

Draft

**Supplemental Archaeological Inventory Survey for
Section 2 of the
Honolulu High-Capacity Transit Corridor Project,
Proposed Pearlridge Station,
Waimalu Ahupua‘a, ‘Ewa District, Island of O‘ahu
TMK: (1) 9-8-009:017 and (1) 9-8-010:002**

**Prepared for
The City and County of Honolulu
and
The Federal Transit Administration**

**On Behalf of
PB Americas, Inc.**

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July 2013

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Section 1 Management Summary

Reference	Supplemental Archaeological Inventory Survey for Section 2 of the Honolulu High-Capacity Transit Corridor Project, Proposed Pearlridge Station, Waimalu Ahupua'a, 'Ewa District, Island of O'ahu TMK: (1) 9-8-009:017 and (1) 9-8-010:002 (Sroat et al. 2013)
Date	July 2013
Project Number (s)	Cultural Surveys Hawai'i, Inc. (CSH) Job Code: WAIMALU 2
Investigation Permit Number	The fieldwork component of the supplemental archaeological inventory survey (AIS) investigation was carried out under archaeological permit number 12-04 issued by the Hawai'i State Historic Preservation Division/Department of Land and Natural Resources (SHPD), per Hawai'i Administrative Rules (HAR) Chapter 13-282.
Project Location and Study Area	The proposed Honolulu High-Capacity Transit Corridor Project (HHCTCP) extends approximately 23 miles (37.0 km) from Kapolei in the west to Ala Moana Shopping Center in the east. The AIS study area for Section 2 of the HHCTCP extended east from the Pearl Highlands Station in Pearl City to the Aloha Stadium Station and included the western portion of the HHCTCP Section 3, which extends further east for approximately 0.2 miles, from the Aloha Stadium Station to Kalaloa Street in Hālawā (Figure 6). This supplemental AIS investigation focuses on an approximately 0.2-acre (809.3 sq. m) portion of the Pearlridge Station (PRS), within the central area of HHCTCP Section 2. The AIS study area is depicted on the U.S. Geological Survey 7.5-minute topographic map, Waipahu (1998) and Pearl Harbor (1999) Quadrangles.
Land Jurisdiction	The supplemental AIS study area (Pearlridge Station within central part of Section 2) is primarily located within the existing or planned expansions of the Kamehameha Highway right-of-way, which is owned by the State of Hawai'i. The Pearlridge Station <i>mauka</i> portion is located on a parcel owned by the City and County of Honolulu (City), recently transferred from 50 th State Properties. The Pearlridge Station <i>makai</i> portion is located on a parcel owned by the City, recently transferred from Continental Investment Company.
Agencies	City, SHPD, and the Federal Transit Administration (FTA)
Funding	FTA, City

Project Description and Related Ground Disturbance	The HHCTCP will provide high-capacity rapid transit in the highly congested east-west transportation corridor between Kapolei and the Ala Moana Shopping Center via a fixed guideway rail transit system. The project will require construction of transit stations and support facilities (vehicle maintenance and storage facility and park-and-ride lots), and relocation of existing utility lines within the project corridor. Minimally, land-disturbing activities would include grading of facility locations and excavations for guideway column foundations, subsurface utility relocation and installation, and facility construction. This supplemental AIS focuses on testing within the <i>mauka</i> and <i>makai</i> footprints of the Pearlridge Station.
Project Acreage	The Pearlridge Station consists of 0.2 acres (809.3 sq. m), which includes the <i>mauka</i> and <i>makai</i> portions of the overall station footprint.
Area of Potential Effect (APE) and Survey Acreage	The HHCTCP area of potential effect for archaeological cultural resources is defined in the HHCTCP final Programmatic Agreement (Stipulation II.A.1.) as all areas of direct ground disturbance. For this supplemental AIS of the Pearlridge Station area, project engineers estimate that the project's area of direct ground disturbance is approximately 0.2 acres. This 0.2 acre area is the survey area for this supplemental AIS investigation.
Historic Preservation Regulatory Context	<p>Because FTA funding is involved, this project is a federal undertaking, which necessitates compliance with Section 106 of the National Historic Preservation Act, the National Environmental Policy Act, and Section 4(f) of the Department of Transportation Act. Through the Section 106 historic preservation review process, the project's lead federal agency, the FTA, has determined that the project will have an adverse effect on historic properties currently listed, or eligible for listing, on the National Register of Historic Places. The Hawai'i State Historic Preservation Officer (SHPO) concurred with this undertaking effect determination. To address the undertaking's adverse effect, a Programmatic Agreement (PA) was executed on January 18, 2011, with the FTA, the Hawai'i SHPO, the United States Navy, and the Advisory Council on Historic Preservation as signatories. PA Stipulation III requires that an archaeological inventory survey plan (AISP) be prepared and reviewed and approved by the SHPD for each of the four HHCTCP Sections. CSH prepared the AISP for Section 2 (Hammatt 2010b), which was reviewed and approved by SHPD in a letter dated May 7, 2010 (Log No. 2010.1748, Doc. No. 1005NM14). The AISP defined the scope of work and detailed the proposed methods of the AIS, in accordance with the requirements for an AISP stated in HAR Chapter 13-275-5(c).</p> <p>The AIS for Section 1 of the HHCTCP (extending east from the East Kapolei Station to the Pearl Highlands Station), was completed by CSH in February 2010. The AIS of Section 1 also included the western</p>

	<p>portion of Section 2, from the Pearl Highlands Station extending east to Waimano Home Road in Pearl City. The <i>Archaeological Inventory Survey of Construction Phase I for 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</i> (Hammatt 2010a) was reviewed and accepted by SHPD in a letter dated April 19, 2010 (Log No. 2010.1749, Doc. No. 1004MV01).</p> <p>In addition, identification and National/Hawai‘i Register eligibility recommendations for the project area’s architectural cultural resources, including historic roads, bridges, buildings, 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).</p> <p>This supplemental AIS report was prepared in compliance with the Secretary of the Interior’s Standards and Guidelines for Archaeology and Historic Preservation and is intended to support the project’s PA and Section 106 compliance. This document was also prepared to support the proposed project’s historic preservation review under Hawai‘i Revised Statutes (HRS) Chapter 6E-8 and HAR Chapter 13-275.</p>
<p>Document Purpose</p>	<p>This archaeological study was conducted to provide supplemental archaeological testing for the Pearlridge Station. During fieldwork for the HHCTCP Section 2 AIS, the Pearlridge Station could not be fully tested due to land owner restrictions. This supplemental AIS, conducted in consultation with SHPD, was implemented to provide better coverage of the Pearlridge Station by adding three additional test excavations (PRS-4, PRS-5, PRS-6). The additional excavations were conducted to provide more information on the subsurface nature of project area, and to identify and document archaeological cultural resources and make eligibility recommendations for the National Register of Historic Places (National Register) and the Hawai‘i Register of Historic Places (Hawai‘i Register)¹. In consultation with 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 identified archaeological cultural resources recommended as National/Hawai‘i Register eligible. This document is intended to support project-related historic preservation consultation with multiple stakeholders, including federal and state agencies, interested Native Hawaiian groups and individuals, and community groups.</p>

Fieldwork Effort	The supplemental AIS fieldwork was carried out by: Kelly Burke, M.Sc.; Brittany Enanoria, B.A.; Nifae Hunkin, B.A.; Frederick LaChance, B.A.; Kimi Matsushima, B.S.; and Tyler Turran, B.A.; under the direction of Matt McDermott, M.A. (principal investigator). Fieldwork was conducted on September 12, 2012 and September 25, 2012 and required approximately ten person-days to complete.
Cultural Resources/Historic Properties² Identified and Recommended Eligibility to the National/Hawai'i Registers³	SIHP # 50-80-09-7150, a subsurface cultural deposit (<i>lo'i</i> sediments) was identified during the Section 2 HHCTCP AIS; however, no cultural resources were identified during the supplemental AIS fieldwork.
Effect Recommendation	The project was determined to have an “adverse effect” on historic properties. Under Hawai'i State historic preservation review legislation, CSH's project-specific effect recommendation is “effect, with proposed mitigation commitments.” These supplemental AIS investigation results are in line with this federal effect determination, since construction for Section 2 will adversely affect any cultural resources within the project area. As with the original mitigation measures of the Section 2 AIS, the recommendation of this supplemental AIS is to reduce the project's effect on the single identified archaeological cultural resource, SIHP # 50-80-09-7150, as well as any other currently unknown cultural resources that may be encountered.
Mitigation Recommendations⁴	Based on the results of this supplemental AIS investigation, and based on findings from the original AIS, a combination of on-call and full-time on-site archaeological monitoring is recommended as an appropriate archaeological mitigation measure during the HHCTCP Section 2 project construction. Four discrete segments within Section 2 are recommended for full-time on-site monitoring, including the area of SIHP # 50-80-09-7150. The remaining segments within the Section 2 project area are recommended for on-call monitoring with weekly spot checks (Sroat et al. 2012).

¹In 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 in 36 CFR 800.16, are any prehistoric or historic districts, sites, buildings, structures, or objects included in, or eligible for inclusion in, the National Register of Historic Places maintained by the Secretary of the Interior. This includes artifacts, records, and remains that are related to and located within such properties, as well as properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria. Determinations of eligibility are generally made by a federal agency official in consultation with the SHPO. 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.

³Cultural resource significance is evaluated and expressed as eligibility for listing on the National and/or Hawai'i Register of Historic Places. 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.

⁴Under 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 (which includes archaeological monitoring); D) Historical Data Recovery; and E) Ethnographic Documentation (HAR Chapter 13-275-8).

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Section 2 Introduction

At the request of the City and County of Honolulu (City) and the Federal Transit Administration (FTA), and on behalf of PB Americas, Inc. (PB), Cultural Surveys Hawai'i (CSH) has prepared this supplemental Archaeological Inventory Survey (AIS) report for the Pearlridge Station (PRS) portion of Section 2 of the Honolulu High-Capacity Transit Corridor Project (HHCTCP). In 2011, CSH completed an AIS for Section 2 of the HHCTCP (Sroat et al. 2012). The approximately 74.8-acre Section 2 study area (which includes the westernmost portion of Section 3) consists of the approximately 4.1 mile-long transit corridor; two transit stations (approximately 1.5 acres); and one park-and-ride facility (approximately 6.8 acres). The focus of this supplemental AIS investigation is the PRS portion of the Section 2 project corridor located within Waimalu Ahupua'a, 'Ewa District, Island of O'ahu, TMK: (1) 9-8-009:017 and (1) 9-8-010:002 (Figure 1 to Figure 5). At the time of the Sroat et al. (2012) AIS study, access to the entirety of the PRS footprint was not possible.

The AIS study area for Section 2 of the HHCTCP extended east from the Pearl Highlands Station in Pearl City to the Aloha Stadium Station and included the western portion of the HHCTCP Section 3, which extends further east for approximately 0.2 miles, from the Aloha Stadium Station to Kalaloa Street in Hālawā (Figure 6). The HHCTCP Section 2 AIS study area is primarily located within the existing or planned expansions of the Kamehameha Highway right-of-way, which is owned by the State of Hawai'i. This supplemental AIS focuses on the *mauka* and *makai* portions of the PRS footprint. The PRS *mauka* portion (TMK [1] 9-8-010:002) is located on a parcel recently transferred to the City from 50th State Properties. The PRS *makai* portion (TMK [1] 9-8-009:017) is located on a parcel recently acquired by the City from Continental Investment Company.

The AIS plan for Section 2 (Hammatt 2010b) proposed a total of 27 test excavations within the project corridor, three test excavations within the Aloha Stadium Station and Park and Ride Facility, and six test excavations within the PRS. Testing proposed in the AIS plan for the PRS footprint included three excavations within the *makai* portion and three excavations within the *mauka* portion footprints.

The three proposed test excavations in the *mauka* portion of the PRS (TMK [1] 9-8-010:002, Figure 7) were not excavated during the AIS fieldwork due to the lack of permitted access from the former landowner, 50th State Properties, alternative testing was conducted within the central corridor of Kamehameha Highway in the vicinity of the station columns (Figure 7). In a letter dated May 23, 2012 (Log No. 2012.1449, Doc. No. 1205NN23; see Appendix A), the State Historic Preservation Division (SHPD) recommended a supplemental AIS study that would involve three additional test excavations for the PRS prior to the start of construction to provide more information on the area of the PRS footprint. The SHPD further stated that "The results of the supplemental archaeological inventory survey will be reported in a supplemental archaeological inventory survey addendum to this approved archaeological inventory survey report."

The transfer of ownership of the PRS *mauka* portion from 50th State Properties to the City allowed for archaeological testing in the AIS plan-proposed test locations. Additionally, from the time of the AIS, the PRS design had changed substantially. Therefore, to provide the desired

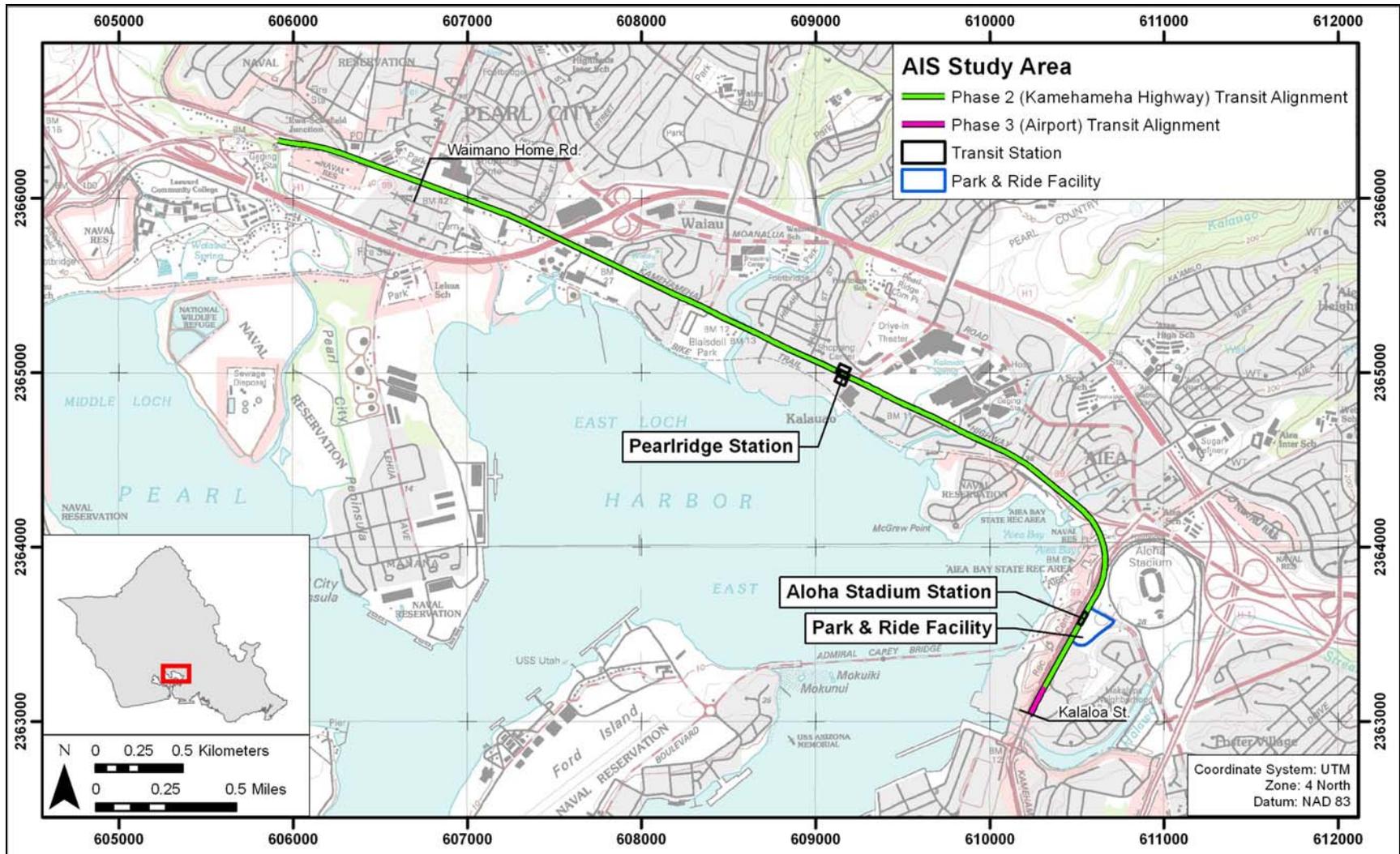


Figure 1. U.S. Geological Survey 7.5-minute topographic map, Waipahu (1998) and Pearl Harbor (1999) Quadrangles, showing the location of the Pearlridge Station within HHCTCP Section 2



Figure 2. Aerial photograph (source: 2005 U.S. Geological Survey orthoimagery) showing the location of the Pearlridge Station within HHCTCP Section 2

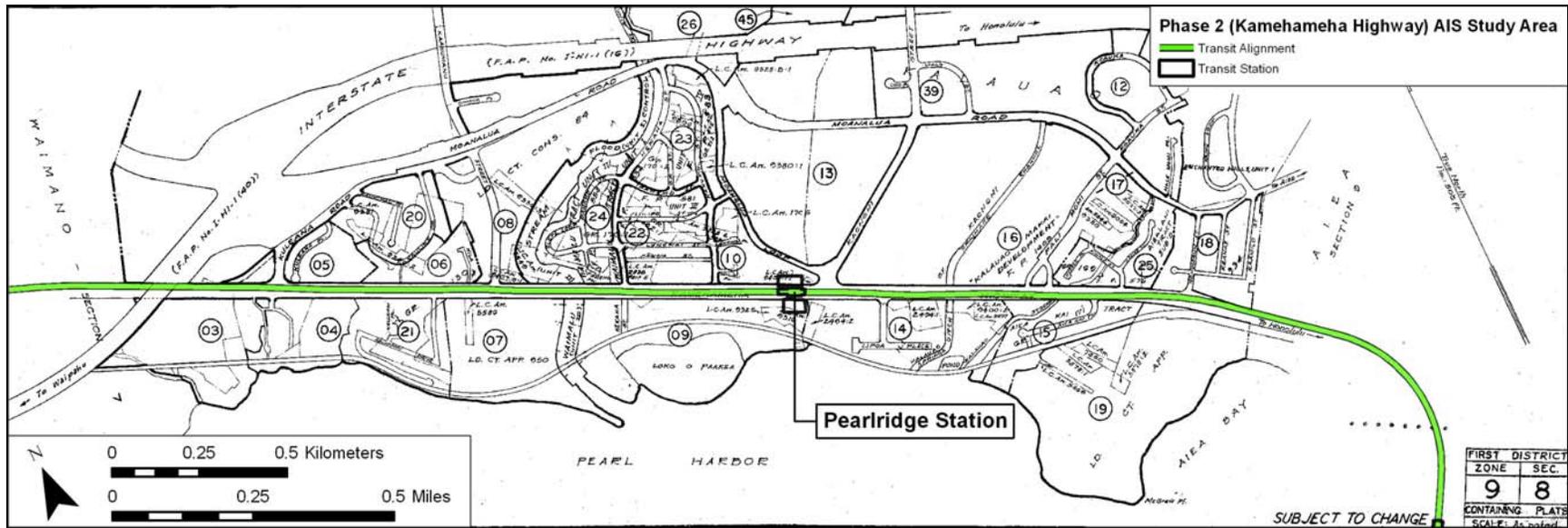


Figure 3. Tax Map Key (TMK) Section map (1) 9-8 showing the location of the Pearlridge Station within HHCTCP Section 2

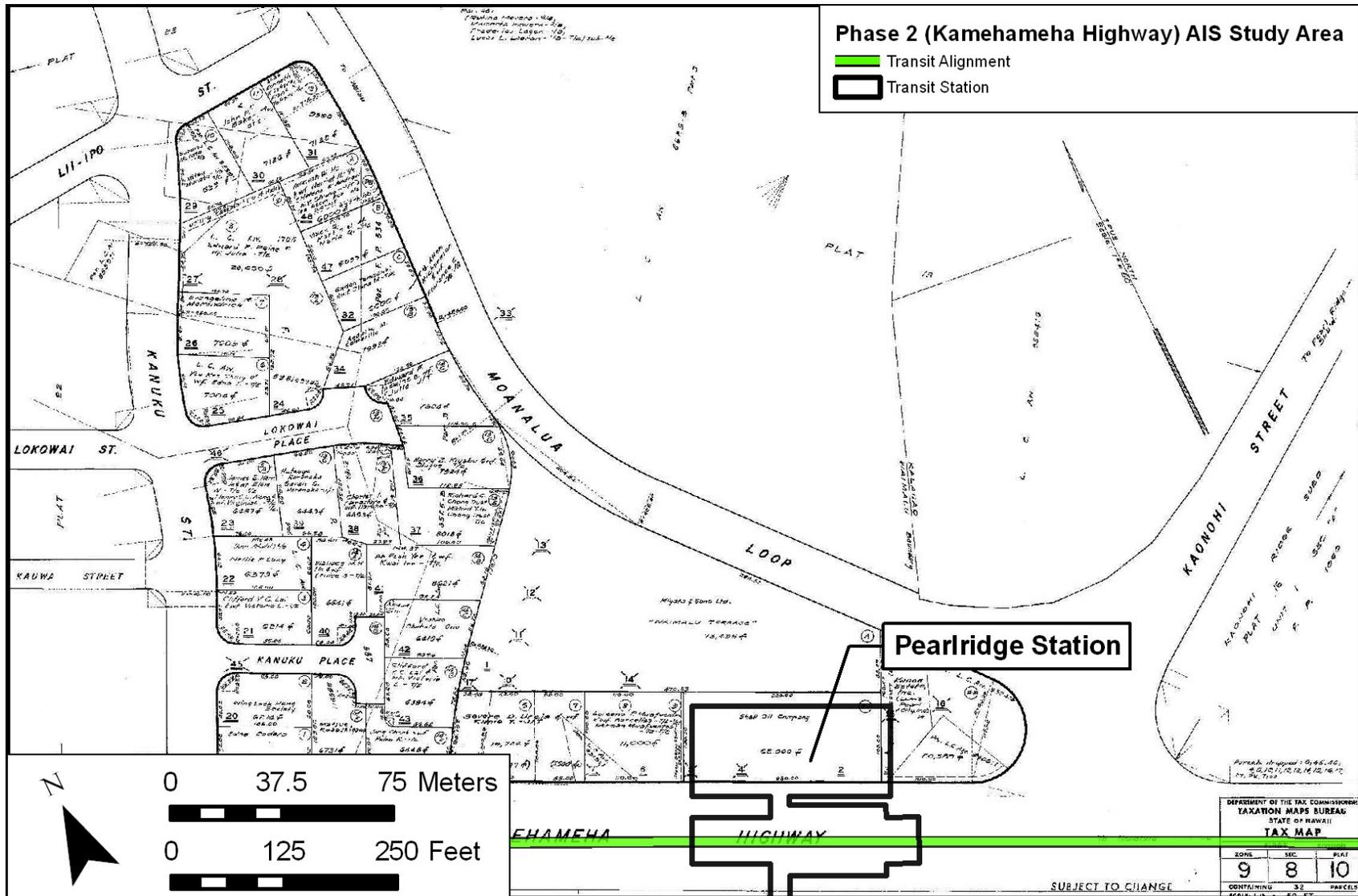


Figure 5. Tax Map Key (TMK) Plat map (1) 9-8-010, showing the mauka (northeast) portion of the Pearlridge Station within HHCTCP Section 2

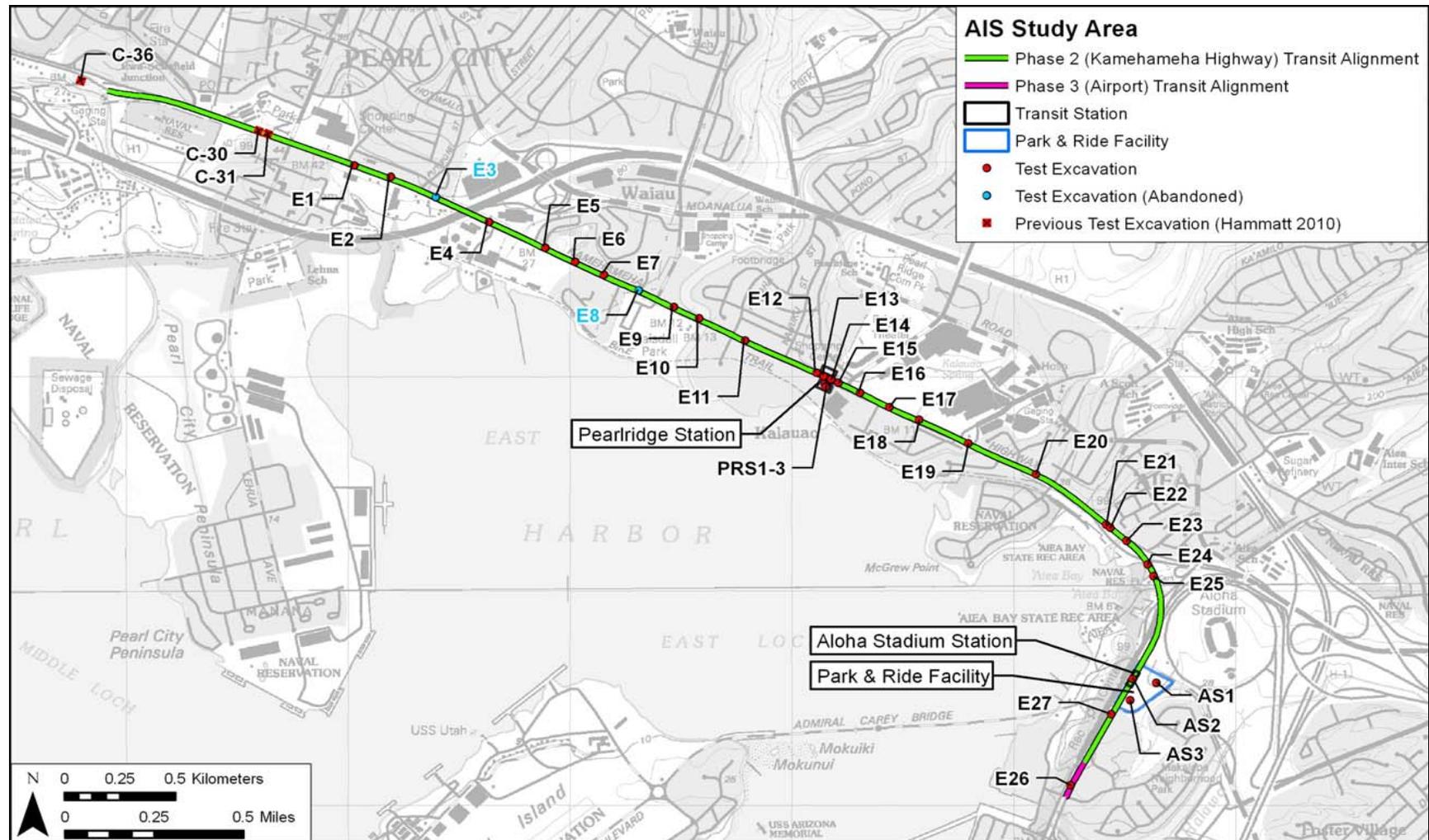


Figure 6. U.S. Geological Survey 7.5-minute topographic map, Waipahu (1998) and Pearl Harbor (1999) Quadrangles, showing HHCTCP Section 2 test excavations for the original AIS, including the PRS1-PRS3 excavations within the Pearlridge Station

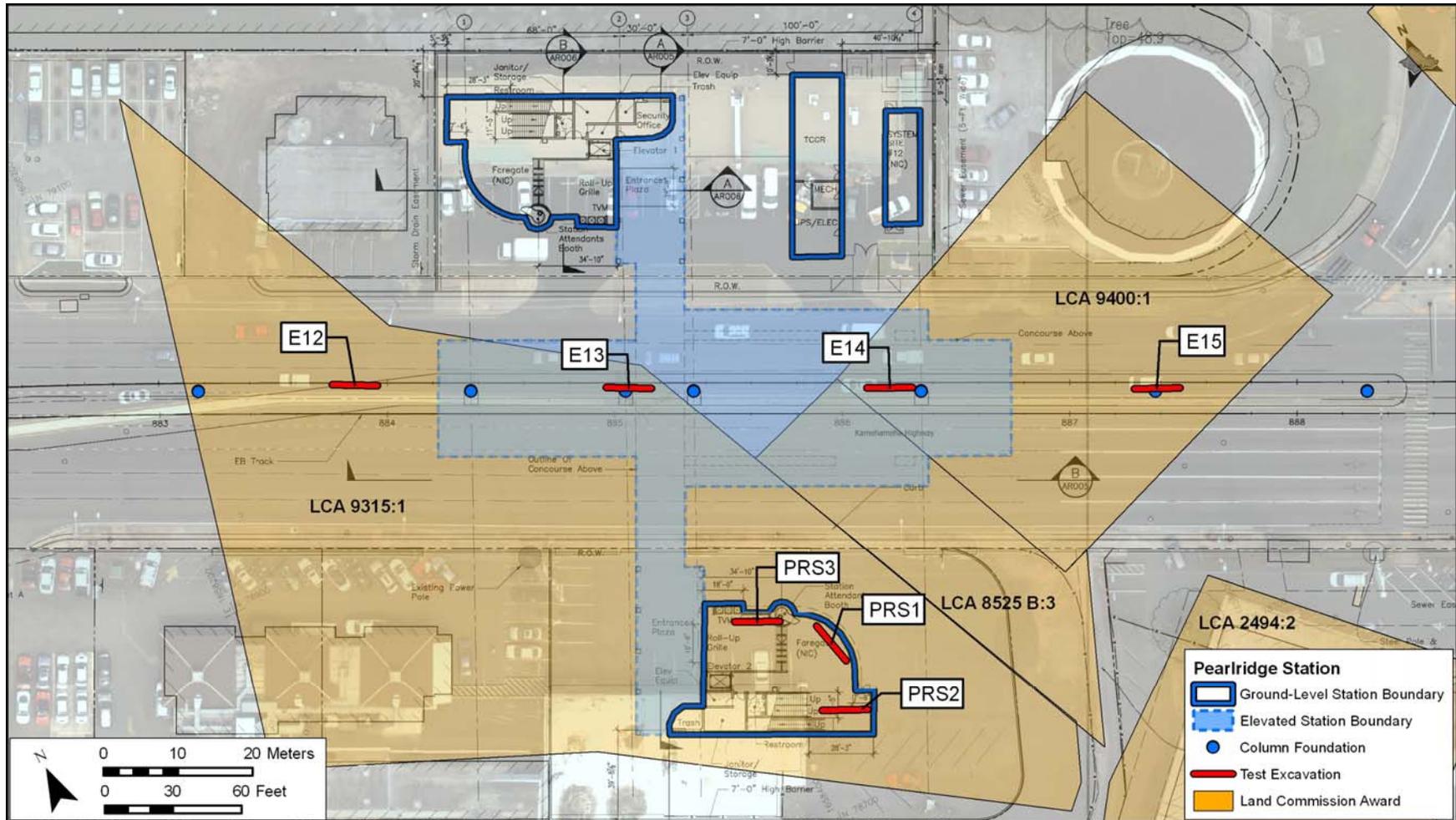


Figure 7. Aerial photograph (source: 2005 U.S. Geological Survey orthoimagery) showing a prior Pearlridge Station footprint, LCAs, and initial test excavation locations

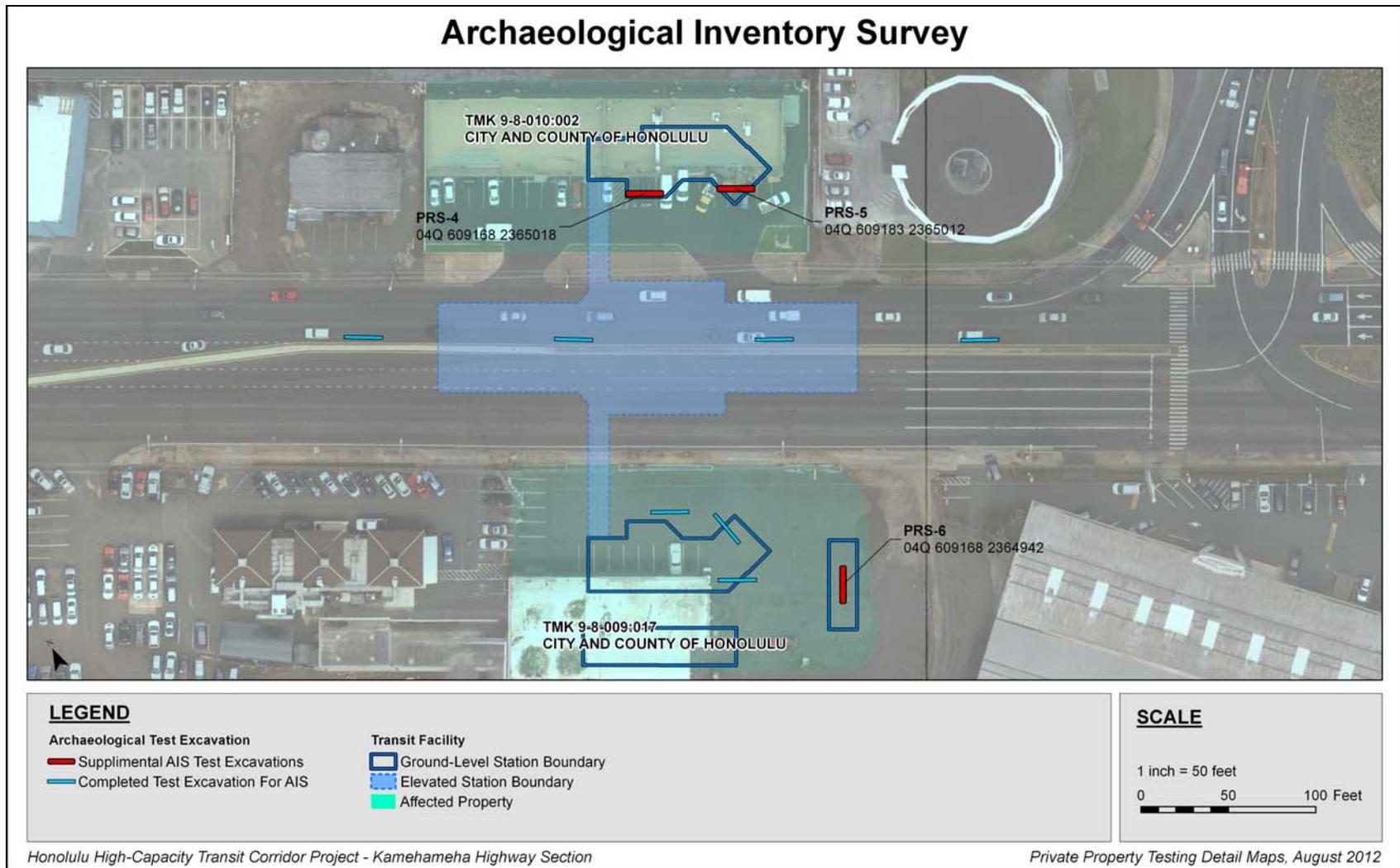


Figure 8. Aerial photograph (source: 2005 U.S. Geological Survey orthoimagery) showing the location of the original PRS test excavations conducted for the AIS (in light blue), which had been in the original PRS footprint(s), as well as the additional test excavations (PRS-4, PRS-5, and PRS-6, in red) conducted for this supplemental AIS, which are in the current PRS footprint(s)

representative coverage in the current PRS footprint, a total of three additional test excavations (PRS-4, PRS-5, and PRS-6) were conducted within the *mauka* (two units) and *makai* (one unit) portions (Figure 8). This supplemental AIS report was written in compliance with the May 23, 2012 SHPD AIS approval (Log No. 2012.1449, Doc. No. 1205NN23) of the *Archaeological Inventory Survey for Construction Phase 2 of the Honolulu High-Capacity Transit Corridor Project, Waiawa, Manana, Waimano, Waiau, Waimalu, Kalauao, Aiea and Halawa Ahupua'a, Ewa District, Island of Oahu, TMK: (1) 9-7, 9-8, 9-9 Various Plats and Parcels (Sroat, Thurman, and McDermott 2012)*. This document fulfills the requirements of the Hawai'i Administrative Rules (HAR) Chapter 13-13-276 and is submitted to SHPD as a supplemental archaeological inventory survey addendum to the approved AIS report listed above for review and acceptance. For a review of the historical background and previous archaeology for this study area, please refer to the HHCTCP Section 2 AIS (Sroat et al. 2012).

2.1 Project Background

Because FTA funding is involved, this project is a federal undertaking that necessitates compliance with Section 106 of the National Historic Preservation Act, the National Environmental Policy Act, and Section 4(f) of the Department of Transportation Act. Through the Section 106 historic preservation review process, the project's lead federal agency, the FTA, has determined that the project will have an adverse effect on historic properties currently listed, or eligible for listing, on the National Register of Historic Places. The Hawai'i State Historic Preservation Officer (SHPO) concurred with this undertaking effect determination. To address the undertaking's adverse effect, a Programmatic Agreement (PA) was executed on January 18, 2011, with the FTA, the Hawai'i SHPO, the United States Navy, and the Advisory Council on Historic Preservation as signatories. PA Stipulation III requires that an archaeological inventory survey plan (AISP) be prepared and reviewed and approved by the SHPD for each of the four HHCTCP Sections. CSH prepared the AISP for Section 2 (Hammatt 2010b), which was reviewed and approved by SHPD in a letter dated May 7, 2010 (Log No. 2010.1748, Doc. No. 1005NM14). The AISP defined the scope of work and detailed the proposed methods of the AIS, in accordance with the requirements for an AISP as stated in Hawai'i Administrative Rules (HAR) Chapter 13-275-5(c).

In 2011, CSH completed an AIS for the HHCTCP Section 2 (Sroat et al. 2012). The three proposed test excavations in the *mauka* portion of the PRS (TMK [1] 9-8-010:002, Figure 7) were not excavated during the AIS fieldwork due to the lack of permitted access from the former landowner, 50th State Properties. In a letter dated May 23, 2012, the SHPD recommended a supplemental AIS study for the PRS prior to the start of construction (Log No. 2012.1449, Doc. No. 1205NN23). Due to a transfer of property ownership in the PRS *mauka* portion, CSH was able to conduct additional excavations to further identify and document any archaeological cultural resources present within the Pearlridge Station footprint and to and make eligibility recommendations for the National Register of Historic Places (National Register) and the Hawai'i Register of Historic Places (Hawai'i Register).

This supplemental AIS investigation was conducted to provide the additional testing within the HHCTCP Section 2 Pearlridge Station requested by the SHPD. This supplemental AIS report was prepared in compliance with the Secretary of the Interior's Standards and Guidelines for Archaeology and Historic Preservation and is intended to support the project's PA and Section 106 compliance. This document was also prepared to support the proposed project's historic

preservation review under Hawai'i Revised Statutes (HRS) Chapter 6E-8 and HAR Chapter 13-275.

This supplemental AIS investigation was 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 below, there are important distinctions between the federal and the 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. The use of the term "cultural resources" in these instances is common practice in cultural resource management and is in keeping with the historic preservation requirements/definitions of both 36 CFR 800 and HAR Chapter 13-275.

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 in 36 CFR 800.16, are any prehistoric or historic districts, sites, buildings, structures, or objects included in, or eligible for inclusion in, the National Register of Historic Places, maintained by the Secretary of the Interior. This includes artifacts, records, and remains that are related to and located within such properties, as well as properties of traditional religious and cultural importance to an Indian tribe or Native Hawaiian organization and that meet the National Register criteria. Determinations of eligibility are generally made by a federal agency official in consultation with the SHPO. 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, a historic property is defined as any cultural resource that is at least 50 years old, regardless of its significance under state law. 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). A site is deemed eligible for the Hawai'i Register 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.

The investigation includes an undertaking-specific effect recommendation and treatment/mitigation recommendations for the cultural resources recommended as eligible for the National/Hawai'i Register. This document is intended to support project-related historic preservation consultation among stakeholders, including federal and state agencies, interested Native Hawaiian groups and individuals, and community groups.

2.2 Environmental Setting

2.2.1 Natural Environment

The HHCTCP Section 2 corridor is situated in the low-lying coastal flats immediately inland of the East Loch of Pearl Harbor, generally within a quarter-mile of the shoreline. The study area traverses Waiau Stream, Waimalu Stream, Kalauao Stream, and 'Aiea Stream, as well as wetland areas fed by Waiau Spring and Kalauao Spring. Elevations in the study area range from approximately 10 to 45 feet above mean sea level. The study area receives an average of about 30 inches of annual rainfall (Giambelluca et al. 1986). As the study area traverses a predominantly urban landscape, vegetation in the study area and immediate vicinity consists primarily of introduced landscaping trees, shrubs, and ground cover plants. The PRS portion of project area is bound by Waimalu Stream to the west and Kalauao Stream to the east.

According to the U.S. Department of Agriculture soil survey data (Figure 9), sediment types in the study area include: Hanalei Silty Clay (HnB); Helemano Silty Clay (HLMG); Honouliuli Clay (HxA); Kawaihapai Clay Loam (KIA); Keaau Clay (KmbA); Makalapa Clay (MdB); Molokai Silty Clay Loam (MuB, MuC); Pearl Harbor Clay (Ph); Rock Land (rRK); Tropaeuqpts (TR); and Waipahu Silty Clay (WzA, WzB, WzC). The PRS area is dominated by the Honouliuli Series.

Soils of Honouliuli Series are described as follows:

This series consists of well-drained soils on coastal plains on the island of Oahu 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 sugarcane, truck crops, orchards, and pasture. The natural vegetation consists of kiawe, koa haole, fingergrass, bristly foxtail, and bermudagrass. (Foote et al. 1972:43)

2.2.2 Built Environment

The study area traverses a predominantly urban environment, through the towns of Pearl City, Waimalu, 'Aiea, and Hālawā. The centerline of the HHCTCP alignment is generally located within the median or shoulder of Kamehameha Highway. The study area also crosses the H-1 Interstate Highway. Parcels bordering the highway include a mix of commercial, industrial, and residential developments. Large developments in the vicinity of the study area include: the Hawaiian Electric Company's (HECO) Waiau Power Plant; the Pearlridge Center shopping mall; and Aloha Stadium (refer to Figure 2).

2.3 Study Area Acreage and Area of Potential Effect

Section 2 of the HHCTCP study area consists a 4.1-mile segment. This supplemental AIS focuses on the footprint of the Pearlridge Station. The PRS *mauka* and *makai* portions of the footprint cover approximately 0.2 acre (809.3 sq. m). The surrounding landscape is dominated by

an urban setting (paved roads, shopping centers and residences). During subsurface testing for the AIS, a single cultural resource (subsurface agricultural sediment, SIHP # 50-80-09-7150) was encountered more than 500.0 m west of the PRS footprint.

2.4 Overview of Proposed Construction

The design, method of construction, and timeline of the project continue to be refined. This overview of proposed project construction is a synopsis of the information provided in the Construction Approach of the HHCTCP Environmental Impact Statement (EIS) (USDOT/FTA and C&C/DTS 2008).

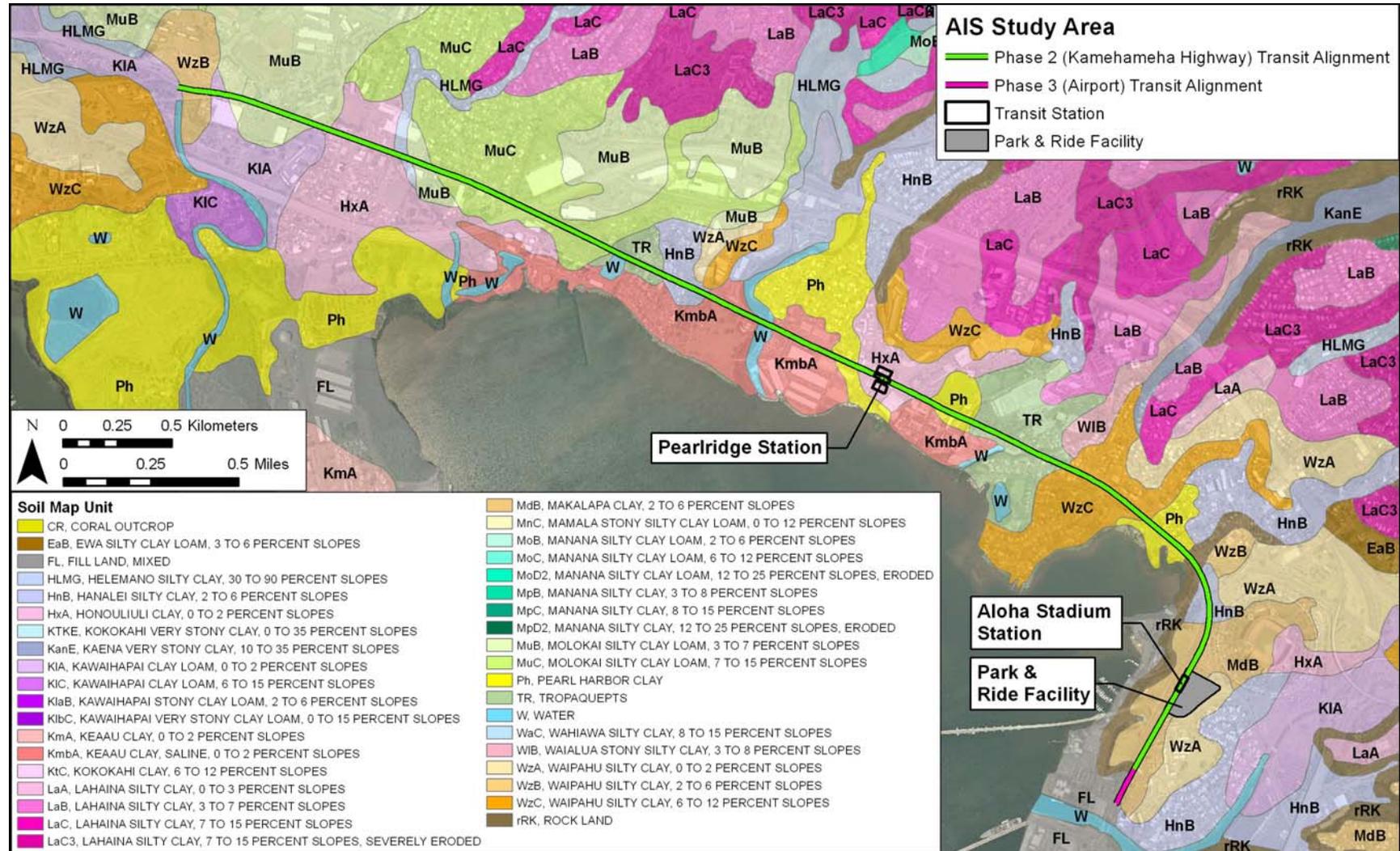


Figure 9. Aerial photograph (source: 2005 U.S. Geological Survey orthoimagery) with overlay of data from the *Soil Survey of Hawai'i* (Foote et al. 1972), showing sediment types in the vicinity of the project area

2.4.1 Fixed Guideway and Transit Stations

The HHCTCP involves construction of a fixed guideway rail transit system that will 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 column is a 6- to 10-ft diameter column spaced, on average, about every 120 ft, with shorter or longer spans used where needed. Transit stations are usually 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 will 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-ft diameter auger to depths of 50 to 150 feet, installing a rebar cage in the shaft, then filling the shaft with concrete. Driven-pile foundations will be constructed where lateral loads, geotechnical issues, or other site conditions prohibit the use of drilled shafts. Construction of driven-pile foundations involves excavating 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, then forming and casting the pile cap with concrete.

2.4.2 Support Facilities

Ancillary 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 or relocation, and landscaping.

2.4.3 Ancillary Impacts

Project construction will require relocation of existing utility lines within the project corridor if they conflict with the proposed project design. Guideway foundation excavations will extend below the water table, creating a significant need for the management of displaced water and/or drilling slurry. De-watering pits might be excavated to temporarily collect and treat wastewater and drilling slurry prior to reuse or disposal.

Construction staging areas will be needed to provide adequate space for construction equipment and materials, parking, and other construction-related items and activities. The proposed ancillary maintenance and storage facilities and transit stations have been identified as potential staging areas. Grading of the construction staging areas might be necessary.

2.5 Scope of Work

In consultation with the project's cultural descendants, the OIBC, the SHPD, and the project proponents, a scope of work for this supplemental inventory survey was developed. Following HAR Chapter 13-276 and Chapter 13-284, the scope of work for the supplemental AIS consists of several components:

- 1) Based on the project's AIS plan and the results of background research, subsurface testing will involve a combination of hand and backhoe excavation to identify and document subsurface historic properties. Appropriate samples from these excavations will be analyzed for cultural and datable materials. All subsurface historic properties identified will be documented to the extent possible, including geographic extent, content, function/derivation, age, interrelationships, and significance.
- 2) As appropriate, consultation with knowledgeable individuals will be conducted regarding the project area's history, past land use, and the function and age of the historic properties documented within the project area.
- 3) As appropriate, samples will be processed in the lab to gather relevant environmental and/or archaeological information.
- 4) Supplemental AIS investigations will be conducted, and the report shall include 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 historic properties;
 - c) Descriptions of all historic properties, possibly including selected photographs, scale drawings, and discussions of age, function, laboratory results, and significance, per the requirements of HAR 13-276. Each historic property will be assigned a Hawai'i State Inventory of Historic Properties number. Each test excavation will be documented with a scale profile, photographs, and sediment descriptions. Documentation of observed archaeological cultural resources will include profiles, plan views when appropriate, sample collection and analysis, written descriptions, photographs, and artifact analysis;
 - d) If appropriate, a section concerning cultural consultations (per the requirements of HAR 13-276-5[g] and HAR 13-275/284-8[a][2]);
 - e) A summary of historic property categories, integrity, and significance based on Hawai'i Register of Historic Places criteria;
 - f) A project effect recommendation;
 - g) Treatment recommendations to mitigate the project's adverse effect on any historic properties identified in the project area that are recommended as eligible to the Hawai'i Register of Historic Places.

Section 3 Methods

3.1 Field Methods

The fieldwork component of the supplemental AIS investigation was carried out under archaeological permit numbers 10-10 and 11-17, issued by SHPD, per Hawai'i Administrative Rules Chapter 13-282. The supplemental AIS fieldwork was carried out by Kelly Burke, M.Sc.; Brittany Enanoria, B.A.; Nifae Hunkin, B.A.; Frederick LaChance, B.A.; Kimi Matsushima, B.S.; and Tyler Turran, B.A. under the direction of Matt McDermott, M.A. (principal investigator). Fieldwork was conducted on September 12, 2012 and September 25, 2012 and required approximately ten person-days to complete.

3.1.1 Ground Penetrating Radar Survey

The ground penetrating radar (GPR) survey was performed in the PRS area at the test excavation locations prior to excavation 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 of the individual reflection waves is recorded in nanoseconds. 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 and to aid in the location of subsurface utilities. 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. The AIS project area had been shown to traverse lands in the moderate, low, very low, and unsuitable, suitability categories.

The 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 such as 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 might be associated with stratigraphic interfaces, sediment types, and subsurface features (e.g. trash pits, construction debris, etc.).

GPR data collection parameters (see GPR Report in Appendix B) were held constant throughout the survey under the assumption that soil conditions were relatively consistent across the study area. A *dielectric constant* of 8 was used in anticipation of the presence of alluvial sediments (silts and clays) within the project area based on the U.S. Geological Survey soil data

on the area (Foote et al. 1972). The dielectric constant is 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.

The estimated depth of view was 2 m. All collected radar data were post-processed using RADAN 6.6 software. Position correction was used to remove unwanted surface “noise” from GPR profiles. Greater detail for comparison with stratigraphic excavation profiles was obtained by using horizontal stretching. In order to retain the image of recorded strata, a Horizontal High Pass Finite Impulse Response “Boxcar” (Background Removal) filter was not used.

3.1.2 Backhoe-Assisted Subsurface Testing

The backhoe-assisted subsurface testing program involved excavating three test units within the Pearlridge Station footprint. Excavation included two test units within the PRS *mauka* portion and one within the *makai* portion. Each test excavation measured approximately 0.75 m wide by 6.7 m in length. Depth of excavation ranged from between 2.65 to 2.95 mbs. Please see *Archaeological Inventory Survey Plan For Construction Phase II of the Honolulu High-Capacity Transit Corridor Project, Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, ‘Aiea, and Halawa Ahupua‘a, ‘Ewa District, Island of O‘ahu TMK: [1] 9-7, 9-8, an 9-9 (Various Plats and Parcels)* (Hammatt 2010b) for details on the excavation sampling strategy used in this supplemental AIS. The sampling strategy was developed in consideration of sediment types; natural geographic features such as streams and ponds; background research, including information from historic maps and LCA documents; previous archaeological studies in the vicinity; the results of consultation with the Native Hawaiian community; assessment of the impact of prior land development; and safety concerns for field work.

Each test excavation was documented with a scale section profile, photographs, and sediment descriptions. Sediment descriptions, using standard USDA soil description observations and terminology, include 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 are represented on the excavation profile. Feature documentation includes 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).

3.1.3 Safety Considerations

Several safety considerations were relevant to the conduct of archaeological investigations along Kamehameha Highway and in adjacent parking lots. Safety issues included sediment vibration within the excavation caused by adjacent traffic with the potential for wall collapse, the potential danger of undermining the parking lot surface, possible petroleum in the soil, and fall hazard concerns.

3.1.4 Subsurface Utility Line Complications

As one of the primary transportation passages through the Pearl Harbor area, the Kamehameha Highway corridor contains an extensive network of utility lines. A typical complex

of utilities within a section of the Kamehameha Highway corridor includes fuel, gas, cable TV, electric, fiber optic, water, and sewer lines. The number and variety of these subsurface utilities posed a significant difficulty for subsurface test excavations.

In order to locate and avoid these utilities, several methods of detection and identification were pursued, including analysis of utility maps, implementation of the one-call process, and, to a lesser extent, GPR survey. As part of the one-call process, utility companies were requested to physically inspect the previously demarcated areas of potential AIS testing and mark the location of any subsurface utility lines with spray paint. Following the one-call process, CSH conducted a GPR survey within the proposed areas of excavation. The GPR results focused on gathering archaeological data, but did provide, in some instances, some indications of potential subsurface utilities or other potential subsurface obstructions. Test excavations were then placed in the most optimal location to avoid subsurface utilities within the general test area.

3.2 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, the Hawai'i Department of Transportation, 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 'Aina Corporation's Māhele Data Base (www.waihona.com).

3.3 Laboratory Methods

Following the completion of fieldwork, the collected materials were analyzed using current standard archaeological laboratory techniques. Laboratory analysis of sediment samples collected during the supplemental AIS consisted of bulk sediment sample wet-screening, taxa identification, radiocarbon dating, and pollen analysis. The results of the analyses are presented in Section 5: Results of Laboratory Analyses.

3.3.1 Bulk Sediment Sample Wet-Screening

Samples were collected from the natural strata within the majority of test excavations, including sediments that appeared sterile as well as those that appeared potentially culturally enriched. The samples were then subjected to wet-screening through 1/16-in fine mesh in order to remove the sediment matrix and identify the obscured organic and/or cultural content. Each sample was placed into a five gallon bucket that was filled with water. The samples were then agitated by hand to break up soil peds and dissolve highly adhesive clays into solution. The resulting slurry was then poured through fine mesh and cleaned with fresh water to remove any adhering sediment. The remaining material was placed on drying trays labeled with the samples' provenience and allowed to dry fully. The material was visually inspected for the types and amounts of organic material, such as seeds or carbonized plant remains, and for the presence of any cultural material.

3.3.2 Disposition of Collections

In compliance with the project's Programmatic Agreement, Stipulation III.F "Curation," the City will curate recovered materials in accordance with applicable laws, including HAR Chapter

13-278 and 36 C.F.R. 79. The City is currently developing a curation program and seeking a curation facility that will meet these requirements. Until these curation measures are in place, all collected materials and associated records generated by the fieldwork will be temporarily curated at CSH's main O'ahu office in Waimānalo.

Section 4 Results of Fieldwork

Fieldwork for this supplemental AIS was conducted on September 12, 2012 and September 25, 2012 by CSH field crew under the direction of principal investigator, Matt McDermott, M.A. The field crew consisted of Kelly Burke, M.Sc.; Brittany Enanoria, B.A.; Nifae Hunkin, B.A.; Frederick LaChance, B.A.; Kimi Matsushima, B.S.; and Tyler Turran, B.A. Fieldwork required approximately ten person-days to complete.

Subsurface testing involved the backhoe excavation of a total of three test excavations, one within the *makai* footprint and two within the *mauka* footprint of the Pearlridge Station on Kamehameha Highway (see Figure 8).

Prior to test excavation demarcation, the excavation area was surveyed with ground penetrating radar (GPR) to aid in the location of any subsurface utilities or other subsurface anomalies and in order to determine the best location for each test excavation. Excavation locations were recorded using a Trimble ProXH GPS unit, which, with post-processing, yields sub-foot (30 cm) horizontal position accuracy. Test excavation locations were also cross-referenced to LCA maps in order to research former land ownership and use (see Appendix H).

The test excavations for the earlier AIS within the *makai* footprint of the Pearlridge Station were labeled PRS1 to PRS3. Accordingly, the test excavations conducted for this supplemental AIS were designated PRS-4, PRS-5, and PRS-6. Each test excavation measured approximately 0.75 m wide by 6.7 m in length. Depth of excavation ranged from between 2.65 to 2.95 mbs. Utilities and possible contaminated material were encountered within one test excavation (PRS-4). Natural sediments were observed at the base of excavation in all three test excavations and were observed between 1.50 to 2.0 mbs. No significant cultural resources were observed within any of the test excavations.

The following sections provide a summary of results for each of the three additional excavations within the Pearlridge Station, including observed stratigraphy.

4.1 Stratigraphic Summary

Section 2 of the HHCTCP segment project area is situated along the low-lying coastal flats immediately inland of the East Loch of Pearl Harbor, generally within a quarter-mile of the shoreline. Traversed by Waiiau Stream, Waimalu Stream, Kalauao Stream, and 'Aiea Stream, the study area is part of a broad alluvial plain with relatively little topographic relief. The USDA soil survey data confirms that this area is notable for its alluvial deposition because, with few exceptions, the soils described for the study area are derived from alluvial parent material. The few exceptions are the higher areas of the area, where remnant eroding ridges in the vicinity of the H-1 overpass and near Aloha Stadium on Kamehameha Highway are noted. In these areas, the soils are derived from igneous bedrock and volcanic cinder.

Originally, six test excavations were planned for testing within the Pearlridge Station footprint. However, due to lack of permitted access within TMK (1) 9-8-010:002, only three excavations (PRS1, PRS2, and PRS3) within the *makai* portion were completed. Also, alternative testing was conducted within the central corridor of Kamehameha Highway in the vicinity of the station columns. The alternative excavations included excavations E12, E13, and E14 from the original AIS. The observed stratigraphy at these excavations generally consisted of multiple

modern and historic fill layers overlying natural sediments. Upper fill strata were associated with either the development of Kamehameha Highway (E12, E13, and E14) or with paving and parking lot construction (PRS1, PRS2, and PRS3). Natural sediments were observed between 1.0 to 1.85 mbs, extending to the base of excavation (Sroat et al. 2012).

The stratigraphy observed within the three test excavations for this supplemental AIS was generally consistent with the stratigraphy documented for PRS1, PRS2, and PRS3. Excavation for the supplemental AIS was confined to two lots (the *mauka* and *makai* portions of the Pearlridge Station) on either side of Kamehameha Highway. All three excavations contained between four and seven layers of modern and historic fill that extended to between 1.95 to 2.10 mbs. Upper fill layers were generally associated with modern paving or parking lot construction and included asphalt, gravel base courses, and loam fills. Lower fill layers consisted of clay, and silty and sandy loams. The fill layers overlie natural, alluvial sediments that occur between 1.5 to 2.0 mbs and extend to the base of excavation. Natural sediments consisted of silty clay, sandy clay loam, silty clay loam, and clay loams.

4.1.1 Pearlridge Station Test Excavation 4 (PRS-4)

Ahupua'a:	Waimalu
LCA:	N/A
TMK #:	(1) 9-8-010:002
Elevation above Sea Level:	4.57 m
UTM:	04Q 609168 2365018
Max Length/Width/Depth:	6.7 m/0.8 m/2.65 m
Orientation:	300/120 TN
Targeted Project Component:	Additional test excavation
USDA Soil Designation:	Honouliuli clay (HxA)

Setting: Pearlridge Station Test Excavation 4 (PRS-4) was located in a paved parking lot along the northern side (*mauka* side) of Kamehameha Highway, approximately 75.0 m west of the Kaonohi Street and Kamehameha Highway intersection. No utilities were indicated in the vicinity of PRS-4. PRS-4 was located on property owned by the City and County of Honolulu. The excavation area was level with the surrounding land surface.

Summary of Background Research and Land Use: An 1873 map of the Pearl Lochs by Lyons (Figure 10) shows PRS-4 in an area dominated by agricultural land and just north of two *loko* (fishponds). Loko Paakea is shown about 255.0 m southwest of PRS-4, while Loko Opu is 130.0 m southeast. The former shoreline is shown more than 210.0 m to the south. The 1919 U.S. Army War Department Fire Control map indicates that taro and rice fields were still present among beginning urban development in the early 1900s (Figure 11). The OR&L railroad line is present 250.0 m south of PRS-4, while other developing roads and buildings are just to the north. A 1939 aerial photograph (Figure 12) shows that the surrounding landscape was still largely devoted to agricultural use at that time. By 1943, the railroad still present, and now Kamehameha Highway has been constructed (1943 U.S. Army War Department Fire Control map, Figure 13). The area remained only sparsely developed through the 1950s (1953 Army Mapping Service Topographic map, Figure 14). However, a 1977-1978 U.S. Geological Survey orthophoto (Figure 15) shows an urban landscape dominated by buildings and large warehouses, with none of the former agricultural lands present.

Documentation Procedures: PRS-4 was excavated to a maximum depth of 2.65 mbs; the water table was reached at 2.5 mbs. The central portion of PRS-4 was not excavated to avoid undermining two metal utility pipes.

Stratigraphic Summary: The stratigraphy of PRS-4 consisted of fill material overlying natural sediment. Observed strata included asphalt (Stratum Ia), very gravelly loam (Stratum Ib), sandy loam (Strata Ic-Id), and natural clay loam (Stratum II). Stratum II generally conformed to the USDA soil survey designation of Honouliuli clay (HxA). In the portion of the excavation where utilities were present, there is an extra later of fill (Stratum Id).

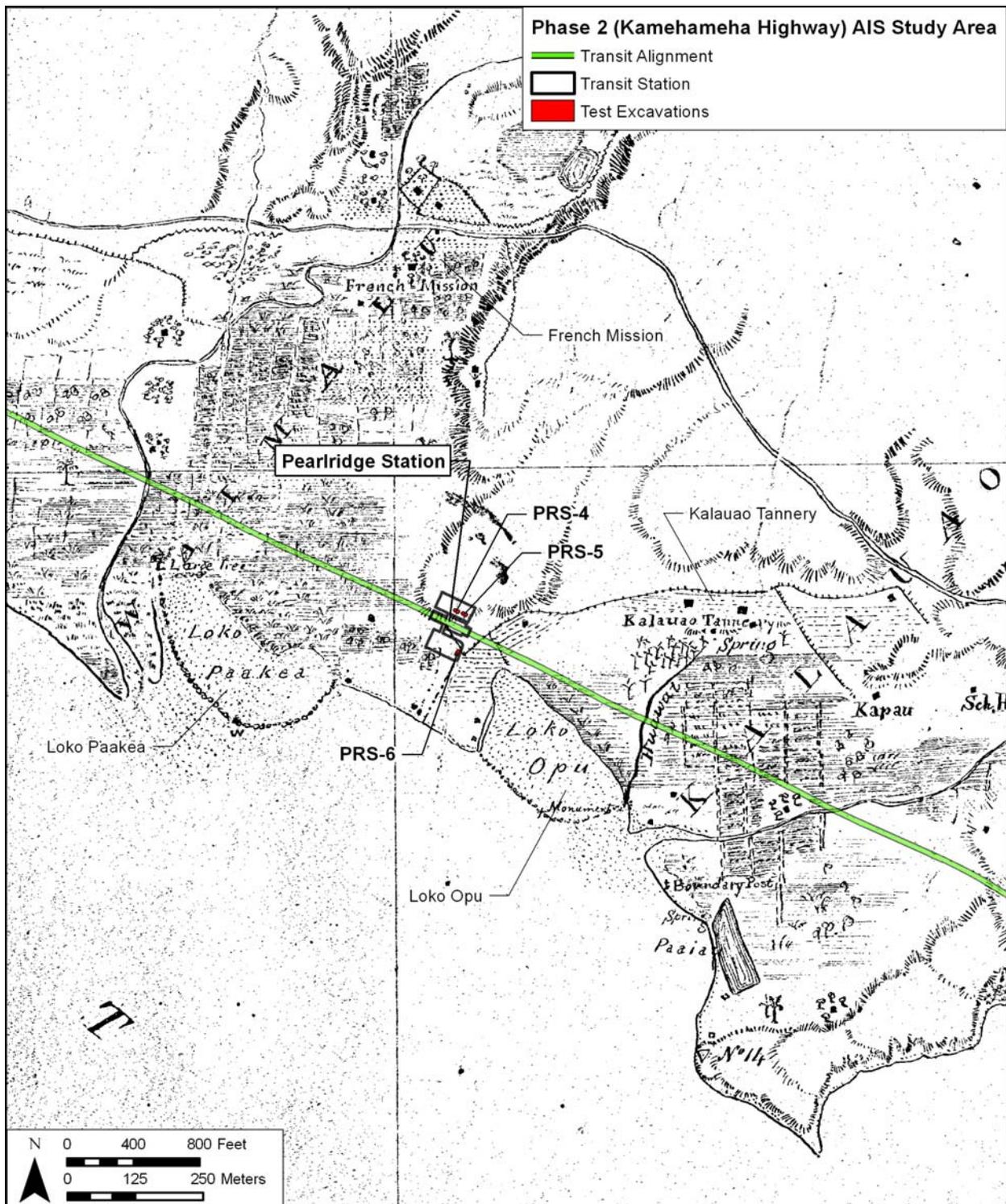


Figure 10. 1873 map of Pearl Lochs by Lyons showing the Pearlridge Station and surrounding *loko* and *lo'i*

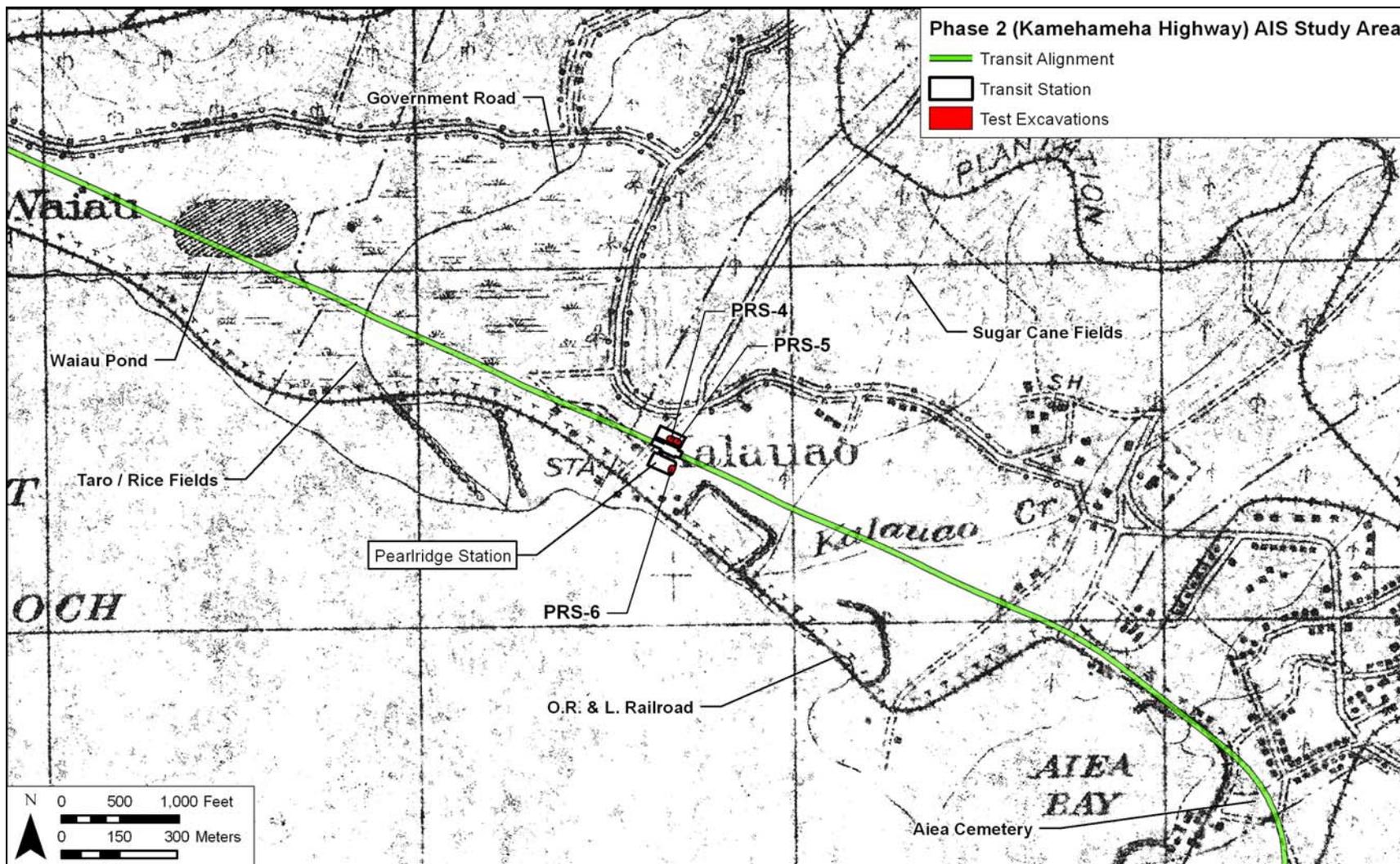


Figure 11. 1919 U.S. War Department Fire Control Map, Pearl Harbor Quadrangle, showing the Pearlridge Station and surrounding landscape

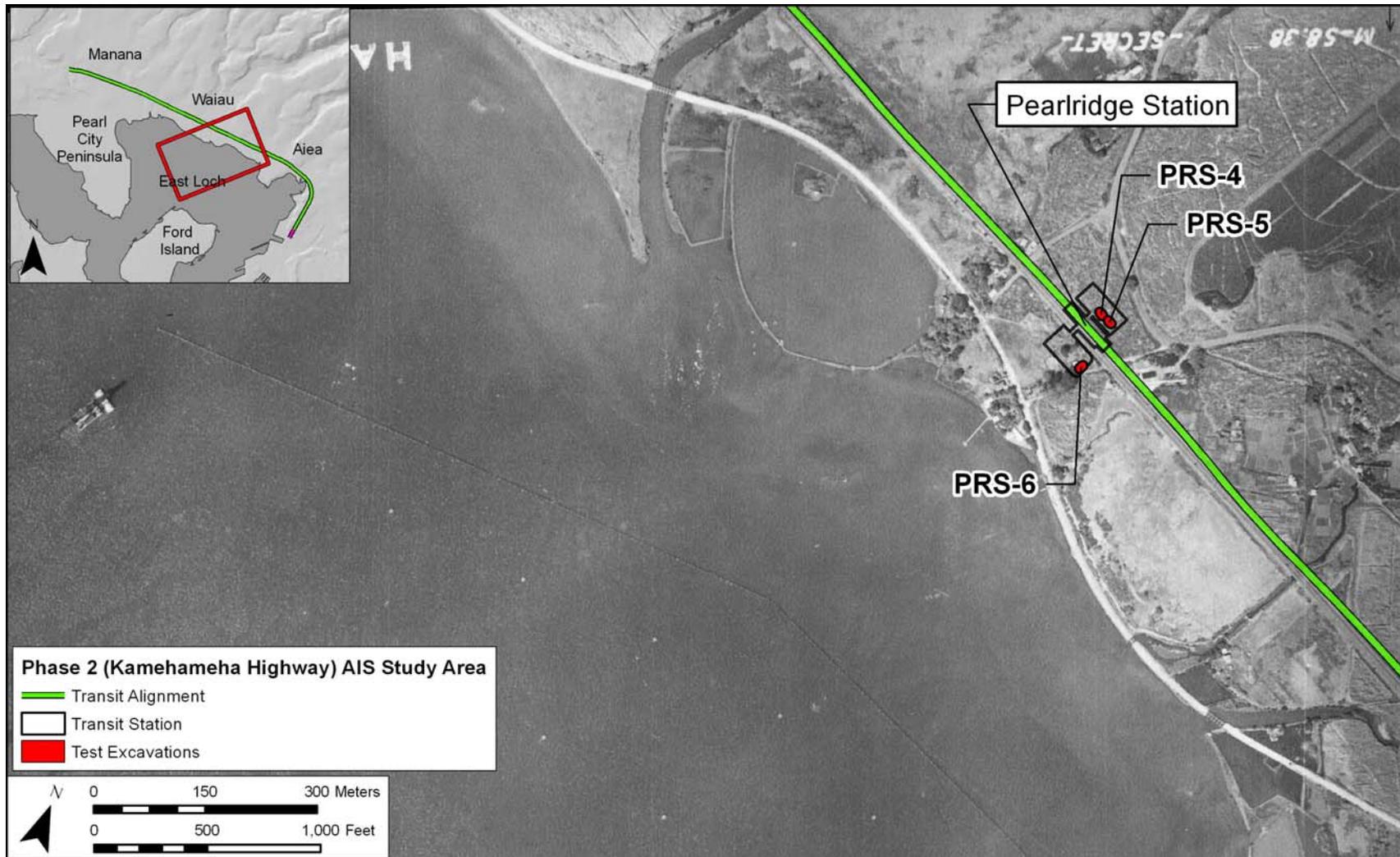


Figure 12. A 1939 Army Air Corps aerial photograph (courtesy of R.M. Towill) of the Pearl Harbor coastal lands of Waimalu and Kalauao showing the Pearlridge Station surrounded by the extant *loko* and agricultural fields

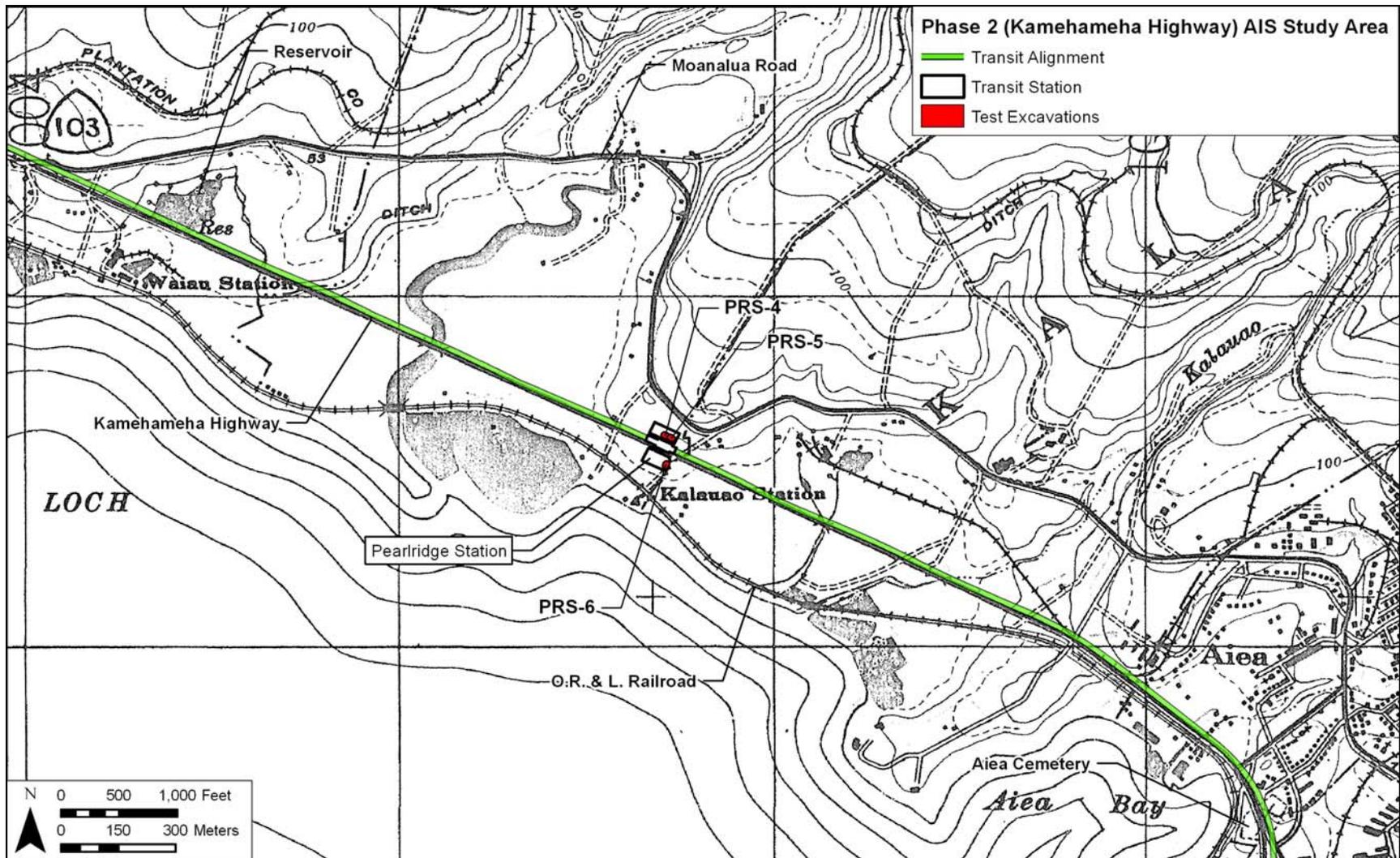


Figure 13. A 1943 U.S. War Department Fire Control Map, Aiea Quadrangle, showing the Pearlridge Station and surrounding landscape

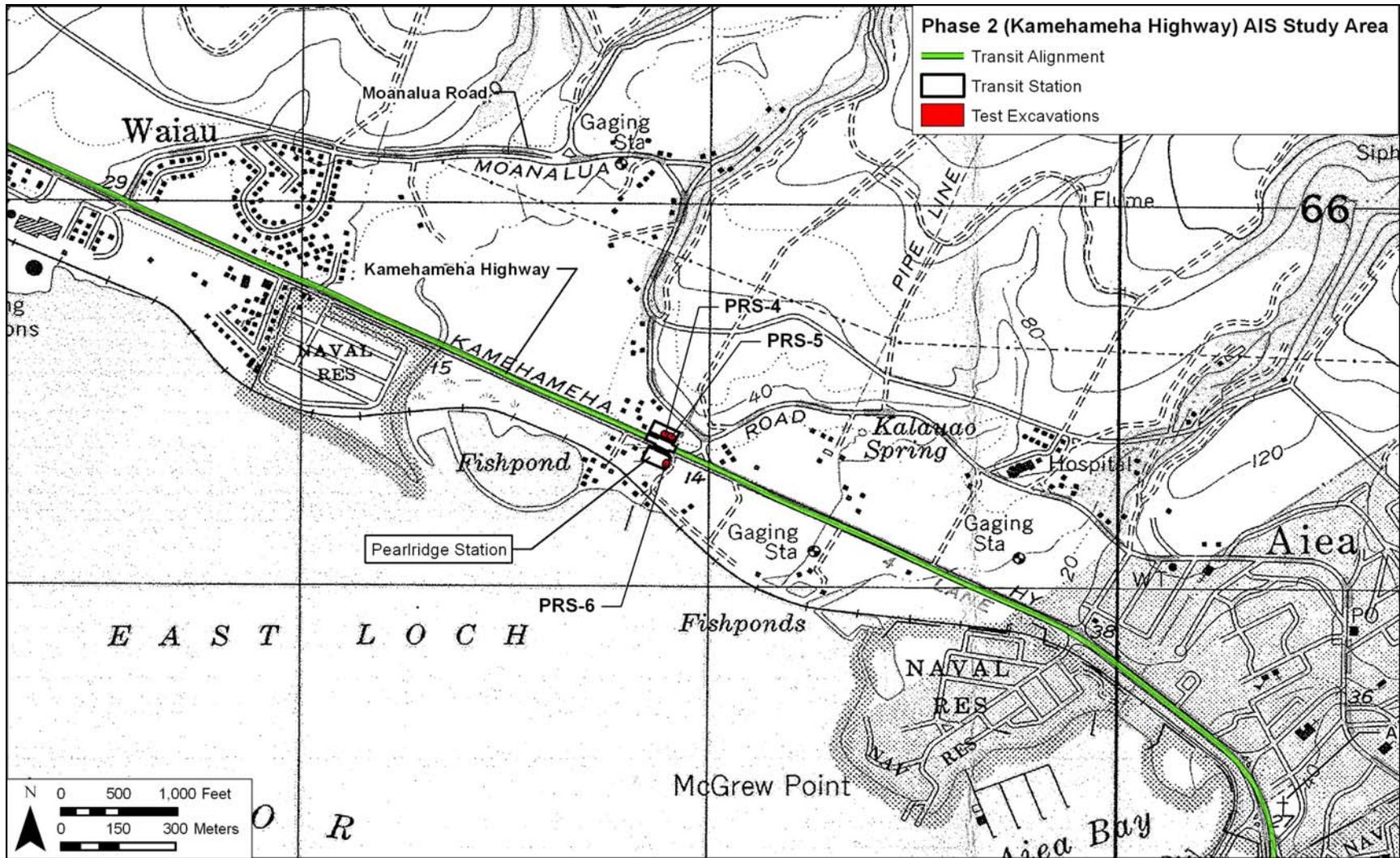


Figure 14. A 1953-1954 Army Mapping Service Topographic Map, Waipahu and Puuloa Quadrangles, showing the Pearlridge Station amongst an increasingly urban setting

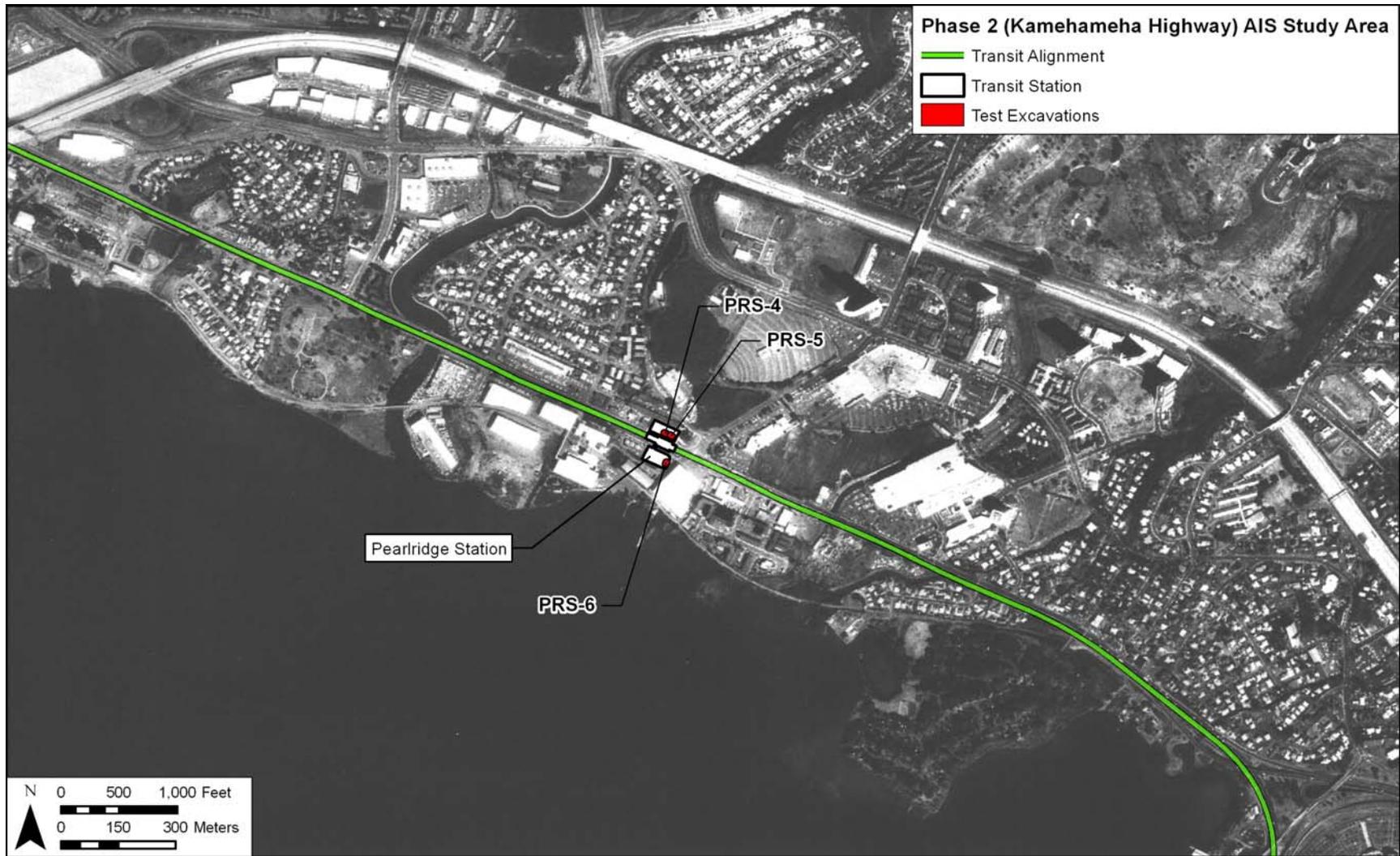


Figure 15. A 1977-1978 U.S. Geological Survey orthophotograph, Waipahu and Puuloa Quadrangles, illustrating the fully urbanized area surrounding the Pearlridge Station

Artifacts Discussion: No artifacts were observed.

Feature Discussion: No features were observed.

Terrestrial Faunal Remains Discussion: No terrestrial faunal remains were observed.

Sample Results: No sample analysis was conducted.

GPR Discussion: A review of amplitude slice maps revealed no linear features that might indicate the presence of utilities. Reflectivity was relatively uniform throughout the grid and stayed continuous with depth. A slight transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (see Appendix B, Figure 29).

GPR depth profiles for PRS-4 identified horizontal banding, commonly associated with stratigraphic layering, throughout the area (see Appendix B: Figure 30). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred around 0.25 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

Summary: PRS-4 was excavated to a maximum depth of 2.65 mbs and the water table was reached at 2.5 mbs. The excavation of PRS-4 was limited by the presence of two metal utility pipes. The stratigraphy of PRS-4 consisted of fill strata (Strata Ia-Id) overlying a natural clay loam (Stratum II). Stratum Id was a fill material with petroleum contamination, possibly associated with a former gas station. Stratum II generally conformed to the USDA soil survey designation of Honouliuli clay (HxA). No archaeological cultural resources were observed within PRS-4.



Figure 16. PRS-4 general location, view to the southeast



Figure 17. PRS-4 southwest profile wall, eastern end, view to the southwest



Figure 18. PRS-4 southwest profile wall, western end, view to the southeast

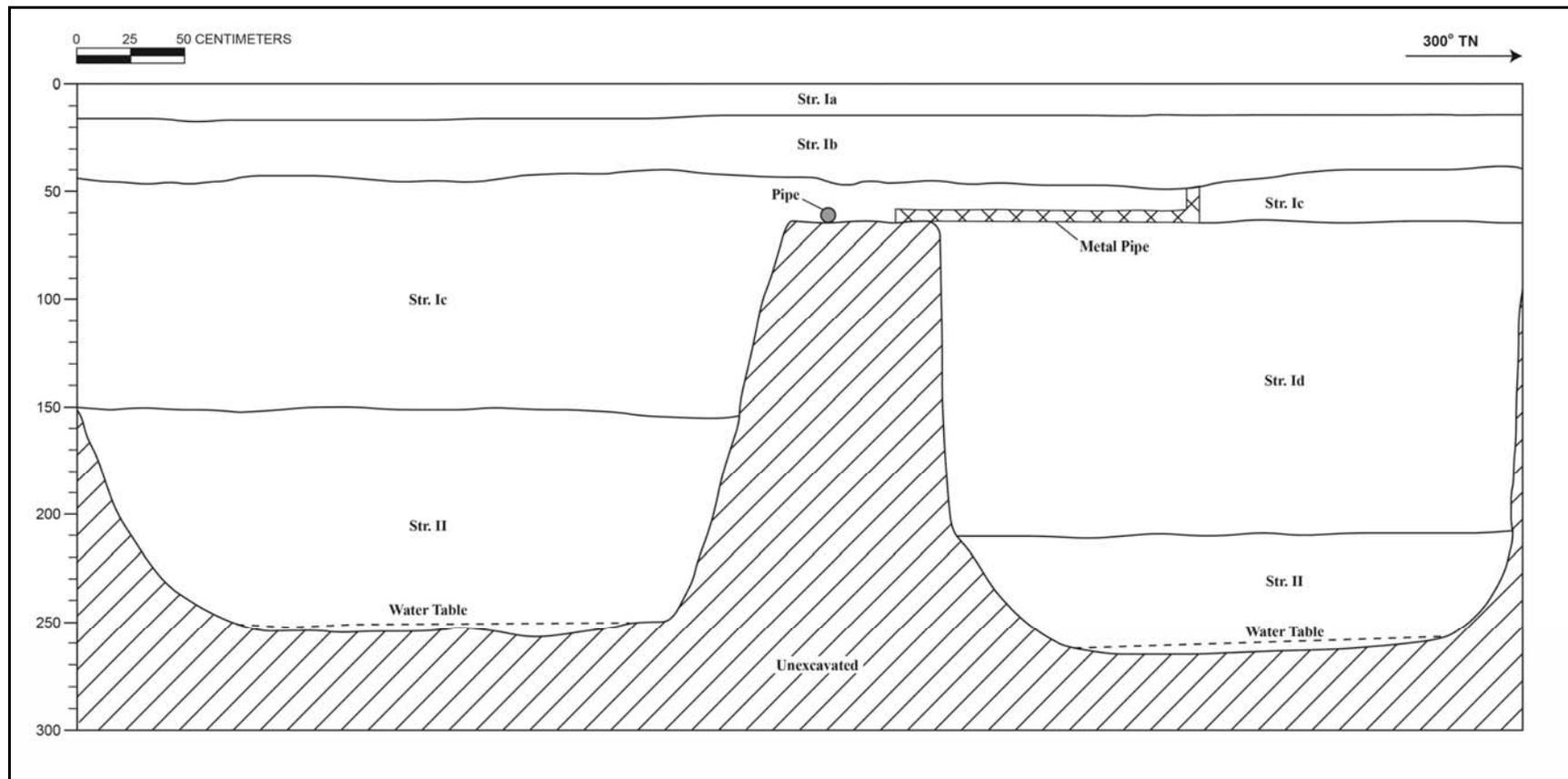


Figure 19. PRS-4 southwest wall profile

Table 1. PRS-4 Stratigraphic Description

Stratum	Depth (cmts)	Description
Ia	0-15	Asphalt; parking lot surface
Ib	15-50	Fill; 10 YR 3/2 (very dark grayish brown); very gravelly loam; structureless, single-grain; moist, very friable consistency; non-plastic; terrigenous origin; clear, smooth lower boundary; gravel base course
Ic	40-150	Fill; 10 YR 5/2 (grayish brown); sandy loam; weak, fine to medium crumb structure; moist, friable consistency; non-plastic; mixed origin; contained utility pipes
Id	65-210	Fill; 10 YR 4/1 (dark gray); sandy loam; weak, fine, crumb structure; moist, loose consistency; non-plastic; mixed origin; clear, smooth lower boundary; petroleum-contaminated material, possibly associated with former gas station
II	150-265	Natural; 10 YR 4/4 (dark yellowish brown); clay loam; moderate, medium, crumb structure; moist, friable consistency; slightly plastic; terrigenous origin; lower boundary not visible; natural clay loam

4.1.2 Pearlridge Station Test Excavation 5 (PRS-5)

Ahupua'a:	Waimalu
LCA:	N/A
TMK #:	(1) 9-8-010:002
Elevation above Sea Level:	4.97 m
UTM:	04Q 609183 2365012
Max Length/Width/Depth:	6.75 m/0.75 m/2.95 m
Orientation:	113/293 TN
Targeted Project Component:	Additional test excavation
USDA Soil Designation:	Honouliuli clay (HxA)

Setting: Pearlridge Station Test Excavation 5 (PRS-5) was located in a paved parking lot on the northern side (*mauka* side) of Kamehameha Highway, approximately 65.0 m west of the Kaonohi Street and Kamehameha Highway intersection. No utilities were indicated in the vicinity of PRS-5. PRS-5 was located on property owned by the City and County of Honolulu. The excavation area was level with the surrounding land surface.

Summary of Background Research and Land Use: An 1873 map of the Pearl Lochs by Lyons (Figure 10) shows PRS-5 in an area dominated by agricultural land and just north of two *loko* (fishpond). Loko Paakea is shown about 255.0 m southwest of PRS-5, while Loko Opu is 130.0 m southeast. The former shoreline is shown more than 210.0 m to the south. The 1919 U.S. Army War Department Fire Control Map (Figure 11) indicates that taro and rice fields were still present among beginning urban developments. The OR&L railroad line is present 250.0 m south of PRS-5, while other developing roads and buildings are just to the north. A 1939 aerial photograph shows the surrounding landscape still largely devoted to agricultural use (Figure 12). By 1943, the railroad still present, and now Kamehameha Highway has been constructed (1943 U.S. Army War Department Fire Control map, Figure 13). The area remained only sparsely developed through the 1950s (1953 Army Mapping Service Topographic Map, Figure 14). However, a 1977-1978 U.S. Geological Survey orthophoto (Figure 15) shows an urban landscape dominated by buildings and large warehouses, with none of the former agricultural lands present.

Documentation Procedures: PRS-5 was excavated to a maximum of depth of 2.95 mbs, and beneath the water table at 2.85 mbs.

Stratigraphic Summary: The stratigraphy of PRS-5 consisted of several fill layers overlying natural sediment. Observed strata included asphalt (Stratum Ia), very gravelly clay loam (Strata Ib-Ic), loamy clay (Stratum Id), clay loam (Stratum Ie), silty loam (Stratum If), clay loam (Stratum Ig), and a natural clay loam (Stratum II). Stratum II generally conformed to the USDA soil survey designation of Honouliuli clay (HxA).

Artifacts Discussion: No artifacts were observed.

Feature Discussion: No features were observed.

Terrestrial Faunal Remains Discussion: No terrestrial faunal remains were observed.

Sample Results: A 3.0 liter bulk sediment sample of Stratum II was collected between 2.25-2.95 mbs. The sample was wet-screened and contained no cultural material.

GPR Discussion: A review of amplitude slice maps showed no linear features which might have indicated the presence of utilities. Reflectivity varied throughout the grid and increased with depth. A transition from lower reflectivity to higher reflectivity was observed at approximately 0.50 mbs (see Appendix B: Figure 31).

GPR depth profiles for PRS-5 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (see Appendix B: Figure 32). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred at around 0.50 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

Summary: PRS-5 was excavated to a maximum of depth of 2.95 mbs, and beneath the water table at 2.85 mbs. The stratigraphy of PRS-5 consisted of fill strata (Strata Ia-Ig) overlying a natural clay loam (Stratum II). Stratum II generally conformed to the USDA soil survey designation of Honouliuli clay (HxA). No archaeological cultural resources were observed within PRS-5.



Figure 20. PRS-5 general location, view to the southeast



Figure 21. PRS-5 northeast profile wall, western end, view to the northeast

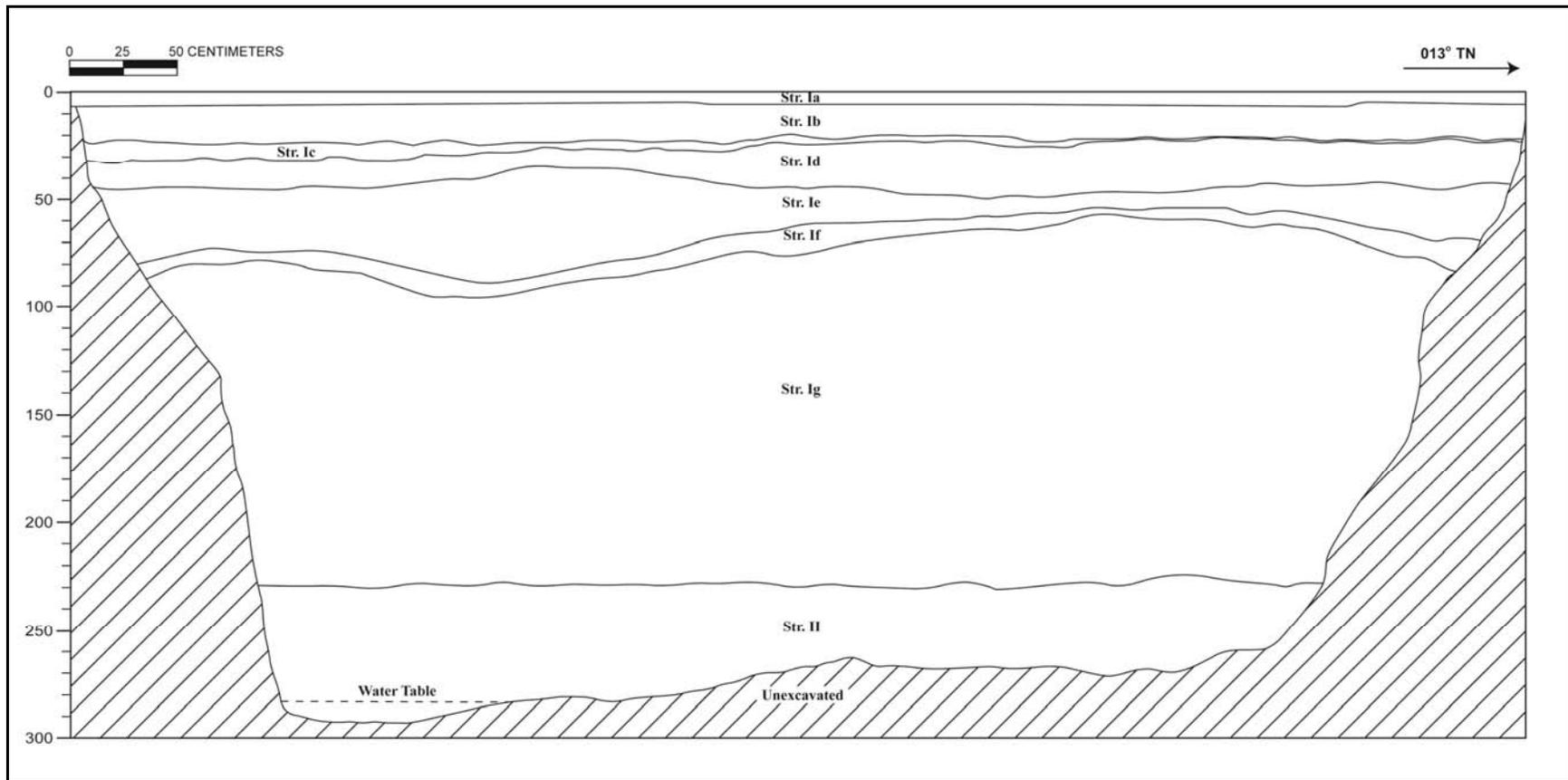


Figure 22. PRS-5 northeast wall profile

Table 2. PRS-5 Stratigraphic Description

Stratum	Depth (cmts)	Description
Ia	0-6	Asphalt; parking lot surface
Ib	6-25	Fill; 7.5 YR 5/4 (brown); very gravelly clay loam; moderate, medium, crumb structure; dry, slightly hard consistency; non-plastic; terrigenous origin; clear, wavy lower boundary; base course fill material
Ic	21-34	Fill; 2.5 Y 4/1 (dark gray); very gravelly clay loam; moderate, fine, crumb structure; dry, weakly coherent consistency; non-plastic, terrigenous origin; clear, wavy lower boundary
Id	22-50	Fill; 10 YR 3/3 (dark brown); loamy clay; moderate, medium, platy structure; dry, slightly hard consistency; slightly-plastic; terrigenous origin; clear, wavy lower boundary
Ie	35-90	Fill; 2.5 Y 4/1 (dark gray); clay loam; moderate, medium, granular structure; dry, slightly hard consistency; non-plastic; terrigenous origin; clear, wavy lower boundary
If	55-97	Fill; 2.5 Y 8/1 (white); silty loam; weak, fine, platy structure; dry, weakly coherent; non-plastic; terrigenous origin; abrupt, wavy lower boundary
Ig	57-233	Fill; 2.5 Y 4/1 (dark gray); clay loam; moderate, medium to coarse crumb structure; dry, slightly hard consistency; non-plastic; clear, smooth lower boundary
II	225-295	Natural; 10 YR 4/4 (dark yellowish brown); clay loam; moderate, fine, crumb structure; moist, friable consistency; slightly plastic; terrigenous origin; lower boundary not visible; natural clay loam

4.1.3 Pearlridge Station Test Excavation 6 (PRS-6)

Ahupua'a:	Waimalu
LCA:	9315:1; 8525 B:3
TMK #:	9-8-009:017
Elevation above Sea Level:	4.97 m
UTM:	04Q 609168 2364942
Max Length/Width/Depth:	6.70 m/0.75 m/2.90 m
Orientation:	29/209 TN
Targeted Project Component:	Additional test excavation
USDA Soil Designation:	Honouliuli clay (HxA)

Setting: Pearlridge Station Test Excavation 6 (PRS-6) was located in a paved parking lot along the southern side (*makai* side) of Kamehameha Highway, approximately 75.0 m southwest of the Kaonohi Street and Kamehameha Highway intersection. No utilities were indicated in the vicinity of PRS-6. The excavation area was level with the surrounding land surface.

Summary of Background Research and Land Use: An 1873 map of the Pearl Lochs by Lyons (Figure 10) shows PRS-6 in an area dominated by agricultural land and just north of two *loko* (fishpond). Loko Paakea is shown about 233.0 m southwest of PRS-6, while Loko Opu is 90.0 m southeast. The former shoreline is shown more than 150.0 m to the south. The 1919 U.S. Army War Department Fire Control Map (Figure 11) indicates that taro and rice fields were still present among beginning urban developments. The OR&L railroad line is present 145.0 m south of PRS-6, while other developing roads and buildings are north. A 1939 aerial photograph shows the surrounding landscape still largely devoted to agricultural use (Figure 12). By 1943, the railroad still present, and now Kamehameha Highway has been constructed (1943 U.S. Army War Department Fire Control map, Figure 13). The area remained only sparsely developed through the 1950s (1953 Army Mapping Service Topographic map, Figure 14). However, a 1977-1978 U.S. Geological Survey orthophoto (Figure 15) shows an urban landscape dominated by buildings and large warehouses, with none of the former agricultural lands present.

Documentation Procedures: PRS-6 was excavated to a maximum depth of 2.9 mbs. The water table was not encountered during excavation.

Stratigraphic Summary: The stratigraphy of PRS-6 consisted of several fill layers overlying natural sediments. Observed strata included asphalt (Stratum Ia), extremely gravelly sand (Stratum Ib), sandy clay loam (Stratum Ic), cobbly gravelly loam (Stratum Id), sandy clay loam (Stratum Ie), silty clay loam (Stratum IIa), sandy silt (Stratum IIb), and a silty clay (Stratum IIc). Strata IIa through IIc generally conformed to the USDA soil survey designation of Honouliuli clay (HxA).

Artifacts Discussion: No artifacts were observed.

Feature Discussion: No features were observed.

Terrestrial Faunal Remains Discussion: No terrestrial faunal remains were collected individually during excavation.

Sample Results: A total of three bulk sediment samples were collected. A 2.0-liter sample was collected from Stratum Ie between 1.08 and 1.24 mbs; a 2.0-liter sample was collected from Stratum Iib from the excavation floor at 2.25 mbs; and a 2.0-liter sample was collected from Stratum Iic between 2.6 and 2.75 mbs. All bulk sediment samples were wet-screened. No material was collected from the sample collected in Stratum Iic. The sample collected from Stratum Ie contained small charcoal pieces (0.3 g), fragments of naturally deposited Mytilidae *Brachidontes crebristriatus* and bivalve shell material, and fish remains from *Pervagor pilosoma* (0.1 g). The sample collected from Stratum Iib contained only a single gastropod shell fragment. The results of sample analysis indicated no significant cultural material was present.

GPR Discussion: A review of amplitude slice maps revealed no linear features which might have indicated the presence of utilities. Reflectivity varied throughout the grid and increased with depth. A transition from lower reflectivity to higher reflectivity was observed at approximately 0.75 mbs (see Appendix B: Figure 33).

GPR depth profiles for PRS-6 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (see Appendix B: Figure 34). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity which occurred at around 0.75 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

Summary: PRS-6 was excavated to a maximum depth of 2.9 mbs. The water table was not encountered during excavation. The stratigraphy consisted of fill layers (Strata Ia-Ie) overlying natural sediments (Strata Iia-Iic). Three bulk sediment samples were collected from Stratum Ie, Stratum Iib, and Stratum Iic. Results of sample analysis indicated that no significant cultural material was present in any of the samples. The presence of marine shell material supports the identification of the lower natural sediments (Strata Iia-Iic) as remnants of the coastal flats. No archaeological or cultural resources were identified within PRS-6.



Figure 23. PRS-6 general location, view to the northeast

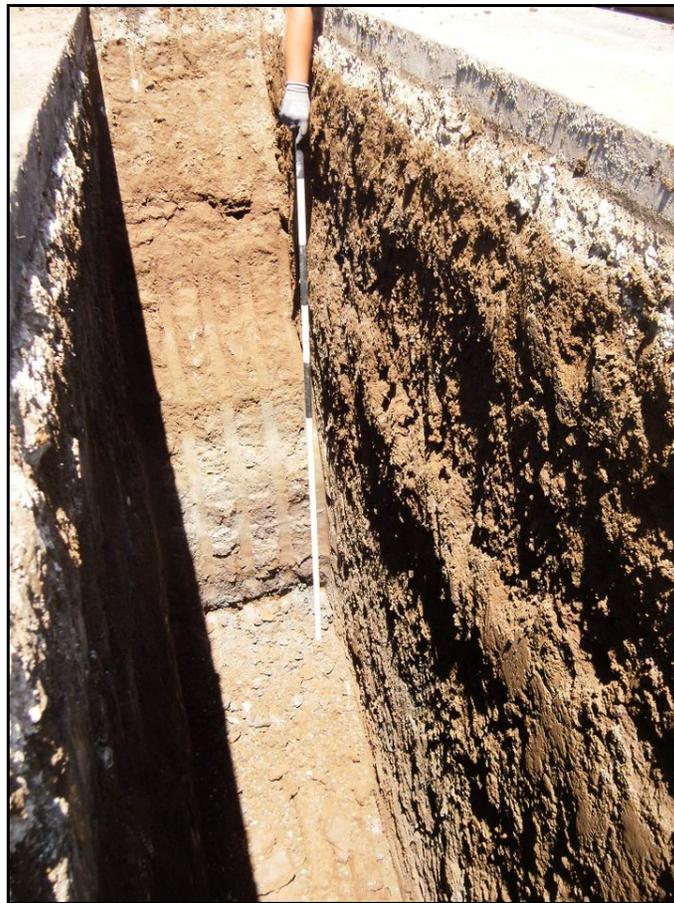


Figure 24. PRS-6 southeast wall, opposite of profiled wall, view to the northeast

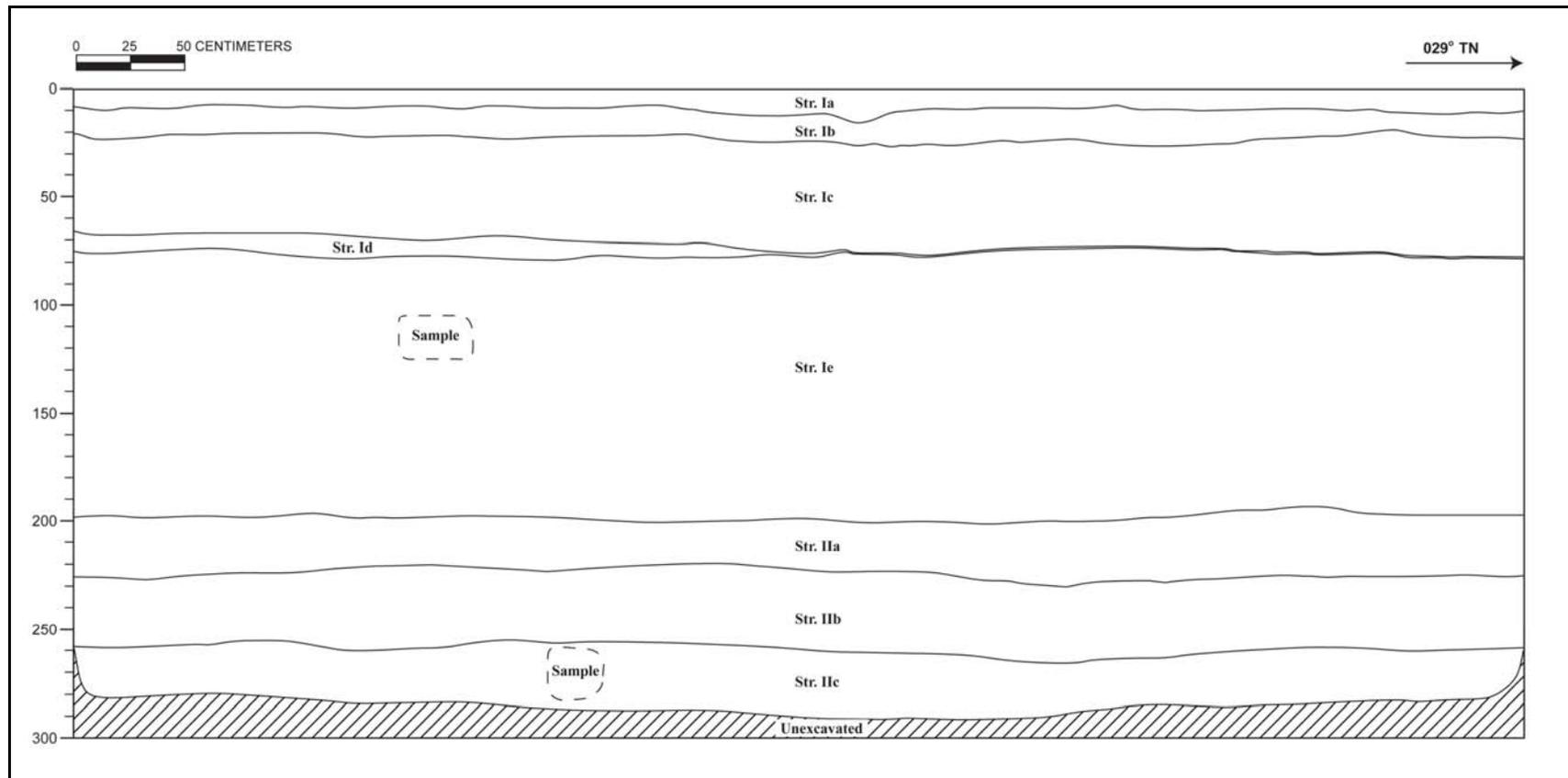


Figure 25. PRS-6 northwest wall profile

Table 3. PRS-6 Stratigraphic Description

Stratum	Depth (cmts)	Description
Ia	0-12	Asphalt; parking lot surface
Ib	12-24	Fill; 10 YR 8/2 (very pale brown); extremely gravelly sand; structureless, single grain; moist, loose consistency; non-plastic; marine origin; very abrupt, smooth lower boundary; crushed coral base course
Ic	24-68	Fill; 10 YR 4/4 (dark yellowish brown); sandy clay loam; weak, fine, blocky structure; moist, friable consistency; slightly plastic; terrigenous origin; abrupt, smooth lower boundary
Id	18-80	Fill; 5 YR 3/4 (dark reddish brown); cobbly gravelly loam; weak, medium crumb structure; moist, friable consistency; non-plastic; terrigenous origin; abrupt, smooth lower boundary; gravel base course
Ie	80-200	Fill; 10YR 3/2 (very dark grayish brown); sandy clay loam; weak, fine to medium blocky structure; moist, friable consistency; slightly plastic; terrigenous origin; clear, smooth lower boundary; contained minor charcoal flecking
IIa	200-225	Natural; 10 YR 3/2 (very dark grayish brown); silty clay loam; weak, fine crumb structure; moist, friable consistency; slightly plastic; terrigenous origin; clear, smooth lower boundary
IIb	225-265	Natural; 10 YR 4/2 (dark grayish brown); sandy silt; moderate, medium blocky structure; moist, firm consistency; non-plastic; terrigenous origin; diffuse, smooth lower boundary; contained few marine shells
IIc	265-290	Natural; 10 YR 4/1 (dark yellowish brown); silty clay; moderate, fine to medium blocky structure; moist, friable to firm consistency; slightly plastic; lower boundary not visible

Section 5 Results of Laboratory Analysis

5.1 Wet-Screening of Bulk Sediment Samples

Bulk sediment samples were collected from Stratum II of PRS-5 and Strata Ie, I Ib, and I Ic of PRS-6. Bulk sediment samples were wet-screened through a 1/16-inch fine mesh.

The 3.0-liter bulk sediment sample of Stratum II from PRS-5 was collected between 2.25-2.95 mbs. The sample was wet-screened and contained no cultural material.

For PRS-6, a 2.0-liter sample was collected from Stratum Ie between 1.08 and 1.24 mbs; a 2.0-liter sample was collected from Stratum I Ib from the excavation floor at 2.25 mbs; and a 2.0-liter sample was collected from Stratum I Ic between 2.6 and 2.75 mbs. All bulk sediment samples were wet-screened. No material was collected from the sample collected in Stratum I Ic. The sample collected from Stratum Ie contained small charcoal pieces (0.3 g), fragments of naturally deposited Mytilidae *Brachidontes crebristriatus* and bivalve shell material, and fish remains from *Perragor spilosoma* (0.1 g). The sample collected from Stratum I Ib contained only a single gastropod shell fragment. The results of sample analysis indicated no significant cultural material was present.

No evidence of cultural modification or activity was found. Shell material collected appears to be non-cultural and represents only natural accumulation. No taxa identification, radiocarbon dating, or palynological analysis was conducted.

Section 6 Summary and Interpretation

At the request of PB Americas, Inc., and on behalf of the FTA and the City, Cultural Surveys Hawai'i, Inc. (CSH) completed this study as a supplement to the AIS for HHCTC Section 2 (*Honolulu High-Capacity Transit Corridor Project, Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a, 'Ewa District, Island of O'ahu TMK: [1] 9-7, 9-8, and 9-9 [Various Plats and Parcels] [Sroat et al. 2012]*). The proposed HHCTCP extends approximately 23 miles from Kapolei in the west to the Ala Moana Shopping Center in the east. This supplemental AIS focuses on the Pearlridge Station footprint in the central portion of HHCTC Section 2.

The HHCTCP Section 2 is a 4.1-mile segment that extends east from the Pearl Highlands Station in Pearl City to the Aloha Stadium Station and includes the westernmost portion of Section 3 (extending east approximately 0.2 miles from the Aloha Stadium Station to Kalaloa Street in Hālawā). The segment includes two proposed transit stations (approximately 1.5 acres) and one park-and-ride facility (approximately 6.8 acres). Not all areas of the Pearlridge Station could be tested during the original AIS fieldwork. This supplemental AIS was conducted to provide supplemental testing within the PRS *mauka* and *makai* portions of the station footprint and to investigate potential subsurface cultural resources. The original AIS methods and sampling strategy were accepted by SHPD with the approval of the Section 2 AIS plan (Hammatt 2010b) in a letter dated May 7, 2010 (Log No. 2010.1748, Doc. No. 1005NM14). In accordance with the original AIS, this supplemental AIS was conducted following the same methods and sampling strategy.

As part of the earlier AIS, a comprehensive pedestrian survey of the project corridor was conducted prior to excavation. No surface archaeological cultural resources were identified. Excavation areas for the supplemental AIS were inspected by all utility companies and the location of subsurface utilities marked with spray paint (the one-call process). The test excavations were surveyed with ground penetrating radar (GPR) to provide additional archaeological information and to potentially locate additional subsurface utilities. Excavations were placed to avoid subsurface utilities. Three test excavations (PRS-4, PRS-5, and PRS-6) were added for this supplemental AIS, two within the *mauka* and within the *makai* portion of the footprint. Each excavation was approximately 0.75 m wide by 6.7 m in length and was excavated to the water table or a maximum depth of 10 ft (3.0 m) below surface.

In general, stratigraphy observed at PRS-4, PRS-5, and PRS-6 was consistent with the findings of test sites PRS-1, PRS-2, and PRS-3 within the PRS footprint, which contained natural sediments from between 1.0 to 1.85 mbs and were capped by multiple layers of modern and historic fill material (Sroat 2012). Natural sediments were sampled from two of the three excavations and wet-screened. Although the *mauka* Pearlridge Station is situated within the former boundary of LCA 9315:1, and the *makai* portion falls within LCA 8525 B:3, results of sample analysis indicated no significant cultural material.

During fieldwork for the earlier AIS, a single cultural resource was documented. SIHP # 50-80-09-7150, located within Trench E7, consists of a subsurface agricultural deposit (*lo'i* sediments) and was recommended to the National/Hawai'i Register as eligible under significance Criterion D. SIHP # -7150 consists of two silty clay strata containing organic material,

yellowish-red mottling, charcoal flecking, and oxidized root tubes. SIHP # -7150 was observed in Trench E7 (Sroat et al. 2012), more than 500.0 m west of the supplemental AIS project area. SIHP # -7150 was not observed within PRS-4, PRS-5, or PRS-6, and no other cultural resources were identified during excavation. Accordingly, as this supplemental AIS did not document SIHP # -7150 or any other new or existing cultural resources within any of the excavations, the findings of this supplemental AIS do not change the findings and recommendations presented in the original AIS report.

6.1 Project Effect

Section 2 of the HHCTCP will have an “adverse effect” on historic properties. CSH’s project-specific effect recommendation is “effect, with proposed mitigation commitments.”

Ground disturbance related to project construction may impact cultural resources in the vicinity of the Section 2 segment corridor. The original AIS documented a single resource that included subsurface agricultural sediments (SIHP # 50-80-09-7150). Portions of SIHP # -7150 might be removed or disturbed during project construction and was recommended for appropriate mitigation measures (Sroat et al. 2012). This supplemental AIS did not document SIHP # -7150 or any other new or existing cultural resources within any of the additional excavations (PRS-4, PRS-5, and PRS-6). The findings of this supplemental AIS do not change the findings and recommendations presented in the original AIS report.

6.2 Mitigation Recommendations

In accordance with the findings of the original AIS report, this supplemental AIS recommends an archaeological monitoring program for HHCTCP Section 2 (beginning with an archaeological monitoring plan for the review and approval of the FTA, the City, and SHPD, per HAR Chapter 13-279-4). The archaeological monitoring program will serve as a mitigation measure that will facilitate the identification, proper documentation, and treatment of any cultural resources encountered during construction-related activities. Previously unidentified archaeological cultural resources will be treated as “post-review discoveries” under 36 CFR 800.13 and HAR Chapter 13-280 (“Procedures for Inadvertent Discoveries During a Project Covered by the Historic Preservation Review Process”). Inadvertent burial discoveries will follow the procedures outlined in Hawai'i State burial law (HAR Chapter 13-300-40). Because the project does not involve federal or tribal (Department of Hawaiian Homelands) property, the Native American Graves Protection and Repatriation Act (NAGPRA) will not apply to potentially Native Hawaiian inadvertent burial discoveries.

The original AIS encountered one cultural resource (SIHP # 50-80-09-7150). Although this supplemental AIS did not identify any new or existing cultural resources, an archaeological monitoring program is recommended to reduce negative impact on any cultural resources present in the HHCTCP Section 2. Additionally, archaeological monitoring will provide the opportunity to record the stratigraphy and depositional sequence, and collect samples, to further refine the understanding of the characteristics, function, age, and geographic extent of any encountered cultural resources, including SIHP # 50-80-09-7150.

Section 7 References Cited

Foote, Donald E., E. L. Hill, S. Nakamura, and F. Stephens

1972 *Soil Survey of the Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii*. U.S. Department of Agriculture, U.S. Government Printing Office, Washington D.C.

Giambelluca, Thomas W., Michael A. Nullett, and Thomas A. Schroeder

1986 *Rainfall Atlas of Hawai'i*, Department of Land and Natural Resources, SHPD/DLNR, State of Hawai'i, Honolulu.

Hammatt, Hallett H.

2010a *Archaeological Inventory Survey of Section I for 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)}*, Cultural Surveys Hawai'i, Kailua, Hawai'i.

Hammatt, Hallett H.

2010b *Archaeological Inventory Survey Plan for Section II of the Honolulu High-Capacity Transit Corridor Project, Waiawa, Mānana, Waimano, Waiawa, Waimalu, Kalauao, 'Aiea, and Hālawa Ahupua'a, 'Ewa District, Island of O'ahu TMK: [1] 9-7, 9-8, and 9-9 (Various Plats and Parcels)*. Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

Hawai'i TMK Service

2013 Tax Map Key (1) 9-8-009:017 and (1) 9-8-010:002. On file at Hawai'i TMK Service, 222 Vineyard Street, Suite 401, Honolulu, Hawai'i.

Lyons, C.J.

1873 Map of Pearl Harbor—Pearl Lochs and Puuloa Entrance, Ewa, Oahu. Registered Map 567. Archived at Hawai'i Land Survey Division, Department of Accounting and General Services, 1151 Punchbowl St., Room 210, Honolulu.

Sroat, Ena, Douglas Thurman, and Matt McDermott

2012 *Archaeological Inventory Survey for Construction Phase 2 of the Honolulu High-Capacity Transit Corridor Project, Waiawa, Mānana, Waimano, Waiawa, Waimalu, Kalauao, 'Aiea, and Hālawa Ahupua'a, 'Ewa District, Island of O'ahu TMK: [1] 9-7, 9-8, and 9-9 (Various Plats and Parcels)* Job Code: MANANA 2. Cultural Surveys Hawai'i, Inc., Kailua, Hawai'i.

U.S. Department of Transportation Federal Transit Administration (USDOT/FTA) and the City and County of Honolulu Department of Transportation Services (C&C/DTS)

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.

U.S. Geological Survey

1977-1978 U.S. Geological Service Orthoimagery, Waipahu and Puuloa Quadrangles. Available at U.S. Geological Survey Maps/U.S. Department of War Maps, USGS Information Services, Box 25286, Denver.

1998-1999 U.S. Geological 7.5-Minute Topographic Map, Waipahu (1998) and Pearl Harbor (1999) Quadrangles. Available at U.S. Geological Survey Maps/U.S. Department of War Maps, USGS Information Services, Box 25286, Denver.

2005 U.S. Geological Service Orthoimagery. Available at U.S. Geological Survey Maps/U.S. Department of War Maps, USGS Information Services, Box 25286, Denver.

U.S. War Department

1919 Fire Control Map, Pearl Harbor Quadrangle. Available at U.S. Army Mapping Service/U.S. Department of War Maps, USGS Information Services, Box 25285, Denver.

1943 Fire Control Map, Aiea Quadrangle. Available at U.S. Army Mapping Service/U.S. Department of War Maps, USGS Information Services, Box 25285, Denver.

Waihona 'Aina

2000 *The Māhele Database*. Electronic document. <<http://waihona.com>>. Accessed July 15, 2013.

Appendix A SHPD Correspondence

SHPD Acceptance Letter of the Archaeological Inventory Survey

<p>NEIL ABERCROMBIE GOVERNOR OF HAWAII</p>		<p>WILLIAM J. AILA, JR. INTERIM CHAIRPERSON BOARD OF LAND AND NATURAL RESOURCES COMMISSION ON WATER RESOURCE MANAGEMENT</p>
	<p>STATE OF HAWAII DEPARTMENT OF LAND AND NATURAL RESOURCES</p>	<p>GUY H. KAULUKUKUI ACTING FIRST DEPUTY</p>
	<p>POST OFFICE BOX 621 HONOLULU, HAWAII 96809</p>	<p>WILLIAM M. TAM ACTING DEPUTY DIRECTOR - WATER</p>
		<p>AQUATIC RESOURCES BOATING AND OCEAN RECREATION BUREAU OF CONVEYANCES COMMISSION ON WATER RESOURCE MANAGEMENT CONSERVATION AND COASTAL LANDS CONSERVATION AND RESOURCES ENFORCEMENT ENGINEERING FORESTRY AND WILDLIFE HISTORIC PRESERVATION KAHOOLAWE ISLAND RESERVE COMMISSION LAND STATE PARKS</p>

May 23, 2012

Hallett H. Hammatt, Ph.D.
Cultural Surveys Hawai'i, Inc.
P.O. Box 1114
Kailua, Hawaii 96734

LOG NO: 2012.1449
DOC NO: 1205NN23

Dear Dr. Hammatt:

Subject: **National Historic Preservation Act (NHPA) Section 106 Consultation - Revised Archaeological Inventory Survey Report for Construction Phase 2 Honolulu High-Capacity Transit Corridor Project Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, 'Aiea, & Hālawā Ahupua'a, 'Ewa District, Island of O'ahu**
TMK: (1) 9-7, 9-8, 9-9 Various Plats and Parcels

Thank you for the opportunity to review this report titled *Archaeological Inventory Survey for Construction Phase 2 of the Honolulu High-Capacity Transit Corridor Project, Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, 'Aiea and Hālawā Ahupua'a, 'Ewa District, Island of O'ahu, TMK: (1) 9-7, 9-8, 9-9 Various Plats and Parcels*, Sroat, Thurman, and McDermott (April 2012), which our office received on September 9, 2012. This report was prepared for Parsons Brinckerhoff, Inc. on behalf of the City and County of Honolulu and the Federal Transit Administration. We have previously provided comments on the archaeological inventory survey plan (Log 2010.1748, Doc 1005NM14), draft archaeological inventory survey (Log 2012.0966, Doc 1205NN02) and the archaeological monitoring plan for this project (Log 2012.1041, 1205NN12). Revisions requested in our prior review of the draft inventory survey have been addressed in this revised report, as indicated below (in summary):

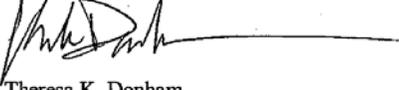
1. The test trench stratigraphy descriptions for Trenches E7, E13, E16, and PRS1 have been expanded to clarify the distinctions made between fill layers, culturally sterile natural layers and possible lo'i or fishpond deposits. In addition, difference between overlying fill layers and underlying natural strata was made.
2. Three test trenches were initially proposed for the *mauka* portion of the Pearlridge Transit Station (TMK [1] 9-8-010:002), but land access onto the property was not permitted. According to the revised AIS report, the City and County of Honolulu obtained ownership of this parcel from 50th State Properties, and Cultural Surveys Hawaii can now complete its three test trenches as part of a supplemental archaeological inventory survey. The supplemental archaeological inventory survey will be conducted prior to the beginning of construction activities. The results of the supplemental archaeological inventory survey will be reported in a supplemental archaeological inventory survey addendum to this approved archaeological inventory survey report.
3. Lastly, provisions of the archaeological monitoring program has been removed from the revised AIS report and was included an archaeological monitoring plan, which has been approved.

Dr. Hammatt
May 23, 2012
Page 2

As indicated in our prior letter, one newly identified historic property (SIHP Site 50-80-09-7150) was identified within Trench E-7, located along Kamehameha Highway, midway between Kuleana Road and Ka'ahumanu Street. This location is in a documented area of former ponded taro fields (LCA#9385). We concur that this site is significant under National Register of Historic Places and Hawaii Register of Historic Places Criterion D, and has the potential to yield information important for understanding prehistory. We concur with the proposed mitigation measures, which is on-site monitoring of any land alteration activities in the vicinity of the site area.

This revised report meets the requirements of HAR 13-276 and *The Secretary of Interior's Standards for Identification and Evaluation*, and is accepted by SHPD. Please send one hardcopy of the document, clearly marked **FINAL**, along with a copy of this review letter and a text-searchable PDF version on CD to the Kapolei SHPD office. Please contact Deona Naboa at (808) 692-8015 or Deona.Naboa@Hawaii.gov if you have any questions or concerns regarding this letter.

Aloha,



Theresa K. Donham
Archaeology Branch Chief

Appendix B GPR Report

Background

The use of Ground-Penetrating Radar (GPR) for this study was specifically dictated in the HHCTCP Programmatic Agreement. The purpose of this investigation was to evaluate the efficacy of GPR surveys within the context of an urban setting, to test this method's ability to map stratigraphy, as well as to locate subsurface cultural deposits, including human burials. The subsurface mapping capabilities and depth information that can be acquired by GPR make it a promising geophysical technique for imaging stratigraphy and subsurface features of interest, especially human burials. As there are a number of archaeologically sensitive areas within the HHCTCP project area, including the Pearl Ridge Station location, it is important to assess whether or not sensitive cultural deposits (e.g. human burials) can be located and mapped in a non-invasive way. Additionally, this study seeks to improve the effectiveness of GPR data analysis through "ground truthing" (comparison of GPR results with actual excavation results).

Previous GPR surveys conducted in nearby locations have demonstrated the potential of GPR to map stratigraphy and subsurface features, though overall depth penetration and feature resolution remain a concern (O'Hare et al. 2009; Pammer et al. 2009). A preliminary GPR investigation for the HHCTCP project conducted by TAG Research by Sturm Inc. sought to evaluate and test which antenna frequencies, collection parameters, and processing procedures would be the most effective for potentially mapping and identifying the cultural features of interest (Sturm 2010). Sturm (2010) concluded that "GPR mapping has use and potential for imaging buried features in this urban environment" (Sturm 2010:34). Additionally, Sturm recommends that a 400 MHz antenna be utilized to conduct the HHCTCP GPR survey, as it "provided the best overall quality data, allowing high resolution mapping of target features of interest (including burials) to a depth of approximately 1 to 1.5 m" (Sturm 2010:4).

This report also intends to offer a reference for future archaeological work within or near the study area that could benefit from the use of GPR analysis to investigate stratigraphy or potentially identify cultural layers or features. The work is presented in a way that allows the reader to directly compare the GPR results to "ground-truthed" excavation results. The report provides a detailed description of field methods, survey methodology, data collection parameters, post-processing, and an interpretation and summary section. The size and scope of this investigation provides a rare opportunity to interpret an intermittent GPR cross-section through one of Hawai'i's more developed urban environments.

Field Methods

Ground Penetrating Radar Survey

Ground-penetrating radar data is acquired by transmitting pulses of electromagnetic energy, in the radar frequency range, into the ground via a sending antenna. Each time a radar pulse encounters a material with a different density, electrical conductivity, or chemical composition, a portion of the radar energy will reflect back to the surface and be recorded via a receiving antenna. The remaining radar energy will continue to pass into the ground to be further reflected, until it finally dissipates with depth. Reflection features may include discrete objects, stratigraphic layering, or other subsurface anomalies such as subsurface disturbances associated with utility installation or human interment.

The effectiveness of GPR is highly dependent on local soil conditions. The penetration depth of GPR is determined by antenna frequency and the electrical conductivity of the earthen materials being profiled (Daniels 2004). Soils having high electrical conductivity rapidly attenuate radar energy, restrict penetration depths, and severely limit the effectiveness of GPR (USDA NRCS GPR n.d.). The electrical conductivity of soils increases with increasing water, clay, and soluble salt contents.

GPR suitability maps created by the National Resource Conservation Service (NRCS) were reviewed in an attempt to anticipate the predominant soil matrix within the project area and to assess the relative suitability of GPR application. Figure 26 shows the project area on the NRCS GPR Suitability Map for Hawai'i; the PRS is in a low suitability area. The NRCS provides the following discussion when defining their GPR suitability categories:

Areas dominated by mineral soil materials with less than 10 percent clay or very deep organic soils with pH values < 4.5 in all layers have very high potential for GPR applications. Areas with very high potential afford the greatest possibility for deep, high resolution profiling with GPR. However, depending on the ionic concentration of the soil solution and the amounts and types of clay minerals in the soil matrix, signal attenuation and penetration depths will vary. With a 200 MHz antenna, in soils with very high potential for GPR, the effective penetration depth has averaged about 16.5 feet. However, because of variations in textural layering, mineralogy, soil water content, and the ionic concentration of the soil water, the depth of penetration can range from 3.3 to greater than 50 feet.

Areas dominated by mineral soils with 18 to 35 percent clay or with 35 to 60 percent clay that are mostly low-activity clay minerals have moderate potential for GPR. Low activity clays are principally associated with older, more intensely weathered soils. In soils with moderate potential for GPR, the effective penetration depth with a 200 MHz antenna has averaged about 7 feet with a range of about 1.6 to 16 feet. Though penetration depths are restricted, soil polygons with moderate potential are suited to many GPR applications.

Mineral soils with 35 to 60 percent clay, or calcareous and/or gypsiferous soils with 18 to 35 percent clay have low potential for GPR. Areas with low potential are very depth restrictive to GPR. In soils with low potential for GPR, the depth of penetration with a 200 MHz antenna has averaged about 1.6 feet with a range of about 0.8 to 6.5 feet.

Areas that are unsuited to GPR consist of saline and sodic soils. These soil map units are principally restricted to arid and semiarid regions and coastal areas of the United States. (USDA NRCS GPR n. d.)

Note that the estimated depth penetration by the NRCS is based on the use of a 200MHz antenna. The current survey will utilize a 400MHz antenna, which balances radar penetration depth with image resolution, so all projected depth estimates by the NRCS must be cut in half. Thus average depth penetration would be 0.8 feet (0.2 m) in this low suitability area.

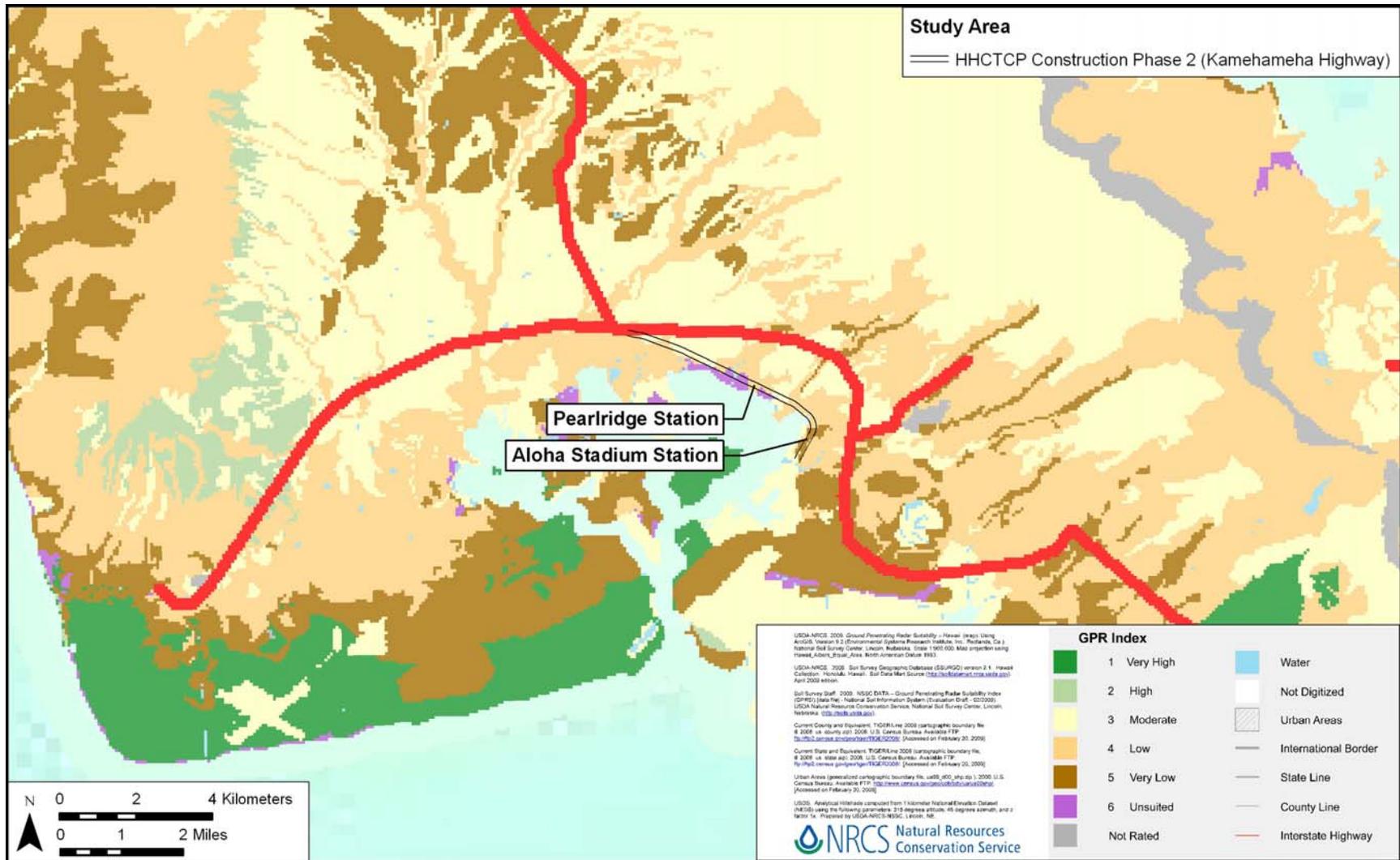


Figure 26. GPR suitability map (source: National Resource Conservation Service) showing the location of the Pearlridge Station, which is in a low suitability area

Survey Methodology

The GPR survey was conducted using a Geophysical Survey Systems, Inc. (GSSI) SIR-3000 system equipped with 400 MHz radar antenna, which was moved along transects within a survey grid (Figure 27). Transects were collected in both the Y and X directions, originating from the southwest corner. Transect spacing for the Y transects were set at an interval of 0.25 m between scans and X transects were collected every meter. Due to computer interpolation software (Radan 7; see Post-Processing section below), it was only necessary to collect Y axis transects for graphic interpretation of the data for sediment analysis. However, to better identify utilities running parallel to the excavation long-axis that might fall between the Y axis scans, it was necessary to collect X axis transects. (Note that while transects are collected in the Y-direction, they are actually located within the X-axis.) GPS points were taken at the corners of the GPR grid using a Trimble Pathfinder Pro XH (with sub-meter post-processed horizontal accuracy). Plan views were also drafted, which include: GPR grid locations, surveyed test excavation locations, marked or potential utilities (designated through the “one-call” utility notification process), and any other objects that might affect analysis.

Data Collection Parameters

GPR data collection parameters were held constant throughout the survey (Table 4). However, a varying dielectric constant (a mathematical constant applied to the signal return to determine depth) was used in anticipation of complex stratigraphic sequences within the project area. USDA soil survey data indicate that the Pearlridge Station project area consists of soils within the Honouliuli series. Soils of Honouliuli series are described as follows:

This series consists of well-drained soils on coastal plains on the island of Oahu 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 sugarcane, truck crops, orchards, and pasture. The natural vegetation consists of kiawe, koa haole, fingergrass, bristly foxtail, and bermudagrass. (Foote et al. 1972:43)

The dielectric constant was adjusted during post-processing once known depths were determined as a form of signal calibration. A dielectric range of 10.0 to 15.0 was used throughout the project area.

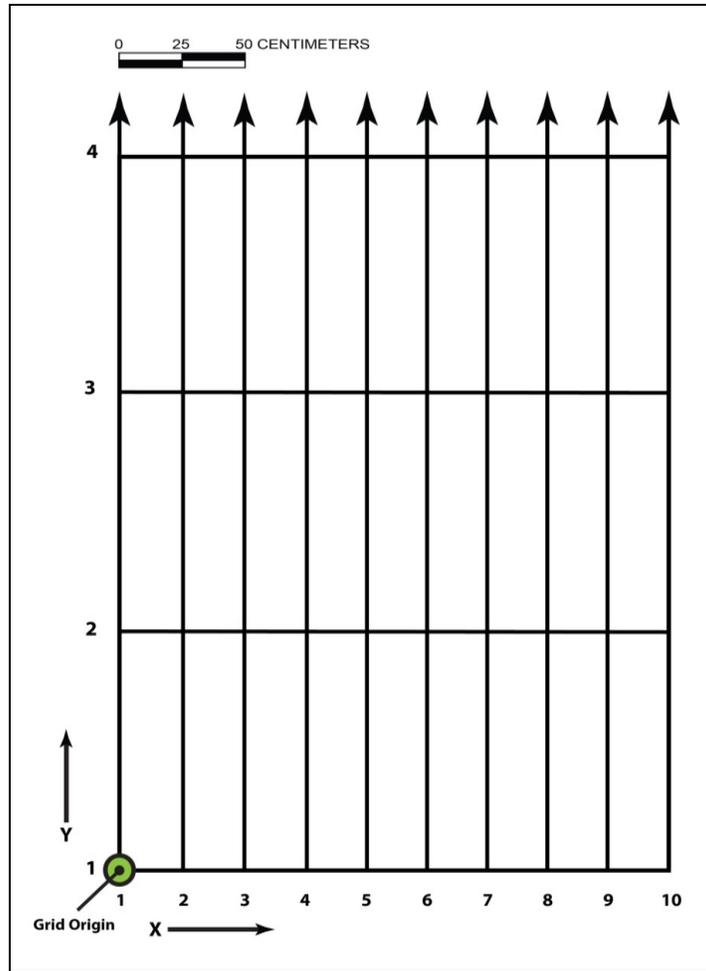


Figure 27. Illustration of GPR survey grid and method of data collection

Table 4. GPR Data Collection Parameters

Parameter	Settings
Antenna	400 MHz
Transmission rate	120KHz
Samples	512
Format	16-bit
Range	47 nanoseconds
Dielectric	10.00 – 15.00
Rate	120
Scans per unit	75 per meter
Low Pass Filter	750MHz
High Pass Filter	200MHz

Post-Processing

All collected radar data were post-processed using *RADAN 7*, which is an industry standard for GPR data processing.

RADAN 7 was utilized to generate two-dimensional depth profiles from the collected GPR data. These profiles illustrate the geometry of the reflections recorded during data collection. An analysis of these profiles can determine whether the radar energy is reflecting from a flat stratigraphic layer (seen as a distinct horizontal band on a profile), a discrete buried object (seen as a hyperbola in profile), or from stratigraphic irregularities such as subsurface disturbances associated with utility installation or human interment (also seen as hyperbolas, but usually are more ephemeral and consist of clustered reflections).

Position correction was used to remove unwanted surface “noise” from GPR profiles. High- and low-pass filters were applied to remove any excess background “noise” generated from nearby power lines, radio frequencies, etc. during data collection. Gain (signal amplification) was also applied to accent poorly defined or ephemeral reflection typically associated with subsurface cultural deposits.

RADAN 7 was also used to generate amplitude slice maps from the collected GPR data. Amplitude slice maps are a three-dimensional tool for viewing differences in radar reflection amplitudes across a given surface at various depths. Amplitude slice maps can be thought of as plan view maps or excavation-level records that display GPR data at user-defined depth intervals. Reflected radar amplitudes are of interest because they measure the degree of physical and chemical differences in buried materials, which in turn can indicate the presence of stratigraphic interfaces, discrete buried objects (e.g. basalt boulders, utility lines, or burial caskets) or stratigraphic irregularities (e.g. subsurface anomalies associated with burial pits, fire pits, or buried irrigation ditches). The amplitude slice maps are also important because they allow the visualization of radar reflections throughout the entire data set collected at a survey area at a given depth. This gives size and shape to collected radar reflections, which can aid in the interpretation of identified subsurface anomalies.

Amplitude slice-maps are generated through the comparison of radar reflection amplitudes recorded in vertical depth profiles, which correspond to individual transects collected within a survey grid along the X-axis. In this method, amplitude variations are analyzed at each location where a radar reflection was recorded. Reflection amplitude data from the X-axis is then used to interpolate reflection data on to the Y-axis.

Ground-Truthing

GPR interpretations, including slice maps and profiles, were provided to field crews prior to excavation of the test units. It was intended that the GPR analysis be used to aid excavation in anticipation of stratigraphic changes, utilities, or anomalies that may represent a buried discrete object. A GPR interpretation form was included in the test excavation documentation packets, and field crews were tasked with checking the accuracy of the pre-excavation GPR analysis. Ground-truthing GPR data with test excavations was accomplished in part by having the field crew answer several questions:

- *Were there factors that limited GPR depth penetration or caused image distortion?*

- *Were there GPR anomalies that corresponded to utility lines (metal or plastic), construction debris, boulders (basalt or limestone), previously backfilled excavations, concrete slabs, trash pits, coffin burials, traditional Hawaiian burials, etc.?*
- *How accurate were pre-excavation GPR interpretations? (Provide specific discussions in relation to both slice maps and profiles.) Were subsurface features present where indicated? Were indicated depths accurate? If initial analysis was inaccurate, try to provide an explanation for the documented anomalies.*
- *Were any subsurface features or sediment transitions present that were not recorded by the GPR (e.g. utility lines, trash pits, burials, drastic stratigraphic transitions, etc.)?*

The completed interpretation forms were then used to compile an excavation by excavation analysis detailing the GPR results, usefulness, and accuracy of the GPR data. The excavation by excavation analysis includes: geospatial referencing of the excavation, proximity to utilities, a brief review of both slice and profile maps, and a visual comparison of excavated profiles and GPR signal profiles. GPR results for the three test excavations conducted during this supplemental AIS are presented in the GPR Data Analysis section.

Summary and Interpretation

Summary of Fieldwork

A GPR survey was conducted within the study area prior to subsurface testing in an attempt to define the local stratigraphy and to prospect for buried cultural deposits. As part of the fieldwork for this supplemental AIS, the Pearlridge Station was surveyed to determine the location for the additional test excavations (PRS-4, PRS-5, and PRS-6).

Interpretation of Results

One of the primary foci of this survey was to test the efficacy of GPR analysis within the PRS footprint, an urban setting. Part of this study was designed to determine the ability of GPR technology to locate discrete objects in areas containing multiple fill events that are heavily disturbed from urban development. The results of this study suggests that it is very difficult to determine the difference between signal reflections caused by significant discrete objects or reflections caused by historic disturbance, subsurface infrastructure (utilities, old foundations, etc.), and imported fill layers. However, it should be noted that PRS-4, PRS-5, and PRS-6 test excavations contained no culturally significant discrete objects. PRS-4 contained metal pipes, as discovered during subsequent excavation, but these were not clearly discerned by the GPR equipment.

Concerning study area stratigraphy, GPR depth profiles indicated that the soils within the survey area consist of a complex variation of fill layers with varying densities and chemical composition. This was indicated thru the presence of horizontal banding, commonly associated with stratigraphic layering, observed at various depth intervals throughout the project area. Excavation of the test units revealed a multiple fill layer environment; however, stratigraphic transitions were not clearly seen in the GPR data.

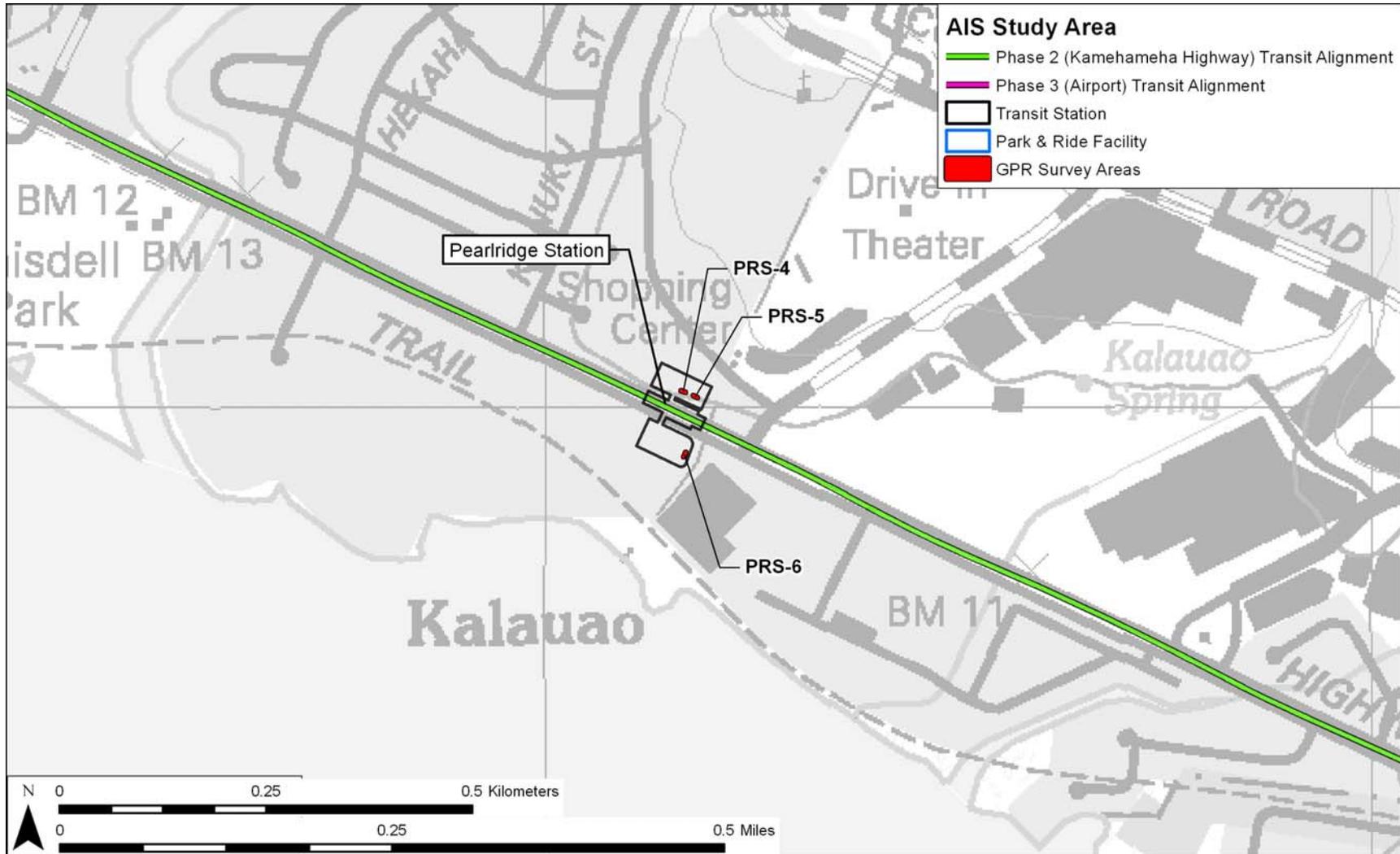


Figure 28. 1998 U.S. Geological Survey topographic map, Waipahu Quadrangle, showing locations of GPR survey areas within the current PRS footprint

GPR Data Analysis

Pearlridge Station Mauka

Test Excavation PRS-4

Pearlridge Station Test Excavation 4 (PRS-4) was located in a paved parking lot on the northern (*mauka*) side of Kamehameha Highway, approximately 75.0 m west of the Kaonohi Street and Kamehameha Highway intersection. No utilities were indicated in the vicinity of PRS-4. PRS-4 was located on property owned by the City. The excavation area was level with the surrounding land surface.

A review of amplitude slice maps showed no linear features which might have indicated the presence of utilities. Reflectivity was relatively uniform throughout the grid and stayed continuous with depth. A slight transition from higher reflectivity to lower reflectivity was observed at approximately 0.25 mbs (Figure 29).

GPR depth profiles for PRS-4 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 30). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.25 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

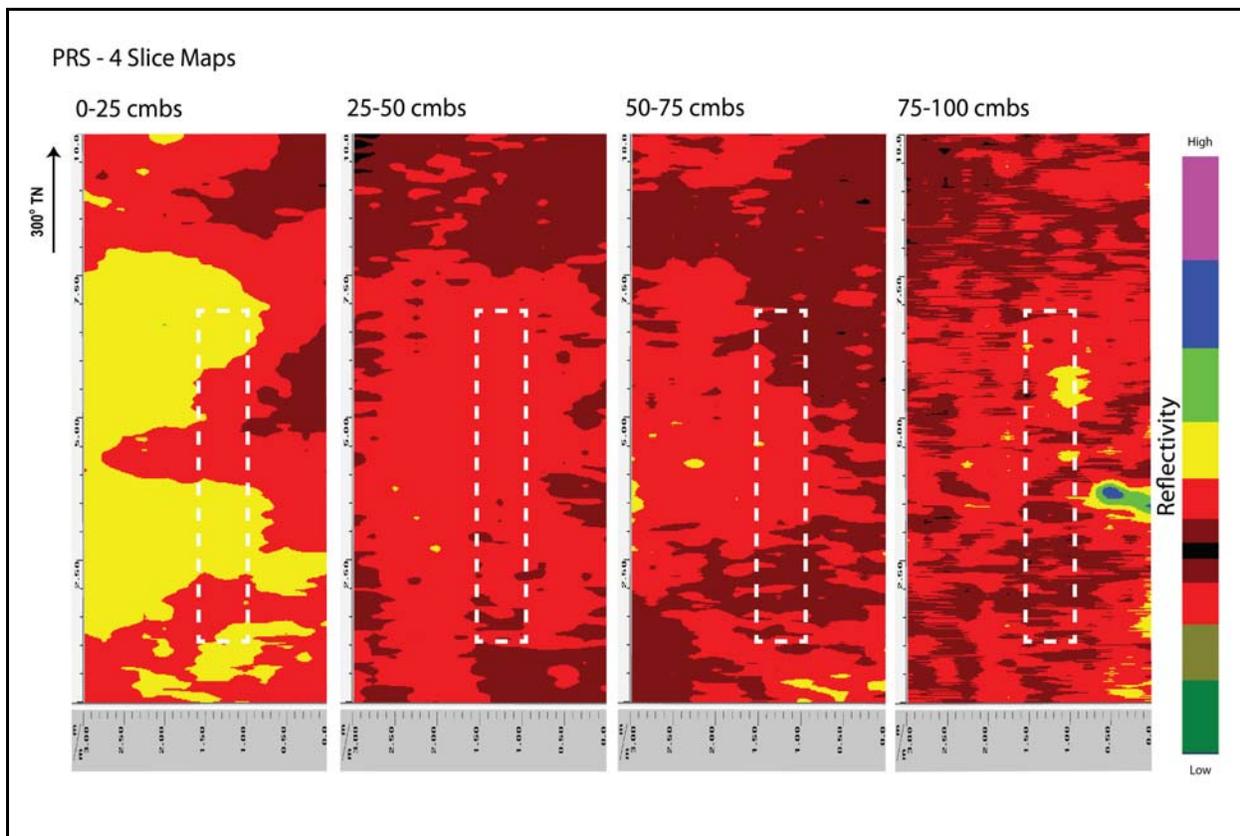


Figure 29. PRS-4 slice maps at 25.0 cm intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 30). The stratigraphic transitions between Strata Ia and Ic were observed and occurred at ground-truthed depths determined by excavation. The strata included a thin layer of asphalt on top of a very gravelly loam fill followed by a sandy loam that continued to 1.5 mbs. All other sediment transitions occurred below the maximum clean signal return of 1.1 mbs. No discrete objects were observed in the GPR results. Metal pipes were encountered during excavation but were not clearly seen on the GPR profiles.

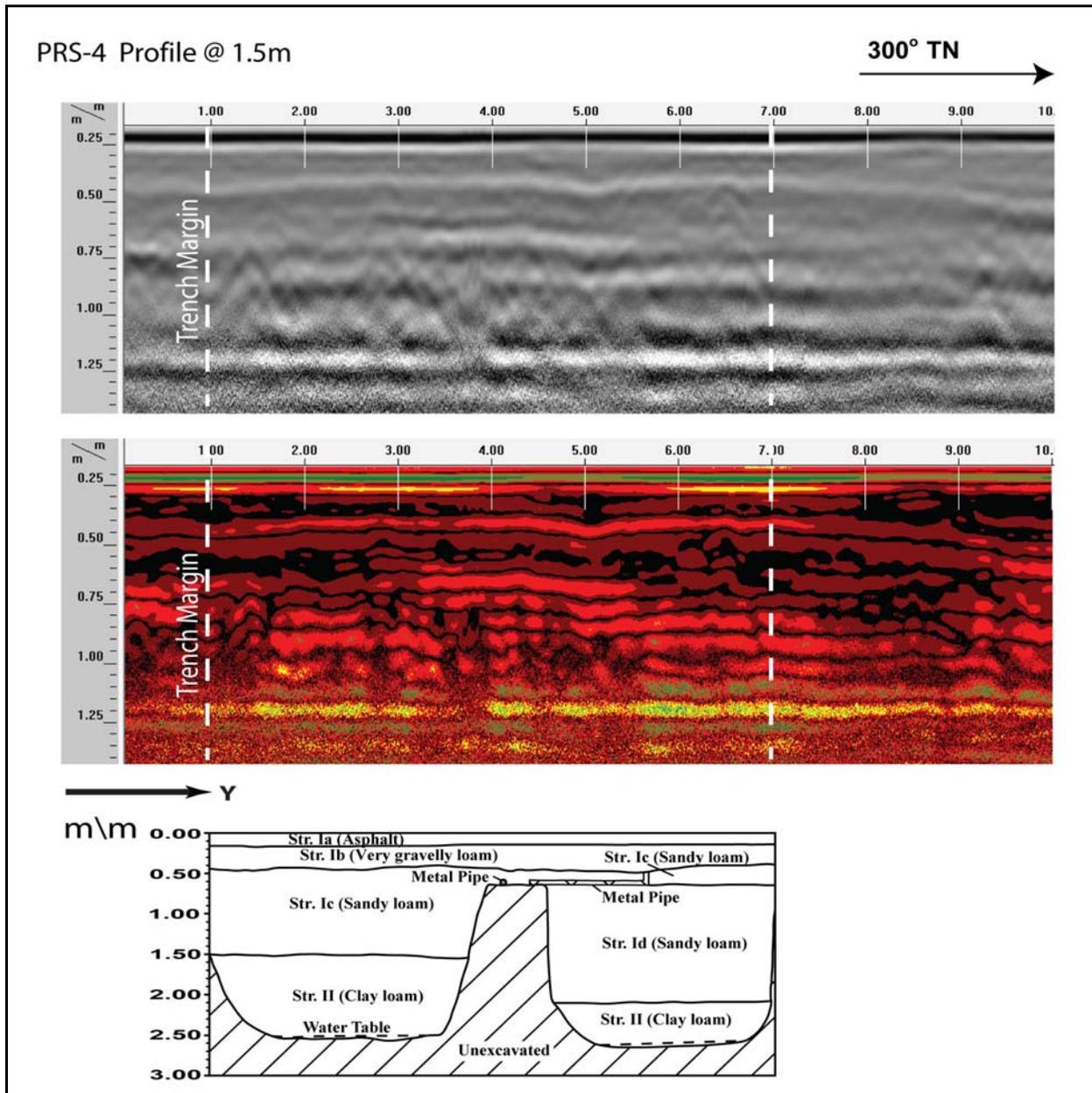


Figure 30. PRS-4, visual comparison of excavated profile and GPR signal profile

Test Excavation PRS-5

Pearlridge Station Test Excavation 5 (PRS-5) was located in a paved parking lot on the northern (*mauka*) side of Kamehameha Highway, approximately 65.0 m west of the Kaonohi Street and Kamehameha Highway intersection. No utilities were indicated in the vicinity of PRS-5. PRS-5 was located on property owned by the City. The excavation area was level with the surrounding land surface.

A review of amplitude slice maps showed no linear features which might have indicated the presence of utilities. Reflectivity varied throughout the grid and increased with depth. A transition from lower reflectivity to higher reflectivity was observed at approximately 0.50 mbs (Figure 31).

GPR depth profiles for PRS-5 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 32). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.50 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

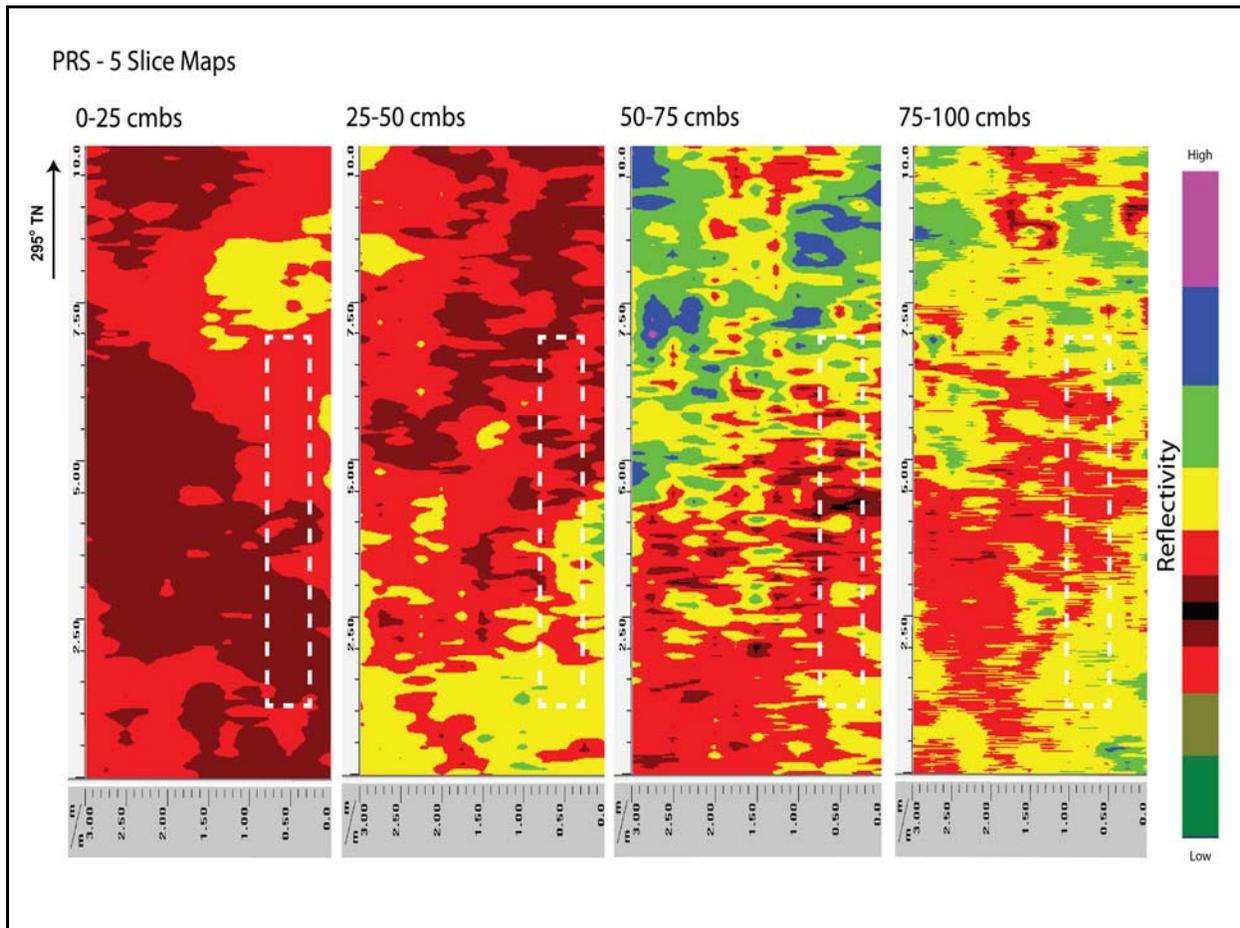


Figure 31. PRS-5 slice maps at 25.0 cm intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 32). The stratigraphic transitions between Strata Ia to Ie were not clearly observed. The stratigraphic transition of Ie to If is clearly displayed in the profile by an abrupt increase in reflectivity at around 0.6 mbs. Upper strata included a thin layer of asphalt on top of very gravelly clay loam fill and loamy clay followed by clay loam that continued to 1.50 mbs. All other sediment transitions occurred below the maximum clean signal return of 0.9 mbs. No discrete objects were observed in the GPR results or subsequent excavation.

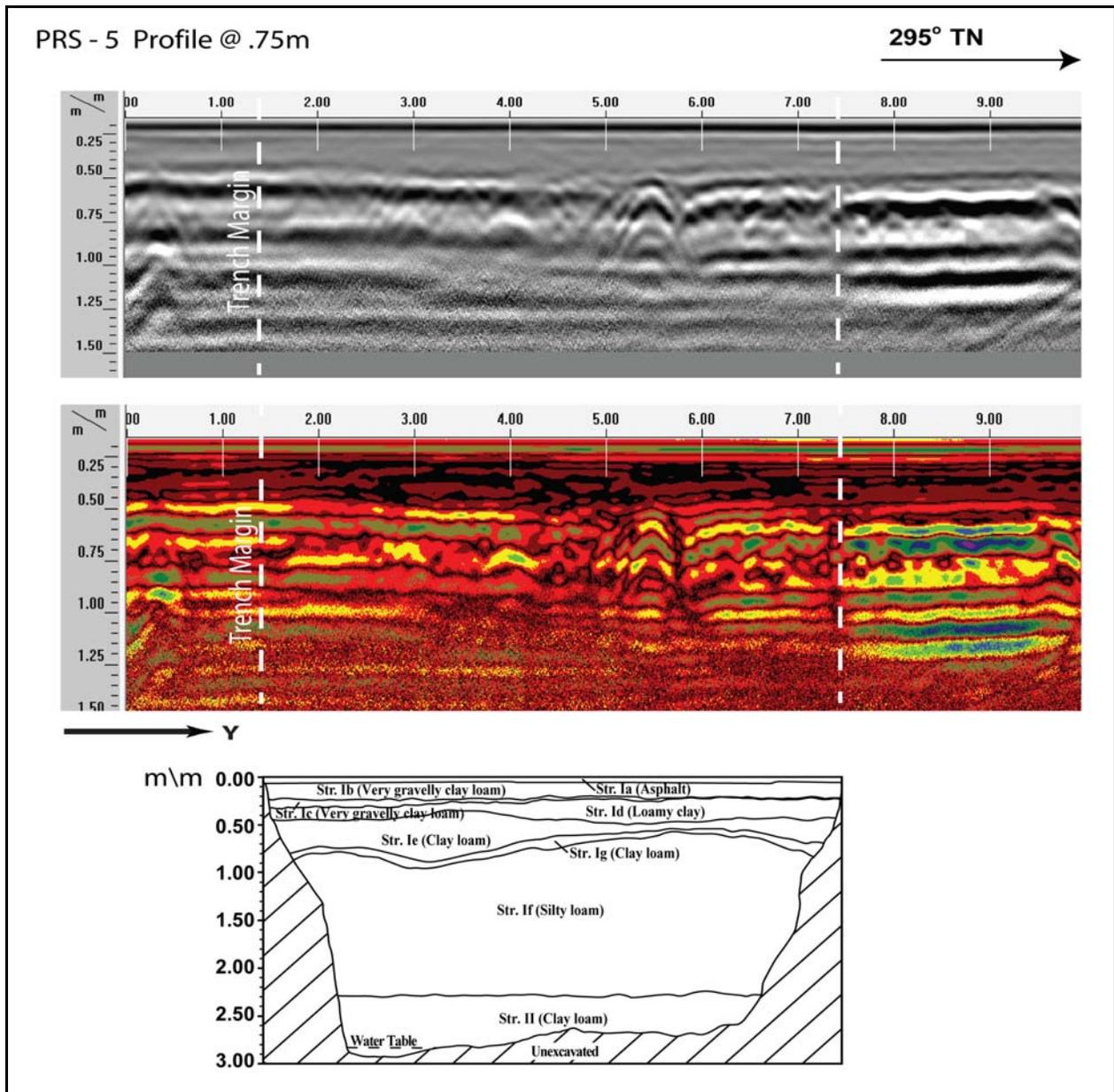


Figure 32. PRS-5, visual comparison of excavated profile and GPR signal profile

Pearlridge Station Makai

Test Excavation PRS-6

Pearlridge Station Test Excavation 6 (PRS-6) was located in a paved parking lot on the southern (*makai*) side of Kamehameha Highway, approximately 75.0 m southwest of the Kaonohi Street and Kamehameha Highway intersection. No utilities were indicated in the vicinity of PRS-6. The excavation area was level with the surrounding land surface.

A review of amplitude slice maps showed no linear features which might have indicated the presence of utilities. Reflectivity varied throughout the grid and increased with depth. A transition from lower reflectivity to higher reflectivity was observed at approximately 0.75 mbs (Figure 33).

GPR depth profiles for PRS-6 identified horizontal banding, commonly associated with stratigraphic layering, throughout the survey area (Figure 34). This banding corresponded to variations of density and chemical composition within fill deposits. The profile also indicated a change in reflectivity that occurred around 0.75 mbs. No utilities were observed in the profile. The maximum depth of clean signal return was approximately 1.0 mbs.

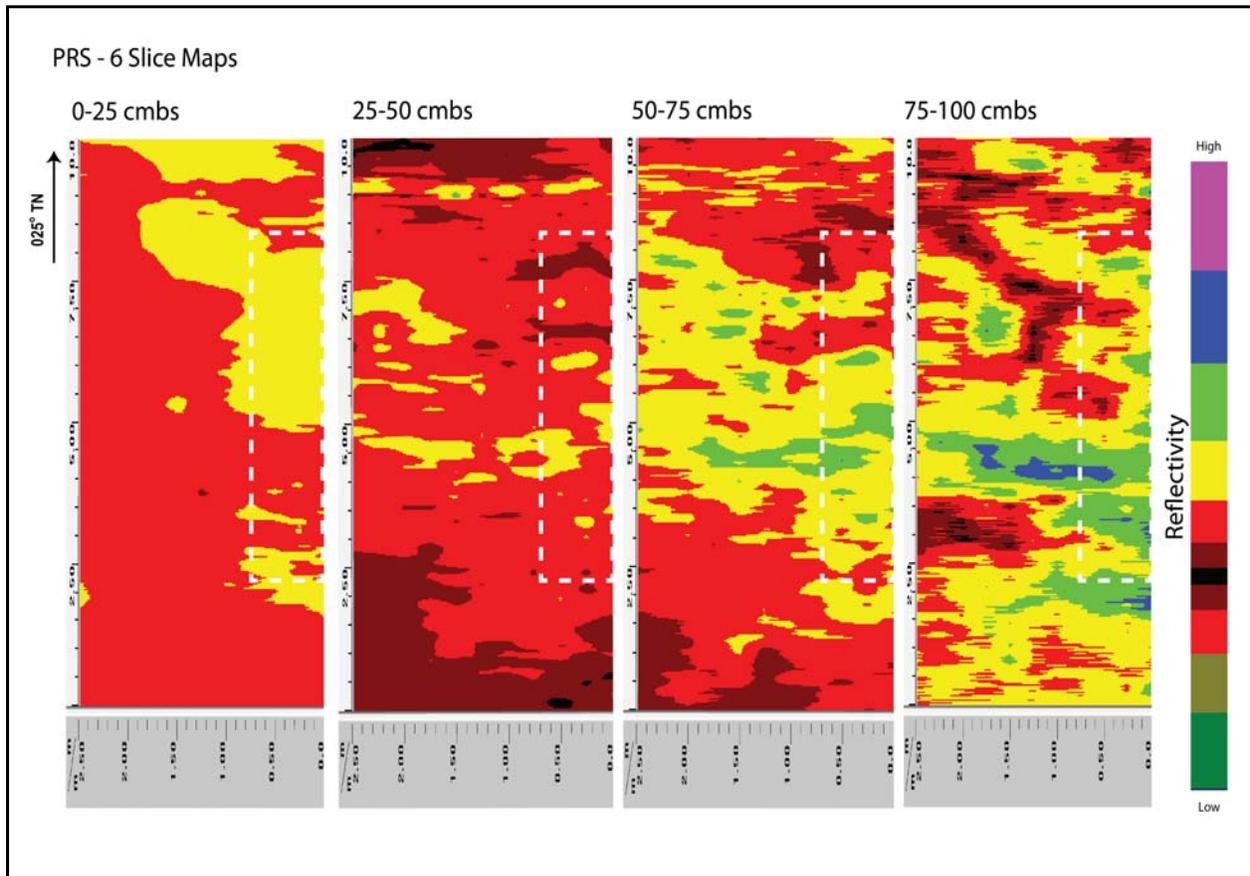


Figure 33. PRS-6 slice maps at 25.0 cm intervals

A visual comparison of the excavated profile and the GPR signal profile showed a moderate correlation in stratigraphic transitions (Figure 34). The stratigraphic transitions between Strata Ia and Ic were not clearly observed. The stratigraphic transition of Ic to Id is clearly displayed in the profile by an abrupt increase in reflectivity at around 0.75 mbs. Upper strata included a thin layer of asphalt on top of an extremely gravelly sand fill followed by a sandy clay loam that continued to 2.0 mbs. All other sediment transitions occurred below the maximum clean signal return of 0.9 mbs. No discrete objects were observed in the GPR results or subsequent excavation.

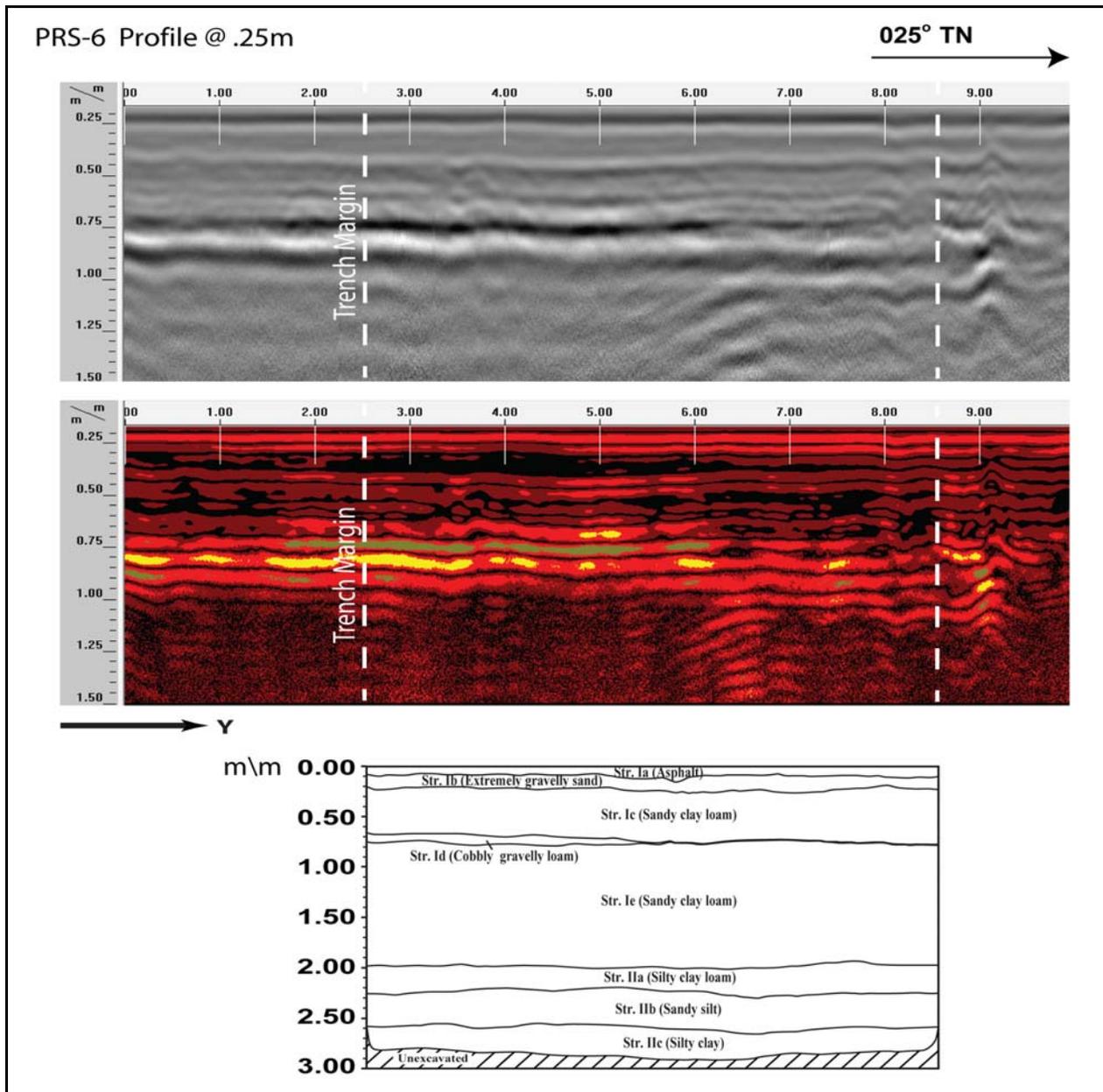


Figure 34. PRS-6, visual comparison of excavated profile and GPR signal profile

GPR (Appendix B) References Cited

Daniels, D. J.

2004 *Ground Penetrating Radar*. 2nd Ed. The Institute of Electrical Engineers, London.

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.

Natural Resources Conservation Service

2009 Ground Penetrating Radar Suitability Map—Hawai'i. National Soil Survey Center, Lincoln, Nebraska. Available at <<http://soils.usda.gov/survey/geography/maps/GPR/>>. Accessed on July 15, 2013.

O'Hare, Constance R., Todd Tulchin, Douglas Borthwick, and Hallett H. Hammatt

2009 *Inventory Survey Plan for Three Kamehameha Schools Kaka'ako Mauka Parcels, Kaka'ako, Honolulu District, O'ahu Island*. Cultural Surveys Hawai'i Inc., Kailua, Hawai'i.

Pammer, Michelle F., Jon Tulchin and Matt McDermott

2009 *Addendum to an Archaeological Inventory Survey and Cultural Impact Evaluation for the Alapai Transit Center and Joint Traffic Management Center Project, Honolulu Ahupua'a, Honolulu District, Island of O'ahu, TMK: (1) 2-1-042:004, 013*. Cultural Surveys Hawai'i Inc., Kailua, Hawai'i.

Sturm, Jennie

2010 *Report on Ground-Penetrating Radar Surveys and Method Testing: Honolulu Transit Project*. TAG Research by Sturm Inc., Albuquerque, New Mexico.

United States Department of Agriculture Natural Resources Conservation Service USDA NRCS GPR)

n.d. *Ground Penetration Radar Methodology*. Electronic document. <<http://soils.usda.gov/survey/geography/maps/gpr/methodology.html>> Accessed December 16, 2010.

U.S. Geological Survey

1998 U.S. Geological Survey Topographic Map, Waipahu Quadrangle. Available at U.S. Geological Survey Maps/U.S. Department of War Maps, USGS Information Services, Box 25286, Denver.

2005 U.S. Geological Service Orthoimagery. Available at U.S. Geological Survey Maps/U.S. Department of War Maps, USGS Information Services, Box 25286, Denver.