughs. Additionally, the subsurface concentration of basalt boulders formed another uneven surface with ridges and troughs (see Figure 83). It is believed that these two irregular surfaces functioned as reflective planes diverting the emitted radar energy away from the GPR antenna, resulting in a severely attenuated GPR signal. Thus resulting in the complete absence of the large basalt boulders in the GPR profile. In contrast, the land surface at Column Test 19 consisted of a level crushed coral road surface, which did not interfere with the propagation and collection of the radar, thus resulting in an accurate location of subsurface features.

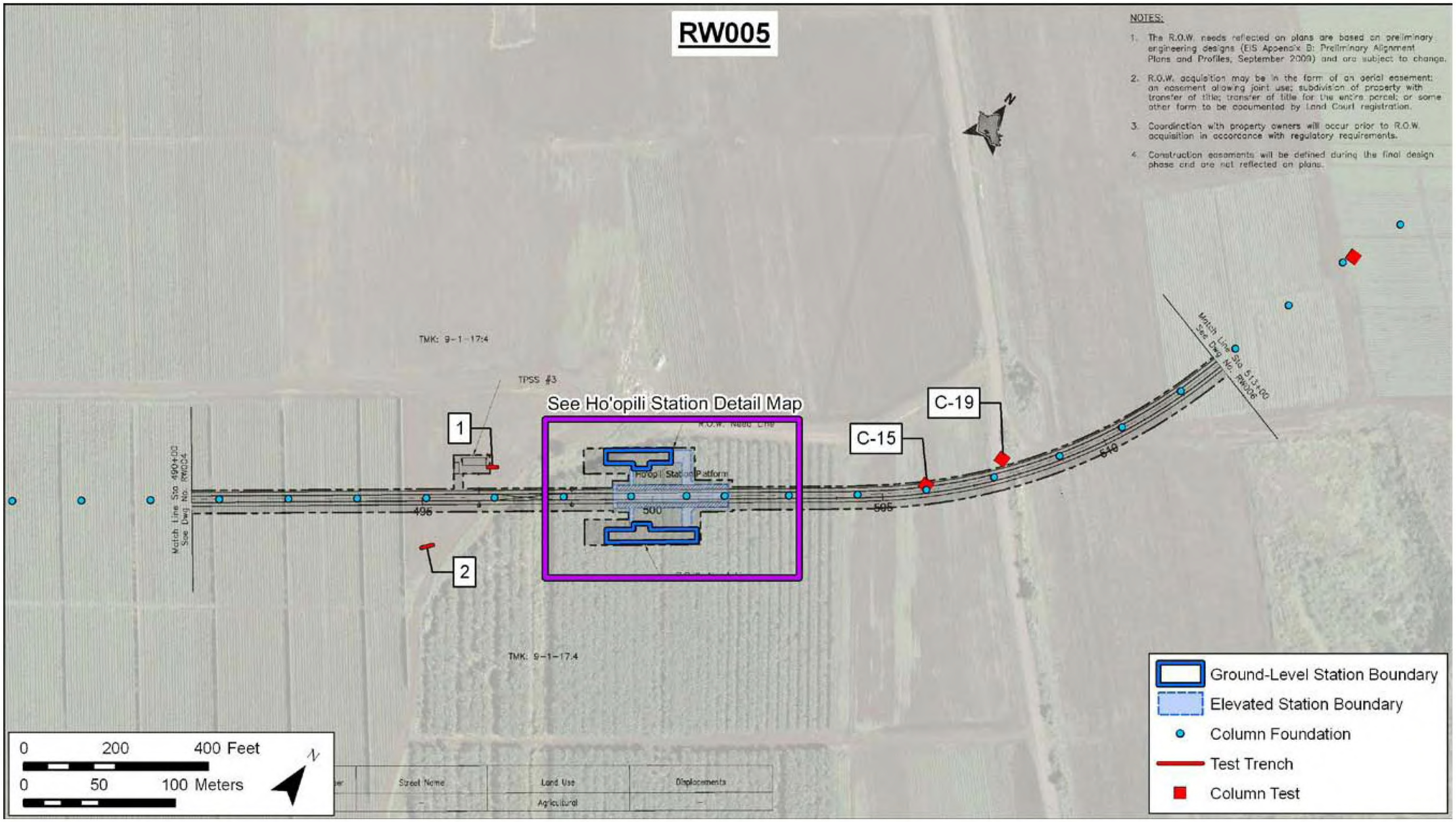

Figure 81. Construction Sheet RW005 showing the location of test excavations

Figure 82.Photo of location for Hoʻopili Station within the Aloun Farms agricultural fields area

Soil chemistry is another factor that likely contributed to the conflicting GPR readings at Ho`opili Station Test Trench 1 and Column Test 19. As Conyers (2004) notes, agricultural soils, usually saturated with nitrogen and potassium, are highly conductive, causing radio transmissions to dissipate and resulting in radio wave attenuation at shallow depths. As mentioned above, the land surface at Ho`opili Station Test Trench 1 was recently tilled, and was likely in active cultivation for decades causing a build up of conductive chemicals in the soil, likely obscuring the presence of the basalt boulders in the GPR profile. Conversely, Column Test 19 was located within a road, not actively cultivated, and probably had a significantly lower concentration of conductive chemicals, thus resulting in an accurate location of subsurface features.

4.5.3 Subsurface Testing

4.5.3.1 Stratigraphic Summary

Four (4) test excavations were placed within the area delineated by Construction Sheet RW005 (see Figure 81). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 83 to Figure 94).

In general the observed and documented stratigraphy consisted of a single stratum of naturally deposited alluvial sediment utilized for modern agriculture. Of note are Ho`opili Station Test Trench 1 and Column Test 19, both of these test excavation deviated from the norm. The stratigraphy of Ho`opili Station Test Trench 1 consisted of two varying fill layers, a clay loam from the local area and a layer of basalt rock and boulders (Figure 83 & Figure 84). As this test excavation was located within a recently tilled agricultural field, it is believed that the layer of basal rocks is related to agricultural activities, possibly related to drainage for a particular crop.

The stratigraphy of Column Test 19 also consisted two varying fill layers, a crushed coral road surface overlying a clay loam fill associated with the installation of a water main (Figure 92 & Figure 93).

All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.5.3.2 Excavation Documentation

Ho`opili Station Test Trench 1

Orientation	238° TN
Length	6m
Width	0.7m
Maximum Depth	1.14m

Stratum	Depth (cmbs)	Description
Ia	0-70	Fill; 5 YR 3/3, dark reddish brown; clay loam; moderate, fine, crumb structure; loose dry consistency; non-plastic; no cementation; very abrupt wavy lower boundary; Agricultural soil
Ib	32-114	Fill; 10 YR 5/1, gray; basalt cobbles; structureless, loose dry consistency; non-plastic; no cementation; Layer of bulldozer push forming berm

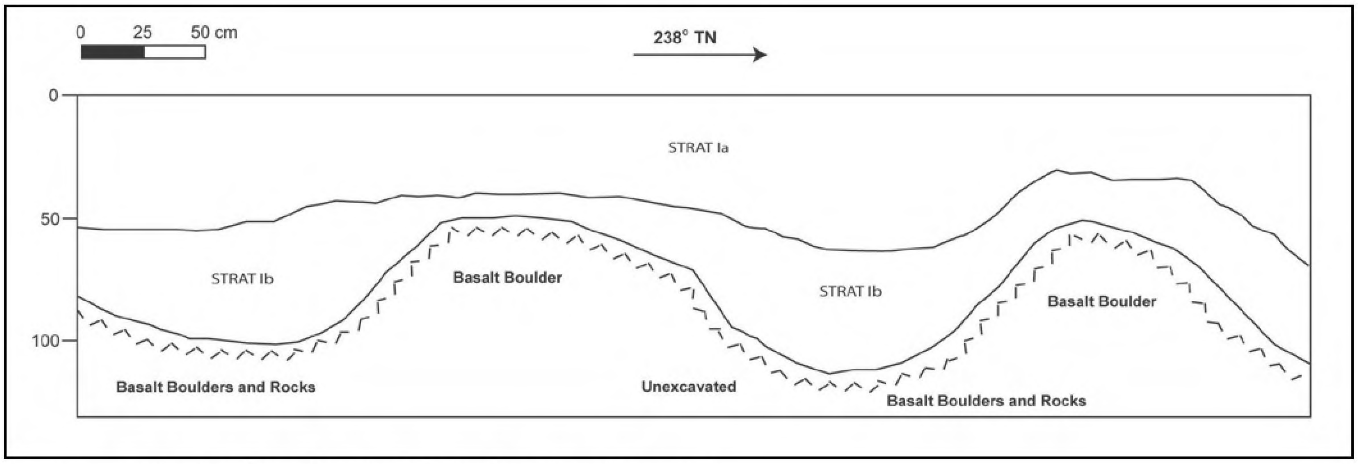

Figure 83. Profile of Ho`opili Station Test Trench 1

Figure 84. Photograph of Ho`opili Station Test Trench 1, view to southeast

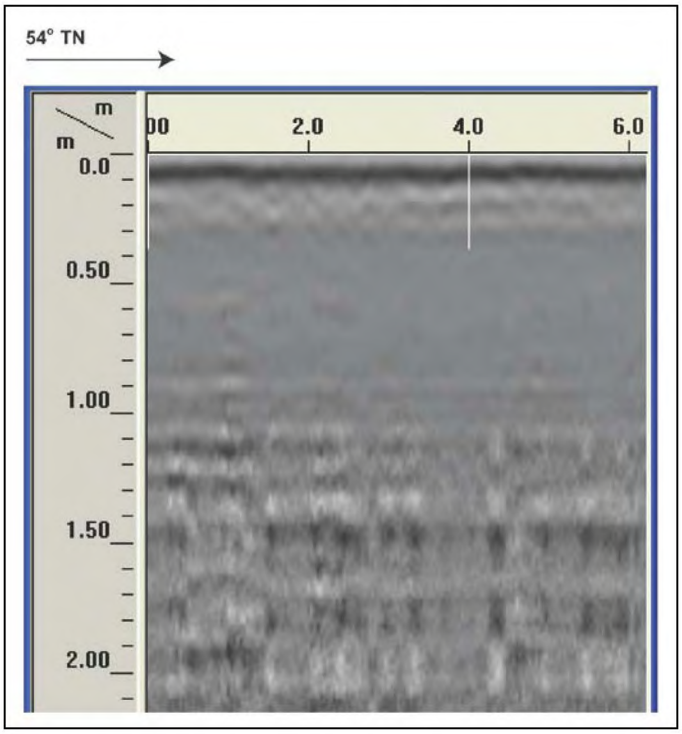

Figure 85. GPR profile of Ho`opili Station Test Trench 1

Ho`opili Station Test Trench 2

Orientation	229° TN
Length	6m
Width	0.7m
Maximum Depth	2m

Stratum	Depth (cmbs)	Description
I	0-20	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 90 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil and instiullation of water lines).

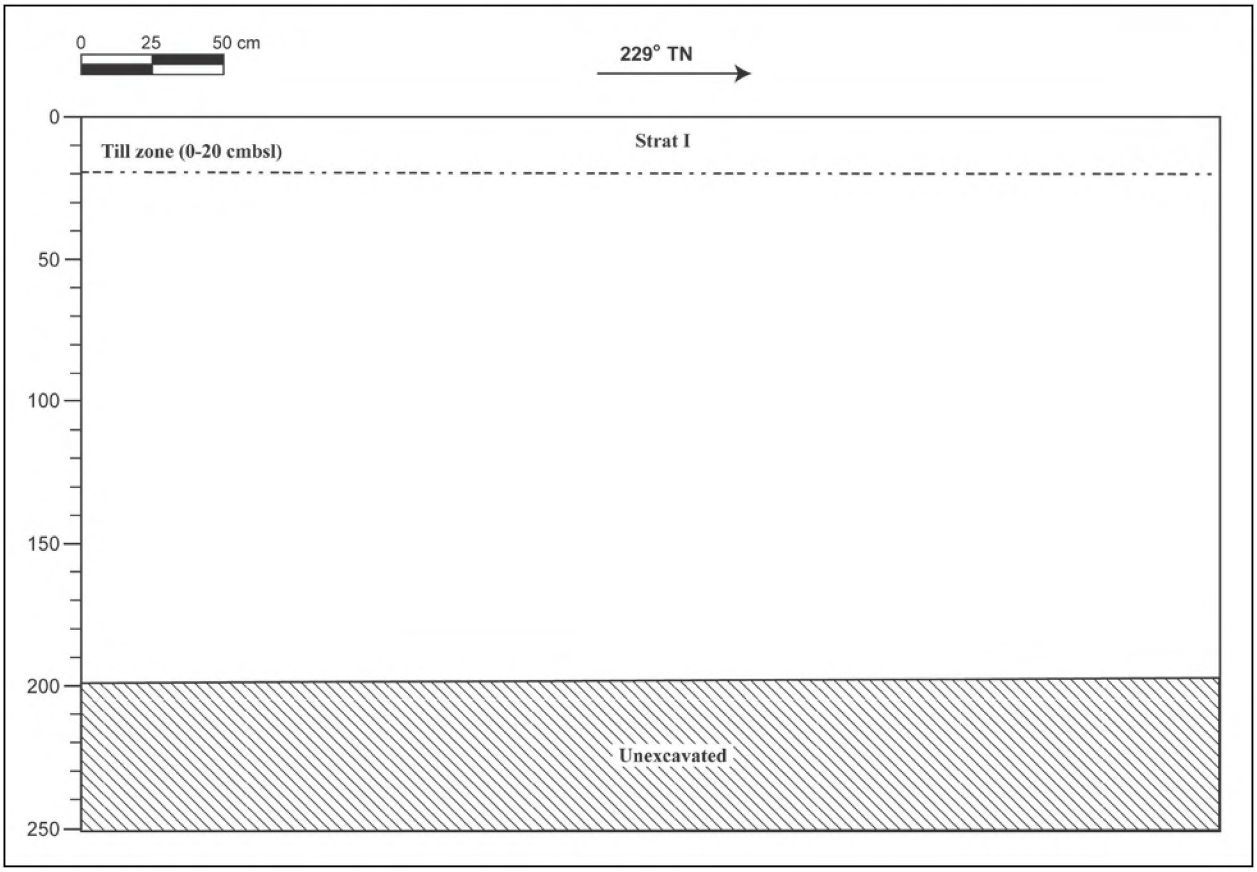

Figure 86. Profile of Ho`opili Station Test Trench 2

Figure 87. Photograph of Ho`opili Station Test Trench 2, view to northeast

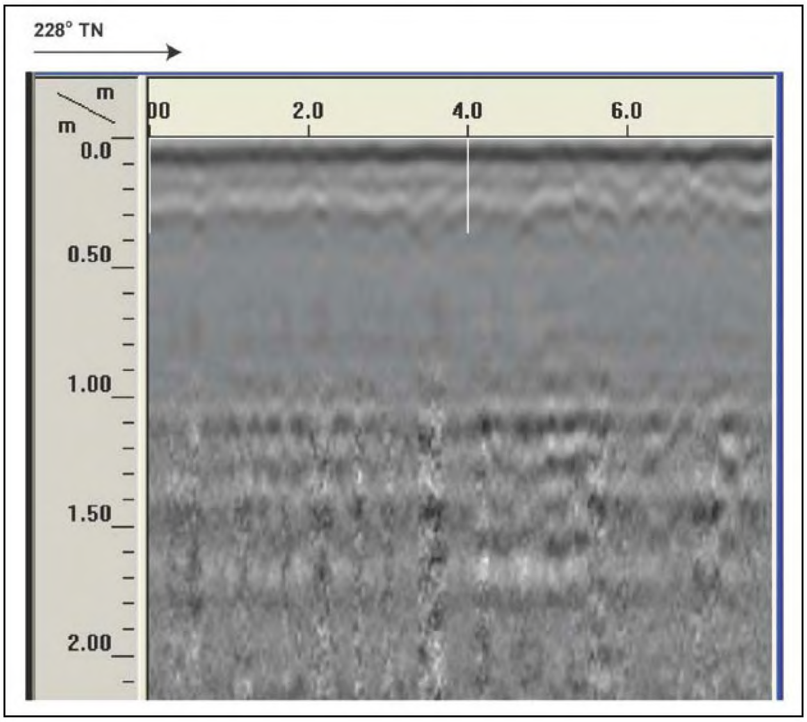

Figure 88. GPR profile of Ho`opili Station Test Trench 2

Column Test 15 (C-15)

Orientation	315° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.7 m

Stratum	Depth (cmbs)	Description
I	0-170	10 YR 4/2, dark grayish brown; clay; moderate, fine, crumb structure; slightly hard dry consistency; friable moist consistency; sticky wet consistency; slightly plastic; no cementation; Natural alluvial clay utilized for agriculture fields - top tilled slightly compacted from crop growing

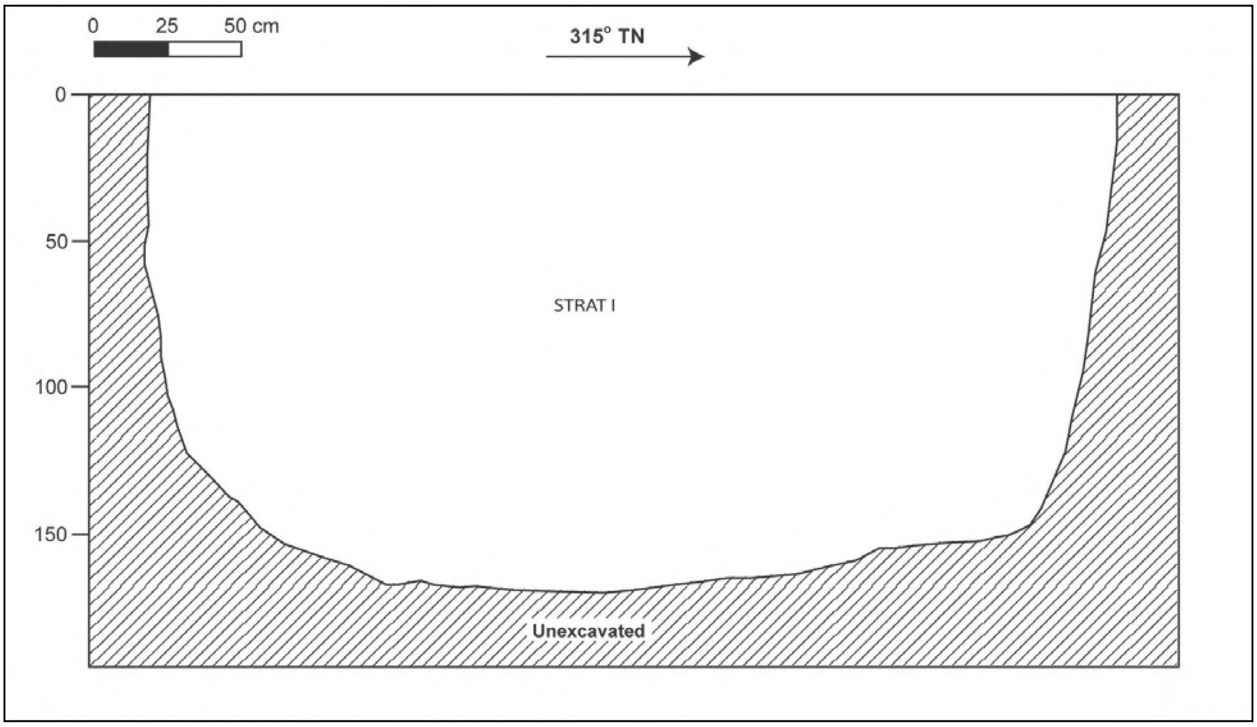

Figure 89. Profile of Column Test 15 (C-15)

Figure 90. Photograph of Column Test 15 (C-15), view to southwest

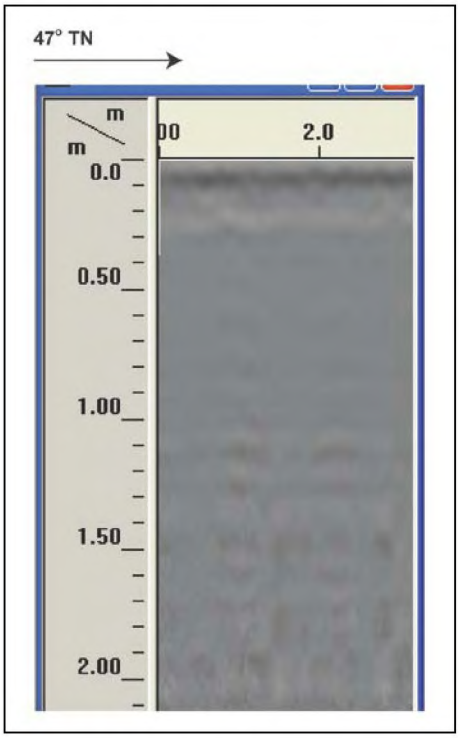

Figure 91. GPR profile of Column Test 15 (C-15)

Column Test 19 (C-19)

Orientation	80° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.2 m

Stratum	Depth (cmbs)	Description
Ia	0-50	Crushed coral fill
Ib	50-120	Fill; 10 YR 4/2, dark grayish brown; clay loam; moderate, medium, grandular structure; moist, firable consistency; sticky wet consistency; slightly plastic; no cementation; terrestrial origin. Fill over top of water main.

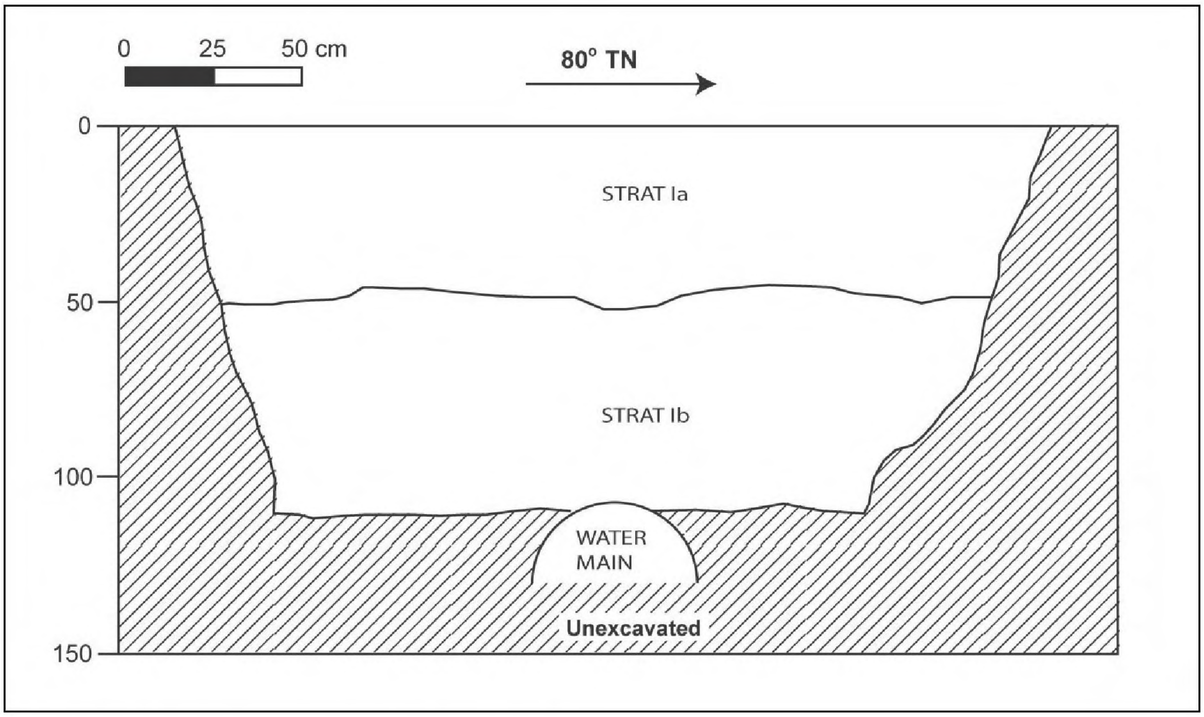

Figure 92. Profile of Column Test 19 (C-19)

Figure 93. Photograph of Column Test 19 (C-19), view to north

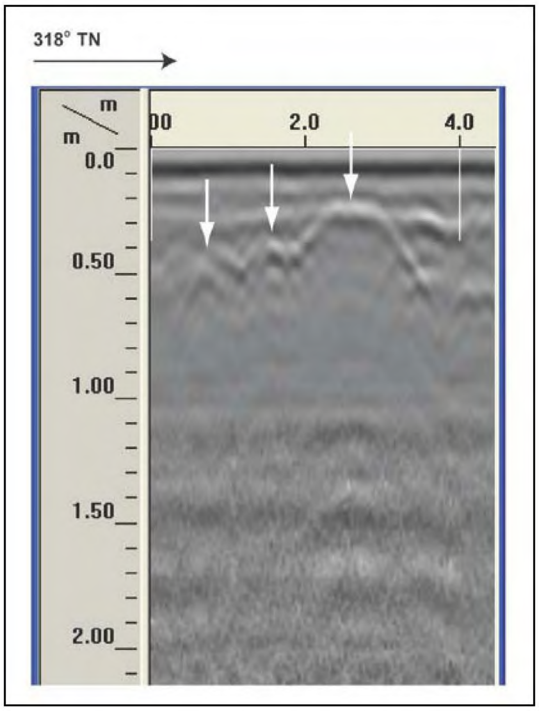

Figure 94. GPR profile of Column Test 19 (C-19) (note: Subsurface anomalies marked with white arrows)

4.6 Construction Sheet RW006

Construction Sheet RW006 consists of a 2,700 ft (0.8 km) segment of the proposed transit corridor (Figure 95). Two column test pits (C-17 & C-18) were excavated within Construction Sheet RW006.

4.6.1 Pedestrian Inspection

This section of the project area transitions from actively cultivated agricultural fields to the Farrington Highway Right of Way, defined by asphalt paved roadways with associated drainage ditches (Figure 96 & Figure 97). Both agricultural and road construction activities would have generated significant land disturbance to have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.6.2 GPR Survey

Prior to the excavation of column test pit 17 (C-17) and 18 (C-18), the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey appears to have identified the stratigraphic interface between the agricultural till zone (Stratum I) and the underlying culturally sterile alluvial sediments (Stratum II) within column test pits 17 (C-17) and 18 (C-18) (Figure 98 & Figure 101). The subtle horizontal banding shown from 0 to 30 cmbs in the GPR profiles seems to correspond to the agricultural till zone (Stratum I) observed during excavation (Figure 100 & Figure 103). It is believed that the variance in consistency and compaction between Stratum I and Stratum II allowed the GPR to delineate the stratigraphic interface between them.

4.6.3 Subsurface Testing

4.6.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW006 (see Figure 95). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the test units, please refer to the excavation profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 98 to Figure 103).

In general the observed and documented stratigraphy consisted of a single stratum of naturally deposited alluvial sediment utilized for agriculture. Of note was an area of disturbance ranging from 0 to 100 cmbs within the test excavations. This disturbance was determined to be associated with modern agriculture (i.e. tilling of the soil and irrigation line installation) as this portion of the project area is situated within actively cultivated fields. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al.* 1972). All excavations were

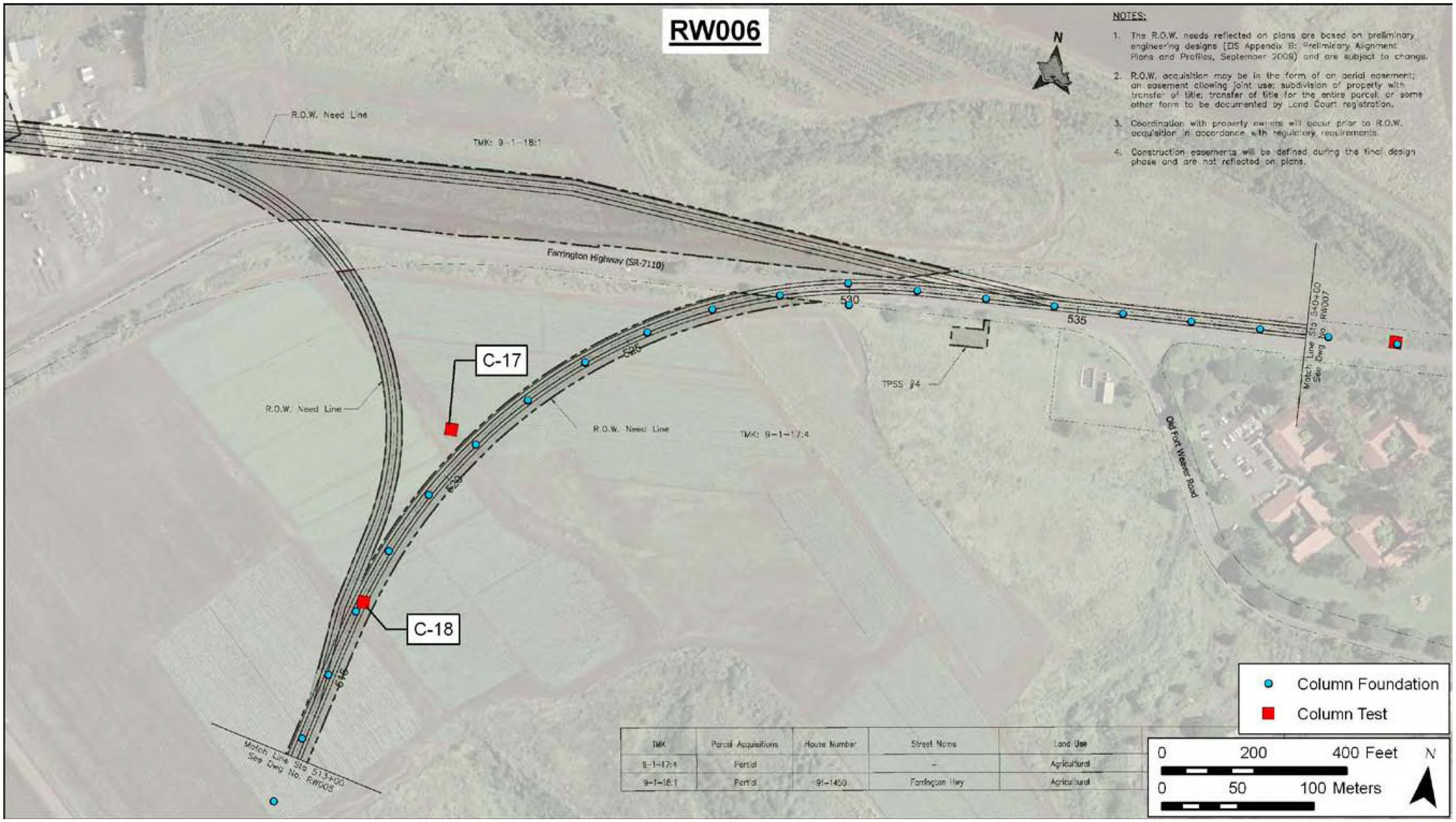

Figure 95. Construction Sheet RW006 showing location of test excavations

Figure 96. Photograph of Aloun Farms agricultural fields along proposed transit route prior to it adjoining Farrington Highway

Figure 97. Photograph of approximate location where proposed transit route will transition from agricultural fields to run alongside Farrington Highway

backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.6.3.2 Excavation Documentation

Column Test 17 (C-17)

Orientation	93° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
I	0-200	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 50 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

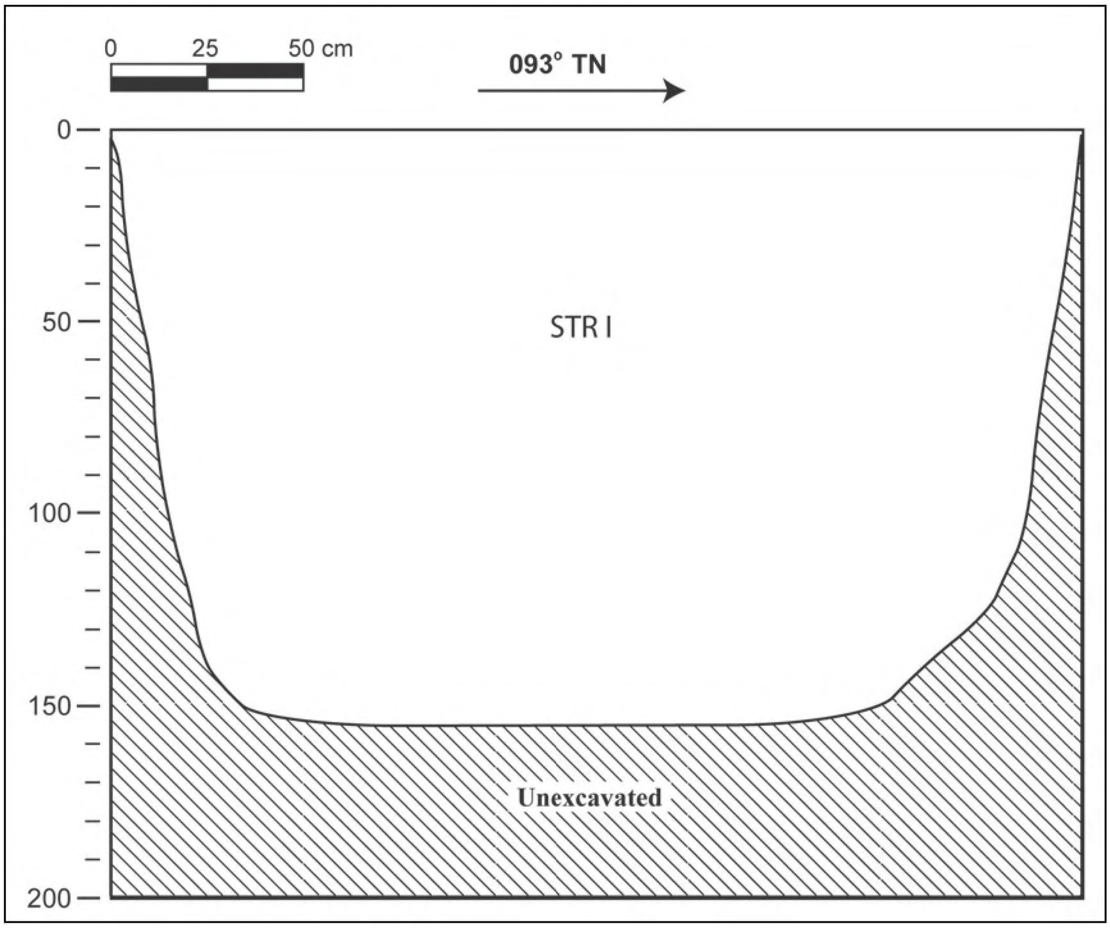

Figure 98. Profile of Column Test 17 (C-17)

Figure 99. Photograph of Column Test 17 (C-17), view to north

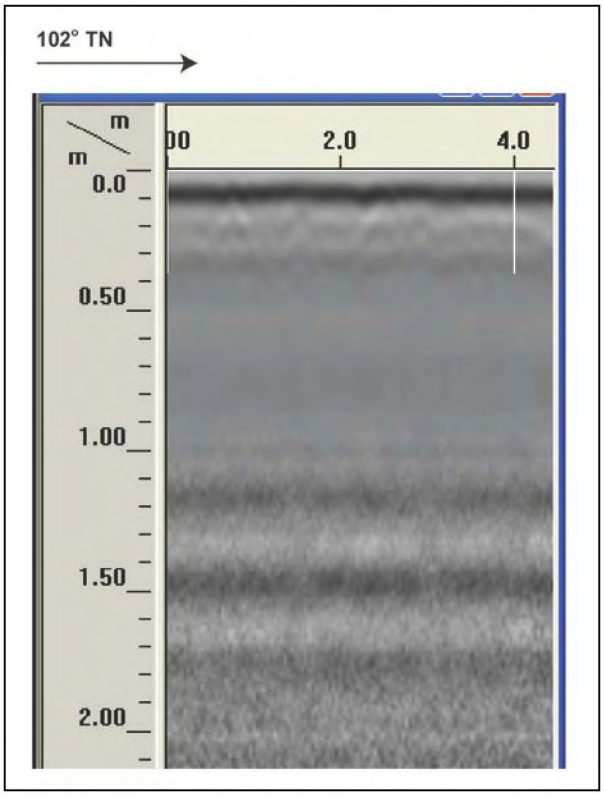

Figure 100. GPR profile of Column Test 17 (C-17)

Column Test 18 (C-18)

Orientation	130° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
I	0-150	7.5 YR 3/4, dark brown; silty clay loam; strong, coarse granular structure; hard dry consistency; slightly plastic; weak cementation; terrestrial origin. Naturally deposited alluvial sediment. Surface to 40 cm depth showed signs of previous disturbance via agriculture (i.e. tilling of soil).

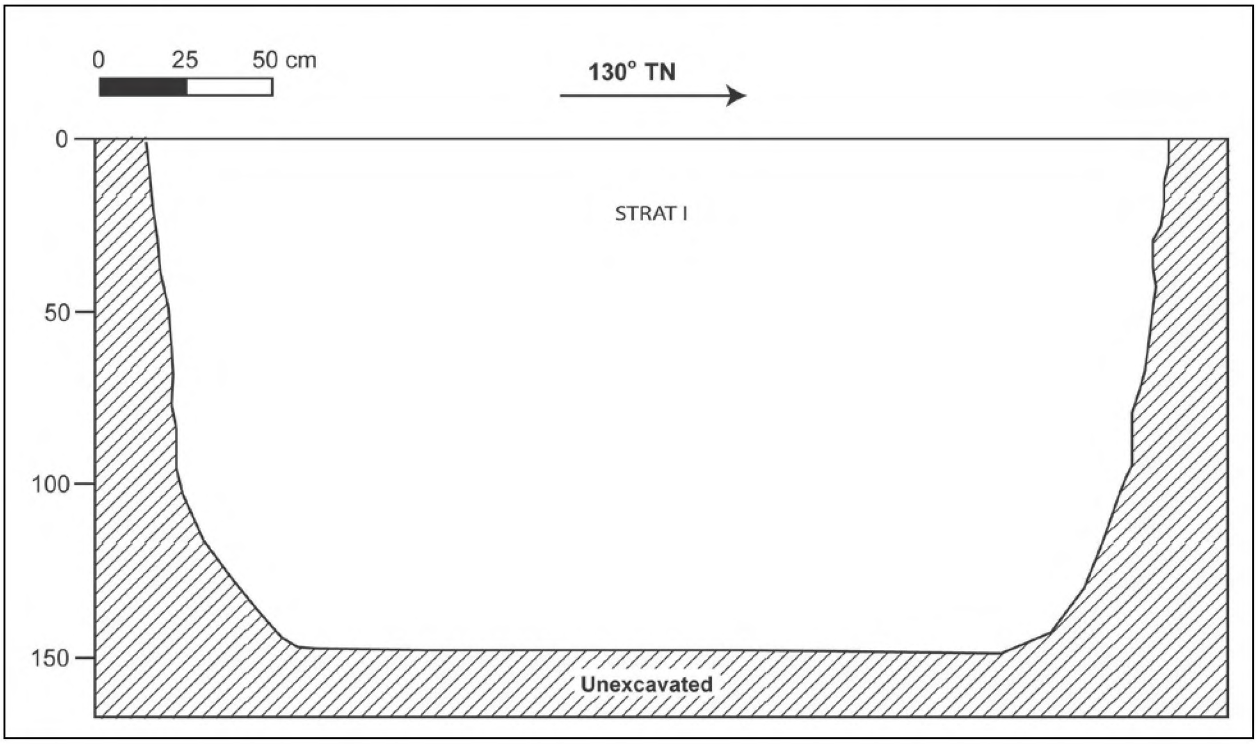

Figure 101. Profile of Column Test 18 (C-18)

Figure 102. Photograph of Column Test 18 (C-18), view to northeast

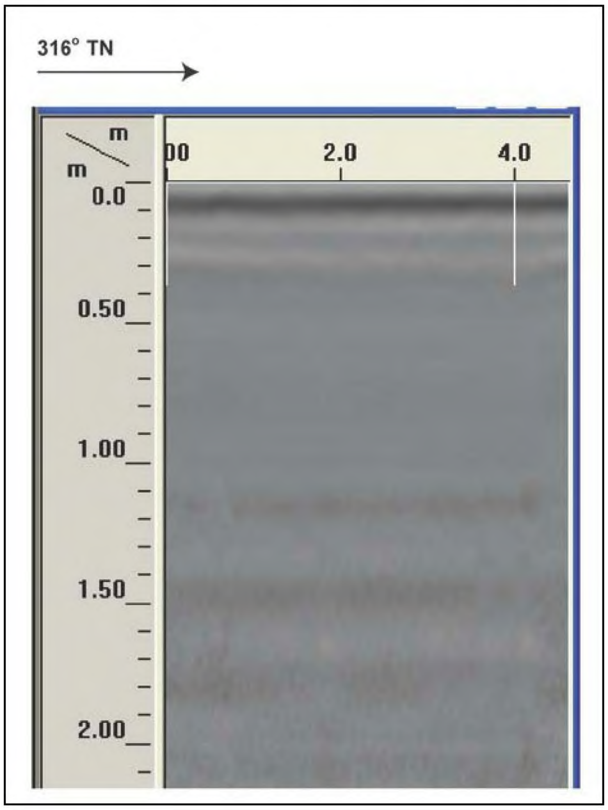

Figure 103. GPR profile of Column Test 18 (C-18)

4.7 Construction Sheet RW007

Construction Sheet RW007 consists of a 2,200 ft (0.7 km) segment of the proposed transit corridor situated within Farrington Highway (Figure 104). Five column test pits (C-5, C-6, C-6 alt, C-7 & C-8) were excavated within Construction Sheet RW007.

4.7.1 Pedestrian Inspection

This segment of the project area is situated entirely within the Farrington Highway Right of Way. The segment is relatively undeveloped with the exception of the Kāhi Mōhala Behavioral Health Center located on the *makai*/south side of the roadway (Figure 105). The proposed route along which the transit is to traverse has been subjected to extensive disturbance in association with road construction. Examination of the grading for Farrington Highway in comparison to the surrounding landscape shows that it is elevated up ~20 feet/6.1 meters from the rest of the surrounding area (Figure 106). This is likely due to the flooding that the area is prone to during heavy rains. No cultural resources were observed during the surface survey of the section of the project area.

4.7.2 GPR Survey

Prior to the excavation of column test pits, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey of column test pits C-5, C-6, and C-6 alt identified numerous subsurface anomalies that likely corresponded to coral and basalt cobbles and boulders that were observed dispersed throughout various stratums during test excavation (Figure 109, Figure 112, & Figure 114).

The GPR survey also identified the stratigraphic interface between the coral and basalt gravel fill layers and the underlying sediments documented in column test pits C-7 and C-8 (Figure 115 & Figure 118). The subtle horizontal banding shown from approximately 0 to 50 cmbs in the GPR profiles seems to correspond to the coral and basalt gravel fill layers observed during excavation (Figure 117 & Figure 120). It is believed that the variance in consistency and compaction between the coral and basalt gravel fill layers and the underlying sediments allowed the GPR to delineate the stratigraphic interface between them.

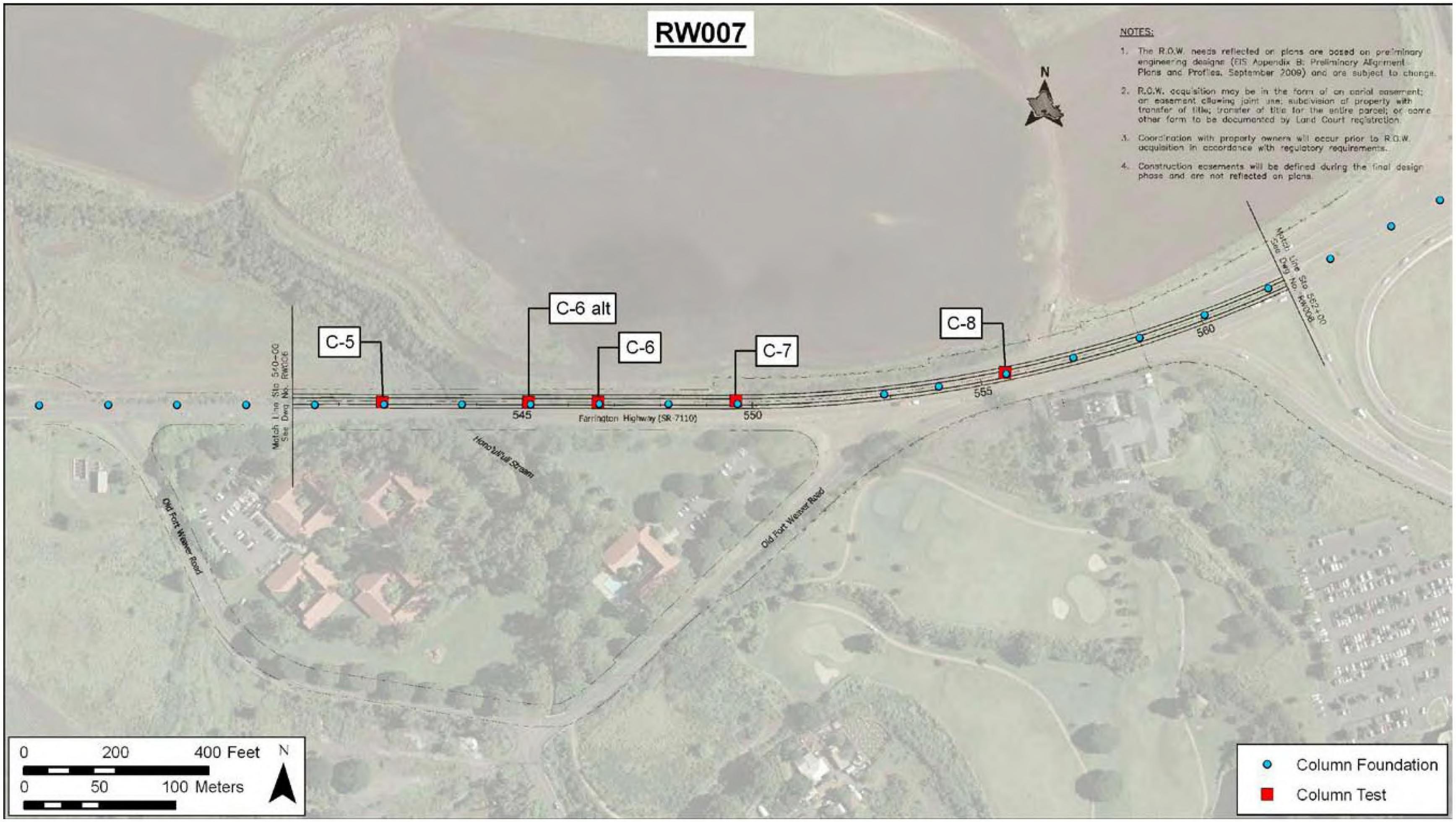

Figure 104. Construction Sheet RW007 showing the location of test excavations

Figure 105. Photo of transit route along Farrington Highway as it heads eastward towards Waipahu

Figure 106.Photograph of Farrington Highway prior to entering Waipahu area along the proposed route for the transit; note the difference in elevation of the road versus the areas along side it

4.7.3 Subsurface Testing

4.7.3.1 Stratigraphic Summary

Five (5) test excavations were placed within the area delineated by Construction Sheet RW007 (see Figure 104). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 39 to Figure 53).

In general the observed and documented stratigraphy consisted of a varying layers of fill associated with the construction of Farrington Highway and the installation of subsurface utilities. Fill layers consisted of basalt gravel, crushed coral, and previously disturbed alluvial sediments originating from the area. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al.* 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.7.3.2 Excavation Documentation

Column Test 5 (C-5)

Orientation	3° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.26 m

Stratum	Depth (cmbs)	Description
Ia	0-61	Fill Horizon; 10 YR 6/3, pale brown; silt; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; wind-blown and construction deposits along side of road
Ib	58-124	Fill Horizon; 10 YR 4/3, brown; silty clay loam; moderate, fine, crumb, blocky structure; hard dry consistency; no cementation; Natural sediment used to create berm for roadway; contains cobbles, boulders
Ic	100-106	Basalt gravel fill for existing 36" water main
II	123-126	Basalt bedrock

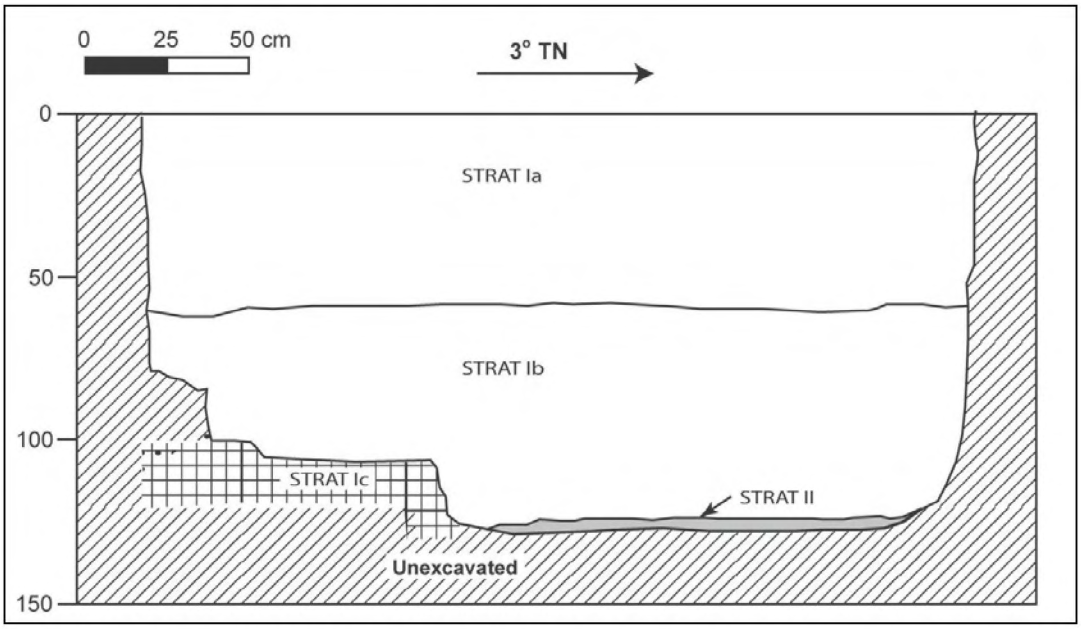

Figure 107. Profile of Column Test 5 (C-5)

Figure 108. Photograph of Column Test 5 (C-5), view to west

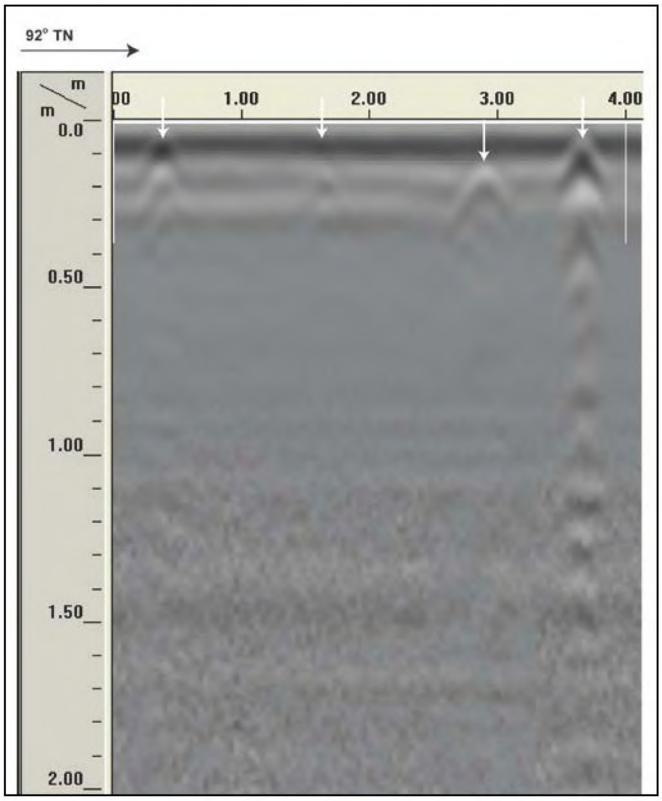

Figure 109. GPR profile of Column Test 5 (C-5)

Column Test 6 (C-6)

Orientation	356° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.18 m

Stratum	Depth (cmbs)	Description
Ia	0-118	Fill; 7.5 YR 4/2, brown; silty clay loam; weak, fine, crumb structure; dry loose consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Previously disturbed, naturally deposited sediment.
Ib	95-118	Basalt gravel fill for existing 36" water main

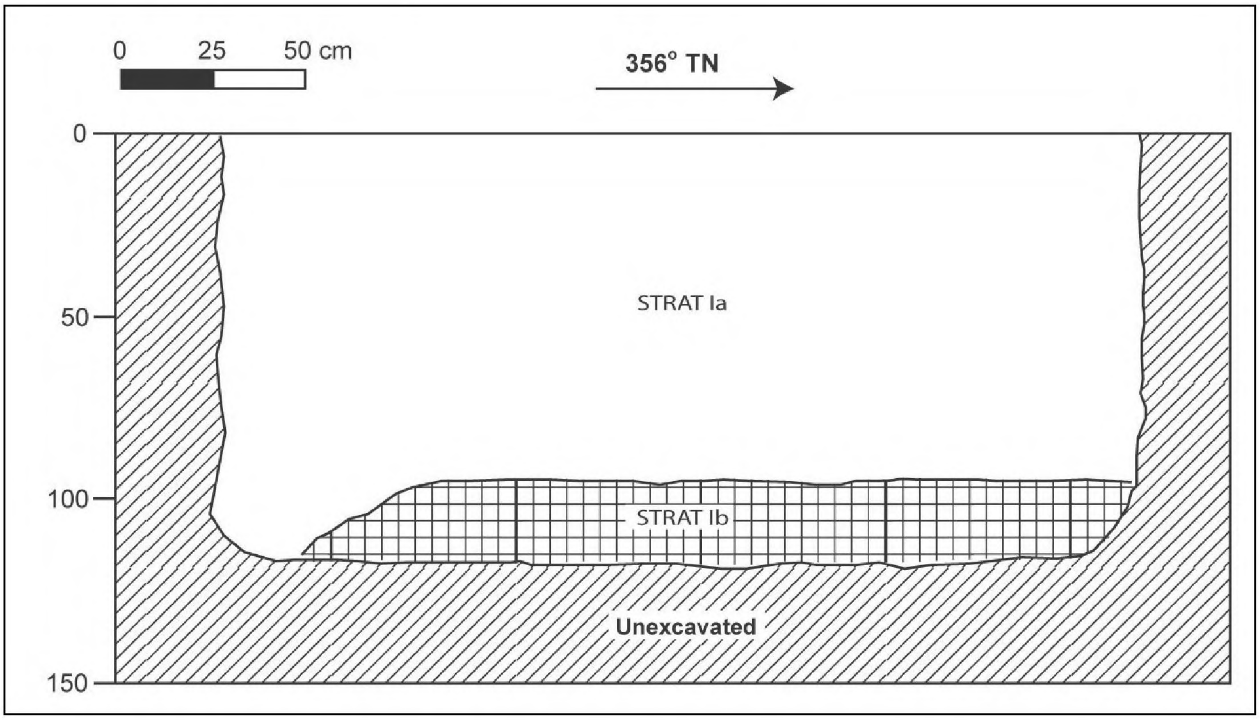

Figure 110. Profile of Column Test 6 (C-6)

Figure 111. Photograph of Column Test 6 (C-6), view to west

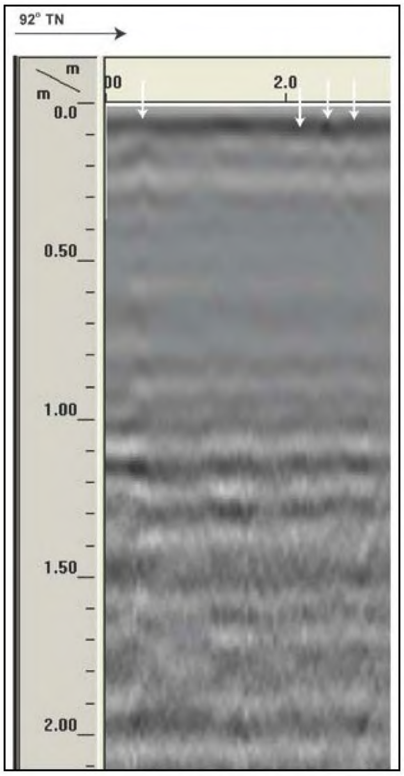

Figure 112. GPR profile of Column Test 6 (C-6)

Column Test 6 alternate (C-6 alt)

Orientation	92° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
Ia	0-118	Fill; 7.5 YR 4/2, brown; silty clay loam; weak, fine, crumb structure; dry loose consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Previously disturbed, naturally deposited sediment.
Ib	95-118	Basalt gravel fill for existing 36" water main

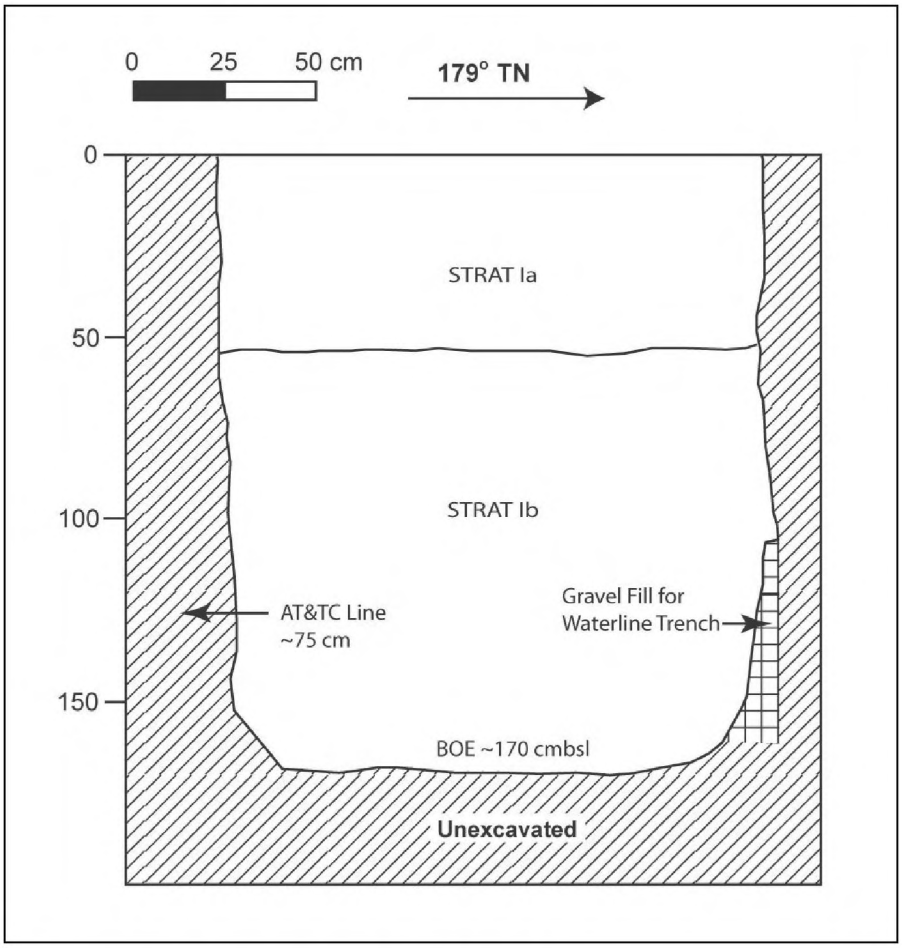

Figure 113. Profile of Column Test 6 alternate (C-6 alt)

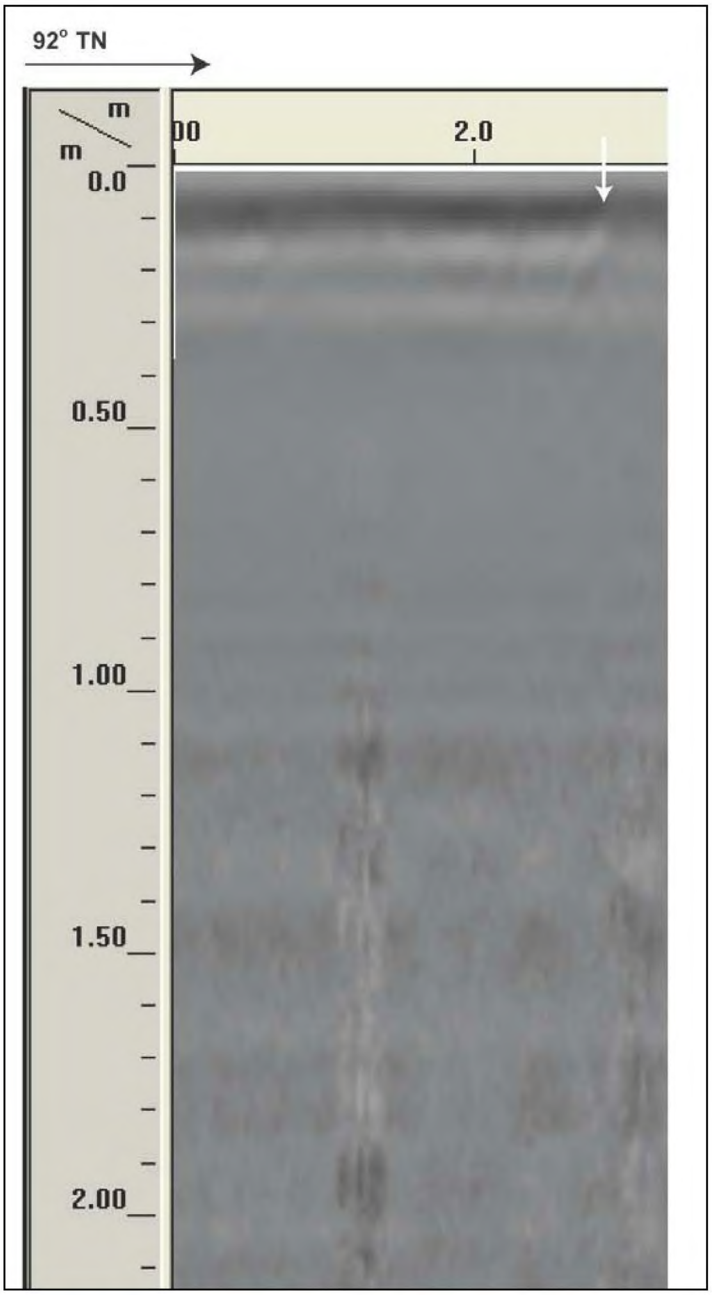

Figure 114. GPR profile of Column Test 6 alternate (C-6 alt)

Column Test 7 (C-7)

Orientation	359° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.2 m

Stratum	Depth (cmbs)	Description
Ia	40-120	Fill; 7.5 YR 4/2, brown; silty clay; weak, fine, crumb structure; loose dry consistency; loose moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; terrigenous fill material containing small cobbles, coral, pebbles
Ib	116-120	Basalt gravel fill for existing 36" water main

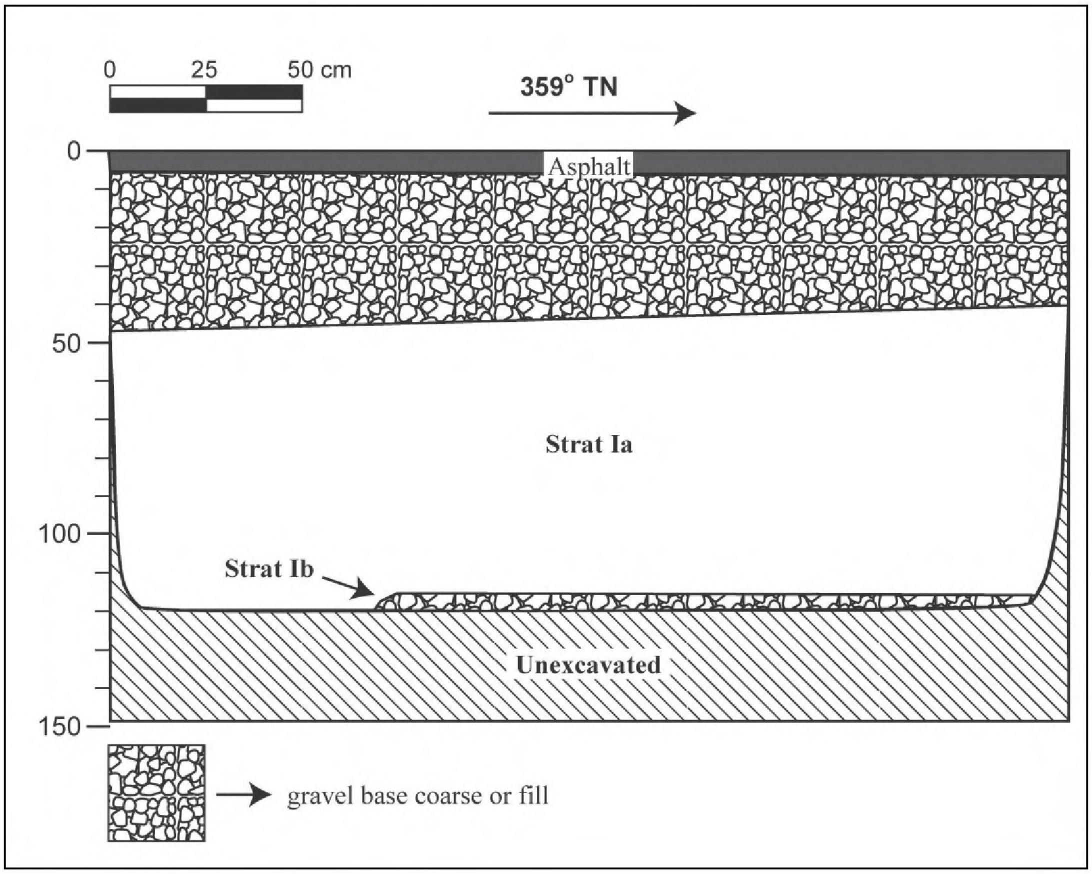

Figure 115. Profile of Column Test 7 (C-7)

Figure 116. Photograph of Column Test 7 (C-7), view to west

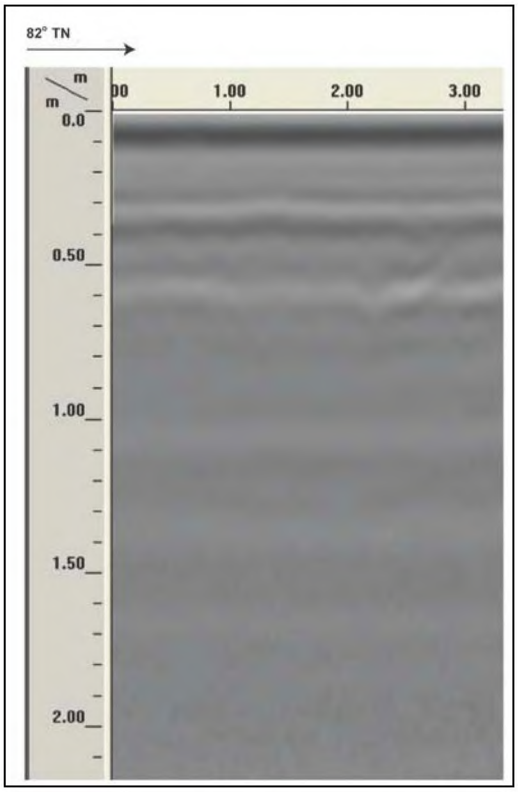

Figure 117. GPR profile of Column Test 7 (C-7)

Column Test 8 (C-8)

Orientation	259° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt road surface
Ib	10-20	Fill Horizon; 5 YR 5/3, reddish brown; silty clay; moderate, fine, crumb structure; weakly coherant dry consistency; slightly plastic; no cementation; abrupt smooth lower boundary;
Ic	20-40	Crushed coral fill
II	40-150	5 YR 4/4, reddish brown; garvelly, clay loam; moderate, fine, crumb structure; weakly coherant dry consistency; slightly plastic; no cementation; terrestrial origin.

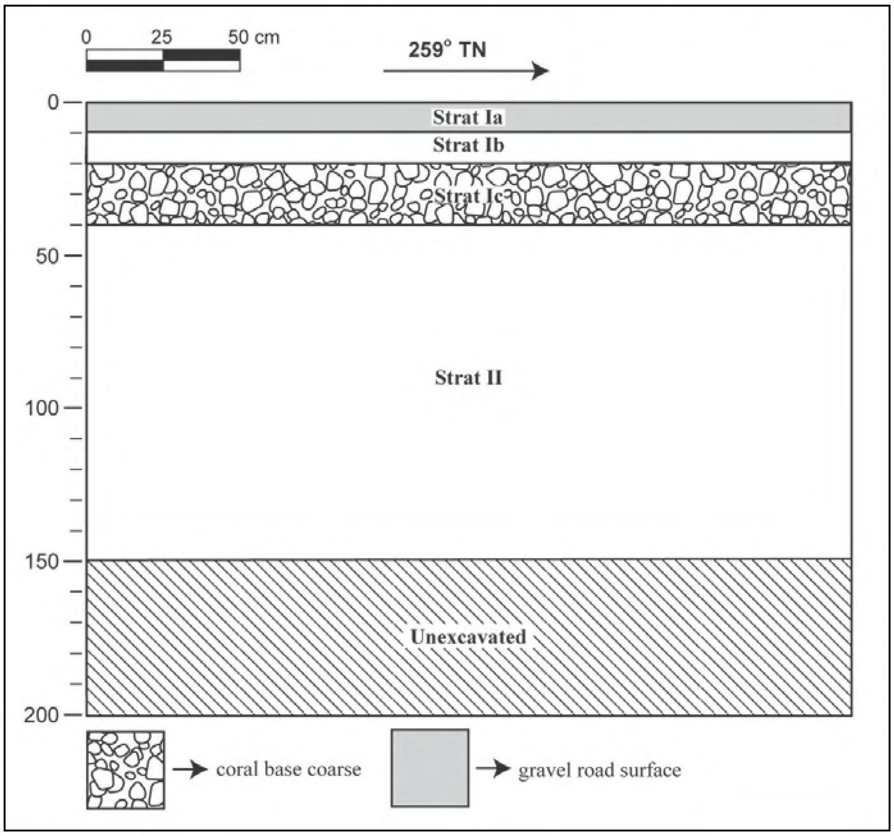

Figure 118. Profile of Column Test 8 (C-8)

Figure 119. Photograph of Column Test 8 (C-8), view to south

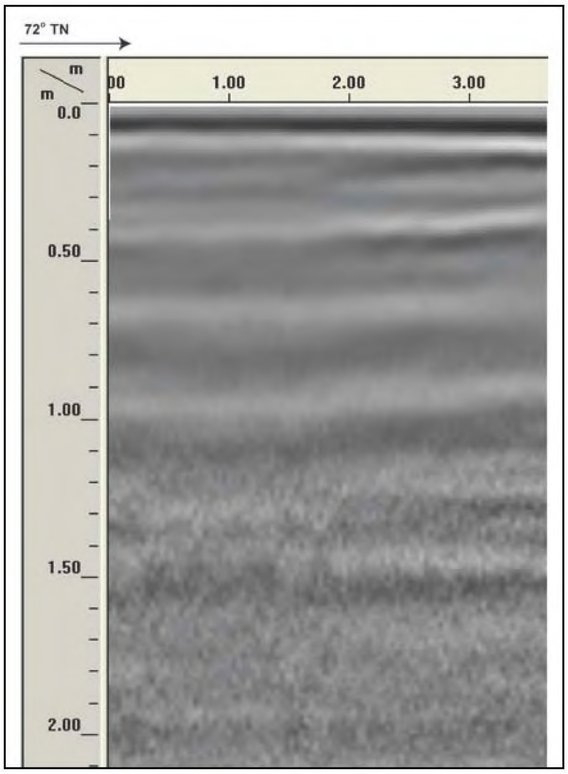

Figure 120. GPR profile of Column Test 8 (C-8)

4.8 Construction Sheet RW008

Construction Sheet RW008 consists of a 2,700 ft (0.8 km) segment of the proposed transit corridor and includes the proposed West Loch Station (Figure 121 & Figure 122). Twelve test trenches were excavated at the station, as well as two column test pits (C-9 and C-10) located to the northwest, totaling 14 test excavations within Construction Sheet RW008.

4.8.1 Pedestrian Inspection

Along this section of the project area the proposed transit route follows Farrington Highway into the highly urbanized town of Waipahu. The formerly single lane highway expands to a multi-lane (four) highway as it enters the town of Waipahu (Figure 123). Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.8.2 GPR Survey

Prior to the excavation of test excavations, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey was able to define the stratigraphic interfaces within the top 25 to 50 cm of all test areas. The subtle horizontal banding shown from approximately 0 to 50 cmbs in the GPR profiles seems to correspond to asphalt or concrete surfaces and their underlying gravel cushions (see Figure 124 thru Figure 165). It is believed that the variance in consistency and compaction between the asphalt, concrete, and basalt gravel fill layers and the underlying sediments allowed the GPR to delineate the stratigraphic interface between them.

Of particular interest was the GPRs inability to locate subsurface utilities that were observed during test excavation at column test 9 (C-9). Numerous metal and PVC pipes were observed during excavation, but no indication of them was present during the GPR survey (Figure 161 & Figure 162). It is believed that soil chemistry is the primary factor to this discrepancy. Column test 9 (C-9) is in the vicinity of agricultural fields that are likely fertilized with potassium and/or nitrogen, which would increase the conductivity of the soils causing limited depth "visibility" and accuracy of the GPR. Also the red color of the soils in this area is likely a sign of high iron content, which would further increase the conductivity of the soil.

In general, the results of the GPR survey were inconclusive. While the GPR was able to delineate stratigraphic interfaces within the top 25 to 50 cm of all test areas, subsurface utilities and other subsurface objects (i.e. buried stream bed deposits, gravel layers, etc.) observed during test excavation were not located. Additionally, the maximum "visibility" within the study area ranged from 75 to 100 cm below the surface. It is believed that the environmental conditions (i.e. soil chemistry) present within Construction Sheet RW008 caused the sediments to be too conductive causing the radar waves to disperse, resulting in limited depth "visibility" and inaccurate data output. Thus it appears that the area defined by Construction Sheet RW008 is not

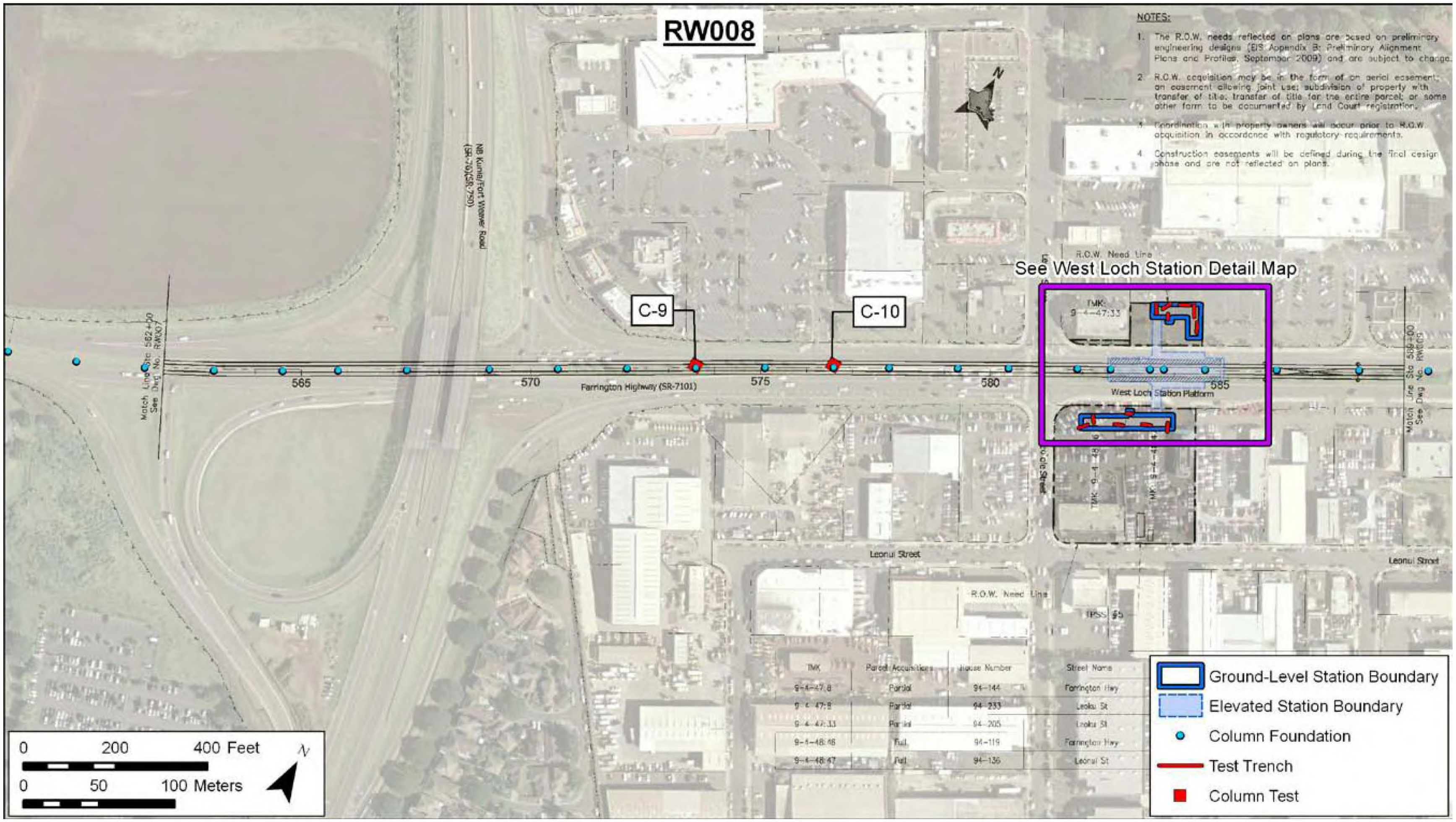

Figure 121. Construction Sheet RW008 showing the location of test excavations

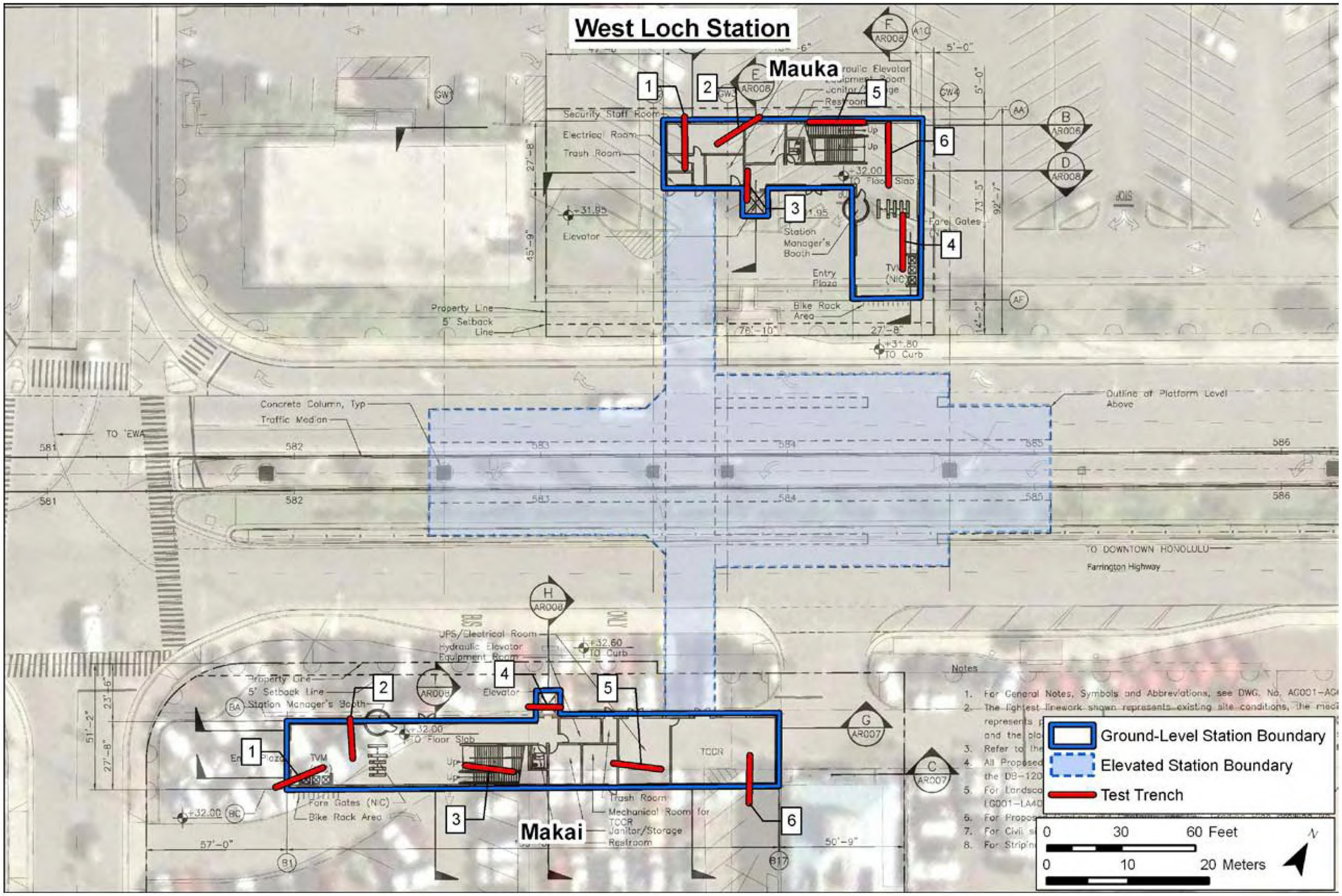

Figure 122. West Loch Station floor plan showing the location of test trenches

Figure 123. Photo of project route along Farrington Highway as it extends into Waipahu

viable for an accurate GPR survey. This conclusion is consistent the NRCS, which also indicated that GPR suitability in this area is moderate to low (see Figure 9).

4.8.3 Subsurface Testing

4.8.3.1 Stratigraphic Summary

Fourteen (14) test excavations were placed within the area delineated by Construction Sheet RW008 (see Figure 121 & Figure 122). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavations, please refer to the excavation profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 124 to Figure 164).

In general the observed and documented stratigraphy consisted of an asphalt paved surface with an associated gravel base course, a thin layer of imported silt loam, followed by varying layers of naturally deposited alluvial silt. Of note were the presence of layers and pockets of water rounded basalt cobbles within some of the test trenches (see West Loch Station Mauka Test Trench 4 and West Loch Station Makai Test Trench 1, 2, 4-6). This suggests that the immediate area once had running water prior to urban development. Based on the results of test excavations it is believed that prior to urban and historic development this area consisted of at least one meandering or braided stream course.

These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.8.3.2 Excavation Documentation

West Loch Station Mauka Test Trench 1

Orientation	150° TN
Length	7m
Width	0.7m
Maximum Depth	2.1m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	30-65	A Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; abrupt smooth lower boundary; natural sediments
III	65-105	5 YR 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; abrupt smooth lower boundary; natural sediments
IV	105-210	7.5 YR 2.5/2, very dark brown; silt; structureless, extremely hard dry consistency; non-plastic; strong cementation; natural sediments

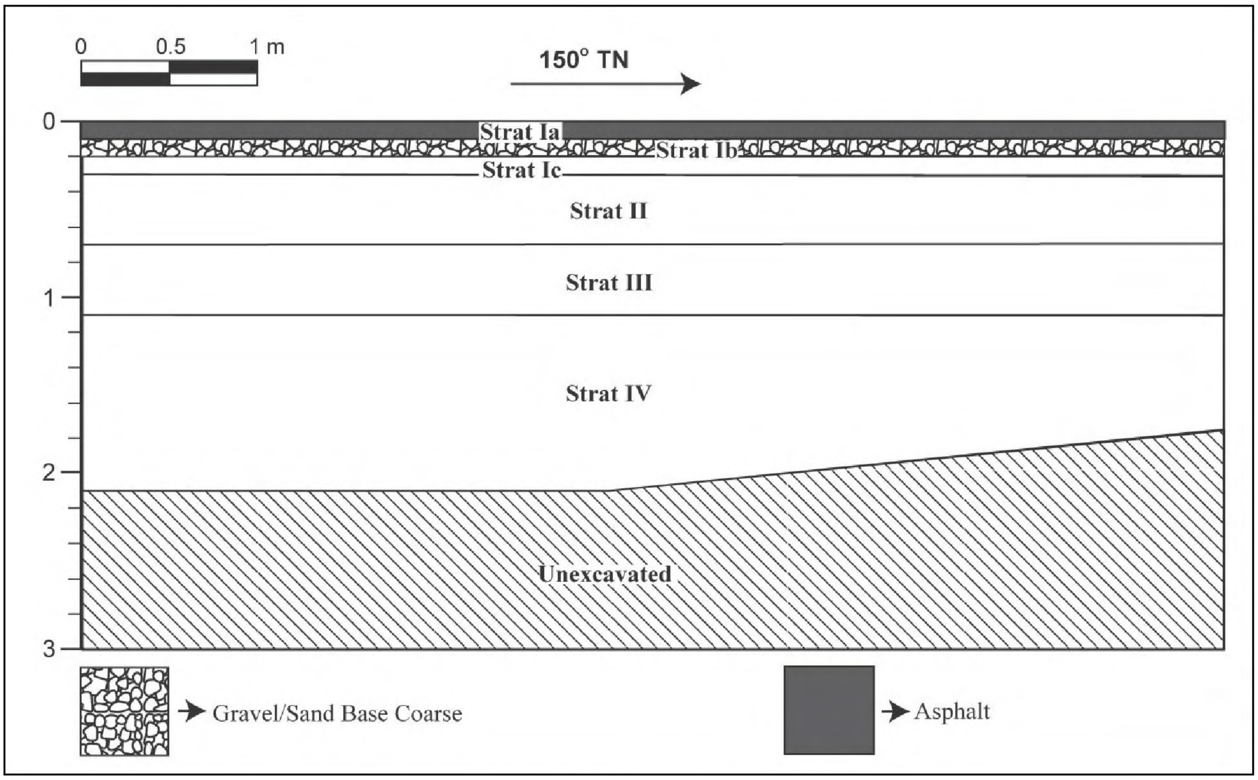

Figure 124. Profile of West Loch Station Mauka Test Trench 1

Figure 125. Photograph of West Loch Station Mauka Test Trench 1, view to north

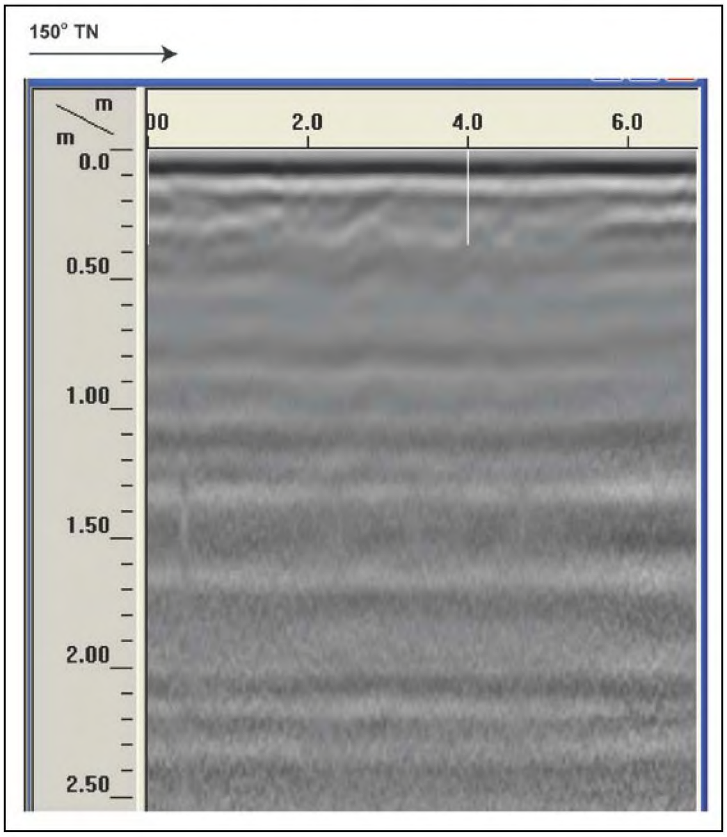

Figure 126. GPR profile of West Loch Station Mauka Test Trench 1

West Loch Station Mauka Test Trench 2

Orientation	338° TN
Length	4 m
Width	0.7 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	25-50	A Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; abrupt irregular lower boundary; natural sediments
III	50-70	5 YR 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; abrupt wavy lower boundary; natural sediment
IV	70-200	7.5 YR 2.5/2, very dark brown; silt; structureless, extremely hard dry consistency; non-plastic; strong cementation; natural sediments

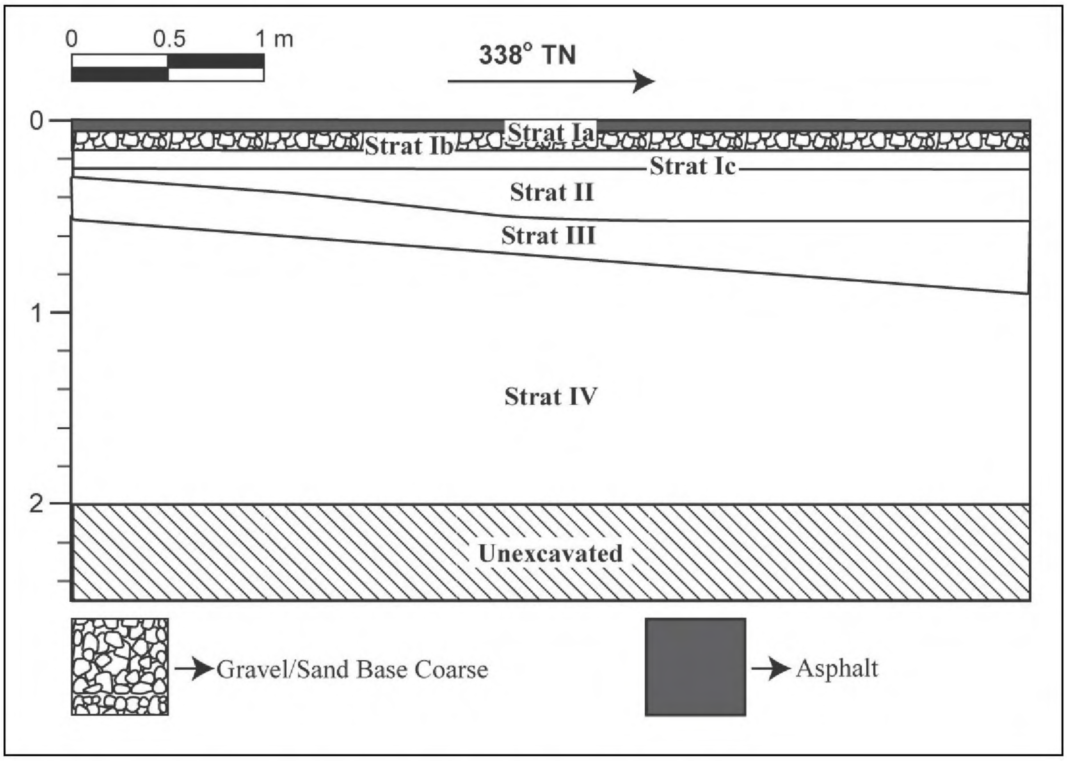

Figure 127. Profile of West Loch Station Mauka Test Trench 2

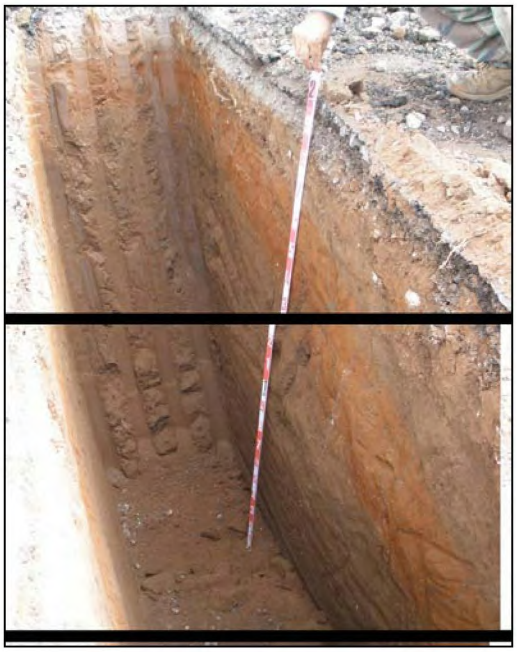

Figure 128. Photograph of West Loch Station Mauka Test Trench 2, view to south

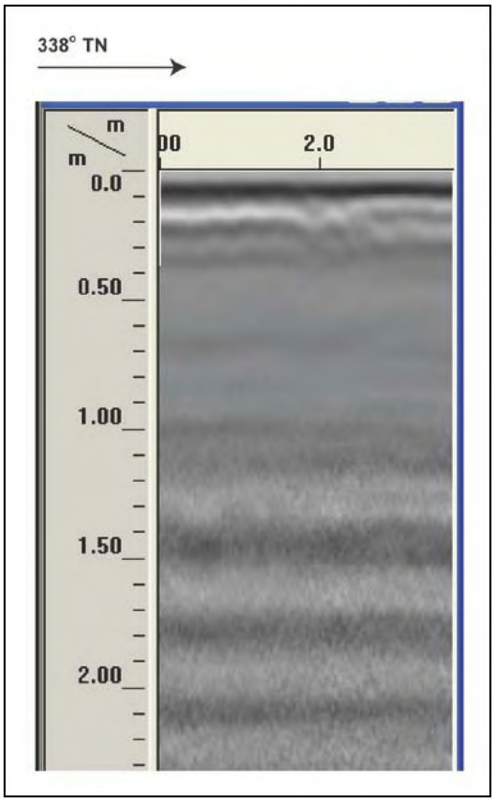

Figure 129. GPR profile of West Loch Station Mauka Test Trench 2

West Loch Station Mauka Test Trench 3

Orientation	26° TN
Length	6.5 m
Width	0.7 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	40-140	A Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
III	140-190	5 YR 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
IV	190-210	7.5 Yr 2.5/2, very dark brown; silt; structureless, extremely hard dry consistency; non-plastic; strong cementation; natural sediments

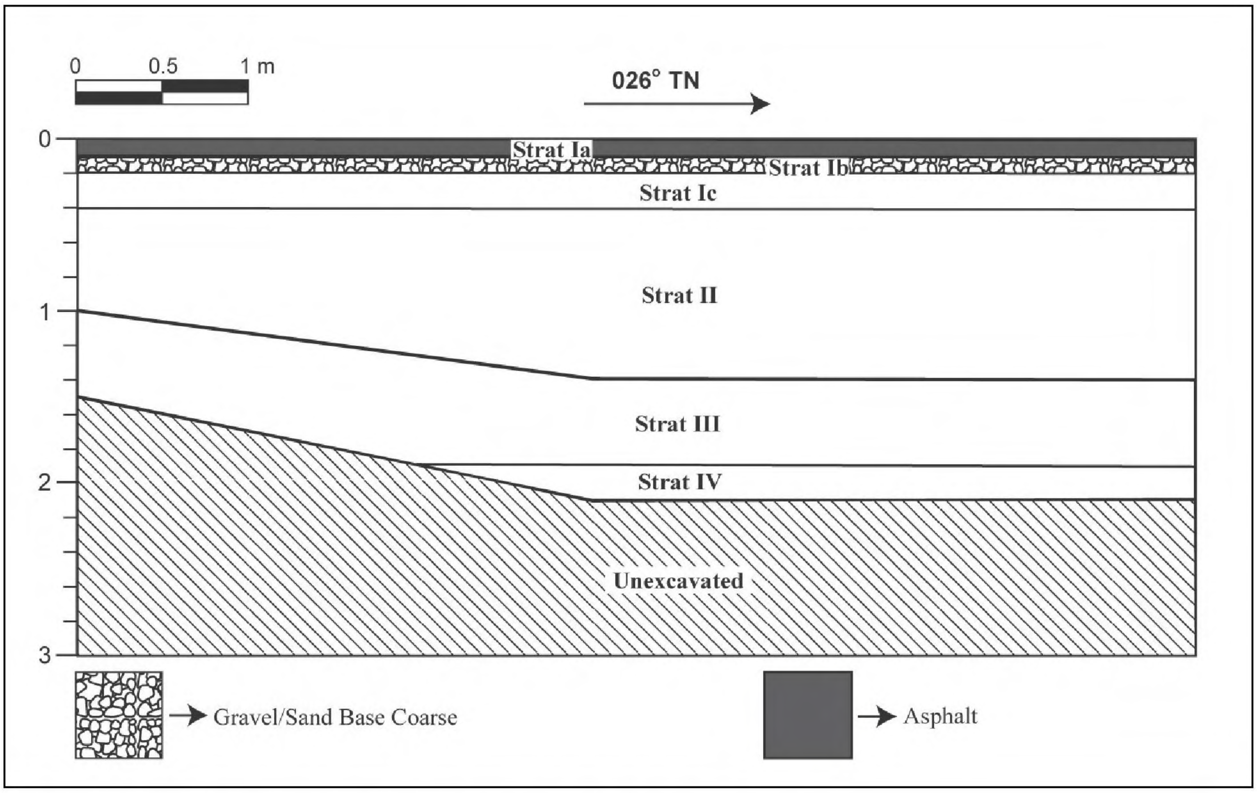

Figure 130. Profile of West Loch Station Mauka Test Trench 3

Figure 131. Photograph of West Loch Station Mauka Test Trench 3, view to southwest

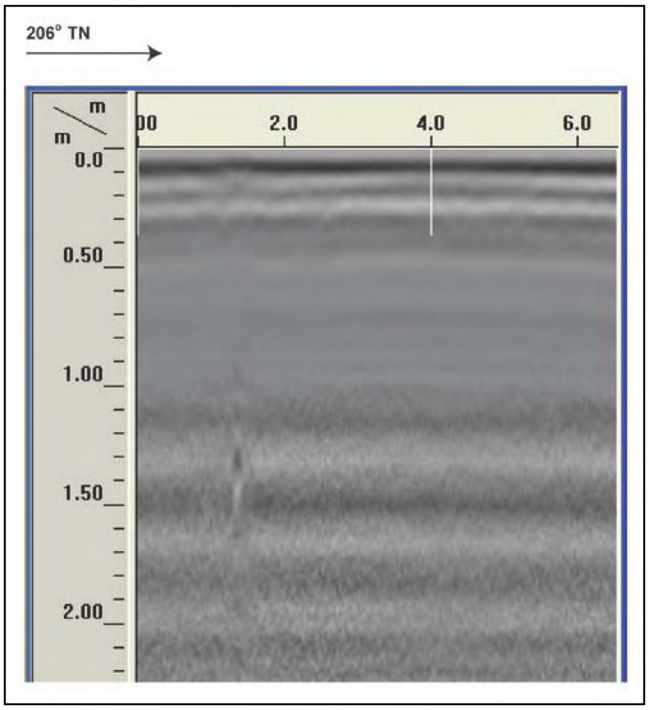

Figure 132.GPR profile of West Loch Station Mauka Test Trench 3

West Loch Station Mauka Test Trench 4

Orientation	150° TN
Length	7 m
Width	0.7 m
Maximum Depth	2.2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
Id	30-70	10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; graded natural sediments
II	70-80	water worn basalt layer; structureless, slightly hard dry consistency; non-plastic; weak cementation; abrupt wavy lower boundary; natural sediments, stream bed or flooding episode
III	80-115	A Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
IV	115-125	5 Yr 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
V	125-220	7.5 YR 2.5/2, very dark brown; silt; structureless, extremely hard dry consistency; non-plastic; strong cementation; natural sediments

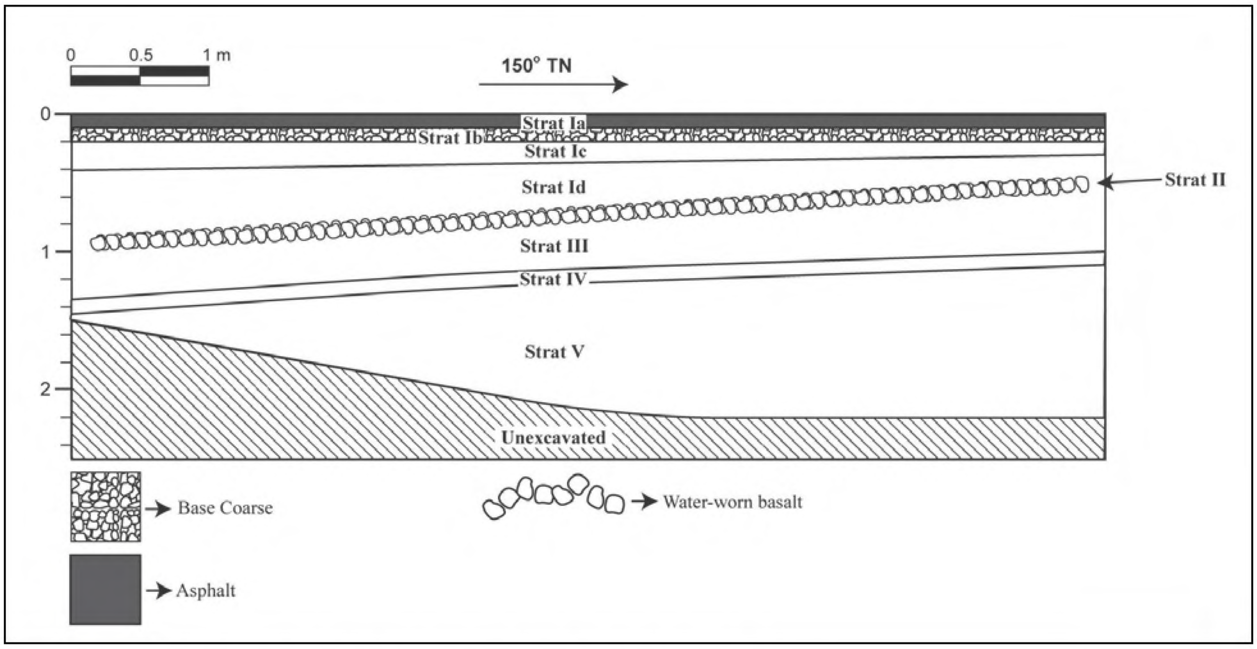

Figure 133. Profile of West Loch Station Mauka Test Trench 4

Figure 134. Photograph of West Loch Station Mauka Test Trench 4, view to east

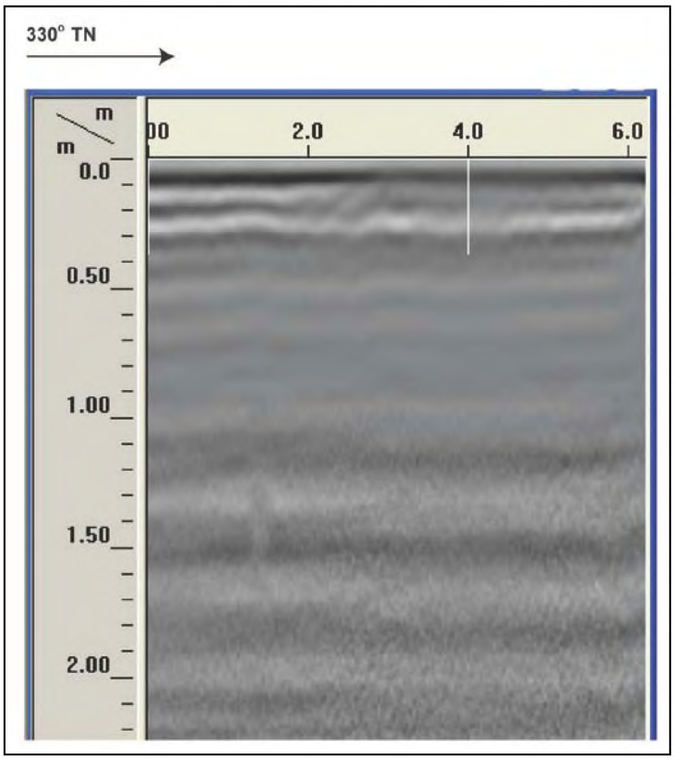

Figure 135. GPR profile of West Loch Station Mauka Test Trench 4

West Loch Station Mauka Test Trench 5

Orientation	065° TN
Length	6 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	20-75	5 YR 4/6, yellowish red; silt loam; moderate, medium, granular structure; very hard dry consistency; non-plastic; strong cementation; abrupt smooth lower boundary; natural sediment
III	39-68	10 YR 3/3, dark brown; silt; strong, granular structure; extremely hard dry consistency; non-plastic; indurated; abrupt smooth lower boundary; natural sediment
IV	68-200	5 YR 3/4, dark reddish brown; silt; moderate, medium, granular structure; extremely hard dry consistency; non-plastic; indurated; natural sediment

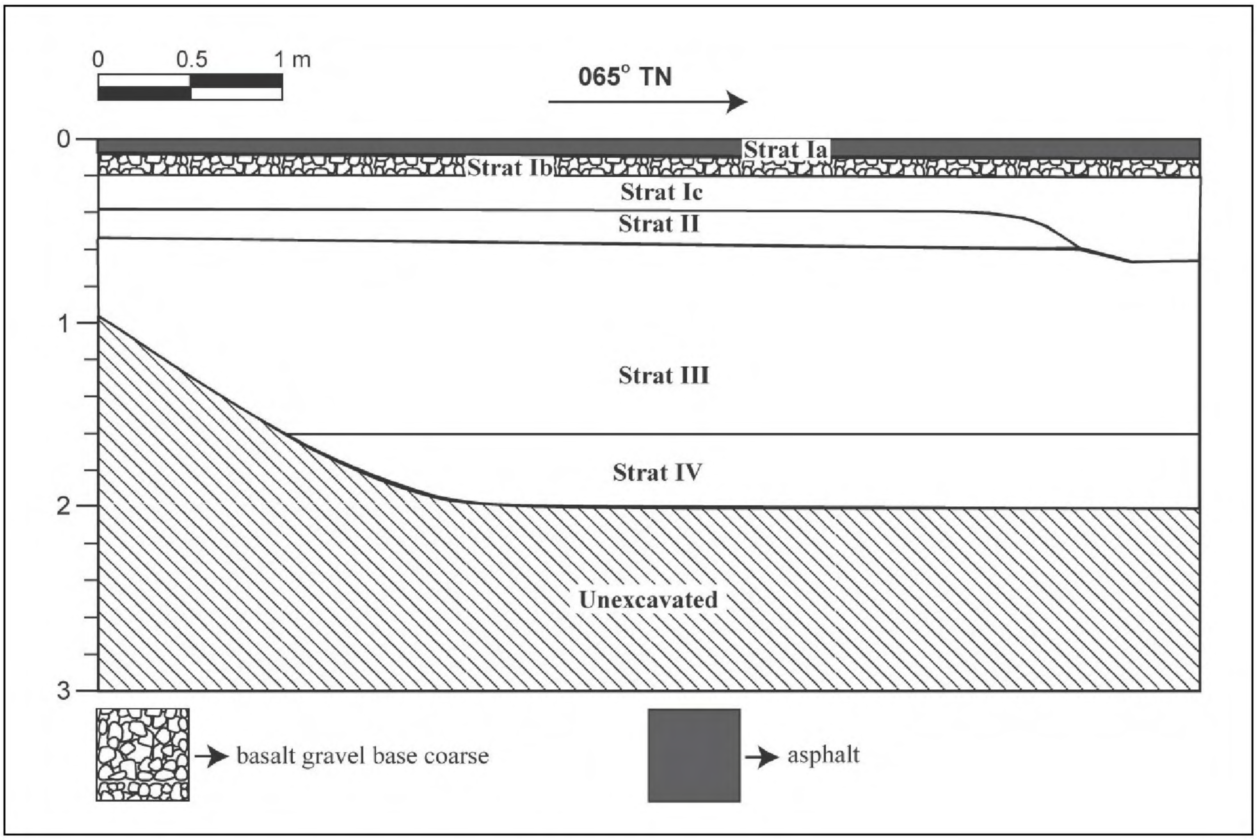

Figure 136. Profile of West Loch Station Mauka Test Trench 5

Figure 137. Photograph of West Loch Station Mauka Test Trench 5, view to northwest

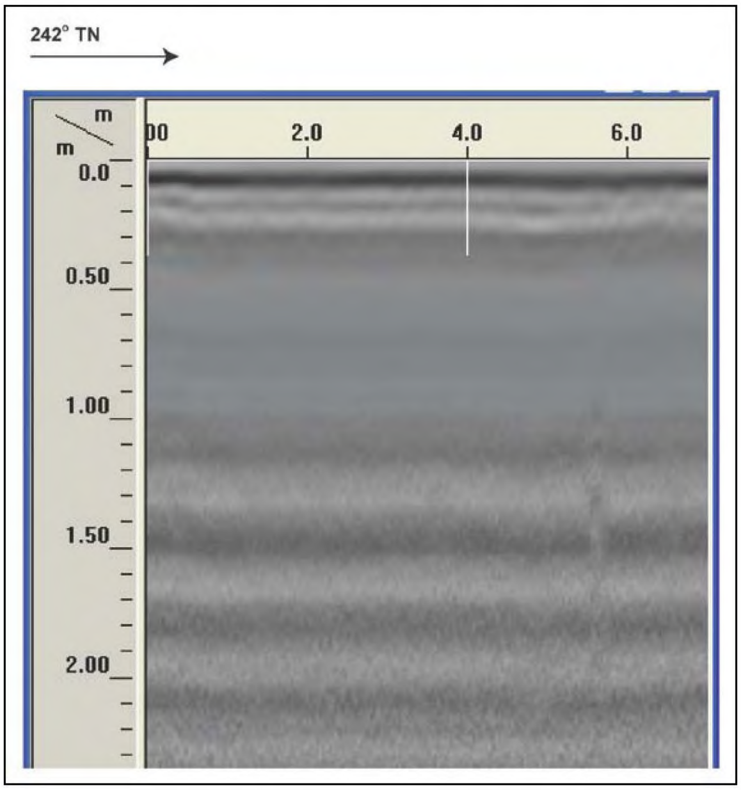

Figure 138. GPR profile of West Loch Station Mauka Test Trench 5

West Loch Station Mauka Test Trench 6

Orientation	150° TN
Length	5 m
Width	0.8 m
Maximum Depth	2.2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Fill; 10 YR 4/1 dark gray; silt loam; weak fine crumb structure; dry loose consistency; non plastic; weak cementation; terrestrial origin; abrupt boundary; smooth topography. 20% cobbles. Imported construction fill.
II	60-160	10 YR 3/4, dark yellowish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; clear wavy lower boundary; natural sediments
III	160-220	5 YR 3/4, dark reddish brown; silt; structureless, very hard dry consistency; non-plastic; strong cementation; natural sediments

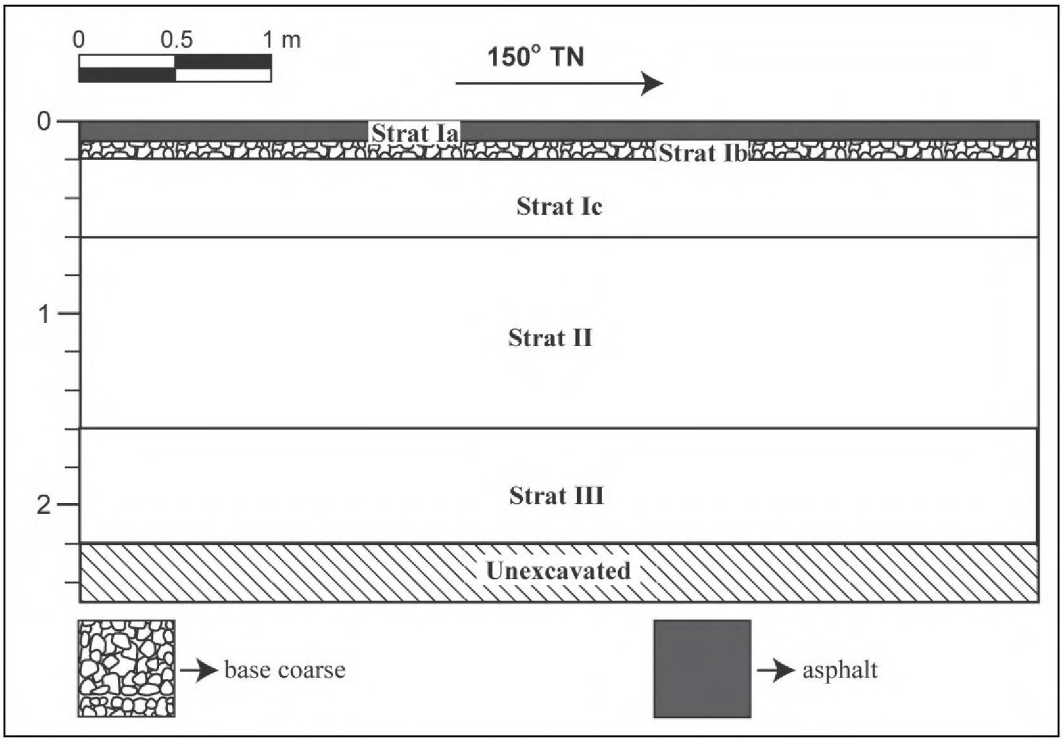

Figure 139. Profile of West Loch Station Mauka Test Trench 6

Figure 140. Photograph of West Loch Station Mauka Test Trench 6, view to north

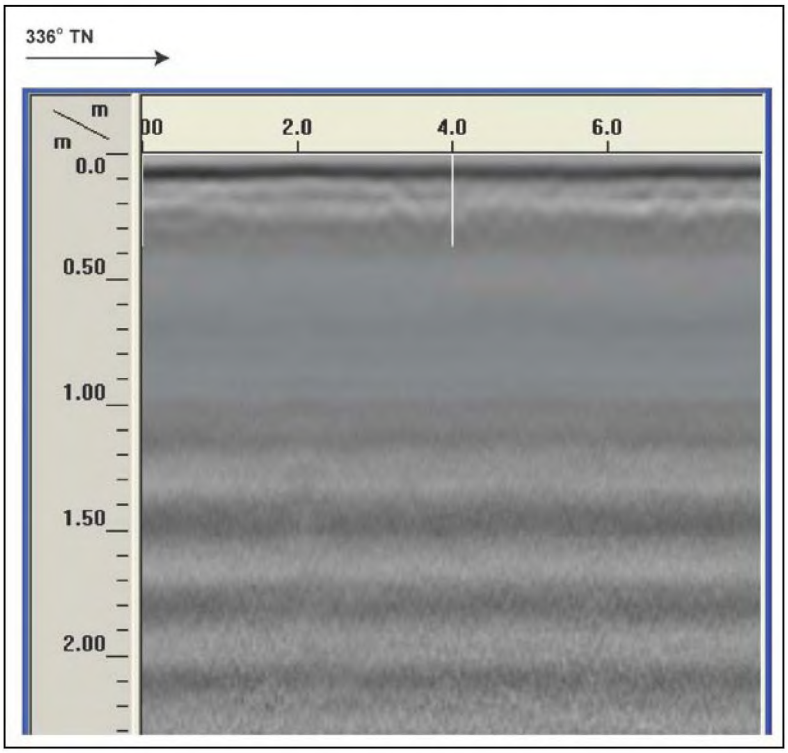

Figure 141. GPR profile of West Loch Station Mauka Test Trench 6

West Loch Station Makai Test Trench 1

Orientation	030° TN
Length	5.5 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-82	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	82-213	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin. Near base of excavation medium to large water-worn basalt cobbles were observed, suggestive of the presance of a stream bed.

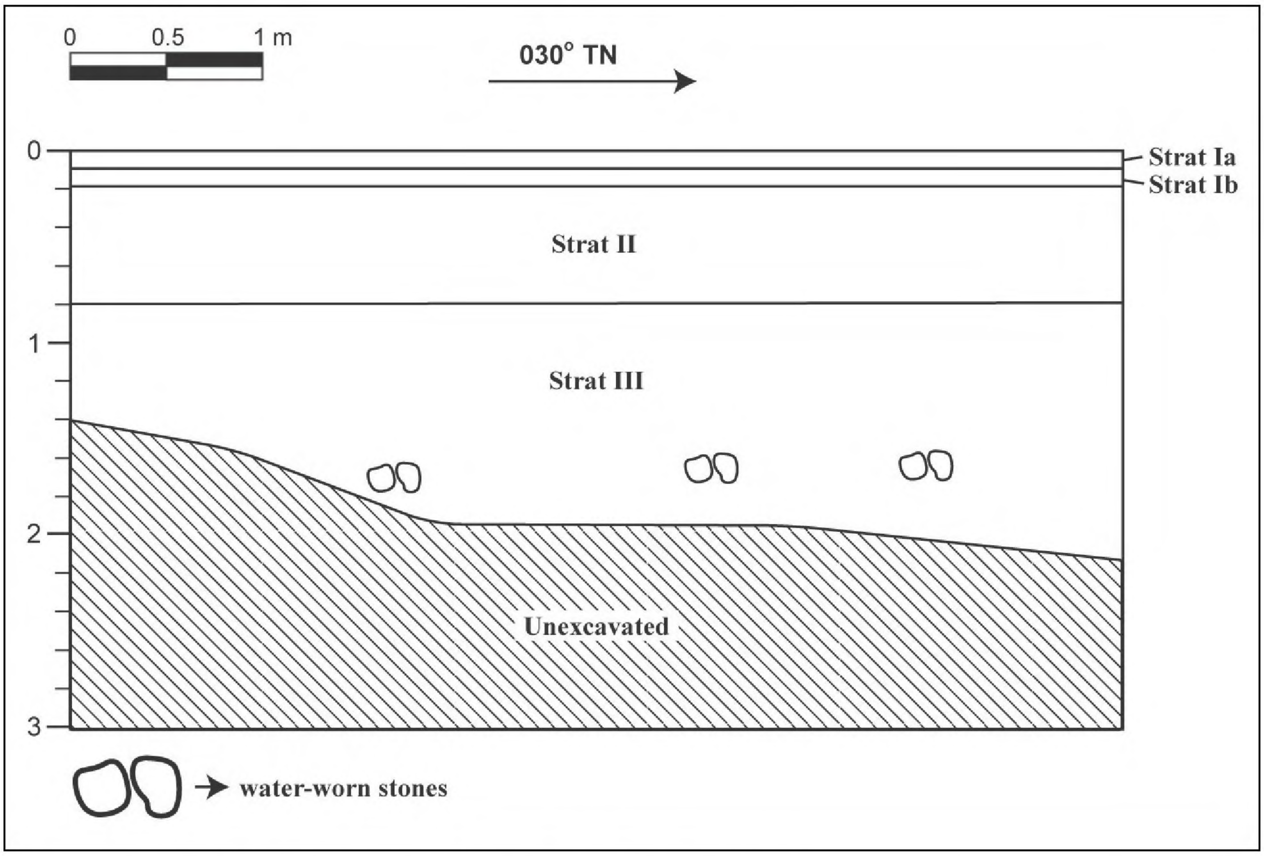

Figure 142. Profile of West Loch Station Makai Test Trench 1

Figure 143. Photograph of West Loch Station Makai Test Trench 1, view to west

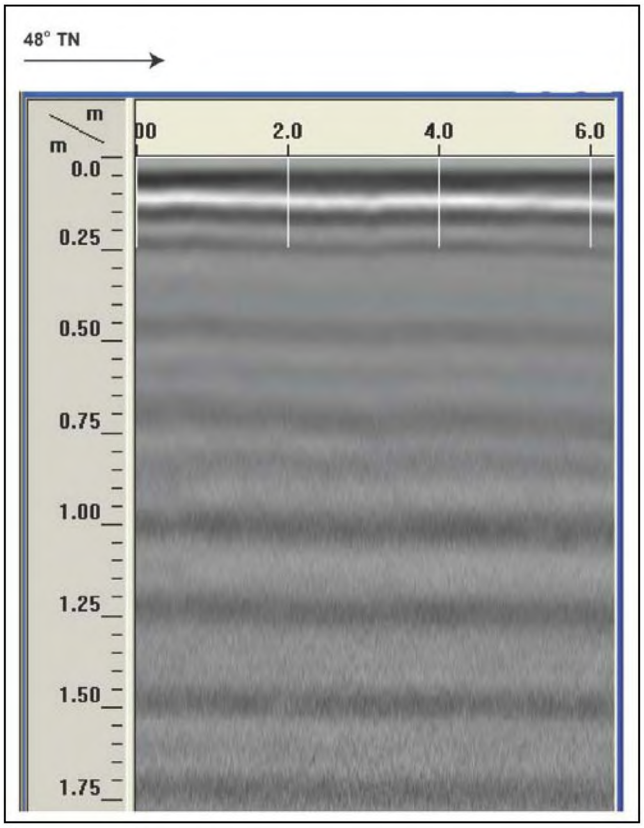

Figure 144. GPR profile of West Loch Station Makai Test Trench 1

West Loch Station Makai Test Trench 2

Orientation	330° TN
Length	4 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-96	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	96-200	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin. Water rounded cobbles observed at base of excavation, likely the remnant of a stream.

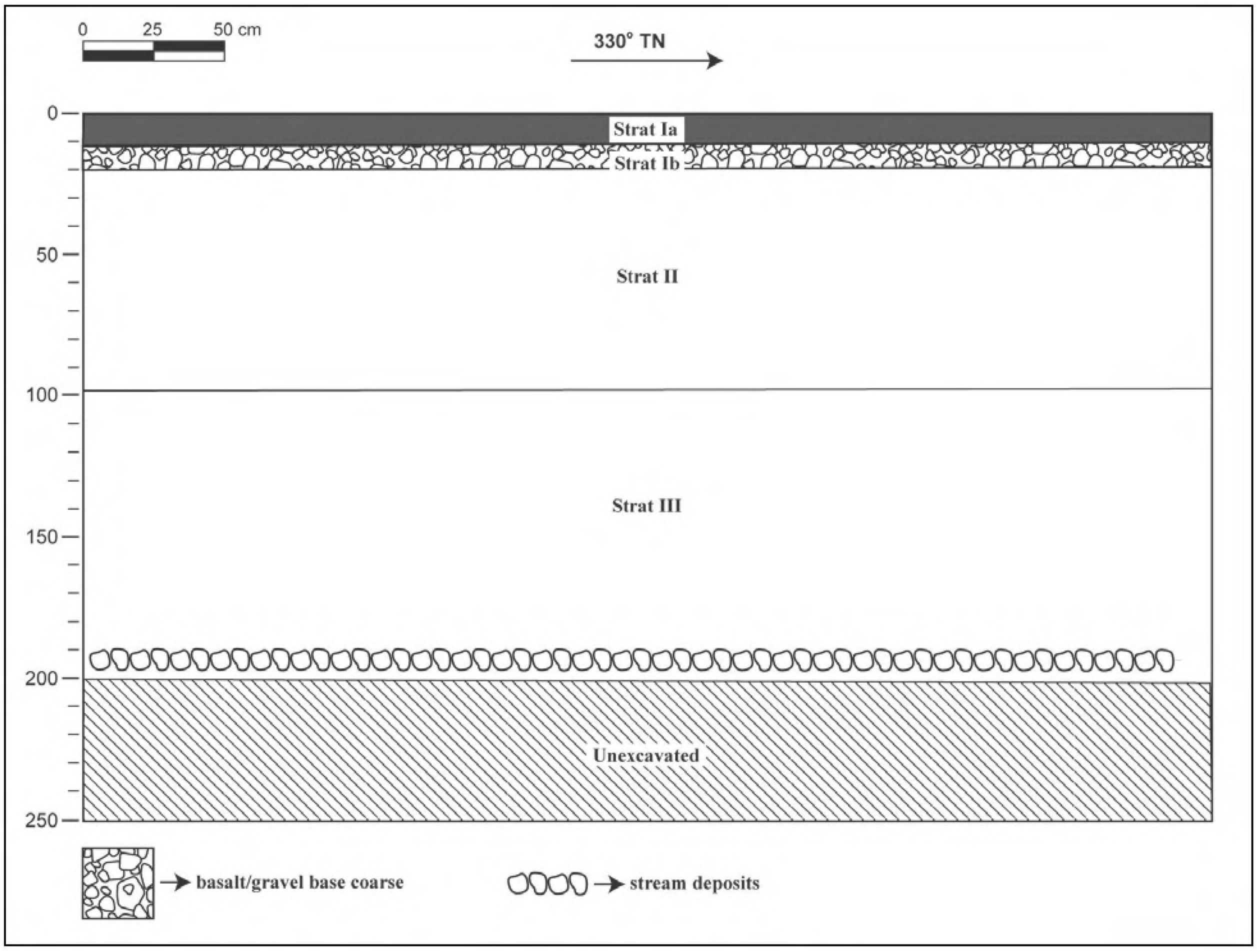

Figure 145. Profile of West Loch Station Makai Test Trench 2

Figure 146. Photograph of West Loch Station Makai Test Trench 2, view to west

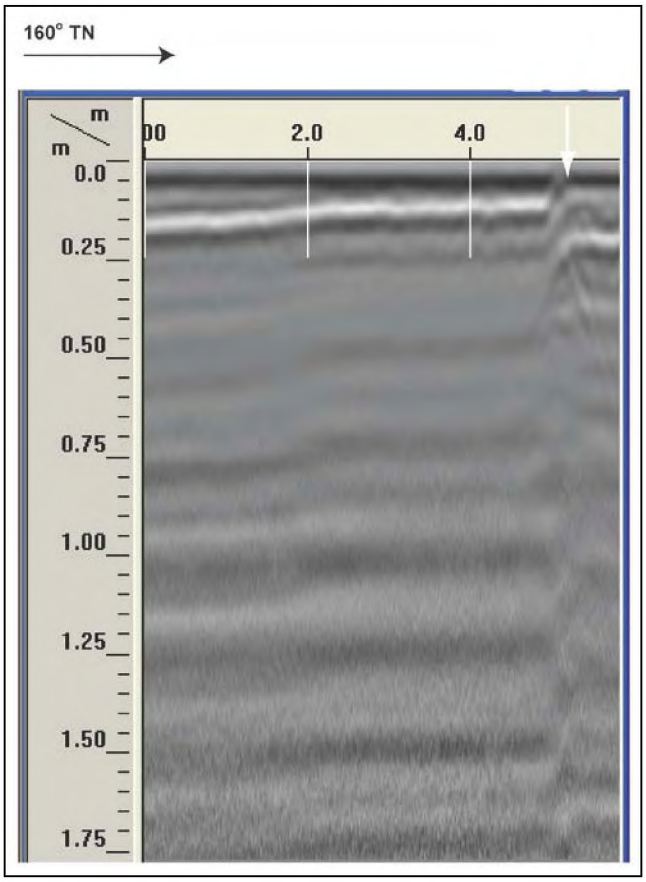

Figure 147. GPR profile of West Loch Station Makai Test Trench 2

West Loch Station Makai Test Trench 3

Orientation	070° TN
Length	6 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
Ic	20-30	Crushed coral fill
II	20-75	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	75-210	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin.
IV	75-210	10 YR 3/3 dark brown; clay; strong fine crumb structure; dry very hard consistency; non plastic; no cementation; terrestrial origin.

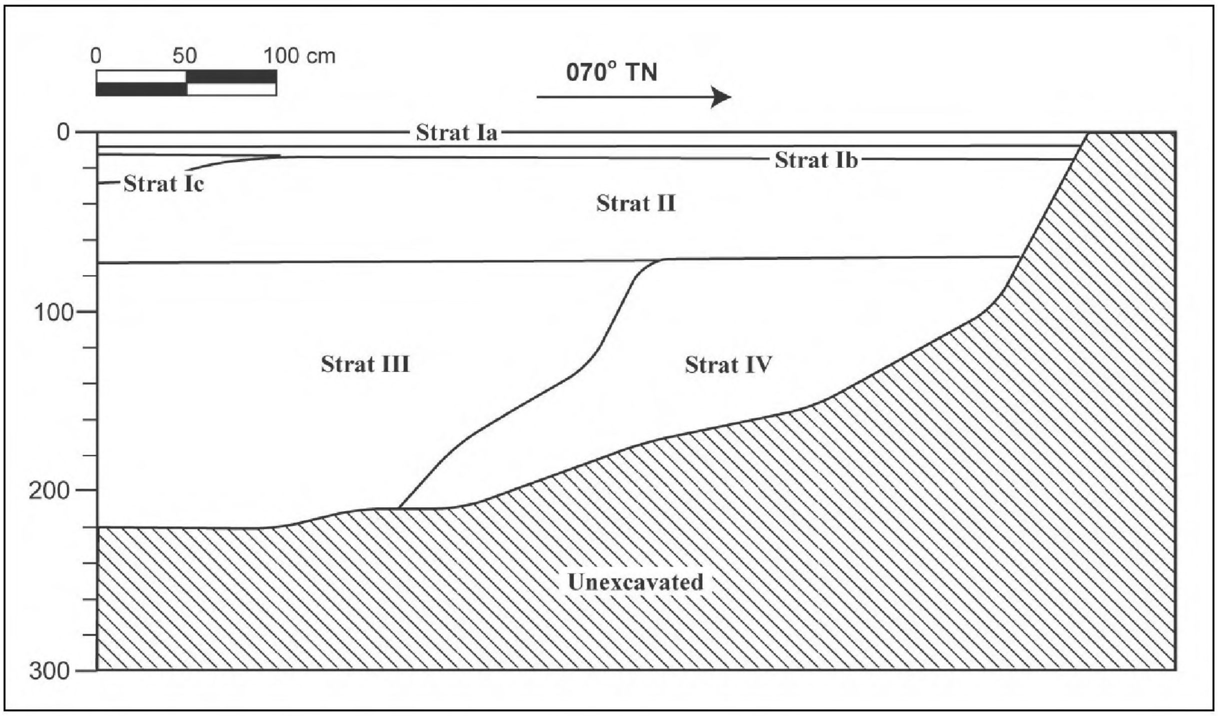

Figure 148. Profile of West Loch Station Makai Test Trench 3

Figure 149. Photograph of West Loch Station Makai Test Trench 3, view to north

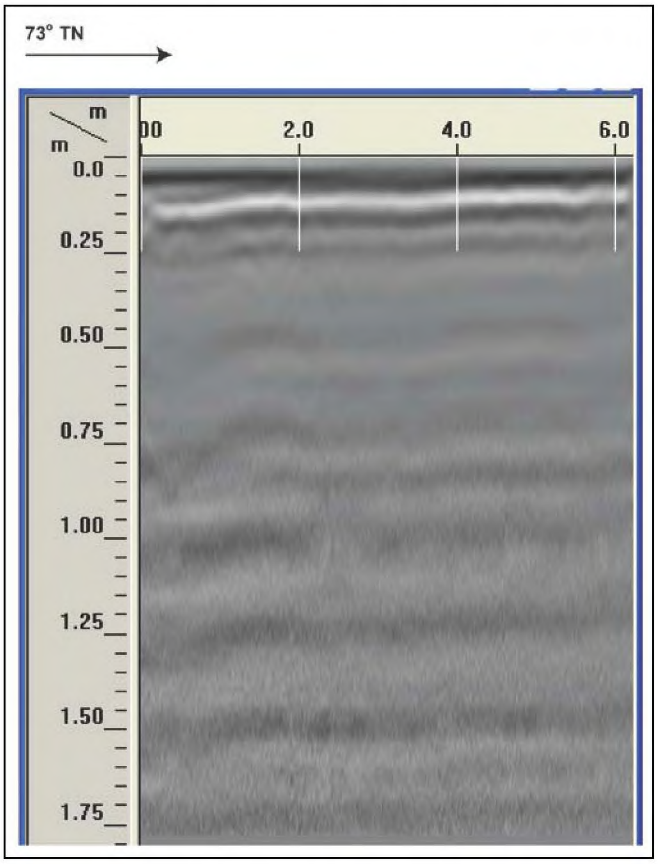

Figure 150. GPR profile of West Loch Station Makai Test Trench 3

West Loch Station Makai Test Trench 4

Orientation	240° TN
Length	4.2 m
Width	0.8 m
Maximum Depth	1.9 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	27-80	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	80-190	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin. Water rounded cobbles observed at base of excavation, likely the remnant of a stream.

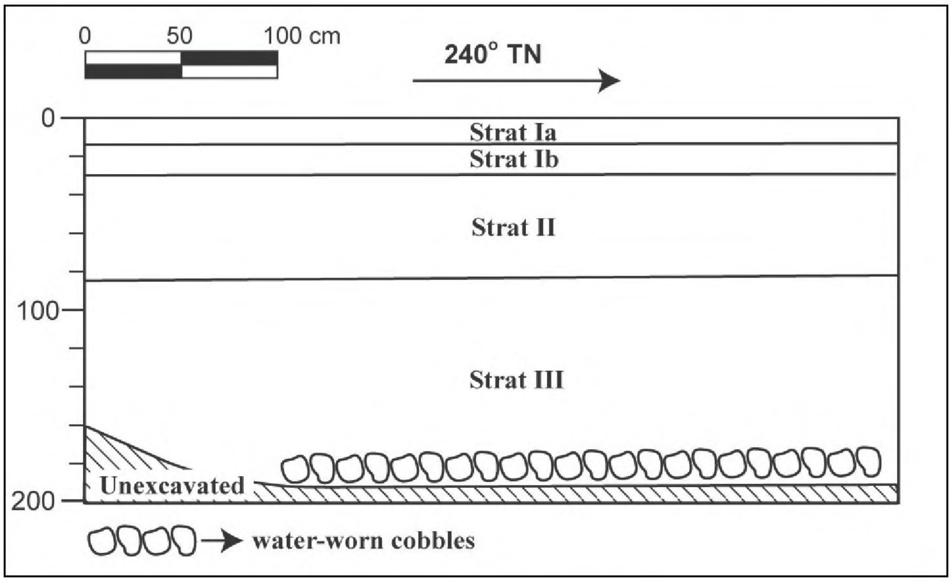

Figure 151. Profile of West Loch Station Makai Test Trench 4

Figure 152. Photograph of West Loch Station Makai Test Trench 4, view to east

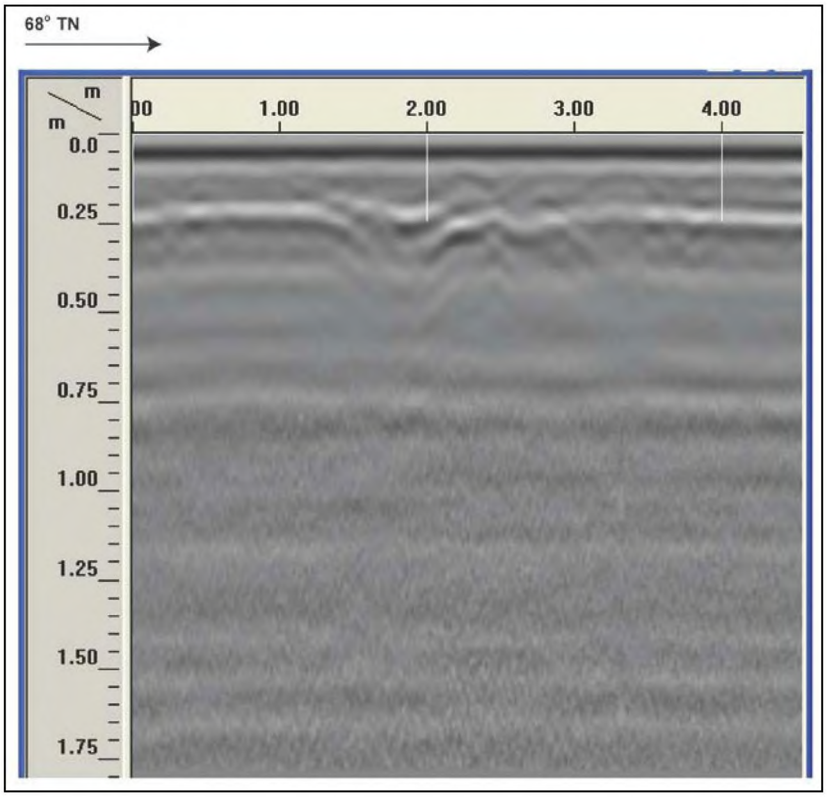

Figure 153. GPR profile of West Loch Station Makai Test Trench 4

West Loch Station Makai Test Trench 5

Orientation	245° TN
Length	6 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-57	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	55-89	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin.
IV	89-200	10 YR 3/3 dark brown; clay; strong fine crumb structure; dry very hard consistency; non plastic; no cementation; terrestrial origin. Water rounded cobbles observed at base of excavation, likely the remnant of a stream.

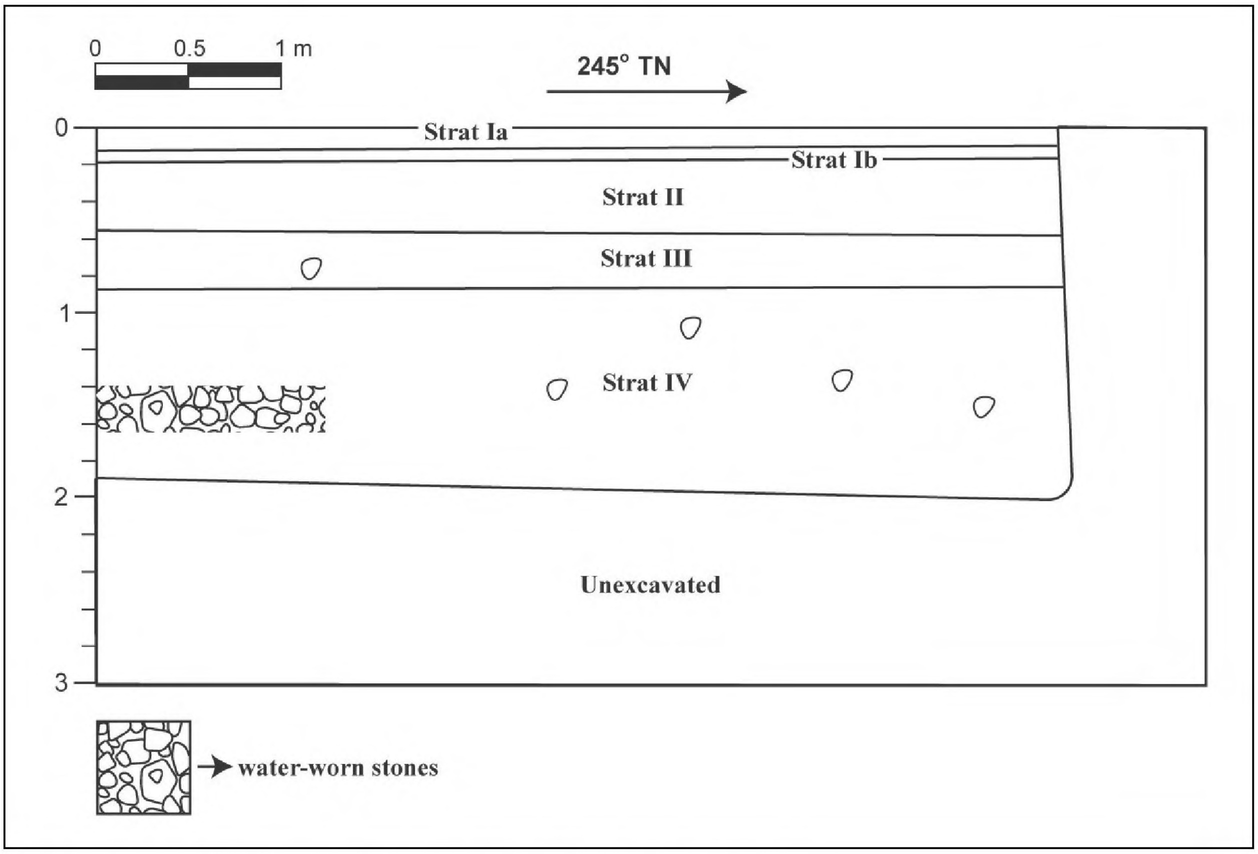

Figure 154. Profile of West Loch Station Makai Test Trench 5

Figure 155. Photograph of West Loch Station Makai Test Trench 5, view to northwest

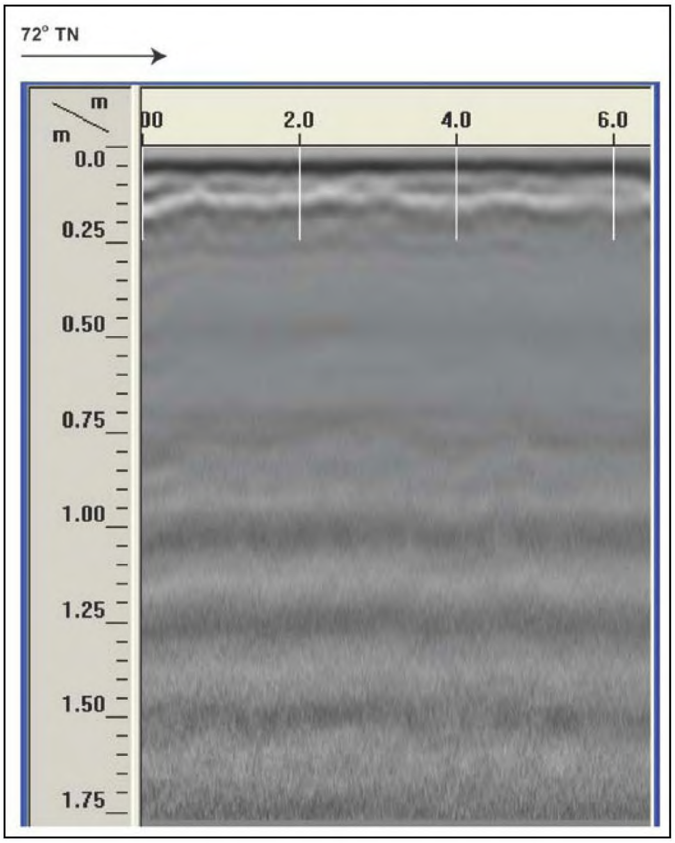

Figure 156. GPR profile of West Loch Station Makai Test Trench 5

West Loch Station Makai Test Trench 6

Orientation	151° TN
Length	6 m
Width	0.8 m
Maximum Depth	1.8 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	25-80	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry loose consistency; slightly plastic; no cementation; terrestrial origin; very abrupt boundary; smooth topography.
III	80-150	10 YR 3/3 dark brown; clay loam; weak medium crumb structure; dry weakly coherent consistency; slightly plastic; no cementation; terrestrial origin.
IV	150-180	10 YR 2/2 dark brown; silty sand; structureless; dry loose consistency; non plastic; no cementation; mixed origin. Contains water-rounded cobbles, likely assocated within a former stream.

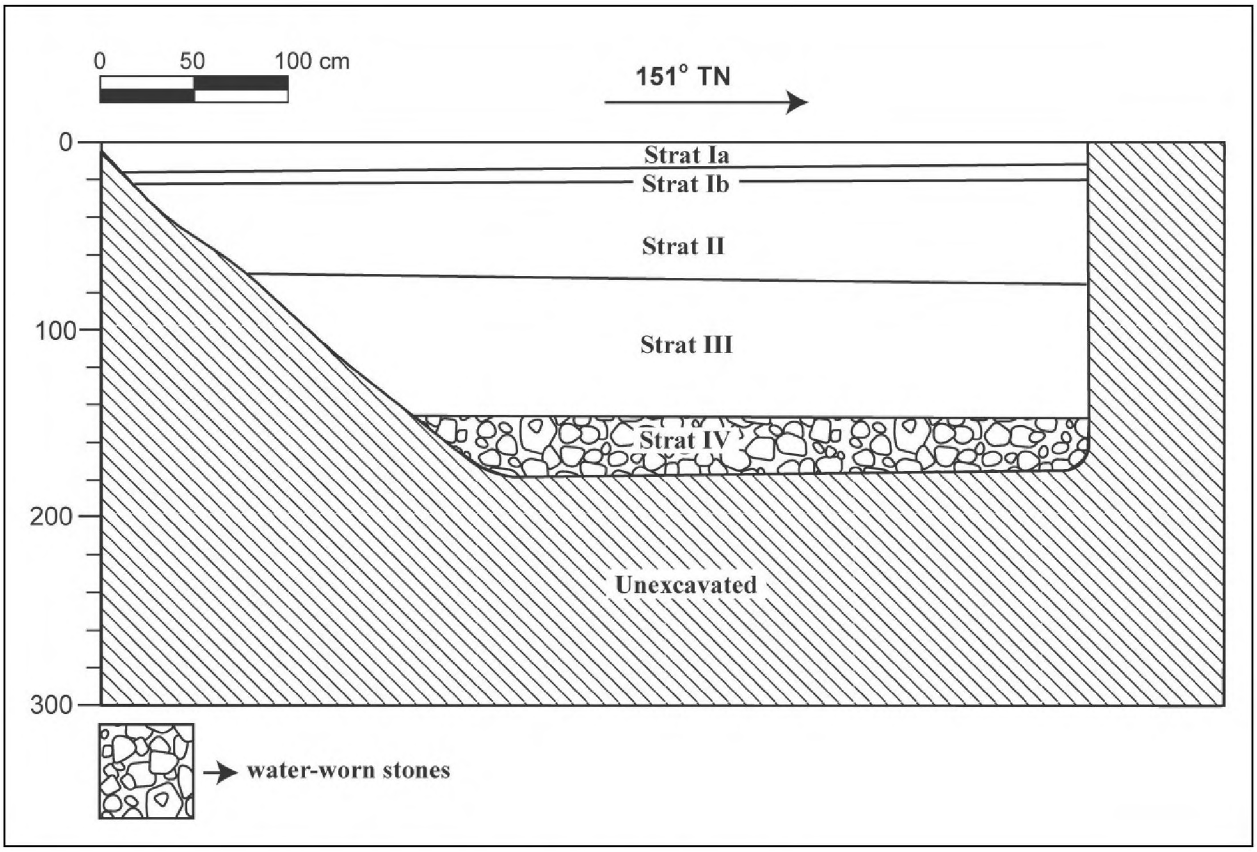

Figure 157. Profile of West Loch Station Makai Test Trench 6

Figure 158. Photograph of West Loch Station Makai Test Trench 6, view to north east

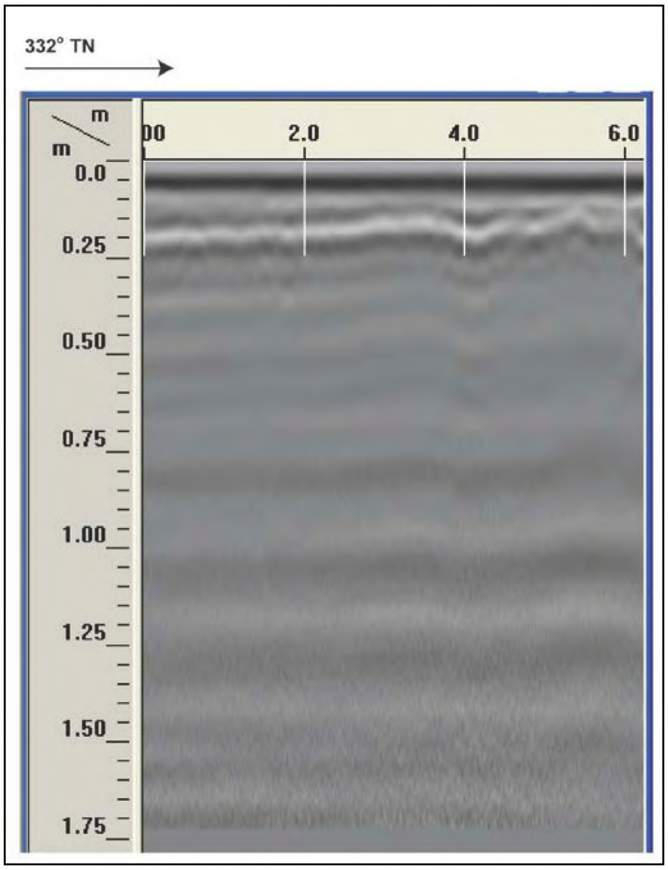

Figure 159. GPR profile of West Loch Station Makai Test Trench 6

Column Test 9 (C-9)

Orientation	333° TN
Length	2 m
Width	2 m
Maximum Depth	1.75 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill Horizon; 10 YR 3/2, very dark grayish brown; silt loam; weak, medium, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary;
Ib	25-50	Basalt gravel. Cushion for subsurface utilities.
Ic	50-160	Fill Horizon; 10 YR 3/2.5, very dark grayish brown, dark brown; silty clay; weak, fine, crumb structure; weakly coherant dry consistency; slightly plastic; no cementation; abrupt smooth lower boundary;
Id	160-175	Basalt gravel. Cushion for subsurface utilities.

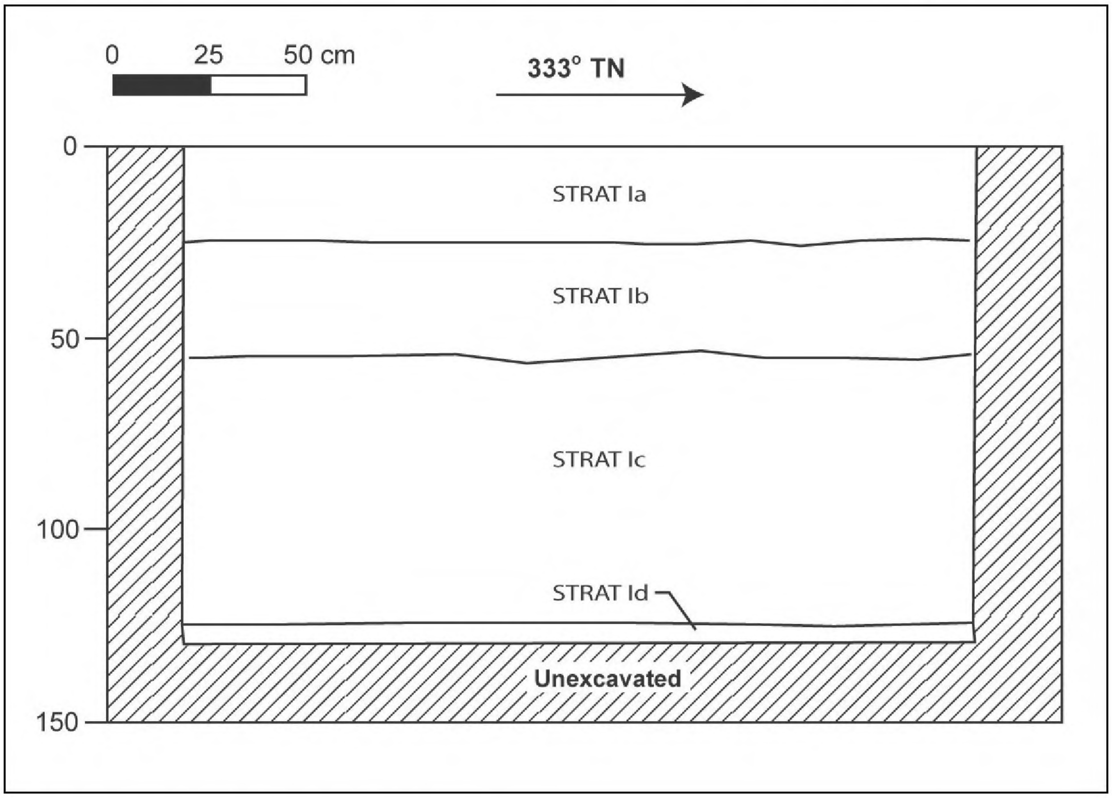

Figure 160. Profile of Column Test 9 (C-9)

Figure 161. Photograph of Column Test 9 (C-9), view to west

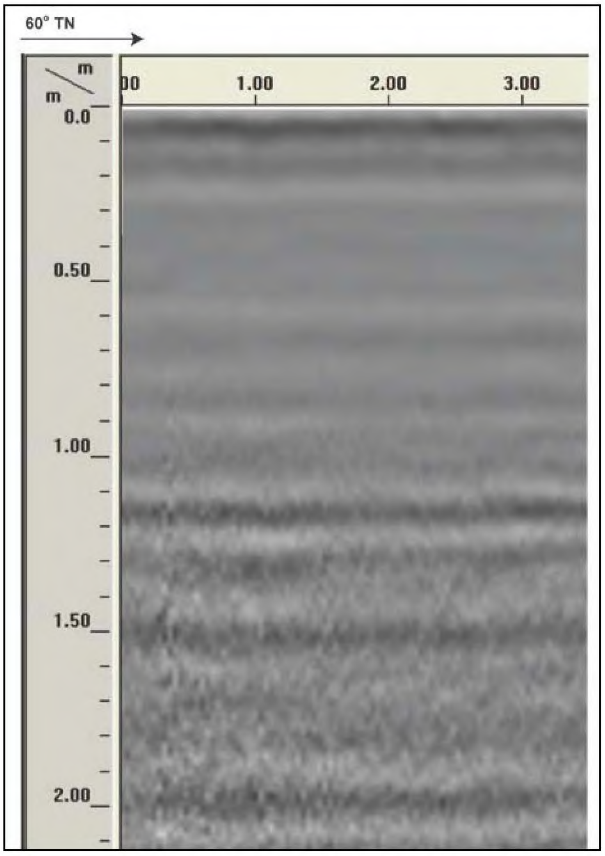

Figure 162. GPR profile of Column Test 9 (C-9)

Column Test 10 (C-10)

Orientation	243° TN
Length	2 m
Width	2 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
Ia	0-15	Concrete sidewalk
Ib	15-50	Basalt gravel base course
Ic	50-160	Fill Horizon; 10 YR 3/2.5, very dark grayish brown; silty clay, clay loam; moderate, fine, medium, granular structure; slightly hard dry consistency; non-plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography.
II	160-175	10 YR 3/3, dark brown; clay loam; weak, fine, crumb structure; friable moist consistency; non-plastic; no cementation; terrestrial origin

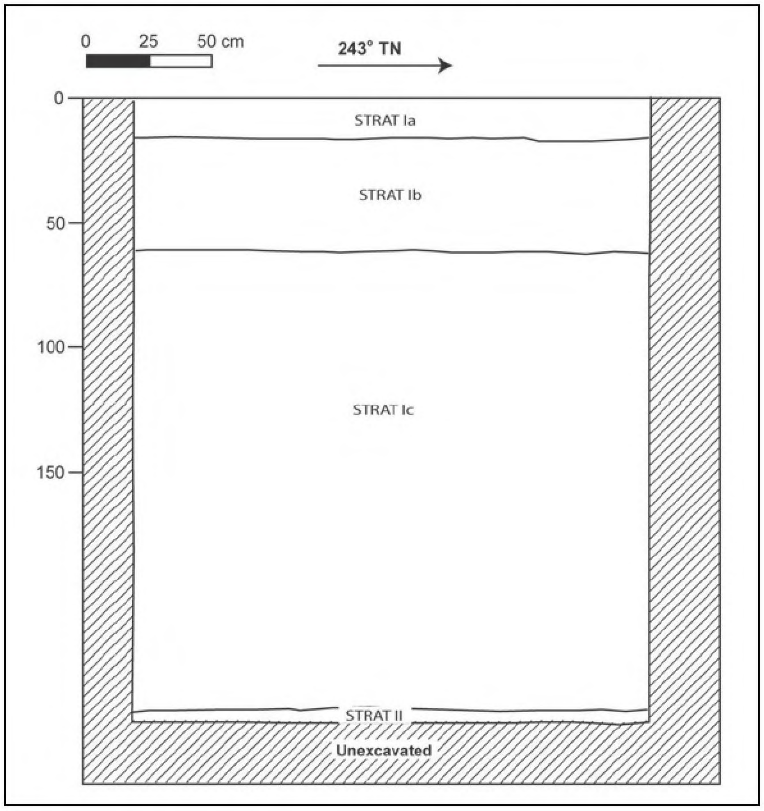

Figure 163. Profile of Column Test 10 (C-10)

Figure 164. Photograph of Column Test 10 (C-10), view to southeast

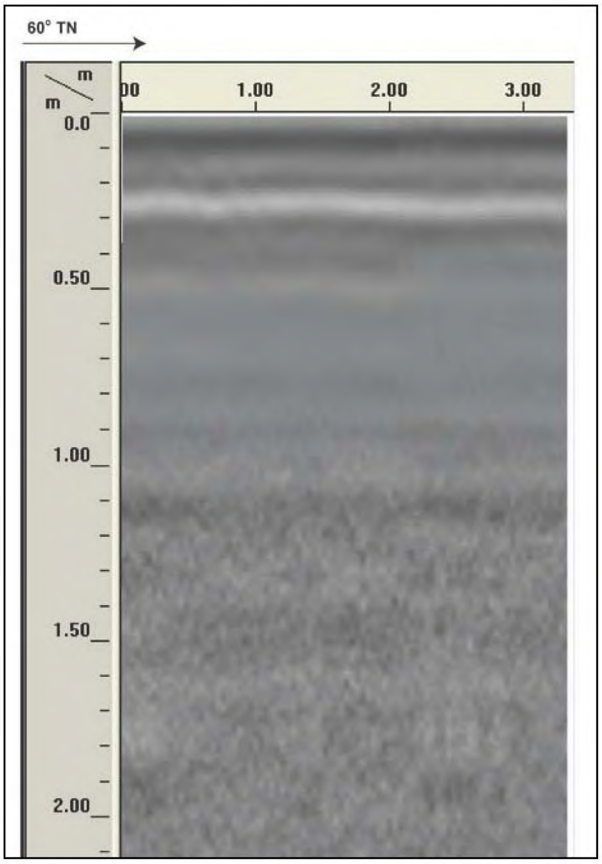

Figure 165. GPR profile of Column Test 10 (C-10)

4.9 Construction Sheet RW009

Construction Sheet RW009 includes a 2,100 ft (0.6 km) segment of the proposed transit corridor (Figure 166). Two column test pits (C-11 & C-12) were excavated within the area delineated by Construction Sheet RW009.

4.9.1 Pedestrian Inspection

The route for the transit corridor through Waipahu is aligned with the landscaped median of Farrington Highway with the surrounding area being heavily populated and developed (Figure 167). The roadway median is landscaped with a variety of trees, shrubs, and grasses. Structures in the surrounding area range from small residential homes and low rise apartments to local 'strip malls' and shopping centers. Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.9.2 GPR Survey

Prior to the excavation of test excavations, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

In general, the results of the GPR survey were inconclusive. The GPR was able to delineate stratigraphic interfaces at both test areas, and subsurface utilities observed during the test excavation of column test 11 (C-11) were not located (Figure 168 thru Figure 173). Additionally, the maximum "visibility" within the study area ranged from 100 to 150 cm below the surface. It is believed that the environmental conditions (i.e. soil chemistry) present within Construction Sheet RW009 caused the sediments to be too conductive causing the radar waves to disperse, resulting in limited depth "visibility" and inaccurate data output. Thus it appears that the area defined by Construction Sheet RW009 is not viable for an accurate GPR survey. This conclusion is consistent the NRCS, which also indicated that GPR suitability in this area is moderate to low (see Figure 9).

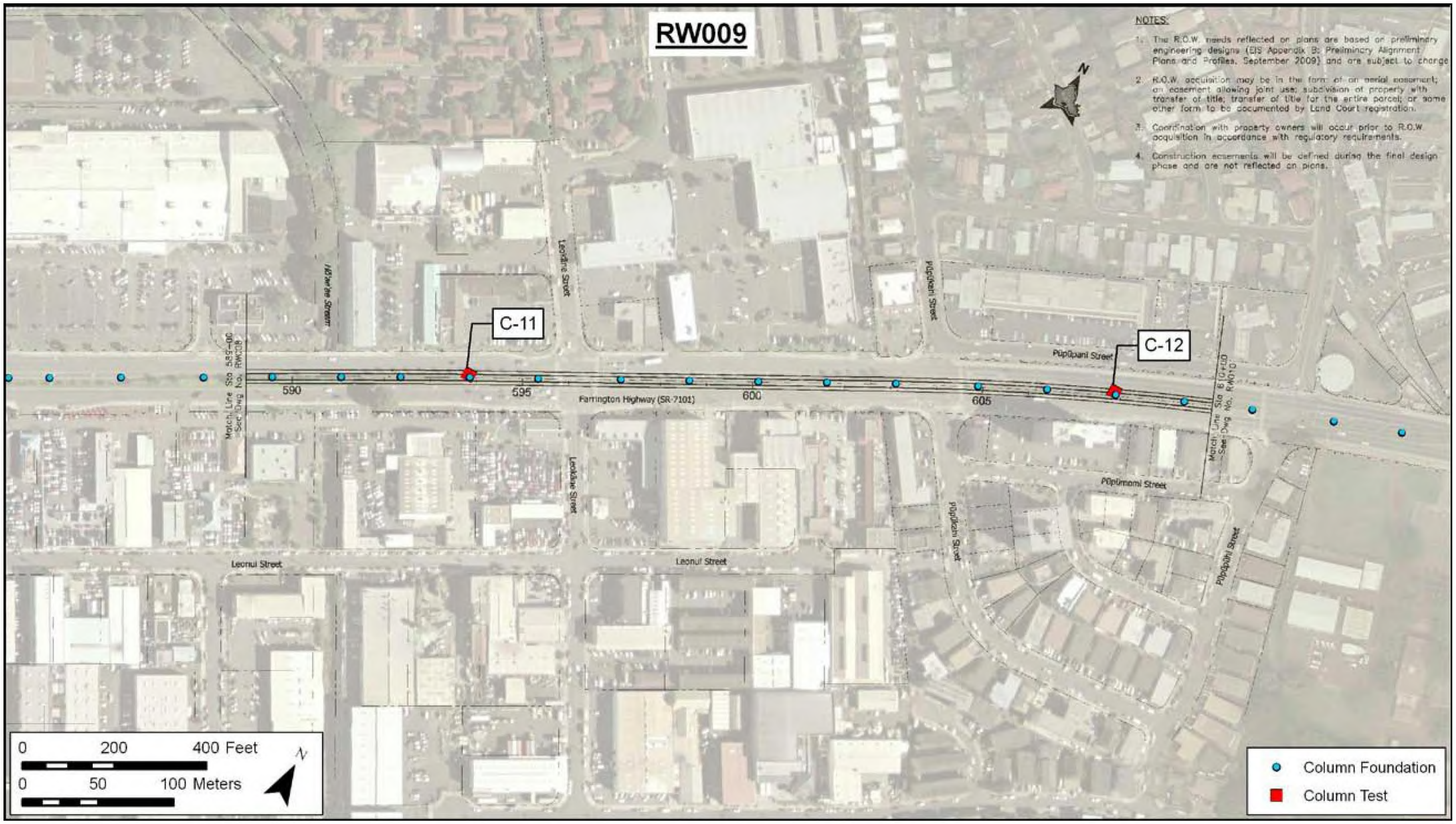

Figure 166. Construction Sheet RW009 showing the location of test excavations

Figure 167. Photograph depicting general surroundings along Farrington Highway through Waipahu showing high urbanization of area

4.9.3 Subsurface Testing

4.9.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW009 (see Figure 166). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 168 to Figure 173).

In general the observed and documented stratigraphy consisted of varying layers of imported fill, associated with median landscaping and subsurface utility installation, overlying naturally deposited alluvial sediment. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.9.3.2 Excavation Documentation

Column Test 11 (C-11)

Orientation	334° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.9 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill; 5 YR 3/2, dark reddish brown; silty clay; moderate, fine, crumb structure; loose dry consistency; slightly plastic; no cementation; abrupt smooth lower boundary. Landscaping topsoil for median foliage, root zone extends to ~45 cmbsl
Ib	25-40	Fill; 10 R 4/4, weak red; clay loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; Agricultural soil for hedge growing along median.
Ic	40-90	Fill; 7.5 YR 5/3, brown; silt loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; Natural silt loam previously disturbed during modernization of area
II	90-190	10 YR 4/2, 10 YR 4/1, dark grayish brown, dark gray; silt, hard dry consistency; non-plastic; weak cementation; natural basalt layer with silt pockets, upper 50cm composed of eroded/weathered basalt

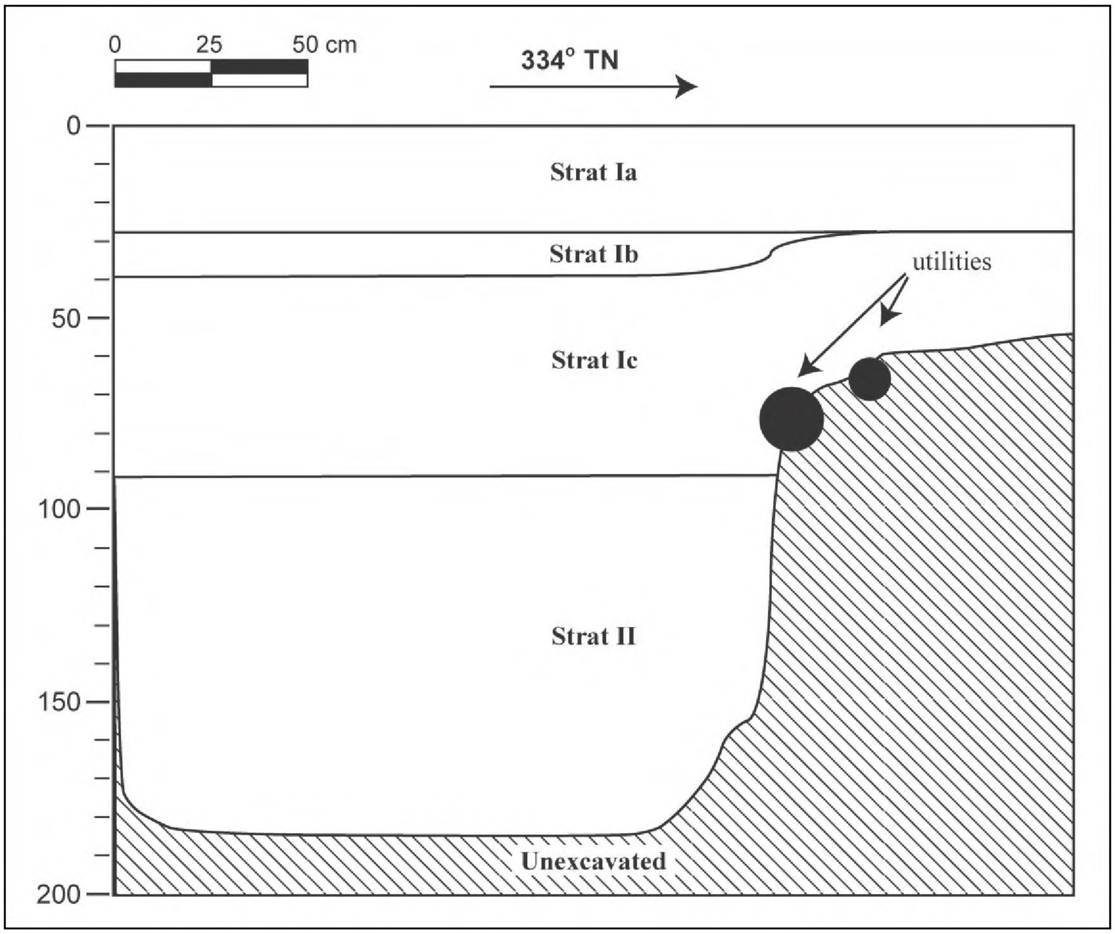

Figure 168. Profile of Column Test 11 (C-11)

Figure 169. Photograph of Column Test 11 (C-11), view to southwest

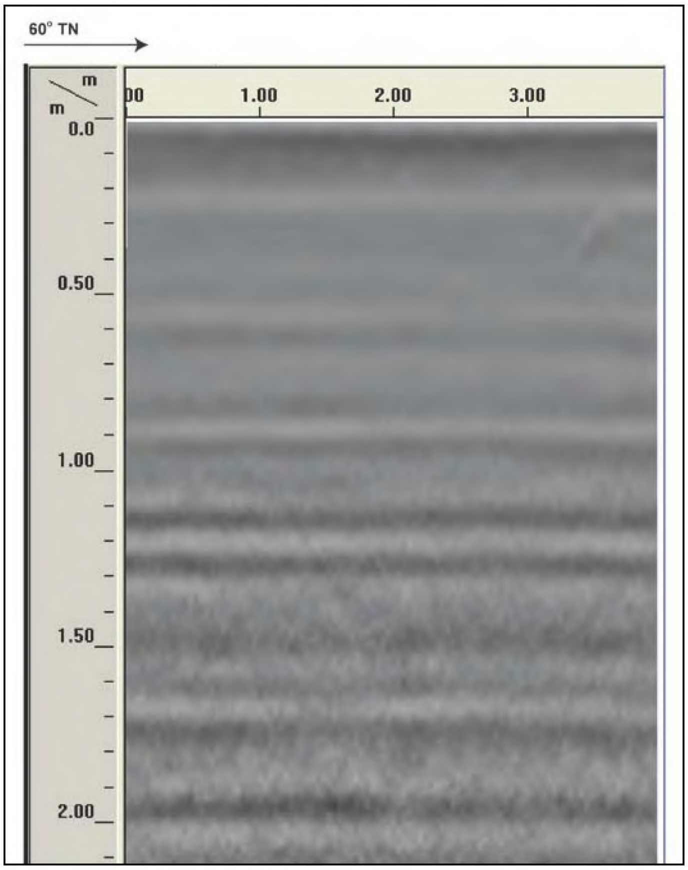

Figure 170. GPR profile of Column Test 11 (C-11)

Column Test 12 (C-12)

Orientation	324° TN
Length	2 m
Width	2 m
Maximum Depth	3 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill; 5 YR 3/3, dark reddish brown; silty clay loam; moderate, medium, crumb structure; firm moist consistency; plastic; no cementation; abrupt smooth lower boundary; organic layer with vegetation, heavy root material, landscaping fill
Ib	25-40	Fill; 10 YR 4/2, dark grayish brown; garvelly, sand; structureless, loose moist consistency; no cementation; abrupt smooth lower boundary; gravel/sand base coarse
II	90-190	10 YR 3/3, dark brown; silty clay; moderate, medium, crumb structure; firm moist consistency; plastic; no cementation; back-filled natural sediments

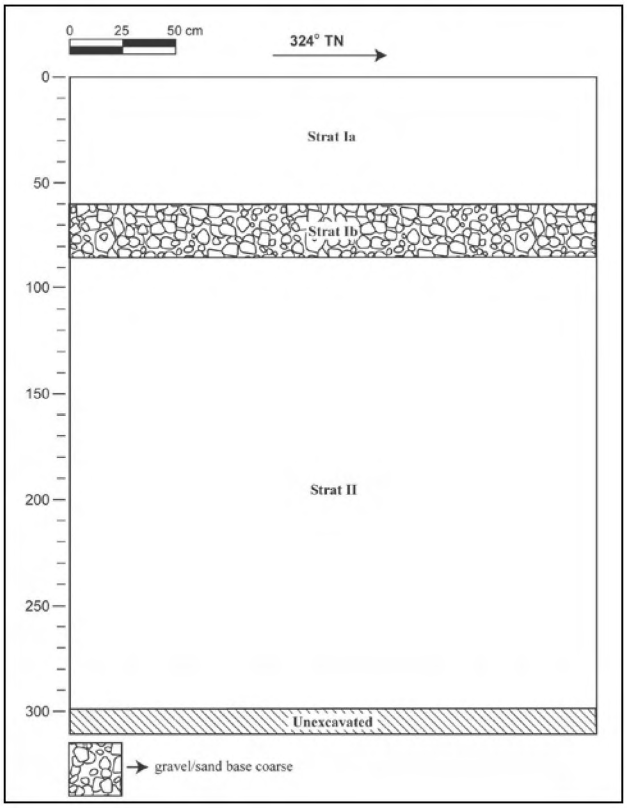

Figure 171. Profile of Column Test 12 (C-12)

Figure 172. Photograph of Column Test 12 (C-12), view to southwest

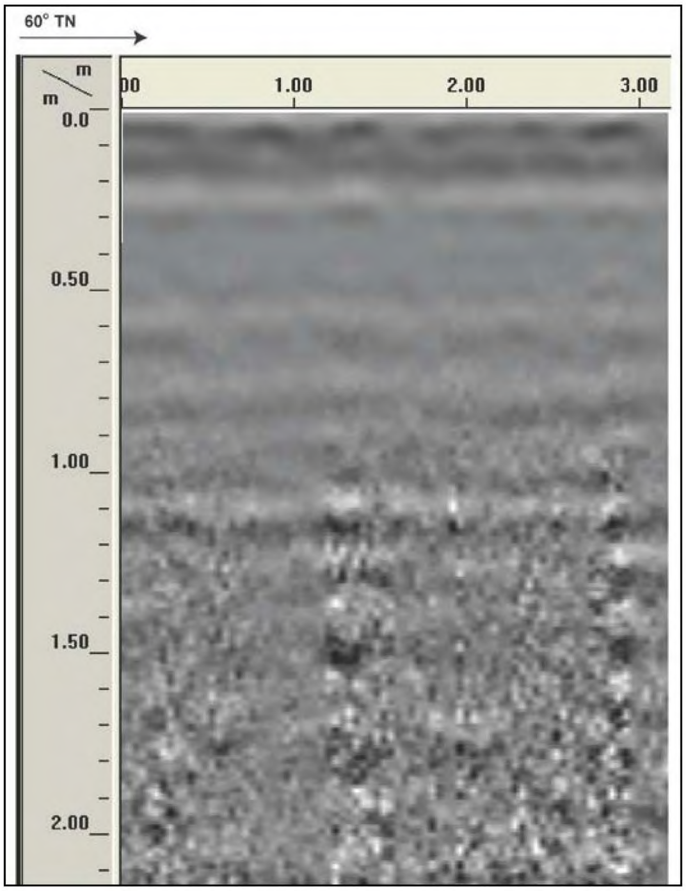

Figure 173. GPR profile of Column Test 12 (C-12)

4.10 Construction Sheet RW010

Construction Sheet RW010 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor (Figure 174). Two column test pits (C-13 & C-14) were excavated within the area delineated by Construction Sheet RW010.

4.10.1 Pedestrian Inspection

This area is located within the middle of Waipahu with the surrounding area being highly urbanized. The transit route is still located along the middle of Farrington Highway with various small businesses (shops, restaurants), low-rise apartments, and small subdivisions being located along both sides of the road (Figure 175). Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.10.2 GPR Survey

Prior to the excavation of column test pits, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey of column test pit C-13 identified a single subsurface anomaly that likely corresponded to a buried pipe that was observed during test excavation (Figure 176 & Figure 178).

The GPR survey of column test pit C-14 was inconclusive. This is due to the fact that the stratigraphy of C-14 consisted of fairly uniform sediments containing no features or foreign objects (Figure 179 & Figure 180). As a result the coinciding GPR data was also fairly uniform, indicating no subsurface anomalies or stratigraphic layers present in the test area (Figure 181).

4.10.3 Subsurface Testing

4.10.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW010 (see Figure 174). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavations, please refer to the excavation profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 176 to Figure 181).

In general the observed and documented stratigraphy consisted of varying layers of imported fill, associated with median landscaping and subsurface utility installation, overlying naturally deposited alluvial sediment. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

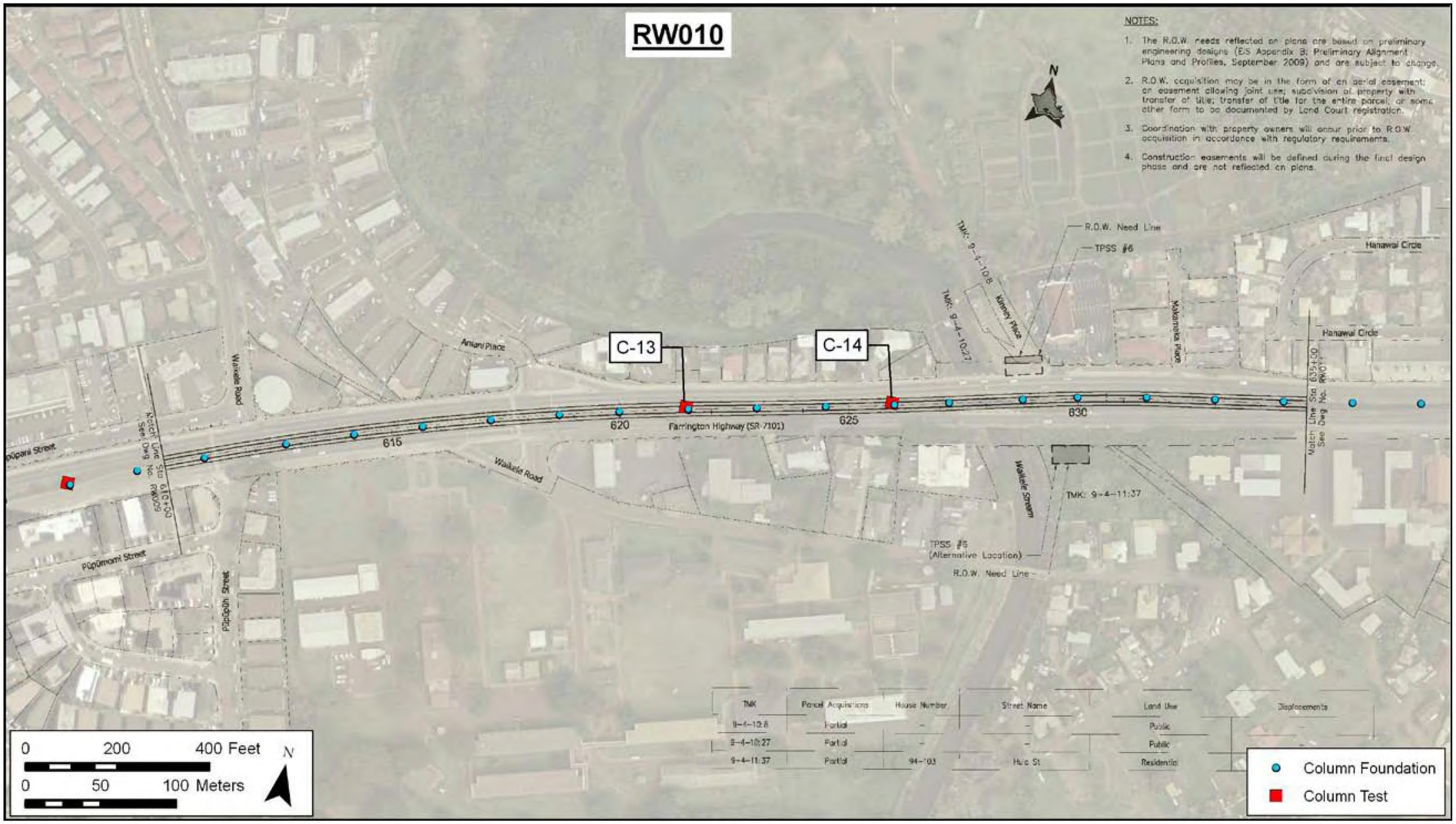

Figure 174. Construction Sheet RW010 showing the location of test excavations

Figure 175. Photo of existing conditions along transit route as it follows Farrington Highway through Waipahu

4.10.3.2 Excavation Documentation

Column Test 13 (C-13)

Orientation	065° TN
Length	2 m
Width	2 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
Ia	0-60	Fill; 5 YR 3/2, dark reddish brown; clay loam; weak, fine, crumb structure; loose moist consistency; non-plastic; no cementation; clear smooth lower boundary; Landscaping fill, excavated unknown cast-iron utility line at 15cm on east side of trench, cont. to dig on west side
II	60-260	7.5 YR 3/3, dark brown; clay loam; moderate, medium, crumb structure; friable moist consistency; non-plastic; no cementation; No culturaly sterile natural sediment.

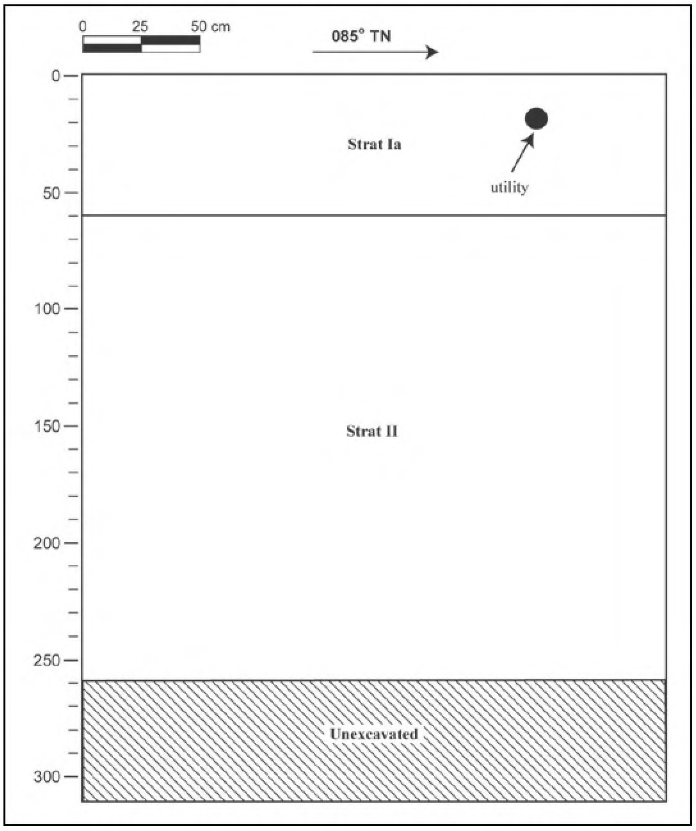

Figure 176. Profile of Column Test 13 (C-13)

Figure 177. Photograph of Column Test 13 (C-13), view to west

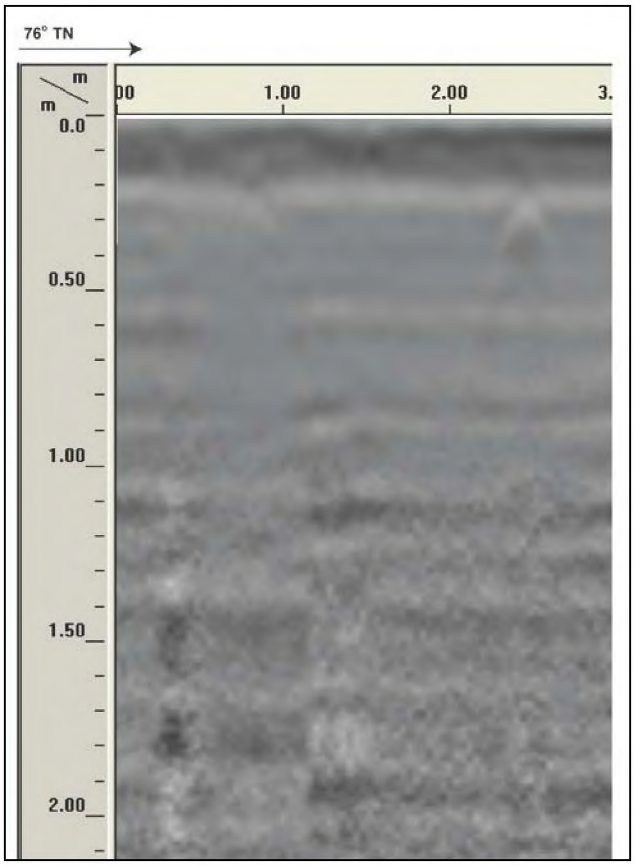

Figure 178. GPR profile of Column Test 13 (C-13)

AR00113540

Column Test 14 (C-14)

Orientation	256° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
Ia	0-30	Fill; 7.5 YR 4/2, brown; silty clay loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; topsoil for landscaping
Ib	30-60	Fill; 10 YR 4/4, dark yellowish brown; silt; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; terrigenous fill layer containing historic debris
II	60-260	7.5 YR 4/6, strong brown; silt loam; moderate, fine, crumb, blocky structure; loose dry consistency; non-plastic; no cementation; very abrupt smooth lower boundary; natural sediment goes from fine grain at top to blocky at BOE, overlies basalt

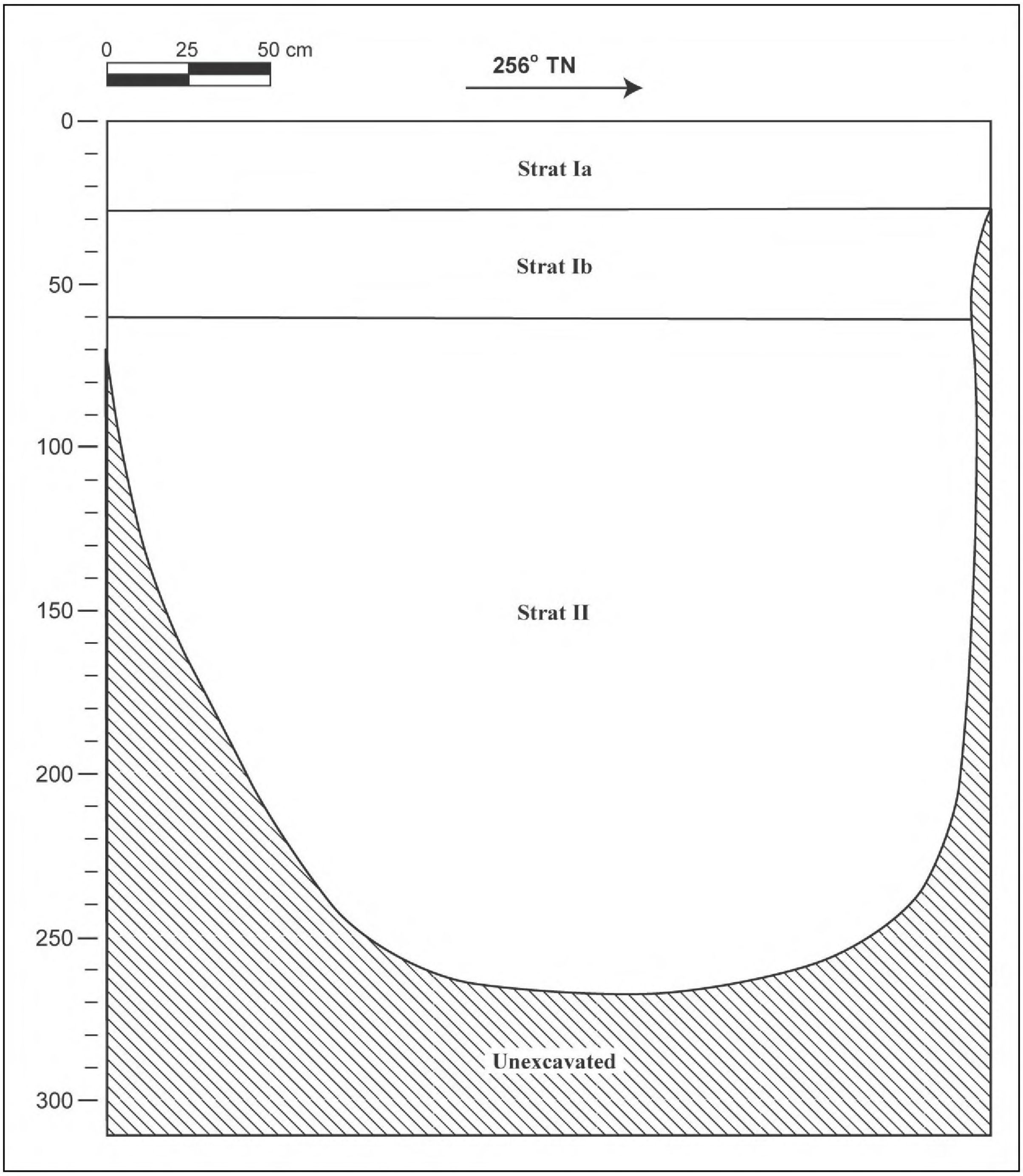

Figure 179. Profile of Column Test 14 (C-14)

Figure 180. Photograph of Column Test 14 (C-14), view to south

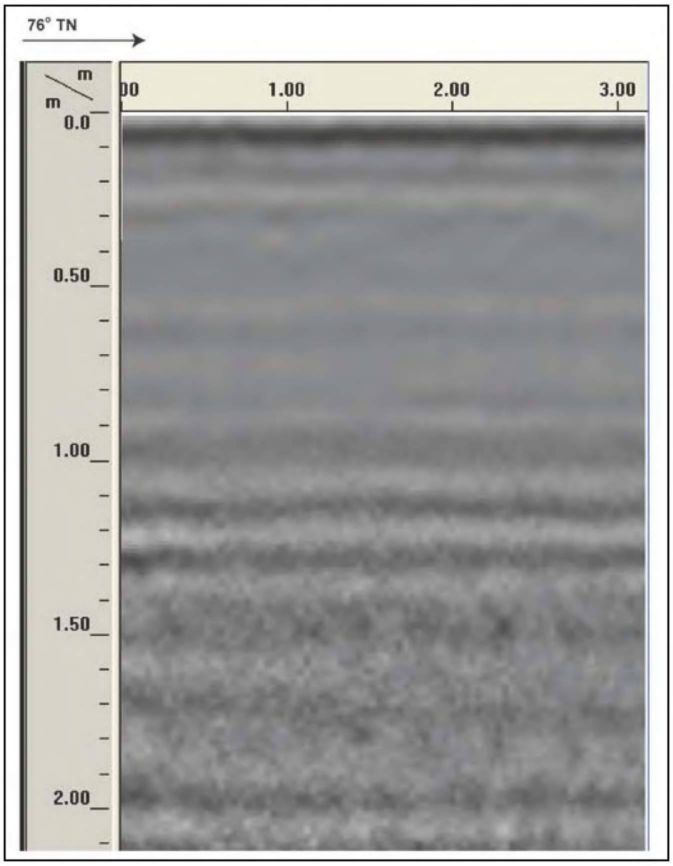

Figure 181. GPR profile of Column Test 14 (C-14)

4.11 Construction Sheet RW011

Construction Sheet RW011 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor, and includes the proposed Waipahu Transit Center Station (Figure 182). 12 test trenches were excavated at the station (Figure 183). Additionally, 7 column test pits (C-21 to C-27) were also excavated (see Figure 182 & Figure 183), totaling 19 test excavations within Construction Sheet RW011.

4.11.1 Pedestrian Inspection

The surrounding area detailed on this construction sheet remains within the highly urbanized area of Waipahu with the environment consisting of various types of structures including low-rise buildings, small housing areas, and some commercial/industrial businesses. The site for the proposed Waipahu Transit Center Station is situated in this segment with a small business located on the *mauka*/northern side of the road (Figure 184). The *makai* /south section of the station was formerly occupied by a used car lot (Figure 185). Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.11.2 GPR Survey

Prior to the excavation of test excavations, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

In general, the results of the GPR survey were inconclusive. The GPR was able to locate subsurface objects (a concrete utility jacket and buried asphalt fragments) in Waipahu Transit Center Station Mauka trenches 1 (Figure 186 & Figure 188) and 6 (Figure 201 & Figure 203), but was unable to identify subsurface utilities in column test C-21 (Figure 222 & Figure 224) and C-25 (Figure 234 & Figure 236). It is believed that the presence of thick wet clay deposits in this area was the primary factor to the inconsistent results of the GPR data. Clay soils (especially those that are inundated) are noted as being very conductive, resulting in radio wave attenuation at shallow depths causing limited depth "visibility" and inaccurate GPR data collection (Conyers 2004).

The GPR survey was also unable to define the stratigraphic interfaces within any of the test areas. The inability to discern stratigraphic interfaces in this area is likely due to the presence of thick clay deposits, as well as varying stratums with similar consistencies.

Thus it has been concluded that GPR survey results are inconclusive within the area defined by Construction Sheet RW011. The environmental conditions (i.e. thick clay deposits) present within this area caused the sediments to be too conductive causing the radar waves to attenuate, resulting in limited depth "visibility" and inaccurate data output. This conclusion is consistent the NRCS, which also indicated that GPR suitability in this area is moderate to low (see Figure 9).

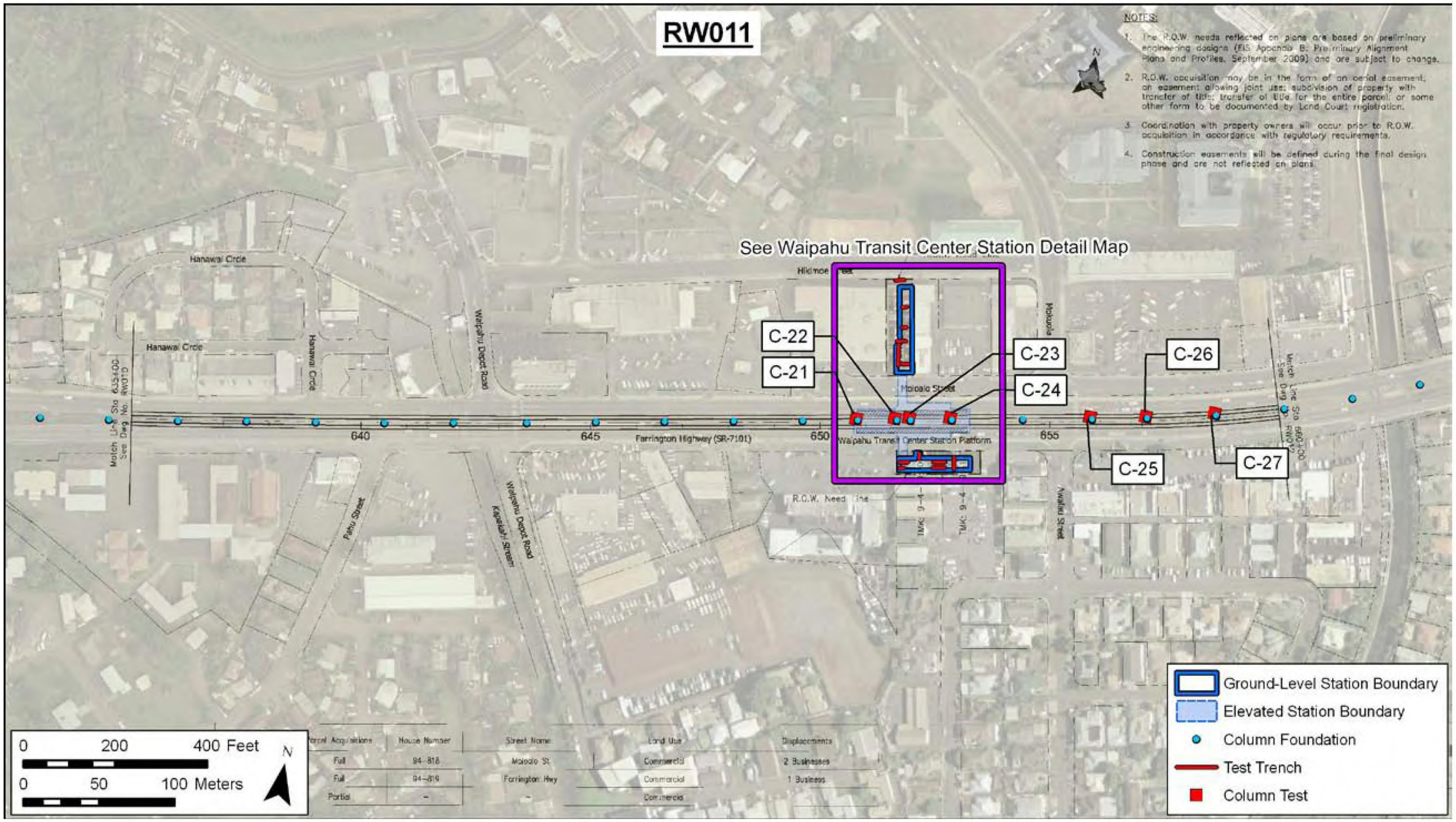

Figure 182. Construction Sheet RW011 showing the location of test excavations

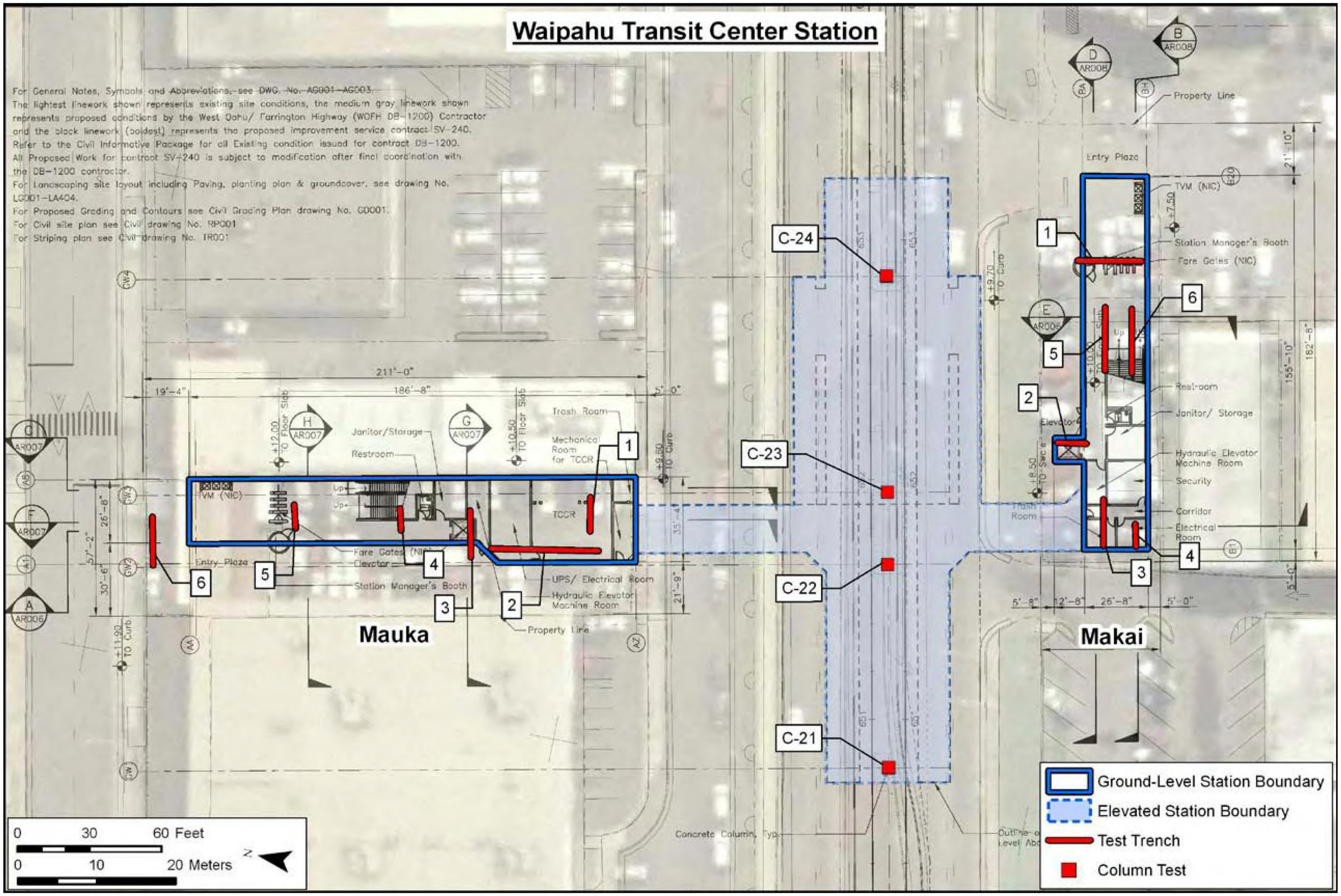

Figure 183. Waipahu Transit Center Station floor plan showing the location of test trenches

Figure 184. Photo of existing conditions along transit route as it follows Farrington Highway through the highly urbanized area of Waipahu, with location of Waipahu Transit (*mauka*/north side) in background

Figure 185.Photograph showing the highly urbanized surroundings of the Waipahu area along the transit route extends through (along Farrington Highway), with site for *makai*/south side of the Waipahu station in background

4.11.3 Subsurface Testing

4.11.3.1 Stratigraphic Summary

Nineteen (19) test excavations were placed within the area delineated by Construction Sheet RW011 (see Figure 182 & Figure 183). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 186 to Figure 242).

In general the observed and documented stratigraphy consisted of varying imported fill layers overlying naturally deposited alluvial sediment inundated with water, suggesting the area was once a marsh prior to urban development. The fill layers appear to be associated with two distinct events: 1) mass grading and filling associated with land reclamation, and 2) asphalt parking lot construction. Of note was the presence of reddish orange mottling and charcoal flecking within the marsh sediments (Stratum II) observed at the *makai* (southern) portion of the proposed Waipahu Station (see Figure 183 and Figure 204 to Figure 221). These inclusions are suggestive that agriculture, specifically taro cultivation, had occurred in this area prior to urban development. A review of LCA documentation for the area confirmed that *lo‘i* (wetland taro fields) were present in the area. Accordingly, the buried agricultural sediments were determined to be a cultural resource, and assigned as State Inventory of Historic Properties (SIHP) # 50-80-9-7751. A detailed description for SIHP 50-80-9-7751 is provided below in Section 6.18 Site Descriptions.

4.11.3.2 Excavation Documentation

Waipahu Transit Center Station Mauka Trench 1

Orientation	247° TN
Length	5.5 m
Width	0.8 m
Maximum Depth	2.4 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-30	Basalt gravel base coarse
Ic	30-50	Fill; 7.5 YR 3/3, dark brown; clay loam; hard dry consistency; non-plastic; no cementation; clear smooth lower boundary; terrigenous fill material
Id	50-60	Fill; 2.5 YR 2.5/4, dark reddish brown; silty clay loam; weakly coherant dry consistency; friable moist consistency; slightly plastic; no cementation; clear smooth lower boundary; alluvial clay sediment used as fill
Ie	60-100	Fill; 7.5 YR 2.5/3, very dark brown; garvelly, clay; weak, loose dry consistency; loose moist consistency; non-plastic; no cementation; clear smooth lower boundary;
If	100-175	Fill; 10 YR 3/2, very dark grayish brown; loose moist consistency; non-sticky wet consistency; non-plastic; no cementation; large amount of oyster shell found in south end of trench; coral fragments; wire
II	175-240	10 YR 3/1, very dark gray; clay; weak, very plastic; no cementation; very plastic, dark gray/black clay, wetland sediments

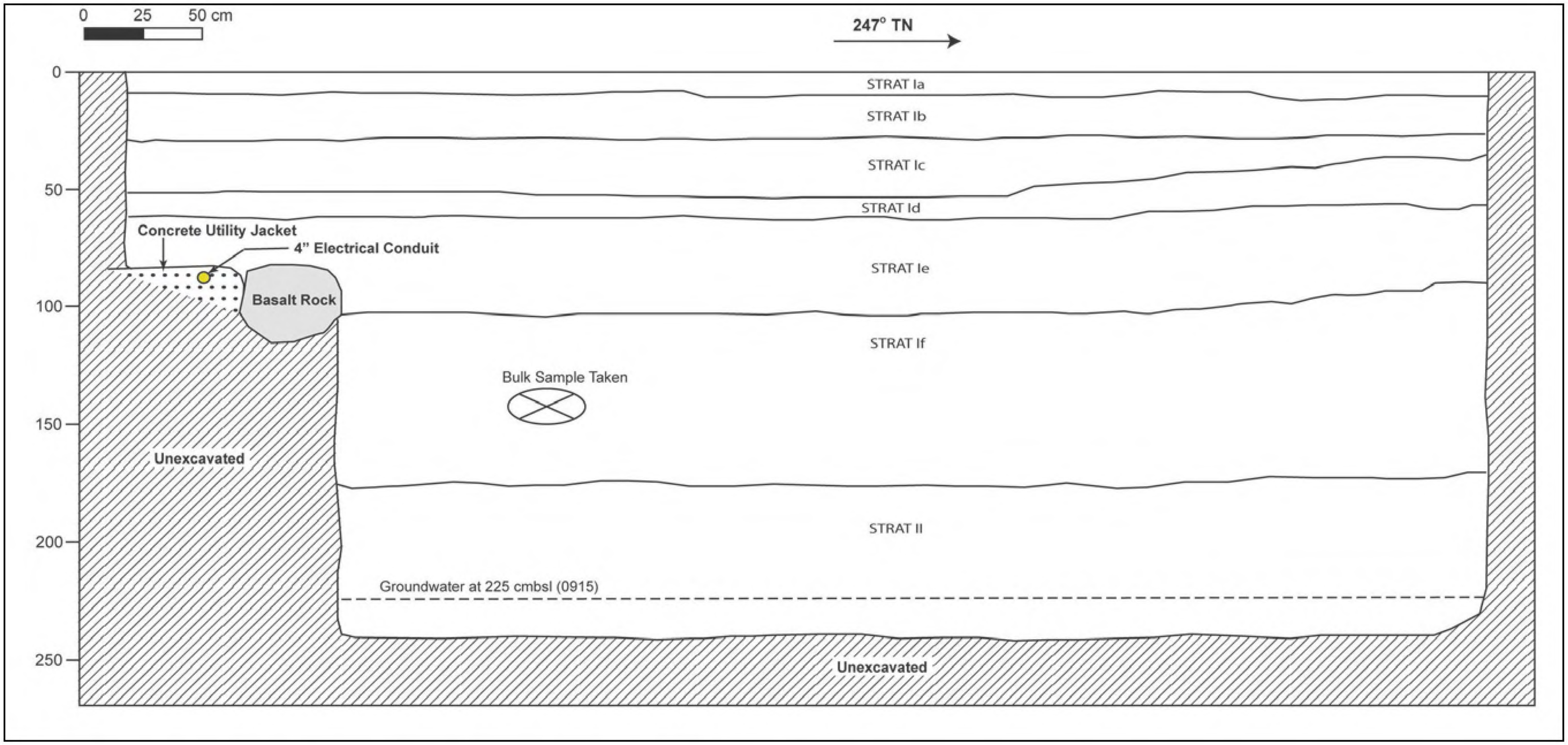

Figure 186. Profile of Waipahu Transit Center Station Mauka Trench 1

Figure 187. Photograph of Waipahu Transit Center Station Mauka Trench 1, view to south

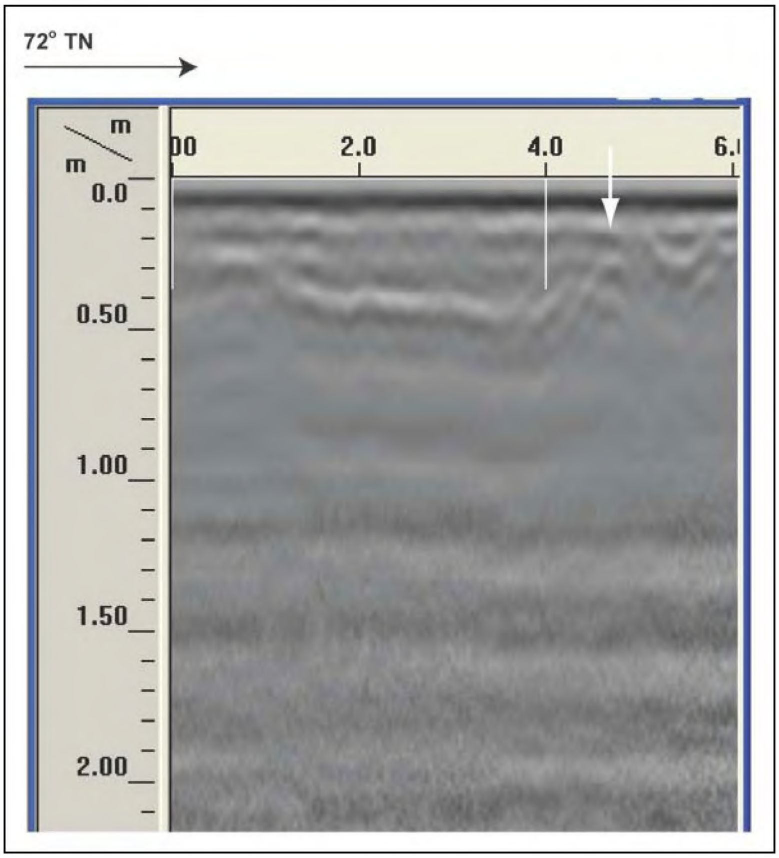

Figure 188. GPR profile of Waipahu Transit Center Station Mauka Trench 1

Waipahu Transit Center Station Mauka Trench 2

Orientation	165° TN
Length	14 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-30	Basalt gravel base coarse
Ic	30-40	Fill; 10 YR 3/2, very dark grayish brown; clay loam; weak, medium, crumb structure; dry, weakly coherent consistency; slightly plastic; no cementation; terrestrial origin; clear boundary; smooth topography. Contains roots and land snalis.
Id	40-160	Fill; 2.5 YR 3/4, dark reddish brown; silty clay loam; weak, medium, crumb structure; dry, weakly coherent consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Contains roots. Imported fill used for land reclamation.
Ie	160-190	Fill; 2.5 YR 4/3, olive brown; sandy clay; structureless; moist, friable consistency; slightly plastic; no cementation; mixed origin; diffuse boundary; wavy topography. Contains marine shells and coral boulders. Imported fill used for land reclamation.
II	190-210	10 YR 3/1, very dark gray; clay loam; moderate, fine structure; wet, very sticky consistency; very plastic; no cementation. Wetland sediment at watertable.

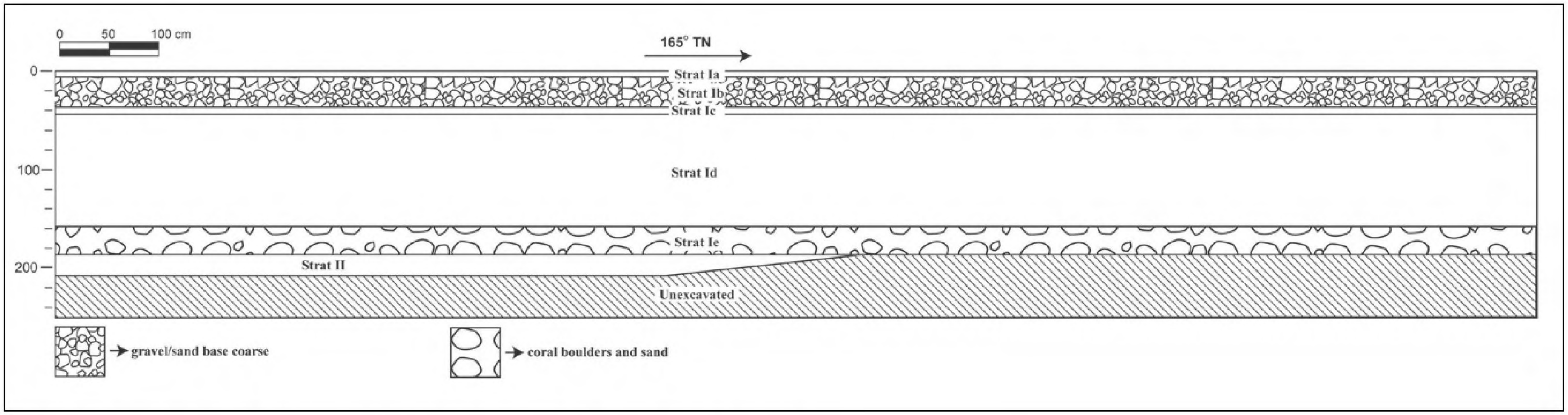

Figure 189. Profile of Waipahu Transit Center Station Mauka Trench 2

Figure 190. Photograph of Waipahu Transit Center Station Mauka Trench 2, view to east

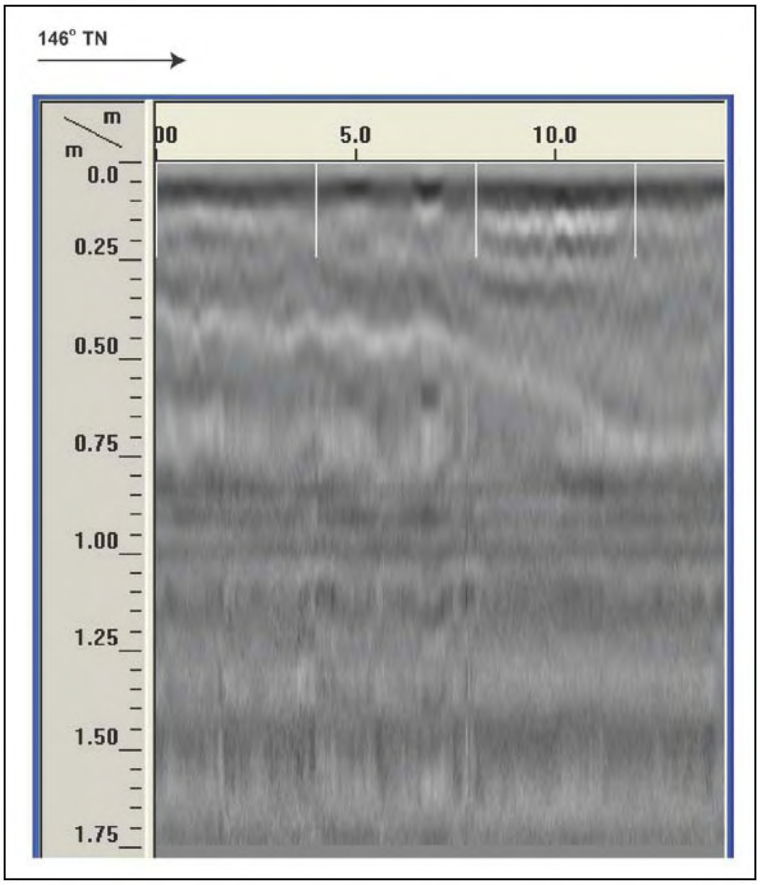

Figure 191. GPR profile of Waipahu Transit Center Station Mauka Trench 2

Waipahu Transit Center Station Mauka Trench 3

Orientation	074° TN
Length	5 m
Width	0.8 m
Maximum Depth	2.7 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-30	Basalt gravel base coarse
Ic	30-40	Fill; 10 YR 3/1, very dark gray; clay loam; moderate, medium, crumb structure; dry, friable consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography.
Id	40-130	Fill; 2.5 YR 3/6, dark red; silty clay loam; moderate, medium, crumb structure; moist, friable consistency; non plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Contains roots.
Ie	130-150	Fill; 10 YR 2/1, black; clay loam; moderate, medium, crumb structure; moist, firm consistency; slightly plastic; no cementation; marine origin; clear boundary; wavy topography. Contains oyster shell.
If	150-200	Fill; 2.5 YR 4/4, olive brown; sandy clay; moderate, medium grandular structure; moist, firm consistency; slightly plastic; no cementation; marine origin; diffuse boundary; wavy topography.
II	200-270	10 YR 2/1, black; clay loam; moderate, fine crumb structure; wet, very sticky consistency; very plastic; strong cementation. Naturally deposited alluvial sediment. Inundated clay indicitive of former marsh envirnoment.

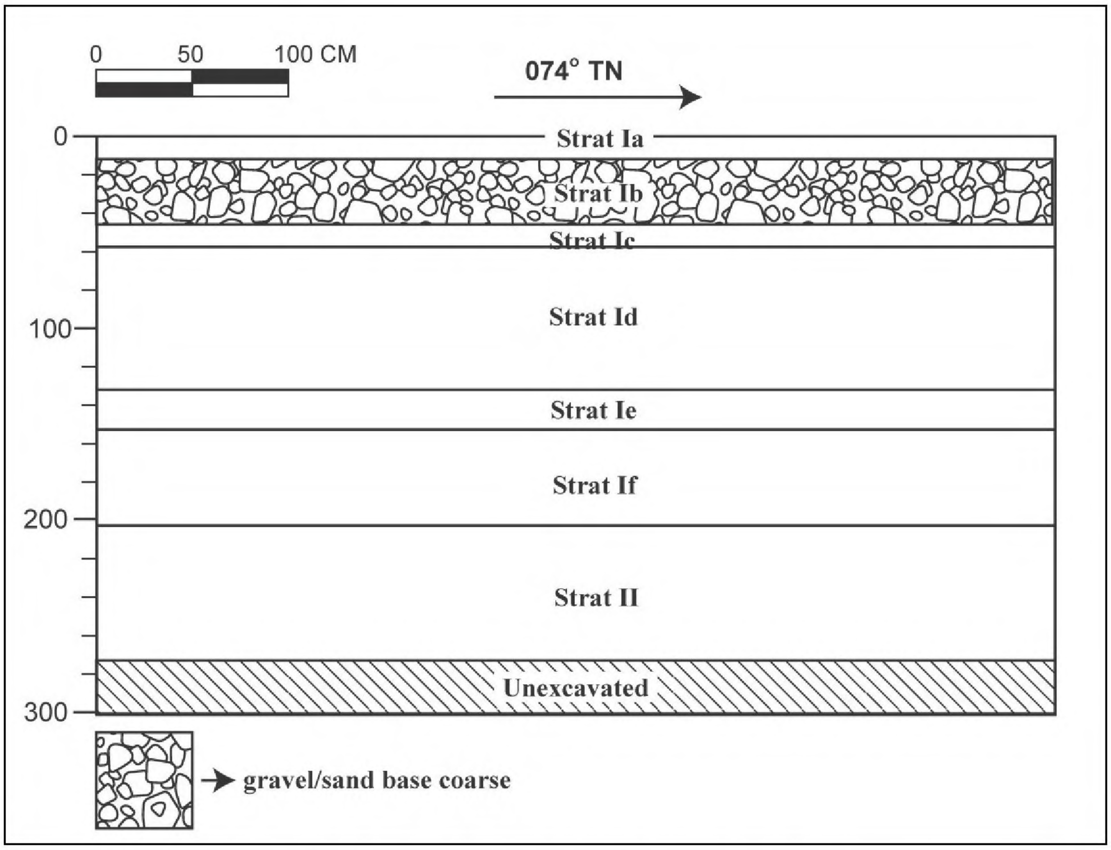

Figure 192. Profile of Waipahu Transit Center Station Mauka Trench 3

Figure 193. Photograph of Waipahu Transit Center Station Mauka Trench 3, view to north

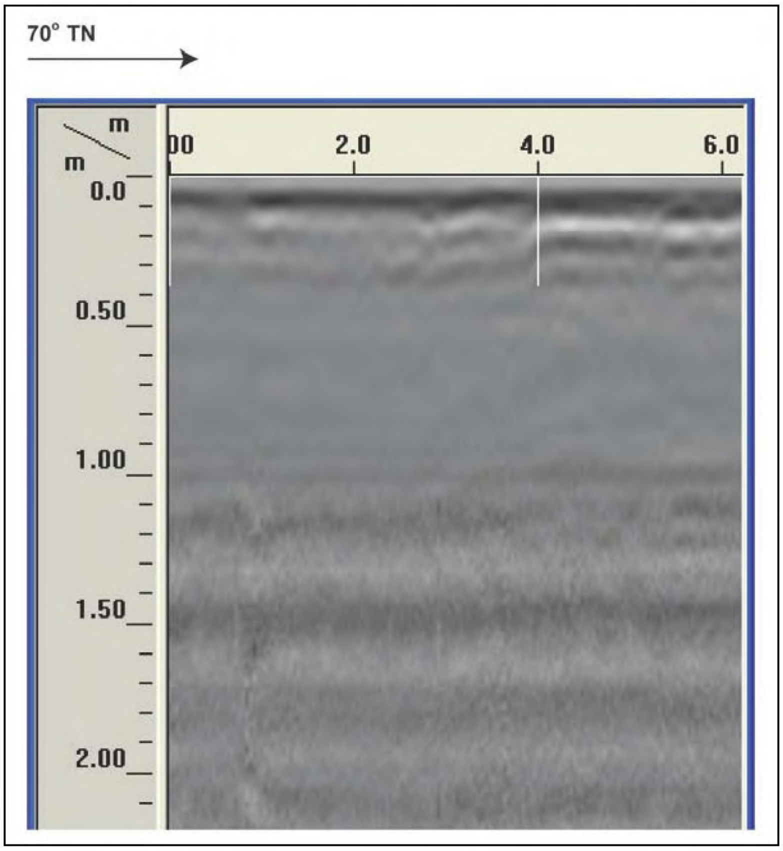

Figure 194. GPR profile of Waipahu Transit Center Station Mauka Trench 3

Waipahu Transit Center Station Mauka Trench 4

Orientation	065° TN
Length	5 m
Width	0.8 m
Maximum Depth	2.7 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-70	10 YR 5/2, grayish brown; clay loam; structureless; dry, loose consistency; slightly plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Contains 50% basalt gravel. Base course for asphalt surface.
Ic	50-190	5 YR 4/4, reddish brown; silty clay; moderate, fine, crumb structure; dry, loose consistency; slightly plastic; no cementation; terrestrial origin; abrupt boundary; wavy topography.
Id	190-205	10 YR 4/4, dark yellowish brown; clay loam; weak, fine, crumb structure; dry, loose consistency; slightly plastic; no cementation; mixed origin; abrupt boundary; smooth topography. Fill sediments containing coral and basalt aggragate to prevent ground water seepage.
II	205-270	Gley 3/10B, very dark bluish gray; clay; strong, fine, crumb structure; wet, very sticky consistency; very plastic; no cementation; terrestrial. Naturally deposited wetland sediments indicating area consisted of a marsh prior to modern urban development.

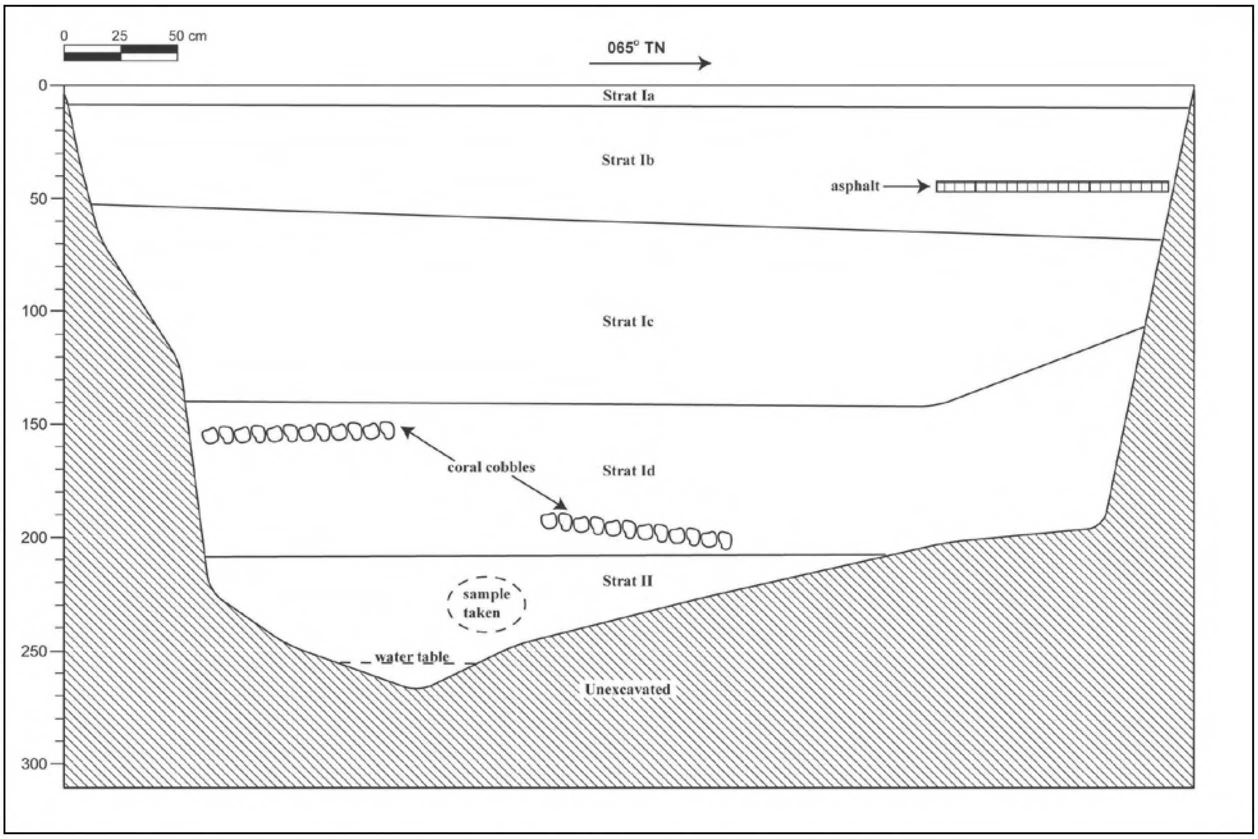

Figure 195. Profile of Waipahu Transit Center Station Mauka Trench 4

Figure 196. Photograph of Waipahu Transit Center Station Mauka Trench 4, view to northwest

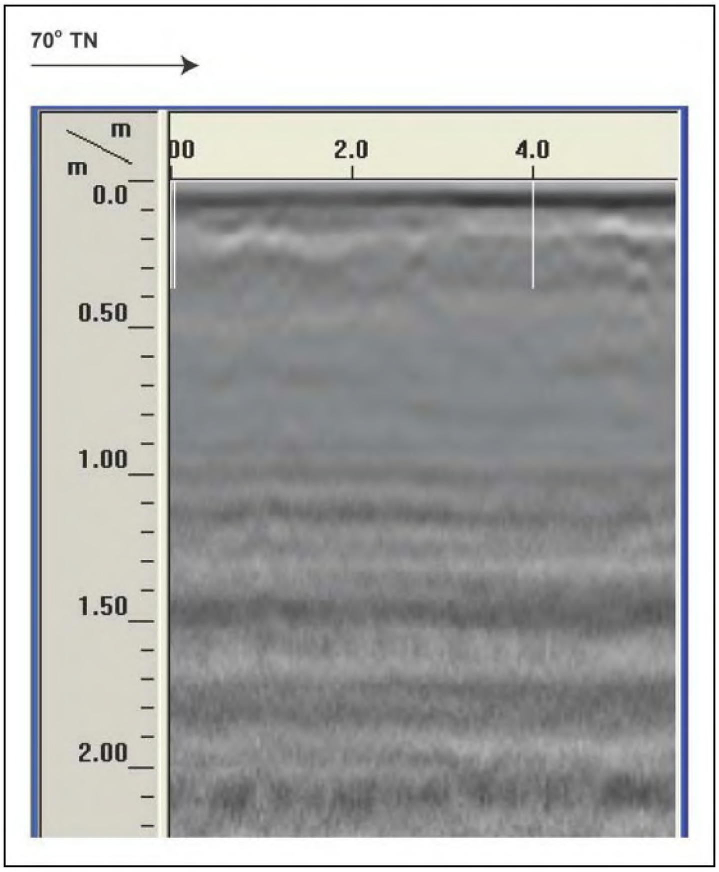

Figure 197. GPR profile of Waipahu Transit Center Station Mauka Trench 4

Waipahu Transit Center Station Mauka Trench 5

Orientation	082° TN
Length	4.5 m
Width	0.8 m
Maximum Depth	2.7 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-50	Fill; 10 YR 5/2, grayish brown; clay loam; structureless; dry, loose consistency; slightly plastic; no cementation; terrestrial origin; abrupt boundary; smooth topography. Contains 50% basalt gravel. Base course for asphalt surface.
Ic	50-200	Fill; 5 YR 4/4, reddish brown; silty clay; moderate, fine, crumb structure; dry, loose consistency; slightly plastic; no cementation; terrestrial origin; abrupt boundary; wavy topography.
II	200-270	Gley 3/10B, very dark bluish gray; clay; strong, fine, crumb structure; wet, very sticky consistency; very plastic; no cementation; terrestrial. Naturally deposited wetland sediments indicating area consisted of a marsh prior to modern urban development.

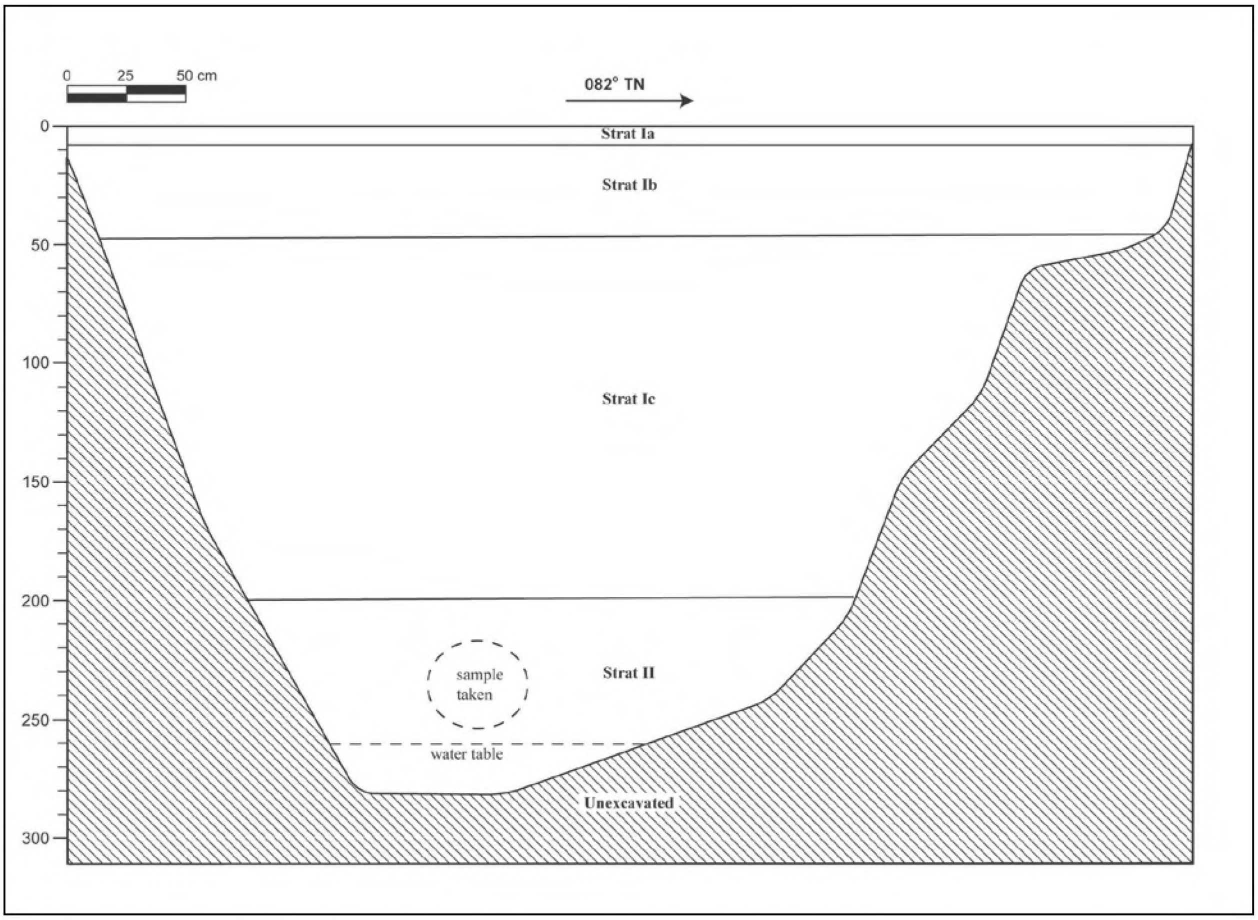

Figure 198. Profile of Waipahu Transit Center Station Mauka Trench 5

Figure 199. Photograph of Waipahu Transit Center Station Mauka Trench 5, view to north

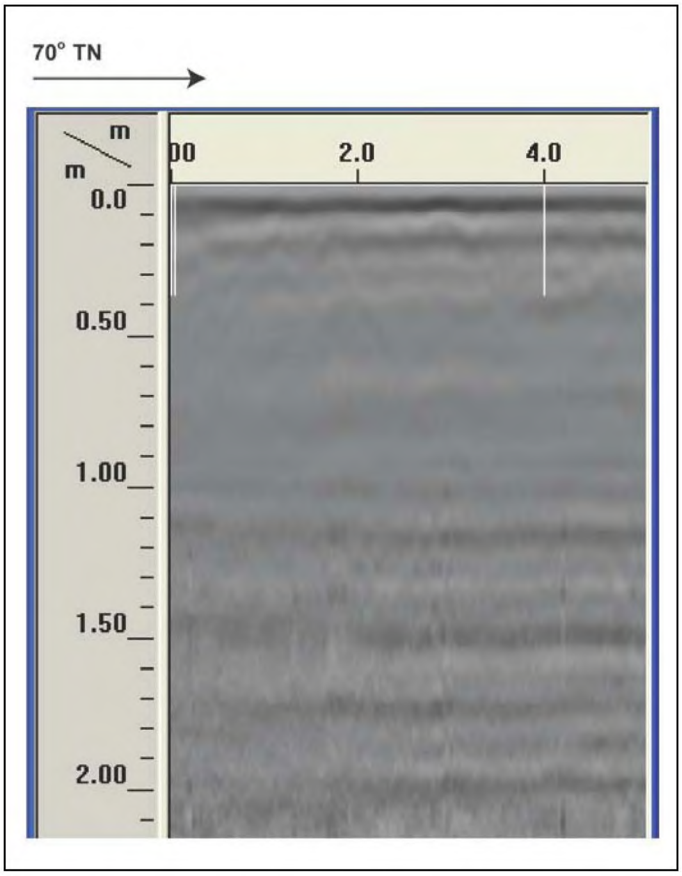

Figure 200. GPR profile of Waipahu Transit Center Station Mauka Trench 5

Waipahu Transit Center Station Mauka Trench 6

Orientation	249° TN
Length	6 m
Width	0.8 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill; 10 YR 4/2, dark grayish brown; asphalt, silt loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Surface grading fill with broken asphalt slab and modern debris - plastic bottles, cans, insulation (foam). Concrete, gravel - roots/rootlings from weeds and grass, small to med. Cobbles
Ib	40-50	Fill; 10 R 4/6, red; silty clay; moderate, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Alluvial fill overlying gravel fill
Ic	50-60	Fill; 10 YR 5/1, gray; gravel; structureless, loose dry consistency; non-plastic; no cementation; very abrupt smooth lower boundary; Gravel fill possibly used for drainage
Id	60-230	Fill; 10R 3/6, red; silty clay; moderate, fine, crumb structure; loose dry consistency; friable moist consistency; slightly plastic; no cementation; very abrupt smooth lower boundary; Silty clay alluvium appears redeposited with layer of basalt cobbles and boulders at base (207 - 226cm bsl)
II	230-250	10 YR 3/1, very dark gray; clay; strong, fine, crumb structure; firm moist consistency; very sticky wet consistency; very plastic; no cementation; wetland clay contains decomposing roots/rootlings, ground water at 250cmbs, sampled at 235 - 245cm bsl.

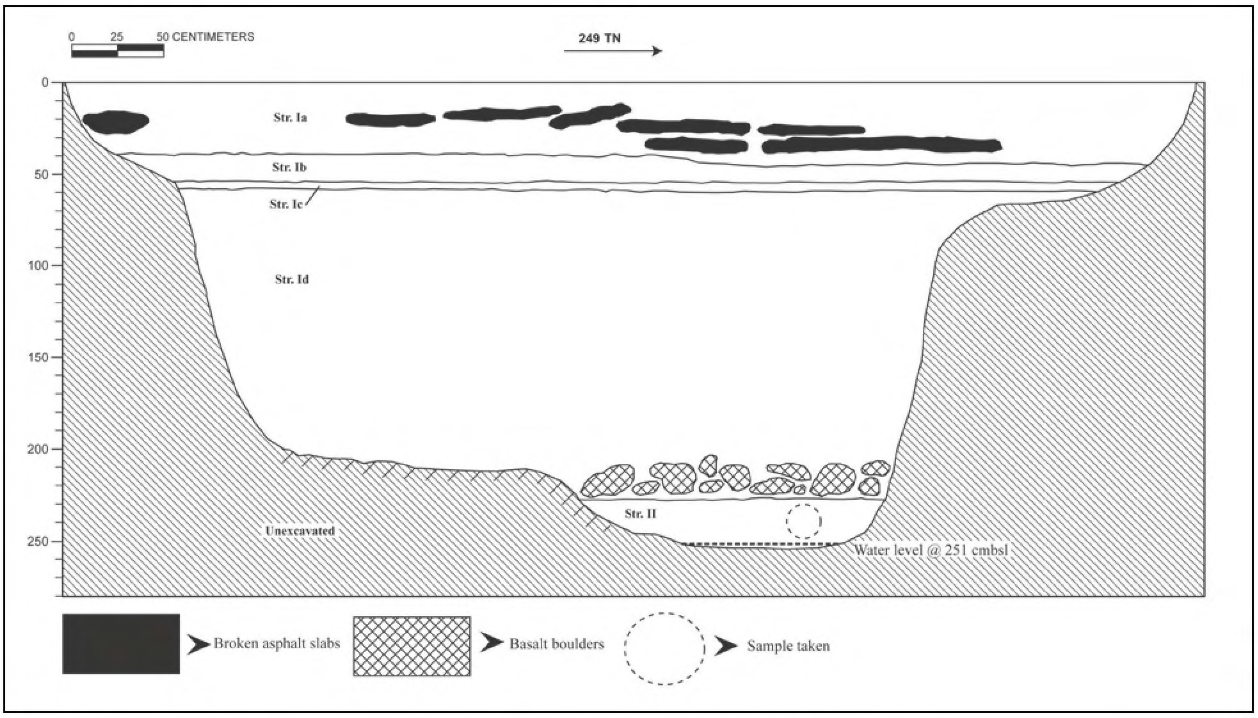

Figure 201. Profile of Waipahu Transit Center Station Mauka Trench 6

Figure 202. Photograph of Waipahu Transit Center Station Mauka Trench 6, view to southeast

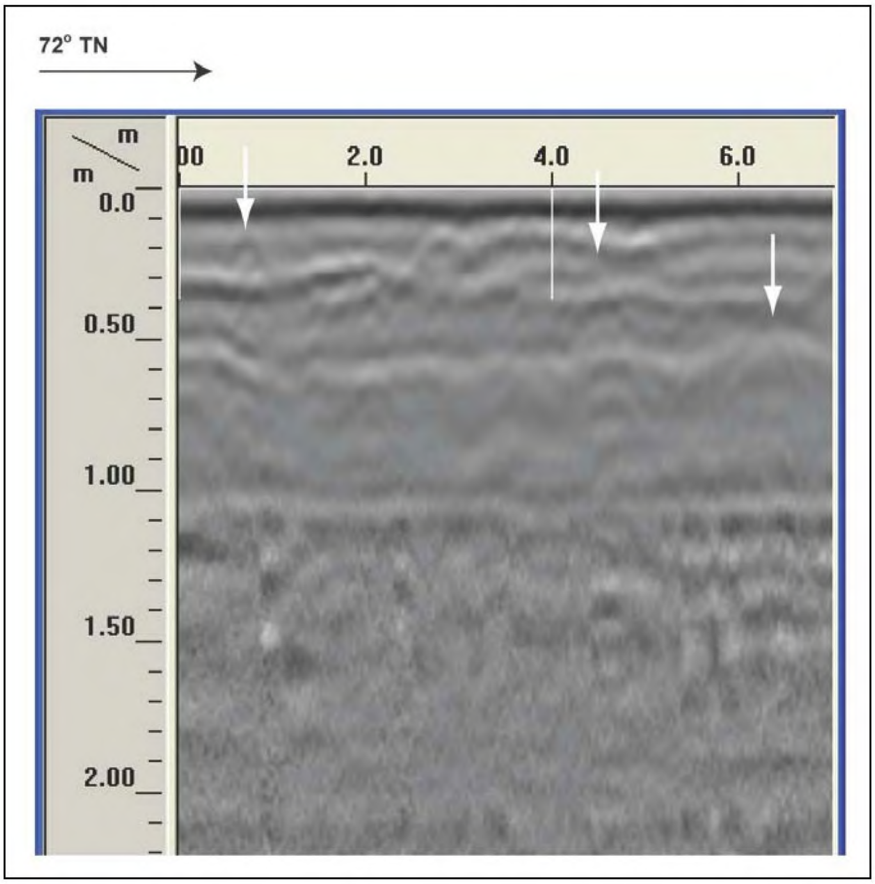

Figure 203. GPR profile of Waipahu Transit Center Station Mauka Trench 6

Waipahu Transit Center Station Makai Trench 1

Orientation	170° TN
Length	8 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-30	Crushed coral fill
Ic	30-100	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface of underlying wetland sediments, indicative of land reclamation construction techniques.
II	100-200	10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

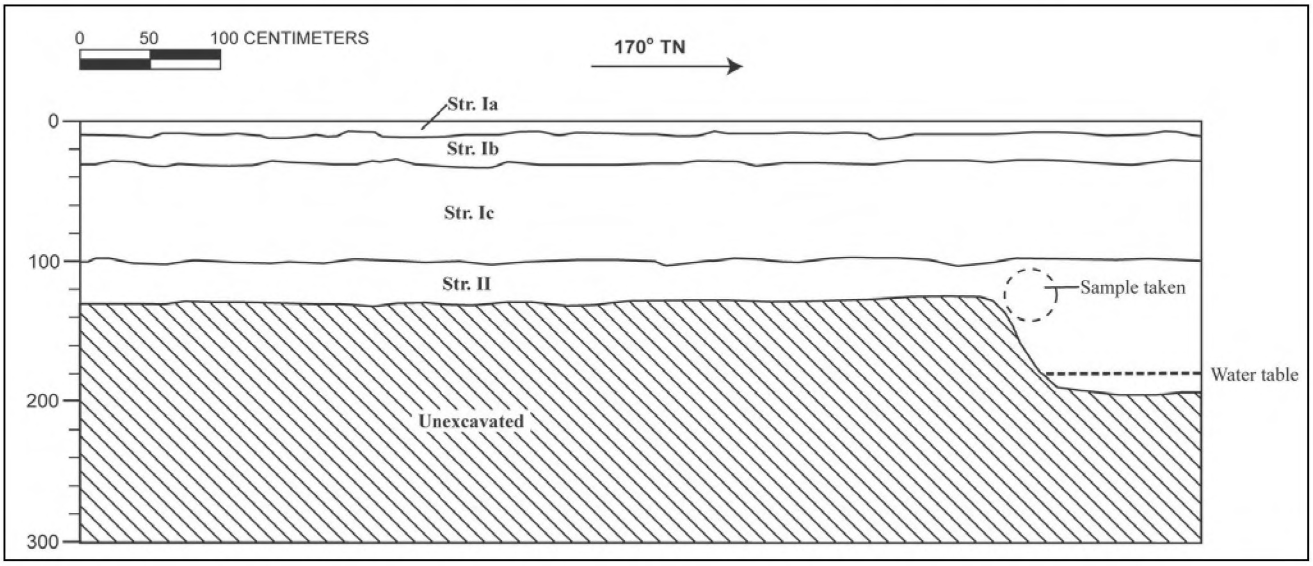

Figure 204. Profile of Waipahu Transit Center Station Makai Trench 1

Figure 205. Photograph of Waipahu Transit Center Station Makai Trench 1, view to east

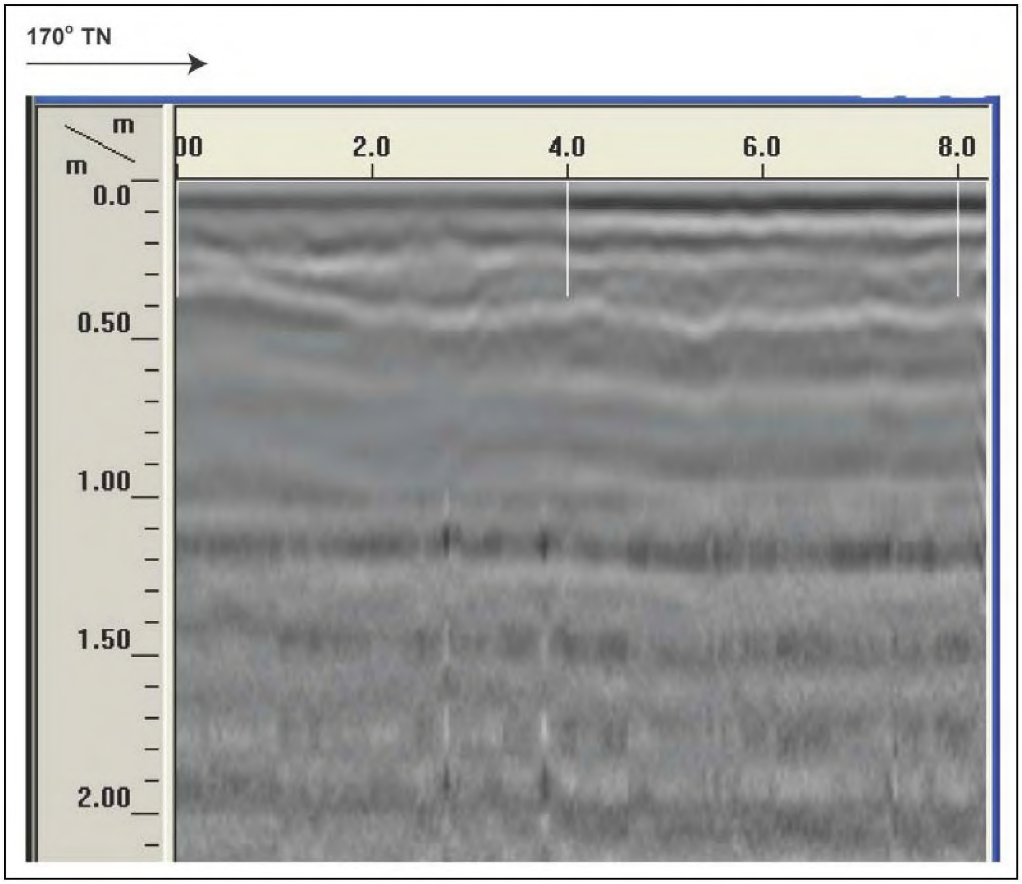

Figure 206. GPR profile of Waipahu Transit Center Station Makai Trench 1

Waipahu Transit Center Station Makai Trench 2

Orientation	170° TN
Length	4 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Crushed coral fill
Ic	20-50	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Id	50-125	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	125-200	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

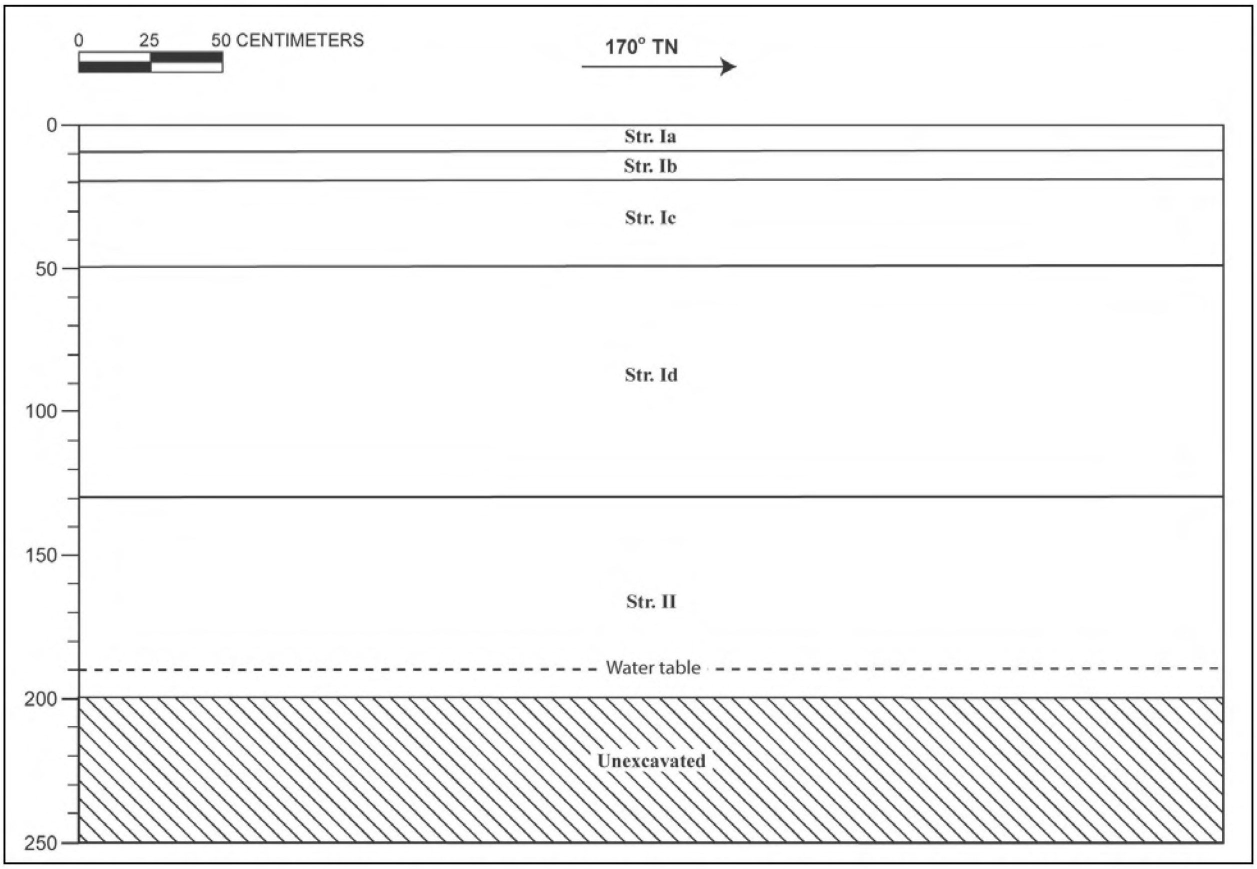

Figure 207. Waipahu Transit Center Station Makai Trench 2

Figure 208. Photograph of Waipahu Transit Center Station Makai Trench 2, view to east

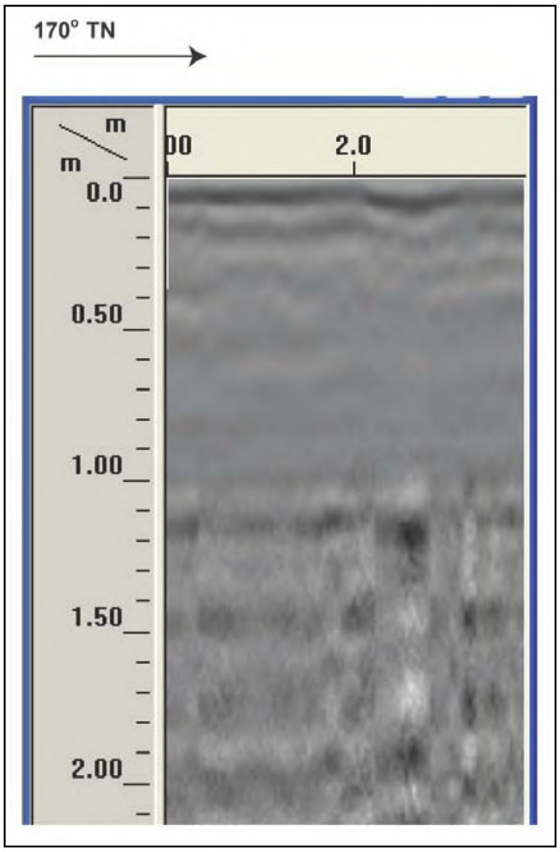

Figure 209. GPR profile of Waipahu Transit Center Station Makai Trench 2

Waipahu Transit Center Station Makai Trench 3

Orientation	170° TN
Length	4 m
Width	0.8 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Crushed coral fill
Ic	20-60	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Id	60-130	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	130-200	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

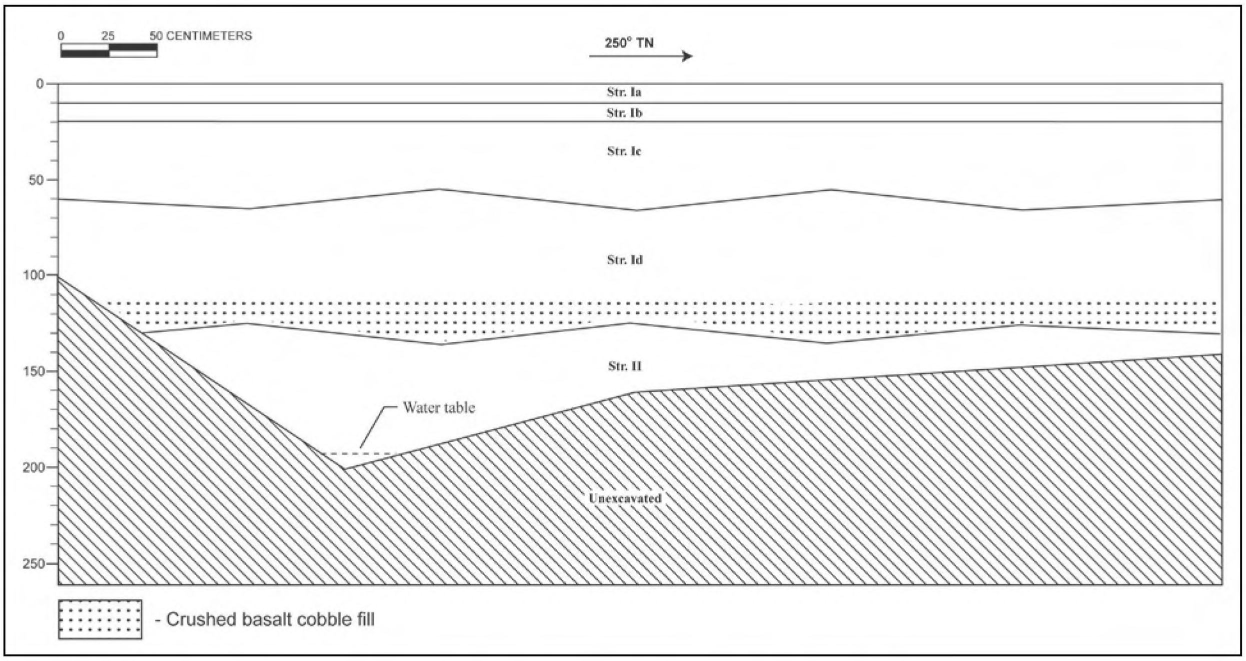

Figure 210. Profile of Waipahu Transit Center Station Makai Trench 3

Figure 211. Photograph of Waipahu Transit Center Station Makai Trench 3, view to south

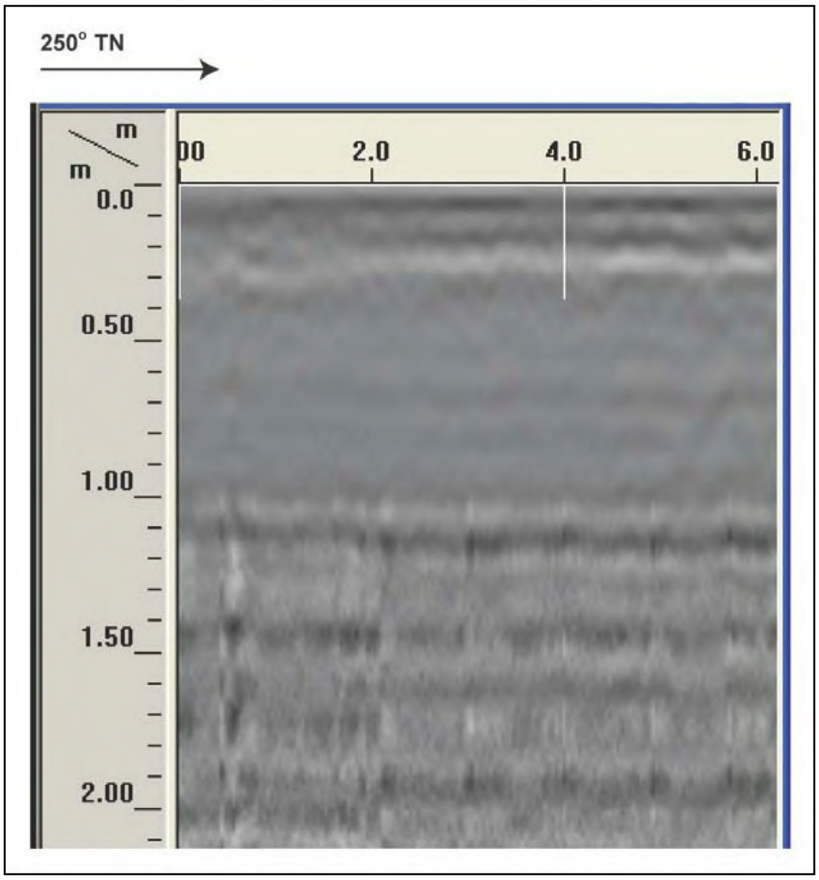

Figure 212. GPR profile of Waipahu Transit Center Station Makai Trench 3

Waipahu Transit Center Station Makai Trench 4

Orientation	250° TN
Length	3 m
Width	0.8 m
Maximum Depth	1.7 m

Stratum	Depth (cmbs)	Description
Ia	0-5	Asphalt
Ib	5-20	Crushed coral fill
Ic	20-75	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Id	75-130	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	130-175	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

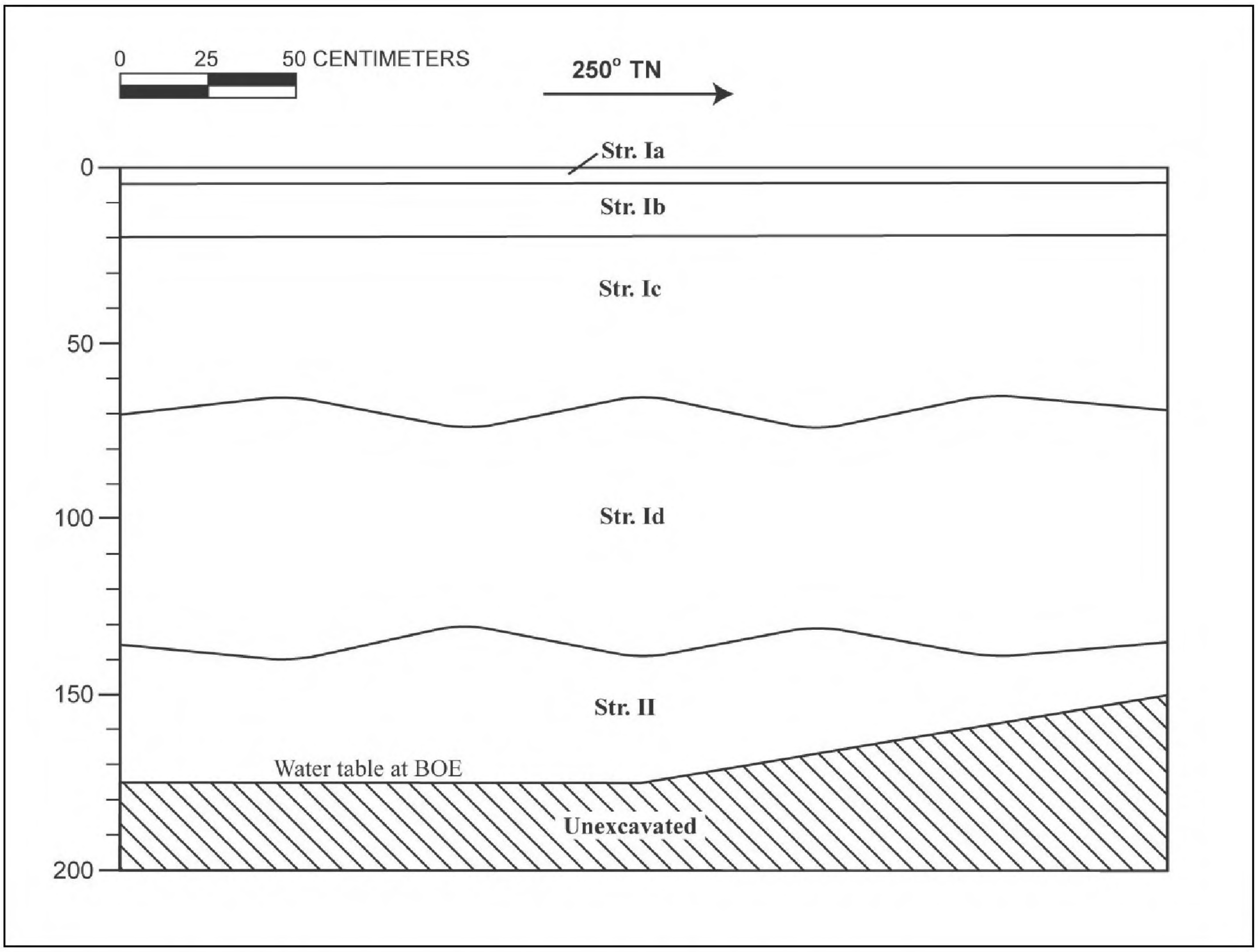

Figure 213. Profile of Waipahu Transit Center Station Makai Trench 4

Figure 214. Photograph of Waipahu Transit Center Station Makai Trench 4, view to south

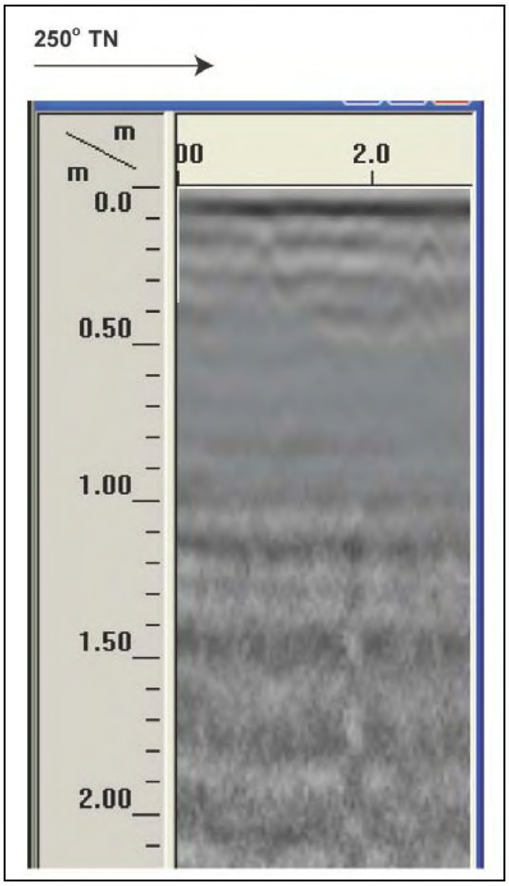

Figure 215. GPR profile of Waipahu Transit Center Station Makai Trench 4

Waipahu Transit Center Station Makai Trench 5

Orientation	256° TN
Length	4.5 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-50	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Ic	50-110	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	110-210	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

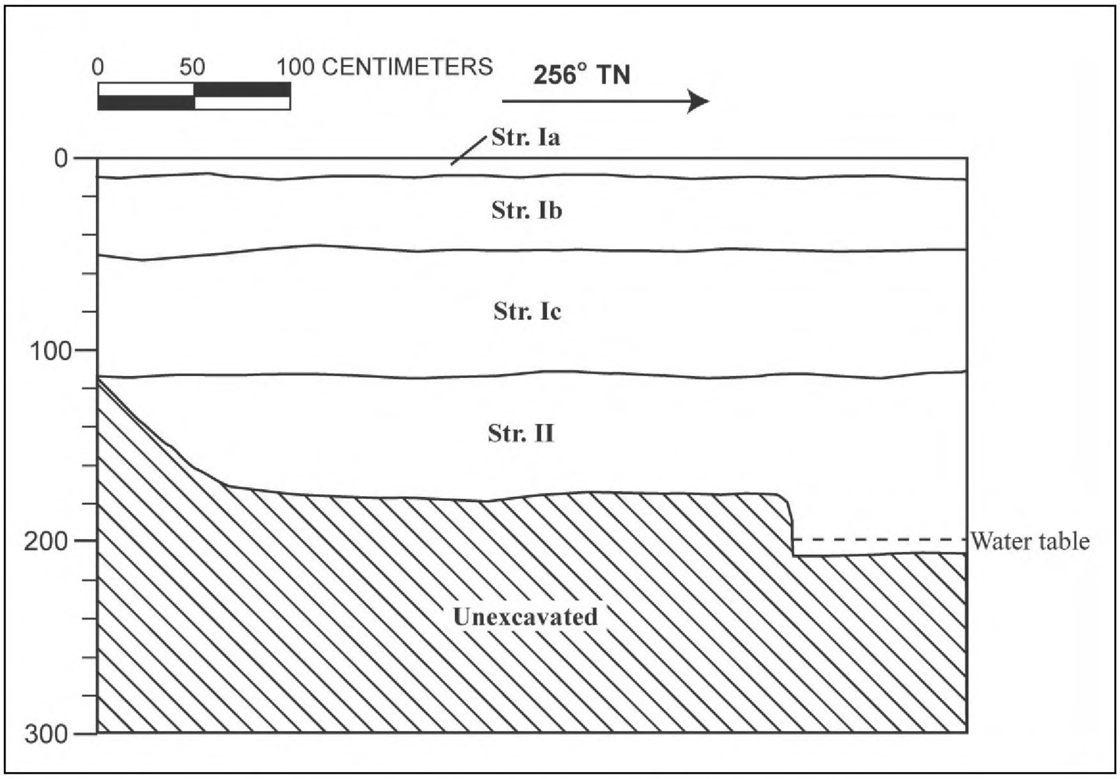

Figure 216. Profile of Waipahu Transit Center Station Makai Trench 5

Figure 217. Photograph of Waipahu Transit Center Station Makai Trench 5, view to south

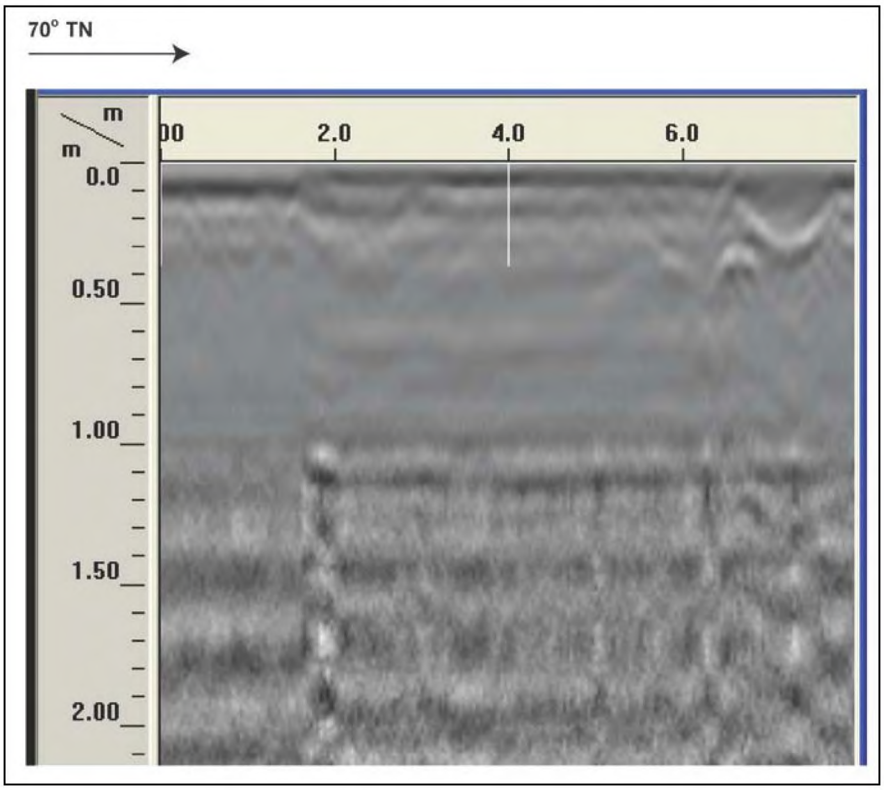

Figure 218. GPR profile of Waipahu Transit Center Station Makai Trench 5

Waipahu Transit Center Station Makai Trench 6

Orientation	70° TN
Length	8 m
Width	0.8 m
Maximum Depth	2.3 m

Stratum	Depth (cmbs)	Description
Ia	0-5	Asphalt
Ib	5-20	Crushed coral fill
Ic	20-50	Fill; 5 YR 3/3, dark reddish brown; silt loam; structureless; moist, friable consistency; non plastic; no cementation; abrupt boundary; smooth topography; terrestrial origin. Contains basalt gravel and cobbles. Imported construction fill.
Id	50-120	Fill; 10 YR 3/4, dark yellowish brown; clay loam; moderate, medium, crumb structure; dry, hard consistency; plastic; weak cementation; abrupt boundary; smooth topography; terrestrial origin. Imported sediment associated with urban development of former wetland environment. Layer of basalt cobbles observed at the interface with underlying wetland sediments, indicative of land reclamation construction techniques.
II	120-230	A Horizon; 10 YR 2/1, black; clay; moderate, medium; blocky structure; moist, firm consistency; very plastic; no cementation; terrestrial origin. Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development. Contains reddish orange mottling and charcoal flecking, which is indicative of wetland taro agriculture (see the SIHP # 50-80-09-7751 historic property description).

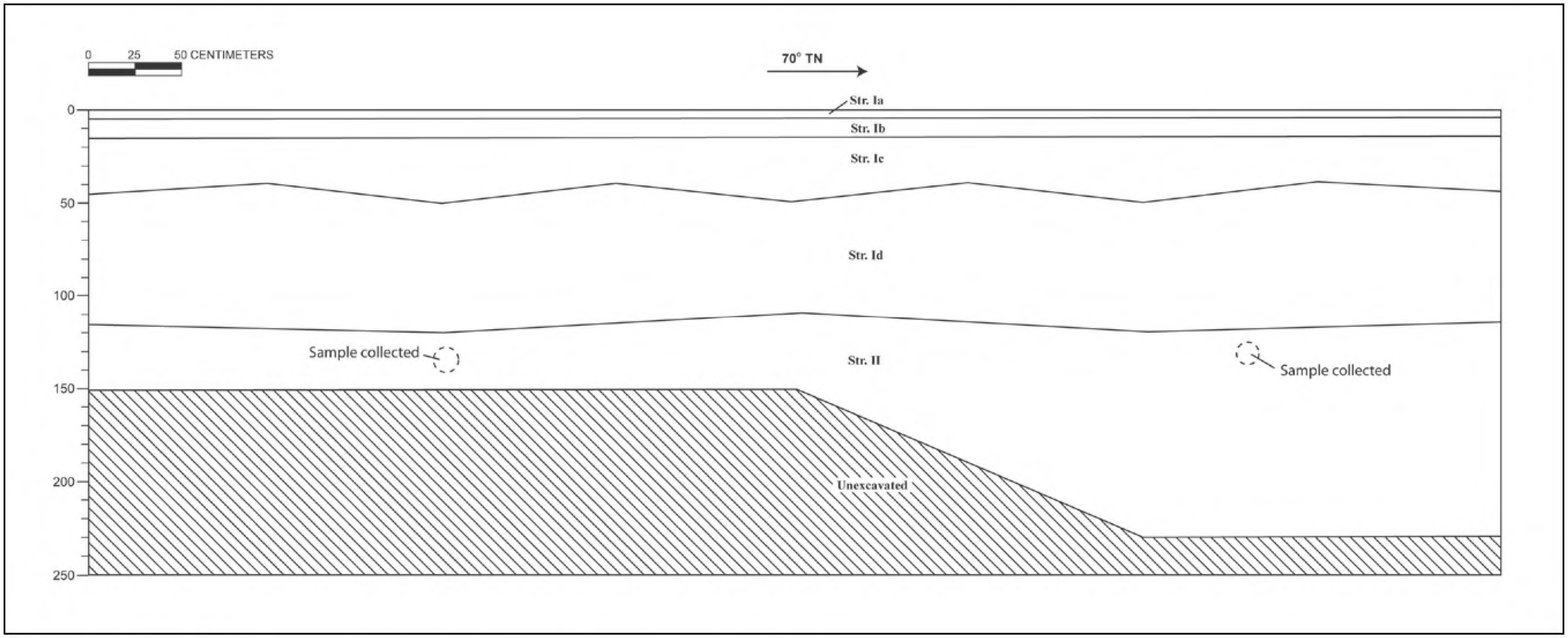

Figure 219. Profile of Waipahu Transit Center Station Makai Trench 6

Figure 220. Photograph of Waipahu Transit Center Station Makai Trench 6, view to north

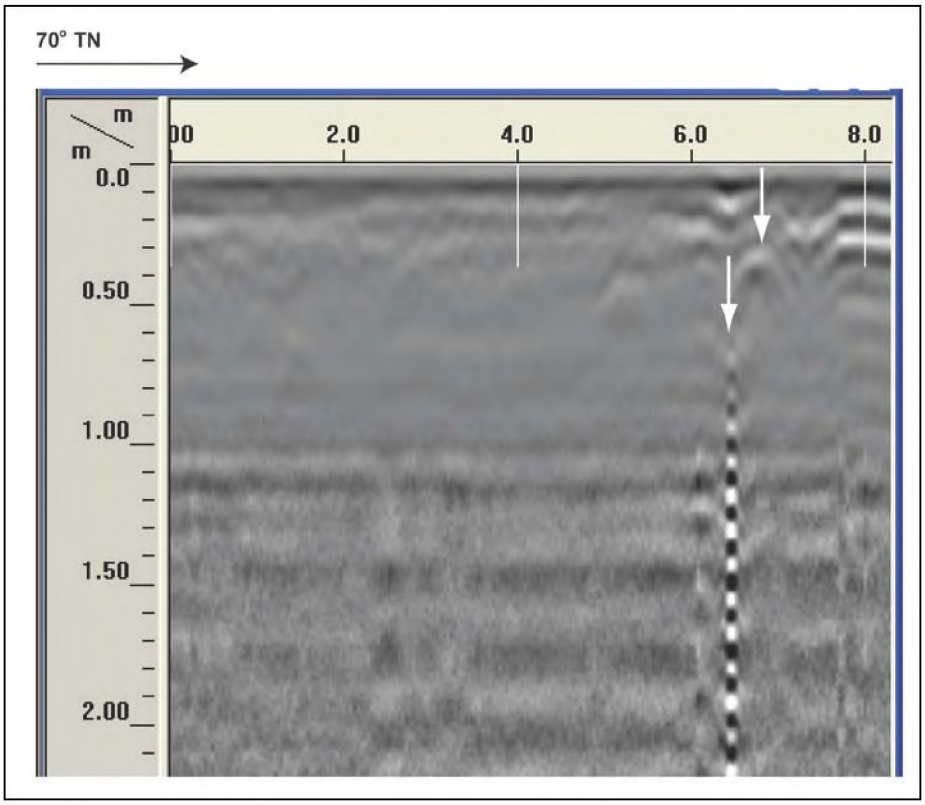

Figure 221. GPR profile of Waipahu Transit Center Station Makai Trench 6

Column Test 21 (C-21)

Orientation	079° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
Ia	0-30	Fill; 7.5 YR 3/2, dark brown; clay loam; moderate, fine, crumb structure; very friable moist consistency; sticky wet consistency; plastic; no cementation; abrupt smooth lower boundary; topsoil for landscaped median, roots and rootlings from grass and trees
Ib	30-60	Fill; 10 YR 4/3, brown; silt loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; grading and landscaping material- 1/2" irrigation hose, pipe at 30 - 45cmbsl
Ic	60-90	Fill; 5 YR 3/2, dark reddish brown; garvelly, coral, silt; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; drainage fill- contains gravel and coral cobbles
II	90-150	7.5 YR 4/3, brown; clay loam; moderate, fine, crumb structure; firm moist consistency; sticky wet consistency; plastic; no cementation; abrupt smooth lower boundary; natural upper sediment contains small cobbles
III	150-160	10 YR 3/2, very dark grayish brown; clay; strong, fine, crumb structure; firm moist consistency; very sticky wet consistency; plastic; no cementation; Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

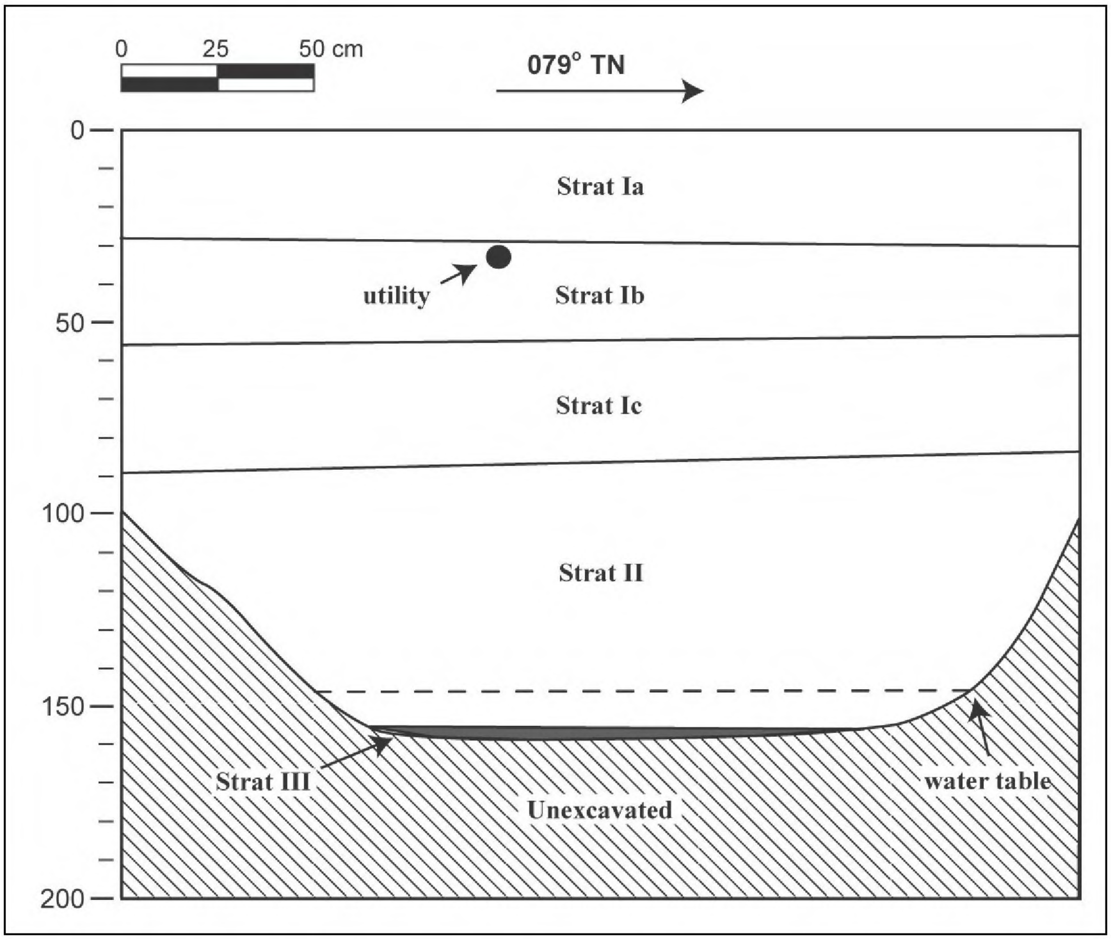

Figure 222. Profile of Column Test 21 (C-21)

Figure 223. Photograph of Column Test 21 (C-21), view to north

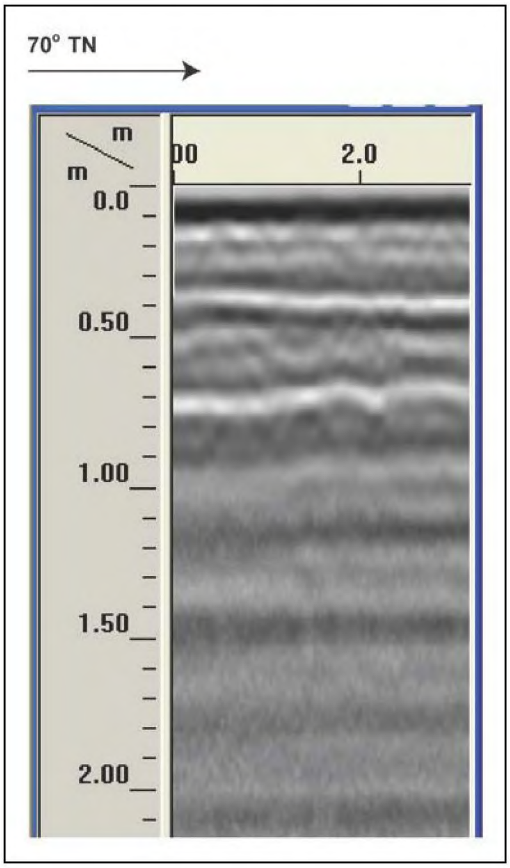

Figure 224. GPR profile of Column Test 21 (C-21)

Column Test 22 (C-22)

Orientation	258° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.5 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Asphalt
Ib	40-75	Fill Horizon; 10 YR 4/1, dark gray; garvelly, cobbly, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; gravel/sand fill underlying asphalt
II	75-150	Fill Horizon; 10 YR 3/3, dark brown; clay loam; moderate, fine, crumb structure; very firm moist consistency; very sticky wet consistency; plastic; no cementation; back-filled natural sediments, water table at BOE

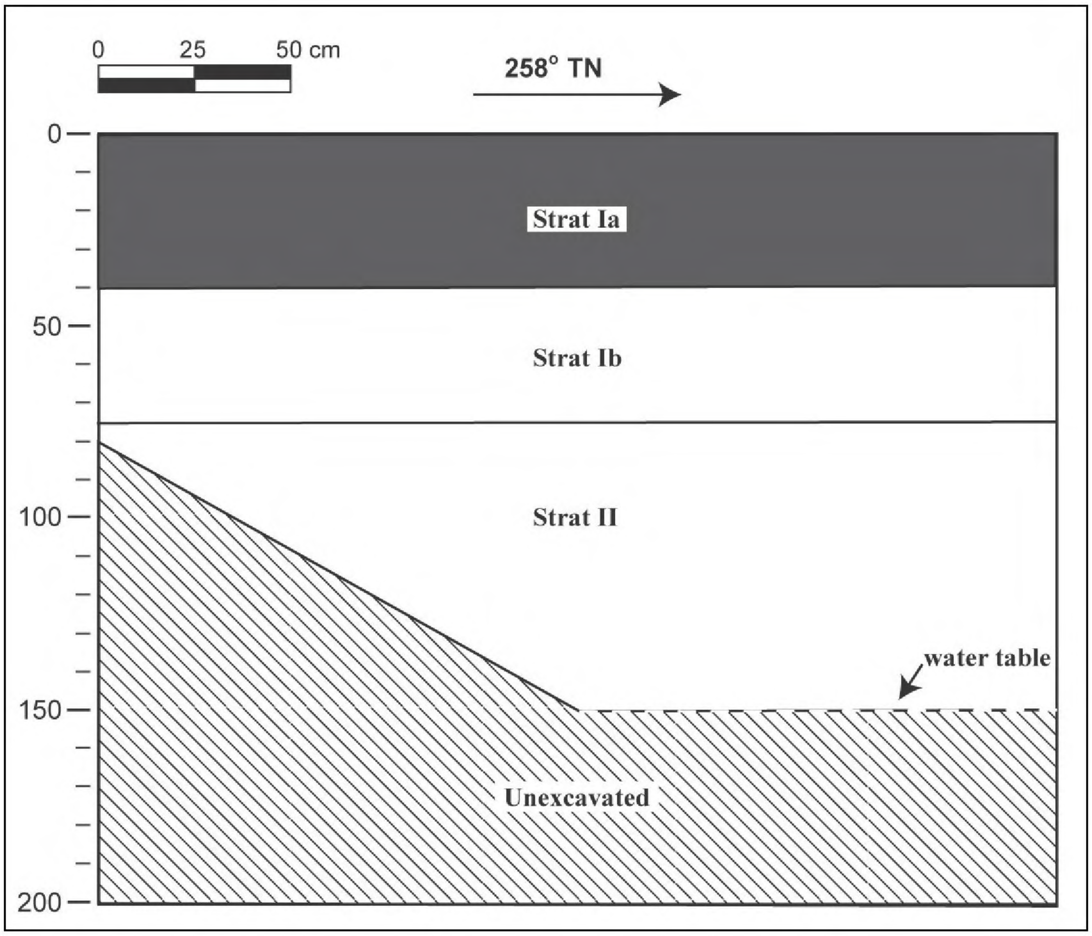

Figure 225. Profile of Column Test 22 (C-22)

Figure 226. Photograph OF Column Test 22 (C-22), view to south

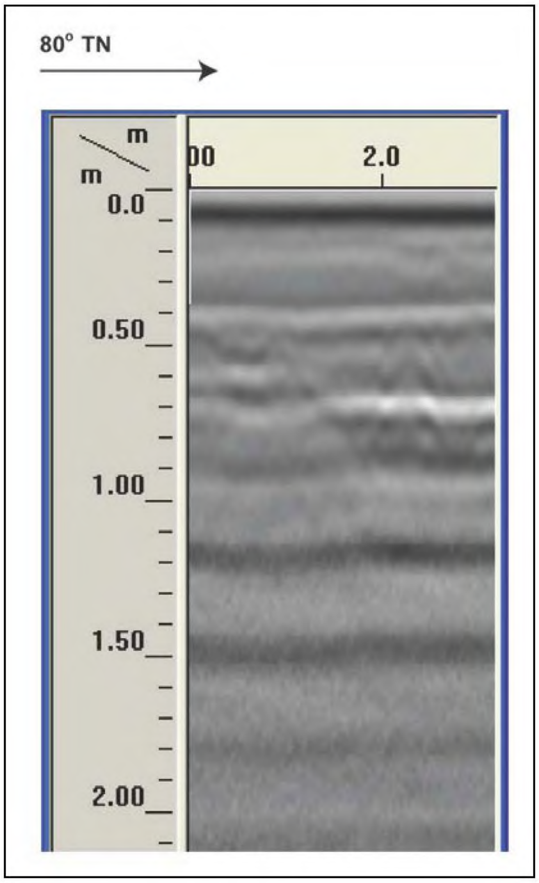

Figure 227. GPR profile of Column Test 22 (C-22)

Column Test 23 (C-23)

Orientation	258° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.9 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Asphalt
Ib	40-70	Fill Horizon; GLEY 2 3/1, very dark greenish gray; garvelly, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; gravel/sand base coarse underlying asphalt
Ic	70-160	Fill; 10 YR 3/4, dark yellowish brown; silty clay loam; moderate, medium, crumb structure; firm moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary; back-filled natural sediments
II	160-190	10 YR 3/1, very dark gray; clay; strong, fine, crumb structure; very firm moist consistency; very plastic; no cementation; water table, very wet sediments, Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

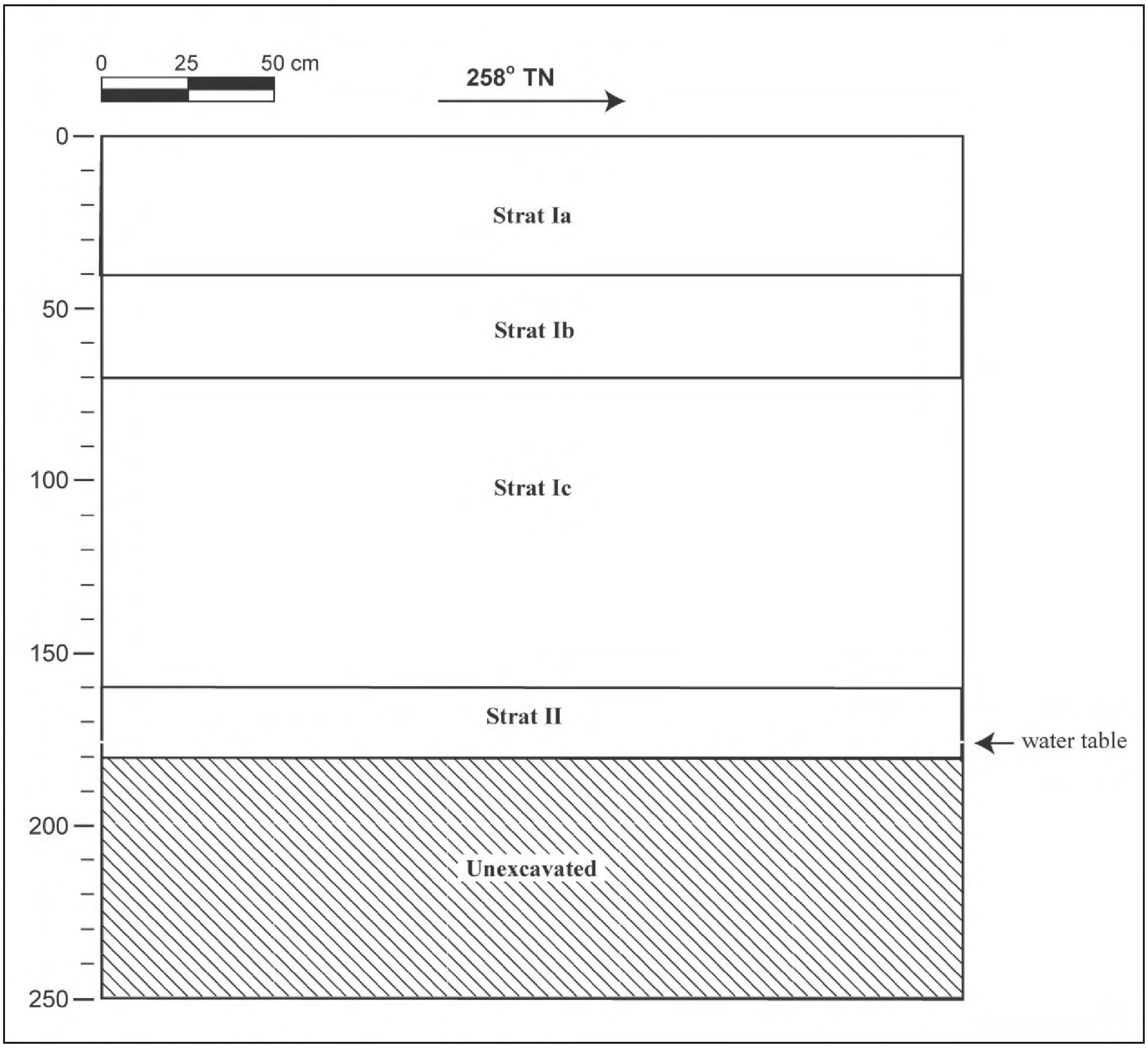

Figure 228. Profile of Column Test 23 (C-23)

Figure 229. Photograph of Column Test 23 (C-23), view to south

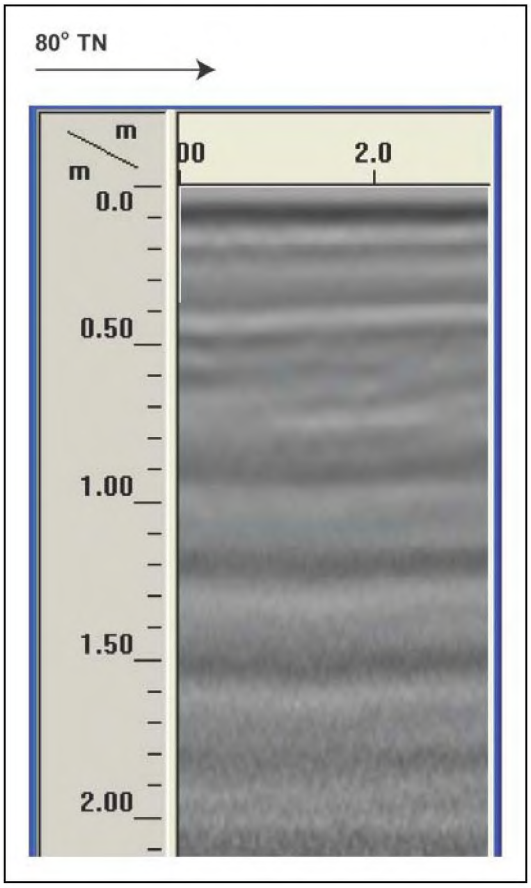

Figure 230. GPR profile of Column Test 23 (C-23)

Column Test 24 (C-24)

Orientation	151° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-50	Asphalt
Ib	50-60	Fill; 10 YR 4/1, dark gray; garvelly, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; gravel/sand fill underlying road surface, grading material
Ic	60-170	Fill; 10 YR 3/4, dark yellowish brown; garvelly, clay loam; weak, fine, crumb structure; loose dry consistency; friable moist consistency; non-sticky wet consistency; slightly plastic; no cementation; abrupt smooth lower boundary; terrigenous fill used to cover wetlands prevent ground water from seeping up
II	170-200	10 YR 3/1, very dark gray; clay; strong, fine, crumb structure; very firm moist consistency; very plastic; no cementation; water table, very wet sediments, Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

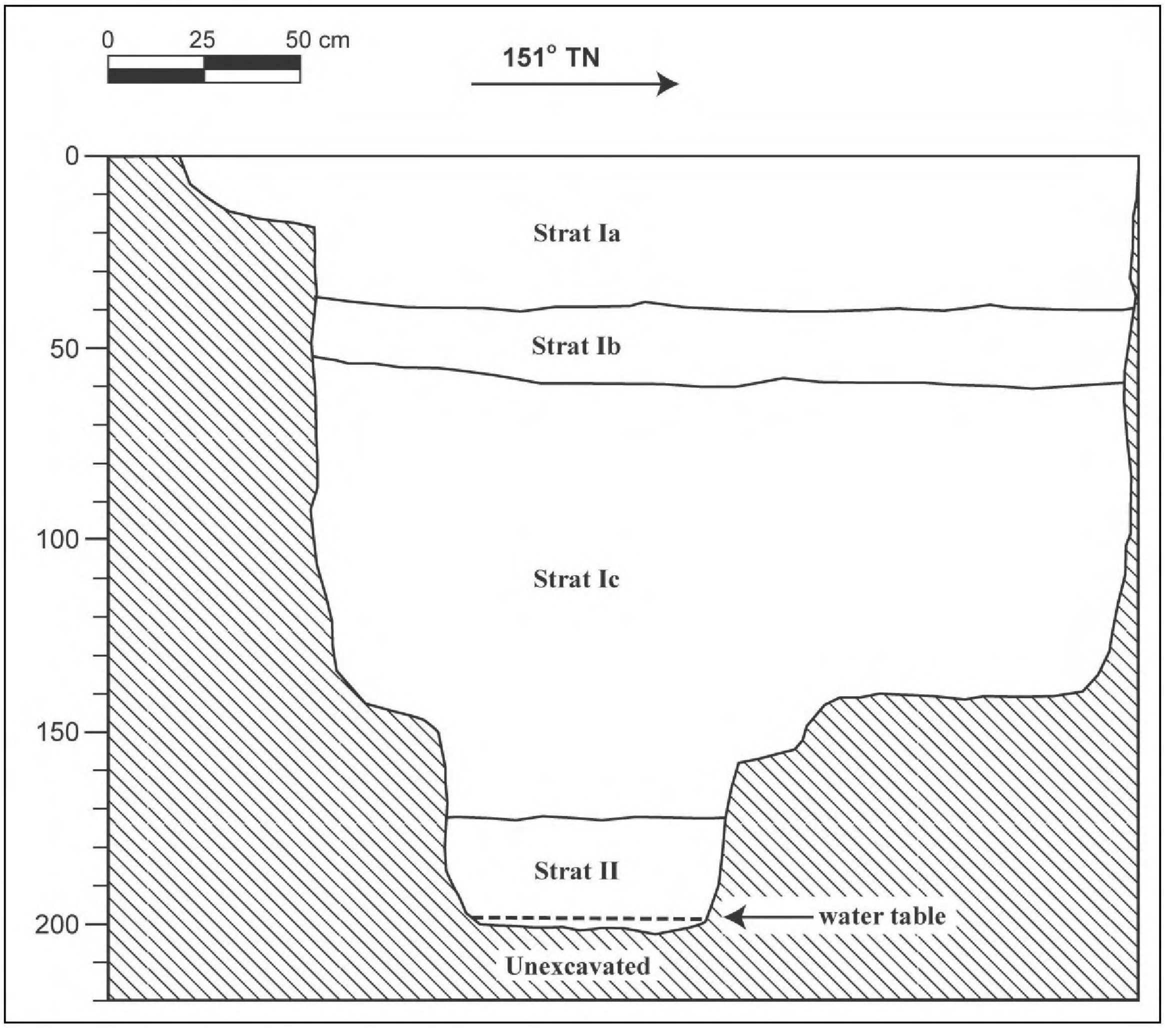

Figure 231. Profile of Column Test 24 (C-24)

Figure 232. Photograph of Column Test 24 (C-24), view to northeast

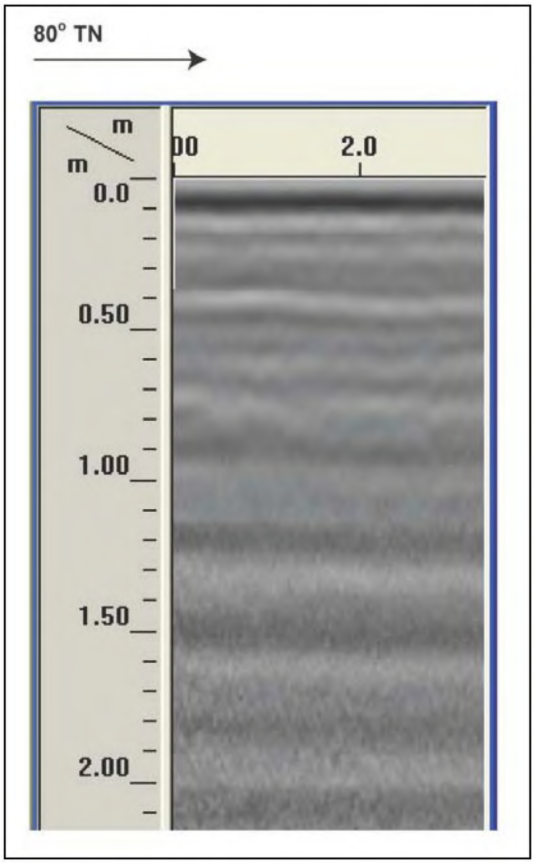

Figure 233. GPR profile of Column Test 24 (C-24)

Column Test 25 (C-25)

Orientation	76° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.4 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill Horizon; 5 YR 3/4, dark reddish brown; silt loam; weak, medium, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Landscaping fill for hwy median.
Ib	40-90	Fill Horizon; 10 YR 4/2, dark grayish brown; coarse, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Contains gravel; appears to be a combination of grading material and grouted coushion material for utilities.
Ic	90-110	Fill Horizon; 2.5 Y 7/3, pale yellow; coarse, sand; weak, coarse or thick, blocky structure; loose dry consistency; non-plastic; no cementation; clear smooth lower boundary; Grading material.
II	110-210	Fill Horizon; 10 YR 3/4, dark yellowish brown; silty clay; moderate, fine, crumb structure; hard dry consistency; very firm moist consistency; plastic; no cementation; diffuse irregular lower boundary; Back-filled possibly by natural sediments used as grading material, possibly mixed w/ clay layer below.
III	140-240	10 YR 3/1, very dark gray; clay; strong, fine, crumb structure; extremely firm moist consistency; very plastic; no cementation; Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

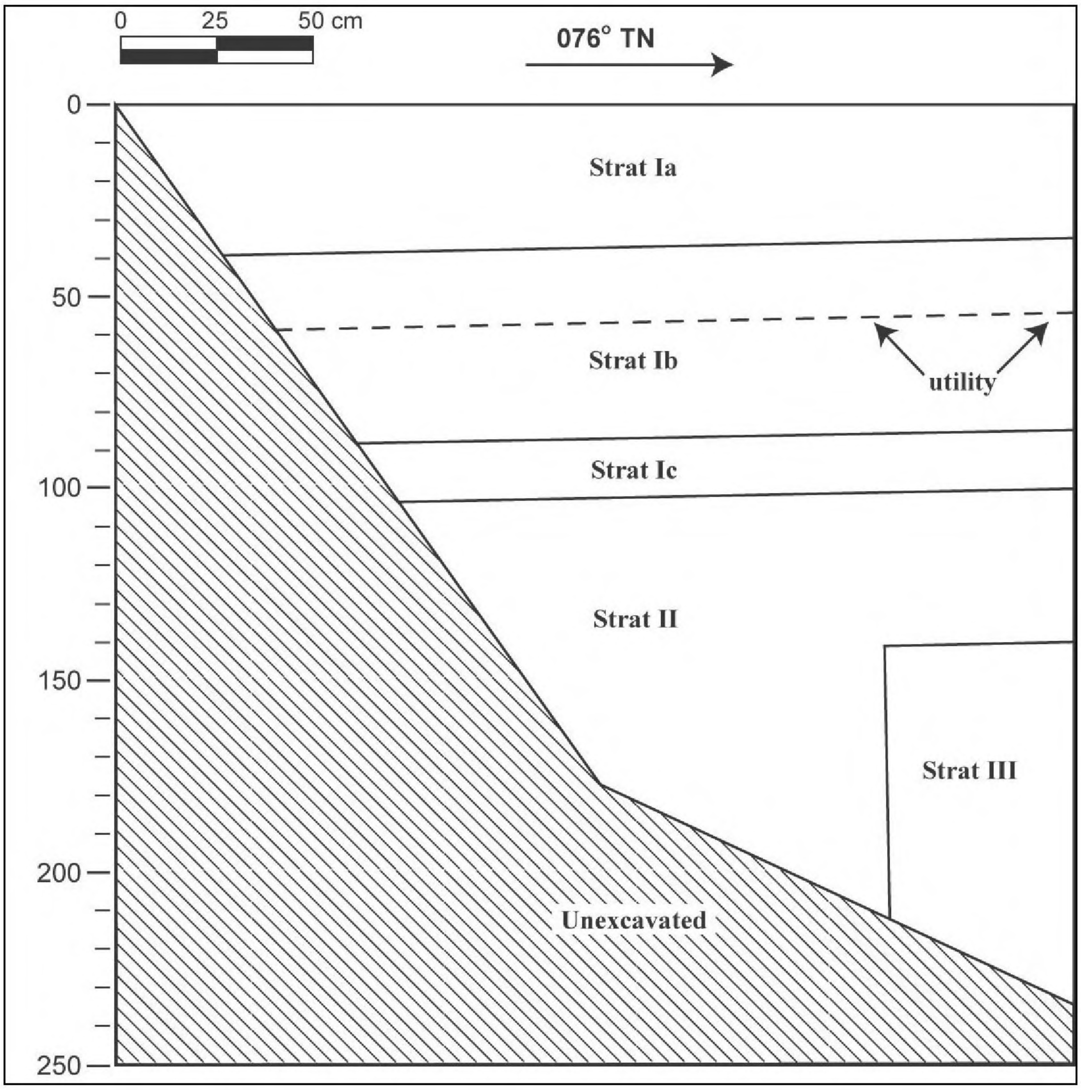

Figure 234. Profile of Column Test 25 (C-25)

Figure 235. Photograph of Column Test 25 (C-25), view to north

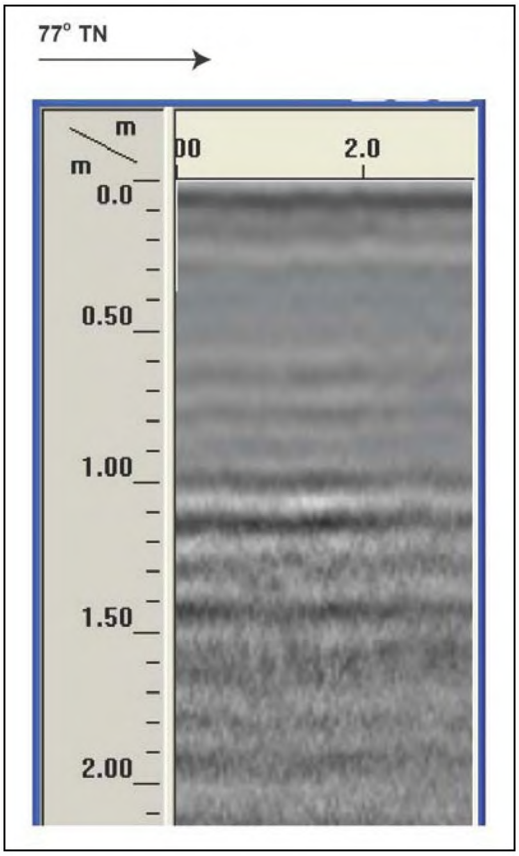

Figure 236. GPR profile of Column Test 25 (C-25)

Column Test 26 (C-26)

Orientation	268° TN
Length	2 m
Width	2 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Fill; 5 YR 3/3, dark reddish brown; silty clay loam; moderate, fine, crumb structure; very friable moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Topsoil for landscaping of median.
Ib	10-30	Fill; 7.5 YR 3/4, dark brown; clay loam; weak, fine, crumb structure; loose dry consistency; very friable moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary; Grading/landscaping (fill) material.
Ic	30-90	Fill; 10 YR 5/1, gray; gravel; structureless, slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill.
Id	90-100	Fill; 10 YR 8/2, very pale brown; very coarse, sand; structureless, loose dry consistency; non-plastic; no cementation; very abrupt smooth lower boundary; Contains crushed coral.
Ie	100-240	Fill; 7.5 YR 2.5/3, very dark brown; silt loam; moderate, fine, crumb structure; loose dry consistency; loose moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Terrigenous fill overlying natural wetland sediments.
II	240-260	GLEY 2 3/10B, very dark bluish gray; clay; strong, fine, crumb structure; firm moist consistency; sticky wet consistency; plastic; no cementation. Natural wetland sediments w/ some biological (root) matter.

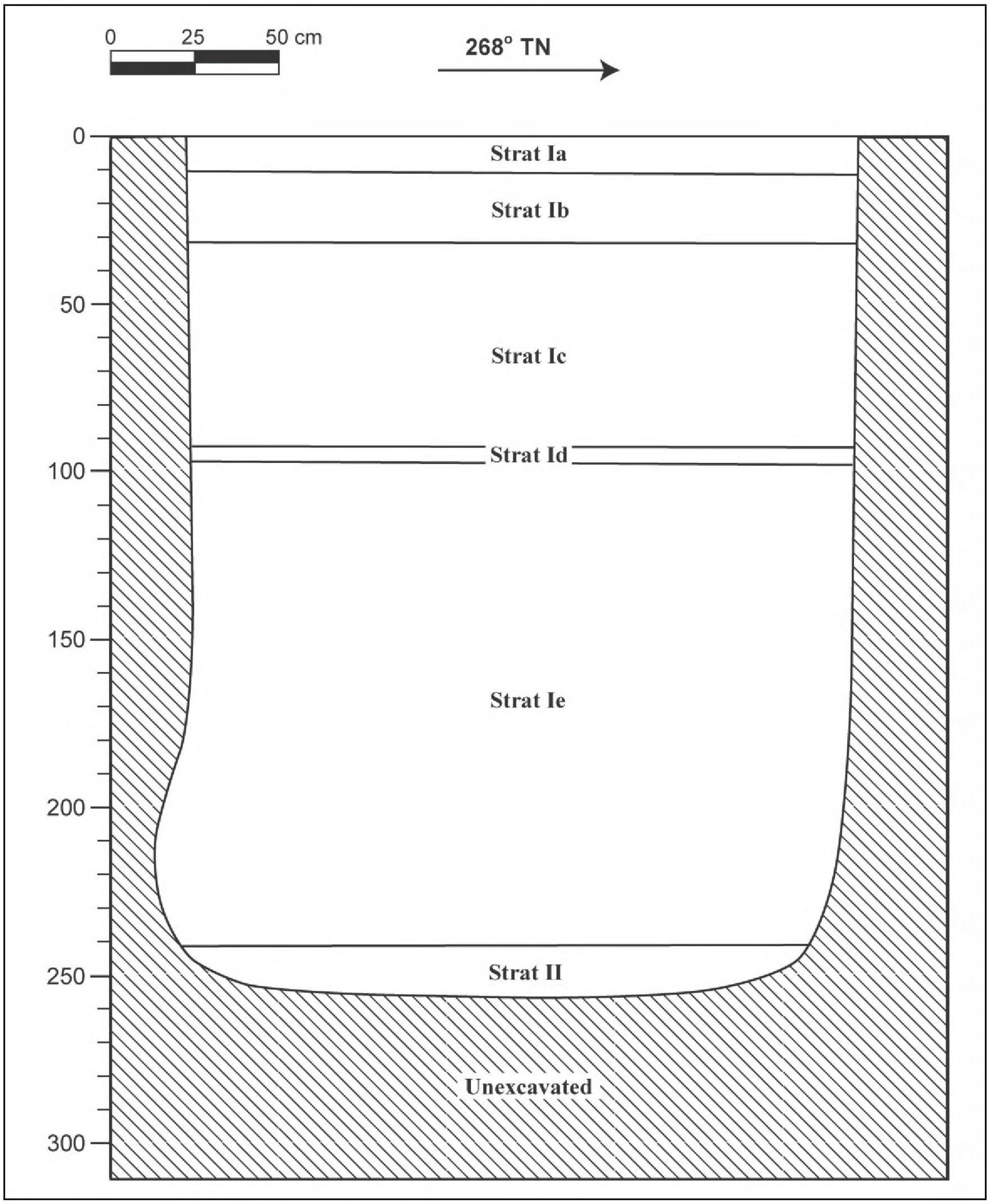

Figure 237. Profile of Column Test 26 (C-26)

Figure 238. Photograph of Column Test 26 (C-26), view to south

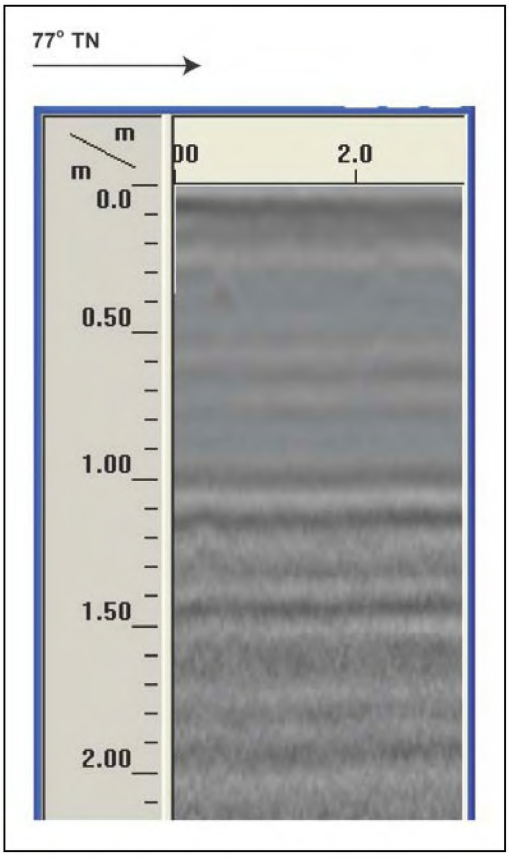

Figure 239. GPR profile of Column Test 26 (C-26)

Column Test 27 (C-27)

Orientation	347° TN
Length	1.5 m
Width	1.5 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill; 2.5 YR 3/4, dark reddish brown; silt loam; structureless, weakly coherant dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Landscaping fill
Ib	25-35	Fill; 10 YR 3/4, dark yellowish brown; silt loam; structureless, weakly coherant dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; 2nd strata of landscaping fill
Ic	35-125	Fill; 10 YR 4/2, dark grayish brown; gravel, sand; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; grading material
Id	125-240	Fill; 10 YR 3/3, dark brown; silty clay loam; weak, medium, crumb structure; weakly coherant dry consistency; slightly plastic; no cementation; clear possibly back-filled natural sediments, maybe grading material
II	240-260	GLEY 2 3/10B, very dark bluish gray; clay; strong, fine, crumb structure; firm moist consistency; sticky wet consistency; plastic; no cementation. Natural wetland sediments w/ some biological (root) matter.

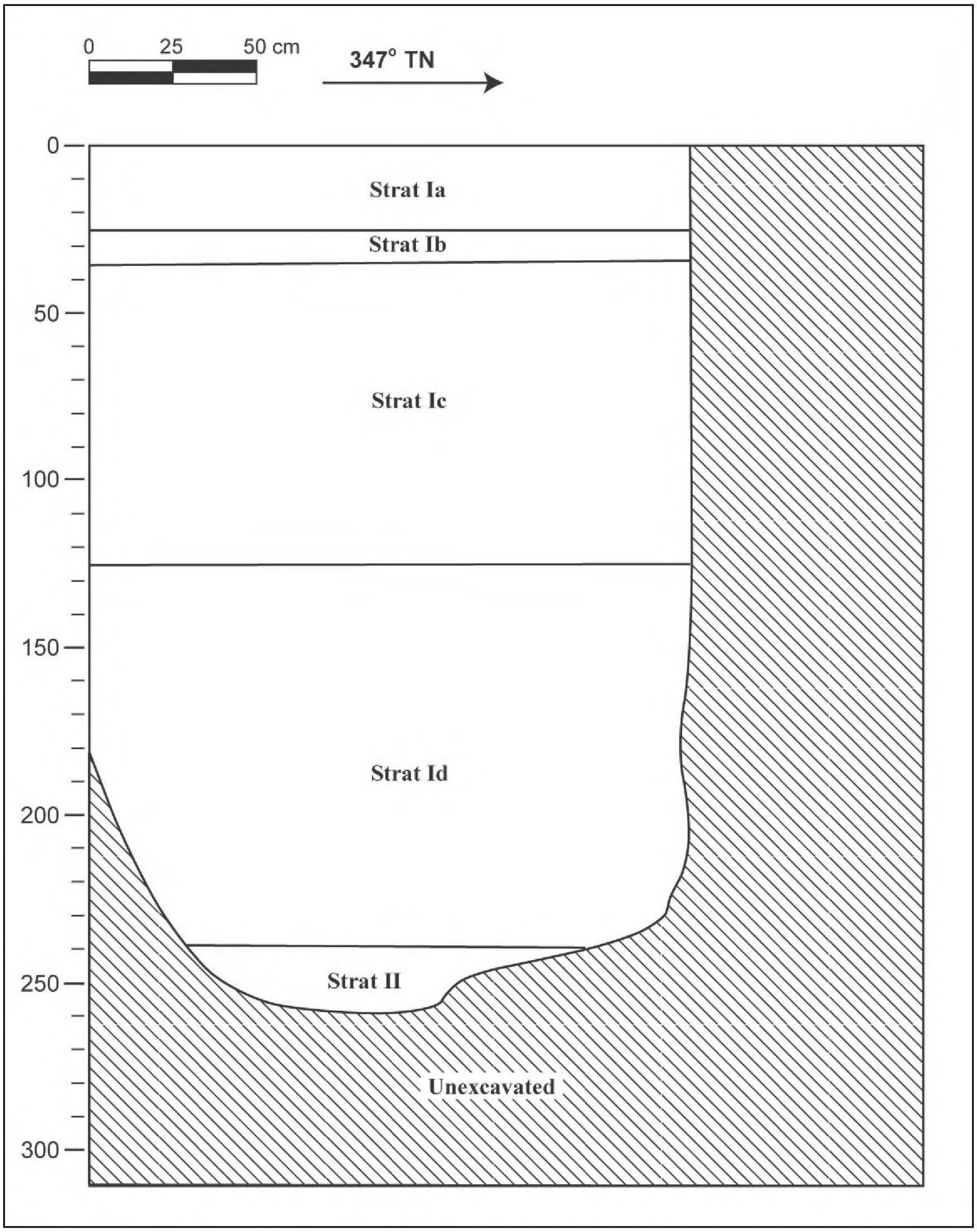

Figure 240. Profile of Column Test 27 (C-27)

Figure 241. Profile of Column Test 27 (C-27)

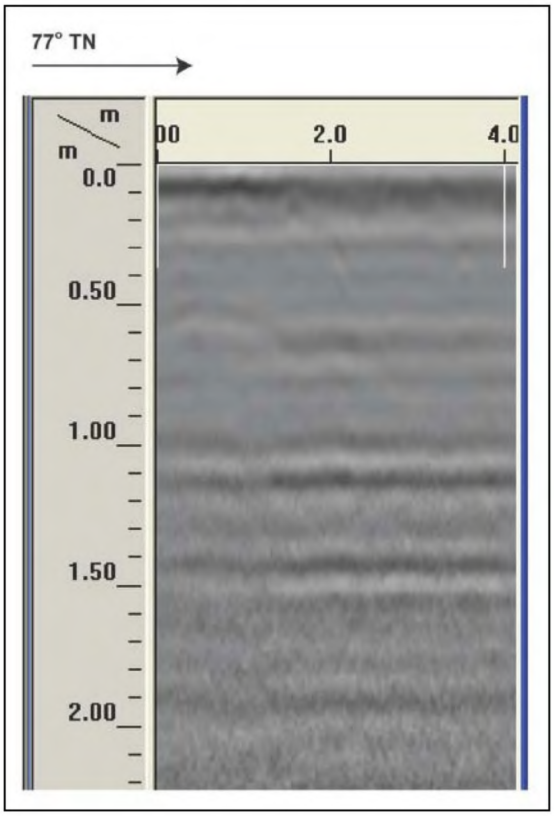

Figure 242. GPR profile of Column Test 27 (C-27)

4.12 Construction Sheet RW012

Construction Sheet RW012 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor (Figure 243). Two column test pits (C-28 & C-29) were excavated within the area delineated by Construction Sheet RW012.

4.12.1 Pedestrian Inspection

The highly urbanized conditions of Waipahu continue to predominate the area along this segment of the proposed transit route. Though not as bustling with small stores and industrial businesses as previously seen, there is a high amount of various types of housing on both sides of Farrington Highway (Figure 244). The *mauka*/northern-northwestern side is mostly low-rise apartments and condominiums while the *makai* /south-southeastern side is a family housing subdivision. Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.12.2 GPR Survey

Prior to the excavation of column test pits, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

In general, the results of the GPR survey were inconclusive. Stratigraphic interfaces of sediments with varying consistencies (i.e. crushed coral and sand vs. clay sediments) were not identified by the GPR (see Figure 245 thru Figure 249). It is believed that the presence of thick clay deposits in this area was the primary factor to the inconsistent results of the GPR data. Clay soils (especially those that are inundated) are noted as being very conductive, resulting in radio wave attenuation at shallow depths causing limited depth “visibility” and inaccurate GPR data collection (Conyers 2004).

4.12.3 Subsurface Testing

4.12.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW012 (see Figure 243). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 245 to Figure 249).

In general the observed and documented stratigraphy consisted of varying imported construction fill layers overlying naturally deposited alluvial sediment. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al*. 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

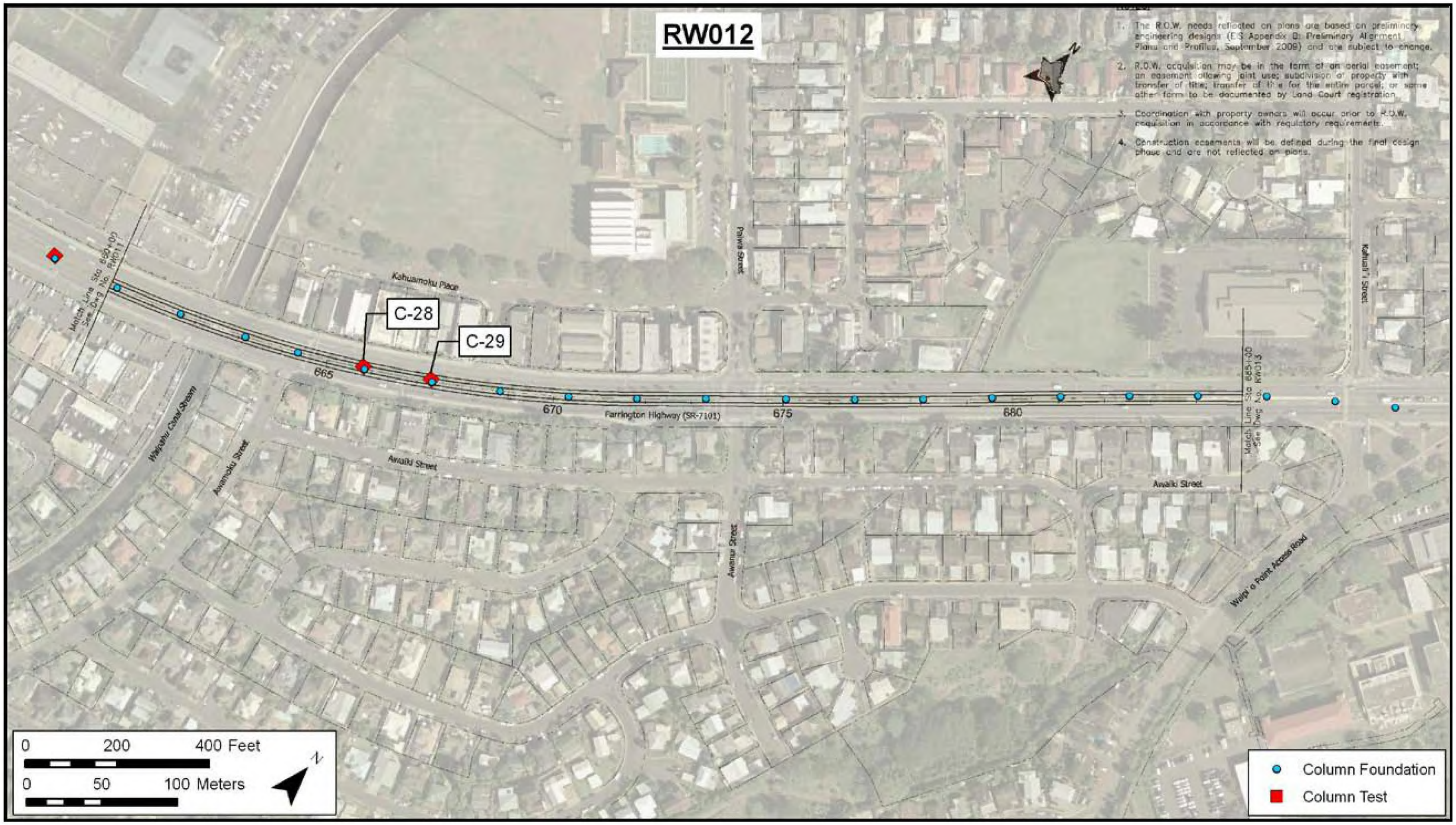

Figure 243. Construction Sheet RW012 showing the location of test excavations

Figure 244. Photo showing various housing types built alongside Farrington Highway and the transit route within the segment covered by map RW012

4.12.3.2 Excavation Documentation

Column Test 28 (C-28)

Orientation	244° TN
Length	1.5 m
Width	1.5 m
Maximum Depth	1.8 m

Stratum	Depth (cmbs)	Description
Ia	0-30	Fill; 10 YR 3/2, very dark grayish brown; silty clay loam; weak, fine, crumb structure; loose dry consistency; very friable moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary; Topsoil for landscaping of highway median.
Ib	30-60	Fill; 7.5 YR 3/3, dark brown; silt loam; weak, fine, crumb structure; loose dry consistency; very friable moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill for highway.
Ic	60-70	Fill; 10 YR 8/1, white; very coarse, sand; structureless, loose dry consistency; non-plastic; no cementation; very abrupt smooth lower boundary; Contains coral; grading/drainage material.
II	70-180	10 YR 4/3, brown; clay loam; moderate, fine, crumb structure; firm moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary. Naturally deposited sediment.

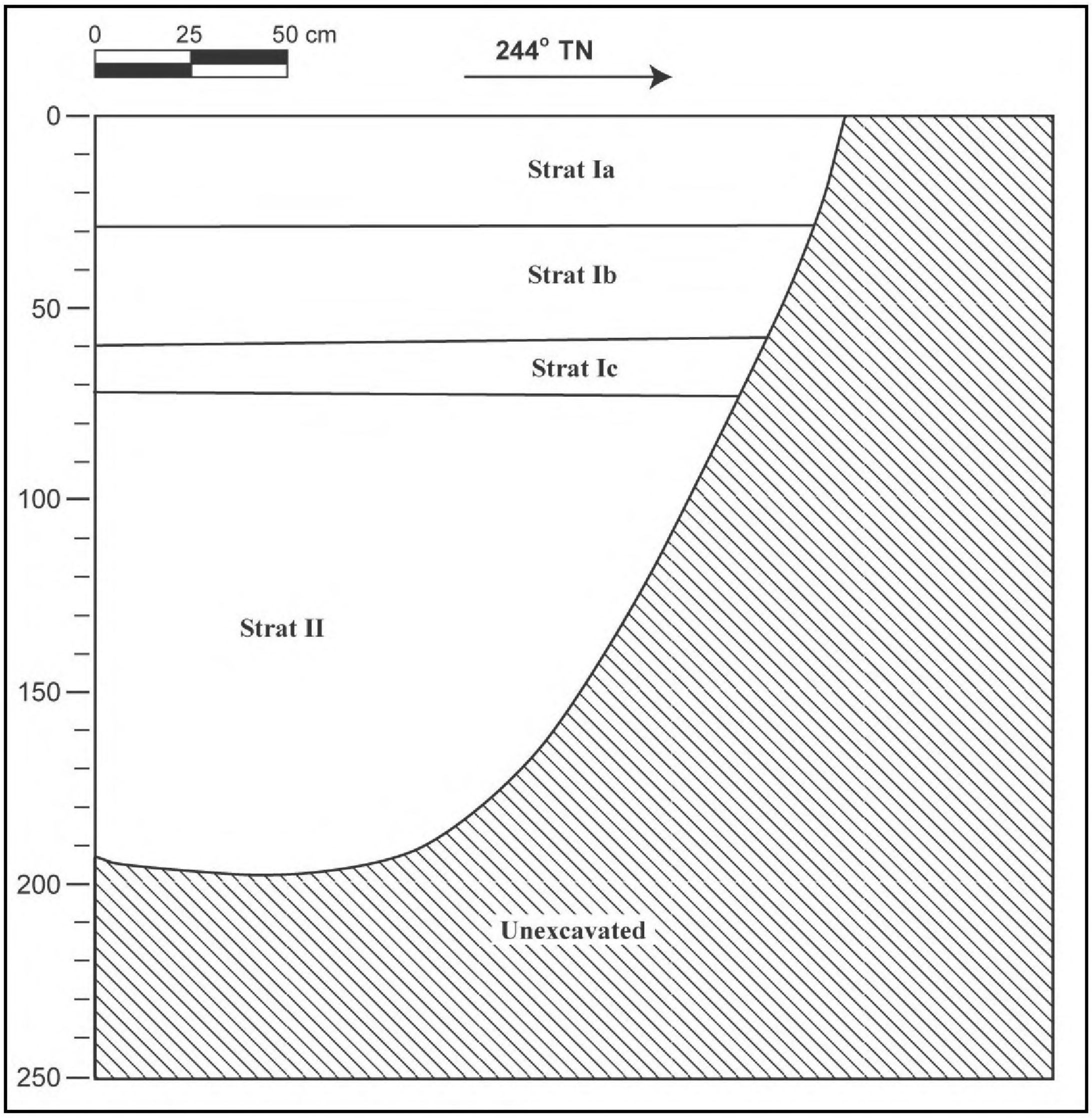

Figure 245. Profile of Column Test 28 (C-28)

Figure 246. Photograph of Column Test 28 (C-28), view to southeast

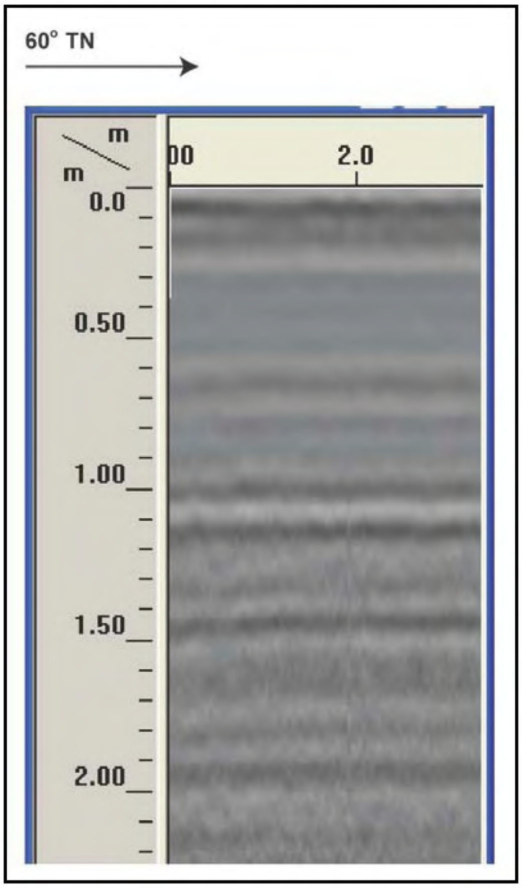

Figure 247. GPR profile of Column Test 28 (C-28)

Column Test 29 (C-29)

Orientation	260° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-50	Fill; 10 YR 3/2, very dark grayish brown; clay loam; moderate, fine, crumb structure; extremely firm moist consistency; very sticky wet consistency; very plastic; no cementation; clear wavy lower boundary; Landscaping fill.
Ib	20-60	Fill; 10 YR 7/6, yellow; coarse, very gravelly sand; structureless, loose moist consistency; slightly plastic; no cementation; diffuse wavy lower boundary; Grading material.
II	30-210	Fill; 10 YR 3/4, dark yellowish brown; silty clay; weak, fine, crumb structure; very firm moist consistency; plastic; no cementation; diffuse irregular lower boundary; Grading material, possibly back-filled natural sediments.
III	170-210	A Horizon; 10 YR 3/1, very dark gray; clay; moderate, fine, crumb structure; very sticky wet consistency; very plastic; no cementation; Naturally deposited alluvial sediment inundated with water suggesting the area was once a marsh prior to urban development.

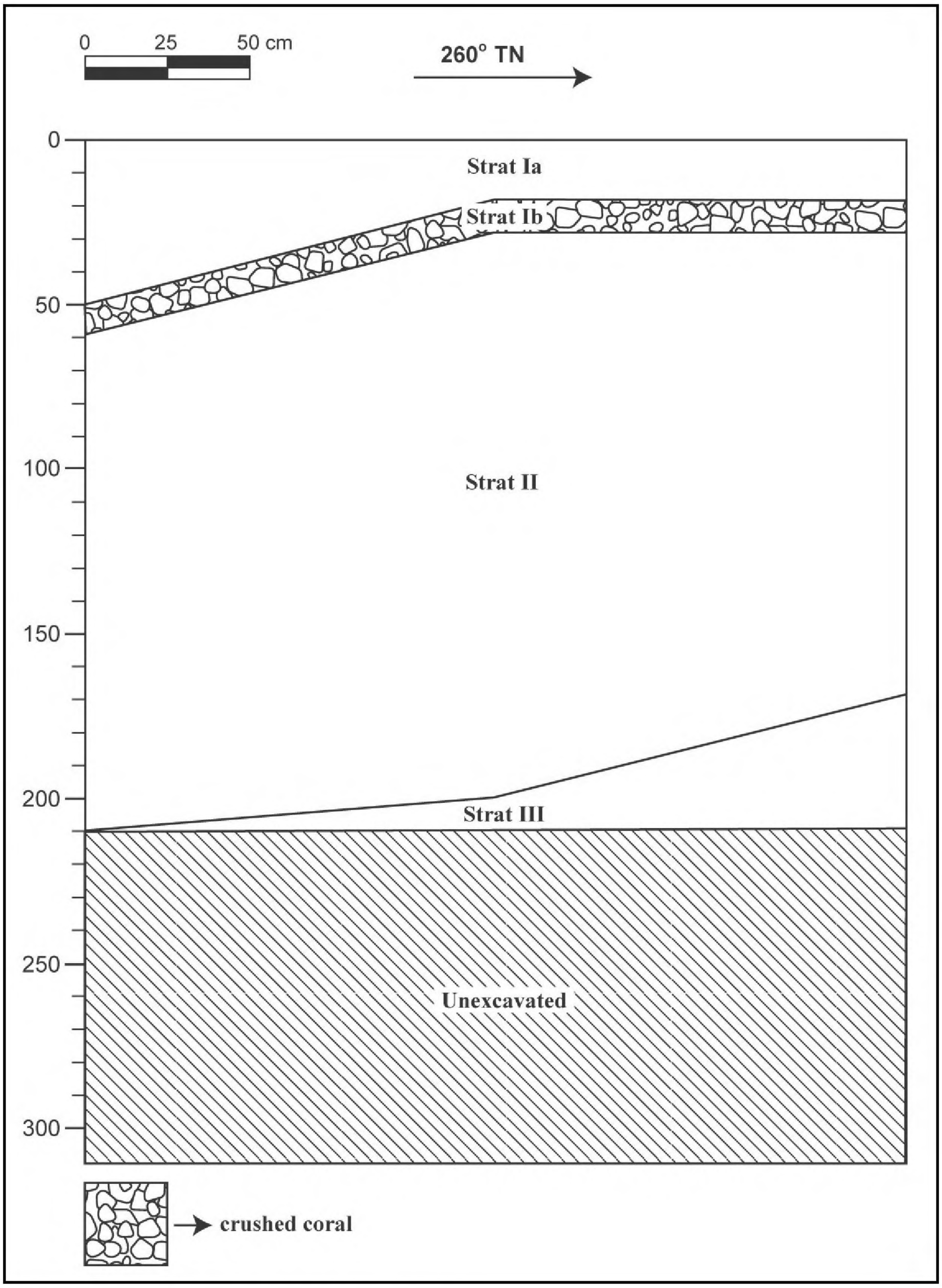

Figure 248. Profile of Column Test 29 (C-29)

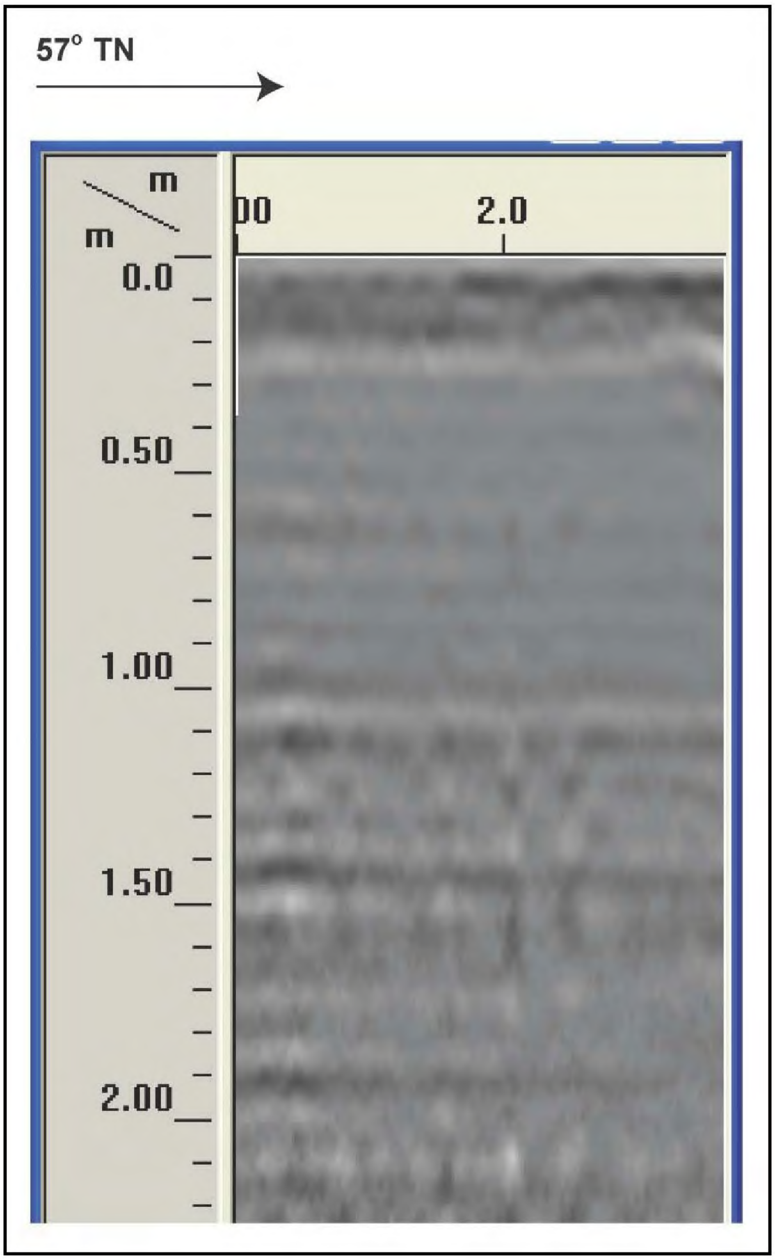

Figure 249. GPR profile of Column Test 29 (C-29)

4.13 Construction Sheet RW013 & RW014

Construction Sheet RW013 and RW014 consist of a 5,000 ft (1.5 km) segment of the proposed transit corridor (Figure 250 & Figure 251), and include the proposed Maintenance and Storage Facility and the Leeward Community College Station. Nine test trenches were excavated at the Maintenance and Storage Facility (Figure 252) and three test trenches were excavated at the Leeward Community College Station (Figure 253), totaling 12 test trenches within construction sheets RW013 and RW014.

4.13.1 Pedestrian Inspection

As the proposed transit route departs the Waipahu area and enters the Pearl City region, it transects the Waiawa area (crossing through the Navy ʻEwa Drum Filling and Storage Area and Leeward Community College).The eastern edge of Waipahu continued to display a high amount of urbanization with housing along both sides of the proposed transit route, with Waipahu High School located *makai*/south of the route prior to it curving east into the Navy ʻEwa Drum Filling and Storage Area.

The proposed site for the Leeward Community College Station is situated on the western end of the campus and is currently occupied by two administrative offices, a parking area, and the motorcycle safety course (Figure 254 & Figure 255). The entire area has been graded and paved over. No archaeological sites or material were identified during the pedestrian survey of this portion of the transit route due to the extensive amount of construction.

The Navy ʻEwa Drum Filling and Storage Area, which houses the footprint of the proposed HHCTC Maintenance and Storage Facility was not subject to a pedestrian inspection, as the entire area was previously surveyed (systematic pedestrian inspection of the gound surface) by Paul H. Rosendahl, Ph.D., Inc. (PHRI) in 1998 (Rechtman and Henry 1998). No cultural resources were observed. The PHRI study was incorporated into an environmental assessment for the Navy ʻEwa Drum Filling and Storage Area, which provided an effect determination of "no historic properties affected" (Commander, Navy Region Hawaii 2005). SHPD was provided an opportunity to comment on the results of the environmental assessment in compliance with Section 106 of the National Historic Preservation Act. SHPD did not object to the environmental assessment's determination of "no historic properties affected" (Commander, Navy Region Hawaii 2005).

Urban development and historic military operations within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

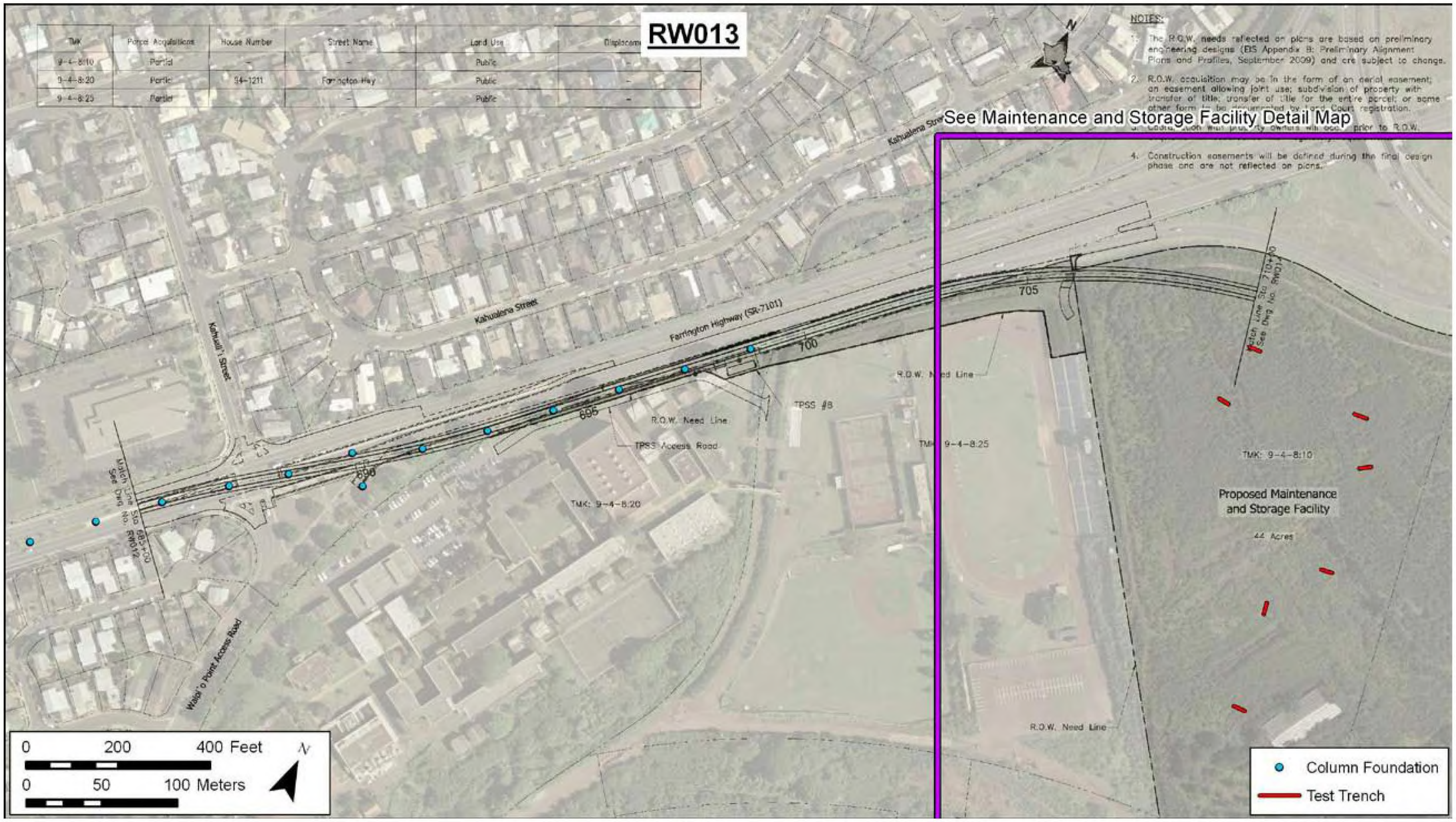

Figure 250. Construction Sheet RW013 showing the location of test excavations

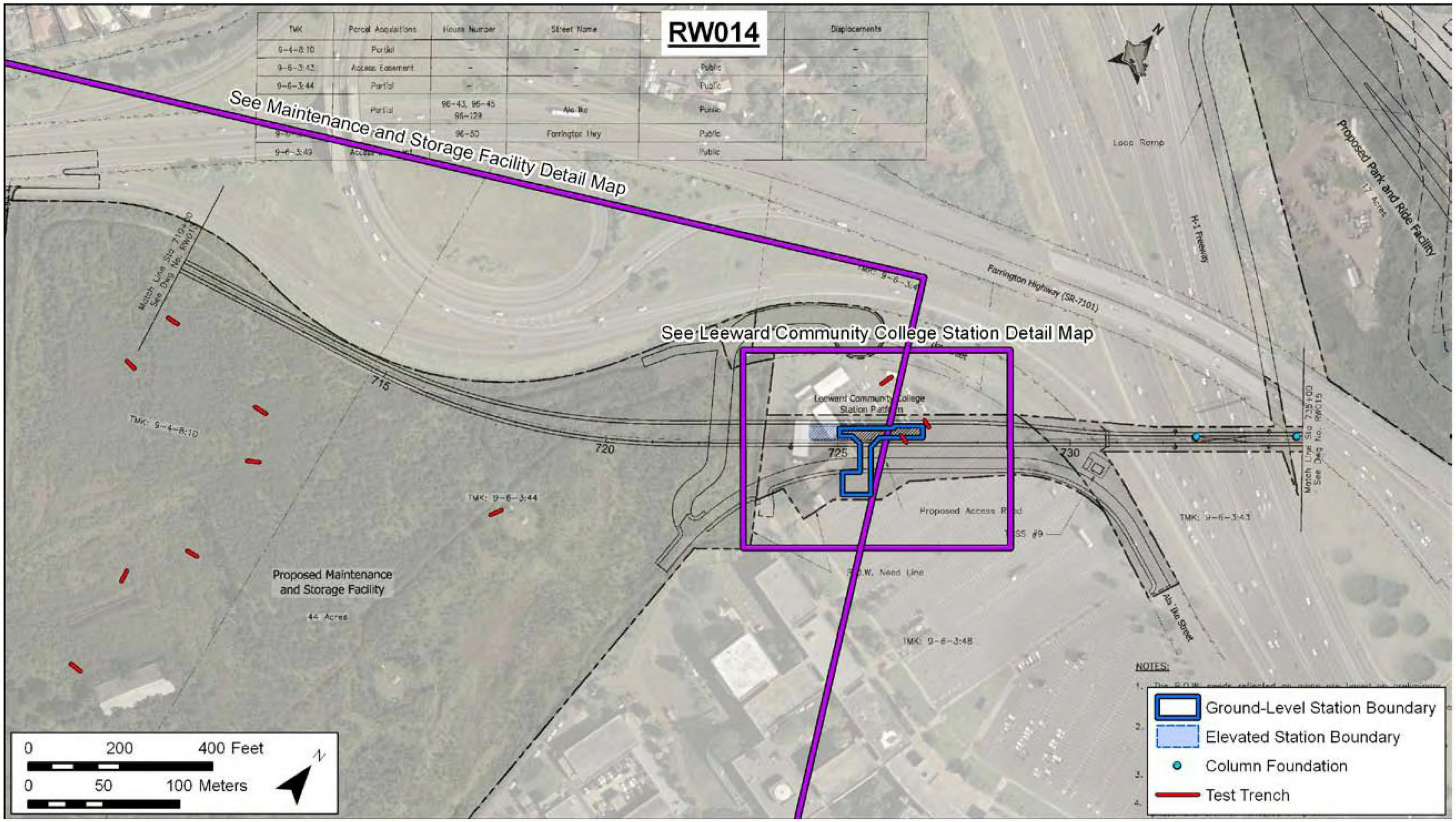

Figure 251. Construction Sheet RW014 showing the location of test excavations

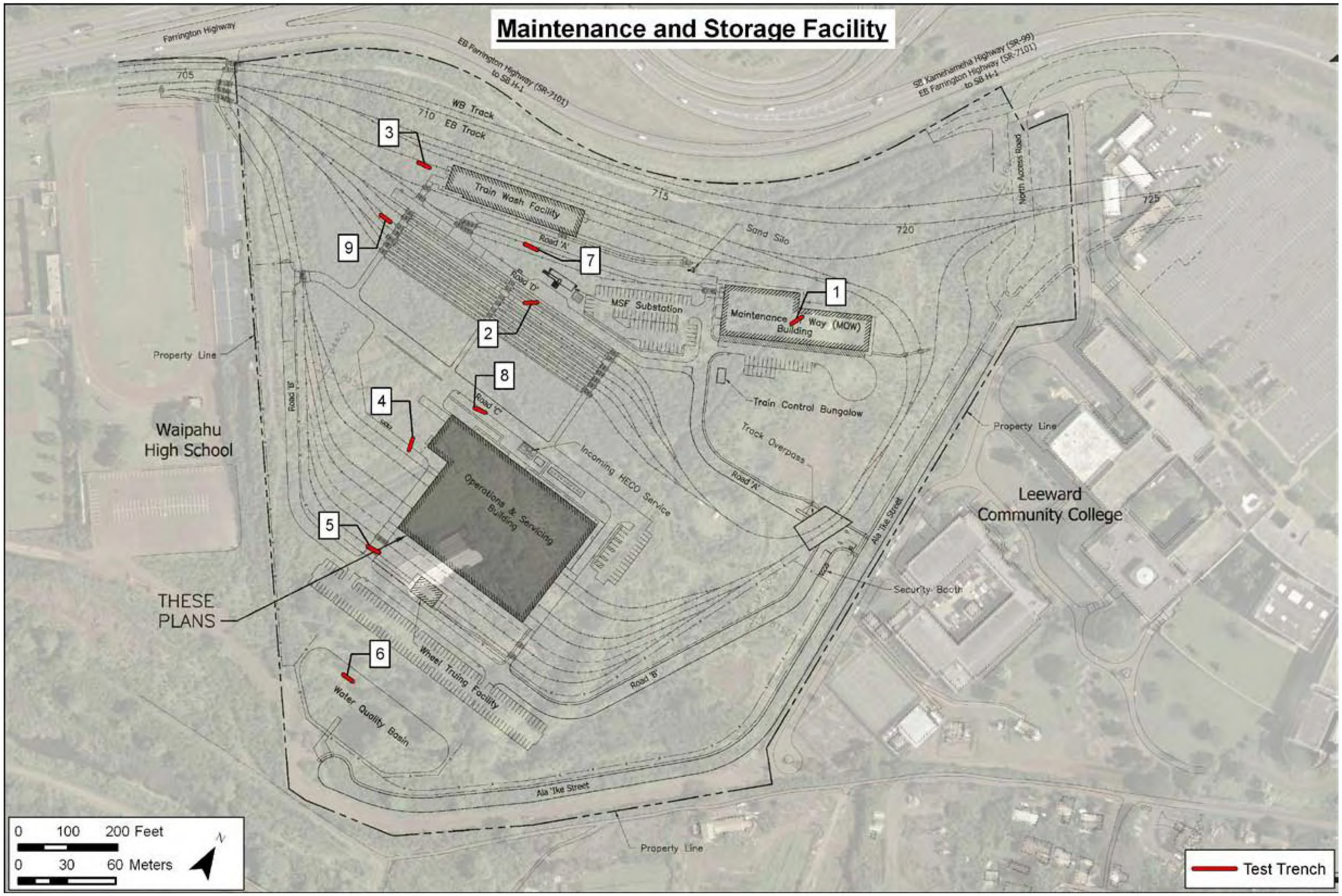

Figure 252. Maintenance and Storage Facility floor plan showing the location of test trenches

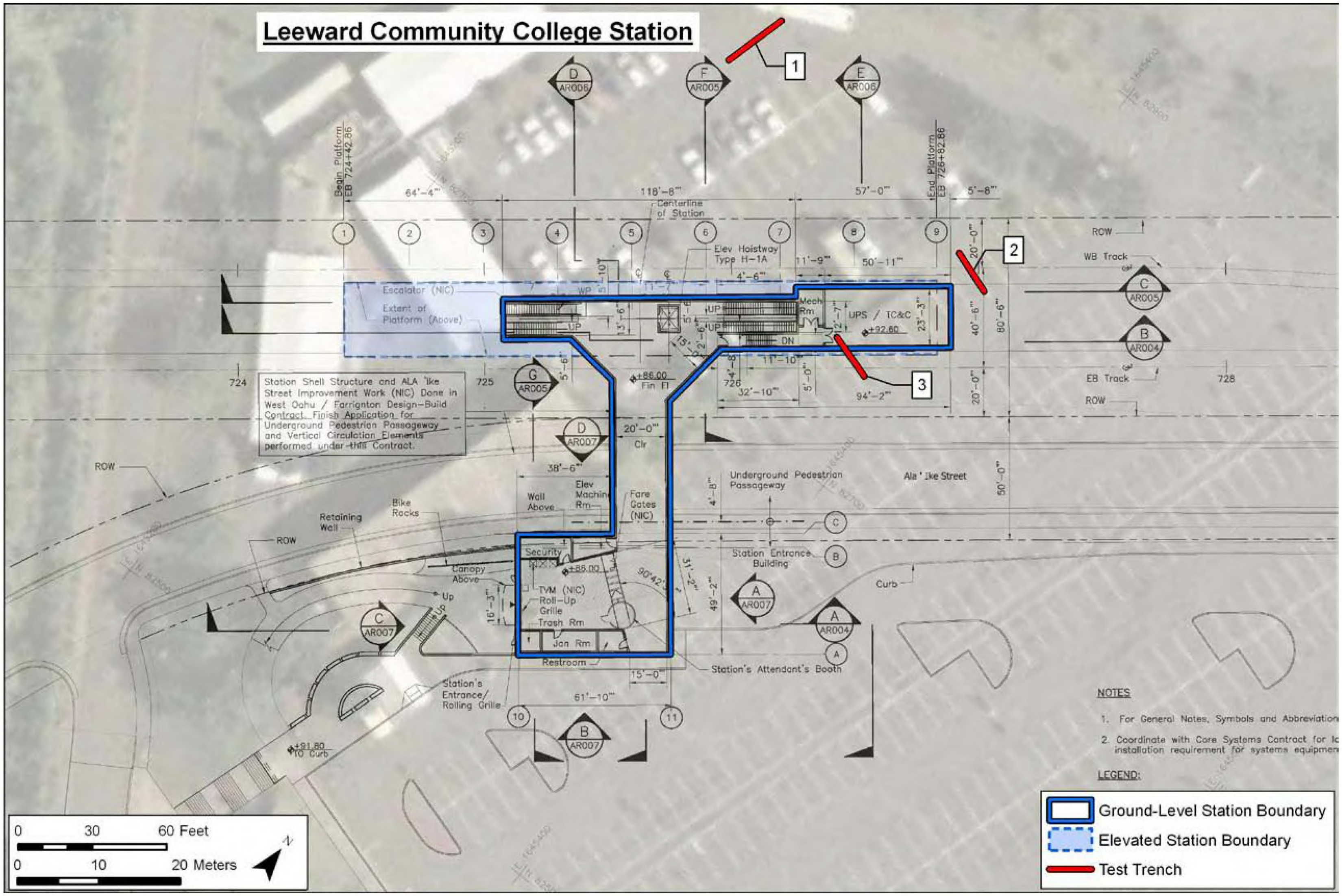

Figure 253. Leeward Community College Station floor plan showing the location of test trenches

Figure 254. Photo of the existing motorcycle safety course and parking area situated within locality for the LCC station

Figure 255. Photograph of parking area and administration building currently located within the vicinity of the proposed LCC station

4.13.2 GPR Survey

Prior to the excavation of test excavations, the test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test areas were excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey was unable able to define stratigraphic interfaces within any of the test areas. The inability to discern stratigraphic interfaces in this area is likely due to the uniform stratigraphy of the area. In general, stratigraphic layers were denoted by color change, and not by sediment type and/or consistency. Thus there was not enough change in the dielectric constant between stratigraphic layers for the GPR to register stratigraphic interfaces. The exception to this was at the proposed LCC Station. At this location the GPR was able to isolate the interface between the asphalt road surface (and associated gravel base course) and the underlying silt loam (Figure 283, Figure 286, & Figure 289). GPR profiles at this location displayed horizontal banding from the surface to an approximate depth of 40 cm (Figure 285, Figure 288, & Figure 291). In this instance there was clearly a variation in dielectric constant between the asphalt, basalt gravel, and the underlying silt loam.

Also of note was the GPRs ability to detect areas where root activity was actively breaking down the soil (i.e. altering compaction and soil chemistry through root growth and decay). This was most clearly observed at Maintenance and Storage Facility Test Trench 1 & 7. Subsurface anomalies detected by the GPR appear to correspond to areas where root concentrations were observed during subsurface testing (Figure 256 thru Figure 258 & Figure 274 thru Figure 276). Thus at these locations the root activity created variations in the dielectric constant from the underlying compacted silt deposits.

4.13.3 Subsurface Testing

4.13.3.1 Stratigraphic Summary

Twelve (12) backhoe trenches were placed within the area delineated by Construction Sheet RW013 and RW014 (see Figure 250 thru Figure 253). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 256 to Figure 291).

The observed and documented stratigraphy within the Maintenance and Storage Facility consisted of varying layers of naturally deposited silt. In some instances limestone and basalt bedrock were encountered (see Figure 265 and Figure 271). These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al.* 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

The observed and documented stratigraphy within the LCC Station consisted of varying layers of imported fill associated with parking lot construction, overlying naturally deposited silt.

These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al.* 1972). All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.13.3.2 Excavation Documentation

Maintenance and Storage Facility Test Trench 1

Orientation	15° TN
Length	8 m
Width	0.7 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
I	0-250	10 YR 3/4, dark yellowish brown; silt loam; structureless; dry weakly coherent consistency; non plastic; no cementation; mixed origin; abrupt broken lower boundary. Contained crushed coral and basalt cobbles. Previously disturbed naturally deposited sediment. Disturbance likely associated with prior military development (i.e. grading for access roads).
II	80-250	10 YR 4/4, dark yellowish brown; silt; structureless; dry very hard consistency; non-plastic; strong cementation; terrestrial origin. Naturally deposited sediment.

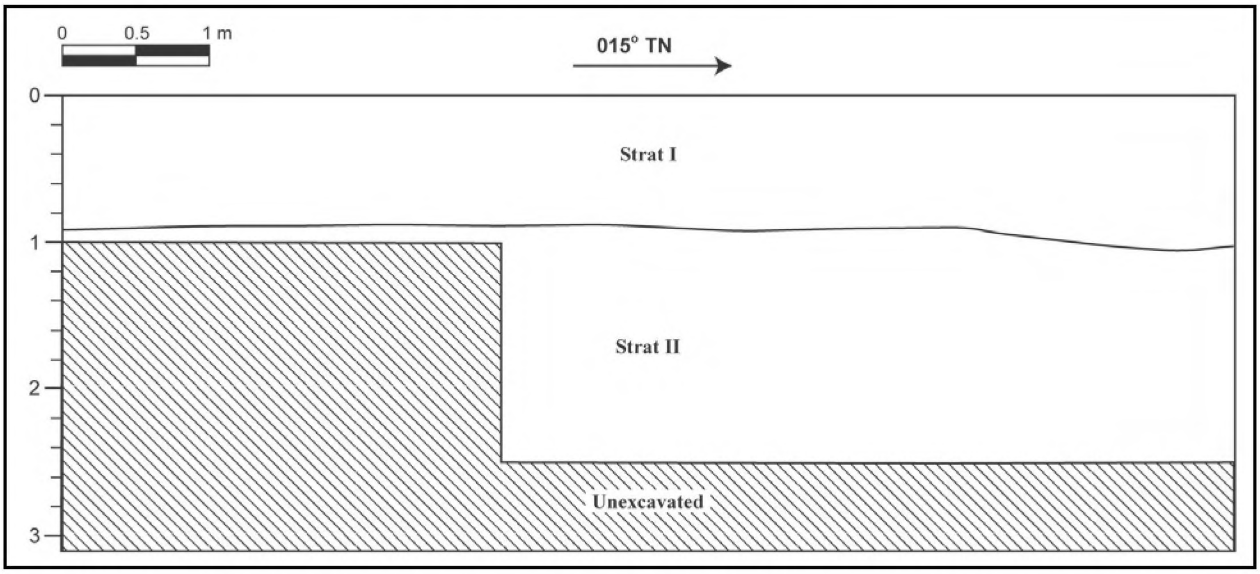

Figure 256. Profile of Maintenance and Storage Facility Test Trench 1

Figure 257. Photograph of Maintenance and Storage Facility Test Trench 1, view to west

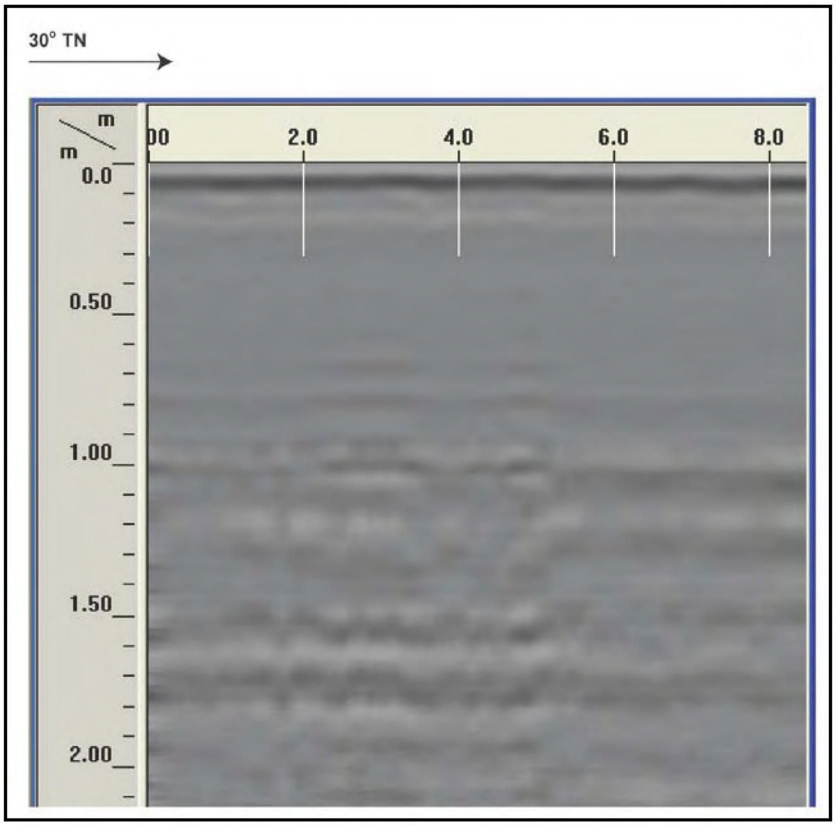

Figure 258. GPR profile of Maintenance and Storage Facility Test Trench 1

Maintenance and Storage Facility Test Trench 2

Orientation	57° TN
Length	7 m
Width	0.7 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
I	0-20	A-Horizon; 10 YR 5/3, brown; silt loam; structureless; dry loose consistency; non-plastic; no cementation; terrestrial origin; clear wavy lower boundary; modern A-Horizon.
II	20-210	B-Horizon; 10 YR 3/4 dark yellowish brown; silt; strong coarse crumb structure; dry extremely hard; non-plastic; strong cementation. Naturally deposited sediment.

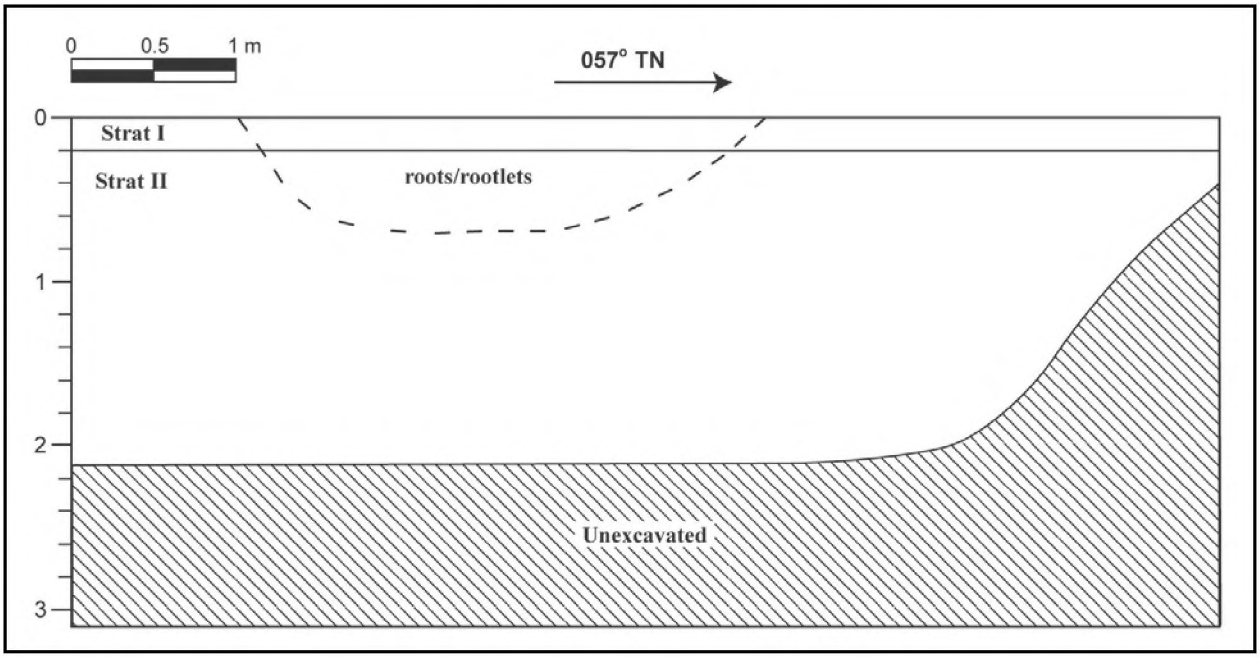

Figure 259. Profile of Maintenance and Storage Facility Test Trench 2

Figure 260. Photograph of Maintenance and Storage Facility Test Trench 2, view to north

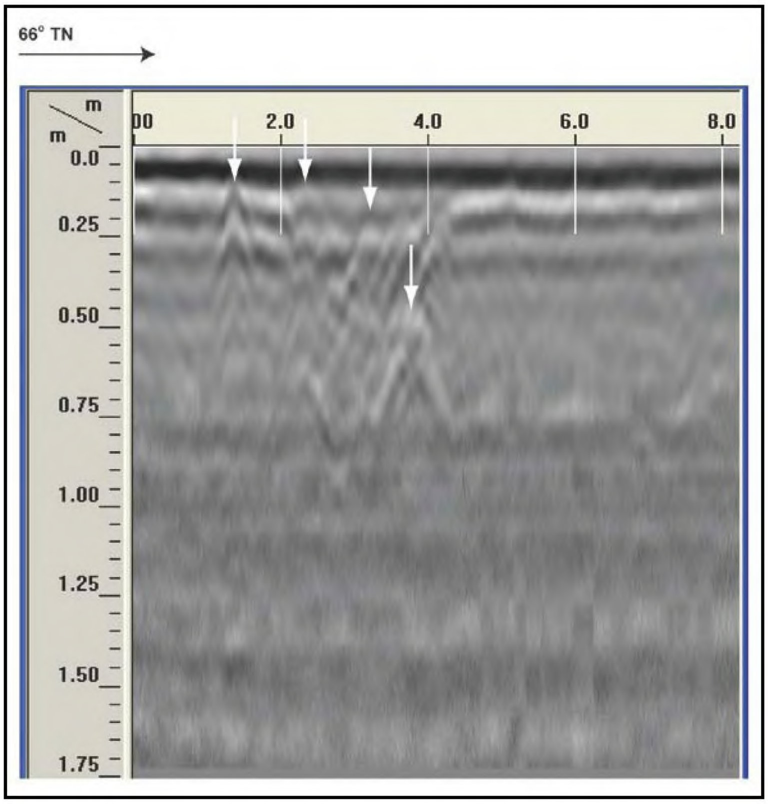

Figure 261. GPR profile of Maintenance and Storage Facility Test Trench 2

Maintenance and Storage Facility Test Trench 3

Orientation	93° TN
Length	8 m
Width	0.7 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
I	0-250	10 YR 3/4, dark yellowish brown; silt; structurless; dry weakly coherent consistency; non-plastic; strong cementation; terrestrial origin. Top 100cm of stratum contains roots and rootlets, which are beginning to break down the sediment.

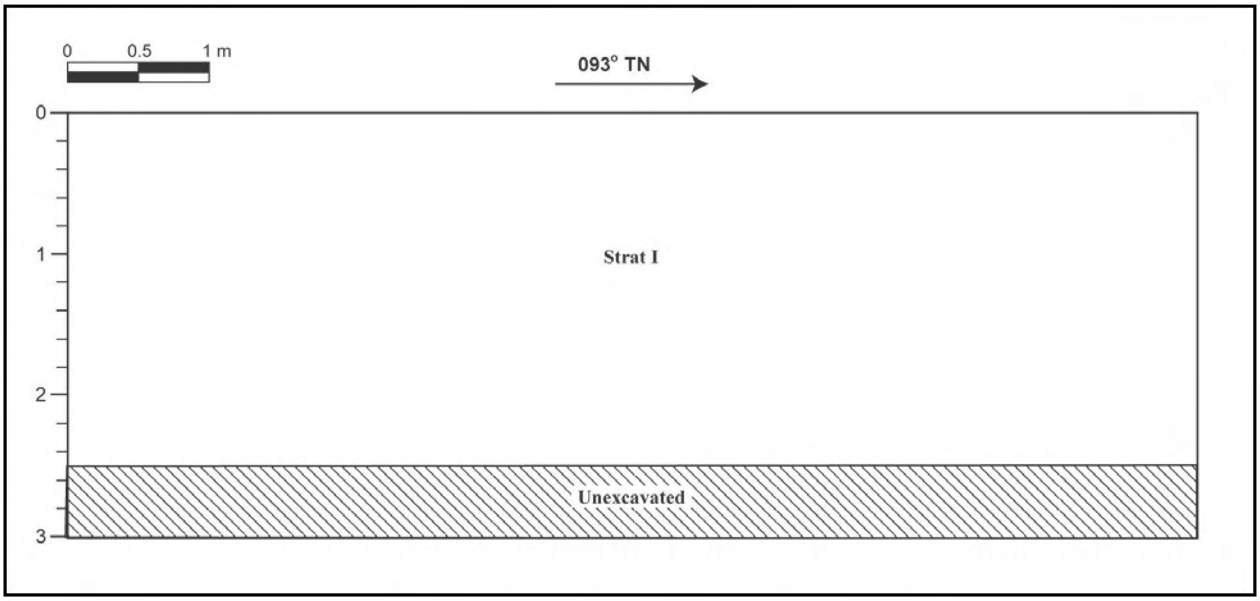

Figure 262. Profile of Maintenance and Storage Facility Test Trench 3

Figure 263. Photograph of Maintenance and Storage Facility Test Trench 3, view to north

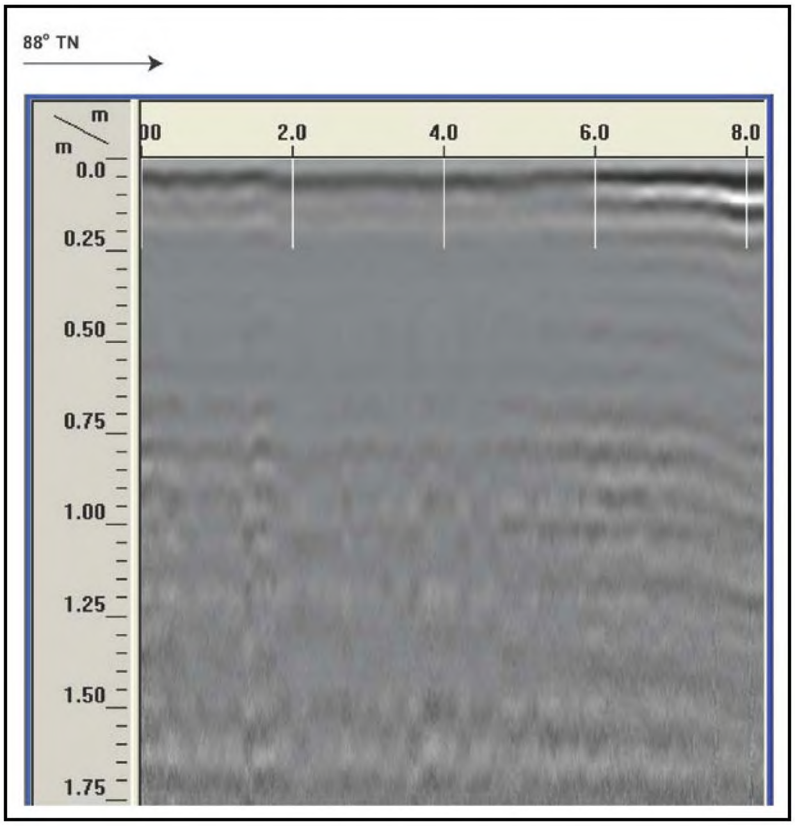

Figure 264. GPR profile of Maintenance and Storage Facility Test Trench 3

Maintenance and Storage Facility Test Trench 4

Orientation	153° TN
Length	8 m
Width	0.7 m
Maximum Depth	150 m

Stratum	Depth (cmbs)	Description
I	0-20	A-Horizon; 10 YR 3/4, dark yellowish brown; silty clay loam; weak fine granular structure; dry weakly coherent consistency; slightly plastic; weak cementation; terrestrial; clear smooth lower boundary. Contains roots. Modern A-Horizon.
II	20-150	10 YR 4/3, brown; silt; strong blocky structure; dry extremely hard consistency; non-plastic; indurated cementation; mixed origin. Contains large amounts of decomposing limestone.

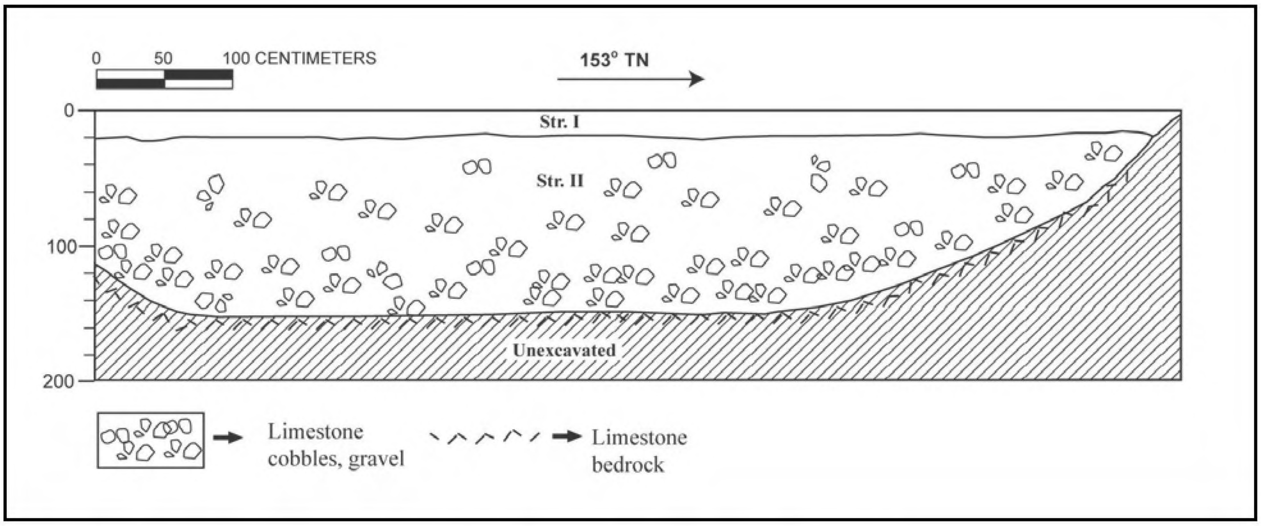

Figure 265. Profile of Maintenance and Storage Facility Test Trench 4

Figure 266. Photograph of Maintenance and Storage Facility Test Trench 4, view to east

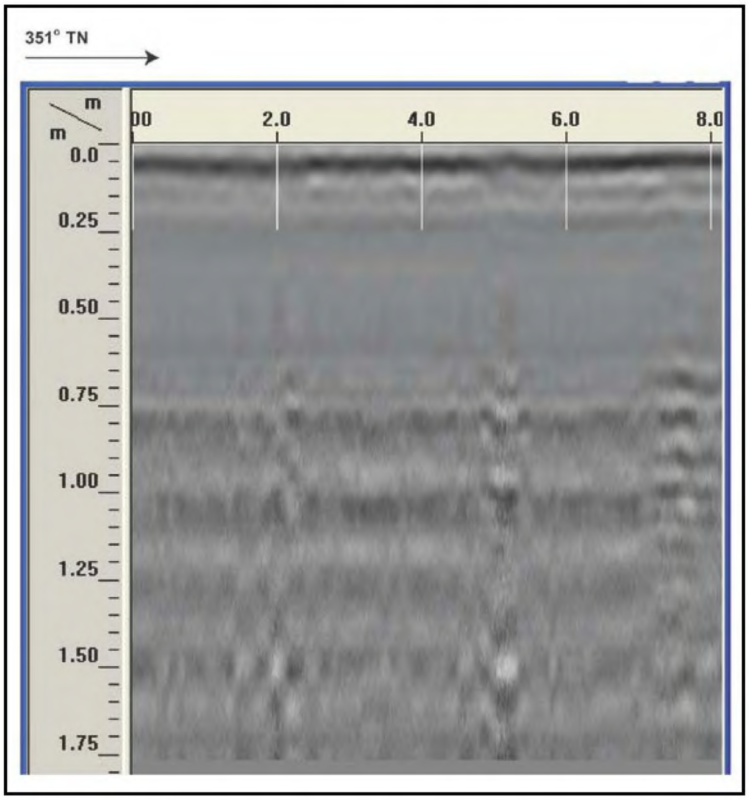

Figure 267. GPR profile of Maintenance and Storage Facility Test Trench 4

Maintenance and Storage Facility Test Trench 5

Orientation	90° TN
Length	8m
Width	0.7m
Maximum Depth	2.5m

Stratum	Depth (cmbs)	Description
Ia	0-150	10 YR 3/6, dark yellowish brown; silt; structurless; dry loose to weakly coherent consistency; non-plastic; strong cementation; terrestrial clear wavy lower boundary. Naturally deposited sediment.
Ib	150-250	5 YR 2.5/2, dark reddish brown; silt; structurless; dry extremely hard consistency; non-plastic; strong cementation; terrestrial origin. Naturally deposited sediment.

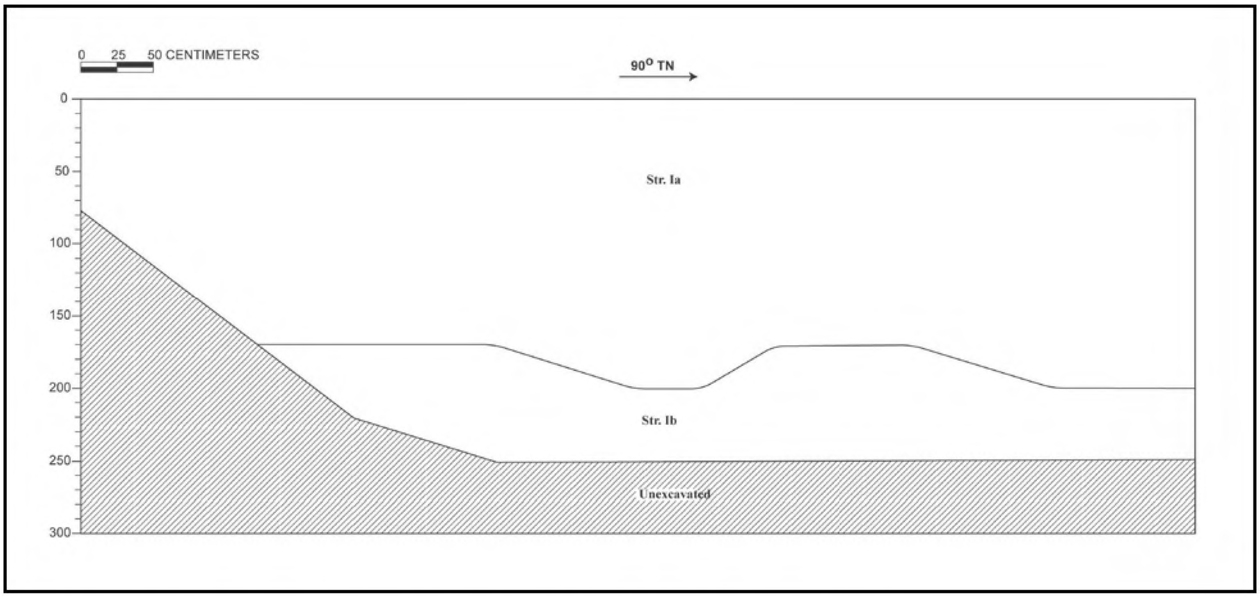

Figure 268. Profile of Maintenance and Storage Facility Test Trench 5

Figure 269. Photograph of Maintenance and Storage Facility Test Trench 5, view to north

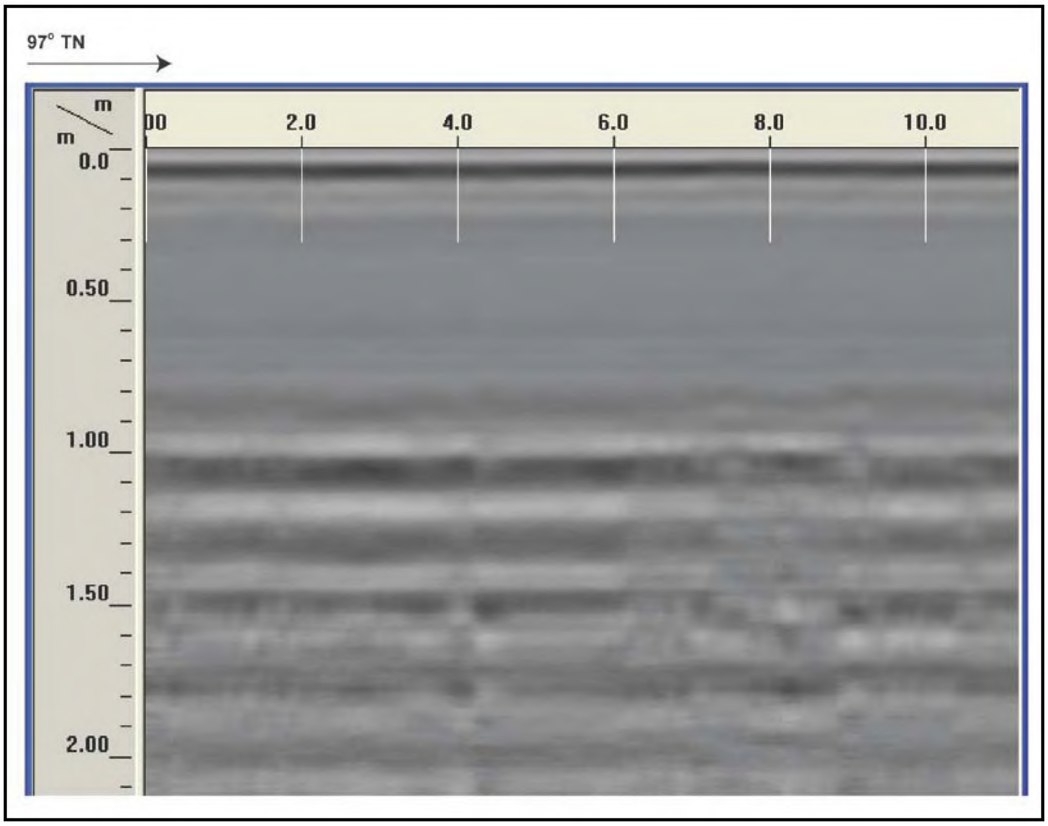

Figure 270. GPR profile of Maintenance and Storage Facility Test Trench 5

Maintenance and Storage Facility Test Trench 6

Orientation	80° TN
Length	7.3m
Width	0.7m
Maximum Depth	2.2m

Stratum	Depth (cmbs)	Description
I	0-200	7.5 YR 3/3, dark brown; silty clay loam; moderate medium blocky structure; dry very hard consistency; slightly plastic; strong cementation; terrestrial origin; diffuse smooth lower boundary. Soil compaction increases with depth.
II	200-220	C-Horizon; 10 YR 5/4, yellowish brown; strong coarse blocky structure; dry extremely hard consistency; slightly plastic; strong cementation; terrestrial origin; decomposing basalt bedrock.

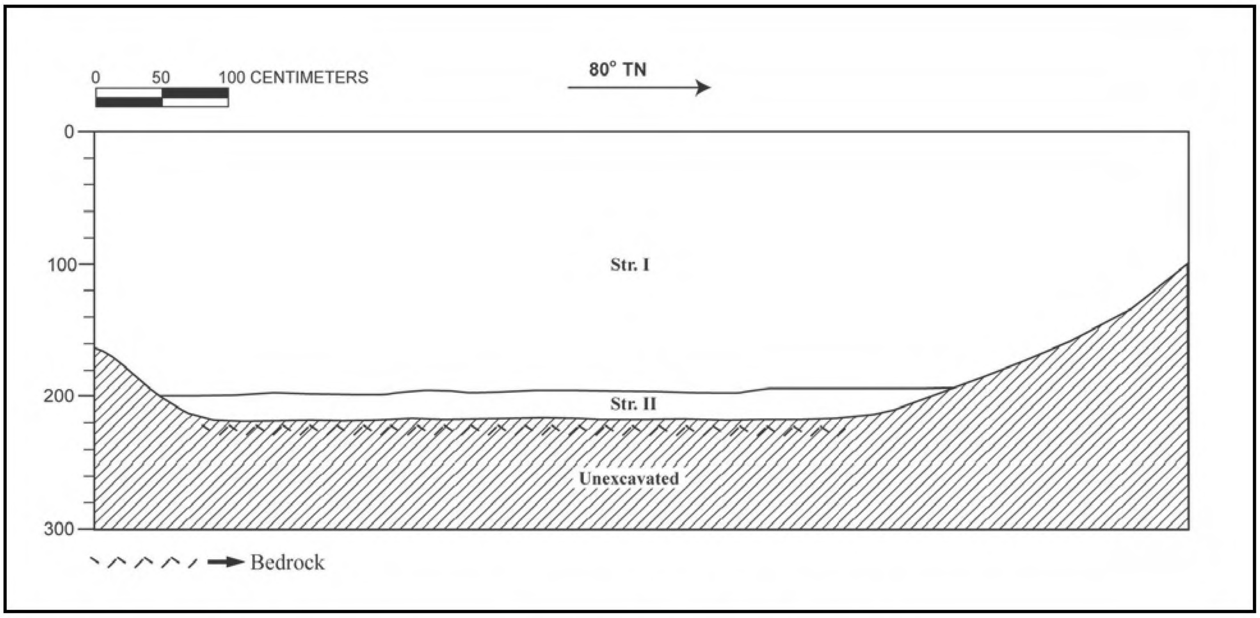

Figure 271. Profile of Maintenance and Storage Facility Test Trench 6

Figure 272. Photograph of Maintenance and Storage Facility Test Trench 6, view to north

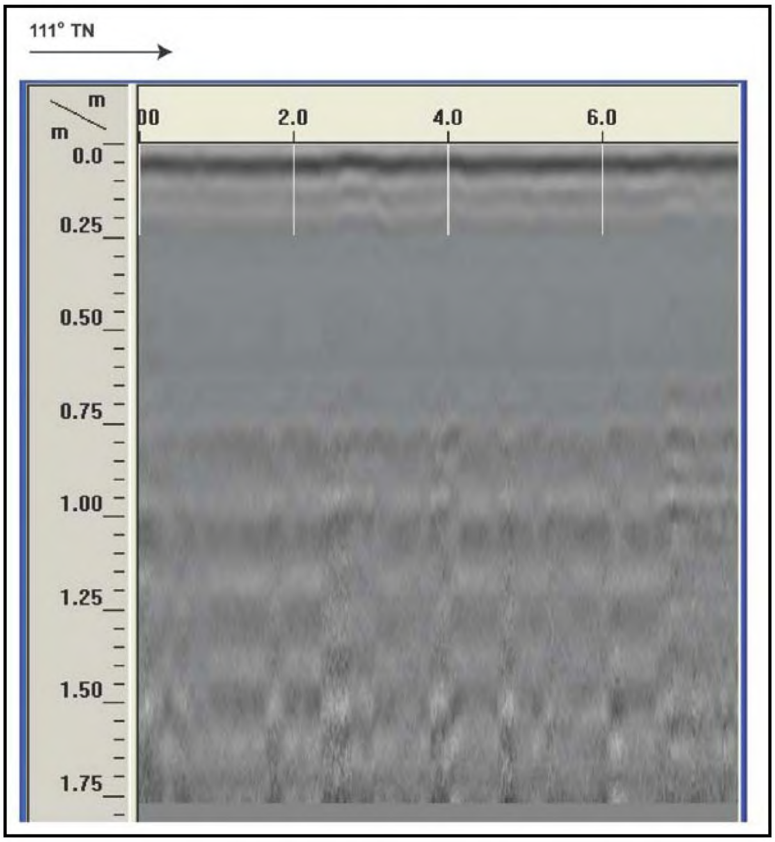

Figure 273. GPR profile of Maintenance and Storage Facility Test Trench 6

Maintenance and Storage Facility Test Trench 7

Orientation	56° TN
Length	8m
Width	0.7m
Maximum Depth	205m

Stratum	Depth (cmbs)	Description
I	0-25	Crushed coral fill
II	25-205	10 YR 4/4, dark yellowish brown; silt; strong medium crumb structure; dry hard consistency; non-plastic; strong cementation; terrestrial origin. Naturally deposited sediment.

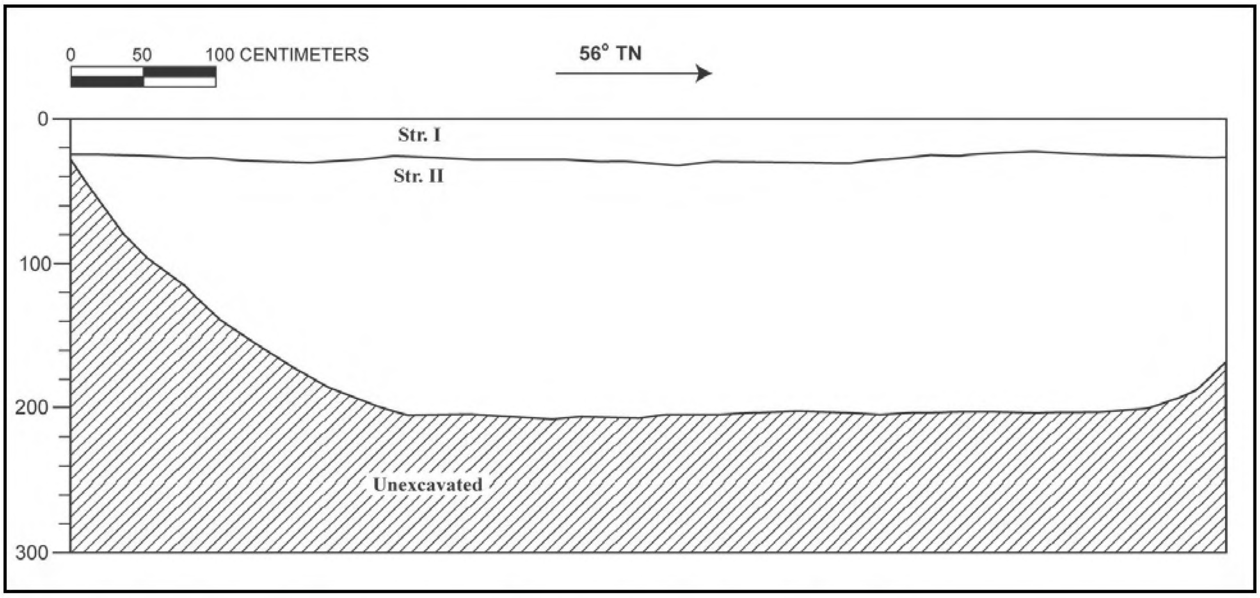

Figure 274. Profile of Maintenance and Storage Facility Test Trench 7

Figure 275. Photograph of Maintenance and Storage Facility Test Trench 7, view to north

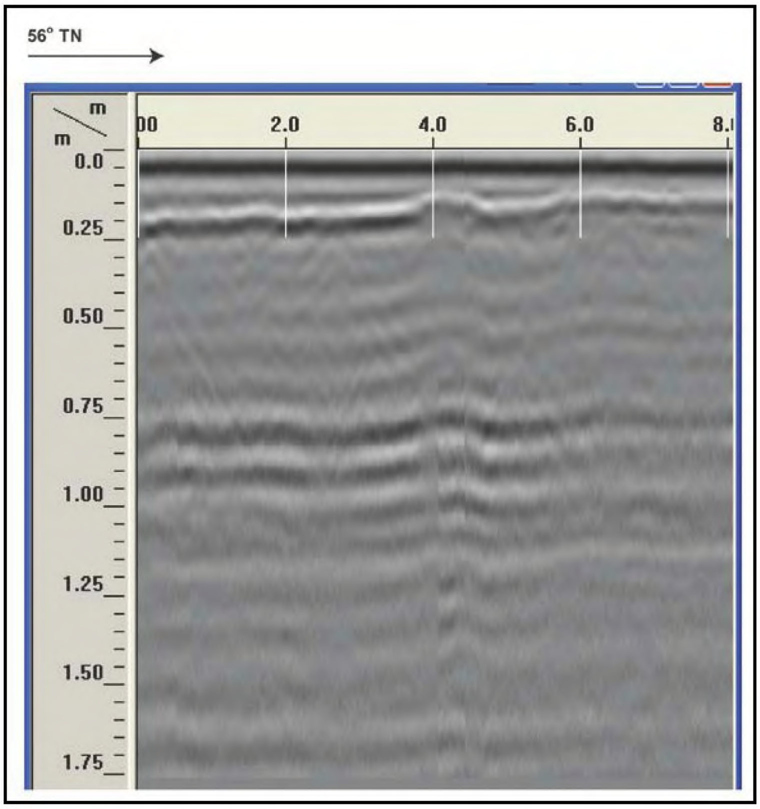

Figure 276. GPR profile of Maintenance and Storage Facility Test Trench 7

Maintenance and Storage Facility Test Trench 8

Orientation	102° TN
Length	8m
Width	0.7m
Maximum Depth	2.6m

Stratum	Depth (cmbs)	Description
I	0-60	A-Horizon; 10 YR 3/3 dark brown; silt loam; weak fine granular structure; weakly coherent consistency; non-plastic; weak cementation; terrestrial origin; clear wavy lower boundary. Modern A-horizon.
II	60-260	10 YR 4/3, brown; silt loam; strong medium blocky structure; dry very hard consistency; non-plastic; strong cementation; terrestrial origin.

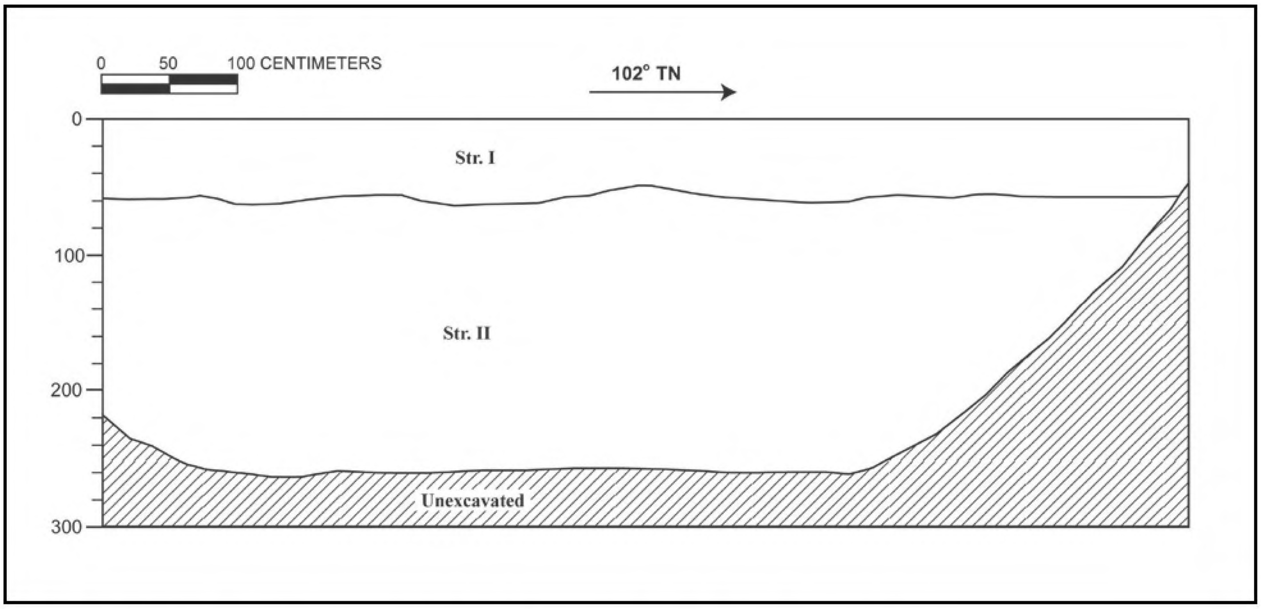

Figure 277. Profile of Maintenance and Storage Facility Test Trench 8

Figure 278. Photograph of Maintenance and Storage Facility Test Trench 8, view to north

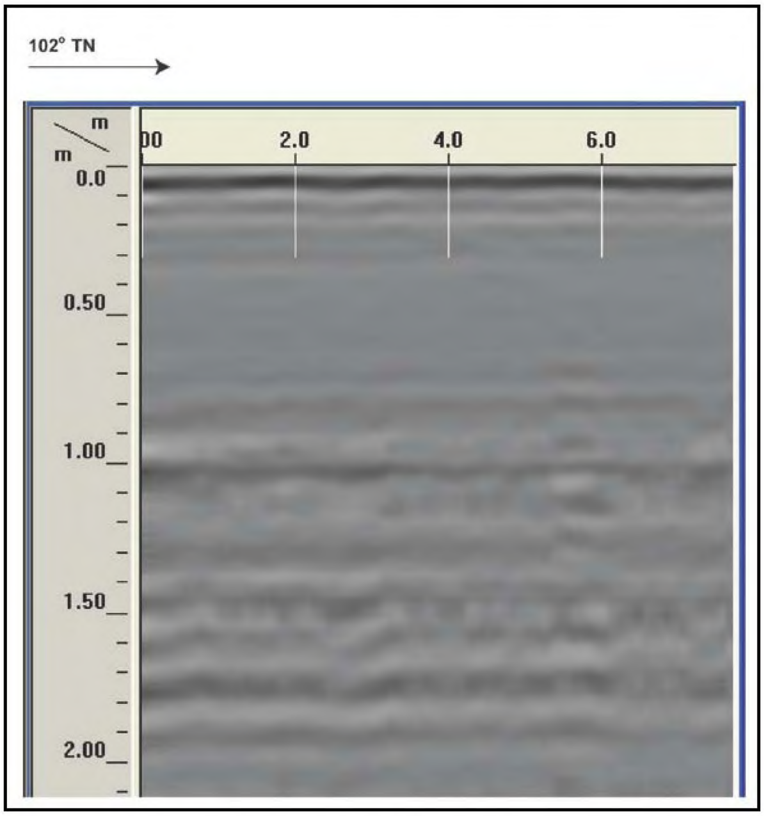

Figure 279. GPR profile of Maintenance and Storage Facility Test Trench 8

Maintenance and Storage Facility Test Trench 9

Orientation	90° TN
Length	6m
Width	0.7m
Maximum Depth	2.5m

Stratum	Depth (cmbs)	Description
I	0-250	10 YR 4/4, dark yellowish brown; silt loam; strong medium blocky structure; dry very hard consistency; non-plastic; strong cementation; terrestrial origin; roots extend to 1 meter below surface. Soil compaction increases with depth.

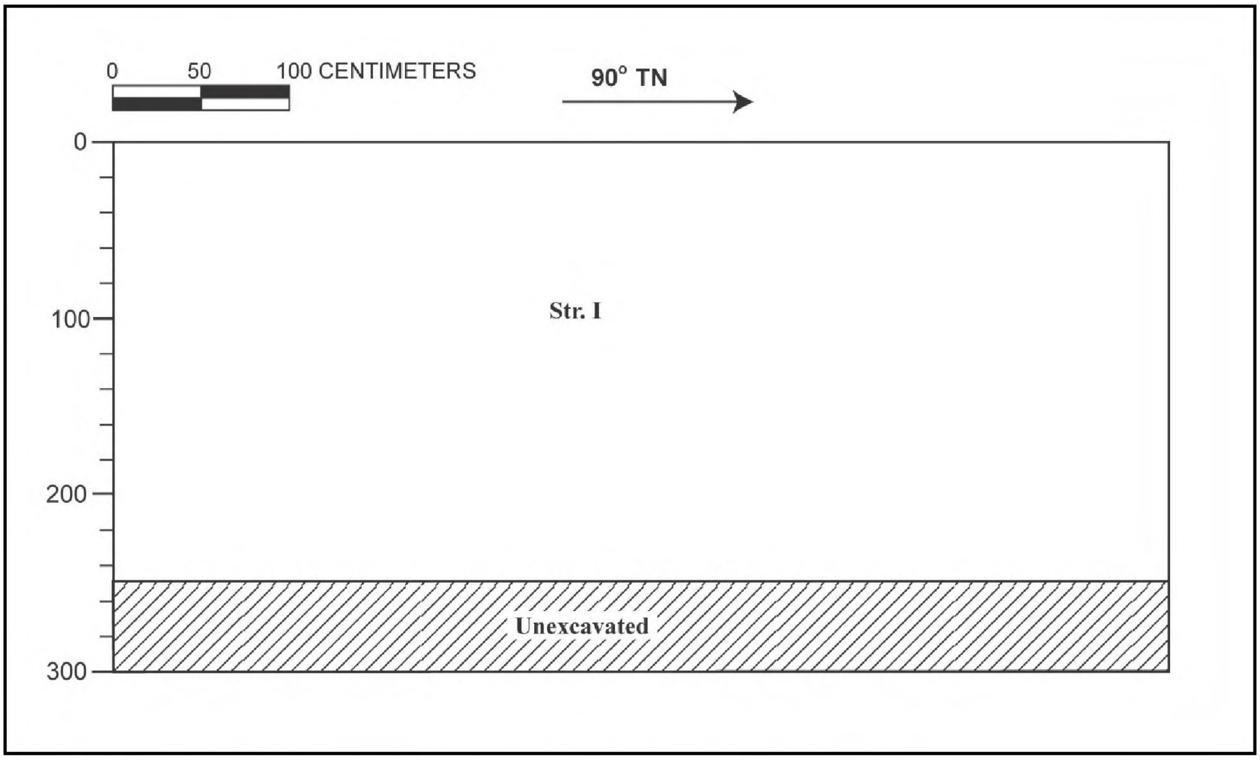

Figure 280. Profile of Maintenance and Storage Facility Test Trench 9

Figure 281. Photograph of Maintenance and Storage Facility Test Trench 9, view to south

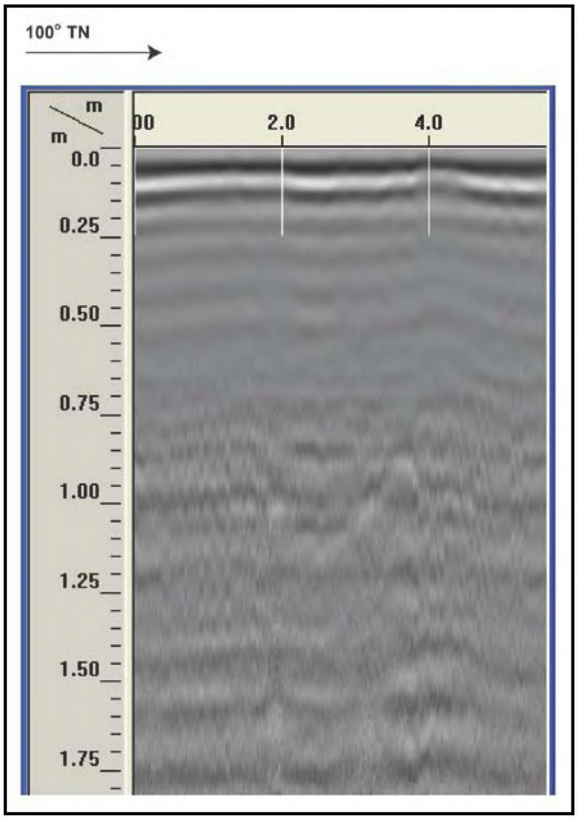

Figure 282. GPR profile of Maintenance and Storage Facility Test Trench 9

Leeward Community College Station Test trench 1

Orientation	200° TN
Length	8 m
Width	0.8 m
Maximum Depth	3.8 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-380	5 YR 4/3, reddish brown; silt loam; strong medium blocky structure; dry hard consistency; non-plastic; weak cementation; terrestrial origin. Naturally deposited sediment.

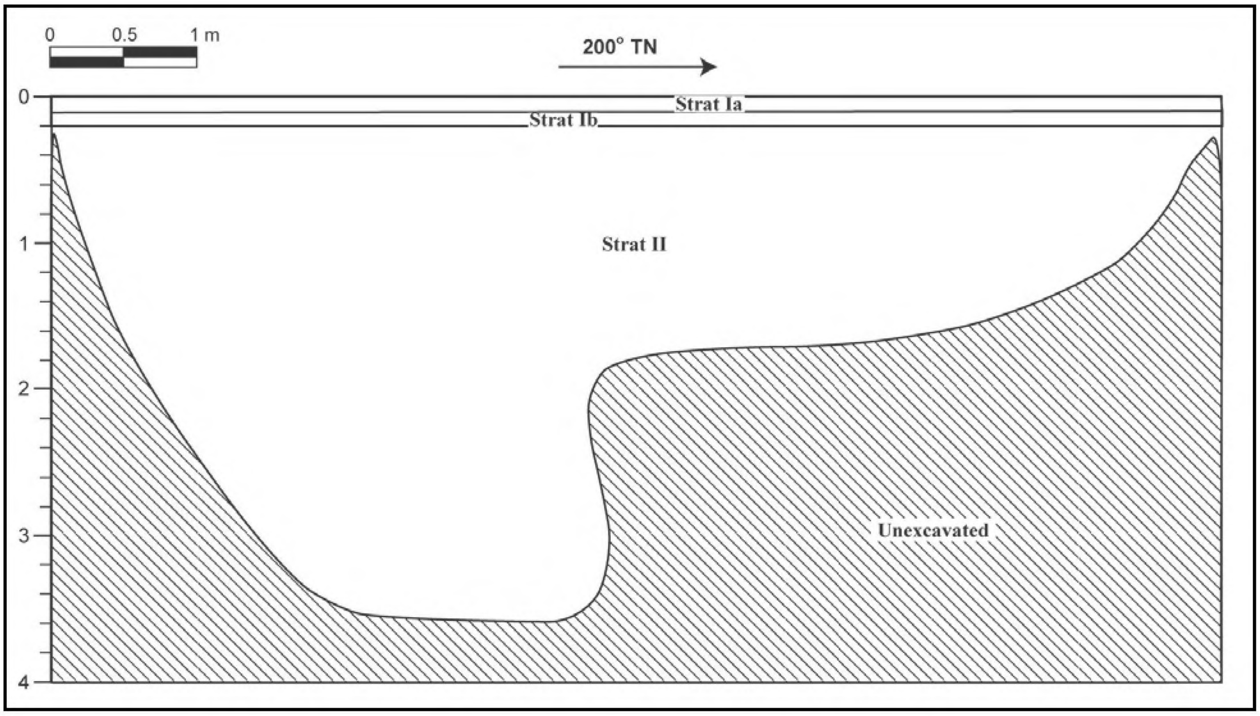

Figure 283. Profile of Leeward Community College Station Test trench 1

Figure 284. Photograph of Leeward Community College Station Test trench 1, view to east

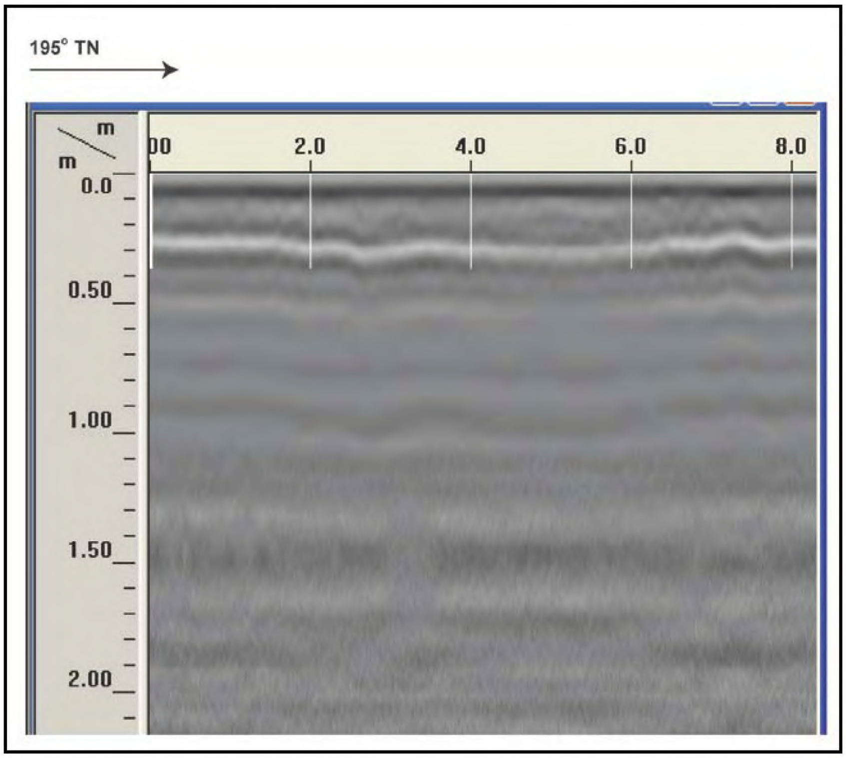

Figure 285. GPR profile of Leeward Community College Station Test trench 1

Leeward Community College Station Test trench 2

Orientation	110° TN
Length	5 m
Width	0.8 m
Maximum Depth	3.5 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-350	5 YR 4/3, reddish brown; silt loam; strong medium blocky structure; dry hard consistency; non-plastic; weak cementation; terrestrial origin. Naturally deposited sediment.

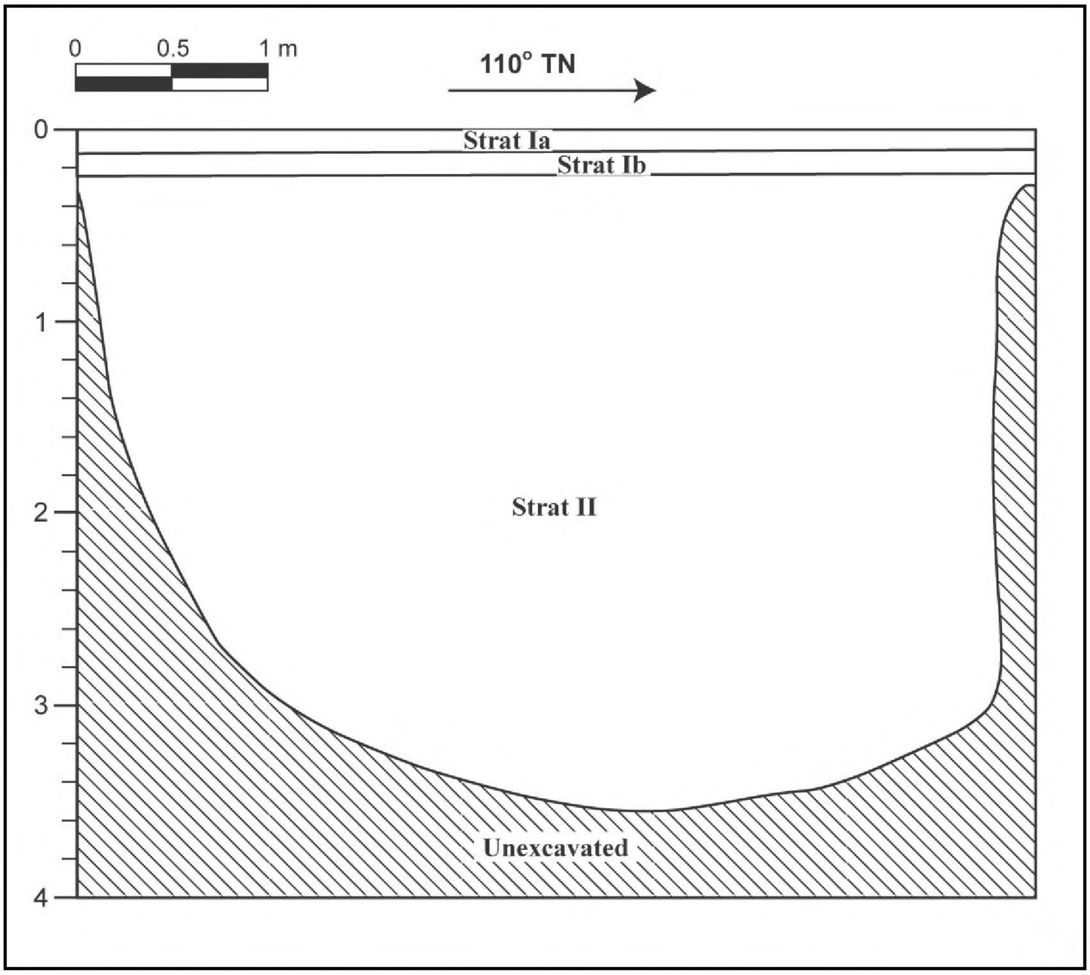

Figure 286. Profile of Leeward Community College Station Test trench 2

Figure 287. Photograph of Leeward Community College Station Test trench 2, view to north

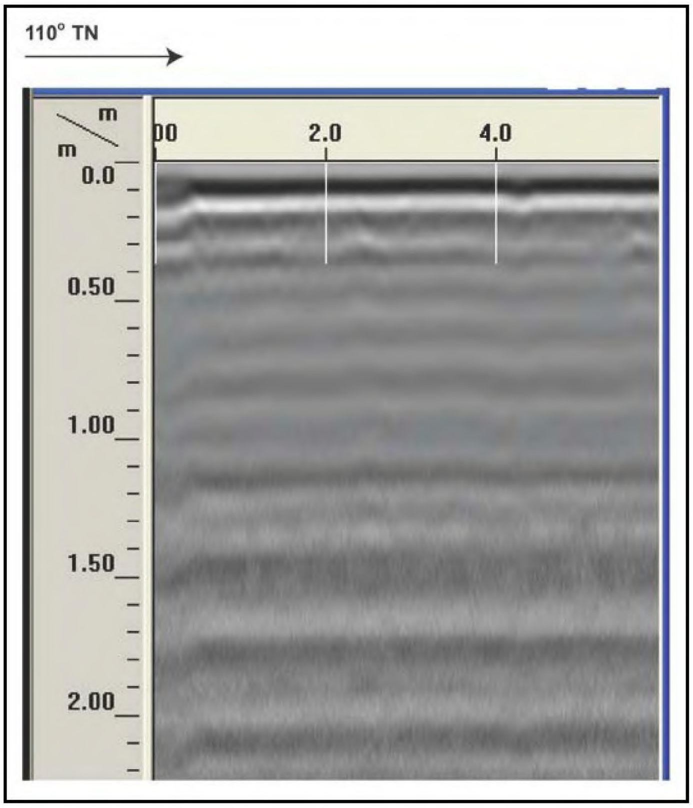

Figure 288. GPR profile of Leeward Community College Station Test trench 2

Leeward Community College Station Test trench 3

Orientation	110° TN
Length	5 m
Width	0.8 m
Maximum Depth	2.1 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Asphalt
Ib	10-20	Basalt gravel base course
II	20-210	5 YR 4/3, reddish brown; silt loam; strong medium blocky structure; dry hard consistency; non-plastic; weak cementation; terrestrial origin. Naturally deposited sediment.

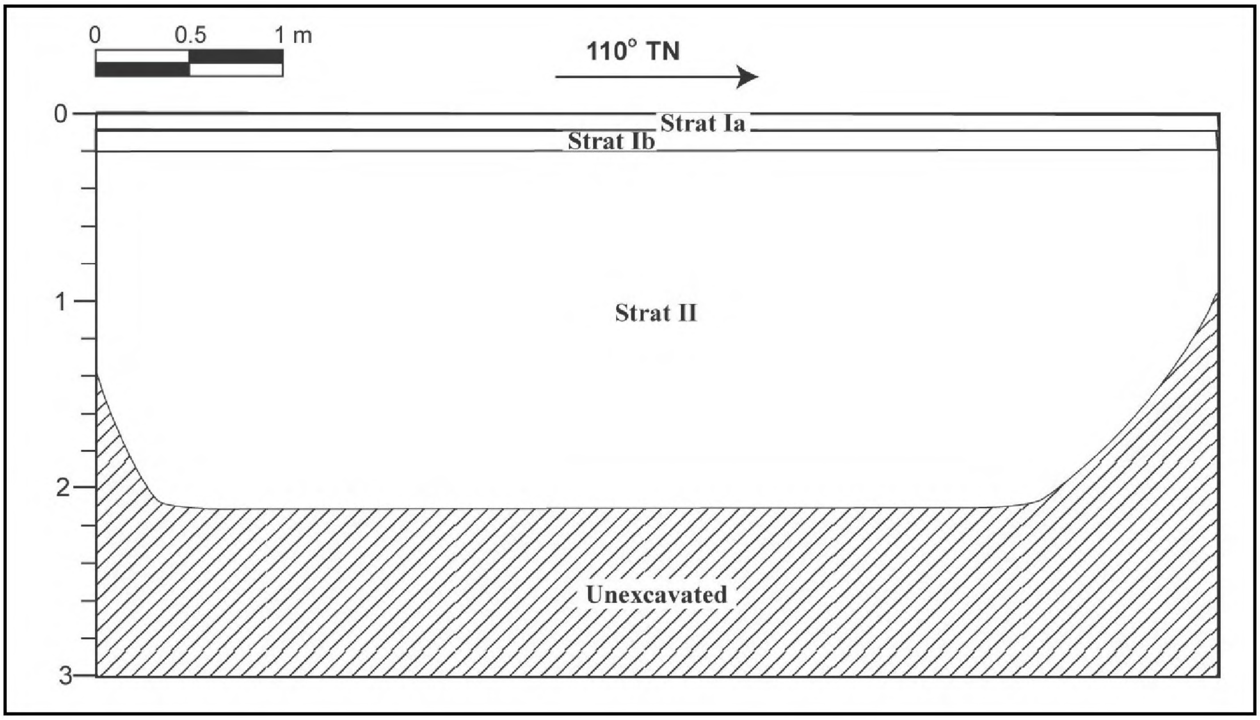

Figure 289. Profile of Leeward Community College Station Test trench 3

Figure 290. Photograph of Leeward Community College Station Test trench 3, view to north

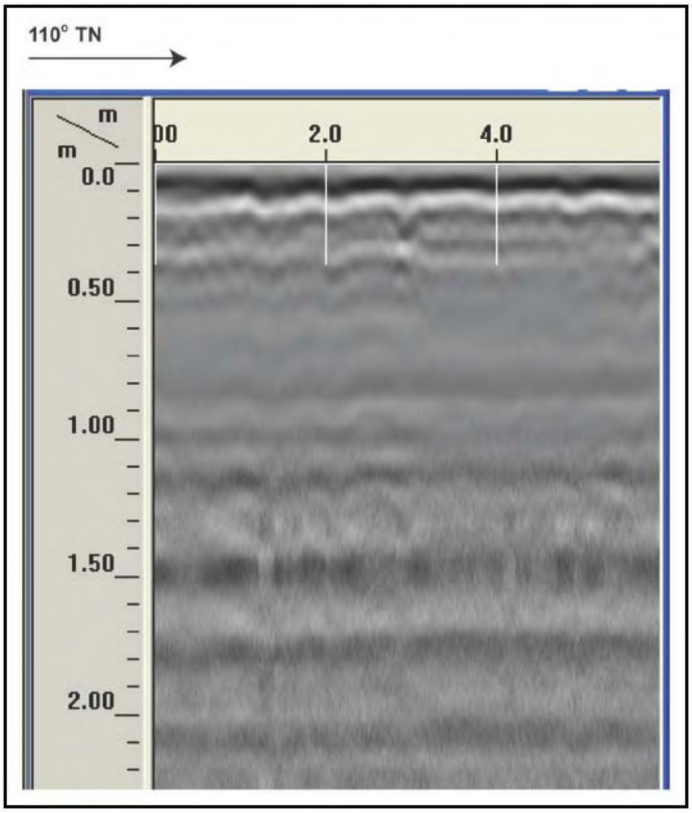

Figure 291. GPR profile of Leeward Community College Station Test trench 3

4.14 Construction Sheet RW015

Construction Sheet RW015 includes a 3,500 ft (1.0 km) segment of the proposed transit corridor, and includes the proposed Pearl Highlands Station and Park and Ride Facility (Figure 292). Eleven test trenches were excavated at both the station and park and ride (Figure 293). Additionally, five column test pits (C-32 to C-36) were also excavated (see Figure 292), totaling 16 test excavations within Construction Sheet RW015.

4.14.1 Pedestrian Inspection

The area defined by Construction Sheet RW015 consists of a roughly 17-acre area proposed for the development of the Pearl Highlands Station and Park and Ride Facility. Current land uses include residential housing, a community church, a construction base yard, and as a storage area for scrap metal. Waiawa Stream flows east along the south side of this area.

In consultation with one of the current landowners, it was ascertained that the area was highly modified from its natural state, as a large amount of fill had been deposited all the way up to the streamside to enable development of the area. According to this landowner, these fill layers were brought in over time between 30 and 40 years ago (Mr. Sam Alipio, personal communication 15 September 2009).Various trees, brush, and grasses grow all about with some being cultivated by the tenants, others growing wildly. High amounts of debris and broken vehicles lay all about the entire vicinity. A mix of dilapidated structures and renovated houses are built about the area (Figure 294).

Development associated with land filling and construction activities within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.14.2 GPR Survey

Prior to excavation all test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

Throughout the entire area defined by Construction Sheet RW015 (excluding C-34 to C-36), the GPR had limited ability to detect buried land fill deposits (asphalt, concrete, cars, home appliances, etc.) and associated subsurface disturbances. Buried objects did not always corresponded with subsurface anomalies detected by the GPR (see Figure 295 thru Figure 333). Only a fraction of the buried debris observed during test excavation were detected by the GPR, and that radar depth penetration (aka "visibility") was limited to an approximate depth of 1 m.

The GPR was generally able to detect stratigraphic interfaces and areas of previous disturbance. Stratigraphic interfaces corresponded to horizontal banding displayed in GPR profiles and areas of disturbance corresponded to irregular horizontal banding that was discontinuous (Figure 298 thru Figure 300 & Figure 313 thru Figure 324).

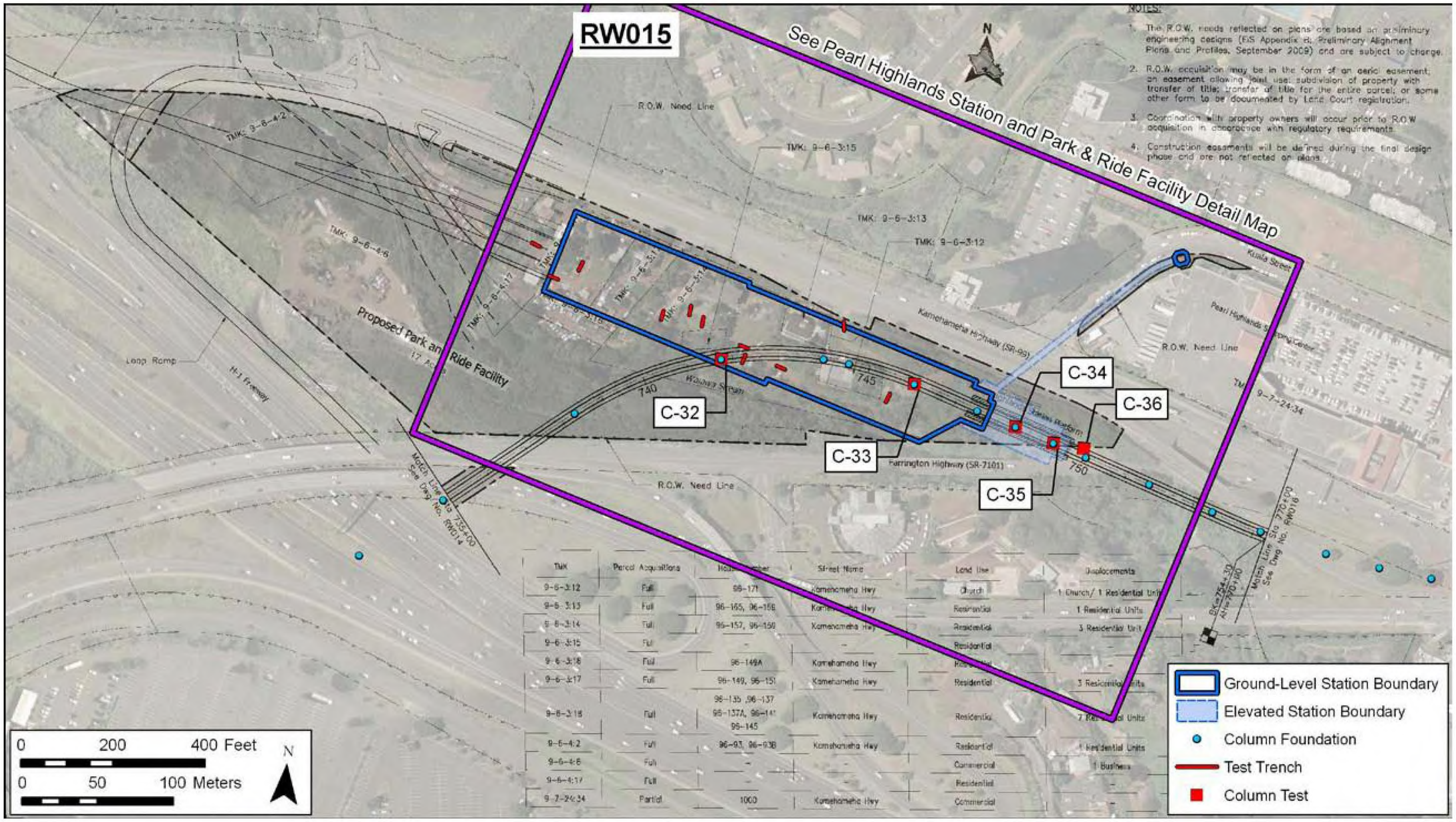

Figure 292. Construction Sheet RW015 showing the location of test excavations

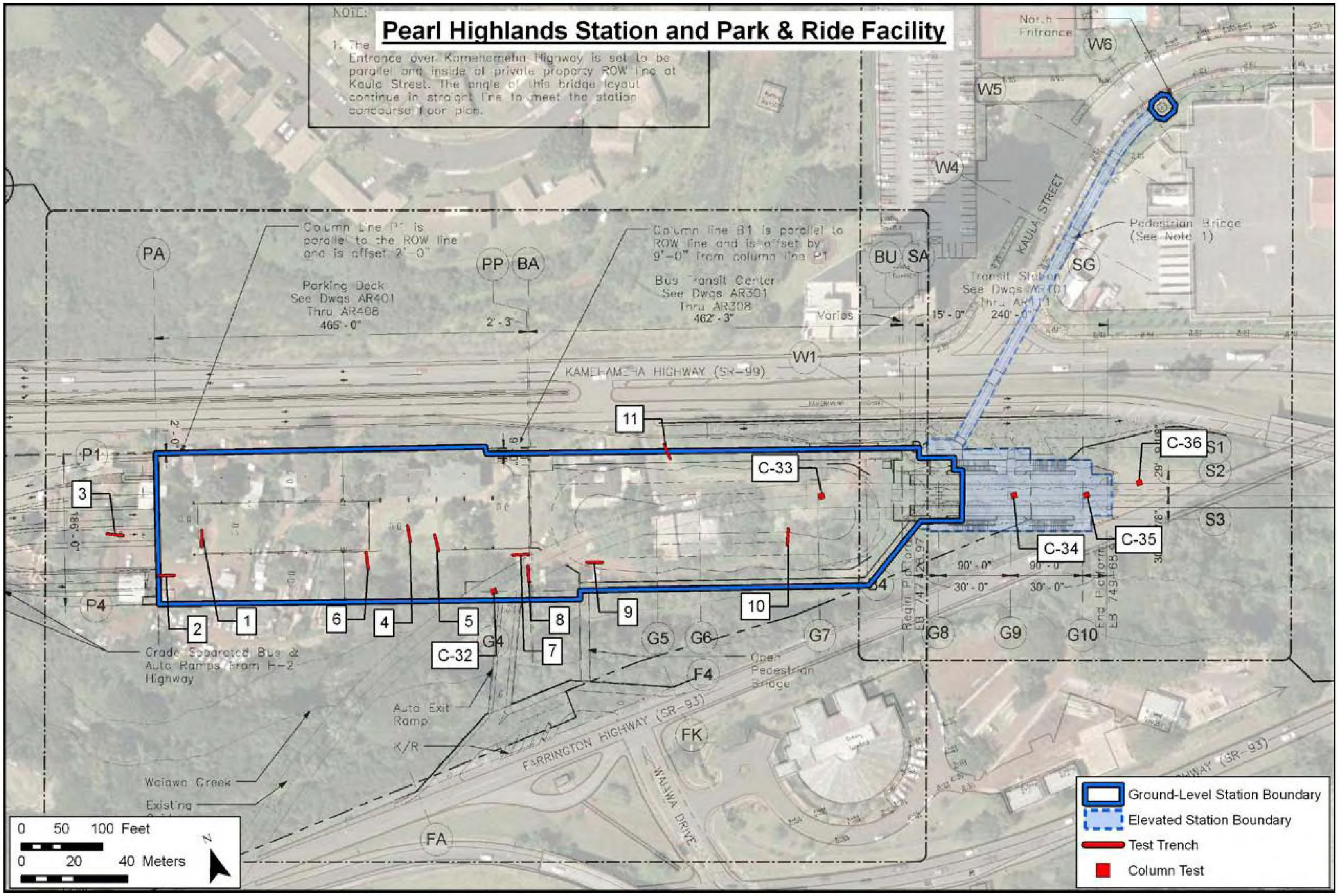

Figure 293. Pearl Highlands Station and Park and Ride Facility floor plan showing the location of test trenches

Figure 294. Photograph of residential dwellings within the project area proposed for the Pearl Highlands Transit Station and Park and Ride facility.

The results of the GPR survey were inconclusive. While the GPR was able to detect buried objects and areas of previous disturbance, it did not detect all buried objects and had a limited depth of view, restricted to an approximate depth of 1 m. It is believed that soil chemistry was theprimary environmental factor that caused the inconsistent and limited GPR results. The mixed GPR results in this area are consistent with the NRCS, which determined a GPR suitability of moderate to low for this area (see Figure 9).

4.14.3 Subsurface Testing

4.14.3.1 Stratigraphic Summary

Sixteen (16) test excavations were placed within the area delineated by Construction Sheet RW015 (see Figure 292 & Figure 293). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 295 to Figure 340).

In general, the observed and documented stratigraphy consisted of varying layers of fill. Fill events were determined to be associated with residential and agricultural development, as well as extensive garbage dumping. Large amounts of modern garbage (concrete, automobiles, home appliances, plastic, etc.) were observed concentrated beneath the ground surface suggesting that the area was once utilized as a dump and landfill. All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

In only three of the 16 test excavations (Trench 2 and 3 and Column excavation 34) excavated within the area delinated by Construction Sheet RW015 (see Figure 292 & Figure 293) were what appeared to be natural (e.g. non-fill related) sediments observed. These sediments, in all cases designated stratum II, were observed at the base of their backhoe excavations, beneath between two and three meters of recently deposted fill sediments. No cultural material was observed with these natural sediments. They appeared to be the types of alluvial sediments that would be expected along the margins of Waiawa Stream. These sediments were likely the land surface as recently as 30 to 40 years ago, before the massive fill layers were brought in to raise the land surface to its current elevation above Waiawa Stream.

4.14.3.2 Excavation Documentation

Pearl Highlands Station and P&R Test Trench 1

Orientation	20° TN
Length	4 m
Width	0.7 m
Maximum Depth	280 m

Stratum	**Depth (cmbs)**	**Description**
Ia	0-70	Fill Horizon; 2.5 YR 4/6, red; sandy loam; structureless, firm moist consistency; slightly plastic; no cementation; very abrupt smooth lower boundary; Grading fill.
Ib	70-80	Fill Horizon; 10 YR 6/4, light yellowish brown; sandy loam; structureless, firm moist consistency; non-plastic; no cementation; very abrupt smooth lower boundary; Grading fill.
Ic	80-96~103	Fill Horizon; 2.5 YR 5/8, red; silt loam; structureless, very firm moist consistency; plastic; no cementation; clear wavy lower boundary; Grading fill.
Id	96~103-173	Fill Horizon; 2.5 YR 5/2, weak red; clay loam; structureless, friable moist consistency; plastic; no cementation; abrupt wavy lower boundary; Grading fill.
Ie	173-220	Fill Horizon; 5 YR 5/2, reddish gray; stony, cobbly, silty sand; structureless, firm moist consistency; non-plastic; no cementation;; excavation terminated due to impenetrable fill layer, grading fill.

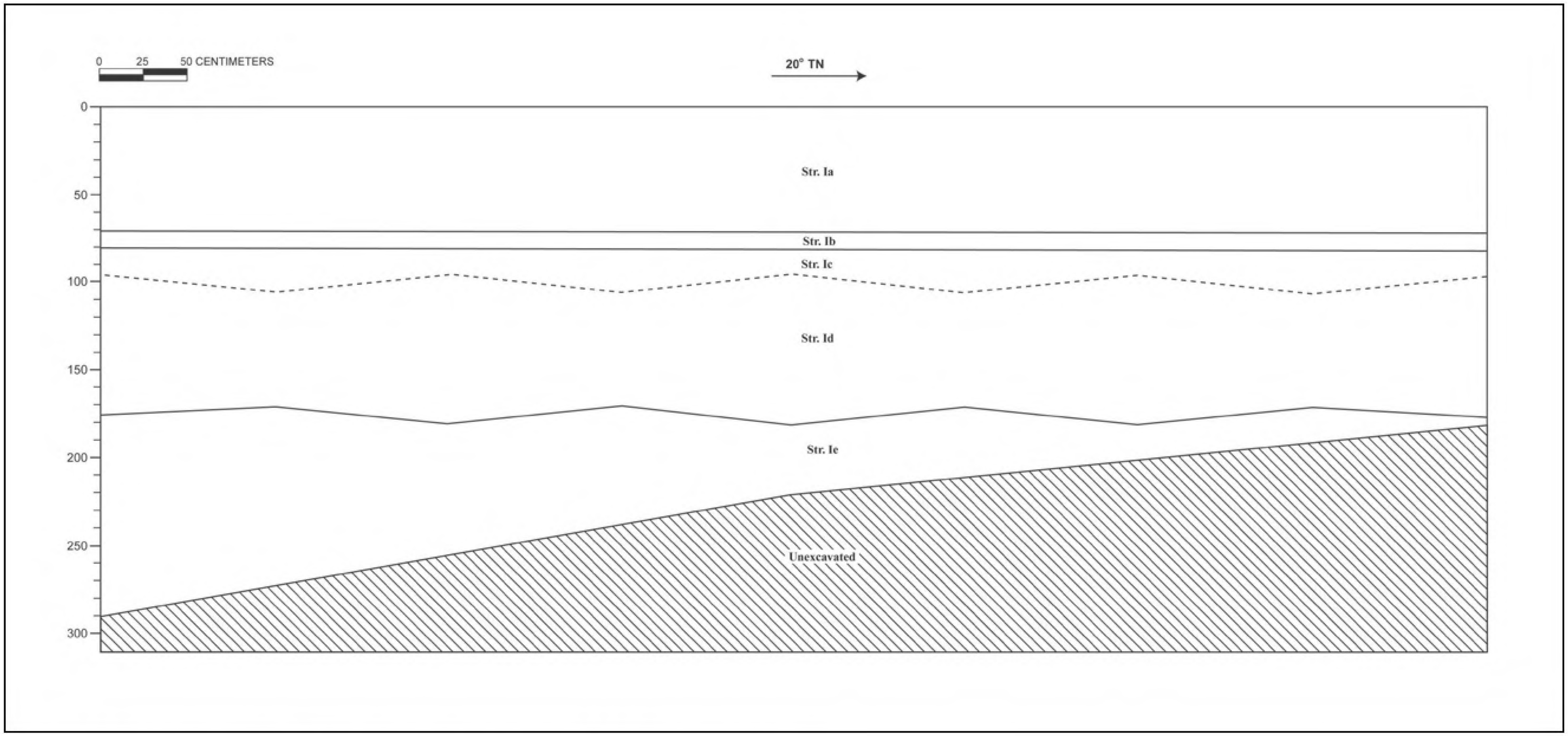

Figure 295. Profile of Pearl Highlands Station and P&R Test Trench 1

Figure 296. Photograph of Pearl Highlands Station and P&R Test Trench 1, view to west

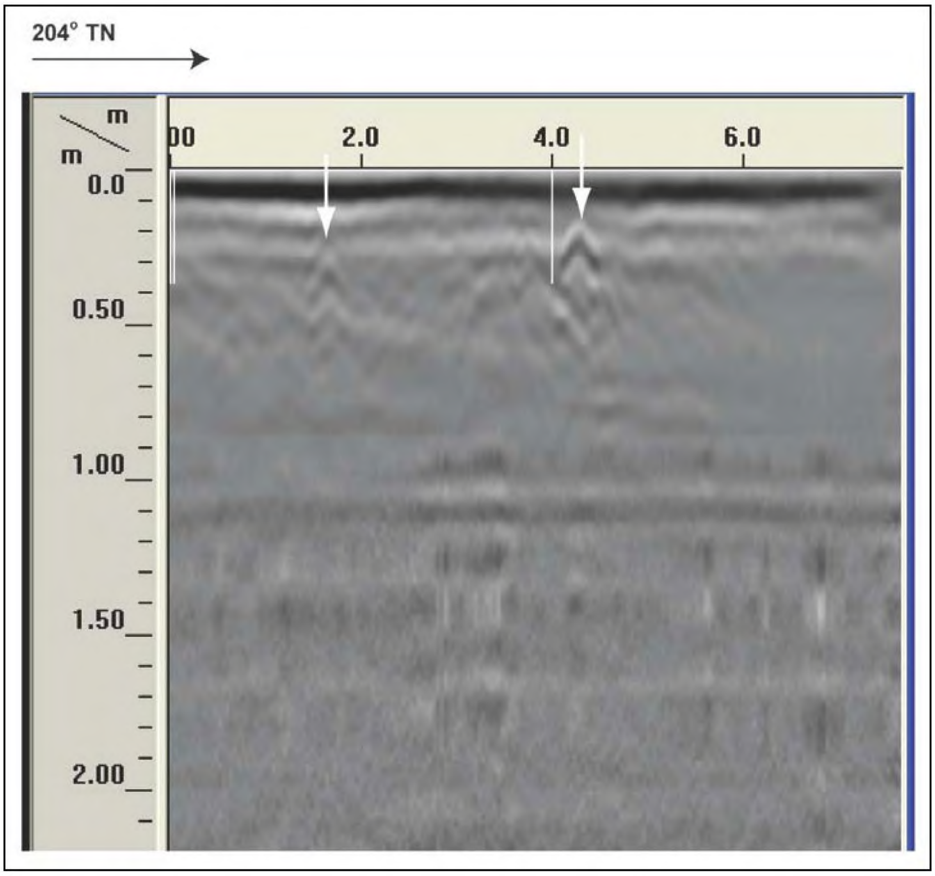

Figure 297. GPR profile of Pearl Highlands Station and P&R Test Trench 1

Pearl Highlands Station and P&R Test Trench 2

Orientation	106° TN
Length	6.5 m
Width	0.8 m
Maximum Depth	3.6 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill Horizon; 2.5 YR 4/4, reddish brown; silty clay loam; weak, fine, crumb structure; loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Surface layer/topsoil for land parcel.
Ib	40-60	Fill Horizon; 10 YR 3/1, very dark gray; asphalt; structureless, slightly hard dry consistency; non-plastic; weak cementation; abrupt smooth lower boundary; Asphalt/pavement fragments and gravel deposited as grading fill.
Ic	60-114	Fill Horizon; 2.5 YR 4/6, red; silt loam; structureless, slightly hard dry consistency; non-plastic; weak cementation; abrupt smooth lower boundary; Terrigenous fill containing gravel (asphalt road?) debris.
Id	111-160	2.5 YR 4/3 reddish brown, reddish brown; clay loam; moderate, fine, crumb structure; weakly coherant dry consistency; friable moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Terrigenous alluvial clay fill; contains various types of debris--glass, basalt, basalt cobbles, pavement/concrete fragments.
Ie	160-323	Fill Horizon; 2.5 YR 2.5/4, dark reddish brown; clay loam; moderate, fine, crumb structure; friable moist consistency; slightly plastic; no cementation; abrupt smooth lower boundary; Terrigenous fill w/ basalt boulders.
II	323-367	Potential natural sediment; 10 R 2.5/1, reddish black; silt; strong, fine, crumb structure; friable moist consistency; non-sticky wet consistency; slightly plastic; no cementation; Possibly a natural sediment below the many fill layers. Sample taken from trench excavation at 340-367 cmbs.

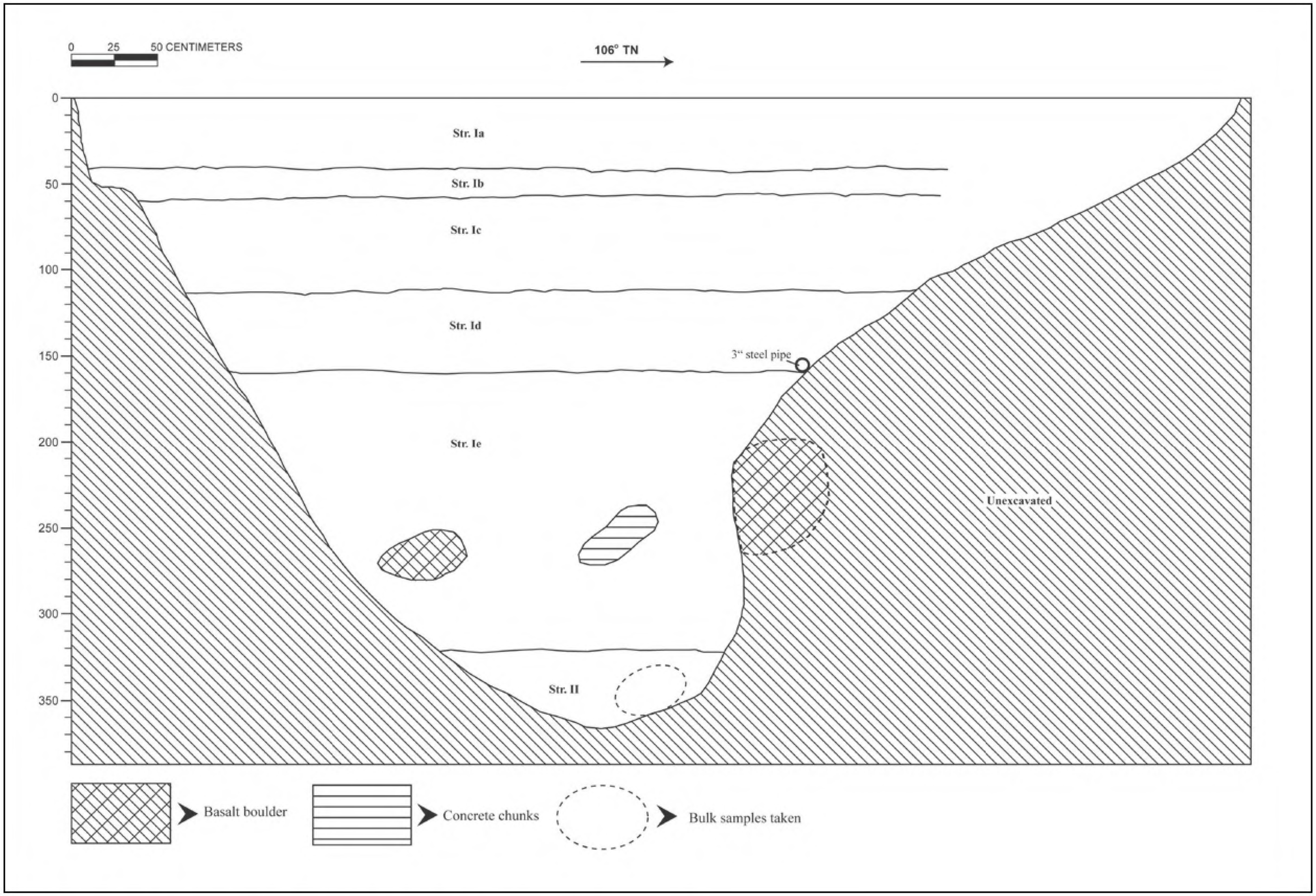

Figure 298. Profile of Pearl Highlands Station and P&R Test Trench 2

Figure 299. Photograph of Pearl Highlands Station and P&R Test Trench 2, view to north

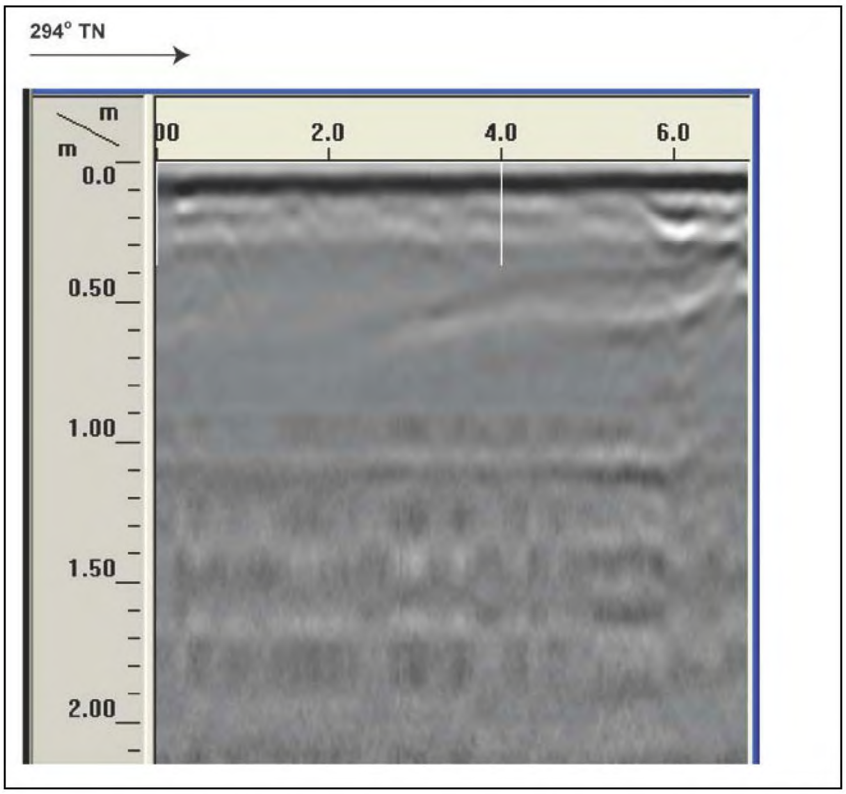

Figure 300. GPR profile of Pearl Highlands Station and P&R Test Trench 2

Pearl Highlands Station and P&R Test Trench 3

Orientation	293° TN
Length	6.5 m
Width	0.8 m
Maximum Depth	3.7 m

Stratum	Depth (cmbs)	Description
Ia	0-30	Fill Horizon; 10 R 3/6, dark red; silty clay loam; moderate, fine, crumb structure; loose dry consistency; loose moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill.
Ib	30-51	Fill Horizon; 10 YR 3/1, very dark gray; asphalt; structureless, slightly hard dry consistency; non-plastic; weak cementation; abrupt smooth lower boundary; Grading fill.
Ic	51-141	Fill Horizon; 5 YR 4/3, reddish brown; silt loam; structureless, slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill.
Id	141-169	Fill Horizon; 10 YR 2/1, black; burnt debris; structureless, loose dry consistency; non-plastic; no cementation; diffuse smooth lower boundary; Grading fill, incinerated fill.
Ie	169-320	Fill Horizon; 7.5 YR 4/4, brown silty clay loam; moderate, fine, crumb structure; loose dry consistency; firm moist consistency; non-plastic; no cementation; abrupt smooth lower boundary; Terrigenous fill deposited by landowner >30 yrs ago as grading material.
II	320-370	Potential natural sediment; 10 YR 4/2, dark yellowish brown; clay; moderate, fine, crumb structure; very firm moist consistency; plastic; no cementation; possibly a natural alluvial sediment below the many fill layers..

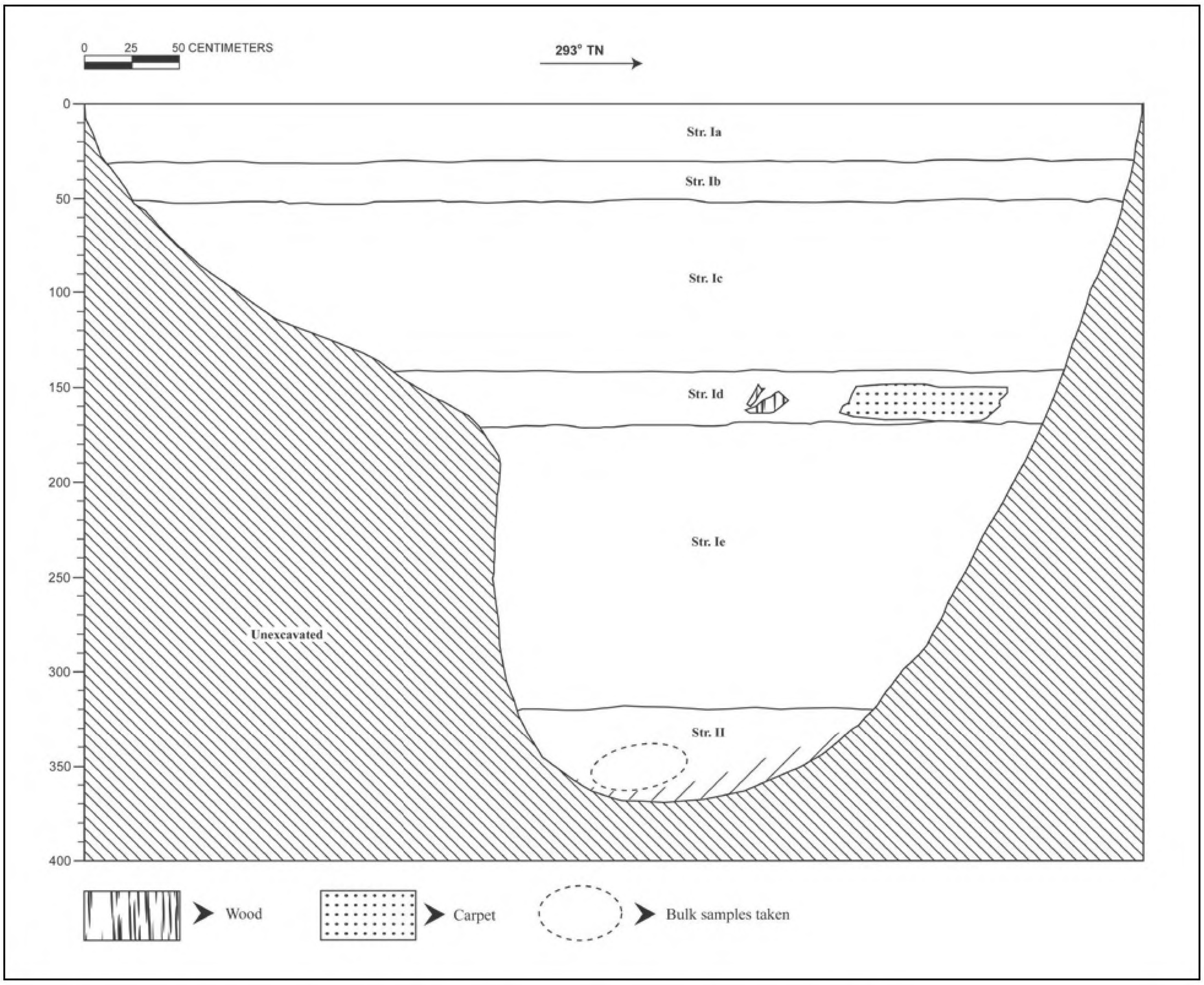

Figure 301. Profile of Pearl Highlands Station and P&R Test Trench 3

Figure 302. Photograph of Pearl Highlands Station and P&R Test Trench 3, view to south

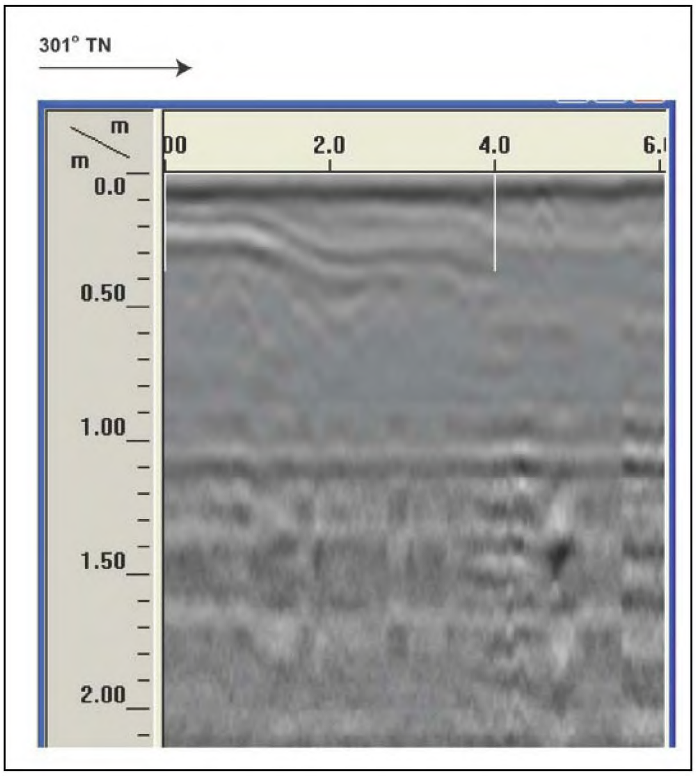

Figure 303. GPR profile of Pearl Highlands Station and P&R Test Trench 3

Pearl Highlands Station and P&R Test Trench 4

Orientation	300° TN
Length	6 m
Width	0.8 m
Maximum Depth	3.3 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill Horizon; 2.5 YR 3/3, dark reddish brown; silt loam; structureless, loose dry consistency; non-plastic; no cementation; abrupt wavy lower boundary; Backyard landscape surface.
Ib	40-65	Fill Horizon; 10 YR 3/2, very dark grayish brown; silt loam; structureless, loose dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Mixed fill.
Ic	65-110	Fill Horizon; 10 YR 4/3, brown; silt loam; structureless, loose dry consistency; non-plastic; no cementation; diffuse irregular lower boundary; Mixed fill.
Id	110-335	Fill Horizon; 10 YR 4/4, dark yellowish brown; silt loam; structureless, loose dry consistency; non-plastic; no cementation; Mixed fill.

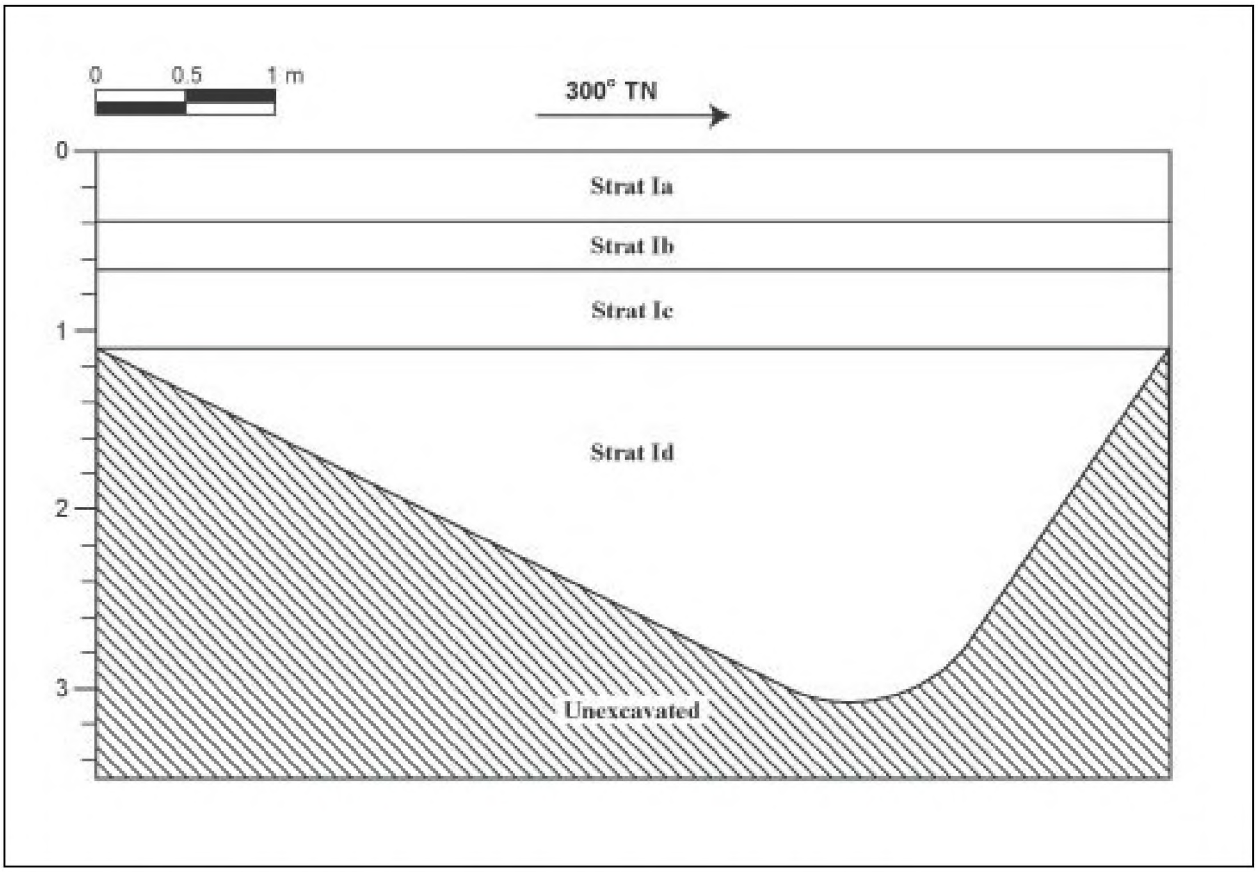

Figure 304. Profile of Pearl Highlands Station and P&R Test Trench 4

Figure 305. Photograph Pearl Highlands Station and P&R Test Trench 4, view to south

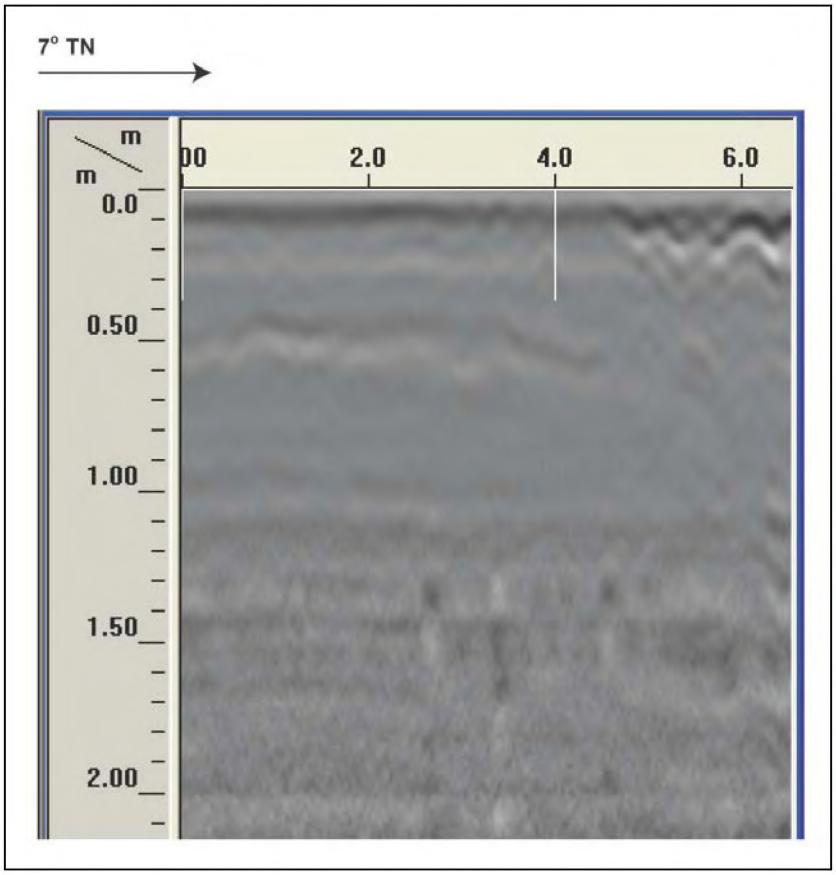

Figure 306. GPR profile of Pearl Highlands Station and P&R Test Trench 4

Pearl Highlands Station and P&R Test Trench 5

Orientation	003° TN
Length	6 m
Width	0.8 m
Maximum Depth	3.6 m

Stratum	Depth (cmbs)	Description
Ia	0-34	Fill Horizon; 10 R 3/4, dusky red; silty clay loam; weak, fine, crumb structure; slightly hard dry consistency; firm moist consistency; sticky wet consistency; plastic; no cementation; abrupt smooth lower boundary; Alluvial clay loam top soil for backyard surface.
Ib	34-65	Fill Horizon; 5 YR 5/3, reddish brown; silt; weak, fine, crumb structure; slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Grading fill containing gravel.
Ic	65-130	Fill Horizon; 2.5 YR 5/8, red; silt; weak, fine, crumb structure; hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Contains gravel.
Id	130-285	Fill Horizon; 7.5 YR 5/3, brown; silt; structureless, slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Contains gravel, crushed coral and basalt.
Ie	285-367	Fill Horizon; 10 YR 4/3, brown; silt; structureless, loose dry consistency; non-plastic; no cementation; Landfill material containing various debris including asfault and concrete fragments, coral, bricks and basalt cobbles.

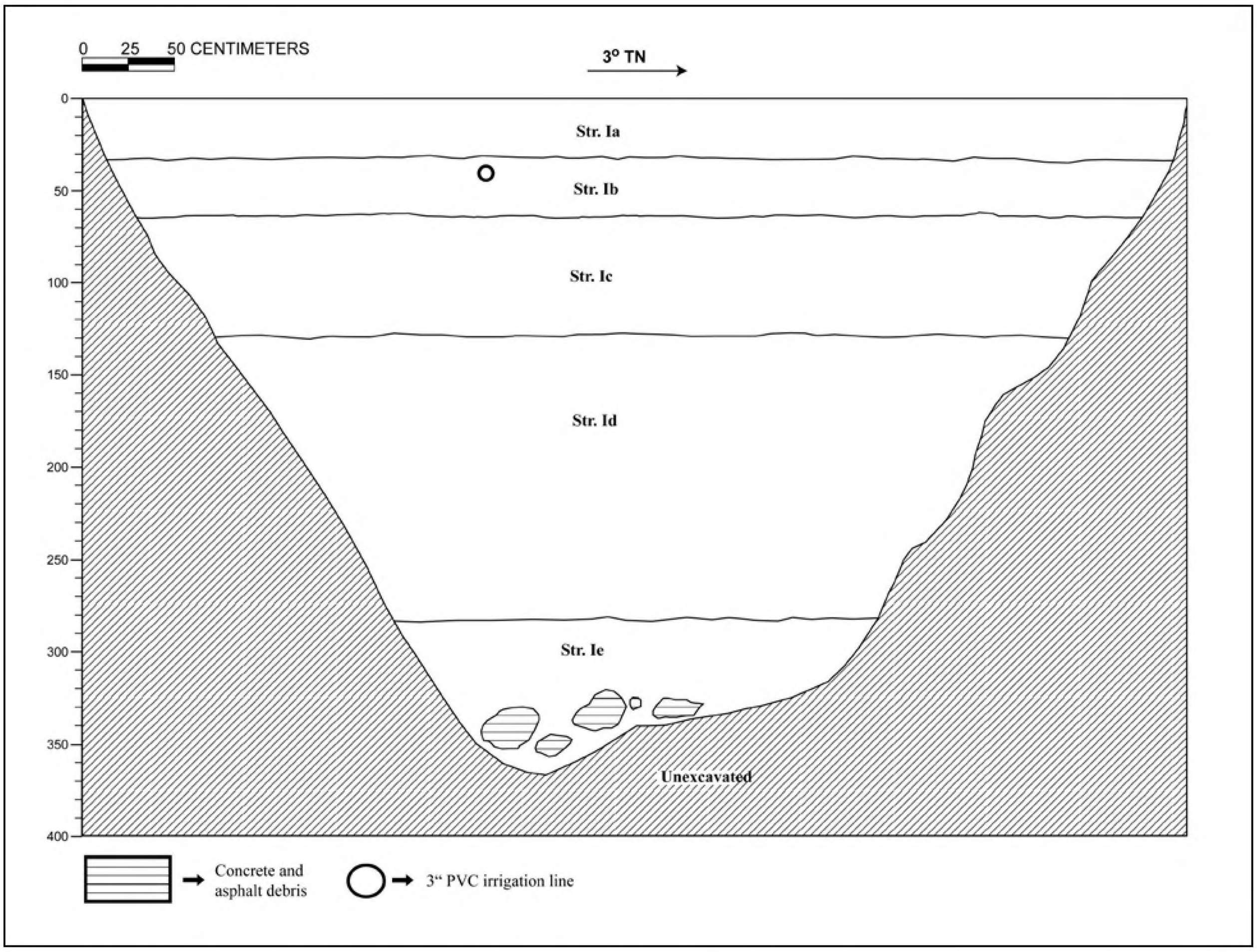

Figure 307. Profile of Pearl Highlands Station and P&R Test Trench 5

Figure 308. Photograph of Pearl Highlands Station and P&R Test Trench 5, view to west

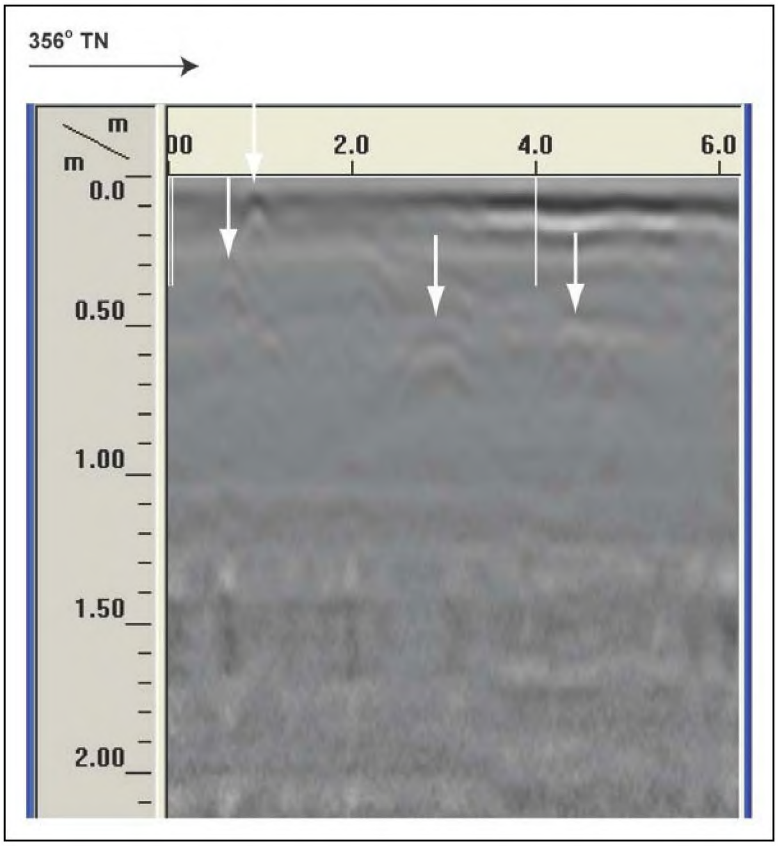

Figure 309. GPR profile of Pearl Highlands Station and P&R Test Trench 5

Pearl Highlands Station and P&R Test Trench 6

Orientation	192° TN
Length	6 m
Width	0.8 m
Maximum Depth	1.6 m

Stratum	Depth (cmbs)	Description
Ia	0-25	Fill Horizon; 10 YR 4/4, dark yellowish brown; silt; structureless, loose dry consistency; non-plastic; no cementation; abrupt broken lower boundary; Driveway surface.
Ib	25-60	Fill Horizon; 7.5 YR 3/3, dark brown; silt loam; structureless, weakly coherant dry consistency; friable moist consistency; no cementation; diffuse broken lower boundary; Mixed fill.
Ic	60-100	Fill Horizon; 10 YR 3/4, dark yellowish brown; silt; structureless, loose dry consistency; non-plastic; no cementation; diffuse irregular lower boundary; Const. material fill.
Id	100-160	Fill Horizon; 10 YR 4/3, brown; silt loam; structureless, weakly coherant dry consistency; non-plastic; no cementation; Mixed fill.

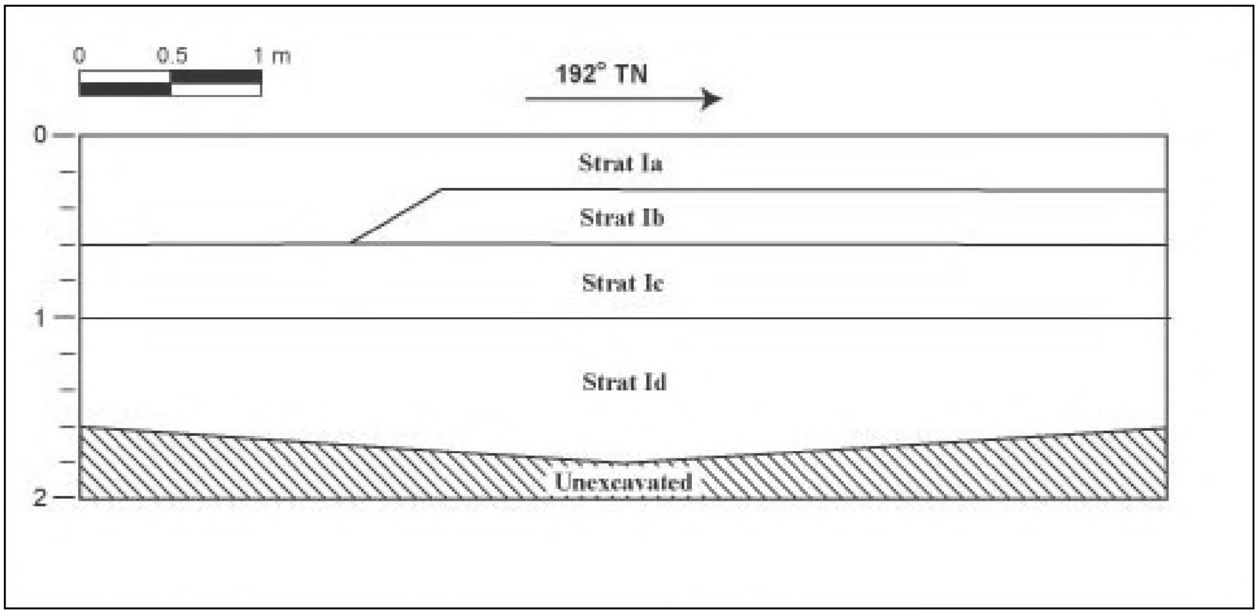

Figure 310. Profile of Pearl Highlands Station and P&R Test Trench 6

Figure 311. Photograph of Pearl Highlands Station and P&R Test Trench 6, view to east

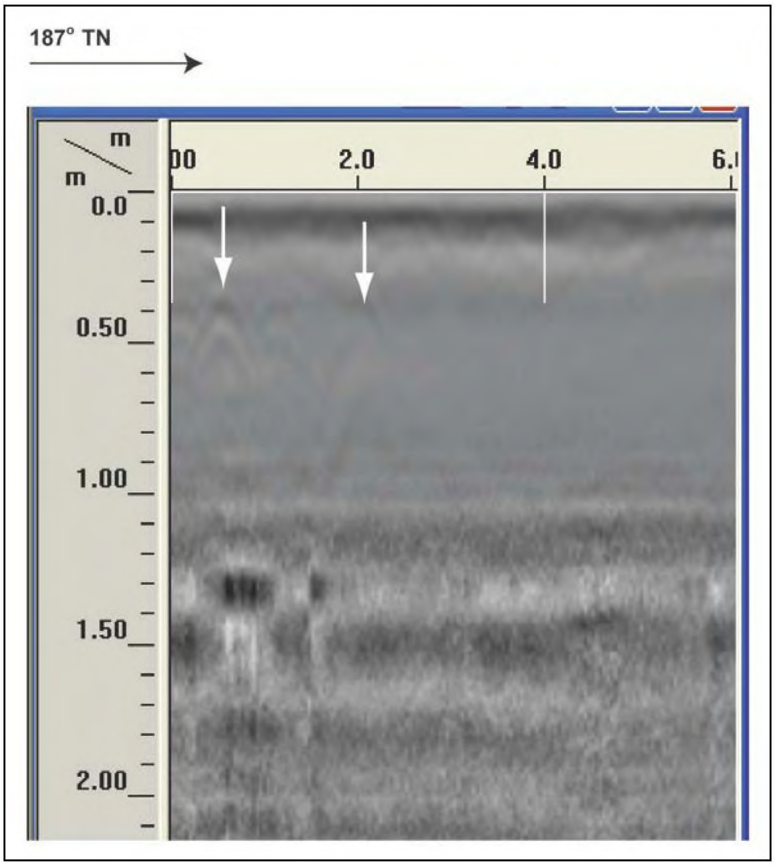

Figure 312. GPR profile of Pearl Highlands Station and P&R Test Trench 6

Pearl Highlands Station and P&R Test Trench 7

Orientation	88° TN
Length	5.5m
Width	0.7m
Maximum Depth	210m

Stratum	Depth (cmbs)	Description
Ia	0-10	Gravel Fill
Ib	10-30	Fill Horizon; 5 YR 3/4, dark reddish brown; clay; strong medium blocky structure; dry very hard consistency; plastic; no cementation; abrupt smooth lower boundary; imported fill
Ic	30-50	Fill Horizon; 5 YR 4/6 yellowish red; clay; moderate medium blocky structure; dry very hard consistency; plastic; no cementation; terrestrial origin; abrupt broken lower boundary; imported construction fill
Id	30-140	Fill Horizon; 5 YR 3/2 dark reddish brown; silty clay loam; moderate medium crumb structure; dry slightly hard consistency; slightly plastic; weak cementation; terrestrial origin; abrupt smooth lower boundary
Ie	140-210	Fill Horizon; 7.5 YR 5/3 silt loam; weak fine crumb structure; dry weakly coherent consistency; non-plastic; weak cementation; terrestrial origin; imported construction fill

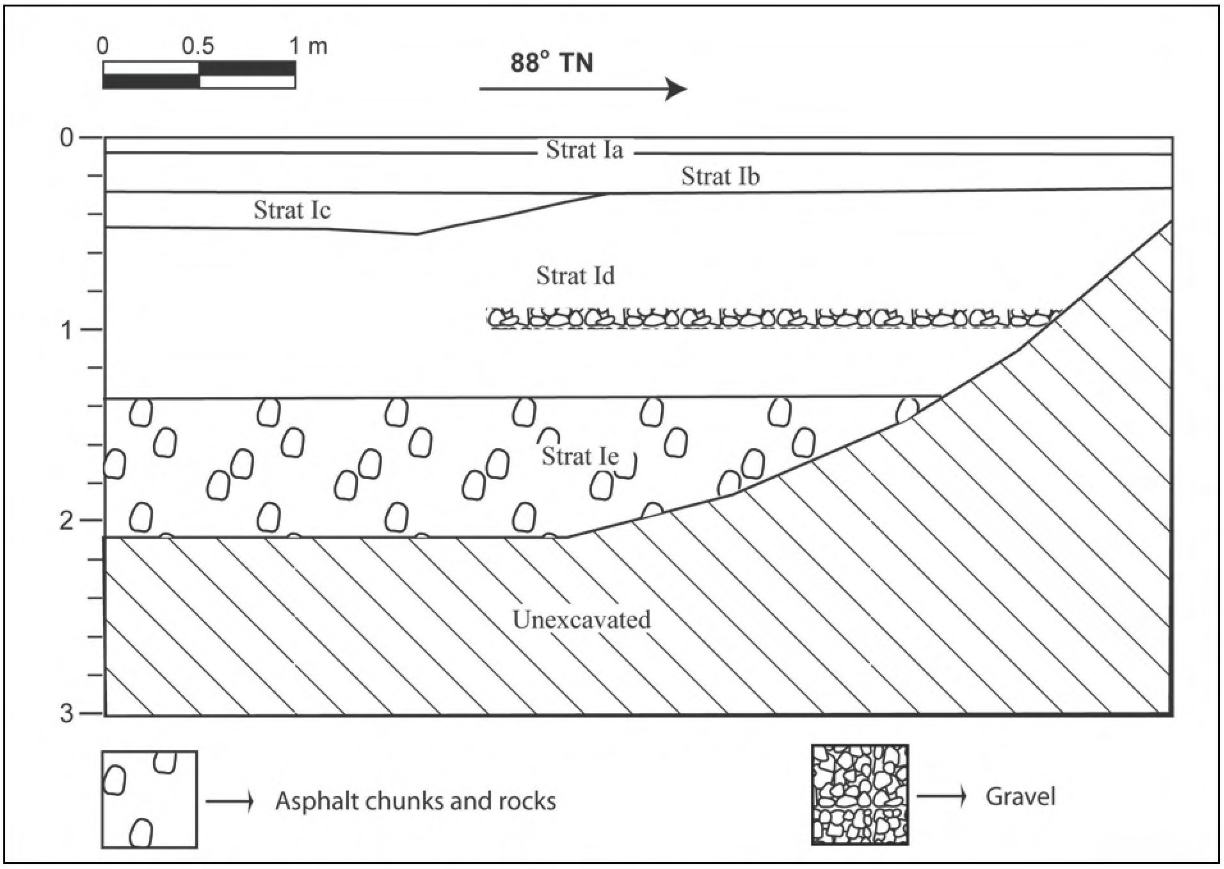

Figure 313. Profile of Pearl Highlands Station and P&R Test Trench 7

Figure 314. Photograph of Pearl Highlands Station and P&R Test Trench 7, view to north

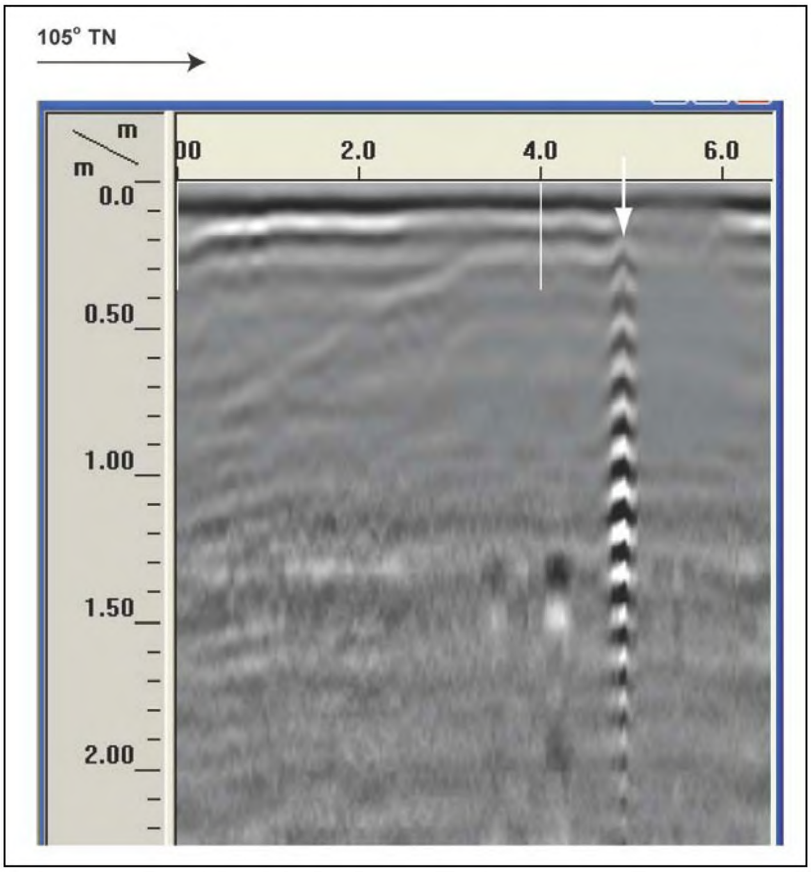

Figure 315. GPR profile of Pearl Highlands Station and P&R Test Trench 7

GPR profile of Pearl Highlands Station and P&R Test Trench 8

Orientation	115° TN
Length	8m
Width	0.7m
Maximum Depth	2.6m

Stratum	Depth (cmbs)	Description
Ia	0-20	Fill Horizon; 10 YR 5/2, very pale brown; crushed coral; structurless; dry loose consistency; non-plastic; no cementation; marine origin; very abrupt smooth lower boundary, contained some modern trash
Ib	20-130	Fill Horizon; 5 YR 2.5/2 dark reddish brown; clay loam; structurless; moist very firm consistency; plastic; no cementation; terrestrial origin;

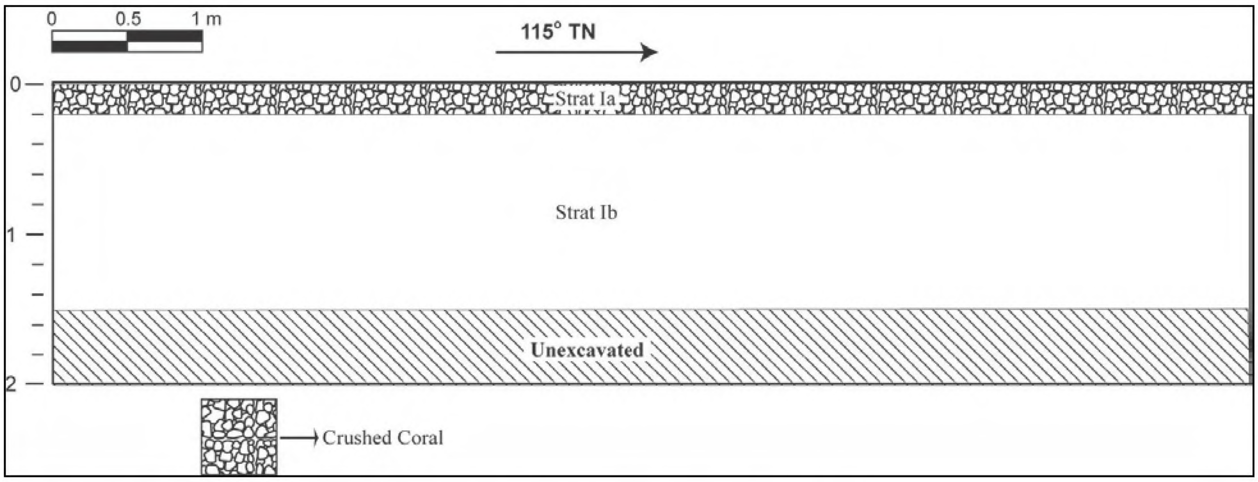

Figure 316. Profile of Pearl Highlands Station and P&R Test Trench 8

Figure 317. Photograph of Pearl Highlands Station and P&R Test Trench 8, view to northwest

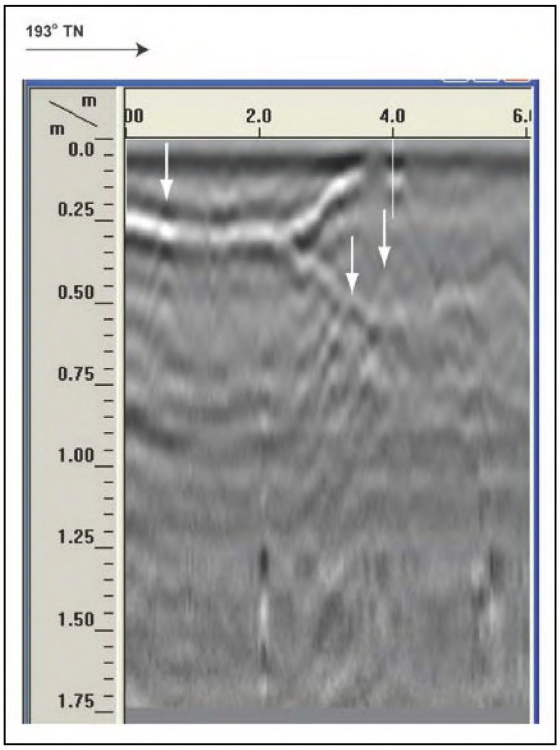

Figure 318. GPR profile of Pearl Highlands Station and P&R Test Trench 8

Pearl Highlands Station and P&R Test Trench 9

Orientation	20° TN
Length	6 m
Width	0.7 m
Maximum Depth	2.7 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill Horizon; 2.5 YR 2.5/2, dark reddish brown; silty clay loam; structurless; moist very friable consistency; non-plastic; no cementation; terrestrial; clear irregular lower boundary; contains modern trash
Ib	40-270	Fill Horizon; 7.5 YR 3/3 dark brown; clay loam; structurless; moist very firm consistency to wet very sticky consistency; very plastic; no cementation; terrestrial origin, contains basalt boulders modern trash crushed coral concrete and gravel

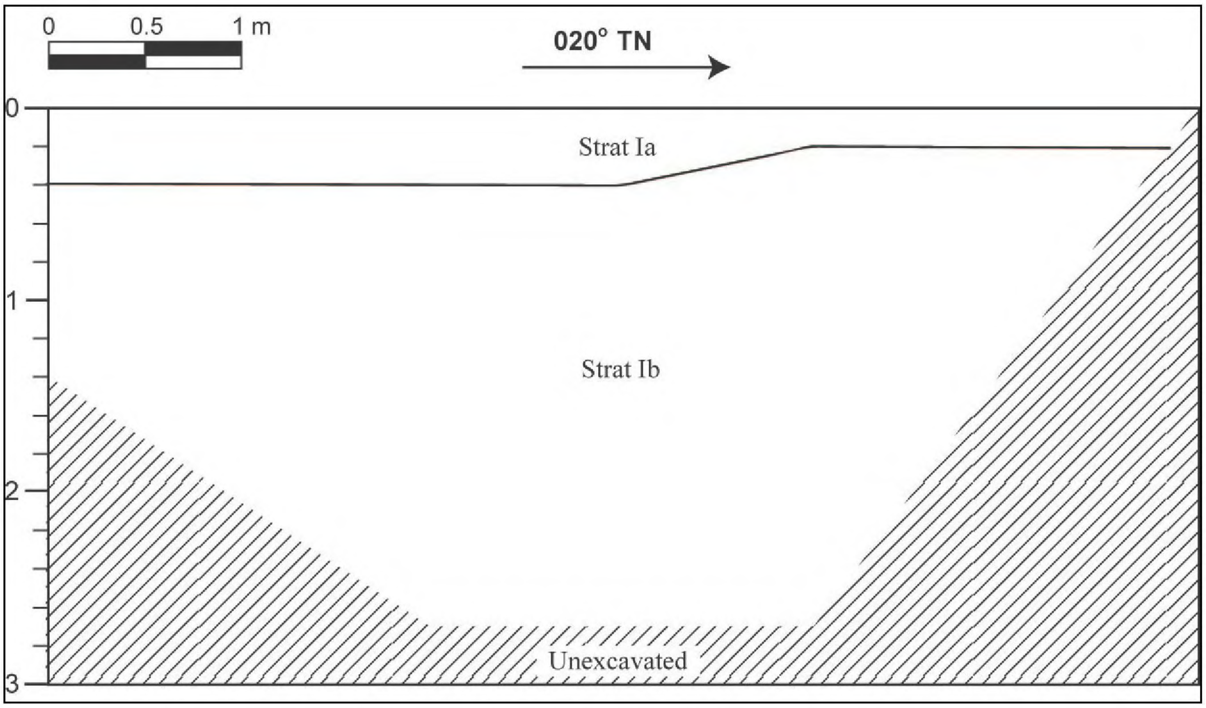

Figure 319. Profile of Pearl Highlands Station and P&R Test Trench 9

Figure 320. Photograph of Pearl Highlands Station and P&R Test Trench 9, view to west

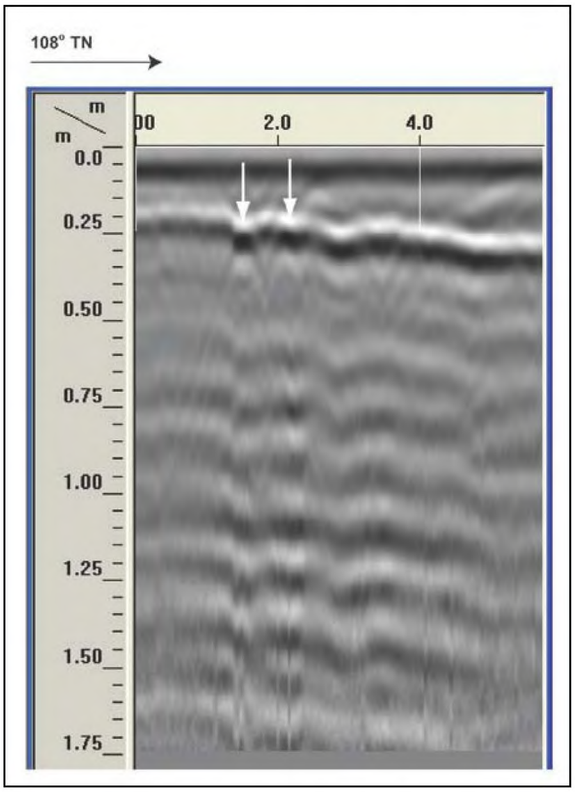

Figure 321. GPR profile of Pearl Highlands Station and P&R Test Trench 9

Pearl Highlands Station and P&R Test Trench 10

Orientation	20° TN
Length	5 m
Width	0.7 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
Ia	0-60	Fill Horizon; 10 YR 4/2, dark grayish brown; silty sandy loam; structurless; dry loose consistency; non-plastic; no cementation; mixed origin; clear irregular lower boundary; contains modern trash, rebar, metal coral, basalt gravel and roots
Ib	60-120	Fill Horizon; 5 YR 3/3 dark reddish brown; clay loam; structurless; dry loose consistency; non plastic; no cementation; mixed origins; clear irregular lower boundary; contains rebar and modern trash
Ic	120-250	Fill Horizon; 10 YR 3/4, dark yellowish brown; silty clay loam; structurless; very friable moist consistency; slightly plastic; no cementation; mixed origin; contains modern trash, rebar, tile, coral and concrete

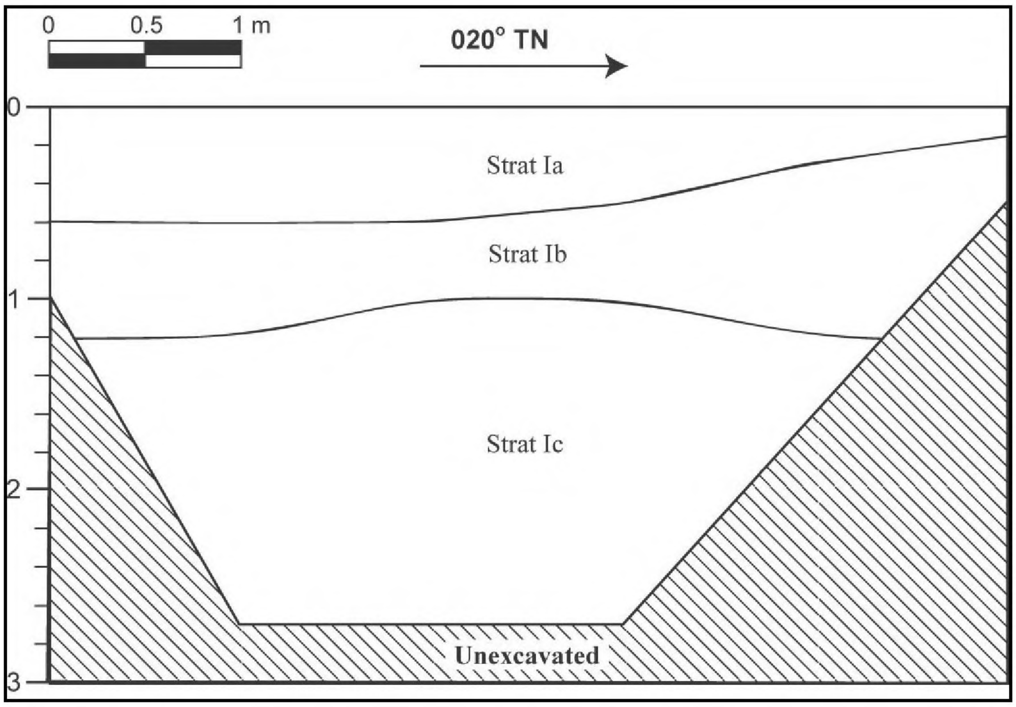

Figure 322. Profile of Pearl Highlands Station and P&R Test Trench 10

Figure 323. Photograph of Pearl Highlands Station and P&R Test Trench 10, view to west

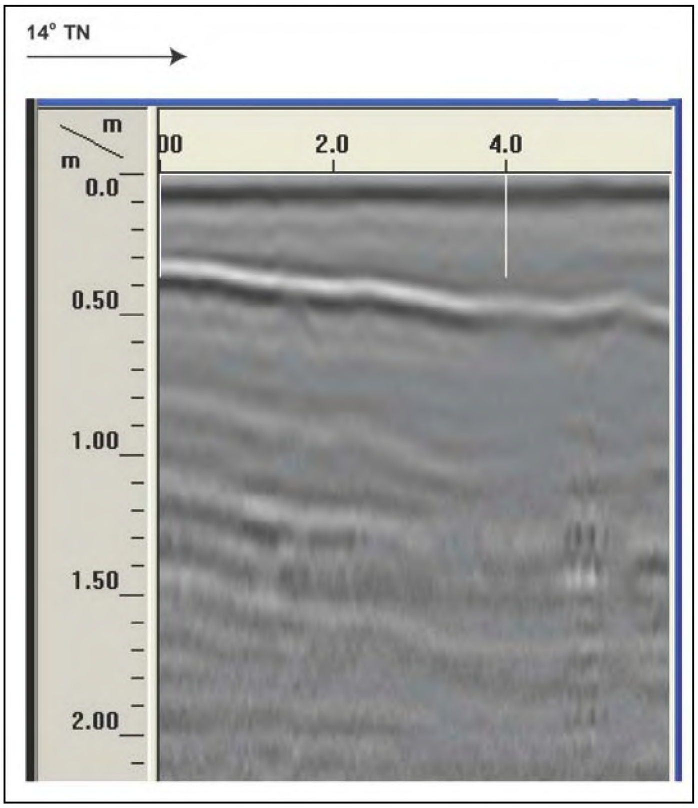

Figure 324. GPR profile of Pearl Highlands Station and P&R Test Trench 10

Pearl Highlands Station and P&R Test Trench 11

Orientation	174° TN
Length	5 m
Width	0.7 m
Maximum Depth	2.4 m

Stratum	Depth (cmbs)	Description
Ia	0-50	Fill Horizon; 7.5 YR 4/1, dark gray; silt loam; weak fine single grain structure; dry weakly coherent consistency; non-plastic; weak cementation; terrestrial; abrupt smooth lower boundary
Ib	50-90	Fill Horizon; 5 YR ¾, dark reddish brown; moderate fine blocky structure; dry hard consistency; plastic; no cementation; terrestrial; abrupt smooth lower boundary
Ic	90-240	Fill Horizon; 5 YR 2.5/2 dark reddish brown; silt loam; weak medium granular structure; dry loose consistency; non-plastic; no cementation; terrestrial origin, contains asphalt, cement blocks and trash

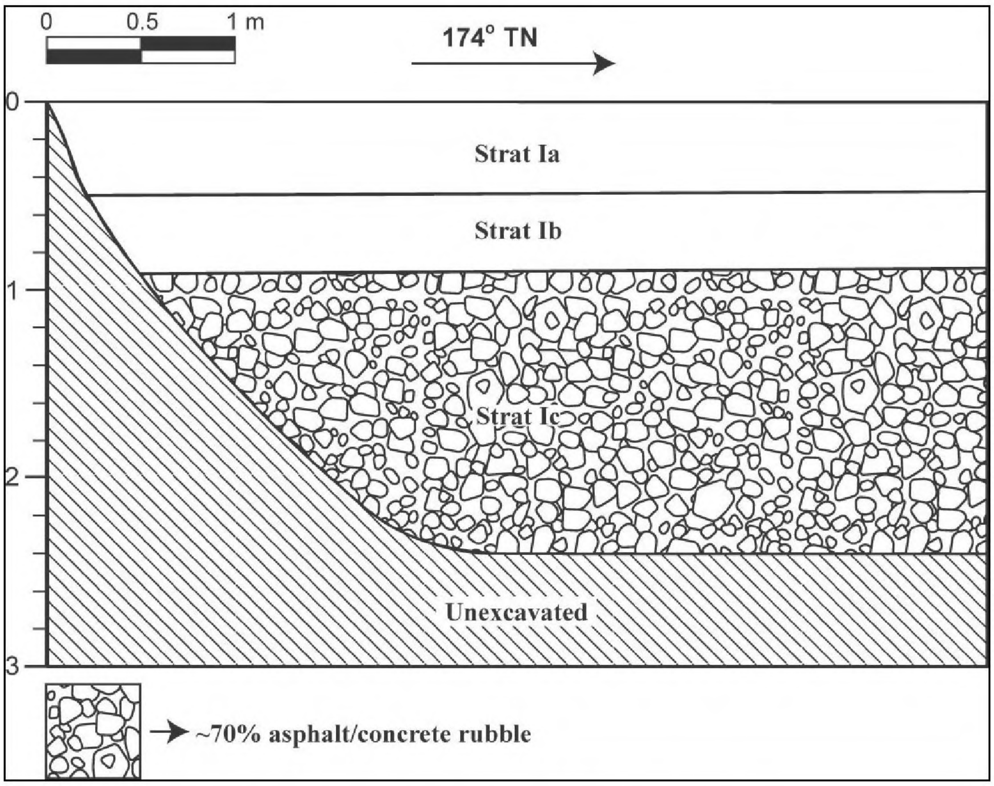

Figure 325. Profile of Pearl Highlands Station and P&R Test Trench 11

Figure 326. Photograph of Pearl Highlands Station and P&R Test Trench 11, view to east

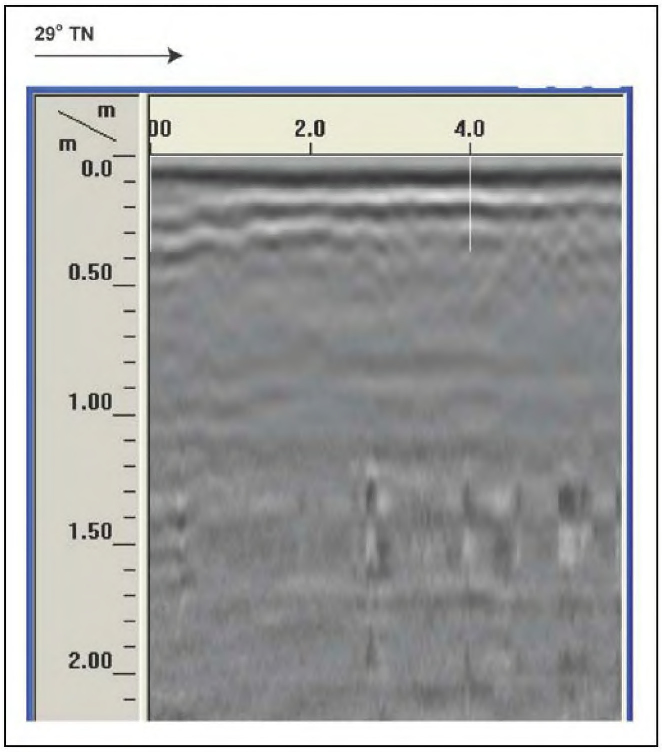

Figure 327. GPR profile of Pearl Highlands Station and P&R Test Trench 11

Column Test 32 (C-32)

Orientation	088° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.5 m

Stratum	Depth (cmbs)	Description
Ia	0-40	Fill; 7.5 YR 2.5/3, very dark brown; silty clay loam; weak, medium, crumb structure; weakly coherant dry consistency; slightly plastic; weak cementation; abrupt smooth lower boundary; imported fill associated with prior land grading.
Ib	40-250	Fill; 2.5 YR 2.5/4, dark reddish brown; clay loam; moderate, medium, crumb structure; slightly hard dry consistency; plastic; no cementation; disturbed sediment associated with modern land filling.

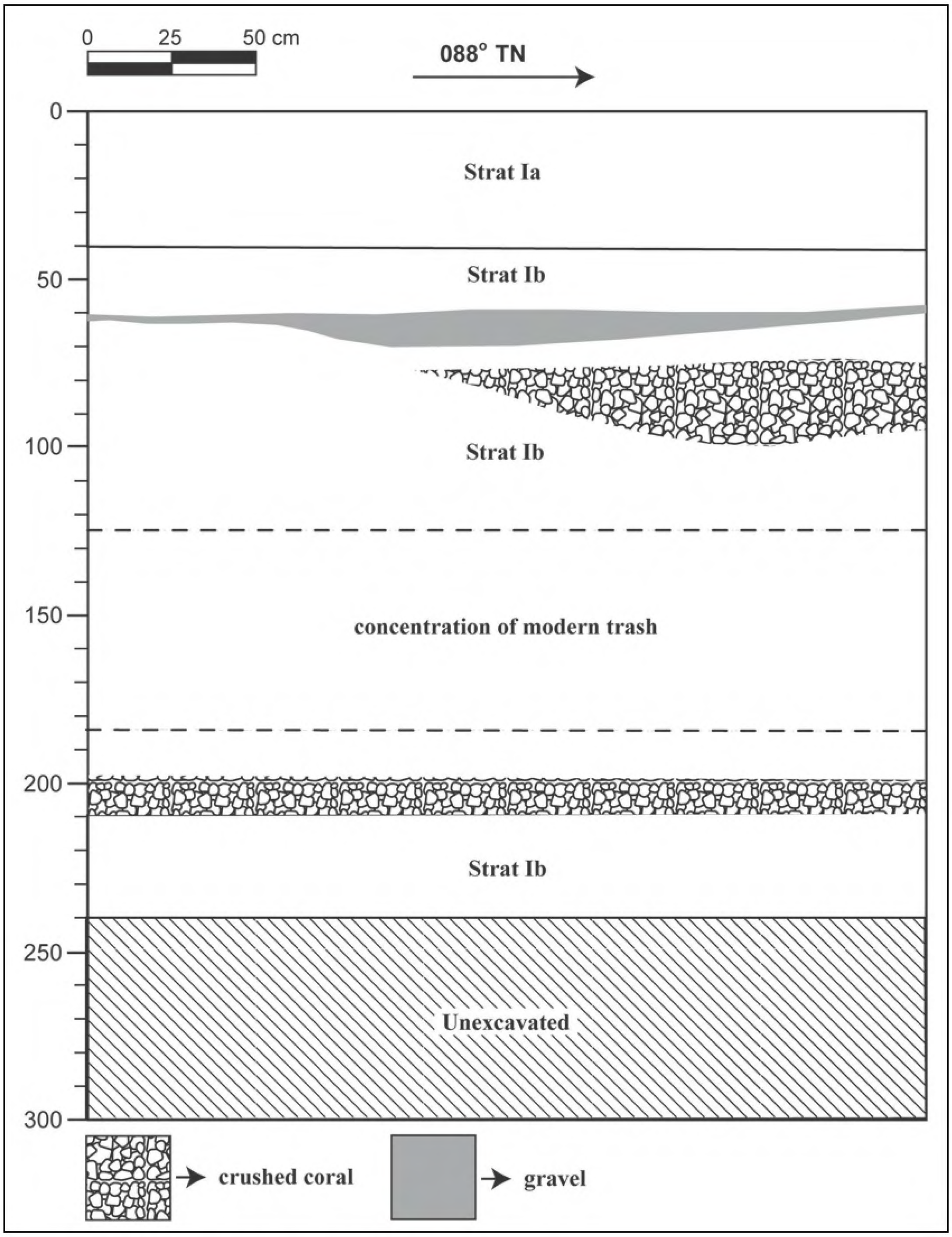

Figure 328. Profile of Column Test 32 (C-32)

Figure 329. Photograph of Column Test 32 (C-32), view to north

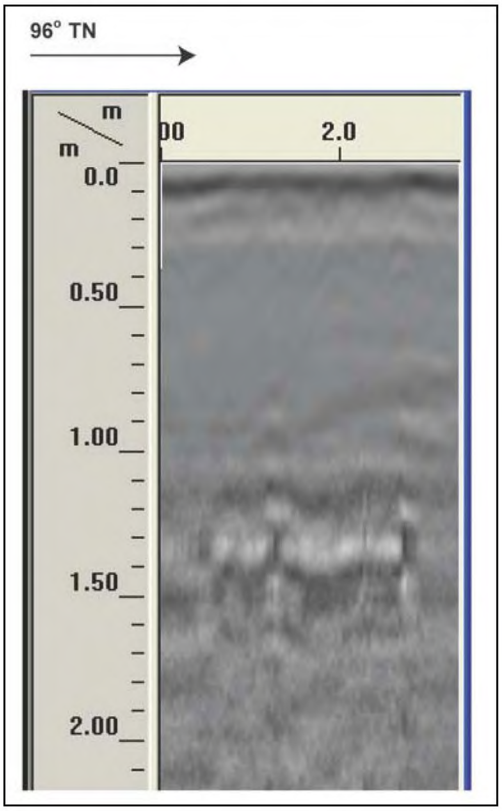

Figure 330. GPR profile of Column Test 32 (C-32)

Column Test 33 (C-33)

Orientation	086° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2 m

Stratum	Depth (cmbs)	Description
Ia	0-10	Fill; 7.5 YR 2.5/3, very dark brown; silty loam; weak, fine, grandular structure; weakly coherant dry consistency; non plastic; weak cementation; abrupt smooth lower boundary; imported fill associated with prior land grading.
Ib	10-40	Fill; 5 YR 3/4, dark reddish brown; clay; moderate, medium, blocky structure; hard dry consistency; plastic; no cementation; abrupt smooth lower boundary;
Ic	40-110	Fill; 7.5 YR 4/6, strong brown; clay; moderate, medium, blocky structure; hard dry consistency; plastic; no cementation; abrupt smooth lower boundary;
Id	110-200	Fill; 5 YR 2.5/2, dark reddish brown; silt loam; weak, fine, granular structure; weakly coherant dry consistency; non-plastic; weak cementation; small amount of modern trash - rebar

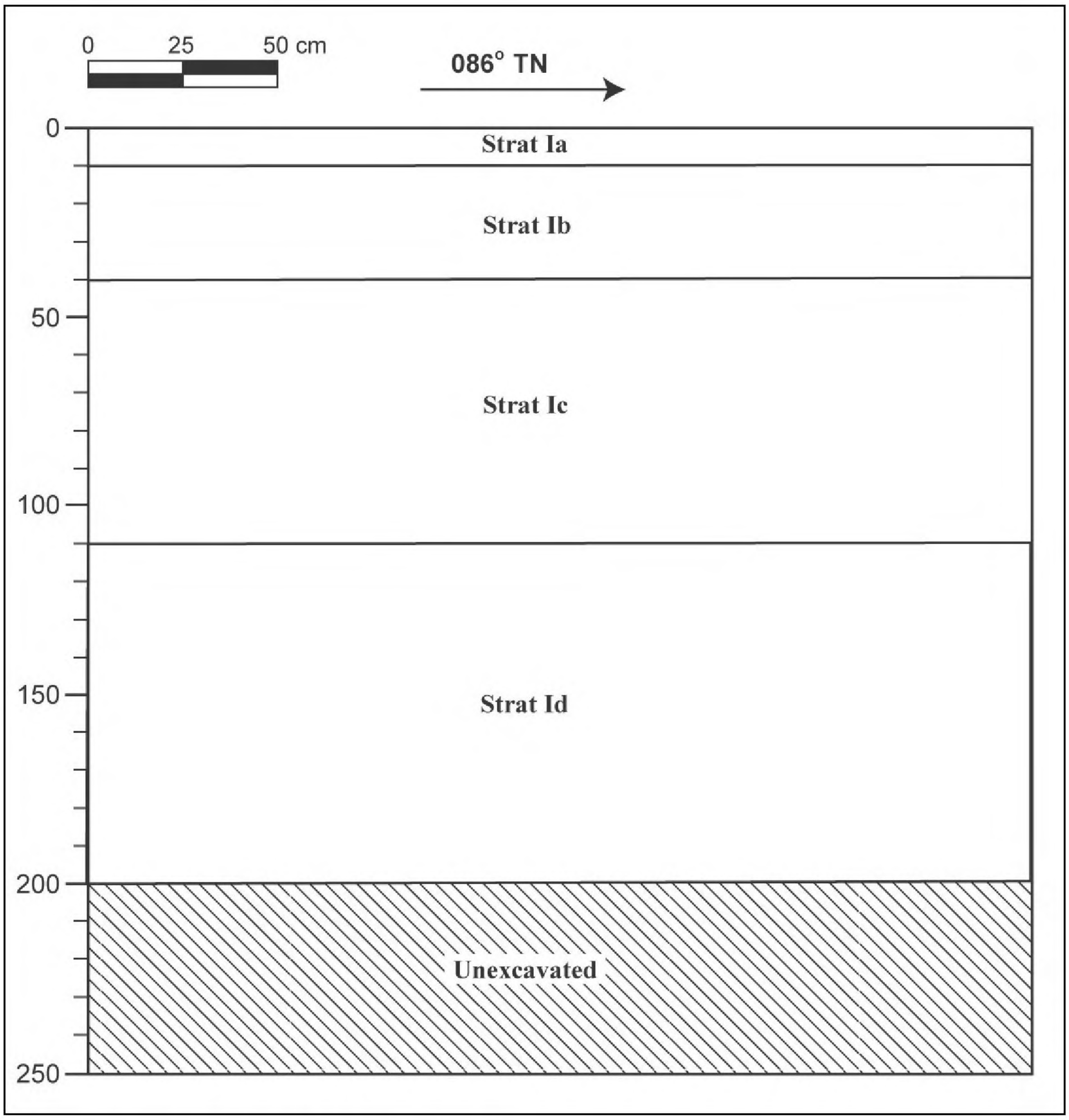

Figure 331. Profile of Column Test 33 (C-33)

Figure 332. Photograph of Column Test 33 (C-33), view to north

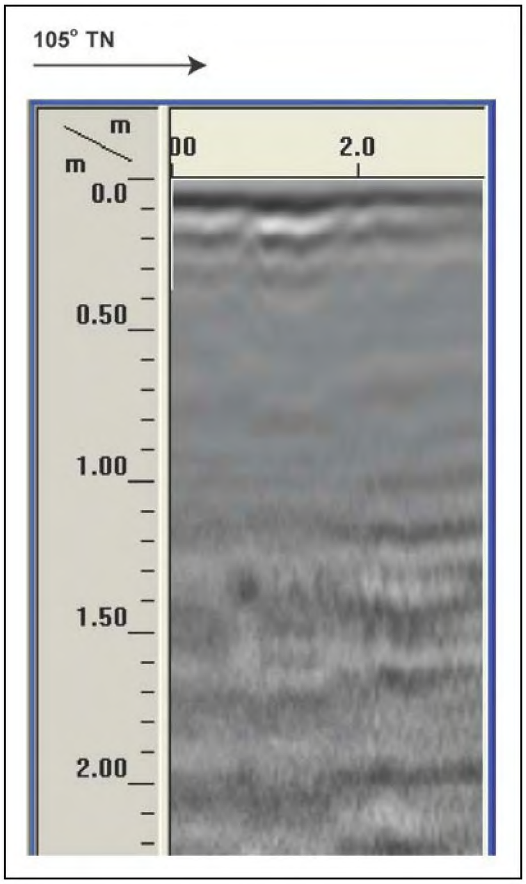

Figure 333. GPR profile of Column Test 33 (C-33)

Column Test 34 (C-34)

Orientation	070° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.6 m

Stratum	Depth (cmbs)	Description
I	0-190	Fill Horizon; 10 YR 3/3, dark brown; silty clay loam; structureless, weakly coherant dry consistency; friable moist consistency; slightly plastic; no cementation; diffuse irregular lower boundary; modern fill, possibly dozer push to build up stream bank
II	190-260	10 YR 3/2, very dark grayish brown; clay; moderate, fine, crumb structure; very sticky wet consistency; very plastic; no cementation; alluvial sediment excavated at water table

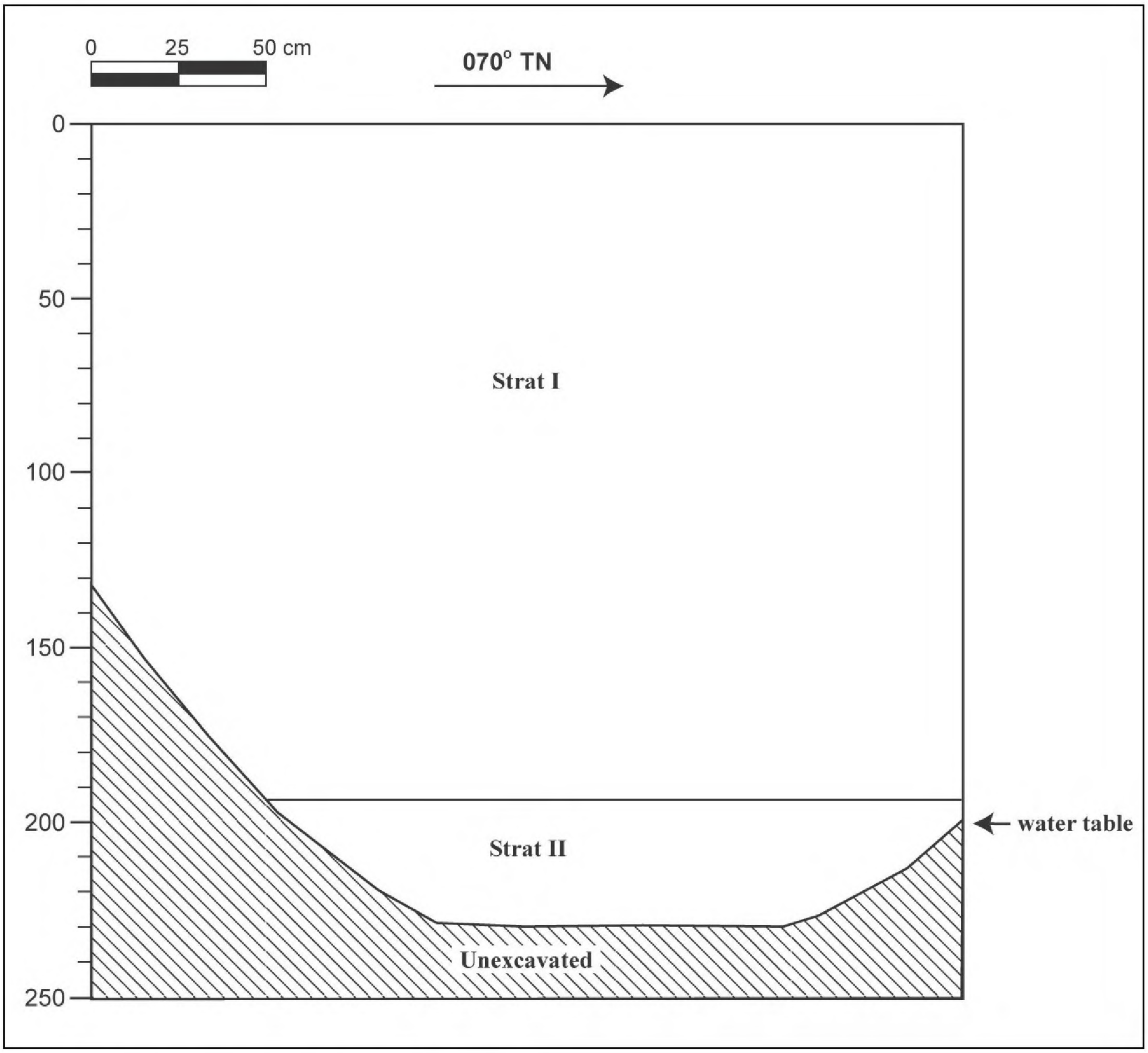

Figure 334. Profile of Column Test 34 (C-34)

Figure 335. Photograph of Column Test 34 (C-34), view to north

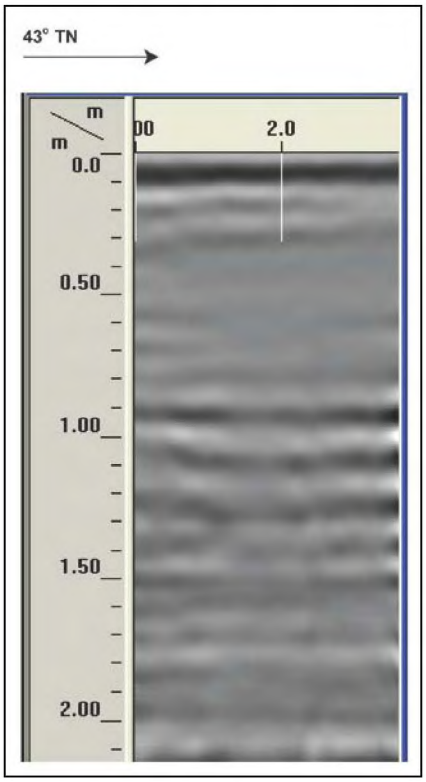

Figure 336. GPR profile of Column Test 34 (C-34)

Column Test 35 (C-35)

Orientation	120° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.2 m

Stratum	Depth (cmbs)	Description
I	0-220	2.5 YR 4/6, red; silty clay loam; loose, weakly coherant dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; Naturally deposited sediment. Top 140 cm was previously disturbed due to subsurface utilities. Construction debris observed: gravel, basalt cobbles, mesh screen, concrete/asphalt, pieces oc lumber, plastics.

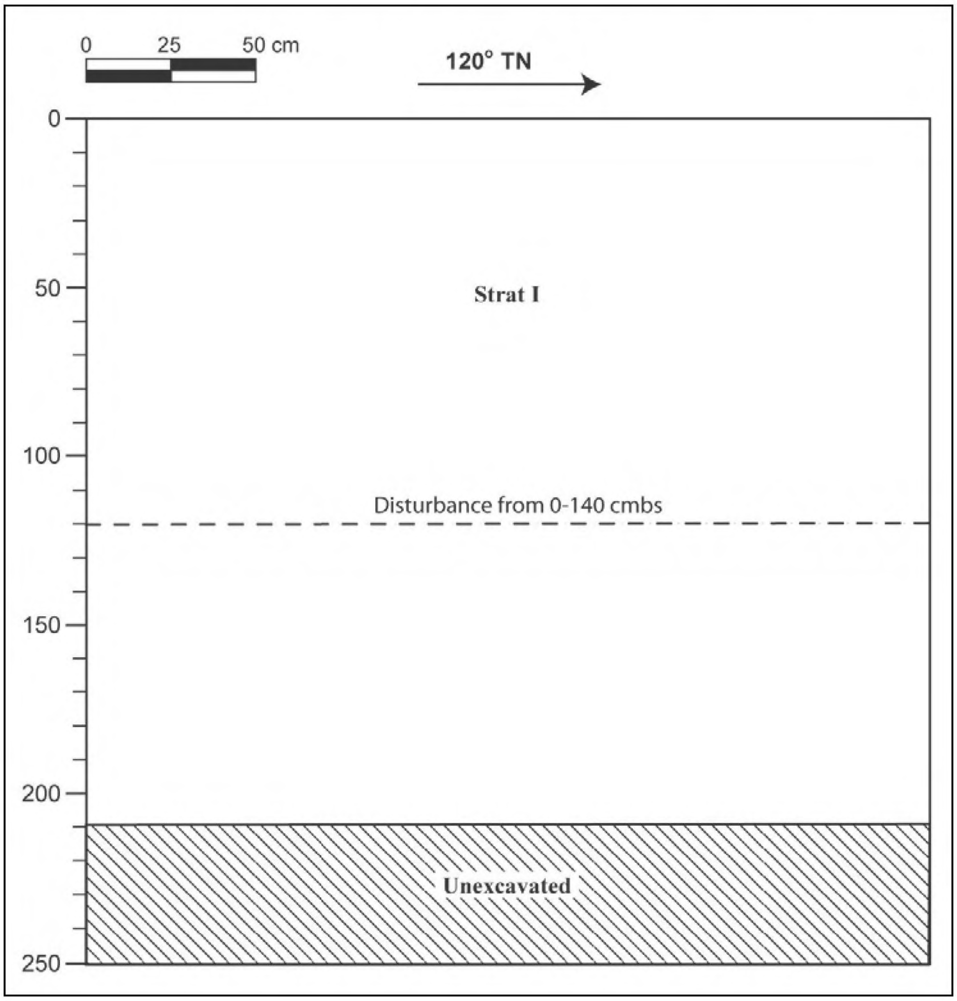

Figure 337. Profile of Column Test 35 (C-35)

Figure 338. Photograph of Column Test 35 (C-35), view to north

Column Test 36 (C-36)

Orientation	091° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	2.8 m

Stratum	Depth (cmbs)	Description
Ia	0-60	Fill; 2.5 YR 4/6, red; gravel, silty clay loam; loose, weakly coherant dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; grading fill containing domestic and construction debris - gravel, basalt cobbles, mesh screen, concrete/asphalt, pieces oc lumber, plastics, rubber, exotic/wild grasses and brush growing about area
Ib	60-75	10 YR 8/2, very pale brown; coral, silty clay loam; structureless, loose, slightly hard dry consistency; non-plastic; no cementation; abrupt smooth lower boundary; crushed coral fill mottled with strat Ia - cap for terrigenous fill layer below
Ic	75-280	Fill; 10 YR 5/3, brown; silt loam; weak, fine, crumb structure; loose, slightly hard dry consistency; non-plastic; no cementation; terrigenous fill containing sm - med cobbles, basalt boulders, concrete fragments

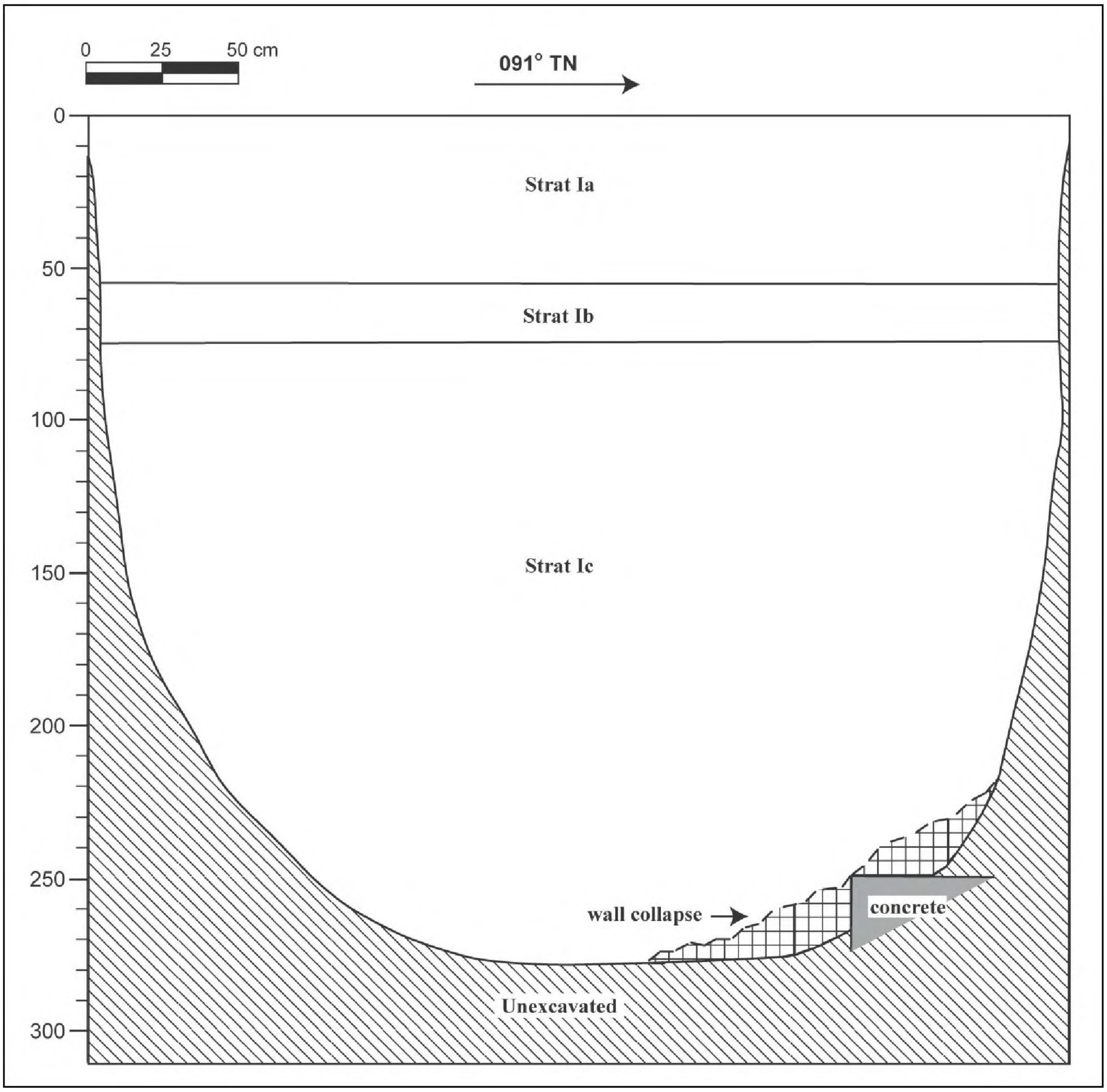

Figure 339. Profile of Column Test 36 (C-36)

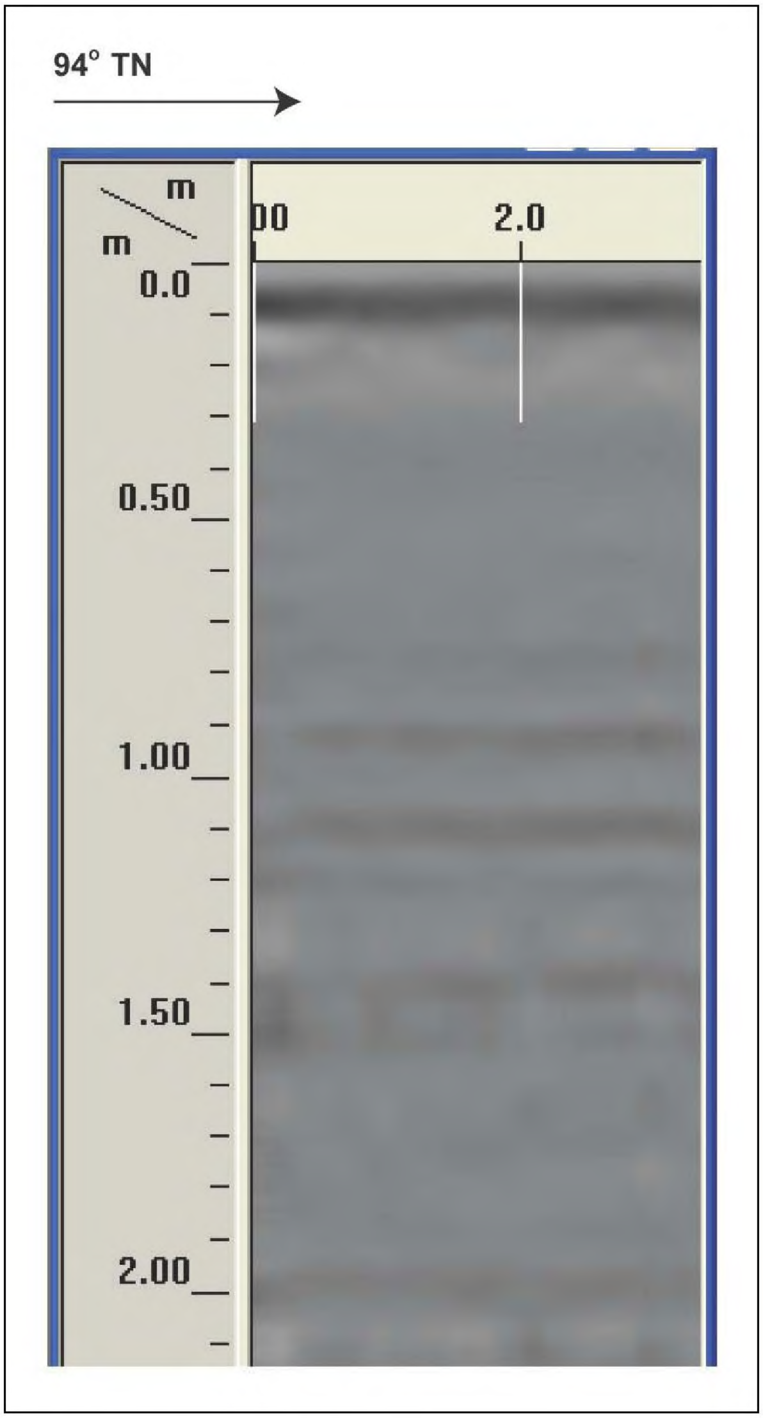

Figure 340. GPR profile of Column Test 36 (C-36)

4.15 Construction Sheet RW016

Construction Sheet RW016 includes a 2,500 ft (0.8 km) segment of the proposed transit corridor (Figure 341). Two column test pits (C-30 & C-31) were excavated within the area delineated by Construction Sheet RW016.

4.15.1 Pedestrian Inspection

As the transit route enters the Pearl City area, it is re-routed to follow the path of Kamehameha Highway, proceeding east towards Honolulu. The surrounding area consists of the lower industrial section of Pearl City, along with several outlet stores (Home Depot, Sam's Club, etc.), a school, a post office, and several small businesses (Figure 342). As with the route through Waipahu, the transit line is situated along the middle of the roadway. However the median strip down Kamehameha highway is drastically different as there is little to no landscaping, being replaced with signs, utilities, and fencing. Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

4.15.2 GPR Survey

Prior to excavation all test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits. Following the GPR survey, the test area was excavated to compare the results of the GPR survey with the observed stratigraphy.

The GPR survey was able to define the stratigraphic interfaces within the top 25 to 50 cm of all test areas. The subtle horizontal banding shown from approximately 0 to 50 cmbs in the GPR profiles seems to correspond to asphalt surfaces and their underlying crushed coral base course (see Figure 343 thru Figure 348). It is believed that the variance in consistency and compaction between the asphalt and coral base course, and the underlying sediments allowed the GPR to delineate the stratigraphic interface between them. However, as with the entire study area, radar penetration was limited to an approximate depth of 1 m.

GPR was also able to detect subsurface anomalies at column test C-30 (Figure 345). These anomalies likely corresponded to cobbles noted during test excavation.

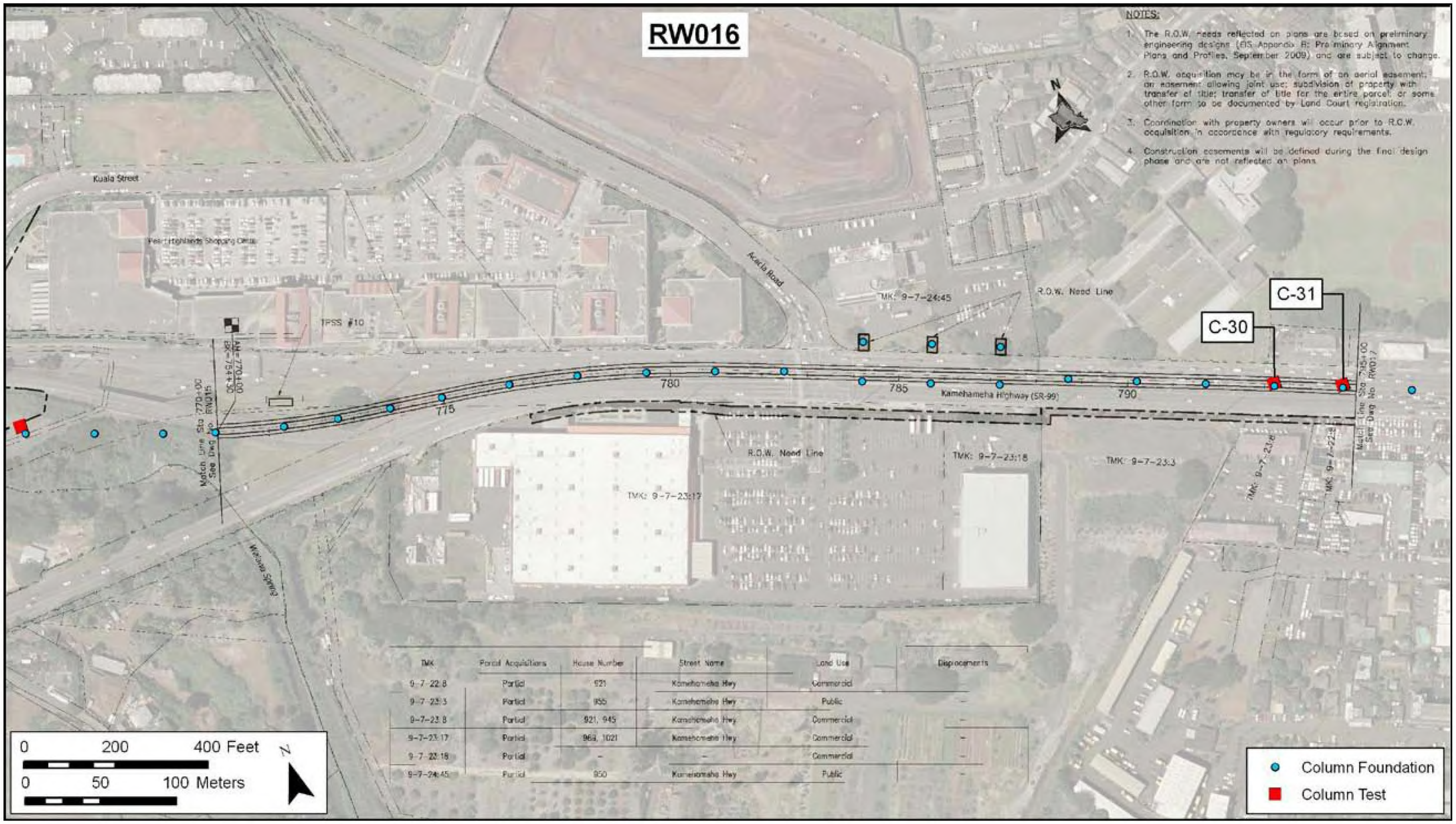

Figure 341. Construction Sheet RW016 showing the location of test excavations

Figure 342. Photograph of transit route (view to northwest) as it enters lower industrial section of Pearl City following Kamehameha Highway

4.15.3 Subsurface Testing

4.15.3.1 Stratigraphic Summary

Two (2) test excavations were placed within the area delineated by Construction Sheet RW016 (see Figure 341). Based on backhoe testing results, the stratigraphy within this segment of the project area is largely as expected. The following paragraphs provide an overview and summary of the backhoe testing results. For detailed information regarding each of the excavated trenches, please refer to the trench profiles, sediment descriptions, and photographs, which follow this more general summary discussion (Figure 295 to Figure 340).

In general, the observed and documented stratigraphy consisted of varying layers of fill overlying naturally deposited alluvial sediment. All excavations were backfilled after completion of stratigraphic documentation. No subsurface cultural resources were observed.

4.15.3.2 Excavation Documentation

Column Test 30 (C-30)

Orientation	108° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.8 m

Stratum	Depth (cmbs)	Description
Ia	0-20	Asphalt
Ib	20-40	Crushed coral fill
Ic	40-60	Fill; 2.5 YR 3/6, dark red; silty clay loam; moderate, fine, crumb structure; loose dry consistency; firm moist consistency; non-plastic; no cementation; Alluvial silty clay loam fill deposited during development of area - contains gravel, cinder, small cobbles.
Id	60-70	Fill; 10 YR 3/4, dark yellowish brown; silt loam; weak, fine, crumb structure; loose dry consistency; friable moist consistency; slightly plastic; no cementation; diffuse smooth lower boundary
Ie	70-145	Fill; 10 R 3/6, dark red; silty clay loam; strong, fine, crumb structure; loose dry consistency; firm moist consistency; non-plastic; no cementation; Alluvial fill material deposited as grading material during development of area.
II	145-180	10 YR 3/3, dark brown; silt loam; moderate, fine, crumb structure; loose dry consistency; friable moist consistency; non-sticky wet consistency; non-plastic; no cementation; Possible natural sediment - contains charcoal, sm-med cobbles. Sediment sample collected at 154-166 cmbs

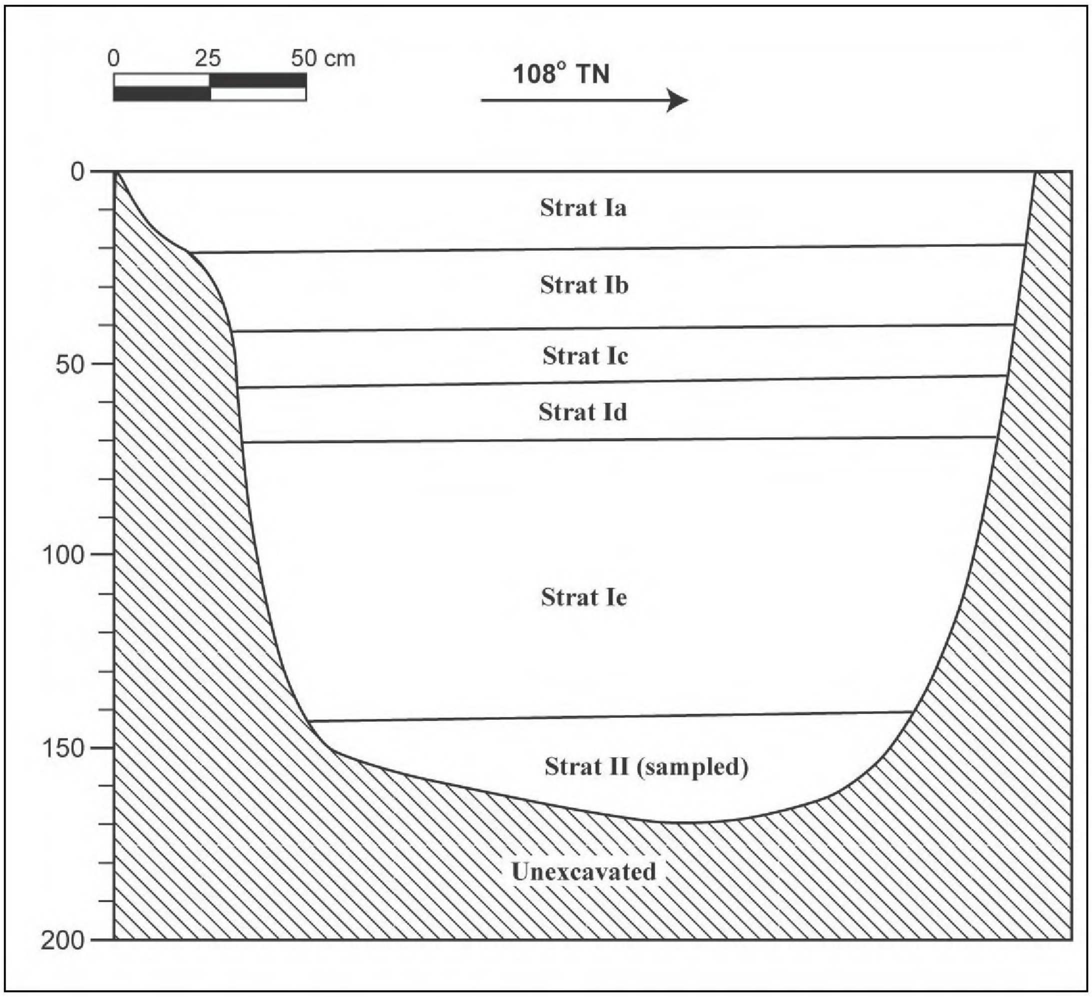

Figure 343. Profile of Column Test 30 (C-30)

Figure 344. Photograph of Column Test 30 (C-30), view to north

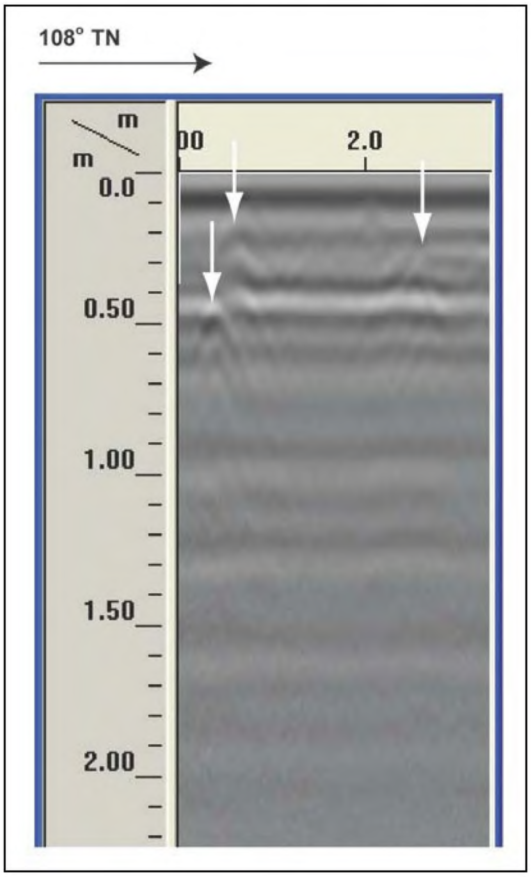

Figure 345. GPR profile of Column Test 30 (C-30)

Column Test 31 (C-31)

Orientation	110° TN
Length	2.5 m
Width	2.5 m
Maximum Depth	1.75 m

Stratum	Depth (cmbs)	Description
Ia	0-20	Asphalt
Ib	20-40	Crushed coral fill
Ic	40-110	Fill; 5 YR 3/4, dark reddish brown; silty clay loam; moderate, fine, crumb structure; loose dry consistency; very firm moist consistency; slightly plastic; no cementation; clear wavy lower boundary; Grading material.
II	110-175	10 YR 3/3, dark brown; clay loam; strong, fine, crumb structure; very firm moist consistency; slightly plastic; no cementation; Compacted clay sediments, possibly natural layer, excavation stopped due to impenetrable layer.

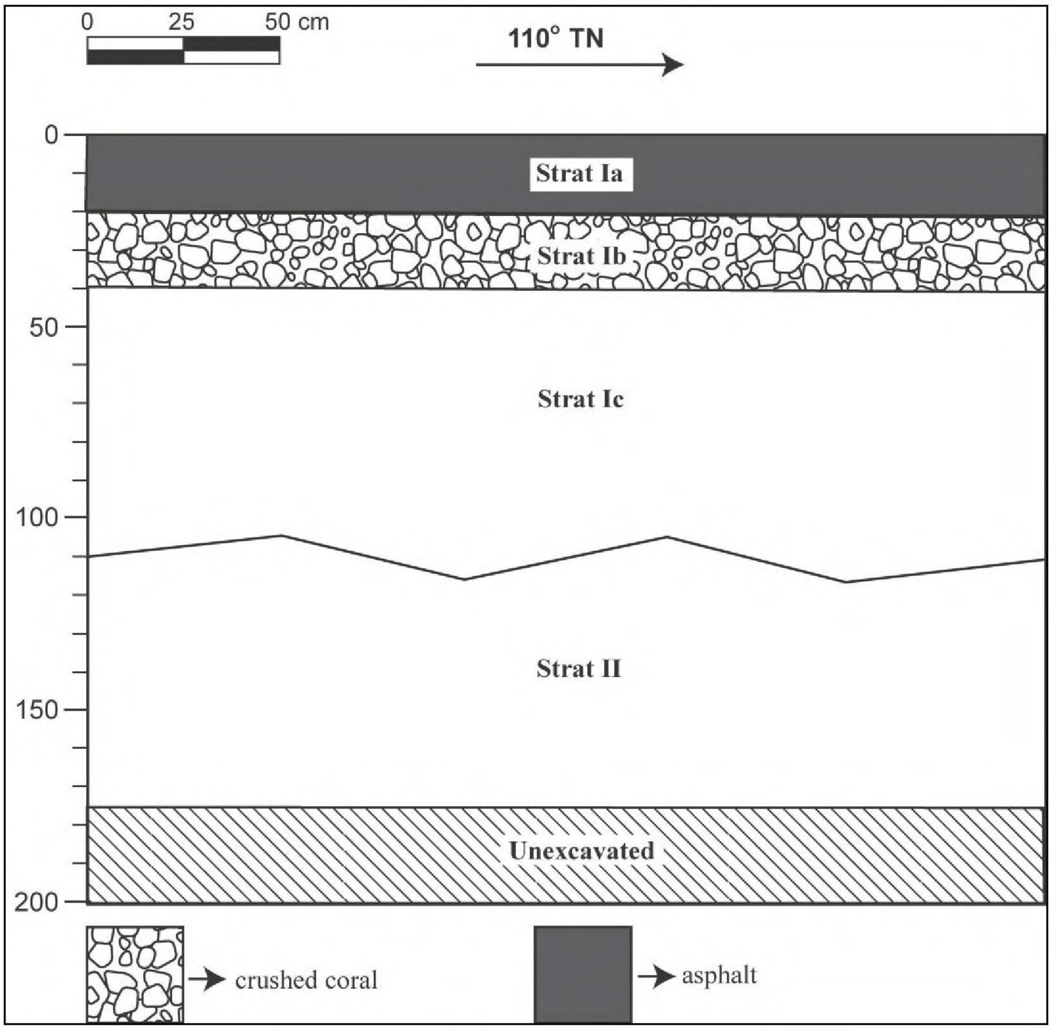

Figure 346. Profile of Column Test 31 (C-31)

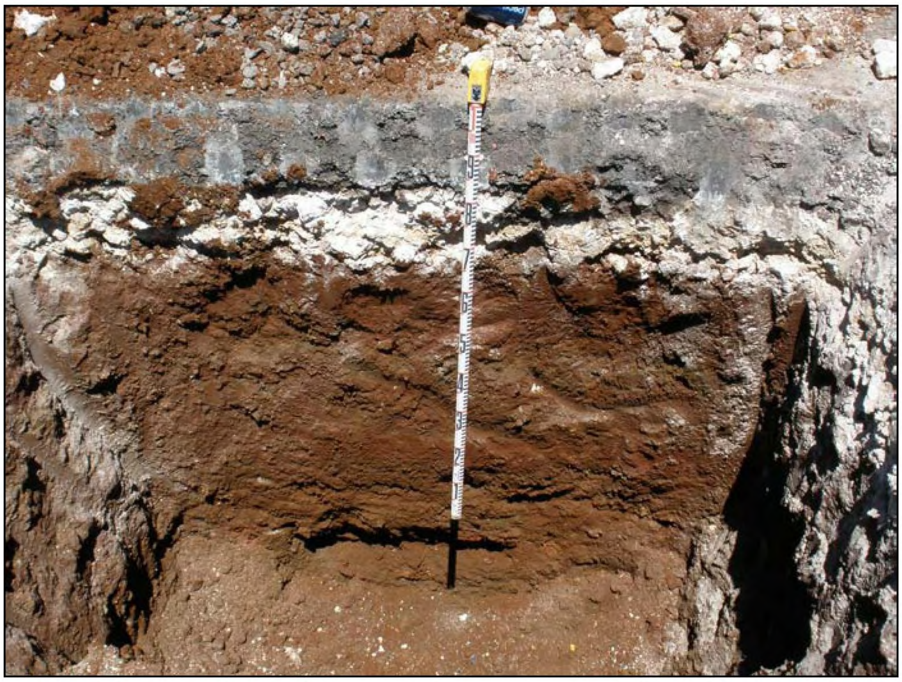

Figure 347. Photograph of Column Test 31 (C-31), view to north

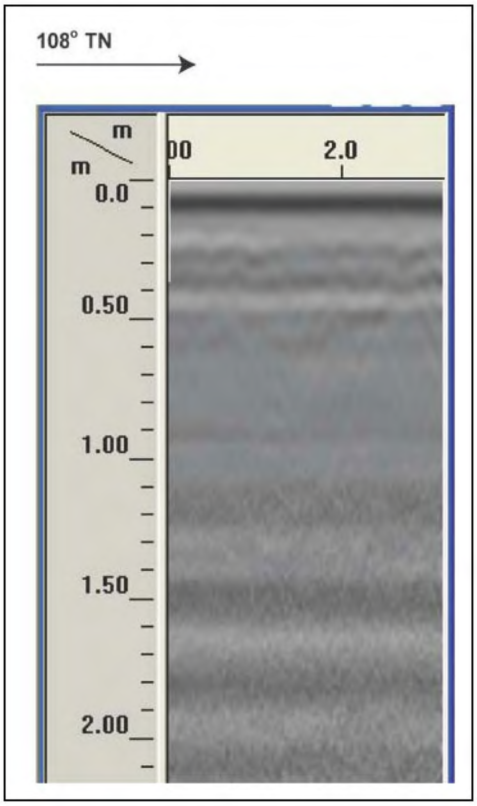

Figure 348. GPR profile of Column Test 31 (C-31)

4.16 Construction Sheet RW017

Construction Sheet RW017 includes a 300 ft (91 m) km segment of the proposed transit corridor (Figure 349). No test units were excavated within the area delineated by Construction Sheet RW017.

4.16.1 Pedestrian Inspection

The area along the transit route into the general Pearl City area becomes even more urbanized with existing buildings becoming more packed together and the existence of housing subdivisions just above the highway (Figure 350). As the route continues into Pearl City, towards Aiea and Pearl Harbor, there is a greater amount of development with housing, apartment buildings, condominium complexes, strip malls, and small businesses located closely together. As with much of the previous transit route, the development of the area has greatly impacted the Urban development within this portion of the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. No cultural resources were observed within this portion of the project area.

Figure 349. Construction Sheet RW017

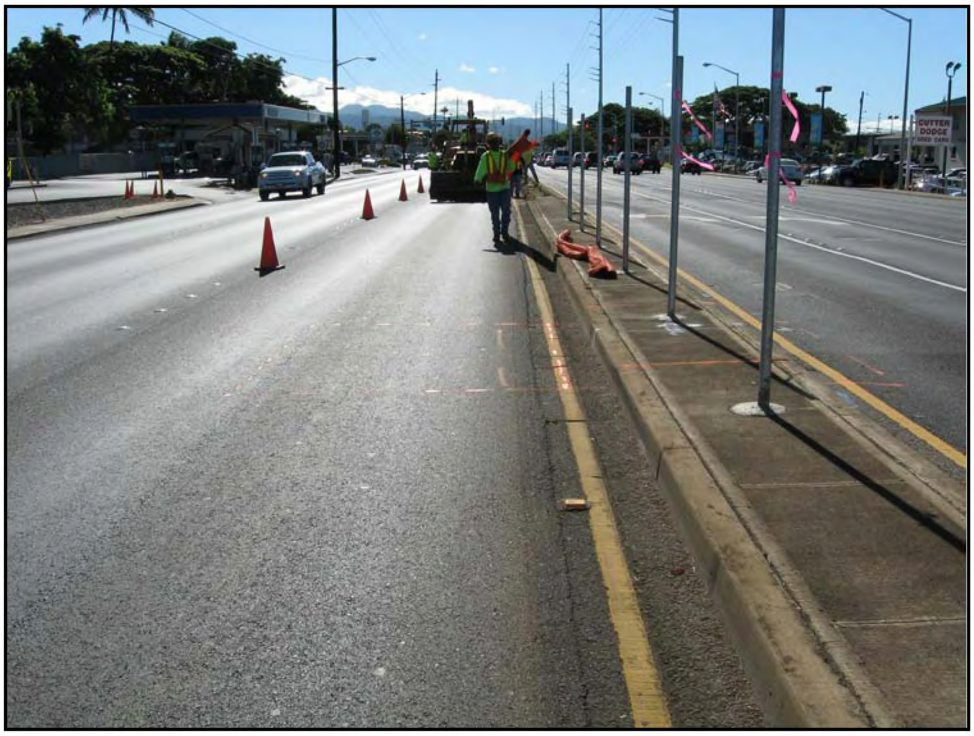

Figure 350. Photograph (view towards southeast) showing urbanized area of Pearl City along the route of Kamehameha Hwy and the transit

4.17 Cultural Resource Descriptions

4.17.1 State Inventory of Historic Properties (SIHP) # 50-80-9-7751

FORMAL TYPE:	Subsurface agricultural sediment (likely from cultivation of wetland *kalo* (taro)—buried lo*‘i* (irrigated pond-field) deposit
FUNCTION:	Agriculture
# OF FEATURES:	NA
AGE:	Undetermined at this time, but likely pre-contact to post-contact
DIMENSIONS:	Observed over a 65 m E/W by 25 m N/S area, the overall extent of the subsurface layer is not known at this time
LOCATION:	*Makai* (southern) portion of the proposed Waipahu Transit Station UTM Coordinates*: 2364963N, 603290E
TAX MAP KEY:	[1] 9-4-019: 050, 061
LAND JURISDICTION:	Private

*UTM Datum = NAD 83, Zone 4N

SIHP # 50-80-9-7751 is located within the *makai* (southern) portion of the proposed Waipahu Transit Station, just south of Farrington Highway (Figure 351). The cultural resource was identified during the subsurface testing in the vicinity of the Waipahu Transit Center, the results of which are described above in Section 4.1.1--Construction Sheet RW011. The surrounding landscape in this portion of the survey area is fully developed with paved streets, paved parking lots, commercial buildings, and residential structures. There are no surface indications of archaeological cultural resources in the vicinity. Based on background research, however, it was understood that in the mid-1800s and likely much earlier into the pre-contact period, this was a well populated area that had abundant *lo‘i* for cultivating taro. This information comes primarily from *Māhele* Land Commission Award (LCA) documentation, but also from other sources (e.g. Handy 1940; Cordy 1996 and 1997).

During the subsurface testing in this area, relatively thick fill layers were observed overlying the natural sediments. These fill layers are derived from both mass grading and in-filling associated with land reclamation, and more recent filling associated with roadway, landscaping, and parking lot installation. Beneath these relatively thick fill layers, marshy or wetland alluvial sediments were observed that indicated that former land surface in this area had been lower, closer to the water table, prior to the relatively massive fill episodes.

Within the footprint of the *makai* portion of the Waipahu Transit Station, just south of Farrington Highway, a distinct stratigraphic layer was observed, which, based on field observations and historical data, is likely the preserved remnant of a former *lo‘i*. Described as Statum II in trenches 1-6 within the *makai* portion of the Waipahu Transit Center (refer to Section 4.1.1) this black (10 YR 2/1) clay contained noticeable, well-dispersed small flecks of

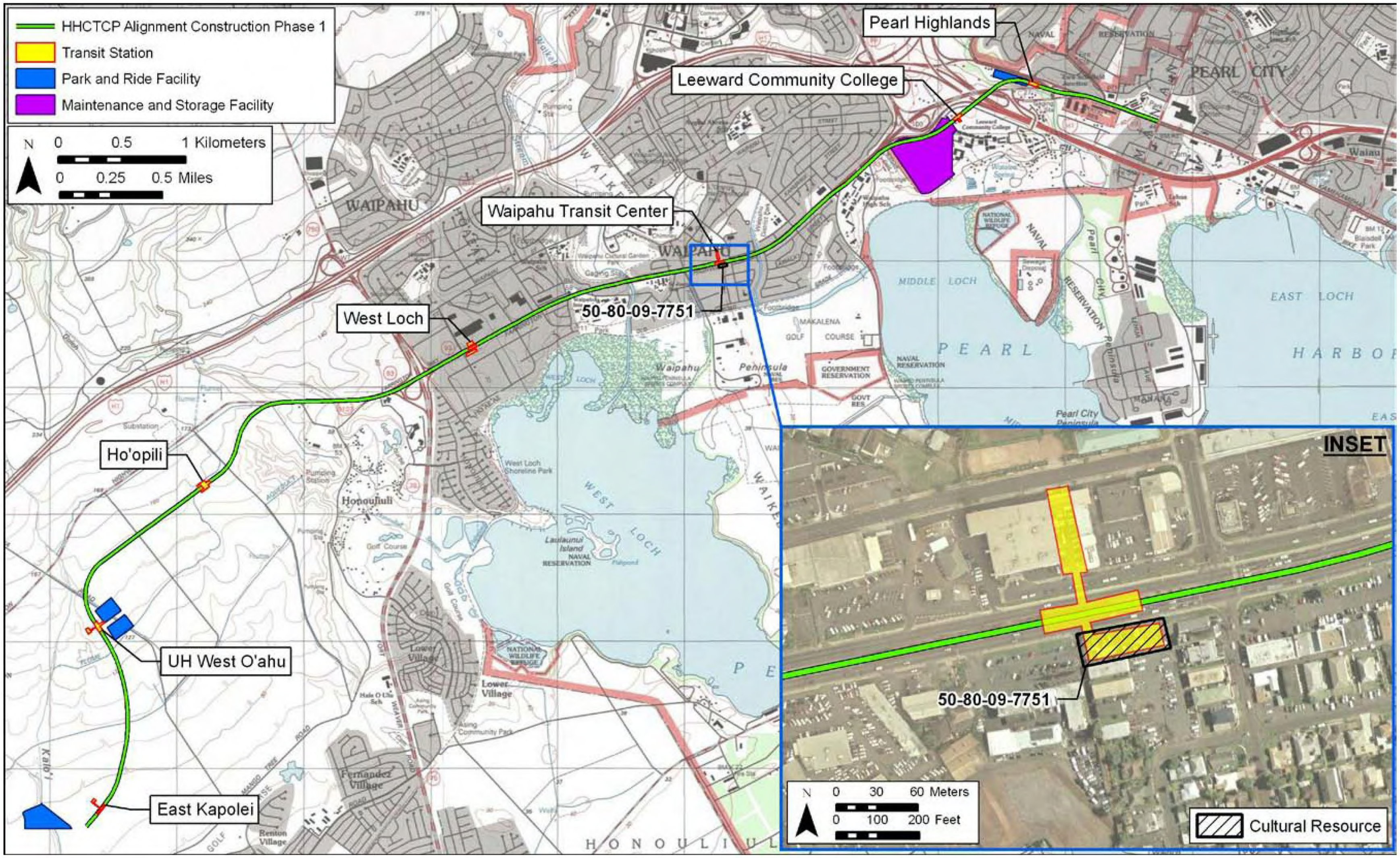

Figure 351. Location of SIHP #50-80-9-7751 within the project area

charcoal (generally less than 1-2 mm maximum dimensions) and many reddish-orange mottles (varying between 2.5 YR 5/8, 10 R 5/6, and 5 YR 6/8) (Figure 352 and Figure 353). Reddish orange mottling and dispersed charcoal are often associated with in-use and remnant (abandoned and buried) *lo‘i* sediments.

A. Rose Schilt made the following observations while working with buried and abandoned *lo‘i* sediments in Hanalei Valley, Kauai:

> Previous archaeological projects in Mākaha Valley, O‘ahu, and Hālawa Valley, Molokai have documented the appearance of pondfield soils in which irrigated taro has been cultivated (Morgenstein and Burnett 1972; Riley 1975). These soils are characterized by hydrated iron-oxide (limonite) tubes which appear as prominent reddish mottles. These ferrogenous tubes are known to develop around the roots of taro plants, although the mechanism of concentration is not well understood . . . These tubes or mottles were quite prominent in the soil core we took in a recently cultivated *lo‘i* in Hanalei Valley. (Schilt 1980:29)

Regarding her extensive investigations of former *lo‘i* in Luluku, Kāneohe, O‘ahu, Jane Allen made the following observations:

> In ponded soils, aeration along roots also oxidies small areas in the subsoil, resulting in bright mottling within a dark, glayed soil matrix; precipates of iron and manganese as limonite casts and manganese nodules, respectively, often occure . . . Charcoal in pondfields is typically churned and dispersed throughout the soil through subsequent cultivation and ponding activities. (Allen et al. 1987:36)

Morgenstein’s work with abandoned and buried *lo‘i* sediments in Kawainui Marsh, Kailua, O‘ahu documented abundant diffused charcoal particles and former root tubes stained red/oranged with “ferruginous oxyhydroxides,” which were interpreted as directly related to the function of former pond fields (e.g. taro cultivation) (Morgenstein 1978:7-8). Based on Morgenstein’s (1978) sediment profiles, the iron oxyhydroxide root tubes he observed in Kawainui Marsh were quite pronounced and very “tube-like.” The stratum II observed at the *makai* portion of the Waipahu Transit Center (SIHP # 50-80-9-7751) clearly had diffuse charcoal particles and red-orange mottling, but the pronounced tube-like structures observed by Morgenstein (1978) where not visible during field observations.

It was only back in the laboratory, where sediment samples collected from SIHP # 50-80-9-7751 (refer to Figure 204 and Figure 219) were wet screen through 1/16-inch mesh, that the pronounced reddish-orange tubules and precipitate concretions were observed (Figure 354 and Figure 355). Five sediment samples, each approximately three liters in volume, from SIHP # 50-80-9-7751 were wet screened. The reddish-orange concretions were observed in all samples; the root tubules were observed in three of the five samples. The observed tubules are generally between 1 and 1.5 cm long and between 2 and 5 millimeters in diameter.

Figure 352 Close up photograph of a sediment sample from SIHP # 50-80-9-7751 (black and white scale in 1 cm units)

Figure 353 Close up photograph of a sediment sample from SIHP # 50-80-9-7751 (black and white scale in 1 cm units)

Figure 354 Close up photograph of iron oxyhydroxide root tubes (right) and and precipitate concretions (left) collected from sediment samples of SIHP # 50-80-9-7751

Figure 355 Close up photograph of iron oxyhydroxide root tubes collected from sediment samples of SIHP # 50-80-9-7751 (black and white scale in 1 cm units)

During the documentation of the six trenches within the *makai* portion of the Waipahu Transit Center, no berms, channels, or other potential field components or infrastructure were observed. The boundaries of this subsurface deposit are currently unknown, as the testing for the current investigation was limited to the project's footprint. It is clear that this agricultural deposit was subsequently buried by modern fill events that brought the land surface to its current elevation. During these fill events, the deposit may well have been disturbed and cut away to varying degrees.

Land Court Application Map 1000 indicates numerous LCAs and *'auwai* (irrigation ditch, canal) in the vicinity of SIHP #50-80-9-7751 (Figure 356). Documentation from LCA 1712C and LCA 10512, both in the immediate vicinity of SIHP # 50-80-9-7751, indicate that wetland taro cultivation (*lo'i*) was on-going in the area during the 1850s (see Appendix B for copies of this LCA testimony). The presence of *'auwai* and LCAs documenting wetland taro cultivation provide further evidence indicating that the clay deposit designated SIHP #50-80-9-7751, is likely a remnant of traditional Hawaiian agricultural activities.

Section 5.1, below, describes the results of radiocarbon dating at SIHP # 50-80-9-7751. These radiocarbon dating results are inconclusive because they are based on the analysis of bulk carbon from sediment samples as a whole rather than from charcoal from a specific event. These dating results indicate that the organic component of the sediments within SIHP #50-80-9-7751 was already formed approximately 1000 years ago. Further dating is required to determine the actual time frame for agricultural use of the pondfield sediments for irrigated agriculture. Based on contextual information, the deposit's agricultural use likely began during the pre-contact period and continued post contact. Further investigation is required to substantiate this.

Admittedly, there is not a great deal of information available regarding SIHP # 50-80-9-7751, the remnant subsurface agricultural layer at the *makai* Waipahu Transit Center. Its boundaries are unknown and the radiocarbon dating results on sediment samples are problematic. Based on stratigraphic observations and historic data, however, there is little doubt that these deposits represent the buried remnants of former *lo'i*. These deposits, on further investigation, can provide information on the age of the agricultural activity (best results are from radiocarbon dates from specific structural features, for example pond field berms). Sometimes information is available regarding periods of abandonment and reconstruction of the pond fields—allowing reconstructions of use over time. Through palynological analysis, these deposits can provide information on the surrounding environment (e.g. was the pollen rain in the surrounding watershed mostly indigenous species, Polynesian-introduced species, or Western-introduced species—and possibly how that pollen spectrum changed over time). Based on current evidence, these deposits contain sufficient archaeological information to be determined Hawaii and National Register eligible.

SIHP # 50-80-9-7751 has integrity of location and materials, but not integrity of design, setting, workmanship, feeling, or association. It is recommended National and Hawaii Register elibible under significance criterion D, for the archaeological information that it contains.

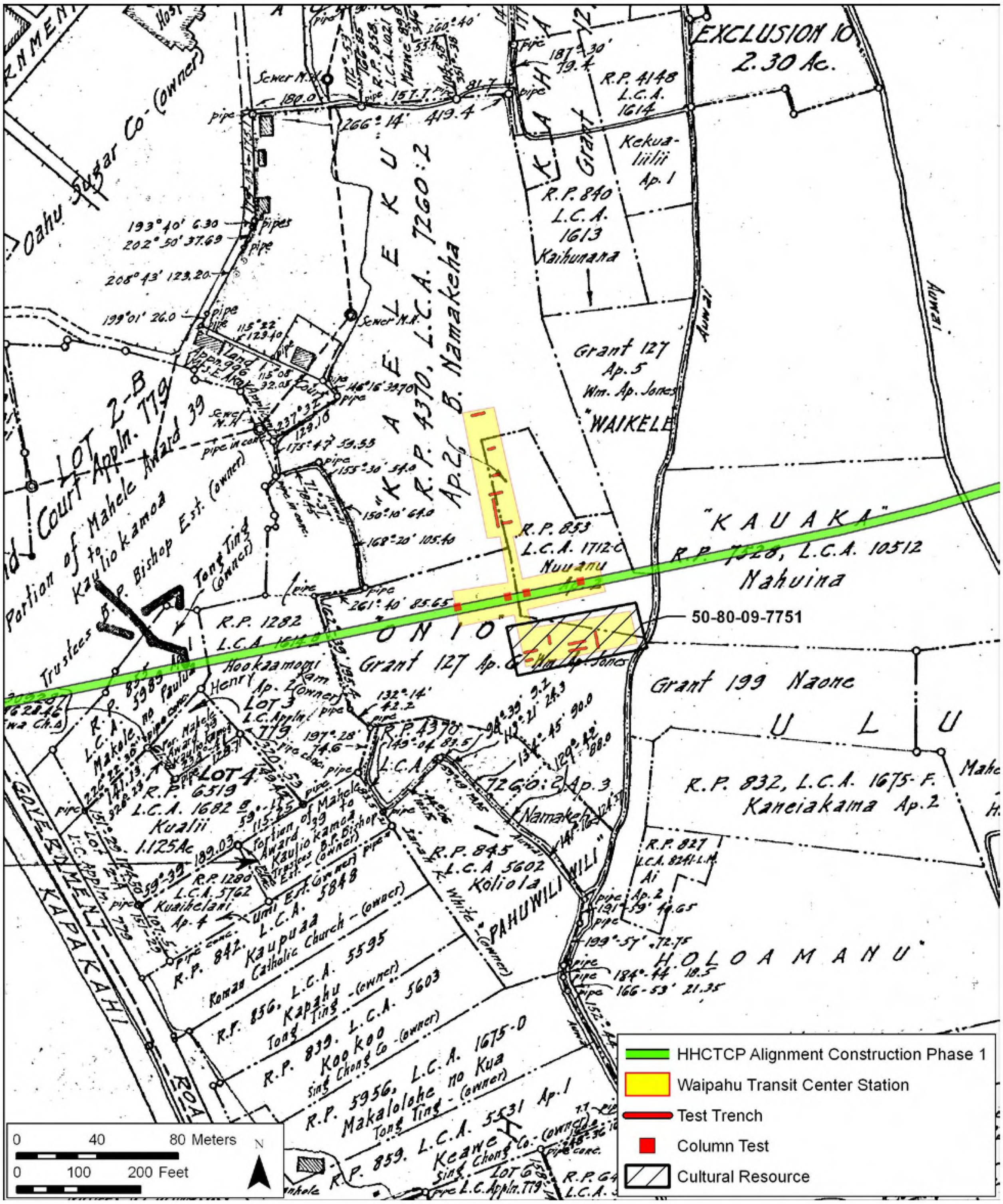

Figure 356. Land Court Application Map 1000 showing LCAs and *'auwai* in the vicinity of SIHP #50-80-9-7751

Section 5 Results of Laboratory Analyses

5.1 Radiocarbon Analysis

Sediment collected from SIHP #50-80-9-7751, a subsurface cultural layer thought to be a remnant of both pre- to post-contact wetland taro cultivation, was sent to Beta Analytic, Inc. for radiocarbon dating, utilizing the accelerator mass spectrometry (AMS) method, in order to better establish the age range of use at the subsurface cultural deposit. Dating results are shown in Table 10 below (also refer to Appendix C). Two samples from SIHP # 50-80-9-7751 were submitted for radiocarbon dating analysis. Both samples consisted of organically enriched sediment that contained small (generally one mm or less in maximal dimensions) charcoal flecks. Charcoal extraction from these sediment samples did not yield sufficient total carbon for AMS analysis; accordingly, AMS analysis was done on the bulk carbon that was extracted from the sediment samples themselves.

The first sample (Beta-267036) yielded one possible date range, a calibrated 2-sigma date of AD 990-1170 (95%). The second sample (Beta-267037) yielded one possible date range, a calibrated 2-sigma date range of AD 1010-1190 (95%) (refer to Appendix C). These relatively early pre-contact date ranges are unfortunately problematic. They date the accumulation of organic material in the sediment itself, which may or may not be related to the use of the sediment for agriculture. Further dating is required to more concretely determine the actual agricultural use of the pondfield sediments for irrigated agriculture.

Table 10. Results of Radiocarbon Analysis

Sample #	Beta #	Type	Trench	Stratum	Depth (cmbs)	Weight (g)	Calibrated 2-Sigma Date Range
WAIPAHU KAI 01	267036	Organic Sediment	6	II	115-150	1000	AD 990-1170 (95%)
WAIPAHU KAI 02	267037	Organic Sediment	1	II	100-125	1000	AD 1010-1190 (95%)

Section 6 Summary and Interpretation

6.1 Pedestrian Inspection

The proposed transit route traverses through the actively cultivated agricultural fields of Aloun Farms at the western end of the route, extending east into the highly urbanized towns of Waipahu and Pearl City. Pedestrian inspection confirmed that that the entire project area has been previously disturbed by either agriculture or urban development. Thus the agricultural activities and urban development within the project area has generated significant land disturbance which would have removed any surface cultural resources that may have been present. As a result no surface cultural resources were observed within the project area.

6.2 GPR Survey

Prior to test excavation, all test areas were surveyed with ground penetrating radar (GPR). The GPR survey was conducted to determine the viability of GPR in determining stratigraphy and locating cultural deposits.

In general, the results of the GPR survey were inconclusive. The maximum "visibility" within the study area was restricted to approximately 75 to 100 cm below the existing ground surface. Furthermore, the results of the GPR within this zone of visibility were inconsistent as buried objects (i.e. metal pipes, large basalt boulders, concrete slabs, etc.) were not always identified and stratigraphic layers with varying consistencies were not always isolated. There appears to be 3 factors causing the inconsistent results within the project area. The first is soil chemistry. Approximately one-third of the project area is situated within actively cultivated agricultural fields that are most likely fertilized with potassium and/or nitrogen, which would increase the conductivity of the soils causing limited depth "visibility" and inaccurate data collection. Adding to this is the red color of the soils observed throughout a majority of the project area. The red coloring is likely a sign of high iron content, which would further increase the conductivity of the soil. Also observed was the presence of thick clay deposits throughout the project area. Clay soils (especially those that are inundated) are noted as being very conductive, resulting in radio wave attenuation at shallow depths causing limited depth "visibility" and inaccurate GPR data collection (Conyers 2004).

The second factor for inaccurate GPR data collection is that a majority of the project area lacked uniform stratigraphy. A majority of the project area is situated within a highly developed urban area, defined by extensive filling associated with road construction, utility installation, and land reclamation. These filling events have caused the artificial deposition of stratigraphic layers with vastly different compositions (i.e. varying parent material and soil chemistry) resulting in layers with very different dielectric constants. GPR is able to effectively locate subsurface anomalies (i.e. buried objects, voids, areas of disturbance, etc.) when the surveyed area has a consistent dielectric constant (i.e. the frequency setting for radio waves to travel through). Subsurface anomalies are able to be located by the GPR because they have a different dielectric constant from the material in which it is situated, resulting in radio waves to be reflected back and recorded by the GPR unit. If the material being surveyed does not have a consistent dielectric constant, radio wave propagation can be attenuated (i.e. limited depth "visibility") and GPR data can become inaccurate.

The third factor is related to surface topography. Uneven surface topography (both at ground level and buried) can cause a phenomenon known as radar scatter. Radar reflections off of surfaces "that contain ridges or troughs, or any other irregular features, can either focus or scatter radar energy, depending on the surface's orientation and the location of the antenna on the ground surface" (Conyers 2004: 73). Irregular surfaces within the project area were observed at recently tilled agricultural fields (construction sheets RW001 through RW006), within a basalt boulder concentration in Ho`opili Station Test Trench 1 (see Figure 83), and within landfill deposits observed at the proposed Pearl Highlands Station and P&R (see Section.6.14 above). It is believed that these irregular surfaces functioned as reflective planes diverting the emitted radar energy away from the GPR antenna, resulting in inaccurate GPR data collection. Of the three limiting factors, this one probably hindered the GPR survey the least

Thus it has been concluded that a number of factors severly limit accurate GPR survey within the project area. The environmental conditions (i.e. soil chemistry) present within project area caused the sediments to be too conductive causing the radar waves to attenuate, resulting in limited depth "visibility" and inaccurate data output. Additionally, a majority of the project area is situated within a highly developed urban area, defined by extensive filling associated with road construction, utility installation, and land reclamation. This filling has caused the stratigraphy of the area to be non-uniform, a factor which limits the GPRs ability to effectively isolate buried objects. This conclusion is consistent with the National Resources Conservation Service (NRCS), which also indicated that GPR suitability in this area is moderate to low (see Figure 9).

6.3 Subsurface Testing

A total of 92 test excavations (57 backhoe trenches and 35 column location test pits) were excavated within the project area. Trenches were excavated at proposed transit stations with a focus on testing areas that are planned for subsurface disturbance (i.e. elevator shafts, subsurface utilities, etc.). Test excavations were also located at selected support column foundations along the proposed elevated rail line. Test excavations were distributed throughout the project area to provide representative coverage and assess the stratigraphy and potential for subsurface cultural resources within the project area. The testing program also focused on characterizing the remnants of the project area's buried land surface that predated historic and modern fill and/or pavement layers, as these remnants of the older land surface are more likely to be associated with significant cultural deposits.

Following a review of the observed and documented stratigraphy, 5 stratigraphic zones were delineated within the project area (Figure 357). Stratigraphic Zone 1 includes construction sheets RW001 through RW006. In general, the observed and documented stratigraphy of Stratigraphic Zone 1 consisted of a single stratum of naturally deposited alluvial sediment utilized for agriculture. Signs of previous disturbance via agriculture (i.e. tilling of soil and installation of water lines) were observed from the surface to an approximate depth of 100 cm. These observations agree with the USDA soil data for the project area and its vicinity (Foote *et al.* 1972). No subsurface cultural resources were observed within this stratigraphic zone.

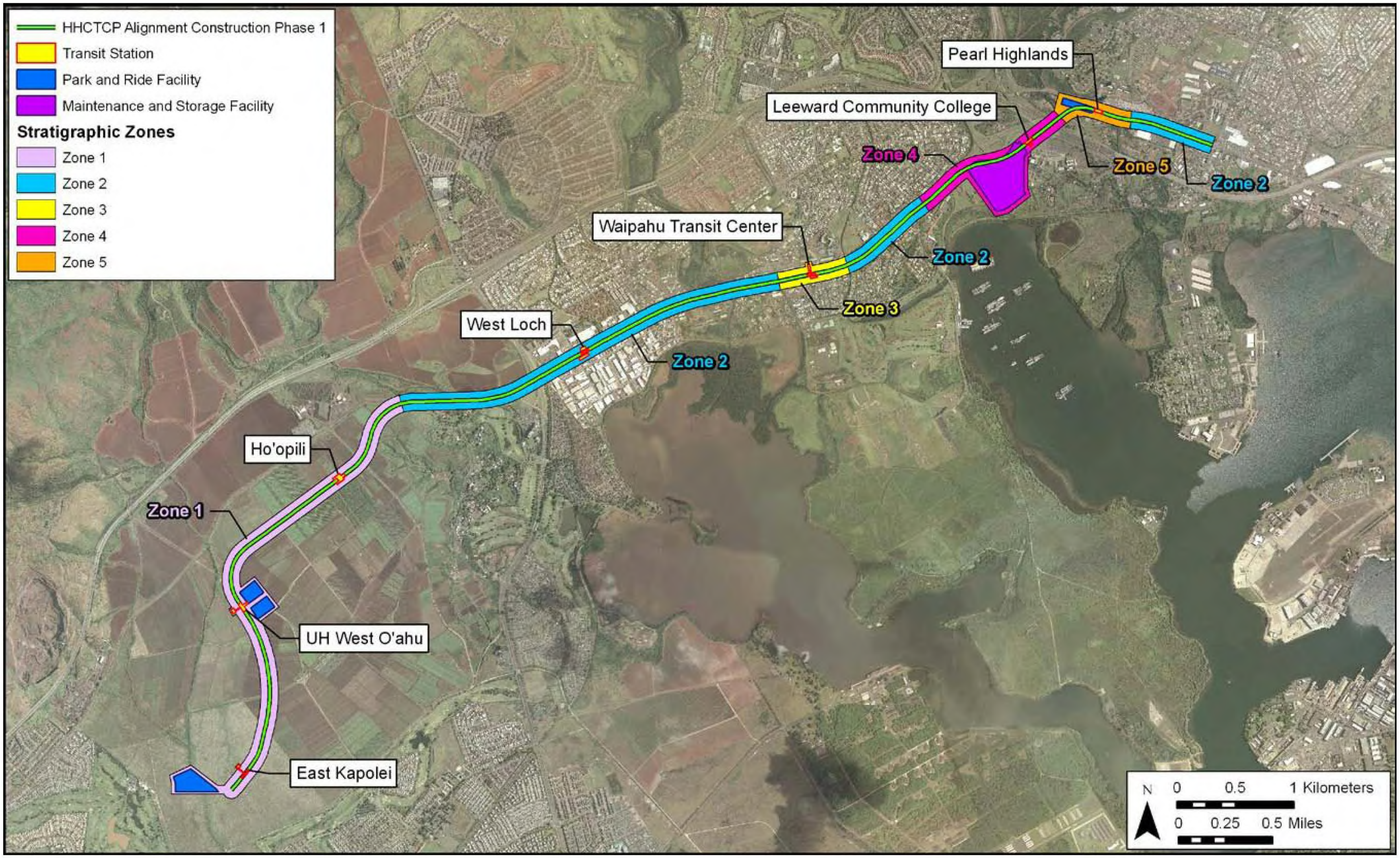

Figure 357. Stratigraphic Zones within the project area

Stratigraphic Zone 2 includes construction sheets RW007 through RW010, as well as RW012 and RW016. In general, the observed and documented stratigraphy of Stratigraphic Zone 2 consisted of varying fill layers associated with urban development (i.e. asphalting paving and utility installation), overlying naturally deposited alluvial sediments. Of particular interest were the testing results at West Loch Station (see Section 6.8 Construction Sheet RW008 above). At this location, layers and pockets of water rounded basalt cobbles were observed within the alluvial sediments, suggesting that the immediate area once had running water prior to modern urban development. A review of historic maps indicates a stream and a concentration of LCAs in the immediate area (Figure 358), providing further evidence of running water in the area prior to development. No subsurface cultural resources were observed within this stratigraphic zone.

Stratigraphic Zone 3 includes construction sheet RW011. In general, the observed and documented stratigraphy of Stratigraphic Zone 3 consisted of varying imported fill layers overlying naturally deposited alluvial sediment inundated with water and containing roots and decomposing organic matter, suggesting the area was once a marsh prior to urban development. The fill layers appear to be associated with two distinct events: 1) mass grading and filling associated with land reclamation, and 2) asphalt parking lot construction. Of note was the presence of reddish orange mottling and charcoal flecking within the dark clay sediments (Stratum II) observed at the *makai* (southern) portion of the proposed Waipahu Station (see Figure 183 and Figure 204 to Figure 221). These inclusions are suggestive that agriculture, specifically taro cultivation, had occurred in this area prior to urban development. A review of LCA documentation for the area confirmed that *lo'i* (wetland taro) was present within the area that was tested. Accordingly, the buried agricultural sediments were determined to be a cultural resource, and assigned as SIHP 50-80-9-7751.

Stratigraphic Zone 4 includes construction sheet RW013 and RW014. In general, the observed and documented stratigraphy of Stratigraphic Zone 4 consisted of varying layers of naturally deposited silt. The silt in this area was extremely compacted and may be associated with historic leveling and grading activities which took place in the area during the construction of the Navy 'Ewa Drum Filling and Storage Area. Additionally, substantial cuts into the existing slope were observed throughout the area, which could have removed a majority of the existing topsoil. Thus leaving an extremely compacted sediment that has not had enough time to be broken down by root activity and organic decomposition. No subsurface cultural resources were observed within this stratigraphic zone.

Stratigraphic Zone 5 includes construction sheet RW015. In general, the observed and documented stratigraphy of Stratigraphic Zone 5 consisted of varying layers of fill. Fill events were determined to be associated with residential and agricultural development, as well as extensive garbage dumping. Large amounts of modern garbage (concrete, automobiles, home appliances, plastic, etc.) were observed concentrated beneath the ground surface, suggesting that the area was once utilized as a dump and landfill. No subsurface cultural resources were observed within this stratigraphic zone.

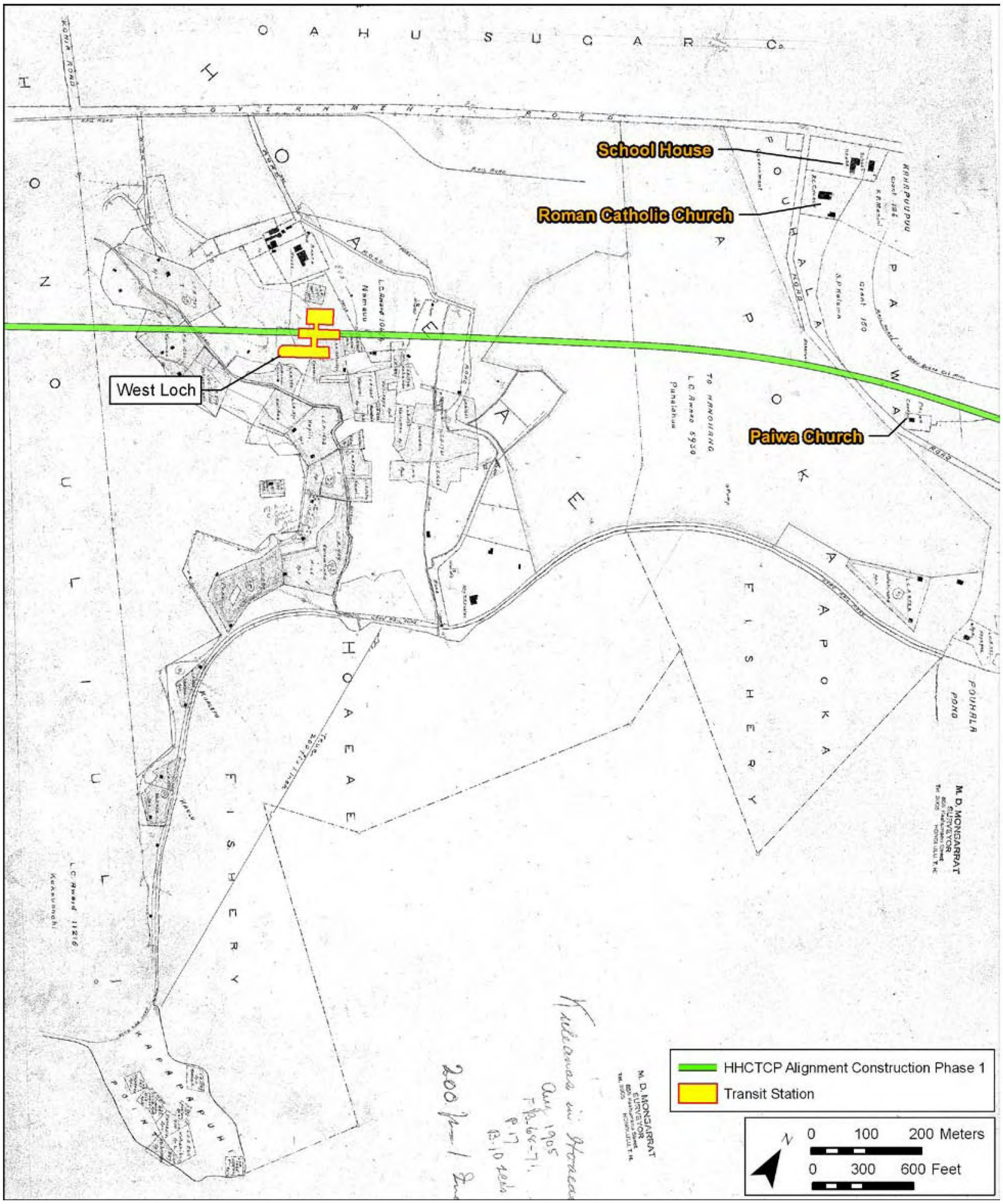

Figure 358. 1905 Map of Hoaeae by M.D. Monsarrat showing a stream and LCA concentration in the vicinity of the proposed HHCTCP West Lock Station

Section 7 Significance Assessments

The cultural resource identified by the current study was evaluated for significance according to the broad criteria established for the National and Hawai‘i Registers of Historic Places. The five criteria are:

A Associated with events that have made an important contribution to the broad patterns of our history;

B Associated with the lives of persons important in our past;

C Embodies the distinctive characteristics of a type, period, or method of construction, represents the work of a master, or possesses high artistic value;

D Have yielded, or is likely to yield information important for research on prehistory or history;

E Have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property, or due to associations with traditional beliefs, events or oral history accounts – these associations being important to the group’s history and cultural identity (Hawaii Register only).

SIHP # 50-80-09-7751 is likely a pre-contact to post-contact subsurface agricultrual deposit (*lo‘i* sediments). The cultural deposit was identified during subsurface testing at the location of the proposed *makai* (seaward) entrance building of the HHCTCP’s Waipahu Transit Center Station. Historic maps and documents indicate the vicinity of the SIHP # 50-80-09-7751 cultural deposit was formerly under relatively dense wetland taro cultivation. SIHP # 50-80-09-7751 is assessed as significant under Criterion D of the National and Hawai‘i Registers of Historic Places evaluation criteria.

Section 8 Project Effect and Mitigation Recommendations

The following project effect discussion and cultural resource management recommendations are intended to facilitate project planning and support the proposed project's required historic preservation consultation. This discussion is based on the results of this archaeological inventory survey investigation and CSH's communication with agents for the project proponents regarding the project's potential impacts to the cultural resources described in the Results of Fieldwork section, above.

8.1 Project Effect

The purpose of the proposed Honolulu High-Capacity Transit Corridor Project (HHCTCP) is to provide high-capacity rapid transit in the highly congested east-west transportation corridor between Kapolei and the University of Hawai‘i at Mānoa via a fixed guideway rail transit system. Construction Phase I of the HHCTCP (which, for the purposes of this investigation includes the western-most portion of Construction Phase II) consists of an approximately 7-mile segment extending from North-South Road in East Kapolei to Waimano Home Road in Pearl City In addition to the guideway, the project will require construction of transit stations and support facilities, including a vehicle maintenance and storage facility and park and ride lots. Seven proposed transit stations are in Construction Phase I of the project, including: East Kapolei Station; University of Hawai‘i at West O‘ahu Station; Ho‘opili Station; West Loch Station; Waipahu Transit Center Station; Leeward Community College Station; and Pearl Highlands Station. Project construction will also require relocation of existing utility lines within the project corridor that conflict with the proposed project design. Minimally, land-disturbing activities would include grading of facility locations and excavations for guideway column foundations, subsurface utility installation, and facility construction.

The approximately 156-acre Construction Phase I project area consists of: the approximately 7 mile long transit corridor; seven transit stations (approximately 5 acres); four park-and-ride facilities (approximately 25 acres); and a vehicle maintenance and storage facility (approximately 44 acres). The Construction Phase I project's area of potential effect (APE) for subsurface cultural resources is defined as all areas of direct ground disturbance. Although the extent of ancillary subsurface impacts, for example those related to the relocation of existing utilities, is still to be determined, it is estimated that the project's area of direct ground disturbance / APE is approximately 75 acres.

This archaeological inventory survey investigation identified the following cultural resource within the project area. This cultural resource may be affected by the proposed project:

1. SIHP # 50-80-09-7751, subsurface agricultural deposit, evaluated as significant under Criterion D of the National and Hawai‘i Registers of Historic Places evaluation criteria.

Under Hawaii State historic preservation review legislation, CSH's project-specific effect recommendation is "effect, with proposed mitigation commitments." Under federal historic preservation review legislation a project effect recommendation of "no adverse effect" is warranted, with the understanding that the proposed mitigation measures (described below) will be carried out to mitigate the undertaking's potential effect on National register-eligible cultural resources.

8.2 Mitigation Recommendations

To reduce the proposed project's potential effect on a significant cultural resource, the following mitigation measure is recommended. An archaeological data recovery program should be carried out within the project footprint of the *makai* (seaward) entrance building of the Waipahu Transit Center Station. This archaeological data recovery program will focus on further documentation of the stratigraphy and the collection of additional samples from the SIHP # 50-80-09-7751 subsurface agricultural (*lo'i* or pondfield*)* cultural deposit, which was identified during the current archaeological inventory survey.

Figure 183, above, shows the locations of the six archaeological inventory survey test excavations that have already been documented within the relatively small footprint of the *makai* entrance building of the Waipahu Transit Center Station, the construction of which has potential to affect at least a portion of the SIHP # 50-80-09-7751 subsurface deposit. These six test trenches did not expose structural elements related to the agricultural deposits, such as pondfield berms, walls, or *'auwai* (irrigation channels). Accordingly, it is quite possible that the proposed data recovery excavations will also not encounter these types of agricultural infrastructure within the relatively small area of the transit staition footprint. It is therefore recommended that the archaeological data recovery program focus on further documentation of the buried sediment layer itself, including collection of bulk column sediment samples, from which palynological (pollen) and radiocarbon dating samples can be extracted and analyzed. (Taxonomic identification of wood charcoal radiocarbon dating samples should be completed prior to radiocarbon dating analysis.) These bulk column sediment samples can be used to better characterize the age and/or use-life of the agricultural sediment, its physical characteristics, and potentially changes in the surrounding environment over time. Should structural elements be located during data recovery excavations, the documentation of these features will provide additional information concerning SIHP # 50-80-09-7751. The additional data developed by the archaeological data recovery program will mitigate the project's potential effect on the SIHP # 50-80-09-7751 subsurface cultural deposit.

An archaeological data recovery plan should be prepared for review and approval of the State Historic Preservation Division (SHPD) prior to project-related construction activities. In accordance with Hawai'i Administrative Rules (HAR) 13-278, the data recovery plan should describe specific research objectives, data requirements, and methods.

Based on the results of this archaeological inventory survey, and with the understanding that archaeological data recovery program described above will be completed prior to project construction in the vicinity of SIHP # 50-80-09-7751, no further archaeological mitigation measures are recommended for the remainder of the HHCTCP Construction Phase I project area. If, in the unlikely event that subsurface cultural deposits or human skeletal remains are encountered during the course of project-related construction activities, all work in the immediate area should stop and the SHPD should be promptly notified.

Section 9 References Cited

Adamski, Mary

1999 Neglect erodes link to past [Waipahu Cemetery]. *Honolulu-Star-Bulletin* December 9, 1999. Page A-1, A-6.

Alexander, W. D.

1907 The Funeral Rites of Prince Kealiiahonui. *Annual Report of the Hawaiian Historical Society f*or 1906, pp. 26-28. Hawaiian Historical Society, Honolulu.

Allen, Gwenfread

1999 *Hawaii's War Years 1941-1945*. Pacific Monograph, Kailua, Hawai'i.

Allen, Jane, Mary Riford, Thecla M. Bennett, Gail M. Murakami, Marion Kelly

1987 *Five Upland* 'Ili*: Archaeological and Historical Investigations in the Kāne'ohe Interchange, Interstate Highway H-3, Island of Oahu.* Report 87-1. Department of Anthropology, Bernice Pauahi Bishop Museum, Honolulu.

Apple, Russell A., and William K. Kikuchi

1975 *Ancient Hawaii Shore Zone Fishponds: An Evaluation of Survivors for Historical Preservation.* Office of the State Director, National Park Service, U.S. Dept. of the Interior, Honolulu.

Barrere, Dorothy B.

1994 *The King's Mahele: The Awardees and Their Lands. Dorothy B. Barrere, Compiler, Hilo, Hawai'i.* Ms. on file, Historic Preservation Division, State of Hawaii Department of Land and Natural Resources, Honolulu.

Beckwith, Martha

1918 *The Hawaiian Romance of Laieikawai*, with introduction and translation by Martha Warren Beckwith. Reprinted from the 33rd Annual report of the Bureau of American Ethnology. Washington, D.C., U.S. Govt. Print. Office. Unpaginated version reproduced online at http://www.blackmask.com/thatway/books164c/hrom.htm#1_3_87, downloaded May 16, 2005).

1940 *Hawaiian Mythology*. University of Hawai'i Press, Honolulu.

1951 *The Kumulipo, A Hawaiian Creation Chant.* University of Chicago Press, Chicago.

Bingham, Hiram

1847 *A Residence of Twenty-One Years in the Sandwich Islands*. Huntington, Hartford Connecticut.

Bishop, Sereno

1901 Ewa, O'ahu. Old Memories. *The Friend*, May 1901.

1916 *Reminiscences of Old Hawaii.* Hawaiian Gazette Co., Ltd., Honolulu.

Bordner, Richard, and Carol Silva
1983 *Archaeological Reconnaissance and Historical Documentation for Waimanalo Gulch and Ohikilolo Valley, TMK: 9-2-03: 2,40,13 (por).* Richard Bordner. Copy on file at Department of Land and Natural Resources, State Historic Preservation Division, Kapolei, Hawaiʻi.

Bowser, George
1880 *The Hawaiian Kingdom Statistical and Commercial Directory.* Geo. Bowser & Co., Honolulu and San Francisco.

Briggs, L. Vernon
1926 *Experiences of A Medical Student in Honolulu, and on the Island of Oʻahu 1881.* David D. Nickerson Co., Boston.

Bureau of Land Conveyances
1915 *Commissioner of Public Lands.* Territory of Hawaiʻi, Honolulu.

Bushnell, K. S., David W. Shideler, and Hallett H. Hammatt
2003 *A Cultural Impact Assessment for 3,600 acres in Waiawa and Waipiʻo Ahupuaʻa, Oʻahu, (TMK 9-4-06:11, 9-6-04:4 and 9-6-5:3).* Cultural Surveys Hawaiʻi, Inc., Kailua, Hawaiʻi.

Campbell, Archibald
1967 *A Voyage Round the World from 1806 to 18*12. University of Hawaiʻi Press, Honolulu.

Chamberlain, Levi
1956 Tour Around Oahu, 1828. Tour Around Oahu, 1828. *Hawaiian Historical Society Annual Report* 65:25-41.

Chang, Roberta
2003 *The Koreans in Hawaiʻi. A Pictorial History, 1903-2003.* University of Hawaiʻi Press, Honolulu.

Charvet-Pond, Ann, and Bertel D. Davis
1992 *Volume I: West Beach Data Recovery Program, Phase 4 - Archaeological and Paleontological Excavations (Two volumes). Ko Olina Resort, Land of Honouliuli, Ewa, Island of Oahu.* Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawaiʻi.

Chiddix, Jim, and MacKinnon Simpson
2004 *Next Stop Honolulu! The Story of the Oahu Railway & Land Company.* Sugar Cane Press, Honolulu.

Clark, John R. K.
1977 *The Beaches of Oʻahu.* University of Hawaiʻi Press, Honolulu.

Cobb, John N.
1903 Commercial Fisheries of the Hawaiian Islands—1903. *Bulletin of the U.S. Fish Commission*, Vol. IIIII, Part 2.

Coletta, Paolo (editor)
1985 *United States Navy and Marine Corps Bases, Domestic.* Greenwood Press, Westport, Connecticut.

Commander, Navy Region Hawai'i (CNRH)

2005 *Environmental Assessment: Disposal of the 'Ewa Drum Property, Wai'awa, O'ahu, Hawai'i*. Helber Hastert & Fee, Planners, Honolulu, HI.

Condé, Jesse, and Gerald M. Best

1973 *Sugar Trains: Narrow Gauge Rails of Hawaii*. Glenwood Publishers, Felton, California.

Conyers, Lawrence B.

2004 *Ground-Penetrating Radar for Archaeology*. AltaMira Press, Walnut Creek, CA.

Cordy, Ross

1981 *A Study of Prehistoric Social Change: The Development of Complex Societies in the Hawaiian Islands*. Academic Press, New York.

1996 *The Great 'Ewa Lands of La'akona 1840-1850 Settlement Patterns in the 'Ewa Lands Located Around Pearl Harbor: A Look at where Houses, Irrigated Taro Fields, Fishponds, and other Types of Sites were Located.* Department of Land and Natural Resources, State Historic Preservation Division, Kapolei, Hawai'i.

1997 *Māhele Era Settlement Patterns of Waikele Ahupua'a, 'Ewa District, O'ahu.* Department of Land and Natural Resources, State Historic Preservation Division, Kapolei, Hawai'i.

2002 *The Rise and Fall of the O'ahu Kingdom. A Brief Overview of O'ahu's History.* Mutual Publishing, Honolulu.

Coulter, J., and C. Chun

1937 *Chinese Rice Farmers in Hawaii.* University of Hawai'i Research Publications, Number 16, University of Hawai'i, Honolulu.

Damon, Frank

1882 Tours Among the Chinese, No. 1. *The Friend*, April 1882.

Day, A. Grove

1984 *History Makers of Hawaii: A Biographical Dictionary.* Mutual Publishing, Honolulu.

Department of Land and Natural Resources

1845-1903 *Land Record Books.* Commissioner of Public Lands, Territory of Hawai'i, Honolulu.

Dicks, A. Merrill, Alan E. Haun and Paul H. Rosendahl

1987 *Archaeological Reconnaissance Survey for Environmental Impact Statement West Loch Estates – Golf Course and Parks, Land of Honouliuli, Ewa district, Island of Oahu*, PHRI, Hilo

Dillingham, B.F.

1885 *Memos concerning Honouliuli, Kahuku, and Hawailoa ranches.* B.F. Dillingham, Honolulu.

Dorrance, William H. and Francis S. Morgan

2000 The 165-Year Story of Sugar in Hawai'i. Mutual Publishing, Honolulu

Downes, Cornelius D., (editor)

1953 History of Pearl Harbor. *Pearl Harbor Shipyard Log* Vol. VII No. 27, July 3, 1953. Pearl Harbor.

Ellis, William

1963 *Journal of William Ellis: Narrative of a Tour of Hawai'i with Remarks on the History and Traditions.* Reprint of 1917 edition. Advertising Publishing Co., Honolulu.

Emerson, J. S.

n.d. Hawaii Sharks. *Hawaiian Ethnological Notes* Vol. 1:586.

1892 The Lesser Hawaiian Gods. *Papers of the Hawaiian Historical Society*, Paper No. 2.

Emerson, Nathaniel B.

1993 *Pele and Hi'iaka*. Original published in 1919. 'Ai Pōhaku Press, Honolulu.

1998 Kalelealuaka. In *Hawaiian Folk Tales*, compiled by Thomas G. Thrum, pp. 74-106. Mutual Publishing, Honolulu.

Emory, Kenneth, P., J. Halley Cox, William J. Bonk, Yosihiko H. Sinoto, Dorothy B. Barrere

1959 *Natural and Cultural History Report on the Kalapana Extension of the Hawaii National Park, Vol. I, Cultural History Report.* Prepared by the Bernice P. Bishop Museum for the Hawai'i National Park Service, Honolulu.

Ewa Plantation Company

1923 *Ewa Plantation Company Annual Report*. Microfilm at University of Hawai'i at Mānoa, Hamilton Library, Honolulu.

Ewa Station Reports

1835 *Ewa Station Reports for 1835.* Microfilm at Hawaiian Mission Children's Museum, Honolulu.

1860 *Ewa Station Reports for 1860.* Microfilm at Hawaiian Mission Children's Museum, Honolulu.

Foote, Donald E., E. L. Hill, S. Nakamura, and F. Stephens

1972 Soil Survey of the Islands of Kaua'I, O'ahu, Maui, Molokai, and Lanai, State of Hawaii. U.S. Department of Agriculture, U.S. Government Printing Office, Washington D.C.

Fornander, Abraham

1917 *History of Kualii*. In, In, *Fornander Collection of Hawaiian Antiquities and Folklore* Vol. IV, Part II:364-434. Memoirs of the Bernice P. Bishop Museum, Bishop Museum Press, Honolulu.

1917 *Story of Pikoiakaalala.* In, *Fornander Collection of Hawaiian Antiquities and Folklore* Vol. IV, Part III:450-463. Memoirs of the Bernice P. Bishop Museum, Bishop Museum Press, Honolulu.

1918 *Legend of Palila*. In, *Fornander Collection of Hawaiian Antiquities and Folklore* Vol. V, Part I:142-143. Memoirs of the Bernice P. Bishop Museum, Bishop Museum Press, Honolulu.

1919 Legend of Maikoha. In, *Fornander Collection of Hawaiian Antiquities and Folklore* Vol. V, Part II:270-273. Memoirs of the Bernice P. Bishop Museum, Bishop Museum Press, Honolulu.

1919 *Legend of Kamapuaa*, In, *Fornander Collection of Hawaiian Antiquities and Folklore* Vol. V, Part II:314-363. Memoirs of the Bernice P. Bishop Museum, Bishop Museum Press, Honolulu.

1919 *Story of Palila.* In, *Fornander Collection of Hawaiian Antiquities and Folklore* Vol. V, Part II:373-375. Bernice P. Bishop Museum, Bishop Museum Press, Honolulu.

1919 A Lamentation for Kahahana. In, *Fornander Collection of Hawaiian Antiquities and Folklore* Vol. VI, Part II:292-306. Bernice P. Bishop Museum, Bishop Museum Press, Honolulu.

1996 *Fornander's Ancient History of the Hawaiian People to the Times of Kamehameha I.* Originally published in 1880 as An Account of the Polynesian Race. Its Origins and Migrations, Volume II. Mutual Publishing, Honolulu.

Frear, Mary Dillingham

1934 *Lowell and Abigail, A Realistic Idyll.* Privately Printed, New Haven.

Frierson, Barbara

1972 *A Study of Land Use and Vegetation Change: Honouliuli, 1790-1925, Manuscript prepared for Graduate Seminar in Geography (750).* University of Hawai'i, Honolulu.

Goodman, Wendy, and Richard C. Nees

1991 *Archaeological Reconnaissance and Inventory Survey of 3,600 Acres in Waiawa, 'Ewa, O'ahu.* Public Archaeology Section, Applied Research Group, Bernice P. Bishop Museum, Honolulu.

Gowans, Alan

1993 *Fruitful Fields. American Missionary Churches in Hawai'i.* Department of Land and Natural Resources, State Historic Preservation Division, Honolulu.

Halliday, William R.

2005 Current Status of the 'Ewa Karst, Honolulu County, Hawai'i. *The Cave Conservationist.* February 1998. Electronic File at http://www.caves.org/section/ccms/wrh/, accessed December 22, 2005.

Hammatt, Hallett H., and Rodney Chiogioji

2000 Archaeological Assessment of an Approximately 2,600-ft Portion of Farrington Highway Project between Anini Place and Waipahu Depot Road, Waikele Ahupua'a, 'Ewa District, Island of O'ahu, (TMK 9-4-11). Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Hammatt, Hallett H., and Rodney Chiogioji

1997a *Archaeological Reconnaisance Survey of a 29,100-ft. Long Land Corridor within Honouliuli Ahupua'a, 'Ewa District, O'ahu Island.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i. March 1997

Hammatt, Hallett H., and Rodney Chiogioji

1997b *Archaeological Reconnaisance Survey of a 4.5-Kilometer (14,730-Ft.) Long Land Corridor within Honouliuli Ahupua'a, 'Ewa District, O'ahu Island.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i. September 1997

Hammatt, Hallett H., and William H, Folk

1981 *Archaeological and Paleontological Investigation at Kalaeloa (Barber's Point), Honouliuli, 'Ewa, O'ahu, Federal Study Areas 1a and 1b, and State of Hawai'i Optional Area 1.* Archaeological Research Center Hawai'i, Lawa'i, Hawai'i.

Hammatt, Hallett H., Sallee Freeman and David W. Shideler.

2004 *Archaeological and Cultural Assessment in Support of the Waipahu Drainage Improvements Project, Waipahu, Waipi'o Ahupua'a, 'Ewa District, O'ahu, TMK 9-4-09 and 9-4-59:72, 73, 74.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Hammatt, Hallett H., Jennifer J. Robins, Mark Stride, and Matthew J. McDermott

1990 *An Archaeological Inventory Survey for the Makaīwa Hills Project Site, Honouliuli, 'Ewa, O'ahu.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Hammatt, Hallett, H., and David W. Shideler

1990 *Archaeological Inventory Survey of the West Loch Bluffs Project Site, Hono'uli'uli, 'Ewa, O'ahu.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

1991 *Archaeological Inventory Survey for a Proposed Expansion of Saint Francis Medical Center West (TMK 9-1-17: por.56), Honouliuli, 'Ewa, O'ahu.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

1999 *Archaeological Assessment for a Proposed Expansion of Saint Francis Medical Center West (TMK 9-1-17: por.17 & 60), Honouliuli, 'Ewa, O'ahu.* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

2009 *Archaeological Inventory Survey Plan For Construction Phase I of the Honolulu High-Capacity Transit Corridor Project Station 392+00 (near East Kapolei Station) to Station 776+00 (near Waimano Home Road), Honouliuli, Hō'ae'ae, Waikele, Waipi'o, and Waiawa Ahupua'a, 'Ewa District, O'ahu* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Handy, E.S. Craighill

1940 *The Hawaiian Planter, Volume 1. His Plants, Methods and Areas of Cultivation.* Bernice P. Bishop Museum Bulletin 161, The Museum, Honolulu.

Handy, E.S. Craighill, and Elizabeth G. Handy

1972 *Native Planters in Old Hawaii: Their Life, Lore, and Environment.* Bishop Museum Bulletin 233. Bernice P. Bishop Museum, Honolulu.

Hawaiian Mission Children's Society
1969 *Missionary Album, Sesquicentennial Edition 1820-1970.* Edward Enterprises, Honolulu.

Ho'oulumāhiehie
2006a *Ka Mo'olelo o Hi'iakaikapoliopele.* Original Hawaiian text taken from series of articles in *Ka Na'i Aupuni* 1905-1906. Awaiaulu Press, Honolulu.

Ho'oulumāhiehie
2006b *The Epic Tale of Hi'iakaikapoliopele. As Told by Ho'oulum'hiehie.* Translated by M. Puakea Nogelmeier. Awaiaulu Press, Honolulu.

Hosmer, F. A.
1898 Religious Opportunities. In, *Hawaiian Almanac and Annual for 1898*, pp. 146-149. Thos. G. Thrum, Honolulu.

'Ī'ī, John Papa
1959 *Fragments of Hawaiian History*. Pukui translation. Bernice P. Bishop Museum Press, Honolulu

Immisch, George B.
1964 *Land Reclamation and the Role of the Hydroseparator at Ewa Plantation: A Case Study of Some of the Effects of Mechanized Harvesting in the Hawaiian Sugar Industry.* Master's thesis, University of Hawaii at Mānoa, Honolulu.

Indices of Awards
1929 *Indices of Awards Made by the Board of Commissioners to Quiet Land Titles in the Hawaiian Islands.* Commissioner of Public Lands, Territory of Hawaii. Star-Bulletin Press, Honolulu.

Jarrett, L.
1930 *A Source Book in Hawaiian Geography*. M.A. Thesis, University of Hawai'i, Honolulu.

Judd, C. A.
1933 The Parasitic Habit of the Sandalwood Tree. *Hawaiian Almanac and Annual for 1933,* pp. 81-88. Thos. G. Thrum, Honolulu.

Judd, Walter F.
1971 Hawaii's Military Heritage, Polynesian to Annexation. Unpublished manuscript. Copy on file at Cultural Surveys Hawai'i, Kailua, Hawai'i.

Ka Hōkū o Hawai'i
1927 He Mo'olelo Ka'ao no Hi'iaka- i-ka poli-o-Pele. *Ka Hōkū o Hawai'i,* February 15, 1927.

1927 He Mo'olelo Ka'ao no Hi'iaka- i-ka poli-o-Pele. *Ka Hōkū o Hawai'i,* February 22, 1927.

Ka Loea Kālai'āina
1899 Na Wahi Pana o Ewa. *Ka Loea Kālai'āina*, June 3, 1899.

1899 Na Wahi Pana o Ewa. *Ka Loea Kālai'āina*, June 10, 1899.

1899 Na Wahi Pana o Ewa. *Ka Loea Kālai'āina*, July 8, 1899.

1899 Na Wahi Pana o Ewa. *Ka Loea Kālai'āina*, July 15, 1899.

1899 Na Wahi Pana o Ewa. *Ka Loea Kālai'āina*, July 22, 1899.

1899 Na Wahi Pana o Ewa. *Ka Loea Kālai'āina*, Oct. 7, 1899.

1899 Na Wahi Pana o Ewa. *Ka Loea Kālai'āina,* Oct. 21, 1899.

1913 Na Wahi Pana o Ewa. *Ka Loea Kālai'āina*, Jan. 13, 1900.

Ka Nūpepa Kū'oko'a

1868 He Wanana Ana [A Prophecy]. *Ka Nūpepa Kū'oko'a*, December 5, 1868. Translation in Hawaiian Ethnological Notes (HEN) Vol. I, p. 2734.

1908 Pōhaku Anae. *Ka Nūpepa Kū'oko'a*, October 2, 1908.

Kahiolo, G. W.

1978 *He Moolelo No Kamapuaa, The Story of Kamapuaa*. Translated by Esther T. Mookini and Erin C. Neizmen with the assistance of David Tom. Hawaiian Studies Program, University of Hawai'i at Mānoa, Honolulu.

Kamakau, Samuel M.

1976 *The Works of the People of Old, Nā Hana a Ka Po'e Kahiko.* Bernice P. Museum Special Publication 61. Originally published 1869-1870. Bishop Museum Press, Honolulu.

1991a *Tales and Traditions of the People of Old; Nā Mo'olelo a Ka Po'e Kahiko.* Originally published 1865-1869. Bishop Museum Press, Honolulu.

1991b *Ka Pō'e Kahiko; The People of Old.* Originally published 1869-1870. Bishop Museum Press, Honolulu.

1992 *Ruling Chiefs of Hawaii*. Revised Edition. Originally published 1867-1870. Kamehameha Schools Press, Honolulu.

Kame'eleihiwa, Lilikala

1992 *Native Land and Foreign Desires. Pehea La E Pono Ai?* Bishop Museum Press, Honolulu.

Ke Au Hou

1910 Place Names – O'ahu. *Ke Au Hou,* Dec. 14, 1910

Kelly, Marion

1983 *Na Mala o Kona: Gardens of Kona, A History of Land Use in Kona, Hawaii*, Bishop Museum Dept. Report Series 83-2, Honolulu.

1985 Notes on the History of Honouliuli. Appendix A IN *An Archaeological Survey of the Naval Air Station, Barber's Point O'ahu, Hawai*'i, by A. E. Haun. Department of Anthropology, Bernice P. Bishop Museum, Honolulu.

1991 Notes on the History of Honouliuli. In A.E. Haun, *Archaeological Survey of the Naval Air Station, Barber's Point O'ahu, Hawai'i, Appendix A.* Applied Research Group, Bernice P. Bishop Museum, Honolulu.

Kirch, Patrick V.

1985 *Feathered Gods and Fishhooks*, University of Hawai'i Press, Honolulu, HI

Kluegel, Chas. H.

1917 Engineering Features of the Water Project of the Waiahole Water Company. *Hawaiian Almanac and Annual for 1916,* pp. 93-107. Thos. G. Thrum, Honolulu.

Knudsen, Eric

1946 *Teller of Hawaiian Tales*. Mutual Publishing, Honolulu.

Kotzebue, Otto

1821 *Voyage of Discovery into the South Seas and to the Bering Straits, Aboard the Kamchatka in the Years 1815-1818*. Translated and published by Longman and Hurst, London.

Krause, F. G.

1911 Cotton Culture in Hawaii. In, *Hawaiian Almanac and Annual for 1911*, pp. 58-67. Thos. G. Thrum, Honolulu.

Kuykendall, Ralph S.

1967 *The Hawaiian Kingdom: l874-l893. Volume 3.* University Press of Hawai‘i, Honolulu.

Landrum, James, Robert Drolet, and Katharine Bouthillier

1997 *Cultural Resources Overview Survey, Naval Magazine Lualualei, Island of O‘ahu, Hawai‘i*. Ogden Environmental and Energy Services Co., Inc. Honolulu.

Lucas, Paul F.

1995 *A Dictionary of Hawaiian Legal Land-Terms*. Published by Native Hawaiian Legal Corporation, Honolulu, and the University of Hawai‘i Committee for the Preservation and Study of Hawaiian Language, Art and Culture, Honolulu.

Maly, Kepā

1992 Historical Documentary Research. Appendix E In, Berdena Burgett and Paul H. Rosendahl *Archaeological Inventory Survey, Contaminated Soil Stockpile/Remediation Facility.*, Paul H. Rosendahl, Ph. D., Inc., Hilo, Hawai‘i.

1997 Historical Documentary Research. In *Archaeological Reconnaissance Survey, Naval Magazine Lualualei, NAVMAG-West Loch, Lands of Pu‘uloa, Honouliuli, Waikele, and Waipi‘o, District of ‘Ewa, Island of O‘ahu*, By Peter M. Jensen, and James Head, pp. 7-59. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai‘i.

Manu, Moses

1885 The Legend of Keaomelemele. *Ka Nūpepa Kū‘oko‘a* April 25, 1885; translation in Hawaiian Ethnological Notes, HEN Vol. II:872. Bernice P. Bishop Museum, Honolulu.

1902 Aiai, son of Ku-ula, Beeing Part of Ku-ula, the Fish God of Hawaii. *Hawaiian Almanac and Annual for 1902,* pp. 114-128. Translation by N. B. Emerson. Thos. G. Thrum, Honolulu.

1904 Traditional Account of the Ancient Hawaiian Prophesy. In, *Hawaiian Almanac and Annual for 1904*, pp. 105-113. Thos. G. Thrum, Honolulu.

2002 Keaomelemele. Translated by Mary Kawena Originally published in serial form in the Hawaiian language newspaper, *Ka Nūpepa Kū‘oko‘a,* September 6, 1884 to

June 27, 1885. Translated by Mary Kawena Pukui. Bishop Museum Press, Honolulu.

Mauricio, Michael (editor)
1997 *Waipahu: Its People and Heritage.* Waipahu Centennial Committee, Waipahu, Hawai‘i.

McAllister, J.G.
1933 *Archaeology of Oahu.* Bernice P. Bishop Museum Bulletin 104, Honolulu.

McGerty, Leann, and Robert Spear
1995 *An Archaeological Assessment of the Mānana and Pearl City Junction Sites, Mānana and Waiawa Ahupua‘a, ‘Ewa District, O‘ahu Island.* Scientific Consultant Services, Inc., Honolulu, Hawai‘i.

McGuire, Ka‘ohulani
2000 *A Traditional Practices Assessment for the Proposed Faulkes Telescope on 1.5 Acres of the University of Hawai‘i Facility at Haleakalā, Papa‘anui Ahupua‘a Makawao District, Island of Maui (TMK 2-2-07:8).* Cultural Surveys Hawai‘i, Inc., Kailua, Hawai‘i.

Morgenstein, Maury
1978 *Geoarchaeological Analysis of Field Remnants, Kawainui March, Kailua, Oahu.* Prepared for the U. S. Army Corps of Engineers by Hawaii Marine Research, Inc.

Morgenstein, Maury and William C. Burnett
1972 Report 5: Geologic Observations at an Agricultural Area in Upper Makaha Valley. In *Makaha Valley Historical Project Interim Report No. 3*, E. J. Ladd and D. E. Yen, editors. Number 18, Pacific Anthropological Records. Department of Anthropology, Bernice P. Bishop Musum, Honolulu

Mylroie, John E., and James L. Carew
1995 Karst Development on Carbonate Islands. Chapter 3, in D. A. Budd and A. Saller, eds. *Unconformities and Porosity in Carbonate Strata.* American Association of Petroleum Geologists Memoir 63.

Nakuina, Emma M.
1904 *Hawaii - Its People and Their Legends.* Hawai‘i Promotion Committee, Honolulu.

Nakuina, Moses K.
1992 *The Wind Gourd of La‘amaomao, The Hawaiian Story of Pāka‘a and Kūapāka‘a, Personal Attendants of Keawenuia‘umi, Ruling Chief of Hawaii and Descendants of La‘amaomao.* Collected, edited, and expanded by Moses K. Nakuina, translated by Esther T. Mookini and Sarah Nākoa. Kalamakū Press, Honolulu.

1998 Fish Stories and Superstitions. In, *Hawaiian Folk Tales*, compiled by Thomas G. Thrum, pp. 269-274. Mutual Publishing, Honolulu.

Nedbalek, Lani
1984 *Waipahu: A Brief History.* Wonder View Press, Mililani, Hawai‘i.

O'Hare, Constance R., David W. Shideler, and Dr. Hallett H. Hammatt

2006 *An Archaeological Inventory Survey for the Ho'opili 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, 9-2-002:004, 005* Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Ohira, Rod.

1997 "Waipahu Turns 100. One Sweet Century." *Honolulu Star Bulletin*, June 12, 1997.

Pacific Commercial Advertiser

1885 *Pacific Commercial Advertiser*, August 15, 1885. Honolulu.

Pagliaro, Penny

1987 *Ewa Plantation: An Historical Survey 1890 to 1940*. Manuscript, Historic Preservation Program, University of Hawaii at Mānoa, Honolulu.

Paradise of the Pacific

1902 Hawaiian Fiber Company. *Paradise of the Pacific*, March 1902. Vol. 15:17-18.

1902 Ewa Plantation Company. *Paradise of the Pacific*, December 1902. Vol. 15:19-22.

Pukui, Mary Kawena

1943 Ke Awa Lau o Pu'uloa: The Many-Harbored Sea of Pu'uloa. *Hawaiian Historical Society Report* 52:56-62. Honolulu.

1983 *'Ōlelo No'eau: Hawaiian Proverbs and Poetical Sayings*. Bishop Museum Special Publication No.71, Bishop Museum Press, Honolulu.

Pukui, Mary Kawena, and Samuel H. Elbert

1986 *Hawaiian Dictionary*. 2nd Edition. University of Hawai'i Press, Honolulu.

Pukui, Mary Kawena, and Laura Green

1995 *Folktales of Hawai'i. He Mau Ka'ao Hawai'i.* Collected and translated by Mary Kawena Pukui with Laura C. S. Green. Bishop Museum Press, Honolulu.

Pukui, Mary K., Samuel H. Elbert, and Esther Mookini

1974 *Place Names of Hawai'i*. University of Hawai'i Press, Honolulu.

Rasmussen, Coral M., and Myra J. Tomonari-Tuggle

2006. *Archaeological Monitoring of Waiau Fuel Pipeline, 'Ewa District, Island of O'ahu.* International Archaeological Research Institute, Inc., Honolulu, Hawai'i.

Rechtman, Robert B. and Jack D. Henry

1998. *Archaeological Reconnaissance Survey, Red Hill Fuel Storage Area and Ewa Drum Filling and Fuel Storage Area, Lands of Waipi'o, Wai'awa, Hālawa,. 'Ewa District and Moanalua, Honolulu District, Island of O`ahu.* Paul H. Rosendahl Ph.D., Inc. Hilo, Hawai'i.

Riley, Thomas J

1975 Survey and Excavation of the Aboriginal Agricultural System. In P.V. Kirch and M. Kelly (eds.) *Prehistory and Ecology in a Winward Hawaiian Valley: Halawa Valley, Molokai*, pp. 79-115. Pacific Anthropological Records 24. Department of Anthropology, B. P. Bishop Museum, Honolulu.

Rosendahl, Paul

1987 *Archaeological ReconnaissanceSurvey for Environmental Impact Statement West Loch Estates – Residential Increments I and II, Land of Honouliuli, Ewa district, Island of Oahu*, PHRI, Hilo

Saturday Press

1883 Dictionary of Hawaiian Localities. *Saturday Press*, Aug. 11, 1883.

1884 Dictionary of Hawaiian Localities. *Saturday Press*, January 12, 1884

Schilt, A. Rose

1980 *Archaeological Investigations in Specified Areas of the Hanalei Wildlife Refuge, Hanalei Valley, Kaua'i.* Prepared for the U. S. Fish and Wildlife Service (Hanalei, Kaua'i) by the Department of Anthropology, Bernice P. Bishop Museum, Honolulu

Schmitt, Robert C.

1968 *Demographic Statistics of Hawaii: 1778-1965.* University of Hawai'i Press, Honolulu.

1973 *The Missionary Censuses of Hawaii*. Bernice P. Bishop Museum, Honolulu.

Schoofs, Robert

1978 *Pioneers of the Faith: History of the Catholic Mission in Hawaii, 1827-1840.* Edited by Louis Boeynaems. Sturgis Printing, Honolulu.

Sheldon, Henry L.

1883 Reminiscences of Honolulu Thirty-Five Years Ago. *Saturday Press,* May 26, 1883.

Silva, Carol

1987 Appendix A: Historical Documentary Research. IN, *Archaeological Reconnaissance Survey for Environmental Impact Statement, West Loch Estates - Golf Course and Parks, Land of Honouliuli, Ewa District, Island of Oahu*, by A. Merrill Dicks, Alan E. Haun, and Paul H. Rosendahl. Paul H. Rosendahl, Ph.D., Inc., Hilo, Hawai'i.

Spear, Robert L.

1996 *Archaeological Reconnaissance and Assessment of the H.F.D.C. – East Kapolei Development Project*. Scientific Consultant Services, Inc., Pu'unene, Hawai'i.

St. John, Harold

1947 The history, present distribution, and abundance f sandalwood on Oahu, Hawaiian Islands. *Pacific Science* 1(1):5-20, January 1947.

Sterling, Elspeth P., and Catherine C. Summers (comp.)

1978 *Sites of O'ahu*. Bernice P. Bishop Museum, Department of Anthropology, Honolulu.

Thrum, Thomas G.

1886 Great Land Colonization Scheme. *Hawaiian Almanac and Annual* for 1887:73-80. Thos. G. Thrum, Honolulu.

1907 Heiau and Heiau Sites throughout the Hawaiian Islands. *Hawaiian Almanac and Annual* for 1907:36-47.

1909 Retrospect for 1908. *Hawaiian Almanac and Annual for 1909*, pp. 163-182. Thos. G. Thrum, Honolulu.

1913 Retrospect for 1912. *Hawaiian Almanac and Annual for 1919*, pp. 163-184. Thos. G. Thrum, Honolulu.

1922 Hawaiian Place Names. In, A *Dictionary of the Hawaiian Language*, by Lorrin Andrews, pp. 625-674. Originally published in 1865. Revised by Henry Parker, 1922. Board of Commissioners of Public Archives of the Territory of Hawai'i, Honolulu.

1923 *More Hawaiian Folk Ta*les. A.C. McClurg & Co., Chicago. *Further Exploits of Maui*, pp. 248-260. *Story of Ka-ehu-iki-mano-o-Pu'u-loa* (The small blonde shark of Puuloa), pp. 293-306.

1927 Our Widening Industries: Macadamia Nut Culture. *Hawaiian Almanac and Annual for 1927*, pp. 95-97. Thos. G. Thrum, Honolulu

1998 This Land is the Sea's. Traditional Account of an Ancient Hawaiian Prophesy. In, *Hawaiian Folk Tales, A Collection of Native Legends,* pp. 203-214. Translated from Moke Manu by Thomas G. Thrum. Mutual Publishing, Honolulu.

Titcomb, Margaret

1979 *Native Use of Marine Invertebrates in Old Hawaii.* University of Hawaii Press, Honolulu.

Treiber, Gale

2005 Oahu's Narrow Gauge Operations in Hawaii Since WWII. *The Railroad Press* 66:10-29.

Tuggle, H. David, and M. J. Tomonari-Tuggle

1997 *Synthesis of Cultural Resource Studies of the 'Ewa Plain, Task 1a: Archaeological Research Services for the Proposed Cleanup, Disposal and Reuse of Naval Air Station Barbers Point, O'ahu, Hawai'i.* International Archaeological Research Institute, Inc., Honolulu, HI.

U.S. Department of Transportation Federal Transit Administration (USDOT/FTA) and the City and County of Honolulu Department of Transportation Services

2008 *Honolulu High-Capacity Transit Corridor Project, City and County of Honolulu, O'ahu, Hawai'i, Draft Environmental Impact Statement/Section 4(f) Evaluation.* Parsons Brinkerhoff, Honolulu, HI.

Vancouver, George

1798 *A Voyage of Discovery to the North Pacific Ocean...performed in the years 1790, 1791, 1792, 1793, 1794, and 1795, in the Discovery . . . and . . . Chatham* . . Vols. 1-3. Amsterdam, N. Israel, London.

Webb, E. Lahilahi

1923 Mikololou. In, *More Hawaiian Folk Tales*, compiled by Thomas G. Thrum, A. C. McClurg, Co., Chicago.

Westervelt, William D.

1923 Lepe-a-moa (The Chicken Girl of Palama). In, *More Hawaiian Folk Tales*, compiled by Thomas G. Thrum, pp. 154-184. A. C. McClurg and Co., Chicago.

1963 *Legends of Old Honolulu*. Collected and Translated from the Hawaiian by W. D. Westervelt. Press of George H. Ellis Co., Boston.

Wilcox, Carol

1996 *Sugar Water: Hawaii‘s Plantation Ditches*. University of Hawai‘i Press, Honolulu.

Wilkes, Charles

1970 *Narrative of the U.S. Exploring Expedition, Volume IV*. Republished by The Gregg Press, Upper Saddle River, New Jersey.

Woodbury, David O.

1946 *Builders for Battle, How the Pacific Naval Air Bases were Constructed*. E. P. Dutton and Company, New York.

Appendix A SHPD Acceptance of Archaeological Inventory Survey Plan

LINDA LINGLE
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STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

STATE HISTORIC PRESERVATION DIVISION
601 KAMOKILA BOULEVARD, ROOM 555
KAPOLEI, HAWAII 96707

March 16, 2009

Mr. David Shideler
Cultural Surveys Hawai'i
P. O. Box 1114
Kailua, Hawai'i 96736

LOG NO: 2009.1325
DOC NO: 0903WT115
Archaeology

Dear Mr. Shideler:

SUBJECT: **Section 106 National Historic Preservation Act (NHPA) Review**
Archaeological Inventory Survey Plan--
For Construction Phase I of the Honolulu High-Capacity Transit Corridor Project, Station 392+00 (Near East Kapolei Station) to Station 776+00 (Near Waimano Home Road),
Hono'uli'uli, Hō'ae'ae, Waikele, Waipi'o, and Waiawa Ahupua'a, 'Ewa District, O'ahu, Hawai'i
TMK: (1) 0-1, 9-4, 9-5, 9-6, 9-7 (Various Plats and Parcels)

Thank you for providing us the opportunity to review this Archaeological Monitoring Plan (AMP), (*Archaeological Inventory Survey Plan For Construction Phase I of the Honolulu High-Capacity Transit Corridor Project, Station 392+00 (Near East Kapolei Station) to Station 776+00 (Near Waimano Home Road), Hono'uli'uli, Hō'ae'ae, Waikele, Waipi'o, and Waiawa Ahupua'a, 'Ewa District, O'ahu, Hawai'i TMK: (1) 0-1, 9-4, 9-5, 9-6, 9-7 (Various Plats and Parcels)[Hammatt and Shideler MA, March 2009]*) which we received on March 10, 2009.

The transit corridor is a very complex project which includes stations, park-and-ride facilities, and piers and requires flexibility on the part of archaeological contractors in inventorying historic properties. Due to geography, urban settlement, previous archaeological work, or the lack thereof, and the non-sensitive and sensitive archaeological areas, the approach was to split the project area in to western and eastern sections with Kunia Road being the arbitrary dividing line. All aspects of the archaeological inventory survey were developed around these distinct loci.

Archaeological survey techniques to be employed are driven by the necessity to determine historic properties subsurface in areas of sensitivity. Additionally, these techniques will also confirm the lack of properties in areas not sensitive. This is an efficient and cost reducing methodology. These include test trenching, Ground Penetrating Radar (GPR) and limited areal excavations. We agree that these methods will adequately document historic properties that, if significant and with further consultation with this office, be investigated in a data recovery phase. Another measure to mitigate possible effects to historic properties, especially human burials, would be the development of a monitoring plan to address the results of this inventory survey and/or data recovery studies.

This AISP is accepted and meets the minimum standards for compliance under Hawai'i administrative Rules.

Dr. David Shideler
Page 2

We are in receipt of a hardcopy of this document, which we will mark as FINAL. Please send text-searchable PDF version on CD along with a copy of this review letter to the attention of Wendy Tolleson and **"SHPD Library"** at the Kapolei SHPD office.

Please contact Wendy Tolleson at (808) 692-8024 if you have any questions or concerns regarding this letter.

Aloha,

Nancy A. McMahon

Nancy A. McMahon (Deputy SHPO)
State Historic Preservation Officer

Appendix B Land Commission Award Documents

Waihona 'Aina
Your ultimate resource for hawaiian history and land use

Articles | Information | Samples | Gallery | About Us | Contact Us

Mahele Database | Boundary Commission | Land Grants | Royal Patents | Review Cart & Checkout

DOCUMENT DELIVERY Change password Log out

Mahele Database Documents

Number: 01712C

Claim Number:	**01712C**
Claimant:	**Nuuanu**
Other claimant:	
Other name:	
Island:	**Oahu**
District:	**Ewa**
Ahupuaa:	**Waikele**
Ili:	**Kapuna, Keahupuaa–**

Apana:	**2**	Awarded:	**1**
Loi:	**4**	FR:	
Plus:		NR:	
Mala Taro:		FT:	**127v9**
Kula:		NT:	**274v9**
House lot:	**1**	RP:	**853**
Kihapai/Pakanu:		Number of Royal Patents:	**1**
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**No**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**
Sugar Cane:		Pali:	**No**

Tobacco:		Disease:	No
Koa/Kou Trees:		Claimant Died:	No
Other Plants:		Other Trees:	
Other Mammals:	No	Miscellaneous:	

Cl. 1712C, Nuuanu, claimant
F.T. 127-128v9]

Claimant appeared and made oath that his claim was made out by Kaopanio & as he supposes was duly presented by the same he is therefore admitted to a hearing.

Ohule, sworn says, the land of claimant is a moo aina called Kalai in the ili of Keahupuaa, Waikele, Ewa, Oahu. Apana 1 contains 4 lois & 2d apana contains a pahale in the kula of Auiole.

Apana 1 is bounded:
Mauka by the ili Waikele
Honolulu by Nio
Makai by moo Kauhaikui
Waianae by ili Kahakuohia.

Apana 2 is bounded: on all sides by the kula of Auiole, except Makai is the sea shore.

Claimant received the land from Makue in the time of Kaahumanu & has held it in quiet ever since.

Heulu, sworn, confirms the above testimony as correct & says it is his own.

N.T. 274-275v9
No. 1712C, Nuuanu (court action)

Claimant, sworn, Kuaipanio wrote this claim and has probably sent it to Honolulu.

Ohule, sworn, he has seen his land Kalai, a moo land in the ili of the ahupuaa of Waikele, Ewa, Oahu - 4 patches in 1 section. Section 2 is a garden in the pasture, of Aniole on the Makai by side of Kapuna.

Section 1:
Mauka by Waikele, a "ku" ili
Honolulu by Nio a "ku" ili
Makai by Kauhaikui moo land
Waianae by Kahakuohia ili.

Section 2 - A garden.
Makai by of Kapuna in the pasture of Aniole, this pasture is surrounded by a fence except for the Makai by side.

Nuuanu's land from Makue at the time of Kaahumanu I. No one objected to him.

Heulu, sworn, he has known in the same way as Ohule.

[Award 1712C; R.P. 853; Kapuna Waikele Ewa;; 1 ap.; .518 Ac.]

Number: 10512*O

Claim Number: **10512*O**

Claimant:	**Nahuina**
Other claimant:	
Other name:	
Island:	**Oahu**
District:	**Ewa**
Ahupuaa:	**Waipio**
Ili:	**Kauaka**

Apana:	**1**	Awarded:	**1**
Loi:	**3**	FR:	
Plus:		NR:	**561v4**
Mala Taro:		FT:	**121v9**
Kula:		NT:	**289v9, 193v10**
House lot:		RP:	**7528**
Kihapai/Pakanu:		Number of Royal Patents:	**1**
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**No**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**
Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**
Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:	1	Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**bounded by Akaakai (bulrushes)**

No. 10512*O, Nahuina
N.R. 561v4

Kauaka `ili, Waipio, Ewa, Oahu. Kindly award the claim.
NAHUINA

F.T. 121v9
No. 10512, Nahuina, claimant (7262 Index)

Naone, sworn, says the land of claimant is a moo aina called Kauaka in the ili Kauaka, Waipio, Ewa, Oahu. Contains 3 lois in one piece,

And is bounded:

Mauka by the koele Keoki
Honolulu by ili of Ulu
Mauka by Waikele
Waianae by Akaakai.

Claimed his land from the King in 1847, when his people's land was apportioned out to them by His Majesty.

Ehu, sworn, says his testimony corresponds with that of Naone.

N.T. 268v9
No. 10512, Nahuina (court action)

Naone, sworn, he has seen his land Kanaka, a moo land in the ili of Kanaka in Waipio, Ewa, Oahu - 3 patches in 1 section.

Mauka by Keoki, big koele
Honolulu by Ulu, an ili
Makai by Waikele
Waianae by Sea onions.

Land from King Kamehameah III, in 1847. No one objected to Nahuina.

Ehu, sworn, he has known in the same way as Naone.

N.T. 193v10
No. 10512, Nahuina, 4 February 1843

COPY
Nahuina's land in the Mahele Book.
Kanaka ili of Waipio, Ewa, Oahu.
1 Keaa 2 ahupuaa, Koolau, Maui.
TRUE COPY
A.G. Thruston, Secretary K.K.
Department of Interior, 4 February 1853

[Award 10512; (Oahu) R.P. 7528; Kauaka Waipio Ewa; 1 ap.; 3.64 Acs; See also 7262; (Maui) R.P. 2356 & 4488; Keaa Koolau; 1 ap.; 140 Acs]

Number: 07260*O

Claim Number:	**07260*O**
Claimant:	**Namakeha, B**
Other claimant:	
Other name:	
Island:	**Oahu**
District:	**Kona, Ewa**
Ahupuaa:	**Honolulu, Waikele**
Ili:	**Kaalaaluna, Kaolipea**

Apana:	**6**	Awarded:	**1**
Loi:	**0**	FR:	

Plus:		NR:	**311v5**
Mala Taro:	0	FT:	**88v16**
Kula:	0	NT:	**169v10**
House lot:	**0**	RP:	**4370, 4371, 4372, 4398**
Kihapai/Pakanu:	0	Number of Royal Patents:	**4**
Salt lands:	0	Koele/Poalima:	**No**
Wauke:	**0**	Loko:	**No**
Olona:	0	Lokoia:	**No**
Noni:	**0**	Fishing Rights:	**No**
Hala:	0	Sea/Shore/Dunes:	**No**
Sweet Potatoes:	0	Auwai/Ditch:	**No**
Irish Potatoes:	0	Other Edifice:	**No**
Bananas:	**0**	Spring/Well:	**No**
Breadfruit:	**0**	Pigpen:	**No**
Coconut:	0	Road/Path:	**No**
Coffee:	0	Burial/Graveyard:	**No**
Oranges:	0	Wall/Fence:	**No**
Bitter Melon/Gourd:	0	Stream/Muliwai/River:	**No**
Sugar Cane:	0	Pali:	**No**
Tobacco:	0	Disease:	**No**
Koa/Kou Trees:	0	Claimant Died:	**No**
Other Plants:	0	Other Trees:	0
Other Mammals:	**No**	Miscellaneous:	

No. 7260*O, B. Namakeha
N.R. 311/v5

Greetings to the Land Commissioners: I hereby state my claims for land at Waikele, Ewa, and at Kaalaa luna in Honolulu. Those are my claims for my two lands from the Mo`i. I have a little claim at Lahaina, on Maui, one small lo`i at Waianae.
NAMAKAEHA
February 11, 1848

F.T. 86v16
No. 7260, B. Namakeha, 23 June 1854

P. Nahaolelua, sworn, says he knows the kalo patch of claimant in Waianae, Lahaina.

It is bounded as follows:
Mauka by Kahikona's lot
Olowalu by Haalelea's land
Makai by King's land
Kaanapali by Foot path.

Claimant has held this patch since the year 1845, without dispute (Namakeha says he received this patch from Asa Kaeo.)

N.T. 169v10

No. 7260, Namakeha, B.

Copy, B. Namakeha's land in the Mahele Book.
Kaalaa, ili of Honolulu, Kona, Oahu.
Waikele, ili of Waikele, Ewa, Oahu.
Department of Interior
29 October 1852
True Copy, A.G. Thruston, Secretary K.K.

[Award 7260; R.P. 4371; Kaalaaluna Honolulu Kona; 1 ap.; 17.28 Acs; R.P. 4372; Kaolipea Waikele Ewa; 1 ap.; 252.18 Acs; R.P. 4370; Waikele Ewa; 4 ap.; 39.13 Acs; R.P. 4398; Waianae-uka; 1 ap.; 1 rood 4 rods; R.P. 4373; Waianae Lahaina(cancelled)]

Appendix C Radiocarbon Dating Analysis

BETA ANALYTIC INC.
DR. M.A. TAMERS and MR. D.G. HOOD
4985 S.W. 74 COURT
MIAMI, FLORIDA, USA 33155
PH: 305-667-5167 FAX:305-663-0964
beta@radiocarbon.com

REPORT OF RADIOCARBON DATING ANALYSES

Dr. Hallett H. Hammatt/Jon Tulchin — Report Date: 11/16/2009

Cultural Surveys Hawaii — Material Received: 10/23/2009

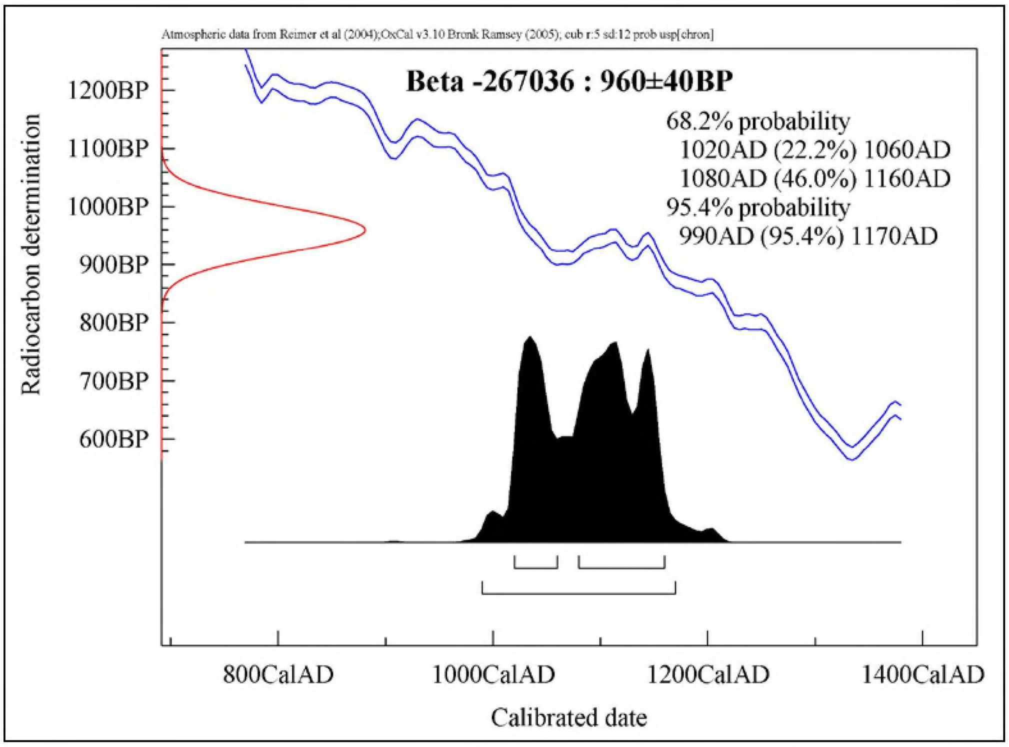
Sample Data	Measured Radiocarbon Age	13C/12C Ratio	Conventional Radiocarbon Age(*)
Beta - 267036	930 +/- 40 BP	-22.9 o/oo	960 +/- 40 BP
Beta - 267037	930 +/- 40 BP	-23.6 o/oo	950 +/- 40 BP

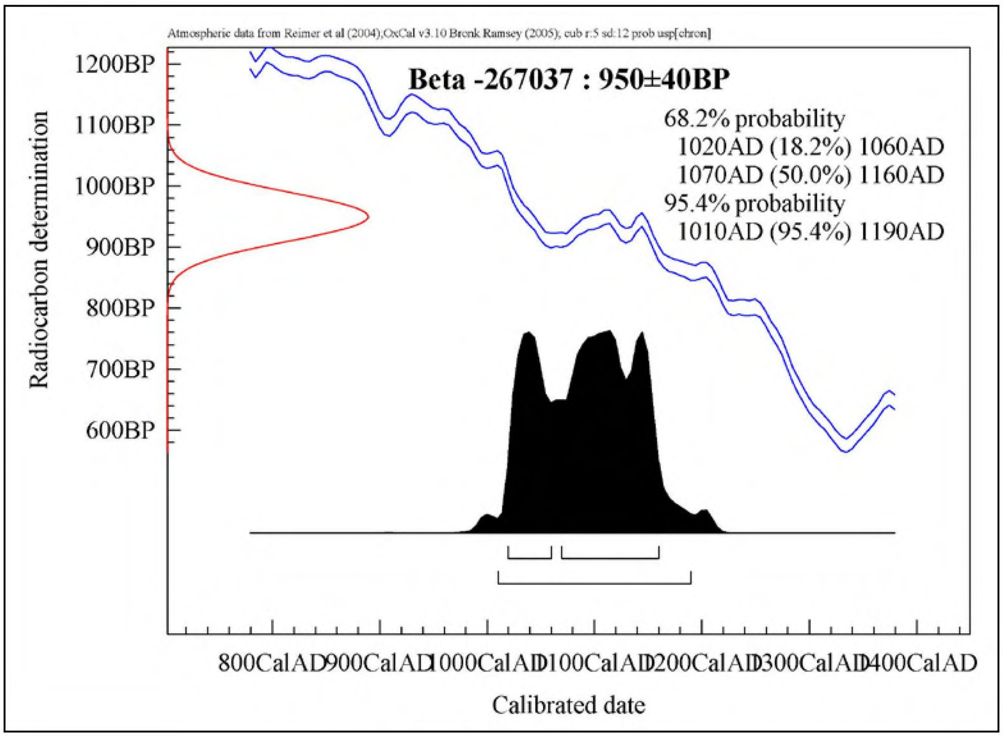
Beta - 267036
SAMPLE : WAIPAHUKAI01
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal AD 1010 to 1170 (Cal BP 940 to 780)

Beta - 267037
SAMPLE : WAIPAHUKAI02
ANALYSIS : AMS-Standard delivery
MATERIAL/PRETREATMENT : (organic sediment): acid washes
2 SIGMA CALIBRATION : Cal AD 1010 to 1170 (Cal BP 940 to 780)

Dates are reported as RCYBP (radiocarbon years before present, "present" = AD 1950). By international convention, the modern reference standard was 95% the 14C activity of the National Institute of Standards and Technology (NIST) Oxalic Acid (SRM 4990C) and calculated using the Libby 14C half-life (5568 years). Quoted errors represent 1 relative standard deviation statistics (68% probability) counting errors based on the combined measurements of the sample, background, and modern reference standards. Measured 13C/12C ratios (delta 13C) were calculated relative to the PDB-1 standard.

The Conventional Radiocarbon Age represents the Measured Radiocarbon Age corrected for isotopic fractionation, calculated using the delta 13C. On rare occasion where the Conventional Radiocarbon Age was calculated using an assumed delta 13C, the ratio and the Conventional Radiocarbon Age will be followed by "*". The Conventional Radiocarbon Age is not calendar calibrated. When available, the Calendar Calibrated result is calculated from the Conventional Radiocarbon Age and is listed as the "Two Sigma Calibrated Result" for each sample.





OxCal Calibration Results