

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

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FILE COPY

JAN - 8 2020

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MAYOR



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DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-117

December 19, 2019

OEQC Director
Office of Environmental Quality Control
Department of Health, State of Hawai'i
235 S. Beretania Street, Room 702
Honolulu, Hawai'i 96813

Dear OEQC Director:

SUBJECT: Notice of Determination Letter
Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Under the provisions of Act 172 (12), the Department of Environmental Services (ENV) has determined that a Draft Environmental Impact Statement (DEIS) is required for the proposed Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities situated at TMK Zone 9 Sections 1 through 4 and Sections 6 through 9 (multiple properties), in the 'Ewa District on the island of O'ahu. This agency letter accompanies the online OEQC Publication Form that was completed and submitted for this project.

Pursuant to the requirements of Sections 11-200-3 and 11-200-15 of the Hawai'i Administrative Rules, we request that you publish notice of this determination and DEIS in the next available edition of *The Environmental Notice* for the public to review and submit comments to the ENV and its consultant, AECOM Technical Services, Inc., during a 45-day public comment period.

Should you have any questions, please contact Mr. Paul Christiansen, Civil Engineer, CIP Program and Planning, at (808) 768-3470 or email at p.christiansen@honolulu.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Lori M.K. Kahikina".

Lori M.K. Kahikina, P.E.
Director

Enclosure: Agency Publication Form

20-170

From: webmaster@hawaii.gov
To: [HI Office of Environmental Quality Control](#)
Subject: New online submission for The Environmental Notice
Date: Thursday, December 19, 2019 11:10:57 AM

Action Name

Honouliuli Wastewater Conveyance Plan

Type of Document/Determination

Draft environmental impact statement (DEIS)

HRS §343-5(a) Trigger(s)

- (1) Propose the use of state or county lands or the use of state or county funds
- (2) Propose any use within any land classified as a conservation district
- (3) Propose any use within a shoreline area
- (9)(A) Propose any wastewater treatment unit, except an individual wastewater system or a wastewater treatment unit serving fewer than fifty single-family dwellings or the equivalent

Judicial district

‘Ewa, O‘ahu

Tax Map Key(s) (TMK(s))

Zone 9 Sections 1 through 4 and Sections 6 through 9 and spans multiple properties.

Action type

Agency

Other required permits and approvals

Numerous (see document)

Proposing/determining agency

Department of Environmental Services, City and County of Honolulu

Agency contact name

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Agency contact email (for info about the action)

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Agency contact phone

(808) 768-3470

Agency address

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United States
[Map It](#)

Accepting authority

Department of Environmental Services, City and County of Honolulu

Accepting authority contact name

Lori Kahikina

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Was this submittal prepared by a consultant?

Yes

Consultant

AECOM Technical Services, Inc.

Consultant contact name

Rae Loui

Consultant contact email

rae.loui@aecom.com

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Consultant address

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Suite 1600
Honolulu, HI 96707
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Action summary

The City and County of Honolulu Department of Environmental Services' (ENV) Proposed Action is a program to upgrade and expand the existing East Interceptor Wastewater Collection System of the Honouliuli sewer basin to accommodate wastewater flows projected through the planning period of 2050. The Proposed Action includes planned improvements to the East Interceptor System and a proposed new sewer conveyance system from the Waiawa area to the East Interceptor System. Two East Interceptor conveyance options and three Waiawa conveyance options are evaluated. ENV anticipates that subsequent to this programmatic plan, and following the development of additional details of the individual projects, there may be further consideration of potential environmental effects for decision-making on the projects. When sufficient design details are available, separate project-specific HRS Chapter 343 documents will be prepared and compliance with other laws and requirements will be demonstrated.

Attached documents (signed agency letter & EA/EIS)

- [PRO-19-117-ltr-to-OEQC-HonWaiPC-DEIS-transmittal.pdf](#)
- [HonWaiPC-DEIS-Mailing-List.pdf](#)
- [OEQC-HonWaiPC-DEIS-Submittal.pdf](#)

Shapefile

- The location map for this Draft EIS is the same as the location map for the associated EIS Preparation Notice.

Authorized individual

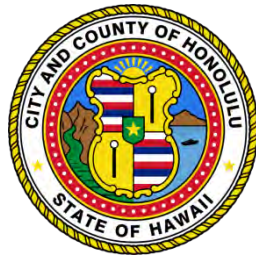
Rae Loui, AECOM Technical Services, Inc.

Authorization

- The above named authorized individual hereby certifies that he/she has the authority to make this submission.

**DRAFT ENVIRONMENTAL IMPACT STATEMENT
HONOULIULI/WAIPAHAU/PEARL CITY
WASTEWATER CONVEYANCE FACILITIES**

City & County of Honolulu
Department of Environmental Services
1000 Ulu'ohia Street, Suite 308
Kapolei, Hawai'i 96707



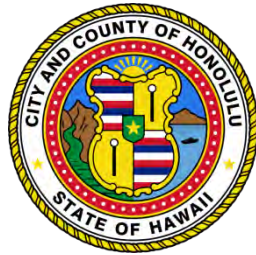
December 2019

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**DRAFT ENVIRONMENTAL IMPACT STATEMENT
HONOULIULI/WAIPAHAU/PEARL CITY
WASTEWATER CONVEYANCE FACILITIES**

Prepared for:

City & County of Honolulu
Department of Environmental Services
1000 Ulu'ohia Street, Suite 308
Kapolei, Hawai'i 96707



Prepared by:

AECOM Technical Services, Inc.
1001 Bishop Street, Suite 1600
Honolulu, Hawai'i 96813-3698

December 2019

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SUMMARY SHEET

Project Name:	Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities
Proposing Agency:	City and County of Honolulu Department of Environmental Services (ENV)
Accepting Authority:	ENV
Tax Map Keys (TMKs):	The project area is located in TMK Zone 9 Sections 1 through 4 and Sections 6 through 9 and spans multiple properties.
Location:	‘Ewa, Central O‘ahu, and a portion of the Primary Urban Center (PUC) Development Plan Areas, O‘ahu, Hawai‘i
Project Area:	The Honouliuli sewer basin includes areas with current wastewater flows to the Honouliuli Wastewater Treatment Plant (WWTP). This programmatic Draft Environmental Impact Statement (DEIS) focuses on proposed improvements and upgrades to the existing East Interceptor System of the Honouliuli sewer basin. The East Interceptor System area includes the primary trunk system of gravity lines, pump stations, and force mains conveying flows from areas generally east (to Hālawā) and north (to Mililani) of the Honouliuli WWTP. The DEIS also focuses on new conveyance corridors in the East Interceptor System to support the proposed Waiawa Master Plan development.
Project Description:	ENV’s Proposed Action is a program to upgrade and/or expand the existing East Interceptor System to accommodate wastewater flows projected through the planning period of 2050. It follows preparation of a separate Environmental Impact Statement that was prepared by ENV for proposed improvements to, and expansion of, the Honouliuli WWTP. The Proposed Action includes replacement, upgrades, and rehabilitation of wastewater pump stations (WWPSs), force mains, and trunk sewers to increase the capacity and rehabilitate the existing conveyance system from Hālawā to the Honouliuli WWTP. This programmatic DEIS evaluates this overall plan.
Existing Uses:	Residential, commercial, industrial, institutional, open space, harbor, and agricultural.
State Land Use:	Urban, Agricultural, and Conservation Districts.

Zoning:	Apartment, agriculture, business, federal and military preservation, industrial, resort, preservation, residential and mixed districts.
Flood Insurance Rate Map:	Portions are in the flood zone.
Special Management Area:	A portion is in the Special Management Area.
Significant Beneficial and Adverse Impacts and Proposed Mitigation Measures:	<p>Short-Term Impacts: The Proposed Action would result in some unavoidable short-term impacts as summarized below. These potential impacts vary depending on the option, are generally minor, and would be further minimized through the implementation of best management practices.</p> <ul style="list-style-type: none"> • Soils: Construction activities would result in unavoidable short-term soil disturbance and in soil loss during construction. Disposal methods may include use as fill material for other projects, temporary stockpiling, or final disposal to a landfill. Construction methods to preserve the integrity of existing utility lines would be implemented and construction equipment would be maintained in good working condition to reduce the potential for accidental spills. Mitigation measures such as erosion and sedimentation controls would be implemented, and a drainage and erosion control plan would be prepared. • Groundwater: Construction activities could potentially impact groundwater if encountered during the proposed work. Mitigation measures would be implemented during construction activities to preserve the integrity of existing utility lines and keep construction equipment in good working condition to prevent accidental spills. Also, dewatering may be necessary for construction below the groundwater table, which would be conducted in accordance with applicable regulations. • Surface Water and Coastal Waters: Excavation and land disturbance may contribute to sedimentation and runoff into nearby streams and Pearl Harbor, and accidental release of construction equipment fluids also could contaminate surface and coastal waters. Construction controls required by National Pollutant Discharge Elimination System (NPDES) permits would reduce the risk of sediment and

construction-related contaminants reaching surface and coastal waters.

- Flood Hazard: Demolition, regrading, excavating and backfilling trenches, and stockpiling of excavated materials in the special flood hazard area (SFHA) would result in temporary impacts to the SFHA during construction, and construction access points and staging areas could result in local increases in stormwater runoff to the SFHA due to a decrease in surface permeability and removal of vegetation.
 - Flora and Fauna: Construction activities would temporarily disturb existing vegetation and associated wildlife. Locations where vegetation is disturbed would be restored to existing conditions or better.
 - Wetlands and Other Waters of the United States: Construction activities may result in temporary loss of wetlands and other Waters of the United States. Locations where wetlands are temporarily impacted would be restored to existing conditions or better.
 - Air Quality: Construction would result in short-term impacts to air quality, including increases in particulate matter or dust from vehicle movement on the construction site and trucks on road, excavation activities, spoils removal activities, and emissions from construction vehicles and equipment. State air pollution controls prohibiting visible emissions of fugitive dust from construction activities at the property line would be followed by the contractor. Dust control measures and idling restrictions would be implemented, and additional emission reduction measures would also be considered to the extent reasonably feasible.
 - Noise: Construction noise would be unavoidable during the duration of construction. Short-term increases in noise levels would result from construction activities, vehicles and equipment. The use of muffled equipment, noise barriers, and restrictions on construction hours, as well as adherence to State of Hawai'i Department of Health (DOH) regulations on noise mitigation, would minimize construction and traffic-related noise. For construction work to be performed at night or on weekends and holidays, a community noise variance
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permit from DOH would be required if noise exceeds regulatory levels.

- **Transportation:** Construction would result in temporary impacts to the various transportation modes in the project area including roadways, pedestrian and bike facilities, and public transit facilities near the Proposed Action. Impacts would include lane closures, disruption of sidewalks and crosswalks, disruption of the Pearl Harbor Bike Path, and potential delays to traffic and City bus routes. Mitigation measures would include preparation of a transportation management plan, minimizing closures during peak travel periods, and providing alternative paths for pedestrians and bicyclists.
 - **Visual and Aesthetic Resources:** During construction activities, the presence of cranes and other heavy equipment would result in short-term impacts to visual aesthetics in the project area. During construction, fencing surrounding construction sites may be provided as needed to provide a visual screen of the project site and materials.
 - **Wastewater:** The Proposed Action would result in short-term impacts to the existing wastewater collection system during construction of the proposed improvements and rehabilitation activities, including potential temporary interruptions to service to connect new structures and facilities to the existing system. Temporary pumping and piping would be provided as needed.
 - **Solid Waste Disposal:** During construction, although most excavated material would be used as backfill on site, excess excavated material that could not be kept on site would require offsite disposal. Coordination with local landfills and recycling centers for the disposal of construction debris and/or hazardous materials may be required. Disposal would be in accordance with appropriate regulations and standards.
 - **Public Schools:** During construction, there may be additional noise and traffic at or near the schools, regardless of the options selected. Construction traffic would be scheduled to avoid conflict with school traffic.
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- Parks and Recreational Areas: During construction, there may be additional noise and traffic at or near parks and recreational areas, regardless of the options selected. Under all options, long-term impairment of public use of Neal S. Blaisdell Park and Aloha Stadium, where conversion of park lands may be subject to National Park Service 6(f) restrictions, as well as all existing parks, has been avoided to the extent possible. However, temporary interference with recreational activities during construction and, under certain alternatives, permanent conversion of park land are anticipated.

Long-Term Impacts: The following unavoidable long-term impacts may result from implementation of the Proposed Action.

- Groundwater, Surface Water, and Coastal Waters: The additional capacity to the conveyance and treatment system resulting from the Proposed Action is expected to minimize the potential of SSOs and associated impacts to water resources. The proposed project would reduce the likelihood of leakage or breakage in sewer lines or force mains. Mitigation measures for operational impacts include proper operation and maintenance of the proposed improvements.
 - Air Quality: Potential long-term emissions from each WWPS—particularly from new WWPSs to be constructed—could have the potential to affect air quality conditions in the neighborhood from operation of generators. The No-Tunnel option would include relocating the existing Pearl City WWPS, the operation of which could cause odor complaints. Through the implementation of the state air pollution control requirements and obtaining preconstruction and operating air permits, pump station operational air quality impacts would be less than significant. For the No-Tunnel option, odor control measures would be implemented for the Pearl City WWPS replacement alternatives to minimize odor impacts to neighboring uses and sensitive receptors, including the Lehua Elementary School and Lehua Community Park.
 - Visual and Aesthetic Resources: Regardless of the options selected, new above-grade facilities likely would be landscaped and are not expected to substantially affect scenic vistas and view planes in
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	<p>the area, although increased capacity in the collection system is expected to result, over time, in a more urbanized look in the area of the East Interceptor system.</p> <ul style="list-style-type: none"> • Public Schools, Parks, and Recreation: For the No-Tunnel option, there are public concerns regarding odor control due to the proximity of the location of the Pearl City WWPS replacement alternatives to Lehua Elementary School and Lehua Community Park. To address these concerns, if the option to relocate the Pearl City WWPS is elected, additional odor control measures would be implemented at the WWPS to minimize any odor impacts to neighboring uses, including the school and park. • This DEIS includes projects that rehabilitate and improve the wastewater conveyance system. Long-term impacts of the projects described are generally positive.
<p>Alternatives Considered:</p>	<ul style="list-style-type: none"> • Alternatives considered for the Proposed Action include the following: • East Interceptor Conveyance Options: No-Tunnel and Hybrid • Waiawa Area Conveyance Options: Corridor A, Corridor D, and Corridor G • Alternative WWPS replacement locations
<p>Unresolved Issues:</p>	<p>The unresolved issues at the time of this DEIS submittal are summarized below:</p> <ul style="list-style-type: none"> • Selection of Preferred Options: There are multiple proposed options to rehabilitate, upgrade and/or expand the existing Honouliuli major sewer conveyance system (East Interceptor System) to accommodate flows through 2050. Identification of preferred options and alignments will be influenced by the findings of this DEIS. • Design of Preferred Options: The Proposed Action design and layout is conceptual at this stage. It is anticipated that some adjustments will be made to conceptual designs and site layout during the design phase after preferred options and alignments have been identified. • Project-Specific HRS Chapter 343 Documents: This DEIS is intended to provide environmental considerations that may assist ENV in its decision-

making. With the planning level of information currently available, the DEIS evaluation is considered programmatic. When sufficient design details are available, separate project-specific Hawai'i Revised Statutes (HRS) Chapter 343 documents will be prepared as appropriate and compliance with special laws (e.g., HRS Chapter 6E Historic Preservation) will be demonstrated.

- Greenhouse Gas Emissions: Greenhouse Gas (GHG) impacts and mitigation measures are not included in this DEIS. A study of whether the Proposed Action may emit substantial GHGs directly or as an indirect or cumulative impact will be conducted for individual projects as designs progress.
- Shoreline Setback: A survey may be necessary to confirm the specific location of the shoreline setback and to verify that project components are or are not located within this area.
- Wetlands: Wetland delineations would be necessary in order to verify the location of wetlands.
- Impacts to Specific Species: For specific projects, observation of nesting birds or other species at the time of construction would be necessary in order to verify that no endangered or threatened species are present.

Compatibility with Land Use Plans and Policies:

State Land Use: The project area extends over portions of land within three (3) of the four (4) land use districts: Urban District, Agricultural District, and Conservation District. The Proposed Action is permissible within the Urban District and the Agricultural District, however, work within the conservation district requires a permit.

Zoning: The Proposed Action spans eleven (11) zoning districts as detailed in the DEIS. ENV's interpretation is that the Proposed Action would be classified as a "Utility Installation Type A" land use, which is a permitted use in all zoning districts except for F-1 (Federal and Military Preservation District).

Compatibility with State and Local Land Use Plans: The Proposed Action generally conforms with the various relevant land use plans, policies, and regulatory controls including but not limited to the Hawai'i State Plan, State Functional Plans, Hawai'i Sustainability Plan, Coastal Zone Management Program, Ocean Resources Management Plan, CCH General Plan, Development Plans and Sustainable Communities Plans,

Neighborhood and Transit-Oriented Development Plans,
Special Management Area, and Shoreline Setback.

List of Required and Potential Permits/Approvals:

Clearances and permits needed from the various federal, state and City and County of Honolulu (CCH) agencies may include but are not limited to the following.

Federal:

- U.S. Army Corps of Engineers
 - *Department of the Army Permit (Clean Water Act Section 404; Rivers and Harbors Act Section 10)*
 - U.S. Coast Guard
 - *Section 9 Permit Applicability Guidance*
 - U.S. Environmental Protection Agency
 - *National Pollutant Discharge Elimination System (NPDES) Form 2A – Discharge of Municipal Wastewater from New and Existing Publicly Owned Treatment Works*
 - *Clean Water Act Section 301(h) Review*
 - *Southern Basal Aquifer Review*
 - U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration National Marine Fisheries Services
 - *Endangered Species Act Section 7 Consultation*
 - *Magnuson-Stevens Fishery Conservation and Management Act Consultation*
 - *Conservation and Management Act Essential Fish Habitat Consultation*
 - U.S. Navy
 - *Real Estate License*
 - *Explosive Safety Submission Determination Request*
 - *Site Approval Request*
 - *Dig Permit*
 - *Waiver Request to the Joint Base Pearl Harbor-Hickam Green Waste Disposal Policy*
 - *Toning Equipment Clearance*
 - *Defense Biometric Identification System*
 - National Park Service
 - *6(f) requirements for Blaisdell Park and Aloha Stadium*
-

State of Hawai'i:

- Department of Business, Economic Development and Tourism, Office of Planning (DBEDT)
 - *Coastal Zone Management Consistency Determination*
- Department of Health (DOH)
 - *Air Pollution Control Permits (Covered Source Permit and/or Noncovered Source Permit)*
 - *Noise Variance Permit*
 - *Individual NPDES – Discharge of municipal wastewater from new and existing publicly owned treatment works (modification)*
 - *NPDES Notice of Intent for General Permit Form C – Storm Water Discharges Associated with Construction Activities*
 - *NPDES Notice of Intent Form F – Discharges Associated with Hydrotesting Waters*
 - *NPDES Notice of Intent Form G – Discharges Associated with Construction Activity Dewatering*
 - *Section 401 Water Quality Certificate*
- Department of Land and Natural Resources Office of Conservation and Coastal Lands
 - *Conservation District Use Permit*
- Department of Land and Natural Resource Commission on Water Resource Management
 - *Stream Channel Alteration Permit*
- Department of Land and Natural Resources Historic Preservation Division
 - *Chapter 6E, Hawai'i Revised Statutes (HRS) Historic Preservation Review*
- Department of Transportation
 - *Highways – Permit to Perform Work within State Highways*
 - *Construction Plan Review and Approval*
 - *Harbors – Work within the Energy Corridor*

City and County of Honolulu:City and County of Honolulu:

- Board of Water Supply (BWS)
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- *Water and Water System Requirements*
 - *Construction Plan Review and Approval*
 - Department of Environmental Services
 - *Environmental Impact Statement (EIS) Approval*
 - *Permission to discharge into sanitary sewer*
 - Department of Facility Maintenance
 - *Permission to Discharge into CCH storm drain system (Required for DOH Clean Water Branch NPDES permits)*
 - Department of Planning and Permitting (DPP)
 - *Building Permit*
 - *Construction Plan Review and Approval*
 - *Development Plan Public Facilities Map Amendment*
 - *Dewatering Permit*
 - *Electrical Permit*
 - *Grading and Erosion Control Plan Review*
 - *Grading, Grubbing, and Stockpiling Permit*
 - *Plumbing Permit*
 - *Shoreline Setback Variance*
 - *Sidewalk/Driveway Work Permit*
 - *Special Management Area Use Permit for areas in the Special Management Zone: Waipahu, Pearl City, and Waimalu WWPSs*
 - *Zoning waiver(s)*
 - Department of Transportation Services
 - *Review for CCH right-of-way*
 - Honolulu Fire Department (HFD)
 - *Review for diesel tanks, hydrants, sprinkler systems*

Other:

- Utility Companies
 - *Utility Service Requirements*
 - *Hawaiian Electric Company, Inc. (HECO)*
 - *Hawai'i Gas*
 - *Spectrum Cable*
 - *AT&T*
 - *Hawaiian Telecom*
-

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- *Sprint PCS*
 - *Verizon*
 - *Island Energy Services*

– *Permit Regarding Work on Utility Lines*

EIS Preparer: AECOM Technical Services, Inc.
1001 Bishop Street, Suite 1600
Honolulu, Hawai'i 96813
Contact: Rae Loui

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ACRONYMS AND ABBREVIATIONS

AECOM	AECOM Technical Services, Inc.
BMP	best management practice
BWS	Board of Water Supply
CAA	Clean Air Act
CCH	City and County of Honolulu
CCD	census county division
CIA	Cultural Impact Assessment
CSH	Cultural Surveys Hawai'i, Inc.
CZM	coastal zone management
dBA	A-weighted decibel(s)
DBEDT	Department of Business, Economic Development and Tourism
DEIS	Draft Environmental Impact Statement
DNL	day-night average sound level
DOFAW	State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife
DOH	State of Hawai'i Department of Health
DP	development plan
DPA	development plan area
DPP	Department of Planning and Permitting
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
EJ	environmental justice
ENV	Department of Environmental Services
EPA	United States Environmental Protection Agency
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FM	force main
°F	degrees Fahrenheit
GHG	greenhouse gas
GMSL	global mean sea level
GST	gravity sewer tunnel
H ₂ S	hydrogen sulfide
HAR	Hawai'i Administrative Rules
HART	Honolulu Authority for Rapid Transportation
HECO	Hawaiian Electric Company, Inc.
HFD	Honolulu Fire Department
Honouliuli Fac Plan	Honouliuli/Waipahu/Pearl City Wastewater Facilities Plan
HPD	Honolulu Police Department
HRHP	Hawai'i Register of Historic Places
HRS	Hawai'i Revised Statutes
IBC	International Building Code
IPCC	Intergovernmental Panel on Climate Change
LF	linear feet
LRFI	Archaeological Literature Review and Field Inspection
MBTA	Migratory Bird Treaty Act

MSL	mean sea level
NAAQS	National Ambient Air Quality Standards
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NSR	New Source Review
O‘ahuMPO	O‘ahu Metropolitan Planning Organization
OEQC	Office of Environmental Quality Control
OR&L	Oahu Railway & Land Company
ORMP	Ocean Resources Management Plan
PUC	Primary Urban Center
ROI	region of influence
SF	square feet
SFHA	special flood hazard area
SHPD	Hawai‘i State Historic Preservation Division
SIHP	State Inventory of Historic Properties
SMA	Special Management Area
SSO	sanitary sewer overflow
TIAR	transportation impact assessment report
TMK	Tax Map Key
TOD	transit-oriented development
$\mu\text{g}/\text{m}^3$	micrograms per cubic meter
USACE	United States Army Corp of Engineers
USBEA	United States Bureau of Economic Analysis
USCB	United States Census Bureau
USFWS	United States Fish and Wildlife Service
WWPS	wastewater pump station
WWTP	wastewater treatment plant

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

The City and County of Honolulu Department of Environmental Services (ENV) is developing the Honouliuli/Waipahu/Pearl City Wastewater Facilities Plan (Honouliuli Fac Plan) for the Honouliuli sewer basin. The study area for the Honouliuli Fac Plan consists of the Honouliuli Wastewater Treatment Plant (WWTP) and its wastewater service area, including the 'Ewa and Central O'ahu area from Ko 'Olina to Hālawā. The intent of the Honouliuli Fac Plan is to define improvements to the existing wastewater collection system and treatment facilities to meet future flow demands and permit compliance.

The Honouliuli sewer basin is delineated in Figure 1-1. As the second largest sewer basin on O'ahu, it serves approximately one-third of the island's population and includes approximately 103,400 acres (about 27 percent of the island's total area). The Honouliuli WWTP provides primary treatment to all flow it receives and secondary treatment to approximately half of the total flow received. Currently, the Honouliuli WWTP treats over 26 million gallons per day of wastewater.

The action evaluated in this programmatic Draft Environmental Impact Statement (DEIS) is the planned improvements to the East Interceptor System and proposed wastewater conveyance alternatives for the future development in the Waiawa area to the East Interceptor System. The existing East Interceptor System is illustrated in Figure 1-2 and is the primary trunk system of gravity lines, pump stations, and force mains conveying flows from areas generally east and north of the Honouliuli WWTP. Two (2) East Interceptor conveyance options and three (3) Waiawa conveyance options are evaluated in this DEIS.

The following two (2) Honouliuli Fac Plan projects have either been or are being evaluated under separate Hawai'i Revised Statutes (HRS) Chapter 343 documents:

- Proposed improvements to, and expansion of, the Honouliuli WWTP. The Environmental Impact Statement (EIS) was completed and approved in 2017 (AECOM Technical Services, Inc. (AECOM) 2017) and was driven by consent decree mandates (see Section 1.2.1).
- Proposed project to construct the Waipahu WWPS Third Force Main. The Environmental Assessment is currently being prepared.


The proposed activities addressed in separate HRS Chapter 343 documents are not detailed in this DEIS. However, their effects are addressed and incorporated by reference as part of the Proposed Action in the DEIS and considered in the evaluation of cumulative effects.

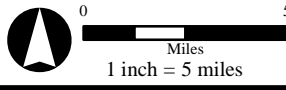
The environmental resources likely to be affected by the Proposed Action are identified in this DEIS and the potential environmental impacts are evaluated. Findings from the EIS process will be used by ENV in its decision-making. As the individual projects described in this DEIS are further developed, project-specific documents will be prepared as needed to meet HRS Chapter 343 obligations.

**City and County
of Honolulu**

**HONOULIULI/
WAIPAHAU/ PEARL CITY
WASTEWATER
CONVEYANCE
FACILITIES**

Legend

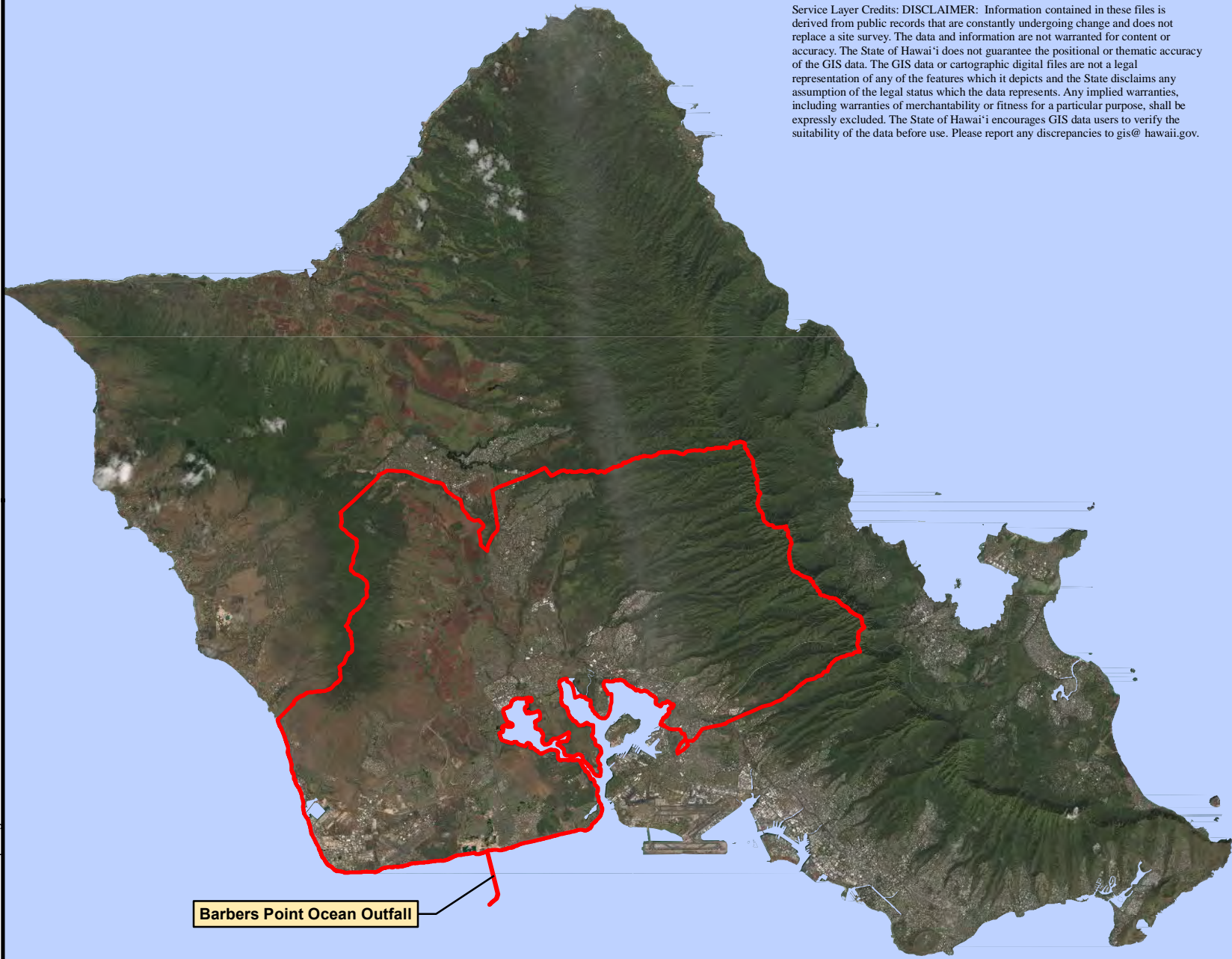
 Honouliuli Sewer Basin



**FIGURE 1-1
HONOULIULI
SEWER BASIN**

AECOM
1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813

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Barbers Point Ocean Outfall

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



Base map data sources:
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City and County of Honolulu

HONOLULU/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

-  Existing WWPS
-  East Interceptor
-  Force Main
-  Major Sewer Main

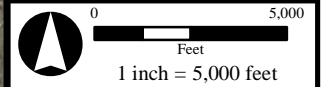
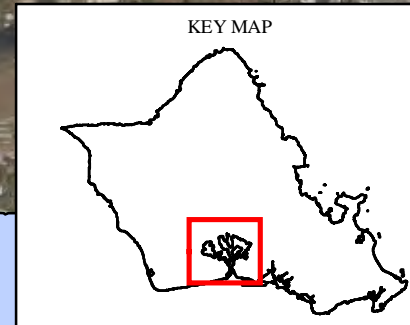


FIGURE 1-2

EXISTING HONOLULU EAST INTERCEPTOR SYSTEM



- 1** Halawa Force Main
- 2** Waimalu Influent Trunk Sewer
- 3** Waimalu Force Main
- 4** Pearl City Influent Trunk Sewer
- 5** Pearl City Dual Force Main
- 6** Waipahu Force Main
- 7** 84-inch Honouliuli Interceptor

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1.2 BACKGROUND

1.2.1 Consent Decree Mandates

ENV previously developed a Capital Improvement Plan that included recommendations from the *Final Sewer Infiltration and Inflow (I/I) Plan* (Fukunaga and Associates, Inc. 1999). The purpose of that plan was to develop the optimal approach to minimize sanitary sewer overflows (SSOs) and fulfill the requirements of a 1995 Consent Decree (Civil Number 94 00765 DAE) between the City and County of Honolulu (CCH), the State of Hawai‘i, and the United States Environmental Protection Agency (EPA). Subsequent planning for a long-range strategy for accommodating the collection, treatment, and disposal of wastewater in the basin resulted in the *West Māmalā Bay Facilities Plan* (Wilson Okamoto & Associates, Inc. and Brown and Caldwell 2001). This plan proposed various planning recommendations for the collection system (addressing storage and conveyance of wet weather flows) and the WWTP.

The collection system recommendations emphasized upgrades of existing wastewater pump stations (WWPSs), constructing large interceptor sewers, and collection system storage at major WWPSs. The intent of collection system storage was to provide flow equalization adjacent to the four primary WWPSs (Hālawā, Waimalu, Pearl City, and Waipahu WWPSs). These improvements would reinforce the adequacy of the existing WWPSs.

On December 17, 2010, EPA, the state, and CCH entered into a Consent Decree to replace the 1995 Consent Decree. The 2010 Consent Decree recognized the need to re-evaluate the projects remaining from the *Final Sewer Infiltration and Inflow (I/I) Plan* (Fukunaga and Associates, Inc. 1999), including sewer relief line projects and WWPS capacity upgrade projects. The 2010 Consent Decree also required upgrading the existing WWTP from partial secondary treatment to full secondary treatment by 2024.

The East Interceptor System improvements required by the 2010 Consent Decree have been completed or are under construction. This DEIS addresses proposed improvements that are beyond the Consent Decree requirements and, therefore, have no mandated Consent Decree deadlines.

1.2.2 Existing Facilities / Honouliuli East Interceptor System

1.2.2.1 HONOULIULI WWTP SEWER BASIN

The Honouliuli WWTP provides service to the developed areas in the region around Pearl Harbor, from Hālawā in the east to Ko ‘Olina in the west, and extending to Mililani in the north. The Honouliuli WWTP services the communities of Hālawā, ‘Aiea, Waimalu, Pearl City, Pacific Palisades, Waiawa, Waipahu, Mililani, Waipi‘o, Village Park, Crestview, Waikele, Kunia, Kapolei, West Loch, Kalaeloa Community Development District (formerly known as Barbers Point Naval Air Station), ‘Ewa Beach, Makakilo, and Ko ‘Olina. Currently the total service area includes approximately 22,000 acres of developed land.

Within the collection and transport system, wastewater flows by gravity or is pumped to the Honouliuli WWTP. Nineteen (19) ENV-operated WWPSs are located throughout the Honouliuli basin, as well as an influent pump station at the WWTP. ENV-operated WWPSs and their respective tributary areas are shown in Figure 1-3. A schematic of the connectivity of the tributary areas for each WWPS is shown in Figure 1-4.

1.2.2.2 WWPSs AND TRIBUTARY AREAS INCLUDED IN THE EAST INTERCEPTOR SYSTEM

The Honouliuli Fac Plan and this DEIS focus on the East Interceptor System area which includes the Hālawā, Waimalu, Pearl City, and Waipahu WWPSs and their associated sewers and force mains, as shown in Figure 1-2. Gravity Sewers and Force Mains

The Honouliuli sewer basin gravity collection system is mainly made up of approximately 83 percent vitrified clay pipes and approximately 9 percent reinforced concrete pipes. The most common pipe size in the sewer basin is 8-inch diameter, which makes up approximately 65 percent of the total length of pipe. There is a total length of almost 494 miles of gravity sewers in the Honouliuli sewer basin and approximately 12 miles of force mains.

1.2.2.3 HONOULIULI WWTP

The Honouliuli WWTP is the second largest WWTP on O‘ahu and has a design capacity of 51 million gallons per day with all units in service. Since the WWTP became operational in 1984, it has undergone several expansions and upgrades to address growth within the service area and additional treatment needs. The full secondary treatment upgrade for the WWTP was evaluated in the Final Environmental Impact Statement (FEIS) completed and approved in 2017 and is not further assessed in this document. The Honouliuli WWTP FEIS considered conveyance and wastewater treatment needs in light of projected development and associated flows. This document is referenced in certain sections where appropriate to provide information and context needed in this assessment.

City and County of Honolulu

HONOULIULI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

- Legend**
- PS Existing WWPS
 - East Interceptor
 - Honouliuli Sewer Basin

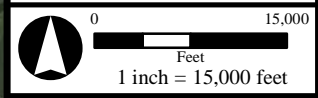
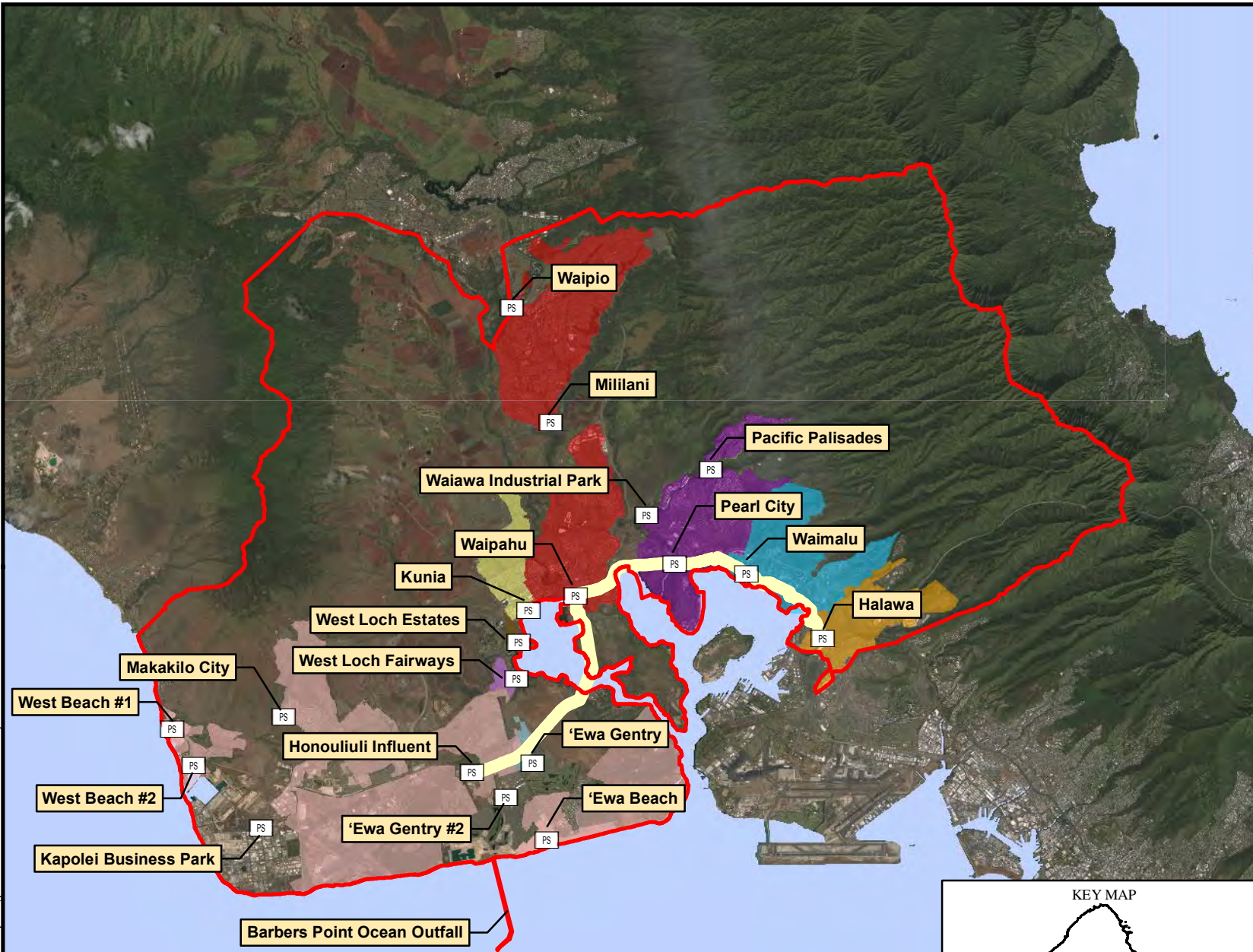
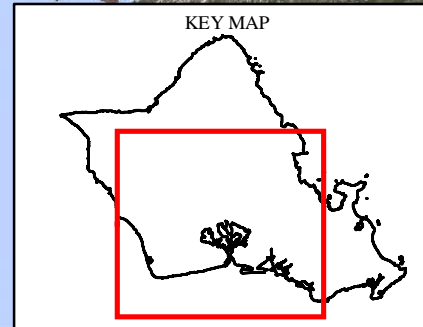


FIGURE 1-3
HONOULIULI
WWPS
TRIBUTARY
AREAS



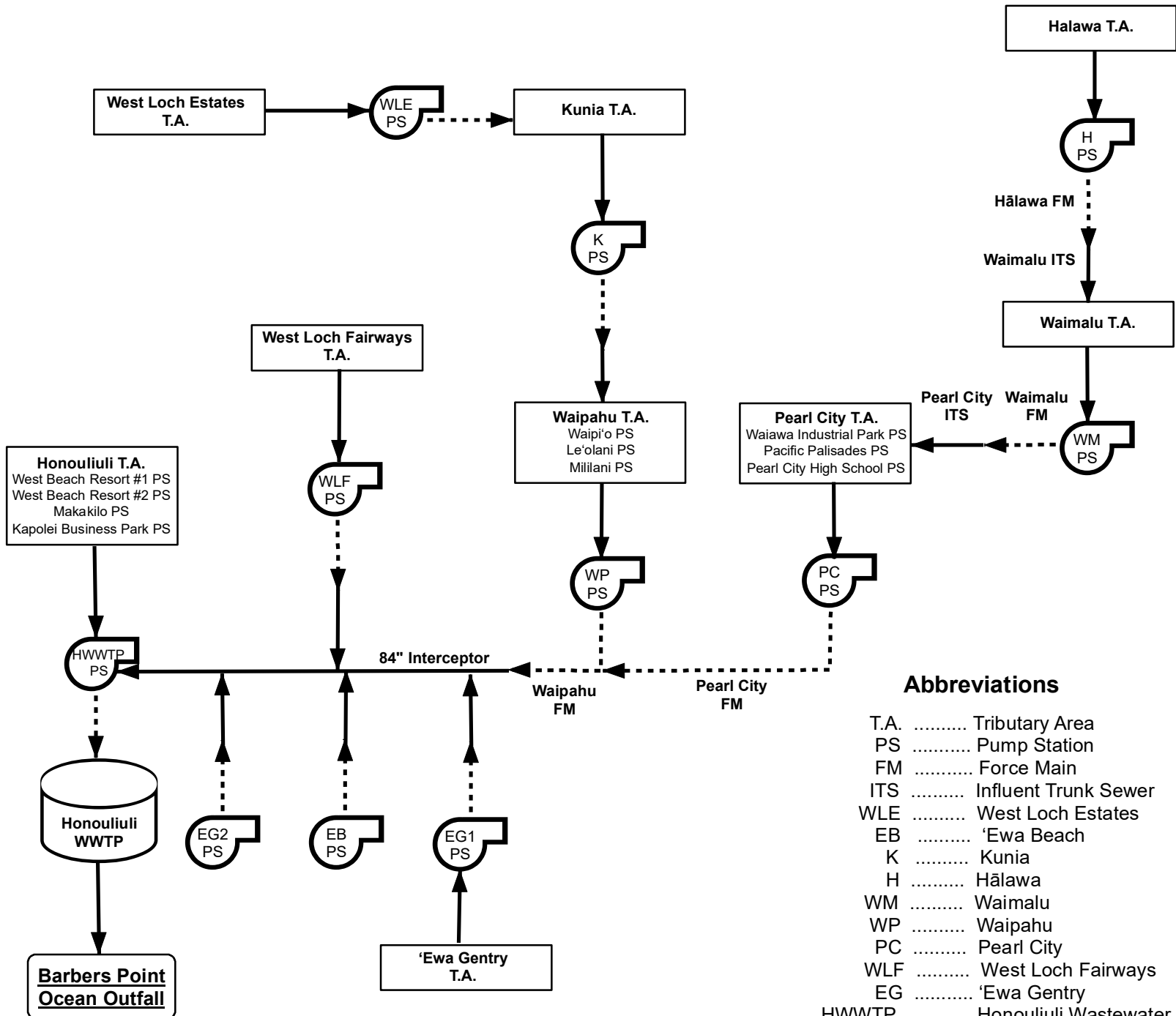
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Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

AECOM
1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813

G:\Projects\MUNI\60220849\HON\Maps\Fig 1-4 Honouliuli Basin Existing Schematic.mxd



City and County of Honolulu

HONOULIULI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

- T.A. (Tributary Area)
- PS (Wastewater Pump Station)
- Force Main Flow (dashed arrow)
- Gravity Flow (solid arrow)
- WWTP (Wastewater Treatment Plant)
- Ocean Outfall (rectangle)

- Abbreviations**
- T.A. Tributary Area
 - PS Pump Station
 - FM Force Main
 - ITS Influent Trunk Sewer
 - WLE West Loch Estates
 - EB 'Ewa Beach
 - K Kunia
 - H Hālawā
 - WM Waimalu
 - WP Waipahu
 - PC Pearl City
 - WLF West Loch Fairways
 - EG 'Ewa Gentry
 - WWTP Honouliuli Wastewater Treatment Plant

FIGURE 1-4 HONOULIULI SEWER BASIN EXISTING COLLECTION SYSTEM FLOW SCHEMATIC

1.3 PURPOSE AND NEED FOR THE PROPOSED ACTION

This Proposed Action (see Section 2.0 for detail) is needed to:

- Address the rehabilitation needs of existing wastewater infrastructure;
- Minimize the potential for SSOs and unscheduled maintenance problems;
- Provide new conveyance infrastructure to serve planned development and growth (including that related to transit-oriented development) in the wastewater tributary area, including proposed development in the Waiawa area;
- Increase the capacity of the existing Honouliuli East Interceptor System to address future flows through the 2050 planning period;
- Protect public health and safety; and
- Comply with the State wastewater regulations (Hawai'i Administrative Rules (HAR) Chapter 11-62).

The purposes (objectives) of the Proposed Action are to:

- Obtain the most favorable long-term life-cycle expenditures, considering both capital and operations and maintenance costs;
- Adequately comply with environmental requirements and controls; and
- Minimize risks (e.g., delays to implementation) associated with large underground construction projects, land entitlements, and environmental liabilities.

1.4 ENVIRONMENTAL SCOPE OF AUTHORITY AND PURPOSE OF THIS DEIS

This DEIS was prepared by ENV in accordance with HRS Chapter 343, and HAR Title 11, Chapter 200. ENV's Proposed Action is an Agency Action subject to HRS Chapter 343 because it involves the following:

- Proposes the use of County and State lands and County funds;
- Proposes any use within any land classified as a conservation district by the State Land Use Commission under HRS Chapter 205;
- Proposes any use within a shoreline area as defined in HRS Section 205A-41; and
- Proposes any wastewater facility, except an individual wastewater system or a wastewater facility serving fewer than fifty (50) single-family dwellings or the equivalent.

An Environmental Impact Statement Preparation Notice (EISPN) was published in the Office of Environmental Quality Control's (OEQC's) *The Environmental Notice* on May 8, 2019. This DEIS incorporates public and agency review comments that were submitted during the EISPN 30-day public comment period.

This DEIS is intended to provide environmental considerations that may assist ENV in its decision-making. With the planning level of information currently available (e.g., wastewater conveyance facilities plan), the DEIS evaluation is considered programmatic. When sufficient design details are available, separate project-specific HRS Chapter 343 documents will be prepared as appropriate and compliance with special laws (e.g., HRS Chapter 6E Historic Preservation) will be demonstrated.

After a 45-day public comment period for the DEIS, substantive comments will be responded to in writing with copies included in the FEIS and addressed, as appropriate, in the FEIS. If ENV, as the Mayor's delegated Accepting Authority (see Appendix A), finds that the EIS meets the criteria in HAR 11-200-23, ENV will issue acceptance of the EIS in the OEQC's *The Environmental Notice*.

The potential need for a federal action is anticipated for project alternatives that involve work in water and the need for a United States Army Corps of Engineers (USACE) permit. Federal actions are also required for alternatives that involve real estate actions (easements) for City projects on Navy property. These federal actions would require National Environmental Policy Act compliance and compliance with other federal special laws, and will be proposed by ENV as separate future actions, for the purpose of meeting federal requirements.

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2.0 PROPOSED ACTION AND ALTERNATIVES

The Proposed Action is to rehabilitate, upgrade, replace, and/or expand portions of the existing Honouliuli major sewer conveyance system (East Interceptor System) as required to accommodate flows through 2050. The East Interceptor System covers a large area and consists of various components, and a number of options are being evaluated to successfully achieve the purpose and need. This section describes the East Interceptor System alternatives evaluated in the Honouliuli/Waipahu/Pearl City Wastewater Facilities Plan (Honouliuli Fac Plan) *Preliminary Engineering Report* (AECOM Technical Services, Inc. (AECOM) 2016b) and *Waiawa Master Plan Modeling Assistance Technical Memorandum* (AECOM 2018) that are the subject of this Draft Environmental Impact Statement (DEIS). They include upgrades, modifications, and new facilities in the East Interceptor System area. Alternatives carried forward for evaluation in this DEIS are referred to as options hereinafter. Alternatives dismissed from further evaluation are referenced in Section 2.4.

Recent developments in tunneling technology, as demonstrated by the City and County of Honolulu Department of Environmental Services' (ENV's) successful completion of the Kāneʻohe-Kailua gravity sewer tunnel (GST), and ENV's re-evaluation of the long-term planning for the island-wide wastewater system presented the opportunity to consider a GST option. Use of a GST could potentially replace certain pumping and force main systems in the East Interceptor System. In addition to a GST option for the collection system, an option without tunnels was evaluated. The No-Tunnel option includes more traditional improvements, upgrades, and/or new facilities for the existing collection system to include trunk sewers, pump station upgrades, and force mains. Various combinations of GST and No-Tunnel projects are also considered under the Hybrid option described below.

The Proposed Action is described in the following sections and organized under two (2) main categories: East Interceptor Conveyance Options and Waiawa Area Conveyance Options. For some portions of the system, proposed activities are described as common projects to all options being assessed.

2.1 EAST INTERCEPTOR CONVEYANCE OPTIONS

Two East Interceptor conveyance options are presented below: No-Tunnel and Hybrid. The No-Tunnel option involves a more traditional approach utilizing gravity sewers, wastewater pump stations (WWPSs), and force mains. For the Hybrid option, a GST would be constructed and certain existing (and/or rehabilitated) No-Tunnel facilities would continue operation. Both options include several common projects regardless of the option, which are described first.

2.1.1 Projects Common to Both East Interceptor Conveyance Options

The projects identified in Table 2-1 and described in the following sections would be required regardless of the conveyance option (i.e., No-Tunnel or Hybrid) that is

ultimately selected. They are presented in the order that the project is anticipated to be designed and constructed.

Table 2-1. Projects Common to Both East Interceptor Conveyance Options

1	Waipahu WWPS Force Main (New)
2	Waipahu WWPS Force Mains Rehabilitation
3	Pearl City Trunk Sewers – Rehabilitation/Replacement
4	Waimalu WWPS Force Main (New)
5	Waimalu WWPS – Reconstruct/Replace
6	Waimalu Trunk Sewers – Rehabilitation/Replacement
7	Hālawā WWPS Force Main (New)
8	Hālawā WWPS – Reconstruct/Replace

2.1.1.1 WAIPAHU WWPS FORCE MAIN (NEW)

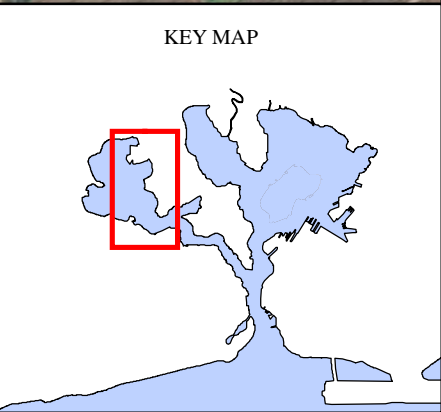
A new third force main (FM) would be constructed for the Waipahu WWPS to convey flow to the Honouliuli 84-inch gravity interceptor sewer. This would increase the firm capacities of both the Pearl City WWPS and the Waipahu WWPS and continue to allow the flows from the two (2) WWPSs to be separated and make the operation of the stations independent of each other. A new FM, approximately 12,510 linear feet (LF), would be constructed following a similar alignment as the Waipahu Dual FMs, and would discharge to the east end of the existing Honouliuli Interceptor Sewer (Figure 2-1). The crossing of the Pearl Harbor West Loch would be accomplished through microtunneling or horizontal directional drilling from new shafts on either landside end of the proposed crossing, while the rest of the alignment would be completed through either conventional open trench or trenchless methods.

2.1.1.2 WAIPAHU WWPS FORCE MAINS REHABILITATION

The existing dual FMs for Waipahu WWPS would be rehabilitated or, alternatively, may be either partially or completely replaced. The dual FMs would continue to discharge to the east end of the existing Honouliuli Interceptor Sewer (Figure 2-1). Total length of the rehabilitated or replacement FMs would be approximately 12,510 LF each. The crossing of the Pearl Harbor West Loch would be accomplished through microtunneling or horizontal directional drilling from new shafts on either landside end of the proposed crossing, while the rest of the alignment would be completed through either conventional open trench or trenchless methods. If rehabilitated, slip-lining would be used.

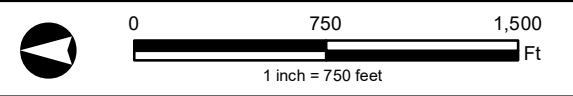
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Base map data sources:
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LEGEND

PS Existing WWPS	 Existing East Interceptor
 Existing Waipahu Dual Force Mains	 Proposed Waipahu WWPS Force Main (New)
 Proposed Waipahu WWPS Force Mains Rehabilitation	



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C:\Projects\MUNI\60220849\HON\Maps\Fig 2-1 Waipahu - Honouliuli.mxd

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2.1.1.3 PEARL CITY TRUNK SEWERS – REHABILITATION/REPLACEMENT

The Pearl City trunk sewer is recommended for upgrade/replacement within the planning period. Some sewer sections appear to be sagging and collecting sediment. Approximately 5,300 LF of new gravity sewer would convey wastewater flow from the Waimalu WWPS FM discharge/transition manhole to a new connection to the influent junction box at the Pearl City WWPS (Figure 2-2), or to the entrance structure for the new GST by the Pearl City WWPS under the Hybrid option. Crossing of the Waiau Stream would be accomplished through either the conventional open trench method (with shoring and dewatering) due to its relatively short run to cross this waterway or by trenchless methods. The remainder of the line would also be completed through either conventional open trench or trenchless methods.

2.1.1.4 WAIMALU WWPS FORCE MAIN (NEW)

Replacement of the Waimalu FM is recommended at the estimated end of its economic life. The proposed replacement FM would be parallel and adjacent to existing lines as much as possible (see Figure 2-2). A new FM would convey wastewater flow from a new connection to the discharge junction box at the Waimalu WWPS to the discharge/transition manhole on the northwest corner of the intersection of Kuleana Road and Kamehameha Highway. Construction is anticipated to be a combination of open trench and trenchless methods.

2.1.1.5 WAIMALU WWPS – RECONSTRUCT/REPLACE

The Waimalu WWPS is recommended for upgrade/replacement within the planning period as it reaches the end of its estimated useful economic life. A new WWPS can be constructed at the same location or at a new alternative location adjacent to the existing WWPS (Figure 2-3).

2.1.1.6 WAIMALU TRUNK SEWERS – REHABILITATION/REPLACEMENT

The Waimalu influent trunk sewers are recommended for upgrade/replacement within the planning period. Some sewer sections appear to be sagging and collecting sediment. Approximately 10,040 LF of new gravity sewer would convey wastewater flow from the Hālawā WWPS FM discharge to a new connection to the influent junction box at the Waimalu WWPS (Figure 2-4). The crossing of Waimalu, Kalauao, and ‘Aiea streams would be accomplished through either the conventional open trench method (with shoring and dewatering) due to the relatively short run to cross these waterways or by trenchless methods. The remainder of the lines would also be completed through either conventional open trench or trenchless methods.

2.1.1.7 HĀLAWA WWPS FORCE MAIN (NEW)

A new FM would replace the existing FM and convey wastewater flow from a new connection to the discharge junction box at the new Hālawā WWPS to the discharge/transition manhole on the south end of the Aloha Stadium parking lot (Figure 2-4). As shown in Figure 2-4, there is also an alternate alignment consisting of a new gravity sewer proposed along Salt Lake Boulevard. Relocation of the Halawa WWPS FM would be done in coordination with the proposed redevelopment of the

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Base map data sources:
Hawaii Statewide GIS Program planning.hawaii.gov/gis



LEGEND		
PS	Existing WWPS	Existing East Interceptor
Transition Manhole	Existing Pearl City Influent Trunk Sewer	Proposed Waimalu WWPS Force Main (New)
	Proposed Pearl City Trunk Sewers-Rehabilitation/Replacement	Existing Waimalu Force Main

0 500 1,000
1 inch = 500 feet

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FIGURE 2-2
**PEARL CITY TRUNK SEWERS REHABILITATION/
REPLACEMENT AND WAIMALU WWPS FM (NEW)**

C:\Projects\MUNI\60220849\HON\Maps\Fig 2-2 Waimalu Pearl City.mxd

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City and County of Honolulu

HONOULIULI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

- Legend**
- PS Existing WWPS
 - WWPS Boundary
 - Wetlands
 - 100-yr Flood Zone
 - Major Landowners
 - Others
 - City and County Honolulu
 - Federal
 - State of Hawai'i
 - Tax Map Key Parcel Boundary

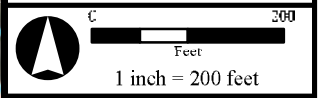
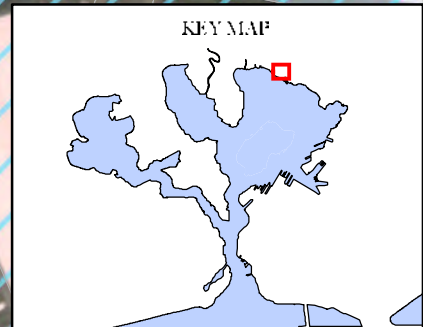


FIGURE 2-3
**WAIMALU WWPS -
 RECONSTRUCT/
 REPLACE**



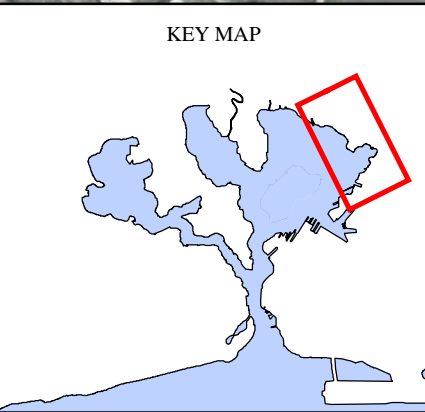
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LEGEND		
PS	Existing WWPS	Proposed Hālawā WWPS Force Main (New)
PS	Existing Waimalu WWPS	Existing Hālawā Force Main
PS	Existing Waimalu Force Main	Existing Waimalu Influent Trunk Sewer
PS	Cutter Ford	Proposed Waimalu Trunk Sewers - Rehabilitation/Replacement
PS	Existing East Interceptor	Alternate Hālawā Gravity Sewer Alignment
PS	Transition Manhole	

0 750 1,500 Ft
 1 inch = 750 feet

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FIGURE 2-4
**WAIMALU TRUNK SEWERS REHABILITATION/
 REPLACEMENT AND HĀLAWĀ WWPS FM (NEW)**

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Aloha Stadium area. Either conventional open trench or trenchless construction methods would be used regardless of the alternative.

2.1.1.8 HĀLAWA WWPS – RECONSTRUCT/REPLACE

The Hālawā WWPS is recommended for replacement as it reaches the end of its estimated useful economic life (Figure 2-5). A new Hālawā WWPS with a higher capacity to accommodate future flows is proposed. The location may remain the same or may be moved to a new alternative location as shown. The proposed relocation area is a preliminary concept only. If relocation of the Hālawā WWPS is determined to be the preferred option, the project would be done in coordination with the proposed redevelopment of the Aloha Stadium area.

2.1.2 No-Tunnel Option

The preferred No-Tunnel option identified in the Honouliuli Fac Plan *Preliminary Engineering Report* (AECOM 2016b) is comprised of a combination of projects including WWPS upgrades, additional force mains, relief sewers, and other near-surface conveyance projects to address overall system deficiencies. The No-Tunnel option would convey peak flows to the wastewater treatment plant (WWTP) by increasing WWPS capacity, increasing force main capacity, and/or adding relief sewers. By increasing WWPS capacities as necessary to convey projected peak flows and providing dedicated force mains, storage tanks adjacent to the WWPSs would not be required to relieve predicted surcharging. As previously stated, increased capacity and treatment options at the Honouliuli WWTP were evaluated in a separate Environmental Impact Statement (EIS) (AECOM 2017) and are not the subject of this DEIS.

The No-Tunnel option projects are identified in Table 2-2 and described in the following sections.

Table 2-2. No-Tunnel Option Projects

1	Waipahu WWPS – Rehabilitation/Upgrade
2	Pearl City WWPS Force Main (New)
3	Pearl City WWPS Force Mains Rehabilitation
4	Pearl City WWPS – Reconstruct/Replace

2.1.2.1 WAIPAHA WWPS – REHABILITATION/UPGRADE

Although the existing Waipahu WWPS has hydraulic capacity to handle projected peak flows and is currently in structurally good condition without excessive O&M requirements, the WWPS will be near the end of the economic design life within the planning period for electrical, mechanical, architectural, and structural components. The rehabilitation option would make use of the existing station, but would provide new pumps and motors.

G:\Projects\MUNI\160220849\HON\Maps\Fig 2-5 Halawa WWPS Replacement.mxd



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City and County of Honolulu

HONOULIULI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

- Legend**
- PS Existing WWPS
 - WWPS Boundary
 - Wetlands
 - 100-yr Flood Zone
 - Major Landowners
 - Others
 - City and County Honolulu
 - Federal
 - State of Hawai'i
 - Tax Map Key Parcel Boundary

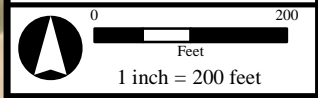


FIGURE 2-5
HĀLAWA WWPS - RECONSTRUCT/ REPLACE



2.1.2.2 PEARL CITY WWPS FORCE MAIN (NEW)

A third FM for the Pearl City WWPS is recommended (Figure 2-6). The third FM would increase the firm capacity of the Pearl City WWPS and provide a backup FM to allow rehabilitation of the existing two (2) FMs, one (1) at a time. The new FM, approximately 11,070 LF, would be constructed following the same alignment as the existing dual FMs. Crossing of the Wailani Flood Control Channel and Waiawa Stream would be accomplished through either conventional open trench method (with shoring and dewatering) due to their relatively short runs to cross these waterways or by trenchless methods. The remainder of the line would also be completed through either conventional open trench or trenchless methods.

2.1.2.3 PEARL CITY WWPS FORCE MAINS REHABILITATION

The existing Pearl City dual FMs would be rehabilitated, which may include slip-lining or replacement of sections of the FMs, or may include complete replacement due to their condition. The dual FMs would convey wastewater flow from the Pearl City WWPS and connect to the force mains coming from the Waipahu WWPS at a new connection box to be built near the Waipahu WWPS (Figure 2-6). The total length of the rehabilitated or replacement FMs would be approximately 11,440 LF. The rehabilitation would be conducted after the third FM is installed.

2.1.2.4 PEARL CITY WWPS – RECONSTRUCT/REPLACE

The existing Pearl City WWPS is located within a flood zone. It has flooded in the past and will be near the end of its economic design life within the planning period for electrical, mechanical, architectural, and structural components. Three (3) Pearl City WWPS replacement location alternatives are identified in Figure 2-7. The Pearl City WWPS Alternative No. 2 location is not preferred and will only be considered if the Hybrid option is not selected and it is determined that the Pearl City WWPS must be relocated outside the 100-year flood zone. The new WWPS would sufficiently pass projected peak flows.

Rehabilitation of the existing Pearl City WWPS is also being considered and would include elevating critical mechanical and electrical components above the 100-year flood elevation by remodeling or constructing a new electrical building and raising building entrances. The existing pumps and motors would be replaced with dry pit submersible pumps and motors. Some rehabilitation work would be done regardless of the options in order to maintain continued reliability.

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LEGEND

PS	Existing WWPS	Existing East Interceptor	Proposed Pearl City WWPS Force Main Rehabilitation
		Proposed Pearl City WWPS Force Main (New)	Existing Pearl City Dual Force Mains

0 750 1,500
 1 inch = 750 feet

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FIGURE 2-6
PEARL CITY WWPS FM (NEW)
AND FM REHABILITATION

C:\Projects\MUNI\6220849\HON\Maps\Fig 2-6 Waipahu - Pearl City.mxd

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HONOULIULI/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

- PS Existing WWPS
- WWPS Boundary
- Wetlands
- 100-yr Flood Zone
- Major Landowners
- Others
- City and County Honolulu
- Federal
- State of Hawai'i
- Tax Map Key Parcel Boundary

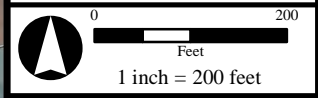
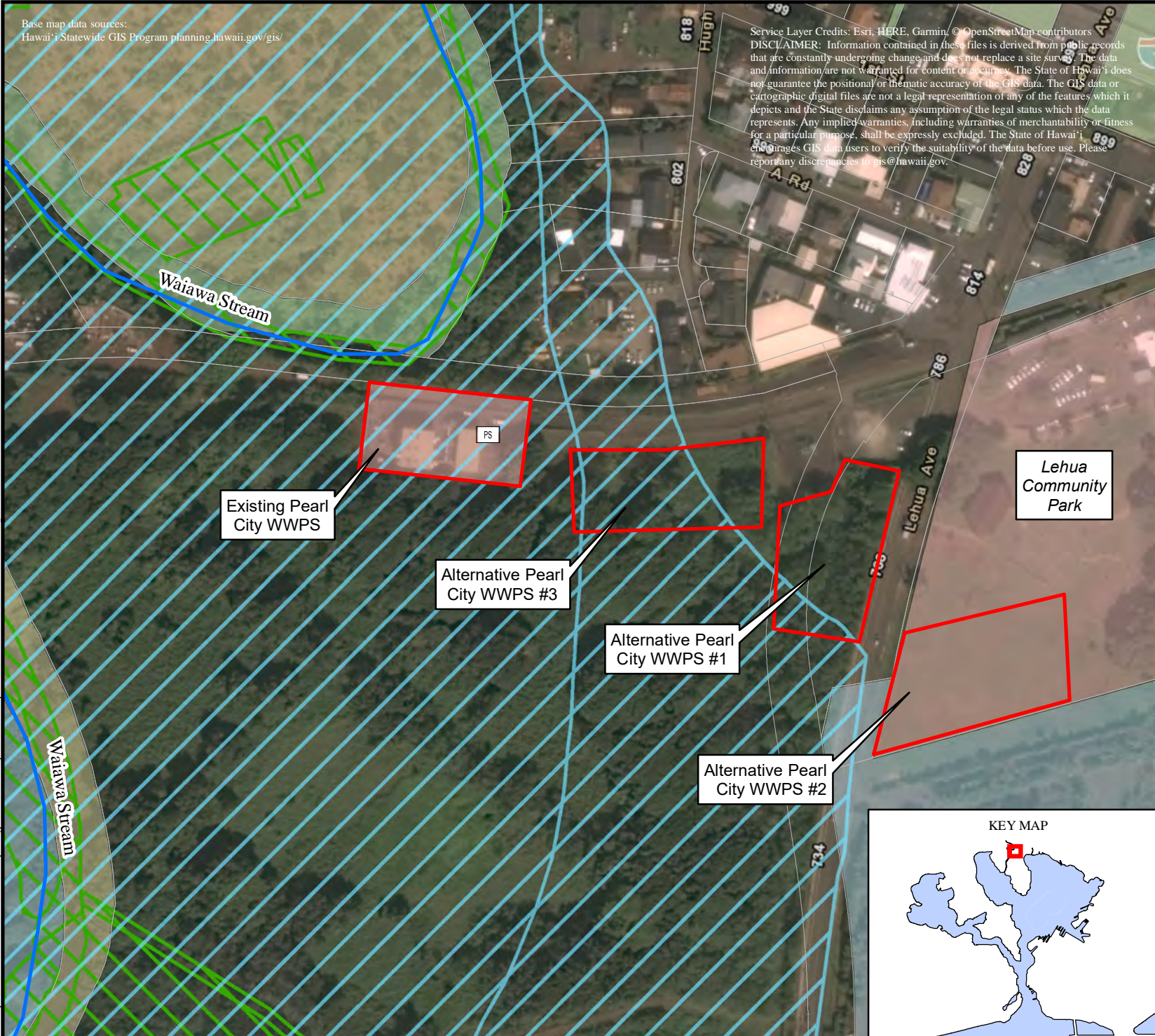


FIGURE 2-7
PEARL CITY
WWPS -
**RECONSTRUCT/
REPLACE**

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2.1.3 Hybrid Option

The preferred Hybrid option identified in the Honouliuli Fac Plan *Preliminary Engineering Report* (AECOM 2016b) focuses on replacing the Pearl City WWPS and dual FM system by constructing a GST between the Pearl City and Waipahu WWPSs. Otherwise, the Hybrid option is similar to the No-Tunnel conveyance option, in which the other WWPSs, associated sewers, and force mains along the East Interceptor System corridor would remain in service (with any needed rehabilitations/relocation). The new GST would route all Pearl City flows to a new Waipahu WWPS. Figure 2-8 presents the layout for the Hybrid option. Two (2) alignments are under consideration by ENV and are evaluated in this DEIS: deep tunnel alignment and microtunnel alignment.

The Hybrid option projects are identified in Table 2-3 and described in the following sections.

Table 2-3. Hybrid Option Projects

1	Pearl City-Waipahu Trunk Sewer
2	Waipahu WWPS No. 2
3	Pearl City WWPS – Demolition

2.1.3.1 PEARL CITY-WAIPAHU TRUNK SEWER

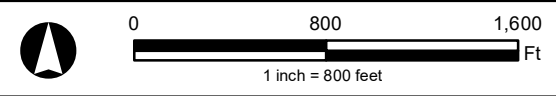
The proposed alignment of the new GST for the Pearl City-Waipahu trunk sewer is shown in Figure 2-8. Two (2) tunneling options are available: either a bored tunnel or a microtunnel. The bored tunnel would be an estimated 96-inch diameter tunnel about 10,900 feet long which includes a launch shaft at the downstream end (Waipahu WWPS) and a tunnel boring machine retrieval shaft at the upstream end (Pearl City WWPS). The proposed vertical alignment would have an invert (i.e., elevation of the bottom of pipe below ground) at El -52.0 at the downstream end (Waipahu WWPS) and an invert at El -40.0 at the upstream end (Pearl City WWPS). The microtunnel would be an estimated 72-inch diameter, about 11,500 feet long which includes an estimated fifteen (15) shafts and fourteen (14) individual microtunneling drives. The layout assumes typical drive lengths of 800 feet, although distances of 1,000 feet or more may also be feasible. The vertical alignment has been proposed to provide adequate soil cover beneath the Waiawa Stream, which is the lowest point along the corridor. The proposed vertical alignment has an invert at El -35.0 at the downstream end (Waipahu WWPS) and an invert at El -23.0 at the upstream end (Pearl City WWPS).

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LEGEND	
PS	Existing WWPS
Yellow line	Existing East Interceptor
Orange line	Deep Tunnel Alignment
Red pentagon	Tunnel Shaft
Blue line	Microtunnel Alignment



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FIGURE 2-8
PEARL CITY - WAIPAHAU TRUNK SEWER

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2.1.3.2 WAIPAHU WWPS NO. 2 OR COMBINED FLOW WWPS

A GST from Pearl City to Waipahu would require a new pump station at the downstream end to accommodate the deeper tunnel flows. Figure 2-9 identifies the location of the existing Waipahu WWPS as well as two (2) alternative locations for the new Waipahu WWPS No. 2. The new Waipahu WWPS No. 2 to pump GST flow or a Combined Flow WWPS to pump all Waipahu flow would be needed to accommodate tunnel flows and Waipahu WWPS tributary flows, including sufficient capacity to accommodate future flows.

2.1.3.3 PEARL CITY WWPS – DEMOLITION

The existing Pearl City WWPS would be demolished since it would not be needed following completion of the GST.

2.2 WAIAWA AREA CONVEYANCE OPTIONS

The Waiawa Ridge development proposed by Waiawa Ridge Development, LLC will include approximately 12,000 residential units, industrial/commercial, commercial, golf courses, parks, schools, incorporated in the Gentry and the adjacent Castle & Cooke parcel (see Figure 2-10). The project as proposed is estimated to produce 7.48 million gallons per day (which does not include the 0.78 million gallons per day of dry weather flow from Pacific Palisades), a significant increase to the existing wastewater collection system. Conveyance requirements were determined, and three (3) optional corridors have been identified by ENV, as described in the following sections and identified in Figure 2-10. Only one (1) corridor would ultimately be selected for use. All corridors would intercept flows to the Waiawa Industrial Park WWPS and allow them to flow by gravity to the downstream sewer system. This would allow the Waiawa Industrial Park WWPS to be removed from service. Gravity sewer options also may include a future new sewer to be constructed along Waihona Street to enable the Pacific Palisades WWPS to be removed from service. Regardless of the corridor, the construction would be a combination of cut and cover and tunneling.

2.2.1 Corridor A

Corridor A consists of approximately 11,500 LF of new gravity sewer beginning at the Waiawa by Gentry development following Waihona Street to Kamehameha Highway then intercepting Lehua Avenue to either the Pearl City WWPS or the proposed Pearl City to Waipahu WWPS Tunnel. The corridor would collect additional wastewater flows from neighboring communities including: Waiawa Industrial Park, Pacific Palisades WWPS, Mānana, and Pearl City.

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HONOULIULI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

- Legend**
- PS Existing WWPS
 - WWPS Boundary
 - Wetlands
 - 100-yr Flood Zone
- Major Landowners
- City and County Honolulu
 - Federal
 - State of Hawaii
 - Tax Map Key Parcel Boundary

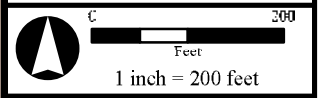


FIGURE 2-9

**WAIPAHU
WWPS NO. 2**

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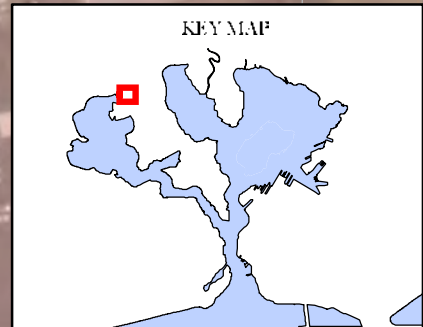
Pearl Harbor Bike Path

Existing Waipahu WWPS

Alternative Waipahu WWPS #1

Alternative Waipahu WWPS #2

Honolulu Police
Training Academy



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Base map data sources:
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City and County of Honolulu

HONOULIULI/ WAIPAHA/ PEARL CITY FACILITIES PLAN

Legend

- PS Existing WWPS
- East Interceptor
- Corridor A
- Corridor D
- Corridor G
- Waiawa Ridge Parcel

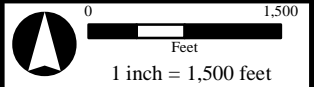
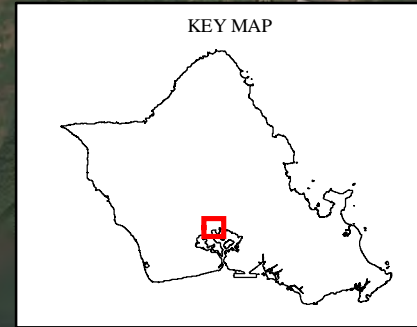


FIGURE 2-10

WAIAWA AREA CONVEYANCE CORRIDORS



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2.2.2 Corridor D

Corridor D consists of approximately 12,000 LF of new gravity sewer. Beginning at the Waiawa by Gentry development following Waihona Street to Kamehameha Highway then using the existing Navy water transmission easement and other public right-of-ways and easements to connect to either the Pearl City WWPS or the proposed Pearl City to Waipahu WWPS Tunnel. The corridor would collect additional wastewater flows from neighboring communities, to include: Waiawa Industrial Park, Pacific Palisades WWPS, Mānana, and Pearl City.

2.2.3 Corridor G

Corridor G consists of approximately 5,800 LF of new gravity sewer beginning at the Waiawa by Gentry development following Waihona Street and crossing Kamehameha Highway, the H-2 and H-1 freeways, and Farrington Highway, respectively, traveling south. The corridor would tie into the proposed Pearl City to Waipahu WWPS Tunnel.

2.3 PROJECT CONSTRUCTION SCHEDULE

The preliminary construction schedule for the No-Tunnel conveyance option and the Hybrid conveyance option are provided in Table 2-4 and Table 2-5, respectively.

Table 2-4. No-Tunnel Conveyance Option Preliminary Construction Schedule

Project	Anticipated Years of Construction
Waipahu WWPS Force Main (New)	2022-2024
Waipahu WWPS Force Mains Rehabilitation	2025-2026
Waipahu WWPS – Rehabilitation/Upgrade	2026-2029
Pearl City WWPS Force Main (New)	2026-2029
Pearl City WWPS Force Mains Rehabilitation	2029-2032
Pearl City WWPS – Reconstruct/Replace	2031-2033
Pearl City Trunk Sewers – Rehabilitation/Replacement	2032-2035
Waimalu WWPS Force Main (New)	2032-2034
Waimalu WWPS – Reconstruct/Replace	2033-2036
Waimalu Trunk Sewers – Rehabilitation/Replacement	2036-2039
Hālawa WWPS Force Main (New)	2036-2038
Hālawa WWPS – Reconstruct/Replace	2037-2040

Table 2-5. Hybrid Conveyance Option Preliminary Construction Schedule

Project	Anticipated Years of Construction
Waipahu WWPS Force Main (New)	2022-2024
Waipahu WWPS Force Mains Rehabilitation	2025-2026
Pearl City-Waipahu Trunk Sewer	2026-2029
Waipahu WWPS No. 2	2027-2030
Waimalu WWPS Force Main (New)	2029-2031
Pearl City Trunk Sewers – Rehabilitation/Replacement	2029-2032
Waimalu WWPS – Reconstruct/Replace	2030-2033
Pearl City WWPS – Demolition	2032-2034
Waimalu Trunk Sewers – Rehabilitation/Replacement	2033-2036
Hālawa WWPS Force Main (New)	2033-2035
Hālawa WWPS – Reconstruct/Replace	2034-2037

The anticipated years of construction are subject to change as project designs progress and the schedule is refined. The projects unique to each conveyance option are in bold.

The schedule for the Waiawa Area conveyance options is dependent on several factors, including the schedule for planned development in the Waiawa area and transit-oriented development in the areas surrounding the Honolulu Authority for Rapid Transportation (HART) Rail Transit Stations. Connection of the Waiawa Area Conveyance option is dependent upon completion of the downstream upgrades/rehabilitation projects due to increased wastewater flows.

2.4 ALTERNATIVES CONSIDERED

Alternatives considered but not carried forward for the purposes of further analysis in this DEIS include the following.

- The “No Action” alternative would not address any of the Proposed Action objectives since it involves no upgrades to or expansion of the East Interceptor System of the Honouliuli sewer basin. Since the No Action alternative would not address the rehabilitation needs of existing wastewater infrastructure, minimize the potential for SSOs and unscheduled maintenance problems, provide new conveyance infrastructure to serve planned development and growth in the wastewater tributary area, or increase the capacity of the existing Honouliuli East Interceptor System to address future flows through the 2050 planning period, it was discontinued from further consideration.
- Alternatives of a significantly different nature that would provide similar benefits with different environmental impacts. The complete GST tunnel previously considered in the Honouliuli Fac Plan *Preliminary Engineering Report* (AECOM 2016b) and several wastewater conveyance alignment alternatives previously considered in the *Waiawa Master Plan Modeling Assistance Technical*

Memorandum (AECOM 2018) are such alternatives. Since these alternatives were discounted based on the findings of previous assessments, they were discontinued from further consideration.

- The “Delayed Action” alternative was not considered feasible since postponement of the Proposed Action may not allow necessary wastewater conveyance improvements to the East Interceptor System to be implemented in time to support projected growth and development in the project area. Therefore, the Delayed Action alternative was discontinued from further consideration.

3.0 **AFFECTED ENVIRONMENT, POTENTIAL IMPACTS, AND MITIGATION MEASURES**

This section includes descriptions of existing conditions in the project area as well as consideration of potential impacts (direct and indirect) resulting from the Proposed Action. Mitigation measures are also identified, as appropriate. Cumulative impacts, considering other actions, are addressed in Section 4.0.

3.1 **CLIMATE AND CLIMATE CHANGE**

3.1.1 **Existing Setting**

3.1.1.1 CLIMATE

Climate is defined as long-term averages and variations in weather measured over a period of several decades. The climate system includes the land surface, atmosphere, ocean, and ice. The climate in Hawai'i is considered subtropical with annual temperatures in the project area ranging from 60 degrees Fahrenheit (°F) to 85°F and mean monthly temperatures ranging from 73°F in January and February to 81°F in August. The mean annual rainfall in the Honouliuli sewer basin ranges from less than 20 inches in the 'Ewa Plains and coastal areas to over 200 inches near the summit of the Ko'olau Range while the mean annual rainfall in the project area is less than 40 inches. Figure 3-1 shows the mean annual rainfall in the project area. The islands are exposed to trade and Kona winds. Trade winds are from the northeast and prevail approximately 70 percent of the time. Kona winds are from the south. Average wind in the area ranges from 15 to 25 miles per hour with gusts over 35 miles per hour.

3.1.1.2 CLIMATE CHANGE

Temperature

Impacts of changing air temperature include the following (City and County of Honolulu Climate Change Commission 2018):

- In Hawai'i, the rate of warming air temperature has increased in recent decades. Currently, the air is warming at 0.3°F per decade, four times faster than half a century ago.
- Statewide, average air temperature has risen by 0.76°F over the past 100 years, and 2015 and 2016 were the warmest years on record.

City and County of Honolulu

HONOLULUI/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

- Legend**
- Honouliuli Sewer Basin
 - Honouliuli WWTP
 - Hybrid Tunnel Shaft
 - East Interceptor
 - Hybrid Option Alignment
 - Waiawa Conveyance Corridors (Options A, D, and G)
 - New and/or Rehabilitated Force Mains and Trunk Sewers
 - Rainfall
 - Major Roadways

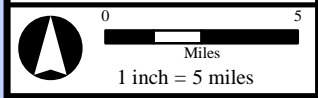
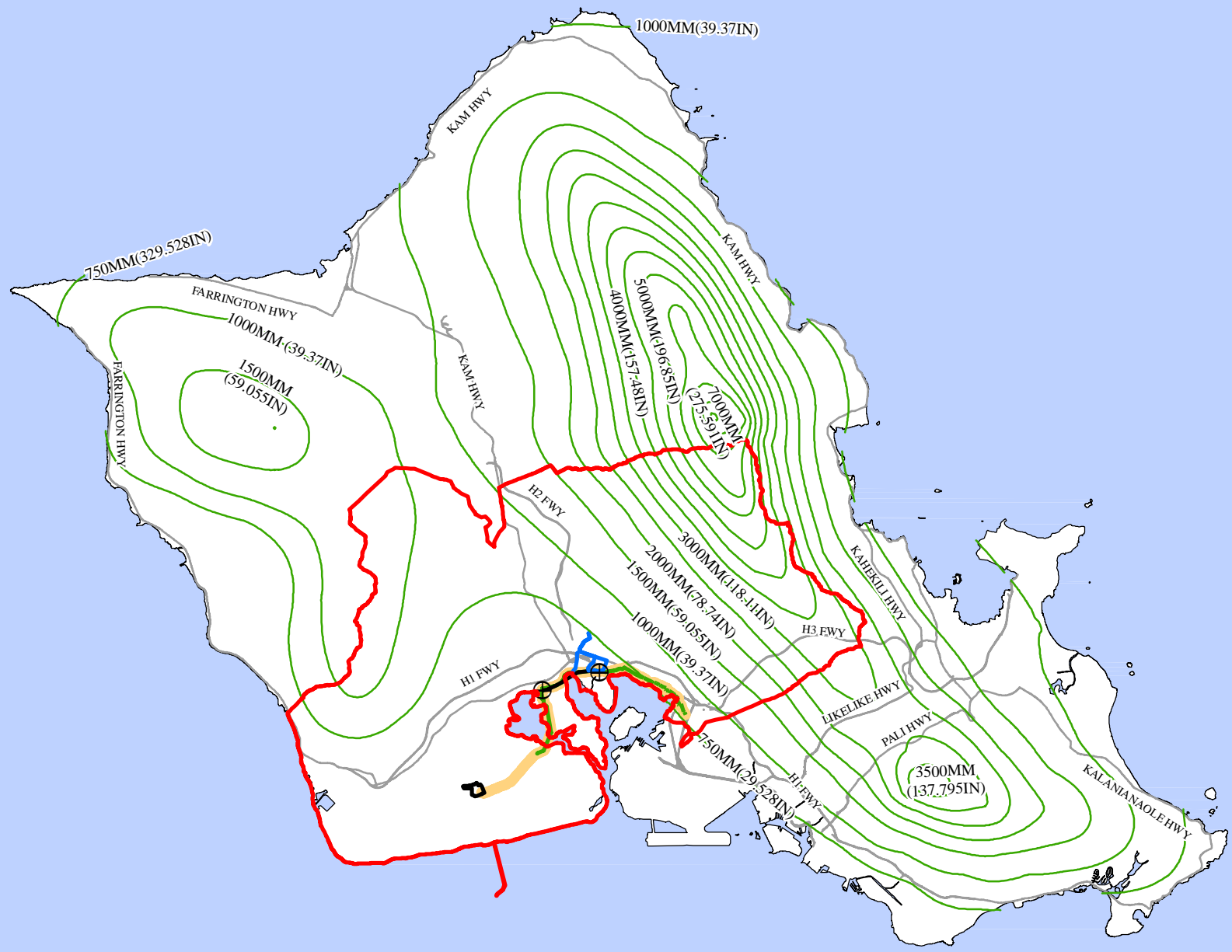


FIGURE 3-1
MEAN ANNUAL RAINFALL

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G:\Projects\MUNI\020849\HON\Maps\Fig 3-1 Mean Annual Rainfall.mxd

Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

- Warming air temperatures lead to heat waves, expanded pathogen ranges and invasive species, thermal stress for native flora and fauna, increased electricity demand, increased wildfire, potential threats to human health, and increased evaporation which both reduces water supply and increases demand. Rapid warming at highest elevations impedes precipitation, the source of Hawai'i's freshwater. During the strong El Niño of 2015, Honolulu set or tied 11 days of record heat. This compelled the local energy utility to issue emergency public service announcements to curtail escalating air conditioning use that stressed the electrical grid.
- Some model projections for the late 21st century indicate that surface air temperature over land will increase 1.8° to 7.2 °F with the greatest warming at the highest elevations and on leeward sides of the major islands.
- Under continued strong greenhouse gas emissions, high elevations above 9,800 feet are predicted to reach up to 7.2° to 9°F warmer temperatures by the late 21st Century.

Wind and Precipitation

Impacts of changing wind and precipitation include the following (City and County of Honolulu Climate Change Commission 2018):

- The frequency of gale-force winds is increasing in the western and south Pacific but decreasing in the central Pacific.
- Average daily wind speeds are slowly declining in Honolulu and Hilo, while remaining steady across western and south Pacific sites.
- Studies indicate there will be future changes to winds and waves due to climate change, which affects ecosystems, infrastructure, freshwater availability, and commerce.
- Hawai'i has seen an overall decline in rainfall over the past 30 years, with widely varying precipitation patterns on each island. The period since 2008 has been particularly dry.
- Declining rainfall has occurred in both the wet and dry seasons and has affected all the major islands. On O'ahu, the largest declines have occurred in the northern Ko'olau mountains.
- Heavy rainfall events and droughts have become more common, as well as increasing runoff, erosion, flooding, and water shortages.
- Consecutive wet days and consecutive dry days are both increasing in Hawai'i.
- There is disagreement regarding predicted precipitation at the end of the century. Model projections range from small increases to increases of up to 30 percent in wet areas, and from small decreases to decreases of up to 60 percent in dry areas.
- Generally, windward sides of the major islands will become cloudier and wetter. The dry leeward sides will generally have fewer clouds and less rainfall.

- Stream flow in Hawai'i has declined over approximately the past century, consistent with observed decreases in rainfall. This indicates declining groundwater levels.
- More frequent tropical cyclones are projected for the waters near Hawai'i. This is not necessarily because there will be more storms forming in the east Pacific; rather, it is projected that storms will follow new tracks that bring them into the region of Hawai'i more often.

Sea Level Rise

In June of 2018, the City and County of Honolulu Climate Change Commission adopted guidance based on findings included in the "Sea Level Rise Vulnerability and Adaptation Report" prepared by the Climate Change Mitigation and Adaptation Commission (Tetra Tech, Inc. et al. 2017) and other scientific literature. This guidance provides specific policy and planning guidance on responding to sea level rise by the City. The following is the summary of key findings:

- A. Relative to the year 2000, the projected rise of global mean sea level (GMSL) by the end of the century is 1.0 to 4.3 feet (Church et al. 2013).
- B. High tide flooding will arrive decades ahead of any GMSL rise scenarios (EIA 2017).
 - i. Based on the location of the Honolulu Tide Station, high tide flooding will occur by mid-century and as early as 2028, at least two (2) dozen times per year, at certain locations in the 3.2 sea level rise-exposure area (Fletcher et al. 2012).
- C. Modeling results, as mapped in the Hawai'i Sea Level Rise Viewer, reveal a critical elevation in GMSL rise between 2.0 and 3.2 feet relative to mean higher high water.
 - i. This is a critical range of rising sea level where there is rapid increase in the amount of land exposed to hazards on low-lying coastal plains, such as characterize the urbanized south shore of O'ahu.
 - ii. This is a dangerous elevation range, where reacting after the fact to establish adaption strategies is likely to be less successful and costlier than taking proactive measures.

Figures 3-2 through 3-6 display the exposure area associated with the 3.2 feet sea level rise scenario for several portions of the project area using available mapping.

Planning for Climate Change

Planning for climate change is challenging as there are several changing and unknown factors. The risks of climate change include changes in rainfall intensity, sea level rise, temperature, groundwater levels, salt water intrusion, and impacts from storm hazards.

CCH has taken steps to plan for the impacts of climate change. As mentioned above, the City and County of Honolulu Climate Change Commission adopted a Climate Change Brief in June 2018 to establish the factual basis and impacts of climate change for the City. In July of 2018, the Mayor of CCH issued Directive 18-02, which requires each City department and agency to:

- Consider the need for both climate change mitigation and adaptation as pressing and urgent matters;
- Take a proactive approach in both reducing greenhouse gas emissions and adapting to impacts caused by sea level rise; and
- Align programs whenever possible to help protect and prepare the infrastructure, assets, and citizens of the City for the physical and economic impacts of climate change.

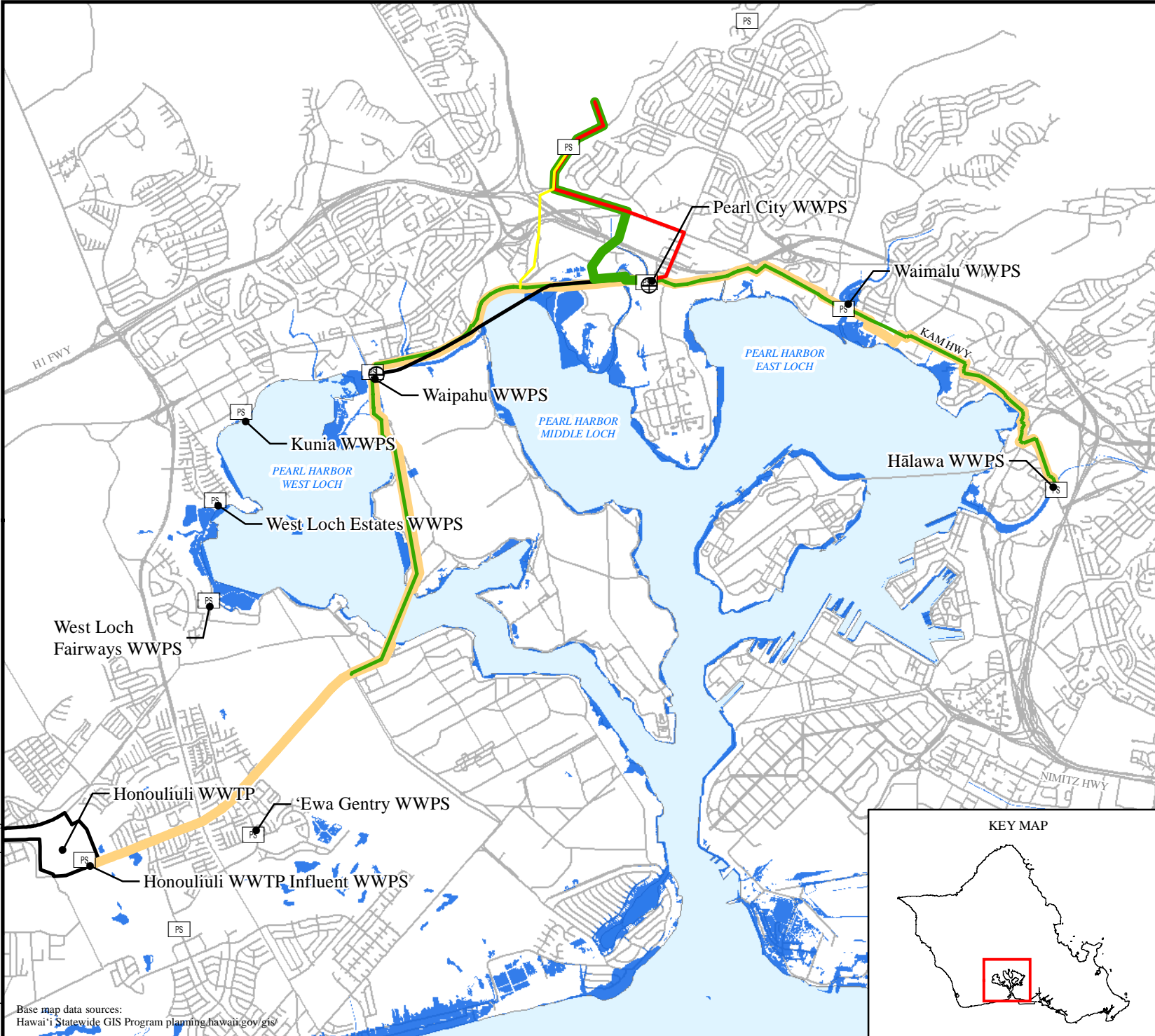
Based on the collective findings of the 2017 Sea Level Rise Report and previous scientific works, the City and County of Honolulu Climate Change Commission recommended the following:

- The research finds that it reasonable to set as a planning benchmark up to 3.2 feet of GMSL rise by mid-century as it will be an area experiencing chronic high tide flooding.
- The research finds that it is reasonable to set as a planning benchmark up to 6 feet of GMSL in the later decades of the century, especially for critical infrastructure with long expected lifespans and low risk tolerance, as it will be an area experiencing chronic high tide flooding.
- That all City departments and agencies be directed to use the 2017 Sea Level Rise Report, the 3.2 feet of GMSL rise, and the 6 feet of GMSL rise in their plans, programs, policies, and capital improvement decisions, to mitigate impacts to infrastructure and critical facilities related to sea level rise.

Based on this guidance, the 3.2 feet sea level rise scenario was selected to depict hazards that may occur in the mid to latter half of the century when considering impacts of climate change on the Proposed Action. Figure 3-2 shows the exposure area of the 3.2 feet sea level rise scenario. Figures 3-3 through 3-6 show the exposure area associated with the 3.2 feet sea level rise scenario in the vicinity of the wastewater pump stations (WWPSs) where work is proposed. Figure 3-2 displays the exposure area for the 2.0 feet and 3.2 feet sea level rise scenario. Projections for future hazard exposure for a scenario greater than 3.2 feet of sea level rise are not currently available; however, it is possible that sea level rise will exceed 3.2 feet.

City and County of Honolulu

HONOLULUI/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES



Legend

- Honouliuli WWTP
- Existing WWPS
- Hybrid Tunnel Shaft
- East Interceptor
- Hybrid Option Alignment
- New and/or Rehabilitated Force Mains and Trunk Sewers
- Waiawa Development Corridors**
- Corridor A
- Corridor D
- Corridor G
- Streets
- SLR Exposure Area 3.2 ft

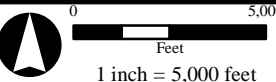
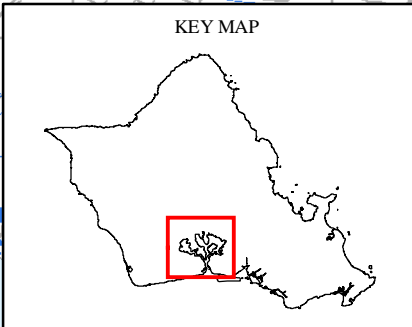


FIGURE 3-2
SEA LEVEL RISE EXPOSURE AREA FOR THE 3.2 FOOT LEVEL RISE SCENARIO



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Base map data sources:
 Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

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Base map data sources:
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City and County of Honolulu

HONOLULU/ WAIPAHA/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

- Legend**
- PS Existing WWPS
 - WWPS Boundary
 - Wetlands
 - Tax Map Key Parcel Boundary
 - SLR Exposure Area 3.2 ft
 - Streams

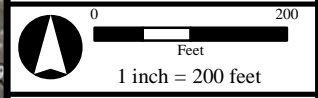
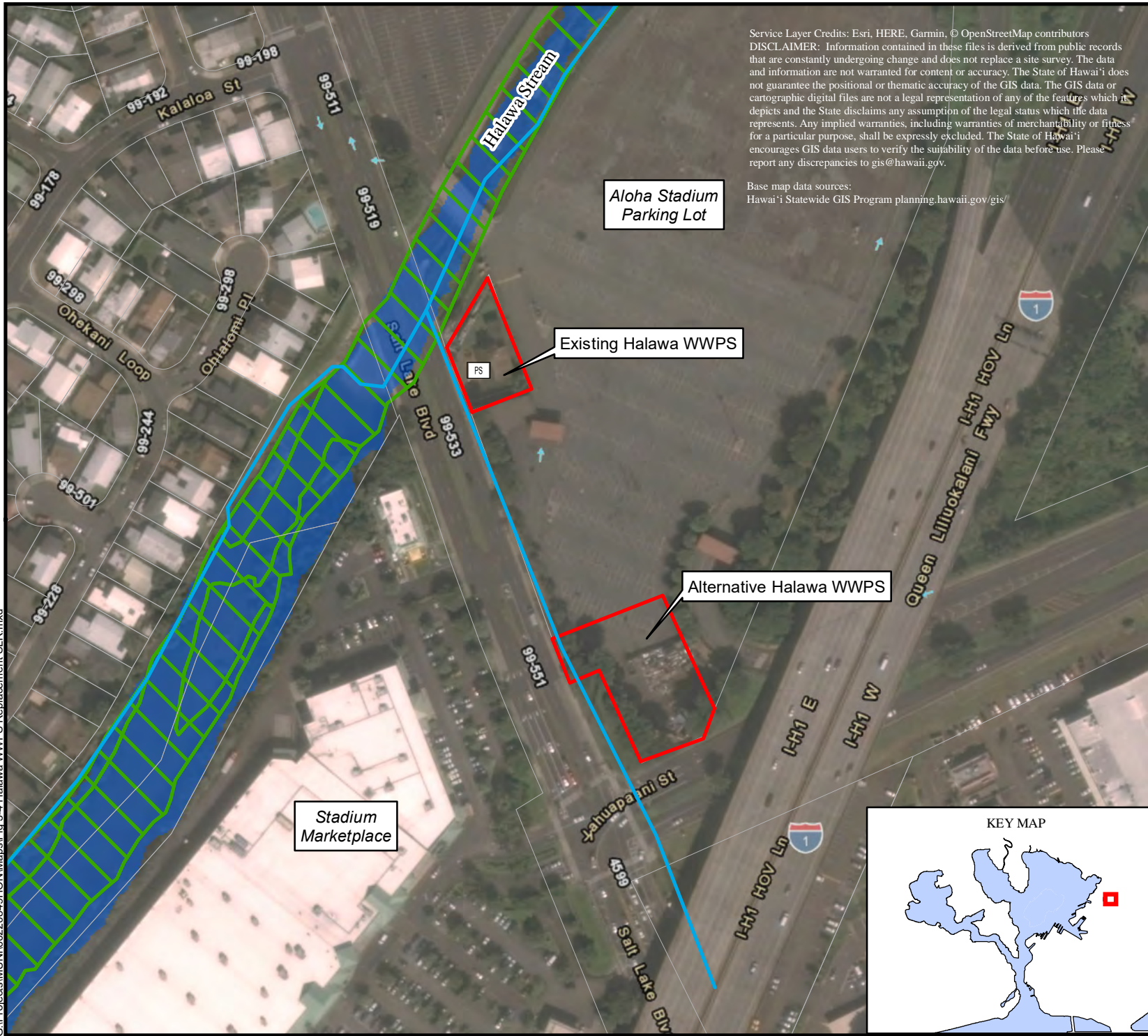


FIGURE 3-3
WAIMALU WWPS -
RECONSTRUCT/
REPLACE AND
SEA LEVEL RISE
EXPOSURE AREA
FOR THE 3.2 FOOT
SEA LEVEL RISE
SCENARIO

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G:\Projects\MUNI\160220849\HON\Maps\Fig 3-3 Waimalu WWPS Replacement SLR.mxd

G:\Projects\MUNI\160220849\HON\Maps\Fig 3-4 Halawa WWPS Replacement SLR.mxd



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Base map data sources:
 Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

City and County of Honolulu
HONOLULU/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

- Legend**
- PS Existing WWPS
 - WWPS Boundary
 - Wetlands
 - Tax Map Key Parcel Boundary
 - SLR Exposure Area 3.2 ft
 - Streams

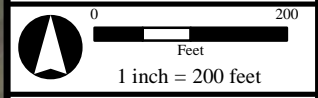


FIGURE 3-4
HAWALA WWPS - RECONSTRUCT/ REPLACE AND SEA LEVEL RISE EXPOSURE AREA FOR THE 3.2 FOOT SEA LEVEL RISE SCENARIO







Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

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City and County of Honolulu

HONOLULU/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

-  Existing WWPS
-  WWPS Boundary
-  Wetlands
-  Tax Map Key Parcel Boundary
-  SLR Exposure Area 3.2 ft
-  Streams

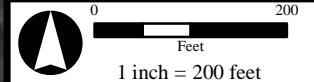


FIGURE 3-5

PEARL CITY WWPS RECONSTRUCT/ REPLACE AND SEA LEVEL RISE EXPOSURE AREA FOR THE 3.2 FOOT SEA LEVEL RISE SCENARIO

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G:\Projects\MUNI\160220849\HON\Maps\Fig 3-5 Pearl City WWPS Replacement SLR.mxd



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City and County of Honolulu

HONOULIULI/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

- PS Existing WWPS
- WWPS Boundary
- Wetlands
- Tax Map Key Parcel Boundary
- SLR Exposure Area 2.0 ft
- SLR Exposure Area 3.2 ft
- Streams

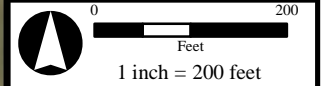


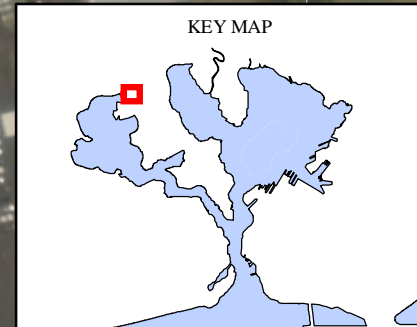
FIGURE 3-6

WAIPAHAU WWPS - RECONSTRUCT/ REPLACE AND SEA LEVEL RISE EXPOSURE AREA FOR THE 3.2 FOOT SEA LEVEL RISE SCENARIO

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3.1.1.3 HAWAII'S CONTRIBUTION TO GHGS

Hawaii's contribution to greenhouse gases (GHGs) includes the following (City and County of Honolulu Climate Change Commission 2018):

- In 2007, Hawaii's total greenhouse gas emissions were 24 million metric tons of CO2 equivalent.
- Total CO2 emissions have slightly declined in the last decade, largely due to energy efficiency gains in the electricity sector.
- O'ahu had 20.8 percent of net sales of electricity from sources deemed renewable in 2017; the law requires 100 percent by 2045.
- Fossil fuel use for transportation continues to increase.
- Hawaii's CO2 emissions are 20 percent lower than the national average.
- However, United States CO2 emissions per capita are over three (3) times the world average and Hawaii's are approximately twelve (12) times larger than other Pacific Islands.
- Passed in 2018, HB 2182 establishes a Greenhouse Gas Sequestration Task Force and sets a 2023 deadline for crafting a plan to meet a zero emissions target by 2045.
- Also passed in 2018, HB 1986 directs the state Office of Planning to work with the task force to create a carbon offset program.

The primary effect the Proposed Action may have on climate change is emission of GHGs associated with burning fuel during construction and operation of the wastewater system. Sources may include vehicles used for construction, travel to construction sites, maintenance, and for transporting materials; equipment; and pump station pumps. As noted below, GHG emissions associated with the Proposed Action would be analyzed further for individual project components during the design phase.

3.1.2 Construction Impacts and Mitigation Measures

3.1.2.1 TEMPERATURE

Extreme heat may impact health and well-being of construction workers. Dehydration, heat exhaustion, and respiratory stress associated with poorer air quality may result. Extreme heat may also impact the function of equipment and the integrity of materials. End of the century temperature may increase by as much as 7.2°F. While the projects associated with the Proposed Action are anticipated to be completed prior to mid-century, it is likely that temperature will be higher than it is today.

To mitigate the impacts of heat on health, drinking water and shade stations would be provided for construction workers.

3.1.2.2 PRECIPITATION AND WIND

Extreme precipitation and or wind may require construction to halt, resulting in potential delays to schedule and cost. Heavy precipitation may increase stormwater runoff and require additional best management practices (BMPs) to manage runoff from disturbed soils during construction. The open trench method of construction may be more vulnerable to extreme precipitation during construction than horizontal directional drilling or microtunneling.

Projects Common to Both East Interceptor Conveyance Options

Construction of new and rehabilitation of existing Waipahu WWPS force mains (FMs) involves both horizontal directional drilling and conventional open trench. Dewatering near the coastline may be further complicated during heavy precipitation.

The Pearl City trunk sewer rehabilitation/replacement, including the portion that crosses the Waiau Stream, would be constructed via either open trench or trenchless methods. Similarly, the crossing of Waimalu, Kalauao, and 'Aiea streams for the Waimalu trunk sewers rehabilitation/replacement would also be accomplished through either conventional open trench or trenchless methods. The Waimalu WWPS FM would be constructed using a combination of open trench and trenchless methods. Extreme precipitation may increase the potential for degradation of stream water quality associated with construction runoff. Additional BMPs would be used to manage the runoff.

East Interceptor Conveyance Options

No-Tunnel

Crossing of the Wailani Flood Control Channel and Waiawa Stream could be accomplished through the conventional open trench method (with shoring and dewatering) due to their relatively short runs to cross these waterways or, alternatively, trenchless methods could be used.

The Pearl City WWPS FM (New), a component of the No-Tunnel conveyance option, is located in a low-lying area that may be susceptible to flooding during heavy rain events.

Hybrid

The microtunnel and deep tunnel options proposed in the Hybrid option for the Pearl-City Waipahu trunk sewer are located in low-lying areas, including floodplains. These options likely would be less vulnerable to impacts from extreme precipitation and flooding during construction because they do not utilize open trench construction. However, access and staging areas may be susceptible to flooding during heavy rain events.

Waiawa Area Conveyance Options

Waiawa Area Conveyance Corridors D and G intersect the Waiawa Stream and may be more vulnerable to impacts from extreme precipitation events and flooding during construction than Corridor A.

The construction method for Corridors A and D include open trench and microtunnels. Approximately 2,460 linear feet (LF) of pipe would be laid via open trench and 9,040 LF of pipe would be laid in microtunnels for Corridor A. The pipe depth ranges from 18.76 to 39.73 feet. For Corridor D, open trench accounts for 3,311 LF of the pipe length, with microtunnels accounting for 8,689 LF. The pipe depth ranges from 14.3 to 97.58 feet. The most probable construction method for Corridor G is deep tunnel boring, although microtunneling may also be feasible. The pipe depth ranges from 28.05 to 116.99 feet. Corridor D, in which more pipe length is laid via open trench, may be more vulnerable to impacts from heavy precipitation. Additionally, both Corridors A and D require soil stabilization adjacent to Waiawa Stream and therefore may present a greater risk from impacts due to heavy precipitation during rain events.

3.1.2.3 SEA LEVEL RISE

The approximate area of the Proposed Action impacted by the exposure area associated with a 3.2 feet sea level rise projected mid to end of the century, or sooner, is included in Table 3-1. These estimates were produced using ArcGIS and are intended for planning purposes only.

Of the projects common to both East Interceptor conveyance options, portions of work areas of the following coincide with the exposure area associated with 3.2 feet of sea level rise:

- Waipahu WWPS FM (New)
- Waipahu WWPS FM Rehabilitation
- Waimalu Trunk Sewers – Rehabilitation/Replacement
- Hālawā WWPS FM (New).

Projects that are vulnerable to sea level rise that are associated with the No-Tunnel option include:

- Pearl City WWPS FM (New)
- Pearl City WWPS FMs Rehabilitation.

The Hybrid option includes the only WWPS alternative that is located within the exposure area. Approximately 3,550 square feet (SF) of the Alternative location fall within this area. Both the microtunnel and deep tunnel options Waipahu WWPS No. 2 for the Pearl City-Waipahu Trunk Sewer coincide with the exposure area.

A small portion of the Waiawa Area Conveyance Corridors D and G are located within the exposure area.

Table 3-1 also shows the anticipated years that construction would occur. Near-term construction activities are less likely to be impacted by sea level rise than those proposed closer to the middle of the century. Significant delays in construction would likely result in greater vulnerability to sea level rise during construction, and project locations and alignments may need to be revised to avoid construction in areas that may be inundated in the future.

Table 3-1. Project Components Located within the Exposure Area Associated with 3.2 feet of Sea Level Rise

Project	Anticipated Years of Construction	Area/Length within the 3.2-foot Sea Level Rise Exposure Area
<i>Common to Both East Interceptor Conveyance Options</i>		
Waipahu WWPS FM (New)	2022-2024	1,139 LF
Waipahu WWPS FM Rehabilitation	2025-2026	1,372 LF
Pearl City Trunk Sewers – Rehabilitation/Replacement	2032-3025	0 LF
Waimalu WWPS FM (New)	2032-2035	0 LF
Waimalu WWPS – Reconstruct/Replace	2033-2036	0 SF
Waimalu Trunk Sewers – Rehabilitation/Replacement	2036-2039	796 LF
Hālawā WWPS FM (New)	2036-2038	71 LF
Hālawā WWPS – Reconstruct/Replace	2037-2040	0 LF
<i>East Interceptor Conveyance Options</i>		
No-Tunnel Option		
Waipahu WWPS – Rehabilitation/Upgrade	2025-2026	0 LF
Pearl City WWPS Force Main (New)	2026-2029	4,571 LF
Pearl City WWPS Force Mains Rehabilitation	2029-2032	4,571 LF
Pearl City WWPS – Reconstruct/Replace	2031-2033	0 SF
Alternative Pearl City No. 1 WWPS	2031-2033	0 SF
Alternative Pearl City No. 2 WWPS	2031-2033	0 SF
Alternative Pearl City No. 3 WWPS	2031-2033	0 SF
Hybrid Option		
Pearl City-Waipahu Trunk Sewer	2026-2029	Microtunnel: 758 LF Tunnel: 2,922 LF
Waipahu WWPS No. 2	2027-2030	3,550 SF
Pearl City WWPS – Demolition	2032-2034	0 SF
<i>Waiawa Area Conveyance Options</i>		
Corridor A	TBD	0 LF
Corridor D	TBD	120 LF
Corridor G	TBD	12 LF

3.1.3 Operational Impacts and Mitigation Measures

CCH recognizes the threat of climate change and the importance of planning for its effects. Full support and cooperation will be provided towards the ongoing efforts to establish State-wide policies and regulations. The City and County of Honolulu Department of Environmental Services (ENV) intends to work with other CCH and

State agencies in the future as the guidance and policies to address climate change are further developed. Additional details pertaining to required adaptation measures (floodproofing, elevation of critical facilities, modifications to project locations and alignments, etc.) would be identified during the planning and design phase and incorporated into project designs as appropriate.

3.1.3.1 TEMPERATURE

Regardless of the options selected, high temperatures may impact the function and performance of equipment and performance of materials. Mechanical and electrical equipment may be shaded to mitigate extreme temperatures and air conditioned spaces may be required. Changes in temperature are not anticipated to impact the operation of subsurface project components.

3.1.3.2 PRECIPITATION AND WIND

Above-grade infrastructure (i.e., WWPSs) is more vulnerable to high winds than below-grade pipes. Flooding may also impact the Proposed Action. Saturation of soil can increase susceptibility of below-grade infrastructure to soil movements. Additionally, flooding could increase the likelihood of sewer system overload, which could cause overflow to the drainage network, resulting in surface and groundwater contamination and potential public health impacts.

Wind, flooding, or storm events may cause direct physical damage to WWPSs, which can result in increased risk of mechanical or electrical failure of treatment systems. Wind and rain events can cause power outages, which may impact pump station operation. WWPSs would be equipped with emergency generators sized to provide WWPS functionality during power outages. Increased frequency of alternating wet and dry or hot and cold cycles and more intense flood and droughts are likely to expand and contract soils, which can damage buried infrastructure. Impacts may include leaks, environmental and health impacts, and repair costs.

3.1.3.3 SEA LEVEL RISE

Sea level rise may have direct and indirect impacts on the Proposed Action. Exposure to salt water can degrade and damage materials, pumps, and other equipment. Storm surge may damage or flood structures. Increased water levels may also impact access to pump stations. Below-grade, sea level rise can cause groundwater levels to rise and saltwater intrusion, which can impact the stability of soil, expose pipes to salt water, and potentially result in infiltration of saline water into the conveyance system. Sea level rise may cause infrastructure to become subject to increased tidal gradient and additional groundwater infiltration, resulting in possible reduction in capacity and increased risk of environmental spills during high rainfall events or high tides.

Projects Common to Both East Interceptor Conveyance Options

Portions of the existing and new Waipahu WWPS FM located near sea level may be subject to increased tidal gradient and additional groundwater infiltration, resulting

in possible reduction in capacity and increased risk of environmental spills during high rainfall events or high tides.

Neither the existing nor the proposed Waimalu WWPSs are located within the exposure area of the 3.2 feet sea level rise scenario. Neither the existing nor the proposed alternative location of the Hālawā WWPS falls within the extent of the exposure area. As shown in Table 3-1 above, a portion of the Waimalu trunk sewer rehabilitation/replacement and the Hālawā WWPS FM are located within the 3.2 feet of sea level rise exposure area.

East Interceptor Conveyance Options

No-Tunnel

Approximately 4,571 feet of the new Pearl City WWPS FM associated with the no-tunnel option are located within the 3.2 feet sea level rise exposure area.

Hybrid

With the Hybrid option, the Pearl City-Waipahu trunk sewers located near sea level may be subject to increased tidal gradient and additional groundwater infiltration, resulting in possible reduction in capacity and increased risk of environmental spills during high rainfall events or high tides.

The Alternative Waipahu WWPS No. 2 location is the only above-grade project component proposed within the exposure area associated with 3.2 feet of sea level rise by mid to late century. However, it is possible that sea level may increase by greater than 3.2 feet by the end of the century and that additional above-grade project components would be vulnerable to sea level rise.

The existing Waipahu WWPS and the Alternative Waipahu WWPS No. 2 location are partially within the extent of the 3.2 feet sea level rise exposure area. Approximately 9,050 SF of the existing WWPS and 3,550 SF of the proposed alternative location are located within this exposure area. As shown in Figure 3-6, the southern end of the Alternative Waipahu WWPS No. 2 location is adjacent to the 2.0 feet sea level rise exposure area. In addition to direct impacts associated with flooding and inundations, access to the Waipahu WWPS from Waipahu Depot Street is projected to be impacted.

The existing and proposed Pearl City WWPSs are not located within the extent of the 3.2 feet sea level rise exposure area. The existing Pearl City WWPS is located at 10 feet above mean sea level (MSL).

Waiawa Area Conveyance Options

The southern end of Corridor G and a portion of D are located within the 3.2 feet sea level rise exposure area. Due to the depth of the pipe, it is not likely that sea level rise would have a direct impact on the pipe. However, Corridors A, D, and G may be vulnerable to salt water intrusion. This could increase infiltration into the sewer system and expose the pipe to salinity, resulting in increased flow and degradation of pipes and intake structures.

3.1.4 Greenhouse Gas Emissions Impacts and Mitigation Measure

GHG impacts and mitigation measures are not included in this Draft Environmental Impact Statement (DEIS). A study of whether the Proposed Action may emit substantial GHGs directly or as an indirect or cumulative impact would be conducted for individual projects as designs progress.

3.2 TOPOGRAPHY, GEOLOGY, AND SOILS

3.2.1 Existing Setting

The island of O‘ahu was created by two (2) volcanoes: the Ko‘olau and the Wai‘anae. The Ko‘olau volcano is the younger of the two (2) and located on the eastern side of the island, and the Wai‘anae volcano is on the western side of the island. The Honouliuli sewer basin is bounded by the Schofield Plateau to the north, Ko‘olau Range to the east, ‘Ewa Plains and Pearl Harbor to the south, and the Wai‘anae Range to the west. The Schofield Plateau was formed as lava from the Ko‘olau volcano flowed to the Wai‘anae Range, which created a flat area between the two (2) mountain ranges. Figure 3-7 shows the geological features in the sewer basin.

Topography within the sewer basin is gently sloping and relatively flat; however, there are steep areas near the mountain ranges. Elevation in the sewer basin ranges from zero to approximately 3,000 feet MSL. The majority of the project area facilities are located between 0 and 100 feet MSL with the exception of the Waiawa Area Conveyance Corridor options which range between 0 and 200 feet MSL. The general topography within the sewer basin is shown in Figure 3-8.

According to the *Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawai‘i* (United States Department of Agriculture Soil Conservation Service 1972), there are seven (7) soil associations on O‘ahu, five of which are present in the Honouliuli sewer basin (Figure 3-9). Most of the proposed conveyance facilities work would occur within the Lualualei-Fill land-‘Ewa soil association. These soils are classified as: deep, nearly level to moderately sloping, well-drained soils that have fine textured or moderately fine textured subsoil or underlying material, and areas of fill land; on coastal plains. A small portion of the Waiawa Area Conveyance project area also lies within the Helemano-Wahiawā soil association, classified as deep, nearly level to moderately sloping, well-drained soils that have fine-textured subsoil; on uplands.

Soils within the East Interceptor Conveyance project area are classified primarily as Pearl Harbor clay, and Honolulu clay, with 0 to 2 percent slopes; with smaller areas of Kea‘au clay, saline, 0 to 2 percent slopes. Soils in the Waiawa Area Conveyance Corridor options are predominantly Kawaihapai clay loam, with slopes varying from 0 to 15 percent; and Waipahu silty clay, with 0 to 12 percent slopes.

City and County of Honolulu

HONOLULULI/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

- ▭ Honouliuli Sewer Basin
- ⊕ Hybrid Tunnel Shaft
- ▬ East Interceptor
- ▬ Hybrid Option Alignment
- ▬ Waiawa Conveyance Corridors (Options A, D, and G)
- ▬ New and/or Rehabilitated Force Mains and Trunk Sewers
- ▬ Major Roadways

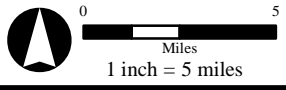
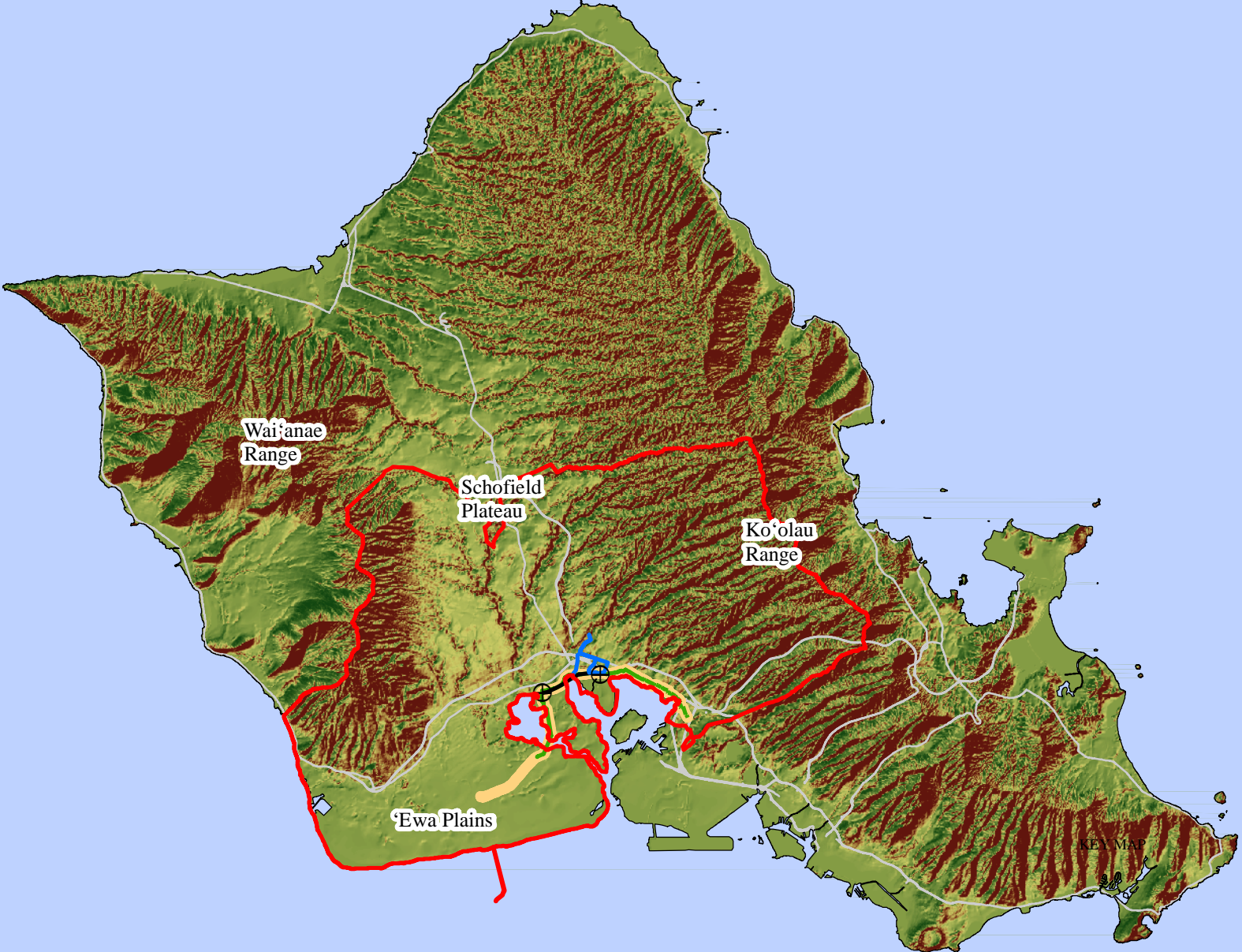


FIGURE 3-7
GEOLOGICAL
FEATURES

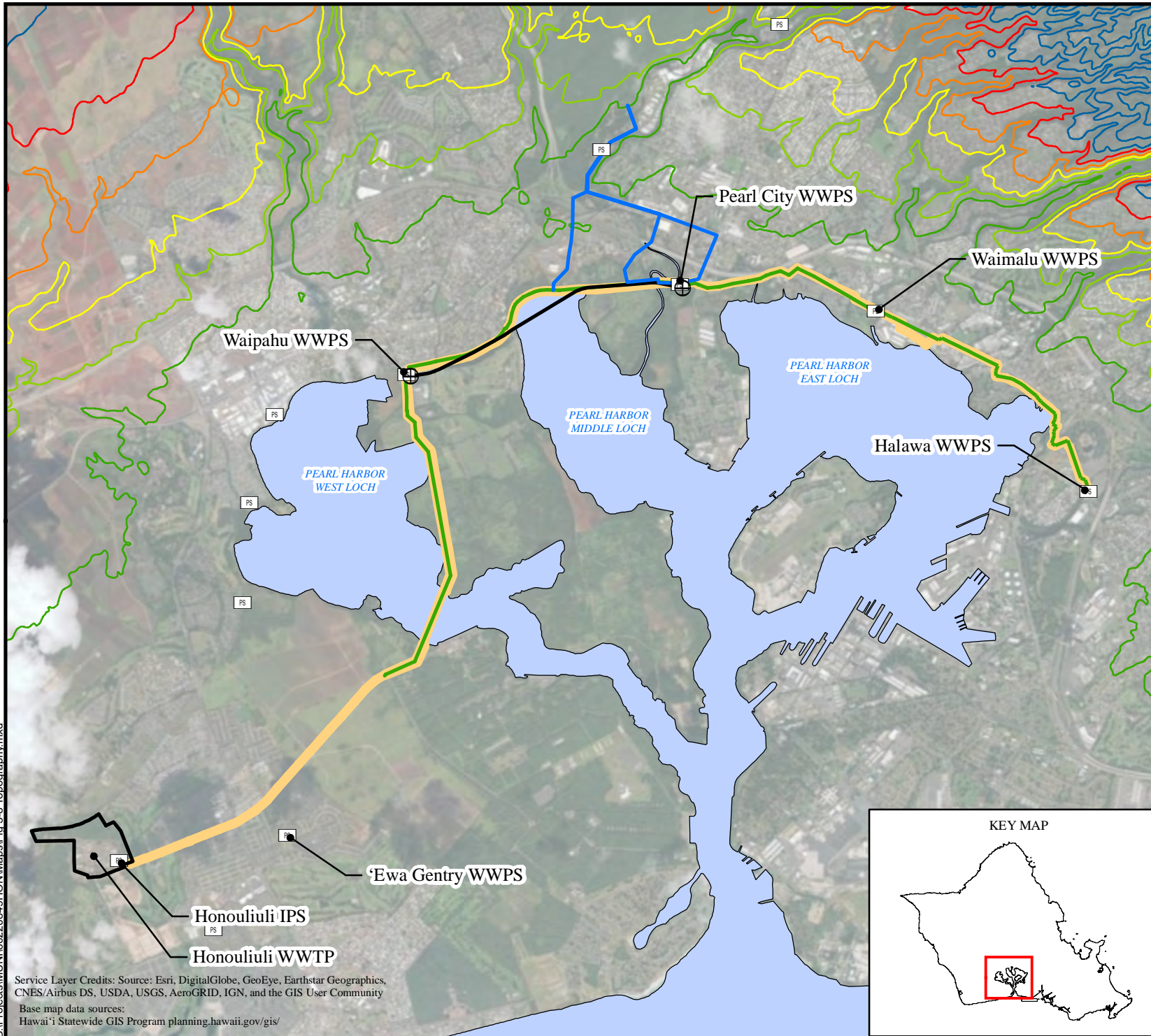


1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813



G:\Projects\MUNI\020849\HON\Maps\Fig 3-7 Geological Features.mxd

Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/



City and County of Honolulu

HONOULIULI/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

- Honouliuli WWTP
- Hybrid Tunnel Shaft
- Existing WWPS
- Waiawa Conveyance Corridors (Options A, D, and G)
- Hybrid Option Alignment
- New and/or Rehabilitated Force Mains and Trunk Sewers
- East Interceptor

Elevation (ft.)

- > 500
- 100
- 200
- 300
- 400
- 500

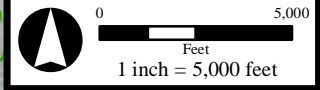
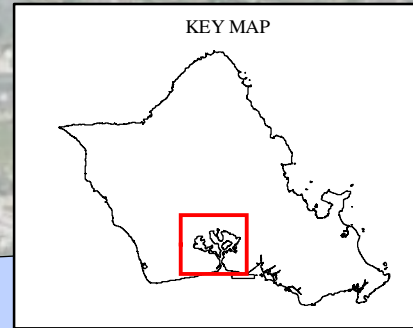


FIGURE 3-8

TOPOGRAPHY



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Service Layer Credits: Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
 Base map data sources:
 Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

City and County of Honolulu

HONOULIULI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

- Honouliuli Sewer Basin
- Honouliuli WWTP
- East Interceptor
- Hybrid Option Alignment
- Waiawa Conveyance Corridors (Options A, D, and G)
- New and/or Rehabilitated Force Mains and Trunk Sewers

- 1 Lualualei-Fill land-Ewa
- 2 Helemano-Wahiawā
- 3 Tropohumults-Dystrandeps
- 4 Rough Mountainous land-Kapa'a
- 5 Rock land-Stony Steep Land
- 6 Ka'ena-Waiialua
- 7 Loleka'a-Waikāne

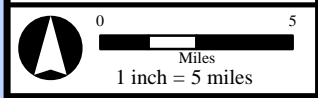
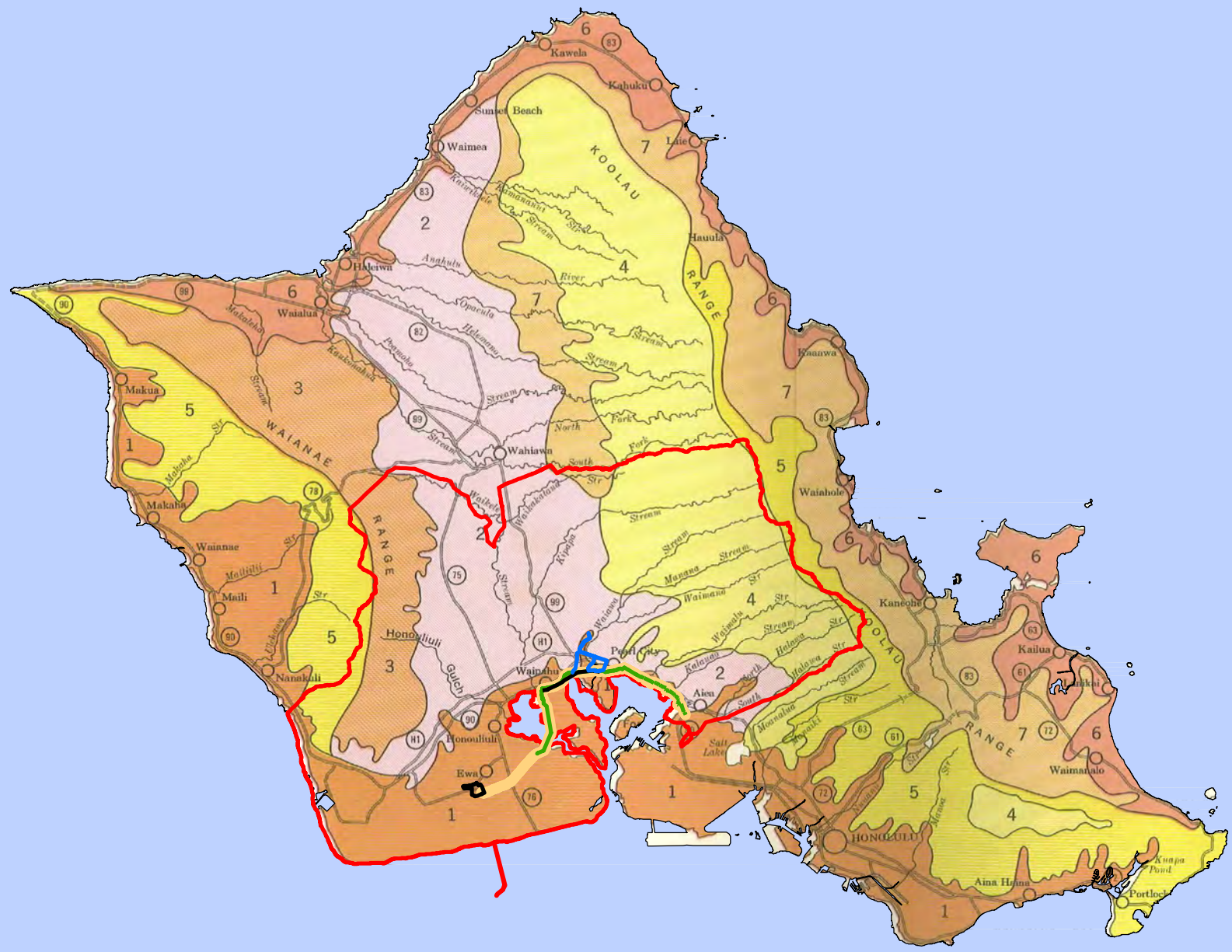


FIGURE 3-9

SOIL ASSOCIATIONS



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Source: Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai. State of Hawai'i (1972)

Soils are classified by the Natural Resource Conservation Service into four (4) hydrologic soil groups based on the soil's runoff potential. The hydrologic soil group classification is generally consistent throughout the project area. Soils within the East Interceptor Conveyance project area are classified as Group C and D. These soils have low to very low infiltration rates when wet, with a high potential for stormwater runoff. Similarly, the soils found in the southern portion of the proposed Waiawa Area Conveyance Corridors are Group C. By contrast, the northern and central portions of the Waiawa Area Conveyance project area have a hydrologic soil group classification of Group A. These soils have a low runoff potential and high infiltration rates even when thoroughly wetted.

3.2.2 Construction Impacts and Mitigation Measures

None of the projects common to both East Interceptor conveyance options is anticipated to significantly impact the topography or geology within the limit of work. The projects requiring open trench excavation (i.e., force main and trunk sewer rehabilitation / replacement) would encounter variations in topography and result in temporary soil disturbance. Trenches would be engineered and constructed per United States Occupational Safety and Health Administration standards. Similarly, reconstructing or replacing the Waimalu WWPS and Hālawa WWPS would result in short-term soil disturbance. Minor regrading is anticipated for work associated with the WWPSs.

Regardless of the East Interceptor conveyance option selected, construction of the project is not anticipated to significantly impact the topography or geology within the limit of work. The No-Tunnel option would encounter variations in topography, and temporary disturbance would be anticipated due to open trench excavation. Similarly, temporary disturbance would result from excavation of the entry and exit shafts for the tunneling associated with the Hybrid option. Major permanent modifications to the topography above the sewer line alignments for either option would not be anticipated and grade levels would be restored. For both East Interceptor conveyance options, some impacts to the soils in the project area, including soil loss, are expected during construction. Open trench excavation would be necessary for construction of the No-Tunnel option, as well as the sewer connections associated with the Hybrid option, and both would result in removal of soil. Depending on the option selected, construction may include the removal of soils and excavation material in the area. Disposal of the excavation material (tunnel muck) would be a substantial part of construction if the Hybrid option is implemented. The volume of muck generated would vary for each of the potential gravity sewer tunnel (GST) options, with muck hauling activities dependent upon the advance rate of the tunnel boring machine. Disposal of the excavation material could potentially pose an environmental impact. Disposal methods may include use as fill material for other projects, temporary stockpiling, or final disposal to a landfill.

Regardless of the gravity sewer conveyance corridor option selected for the Waiawa area, construction of the project is not anticipated to significantly impact the topography or geology within the limit of work. However, some impacts to the soils

in the project area, including removal of soil and soil loss, are expected during construction.

In general, construction activities, including excavation and trenching, could potentially impact sewer lines or force mains that could result in localized contamination of soils. There is also a chance of accidental release of construction equipment fluids (e.g., oil and grease) that could contaminate soils.

Mitigation measures would be implemented during construction activities to minimize the potential for impacts presented. Construction methods to preserve the integrity of existing utility lines would be implemented and construction equipment would be maintained in good working condition to reduce the potential for accidental spills. In addition, although construction activities would involve grading, excavation and trenching, mitigation measures such as erosion and sedimentation controls (i.e., silt fence, filter socks) would be implemented to reduce impacts to the natural environment. Trenches would be backfilled to grade or covered with plates at the end of each day. Soil which is not immediately used for backfilling would be stockpiled and covered or otherwise protected (e.g., surrounded by silt fence) to prevent erosion or sedimentation of adjacent areas. In addition, temporary seeding and mulching may be used to minimize soil erosion and provide soil stabilization on slopes.

Based on the area of disturbed soil associated with any of the proposed project options, a drainage and erosion control plan would be prepared by an engineer and submitted for approval to City and County of Honolulu Department of Planning and Permitting.

3.2.3 Operational Impacts and Mitigation Measures

The primary objective of each conveyance option is to rehabilitate existing sewers and improve the carrying capacity of the existing Honouliuli wastewater system; thereby minimizing SSOs and contamination of soils in the project area. Soils stability inspections near the proposed facilities would need to be conducted periodically to make sure there are no issues with the foundation of the facilities.

3.3 HYDROLOGY

3.3.1 Groundwater

3.3.1.1 EXISTING SETTING

The Honouliuli sewer basin overlies the entire Pearl Harbor aquifer area (with an additional small section of the sewer basin extending into the Central aquifer area). The Pearl Harbor aquifer is divided into four areas: Mākāiwa, 'Ewa-Kunia, Waipahu-Waiawa, and Waimalu, with a total sustainable yield of approximately 165 million gallons per day (Figure 3-10) (State of Hawai'i Office of Planning 2010).

City and County of Honolulu

HONOLULU/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

- Legend**
- Honouliuli Sewer Basin
 - Hybrid Tunnel Shaft
 - East Interceptor
 - Hybrid Option Alignment
 - Waiawa Conveyance Corridors (Options A, D, and G)
 - New and/or Rehabilitated Force Mains and Trunk Sewers
 - Streets
 - Aquifer Boundary

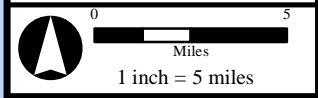
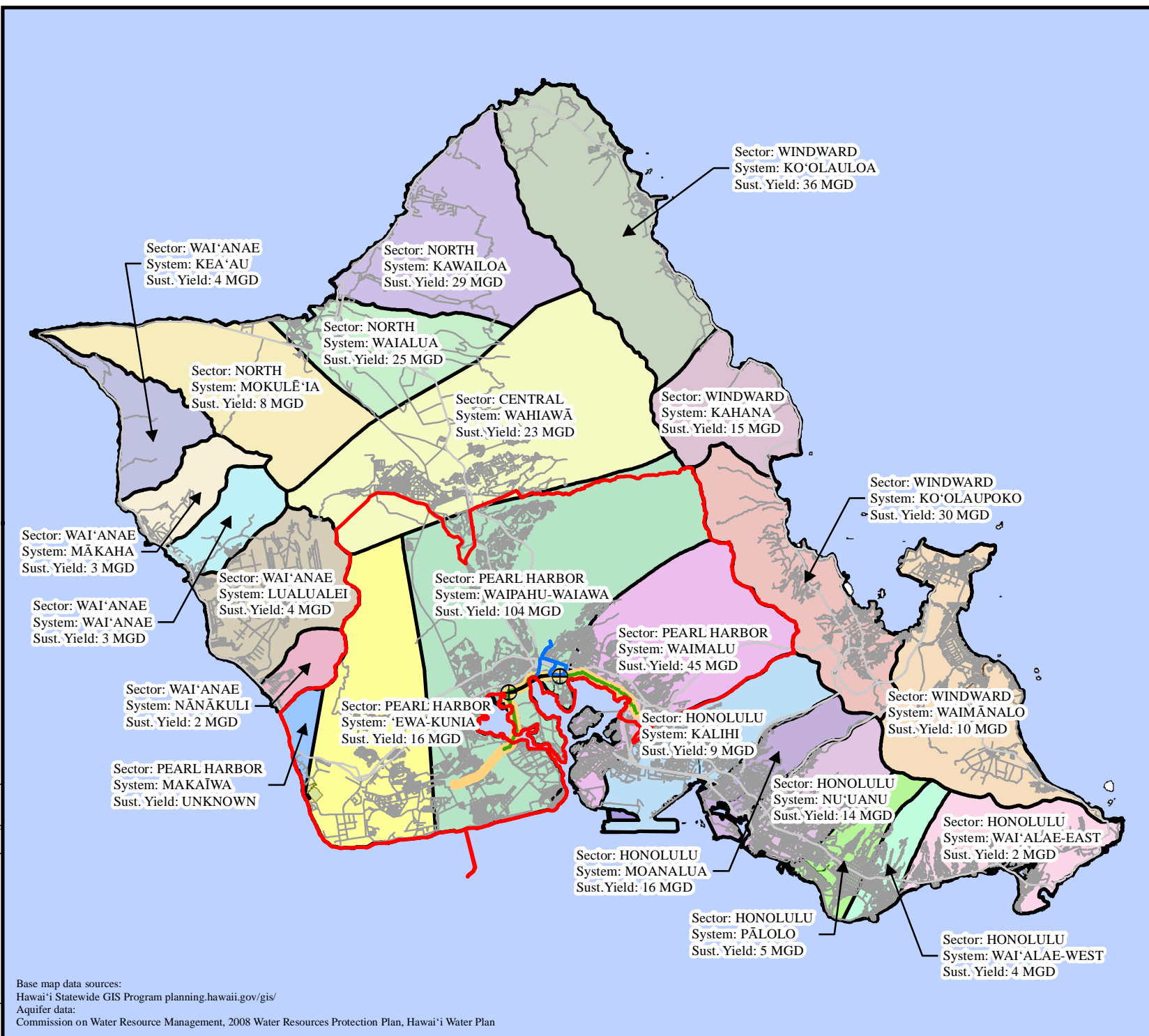


FIGURE 3-10
AQUIFER



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Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/
Aquifer data:
Commission on Water Resource Management, 2008 Water Resources Protection Plan, Hawai'i Water Plan

Groundwater moves downward until it encounters impermeable geological features and contributes to the freshwater (Ghyben-Herzberg) lens or emerges as springs. In Hawai'i, the thickness of the lens generally decreases seaward, but it can be “dammed” near the coastline by sediments or limestone caprock. Groundwater delivery to Pearl Harbor through springs was an important component of the estuarine system, critical to the use of the area by Hawaiians, and later to large-scale agriculture in the area. Since the arrival of the first Polynesians, this highly productive natural ecosystem has been changed by human activities both directly and indirectly.

3.3.1.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Construction activities could potentially impact groundwater if encountered during the proposed work. Construction/rehabilitation of the Waipahu force main would require crossing of the Pearl Harbor West Loch. Construction complexities associated with this work include dewatering near the coastline, and proximity to sensitive wetlands. However, in order to mitigate these environmental impacts, horizontal directional drilling methods could be used for the water body crossing.

For both East Interceptor conveyance options, construction activities including excavation, trenching, drilling and tunneling would be designed to avoid adverse impacts to groundwater. This includes designs to avoid affecting existing sewer lines or force mains, and plans to prevent the accidental release of construction equipment fluids (e.g., oil and grease) that could contaminate groundwater. For the Hybrid option, drilling and tunneling could alter groundwater dynamics and quality in the event that tunneling encounters artesian water currently flowing to the surface.

Mitigation measures would be implemented during construction activities to preserve the integrity of existing utility lines and keep construction equipment in good working condition to prevent accidental spills. Also, dewatering may be necessary for construction below the groundwater table which would be conducted in accordance with applicable regulations. Dewatering during construction is covered under Hawaii's NPDES Construction General Permit. For drilling and tunneling work, the conditions of water flow in and near the tunneling activities would be monitored and, if any potentially detrimental changes occur, the problem would be addressed as quickly as possible. In addition, appropriate BMPs (e.g., vegetated buffers, drainage swale to intercept/direct surface runoff to temporary storage/sedimentation basin) and careful site preparation would be utilized to minimize adverse impacts

3.3.1.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, the Proposed Action would be implemented to reduce the potential of SSOs by increasing capacity to the existing wastewater conveyance and treatment system for current and future needs. Improvements to the existing system would reduce the likelihood of breakage in sewer lines or force mains which could contaminate groundwater.

The increase in capacity could also enable and/or encourage currently unsewered areas to connect to a centralized system. This could result in a reduction to localized groundwater recharge in areas that currently have on-site wastewater treatment systems.

As with any wastewater system, there is the potential for leakage and breakage in sewer lines that would result in impacts to groundwater. Therefore, mitigation measures for the operational impacts include proper operation and maintenance of the proposed facilities.

3.3.2 Surface Water

3.3.2.1 EXISTING SETTING

Pearl Harbor is a natural estuary formed by successive periods of flooding during glacial epochs. A combination of perennial and intermittent streams, as well as several springs and small dry gulches discharge into Pearl Harbor. The lower reaches of these streams, springs, and wetlands overlay oyster beds, reefs, and mud deposits eroded from the Koʻolau and Waiʻanae Mountain ranges.

Discharge of streams draining the Koʻolau Mountains is relatively low above the emergent Pearl Harbor springs, and often disappears completely into the channel alluvium during droughts. Numerous perennial springs fed by groundwater emerge near an elevation of 20 feet above sea level. Streams from the Waiʻanae Mountains are intermittent and discharge only during storm events. High flood peaks and low base flows characterize all Pearl Harbor streams. Stream flows are perennial and chemically more characteristic of groundwater below the Pearl Harbor springs. The terminal reaches of perennial streams entering Pearl Harbor are tidal. A saltwater wedge is commonly found underlying fresh surface waters several hundred feet upstream.

There are eight (8) perennial streams in the project area (Hālawa, ʻAiea, Kalauao, Waimalu, Waiawa, Waikele, Kapakahi, and Honouliuli) that discharge into Pearl Harbor. Table 3-2 lists the streams in the project area, if the stream is considered navigable, whether the stream is impaired (waterbodies that contain segments that do not meet State Water Quality Standards), and the confluence with Pearl Harbor.

Table 3-2. Streams Located in the Project Area

Stream	Navigable Waters¹	Impaired Waterway²	Pearl Harbor Confluence
Hālawa	Yes	Yes	East Loch
‘Aiea	Yes	Yes	East Loch
Kalauao	No	Yes	East Loch
Waimalu	No	Yes	East Loch
Waiawa	No	Yes	Middle Loch
Waikele	No	Yes	West Loch
Kapakahi	No	Yes	West Loch
Honouliuli	No	No	West Loch

1 Navigable Waters as defined by the United States Coast Guard as waters subject to tidal influence and non-tidal streams that carry commercial traffic

2 State of Hawai‘i Department of Health (DOH) 303(d) List of Impaired Waters; listed in 2018 State of Hawai‘i Water Quality Monitoring and Assessment Report, DOH.

Inland streams in Hawai‘i have two classifications for water use. According to Administrative Rules Title 11, Chapter 54 Water Quality Standards (Hawai‘i Administrative Rules (HAR) §11-54-3), the objective for Class 1 waters is “...that these waters remain in their natural state as nearly as possible with an absolute minimum of pollution from any human-caused source.” The objective for Class 2 waters “...is to protect their use for recreational purposes, the support and propagation of aquatic life, agricultural and industrial water supplies, shipping, and navigation.” Class 1 streams are typically found in undeveloped areas near the Ko‘olau summits; there are no Class 1 streams located within the project area.

3.3.2.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, there is a potential for surface water impacts to occur during construction. Excavation and land disturbance may contribute to sedimentation and runoff into nearby streams, particularly during rainfall events, and tunneling could result in potential draining of surface water supplies and resource areas.

Crossing Waiawa Stream (Pearl City Trunk Sewers rehabilitation/ replacement), and Waimalu, Kalauao, and ‘Aiea streams (Waimalu Trunk Sewers rehabilitation/replacement), would be conducted through either conventional open trench or trenchless methods. Shoring and dewatering techniques would be employed to mitigate potential surface water impacts. Similar methods would be used to cross the Wailani Flood Control Channel and Waiawa Stream, required to construct the Pearl City WWPS FM (New) (under the No-Tunnel option).

For the Waiawa Area Conveyance project, construction of either Corridor D or G would require tunneling beneath Waiawa Stream.

Many of the pump stations are located in close proximity to streams within the project area. Therefore, construction activities have the potential to impact these surface waters by stormwater runoff and sedimentation.

If selected, the Hybrid option would involve tunneling beneath streams. For certain alignments the vertical alignment beneath the stream provides relatively little cover. Tunneling beneath water bodies carries the risk of an occurrence known as “frac-out”, where drilling mud is released through fractured bedrock into the surrounding rock and sand and travels toward the surface. If a frac-out did occur, sediments would be suspended in the water column affecting turbidity. Specific mitigations measures to minimize effects of a frac-out include the deployment of silt curtains to contain any turbidity plumes. Specific measures to monitor for and respond to frac-out would be identified in required permit applications. In addition, for access to certain shafts and pump stations, temporary bridges may need to be constructed to pass over streams nearby.

3.3.2.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, implementation of the Proposed Action is anticipated to result in a positive impact to surface water. The additional capacity to the wastewater conveyance system resulting from the Proposed Action is expected to minimize the potential of SSOs and associated impacts. Although the proposed project would reduce the likelihood of leakage or breakage in sewer lines or force mains, there is always the potential for them to occur. Mitigation measures for operational impacts include proper operation and maintenance of the proposed improvements.

3.3.3 Coastal Waters

3.3.3.1 EXISTING SETTING

Pearl Harbor is a natural estuary formed by successive periods of flooding during glacial epochs. It is divided into three (3) main embayments or lochs (West, Middle, and East Loch) that join to form a single channel (Pearl Harbor Entrance Channel) that opens to the sea. It is recognized as Hawai'i's largest natural estuary and possesses a rich diversity of salt-tolerant aquatic species, many of which are important to recreational and subsistence fisheries. The waters of Pearl Harbor are considered an inland estuary and classified as Class 2 waters (HAR §11-54-6).

Several anthropogenic activities have greatly altered the character of the Pearl Harbor estuary, including extensive cattle grazing in the 18th century which resulted in the loss of topsoil, increased runoff, and sedimentation of inshore waters; and a subsequent conversion from agricultural to urban land use, which further affected soils, hydrology, water quality, and other aspects at the down slope margin of the Pearl Harbor watershed. As a result of natural and anthropogenic sedimentation, as well as military, agricultural, industrial, and urban activities within the watershed, numerous contaminants have been recorded in Pearl Harbor waters, sediments, and fish tissues, including polychlorinated biphenyls, copper and organotin antifouling materials, hydrocarbons (lubricants and fuels), metals (arsenic, cadmium, lead,

mercury, silver, and zinc), and cis-chlordane. The natural resources of Pearl Harbor estuary have also been significantly altered by the introduction of alien marine and estuarine species. For example, much of the margin of the harbor is now dominated by mangroves (*Rhizophora* sp.) which reduce water circulation, increase sediment retention, and co-opt shoreline habitats required by native estuarine species. Above tidal influences, hau (*Hibiscus tiliaceus*), California grass, and pickleweed cover significant parts of the margins of waterways.

The open coastal waters in the Honouliuli sewer basin extend from Ko ‘Olina to outside the Pearl Harbor Entrance Channel (West Māmala Bay), and are classified as Class A. According to HAR §11-54-3, the objective for Class A marine waters is “...that their use for recreational purposes and aesthetic enjoyment be protected. Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. These waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class.”

3.3.3.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

If the Hybrid option is implemented, portions of the alignment could require tunneling beneath Pearl Harbor. In addition, during construction regardless of the options selected, there is a possibility of stormwater runoff carrying sediments and construction related pollutants into Pearl Harbor. However, construction controls required by National Pollutant Discharge Elimination System (NPDES) permits would reduce this risk.

3.3.3.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Operation of the Proposed Action is expected to result in a positive impact to coastal water by minimizing the potential for SSOs from the existing wastewater conveyance system.

3.4 NATURAL HAZARDS

3.4.1 Earthquakes

3.4.1.1 EXISTING SETTING

O‘ahu does not have any active volcanoes; therefore, the island is not subject to significant earthquakes from volcanic activity. However, earthquakes are not uncommon in Hawai‘i. Most earthquakes in the Hawaiian Islands are caused by volcanic activity on the island of Hawai‘i, the Big Island. Earthquakes that reach O‘ahu are generally not strong and cause little or no damage. One of the larger and more recent earthquakes occurred offshore of Puakō, Hawai‘i in 2006. The earthquake measured 6.7 on the Richter scale and caused minor damages on the island of O‘ahu. In 2017, a magnitude 5.28 earthquake occurred southeast of Volcano, Hawai‘i and was felt on O‘ahu, Maui, and Hawai‘i.

Peak ground acceleration maps show a low level of seismic hazard on O‘ahu. CCH has no National Earthquake Hazards Reduction Program Class D and E soils, which are softer soils that magnify ground shaking and increase building damage and loss and are more susceptible to liquefaction (Tetra Tech, Inc. 2018).

The International Building Code (IBC) classifies likelihood of seismic activity into zones ranging from 0 to 4. Seismic Zone 0 represents no chance of severe ground shaking and Seismic Zone 4 represents a 10 percent chance of severe shaking in a 50-year interval. The IBC classifies O‘ahu as Seismic Zone 2A (AECOM Technical Services, Inc. (AECOM) 2011).

3.4.1.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, construction activities are not anticipated to impact earthquakes or the frequency of earthquakes in the project area. It is possible that an earthquake could occur during construction. Impacts associated with earthquakes include shifting equipment or materials that may damage the equipment or materials or injure personnel. Earthquakes may result in loss of power, which could disrupt service and construction. There is also potential for fires to occur after earthquakes, with additional impacts to project construction. An earthquake that occurs during construction may impact the project cost and result in delays to the construction schedule.

While there is no reliable way to predict the day or month that an earthquake will occur in any location, forecasting and alerts and warning systems help to increase public safety and reduce loss. The United States Geological Survey is responsible for issuing alerts for earthquakes. The survey issues information via the internet, email, text, and social media. Currently, warning systems provide approximately 40 seconds of notice of a major earthquake (Tetra Tech, Inc. 2018). In the event of an earthquake, construction activities would be halted and the contractor would implement emergency response procedures. Equipment and materials would be secured, as feasible. All federal, state, and CCH requirements would be implemented for the safety of construction personnel and nearby people.

The Proposed Action projects would be designed to meet Seismic Zone 2A requirements and applicable IBC, federal, state, and CCH requirements.

3.4.1.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, operations are not anticipated to impact earthquakes or the frequency of earthquakes in the project area.

It is possible that an earthquake could impact infrastructure and continuity of service of the wastewater system. Post-construction impacts include structural and non-structural damage to WWPSs, pipes, and equipment. Damage to buildings may result in the need to relocate and replace buildings.

An earthquake that compromises the integrity of the wastewater system, causing breakages in sewer lines or releasing hazardous materials, could result in significant public health and environmental impacts.

Proposed WWPSs would be designed and constructed to meet Seismic Zone 2A requirements and all applicable IBC and federal, state, and CCH requirements. A back-up power supply would be available to help prevent sewer system overflows during emergencies and power outages.

3.4.2 Tsunamis

3.4.2.1 EXISTING SETTING

Tsunamis are a series of waves that are created by sea floor movements caused by earthquakes, landslides, or volcanic eruptions. The Hawaiian Islands are always at risk for tsunamis since the islands are susceptible to tsunamis generated from earthquake and volcanic activity from the area bordering the Pacific Ocean (also known as the “Ring of Fire”). Between 1812 and December 2017, a total of twenty-seven (27) tsunamis with runup heights greater than one meter made landfall in Hawai‘i (Tetra Tech, Inc. 2018). The last major tsunami was the 1960 Hilo tsunami. Although this particular tsunami did not affect O‘ahu, tsunamis can be a hazard on O‘ahu. Three (3) of the six (6) tsunamis that have crossed the Pacific Ocean in the last decade have required mandatory shoreline evacuations.











Tsunamis can strike anywhere along the coast. Areas that are less than 25 feet above sea level and within one mile of the shoreline are at the greatest risk to tsunamis (Tetra Tech, Inc. 2018). The City and County of Honolulu Department of Emergency Management has developed maps that depict tsunami evacuation zones for public safety as part of its emergency management program. In the projected worst-case scenario for the State – a Great Aleutian Tsunami, which has an expected recurrence interval of 1,000 years – approximately 61 square miles, or 10 percent of the total area of CCH would be inundated (Tetra Tech, Inc. 2018). The Great Aleutian Tsunami inundation area has been used by CCH as the basis for new secondary evacuation zones, which are known as Extreme Tsunami Evacuation Zones. The Evacuation Zone and Extreme Tsunami Evacuation Zones are displayed in Figure 3-11.

The National Oceanic and Atmospheric Administration has two tsunami warning centers – the Pacific Tsunami Warning Center in Honolulu and the National Tsunami Warning Center in Palmer, Alaska – which provide early warnings of potentially destructive tsunamis. The Pacific Tsunami Warning Center provides the official tsunami warnings for Hawai‘i, including warnings, watches, advisories, information statements, seismic information statements, and warning cancellations. Sirens are used as an attention alert signal.

City and County of Honolulu

HONOLULU/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

-  Honouliuli WWTP
-  Existing WWPS
-  Hybrid Tunnel Shaft
-  East Interceptor
-  Hybrid Option Alignment
-  Waiawa Conveyance Corridors (Options A, D, and G)
-  New and/or Rehabilitated Force Mains and Trunk Sewers
-  Streets
-  Tsunami Evacuation Zone
-  Extreme Tsunami Evacuation Zone

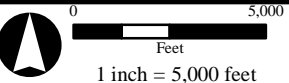
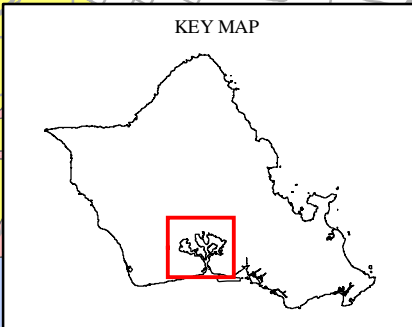
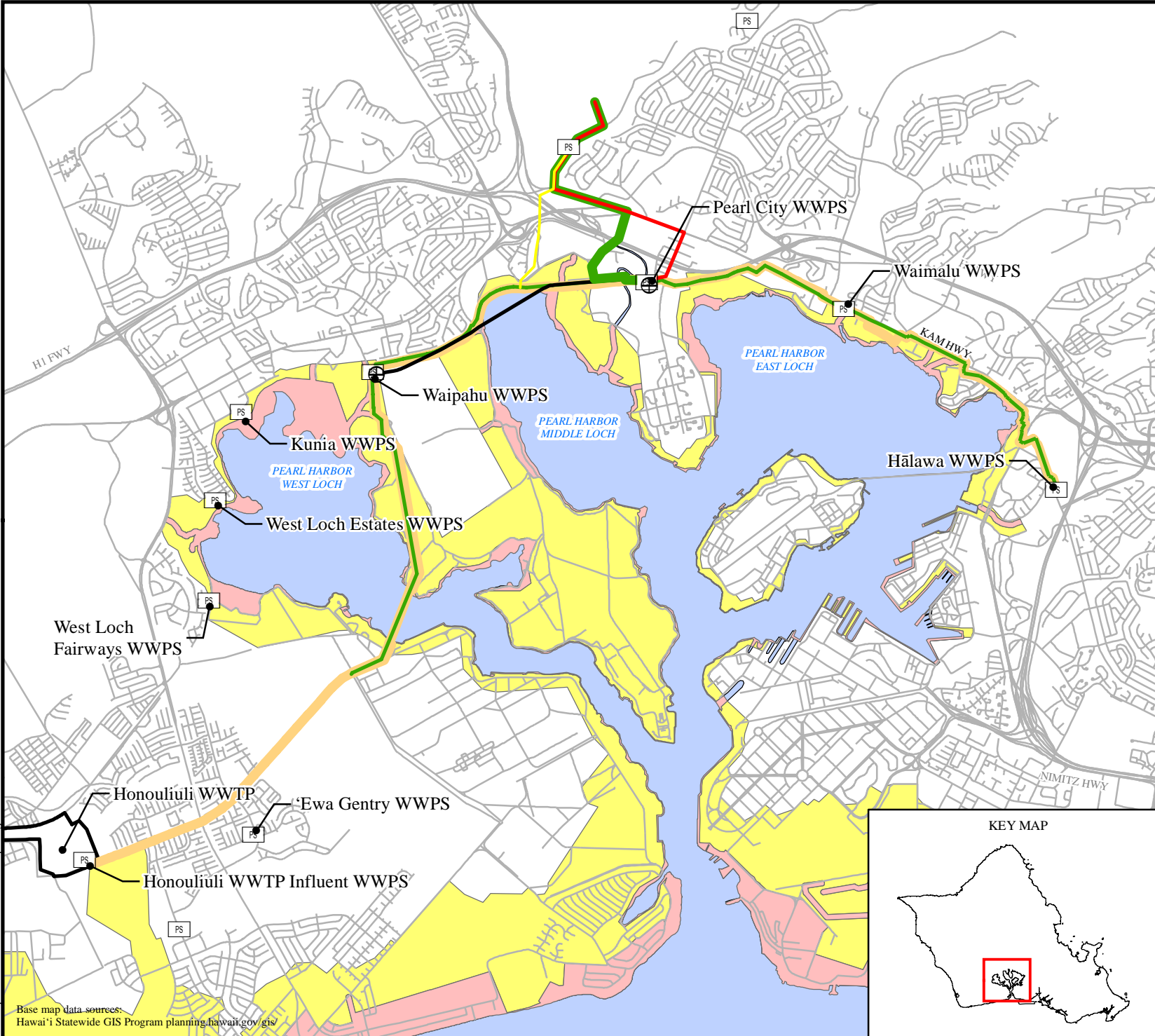


FIGURE 3-11
EVACUATION ZONE AND
EXTREME
TSUNAMI
EVACUATION
ZONES

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1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813



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Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

3.4.2.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, it is not anticipated that the construction would increase the potential of a tsunami occurring or the severity of the event. It is possible that a tsunami could impact construction of the Proposed Action projects. A tsunami could cause impacts including injuries, drowning, and damage to infrastructure and equipment from the impact of waves and scouring associated with debris in the water. Damage and flooding may result in potential release of hazardous materials or sewage leaks. Project components that are located close to the coast at low elevations are vulnerable to tsunamis during construction. As displayed in Table 3-3, portions of projects that are common to both East Interceptor conveyance options, the No-Tunnel option, the Hybrid option, and the Waiawa Area Conveyance options are located within tsunami evacuation zones and extreme tsunami evacuation zones. Projects further from shore, including those in the vicinity of the Hālawā WWPS, Pearl City WWPS, and the Waiawa Area Conveyance options, are less likely to be directly impacted by tsunamis. These estimates were produced using ArcGIS and are intended for planning purposes only.

In the event that a tsunami alert is given, equipment would be secured and all applicable federal, state, and CCH requirements would be implemented to reduce potential damage. Areas located within the extreme tsunami evacuation zone are required to evacuate if an extreme tsunami warning is issued. Within the tsunami evacuation zone, evacuation is required for any tsunami warning.

3.4.2.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, it is not anticipated that the operations would increase the potential of a tsunami occurring or the severity of the event.

A tsunami could cause impacts including injuries, drowning, and damage to infrastructure and equipment from the impact of waves and scouring associated with debris in the water. Damage and flooding may result in potential release of hazardous materials or sewage leaks.

In the event that a tsunami alert is given, equipment would be secured and all applicable federal, state, and CCH requirements would be implemented to reduce potential damage. The State of Hawai'i has adopted building code requirements for structures located within identified Tsunami Design Zones. The wastewater management facilities would be designed and constructed to meet all applicable IBC and federal, state and CCH requirements to help protect against potential structural impacts resulting from a tsunami.

Table 3-3. Projects Located within the Tsunami Evacuation Zone and the Extreme Tsunami Evacuation Zone

Project	Area/Length of Project in Tsunami Evacuation Zone	Area/Length of Project in Extreme Tsunami Evacuation Zone
<i>Common to Both East Interceptor Conveyance Options</i>		
Waipahu WWPS FM (New)	343 LF	7,295 LF
Waipahu WWPS FM Rehabilitation	441 LF	8,531 LF
Pearl City Trunk Sewers – Rehabilitation/Replacement	0 LF	1,804 LF
Waimalu WWPS FM (New)	0 LF	594 LF
Waimalu WWPS – Reconstruct/Replace	2,021 SF	6,083 SF
Waimalu Trunk Sewers – Rehabilitation/Replacement	246 LF	2,622 LF
Hālawā WWPS FM (New)	0 LF	0 LF
Hālawā WWPS – Reconstruct/Replace	0 SF	0 SF
<i>East Interceptor Conveyance Options</i>		
No-Tunnel Option		
Waipahu WWPS – Rehabilitation/Upgrade	0 SF	20,763 SF
Pearl City WWPS Force Main (New)	4,031 LF	2,617 LF
Pearl City WWPS Force Mains Rehabilitation	4,031 LF	2,617 LF
Pearl City WWPS – Reconstruct/Replace		
Alternative Pearl City No. 1 WWPS	0 SF	0 SF
Alternative Pearl City No. 2 WWPS	0 SF	0 SF
Alternative Pearl City No. 3 WWPS	0 SF	0 SF
Hybrid Option		
Pearl City-Waipahu Trunk Sewer	Microtunnel: 1,678 LF Deep Tunnel: 2,847 LF	Microtunnel: 5,502 LF Deep Tunnel: 1,318 LF
Waipahu WWPS No. 2	373 SF	19,986 SF
Pearl City WWPS – Demolition	0 SF	0 SF
<i>Waiawa Area Conveyance Options</i>		
Corridor A	0 LF	0 LF
Corridor D	0 LF	369 LF
Corridor G	34 LF	218 LF

Table 3-2 displays the area of WWPS and length of pipes and tunnels that are located within the tsunami evacuation zone and the extreme evacuation zone. The existing Waipahu WWPS and both proposed alternative locations for Waipahu WWPS No. 2 are within the extreme tsunami evacuation zone. A small portion of Alternative No. 2 location for the Waipahu WWPS No. 2 is in the tsunami evacuation zone. Portions of the Waipahu WWPS FM are also located, or proposed to be located, within both the tsunami and extreme tsunami evacuation zones. Several of the below-grade project components are located partially within the extreme tsunami evacuation zone, as shown in Table 3-2. Of the Waimalu Area conveyance options, Corridor G is most vulnerable to tsunamis.

3.4.3 Hurricanes

3.4.3.1 EXISTING ENVIRONMENT

Hurricanes are storm systems that have sustained winds of 74 miles per hour or greater that form in warm tropical waters near the equator. In Hawai'i, hurricane season runs from June 1st to November 30th. The last hurricane to impact the state was Hurricane Lane in August 2018. While Lane did not make landfall, the storm resulted in extensive flooding, landslides, and road closures on the island of Hawai'i. Maui and Moloka'i were also impacted, while Kaula'i and O'ahu were not as greatly affected.

Hurricane winds can cause strong uplift force on structures, resulting in damage and producing flying debris. Hurricanes and tropical storms are projected to increase in average size and strength due to climate change and sea level rise (Tetra Tech, Inc. 2018).

3.4.3.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, it is not anticipated that the construction would increase the potential of a hurricane occurring or the severity of the event. However, during construction, there is the potential that a hurricane could occur.

Regardless of the options selected, materials and equipment are vulnerable to high winds associated with hurricanes. Due to their height, above-grade structures would likely be more vulnerable than pipes; however, exposed stockpiles of material and equipment may be impacted by wind or other objects.

The Central Pacific Hurricane Center issues tropical cyclone advisories when a storm is active in the Central North Pacific Basin. If a tropical cyclone is active in the Eastern North Pacific, the National Hurricane Center issues the advisory package (Tetra Tech, Inc. 2018).

A public emergency siren operated by the State of Hawai'i Department of Defense would be used in the event of a hurricane. The sirens are typically audible within 0.5 miles and may not be audible at all project locations. However, information would also be available via television, internet, and radio (AECOM 2017).

In the event of a hurricane, equipment would be secured by the contractor and all applicable federal, state, and CCH requirements would be implemented to reduce potential damage. If evacuation is required, the nearest Public Emergency/Hurricane Evacuation Shelter can be found by texting “shelter” followed by the zip code to 43362 (AECOM 2017). The following are zip codes for the project area:

- Projects west of the Kamehamaha and Farrington Highway interchange: 96797
- Projects east of the Kamehamaha and Farrington Highway interchange to the east side of Neal Blaisdell Park: 96782
- Projects to the east of Neal Blaisdell Park: 96701.

3.4.3.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, equipment would be secured by ENV in the event of a hurricane and all applicable federal, state, and CCH requirements would be implemented to reduce potential damage. In addition, as a long-term measure, the wastewater management facilities would be designed and constructed to meet all applicable IBC and federal, state, and CCH requirements to help protect against potential structural impacts resulting from a hurricane. Wind loads shall be determined in accordance with Chapters 26 to 30 of ASCE 7. Wind design provisions for new construction, including maps of effective wind speed, are included in Appendix H of the State Building Code.

Back-up power supply would be required at the facilities to help prevent SSOs during emergencies and power outages.

Below-grade infrastructure is not likely to be significantly impacted by a hurricane; however, strong winds may cause access to manholes to be impacted. The proposed WWPSs are more vulnerable to hurricanes. Above-grade structures that are common to both East Interceptor conveyance options include Waimalu WWPS and Hālawā WWPS. The alternative location for the Waimalu WWPS is located approximately 600 feet from the East Loch and therefore may be classified as exposure D. All other above-grade project components, including the Waipahu and Pearl City WWPSs associated with the No-Tunnel option, are likely classified as exposure B. Specific design requirements would be determined during the design of each project.

3.4.4 Flood Hazard

3.4.4.1 EXISTING ENVIRONMENT

The Honouliuli sewer basin is located along the southwestern coastline on the island of O‘ahu and includes several streams. Figure 3-12 shows the flood prone areas in the project area that are located within the special flood hazard area (SFHA), or 100-year floodplain and area with a 1 percent annual chance of flooding, as delineated by the Federal Emergency Management Agency (FEMA). Areas within Zone X are also identified. Zone X is defined as the flood insurance rate zones that correspond to areas outside the 1 percent annual chance floodplain and areas

City and County of Honolulu

HONOLULUI/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

FLOOD ZONES

- A = 100 Year Flood, No Base Flood Elevation Determined
- AE = 100 Year Flood, Base Flood Elevation Determined
- AH = 100 Year Flood, 1 to 3 Ft, with ponding
- AO = River or Stream Flow Hazard, 100 year Flood, 1-3 Ft, Sheet Flow
- D = Undetermined Flood Hazard
- VE = 100 Year Flood, Coastal, Wave Action, Base Elevation determined
- X = Beyond 500 Year Flood Plain

Legend

- Honouliuli WWTP
- Existing WWPS
- Hybrid Tunnel Shaft
- East Interceptor
- Hybrid Option Alignment
- Waiawa Conveyance Corridors (Options A, D, and G)
- New and/or Rehabilitated Force Mains and Trunk Sewers
- Streets

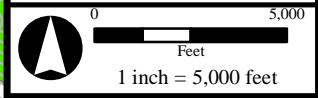
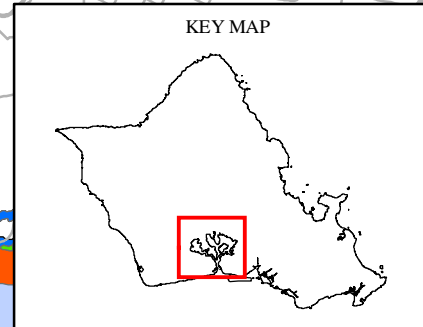
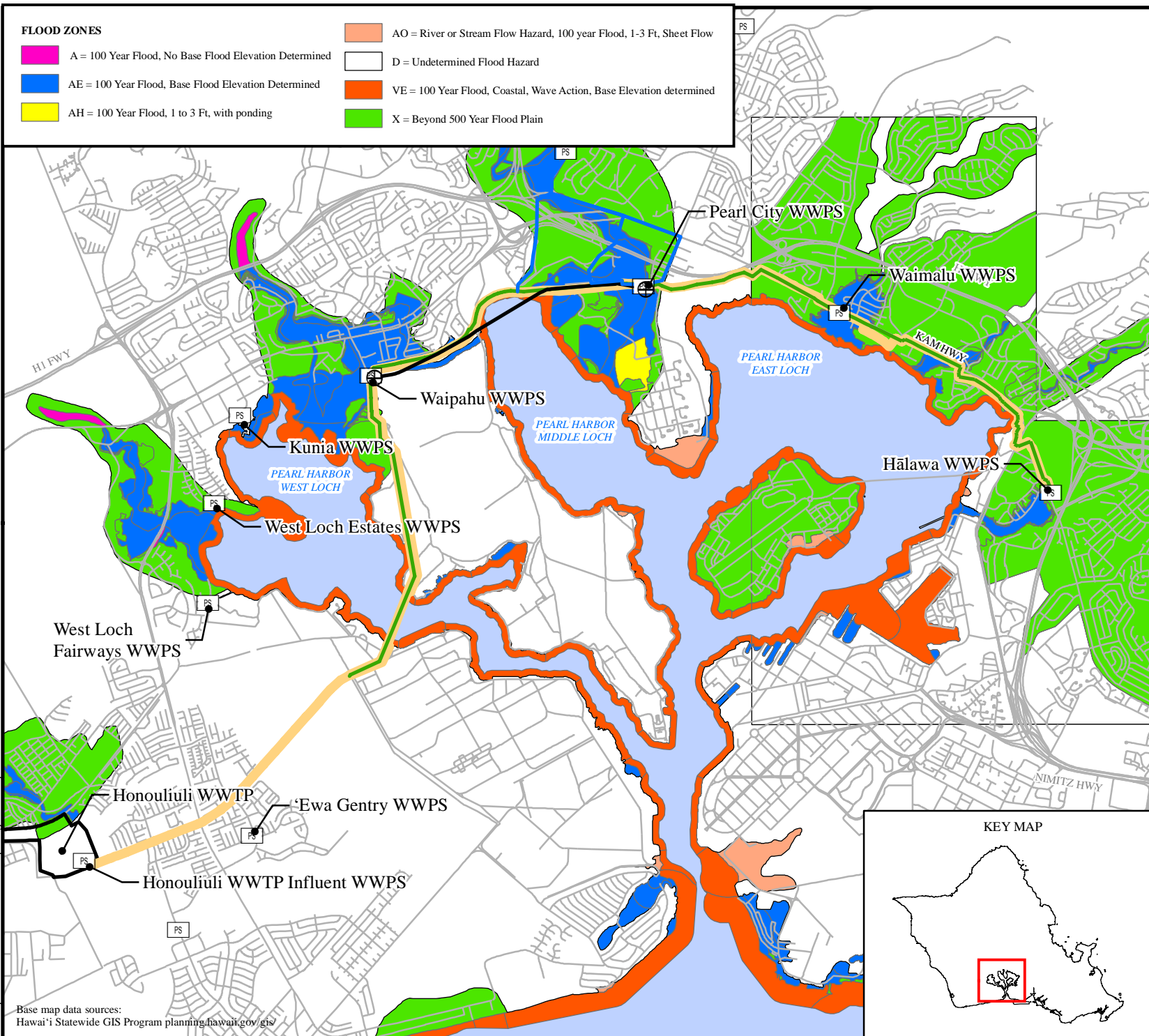


FIGURE 3-12

PROJECT AREA FEMA FLOOD HAZARD ZONES



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Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

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protected from the 1 percent annual chance flood by levees. Areas within the 100- and 500-year floodplain are more vulnerable to flooding. Other factors that increase vulnerability to flooding include drainage, topography and elevation, and impervious surface cover. Refer to Figures 2-3, 2-5, 2-7, and 2-9 for more detailed maps of the above-grade project components within the SFHA.

Table 3-4 displays the approximate area of proposed projects that are located within the SFHA, as well as the percent of total WWPS area or pipe length within the SFHA. For comparison purposes, the area of each existing WWPS that is within the SFHA is included in the table. These estimates were produced using ArcGIS and are intended for planning purposes only. Below-grade projects are less vulnerable to flooding but may still be impacted by saturated, less stable soils and increased infiltration.

3.4.4.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

If flooding occurs during construction, potential impacts include delays to the schedule and potential increased project costs. If significant flooding were to occur, equipment may be damaged, sewage or hazardous materials may leak into the environment, and floodwaters could create unsafe conditions for construction workers. There is potential for increased stormwater runoff if heavy precipitation occurs during construction. Grading and placement of fill within the floodplain may cause temporary impacts to flooding.

Projects Common to Both East Interceptor Conveyance Options

Demolition, regrading, and stockpiling of excavated materials would result in temporary impacts to the SFHA surrounding the Waimalu WWPS during construction. The construction access points and staging areas would result in local increases in stormwater runoff to the SFHA surrounding the WWPS due to a decrease in surface permeability and removal of vegetation. Similarly, construction of pipes within the SFHA would create temporary impacts.

East Interceptor Conveyance Options

No-Tunnel Option

Demolition, regrading, and stockpiling of excavated materials would result in temporary impacts to the SFHA surrounding the Alternative Pearl City WWPS No. 1 and No. 3 locations, as well as the existing Waipahu and Pearl City WWPSs. The construction access points and staging areas could result in local increases in stormwater runoff to the SFHA surrounding the WWPS due to a decrease in surface permeability and removal of vegetation. Construction of the proposed Alternative would relocate the WWPS out of the SFHA, and therefore may have a net positive Waipahu WWPS No. 1 impact on flooding. Similarly, the Alternative Pearl City WWPS No. 1 and WWPS No. 3 locations would have a smaller footprint within the SFHA than the existing Pearl City WWPS. Alternative Pearl City WWPS No. 2 is located entirely outside of the SFHA.

Table 3-4. Existing and Proposed WWPSs and Conveyance Lines within Flood-Prone Locations

WWPS	Approx. Area/Length within SFHA	Approx. Percent of WWPS Limit of Work within SFHA	Approx. Total Area/Length
Common to Both East Interceptor Conveyance Options			
Waipahu WWPS FM (New)	906 LF	7	12,510 LF
Waipahu WWPS FM Rehabilitation	1,506 LF	12	12,510 LF
Pearl City Trunk Sewers – Rehabilitation/Replacement	290 LF	6	5,000 LF
Waimalu WWPS FM (New)	364 LF	14	2,624 LF
Existing Waimalu WWPS	0 SF	0	2,946 SF
Waimalu WWPS – Reconstruct/Replace	8,104 SF	100	8,104 SF
Waimalu Trunk Sewers – Rehabilitation/Replacement	703 LF	7	10,040 LF
Hālawā WWPS FM (New)	0 LF	0	2,080 LF
Existing Hālawā WWPS	0 SF	0	13,445 SF
Hālawā WWPS – Reconstruct/Replace	0 SF	0	31,960 SF
East Interceptor Conveyance Options			
No-Tunnel Option			
Existing Waipahu WWPS	7,825 SF	20	37,650 SF
Waipahu WWPS – Rehabilitation/Upgrade	0 SF	0	21,094 SF
Pearl City WWPS Force Main (New)	8,471 LF	84	10,070 LF
Pearl City WWPS Force Mains Rehabilitation	8,471 LF	74	11,440 LF
Existing Pearl City WWPS	31,195 SF	100	31,195 SF
Pearl City WWPS – Reconstruct/Replace			
Alternative Pearl City No. 1 WWPS	5,270 SF	15	34,602 SF
Alternative Pearl City No. 2 WWPS	0 SF	0	43,280 SF
Alternative Pearl City No. 3 WWPS	24,320 SF	70	34,611 SF
Hybrid Option			
Pearl City-Waipahu Trunk Sewer	Microtunnel: 4,589 LF Tunnel: 6350 LF		Microtunnel: 5,502 LF Tunnel: 1,318 LF
Waipahu WWPS No. 2	13,410 SF	66 SF	20,358 SF
Pearl City WWPS – Demolition	31,195 SF	100 SF	31,195 SF
Waiawa Area Conveyance Options			
Corridor A	3,017 LF	26	11,696 LF
Corridor D	6,067 LF	51	11,980 LF
Corridor G	2,081 LF	35	5,979 LF

a Waimalu WWPS: FEMA Flood Insurance Rate Map (FIRM) 15003C0243H, BFE=7

b Hālawā WWPS: FEMA FIRM Panel 15003C0332H, BFE not available, estimated to be greater than 12 feet

c Waipahu WWPS: FEMA FIRM Panel 15003C0238G, BFE=2

d Pearl City WWPS: FEMA FIRM Panel 15003C0239G, BFE=16

e Digitized FEMA FIRM, State of Hawai'i Office of Planning

Hybrid Option

If the Hybrid option is selected, construction of Alternative Waipahu WWPS No. 2 would result in relocation of a WWPS from an area outside a SFHA to an area within the SFHA. The Hybrid option involves a significant amount of tunneling, which would be completed underground with the exception of the entry and exit shafts. Depending on the location and finish grade of the entry and exit shafts, this construction activity could temporarily impact flood zones. The Hybrid option also would involve the demolition of the Pearl City WWPS, which would eliminate a structure that is currently located within a flood zone.

When developing tunnels, excavation out of a shaft into the ground (“break-out”) and excavation into a shaft from the tunnel into the ground (“break-in”) requires measures to minimize the volume of soil excavated in excess of designed excavation. At both break-outs and break-ins, groundwater control must be maintained to prevent flooding and soil transport into the shaft.

Waiawa Area Conveyance Options

The construction access points and staging areas could result in local increases in stormwater runoff to the SFHA surrounding the WWPS due to a decrease in surface permeability and removal of vegetation. However, the construction method for microtunnels and deep trench are completed underground with the exception of the entry and exit shafts, and therefore result in minimal potential impact on SFHAs. The construction method for Alignments A and D include open trench and microtunnels. Approximately 2,460 LF of pipe would be laid via open trench and 9,040 LF of pipe would be laid in microtunnels for Alignment A. For Alignment D, open trench accounts for 3,311 LF of the pipe length, with microtunnels accounting for 8,689 LF. The construction method for Alignment G may include deep tunnel boring, microtunneling, and/or open trench methods.

3.4.4.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Regardless of the project option selected, there is potential for operation to impact flooding at a localized scale. No permanent changes in grade are anticipated associated with new pipes and tunnels; therefore, no operational impacts pertaining to flooding impacts are anticipated associated with below-grade infrastructure. Development of new WWPSs would increase impervious surfaces and therefore may have an impact on local flooding and stormwater management.

To mitigate for any flooding within a facility that is located within or partially within the flood zone, structures would be designed pursuant to CCH Land Use Ordinance 21-9.10 Flood Hazard Districts and the US National Flood Disaster Protection Act of 1973. Required flood mitigation measures, such as floodproofing and elevation of critical facilities, would be identified during the planning and design phase and incorporated into project designs as appropriate.

Projects Common to Both East Interceptor Conveyance Options

The proposed alternative location for the Waimalu WWPS is located entirely within the SFHA and has a BFE of approximately 7 feet. Neither the existing Waimalu WWPS nor the existing Hālawā and proposed Hālawā WWPSs are within the SFHA. The existing Waimalu and Hālawā WWPSs and alternative location for the Hālawā WWPS are located within the 500-year floodplain.

According to 5-foot elevation contour data from United States Geological Survey Digital Elevation Models, both the existing Waimalu WWPS and alternative location for the Waimalu WWPS are located less than 5 feet above sea level. The alternative location for the Hālawā WWPS has a slightly higher elevation (10 feet above sea level) than the existing WWPS (5 feet above sea level).

Waimalu and Hālawā WWPSs may be designed with submersible dry pit type pumps. This type of pump is advantageous because it eliminates the vertical shafting required for vertical pumps with motors placed above grade to address flooding concerns.

East Interceptor Conveyance Options

No-Tunnel Option

Several above-grade, No-Tunnel option projects are located partially within the SFHA. These include the Alternative Pearl City WWPS No. 1 and No. 3 locations, as well as the existing Waipahu and Pearl City WWPSs. The Pearl City WWPS FM (New) is located in a low-lying area that may be susceptible to flooding during heavy rain events. The Alternative Waipahu WWPS No. 1 location is within the 500-year floodplain and has an estimated BFE of 2 feet.

The Pearl City WWPS has flooded in the past. Operational impacts are expected to be beneficial if the project results in relocating the facility out of or partially out of the flood prone area.

Rehabilitation of the existing Pearl City WWPS or flood proofing by raising electrical components and building entrances above the flood level have been considered. Two (2) conveyance projects were developed to address the flooding and hydraulic capacity issue of the Pearl City WWPS. The first option is significant rehabilitation to the existing WWPS, while the second is to construct a new WWPS on a site outside of the 100-year flood zone that could sufficiently pass the 2030 peak flow projections and abandon the existing site. Four (4) options have been identified to mitigate further flooding of the existing WWPS:

1. Install a sheet pile barrier-wall around the site
2. Install a gravity dike wall
3. Install a cast-in-place retaining wall system

4. Raise the building entrance and/or mechanical and electrical components above the 100-year flood elevation to protect the mechanical and electrical components.

The main level of the pumping station facilities, including the generator building, is at approximately elevation +9.0. Anticipated water surface elevation at flood state is estimated to be at elevation 14.0 ±. Therefore, in order to provide 3 feet of freeboard, the top of a retention wall system would need to be at elevation + 17.0 ±. The overall length of a perimeter flood containment wall would be about 810 linear feet, which would enclose an area of approximately 39,000 SF. For options that include a containment wall, provisions for a gate that would allow vehicle access to the WWPS during non-flooding conditions would need to be included.

A flood retaining wall would need relatively deep sheet piling to prevent the flood water from seeping beneath the piles under the flood retaining wall. A storage tank located adjacent to the Pearl City WWPS was considered to control flooding of the WWPS and surcharging in the East Interceptor System during the 2-year, 6-hour design storm.

Wet well/dry wells are recommended for the pump stations. There are several options for the pump and motor selection and arrangement. The recommended option includes dry pit submersible pumps. This, along with leak detection within the dry well and quick closing suction isolation valves, provides a reliable, less complex system for practical flood protection.

Even after rehabilitation of the existing Pearl City WWPS, flooding would remain a concern for emergency site access, and for infiltration and inflow in surrounding sewers and manholes.

Hybrid Option

Elimination of the Pearl City WWPS is an important benefit of the GST option because the existing WWPS is located in the 100-year floodplain for Waiawa stream, at around 5 feet above sea level, and has flooded in the past.

The Alternative Waipahu WWPS No. 2 location, associated with the Hybrid East Interceptor conveyance option, is partially within a SFHA and partially within the 500-year floodplain.

Waiawa Area Conveyance Options

Below-grade project components are not likely to be impacted by flooding to the extent that above-grade components may be. However, extensive inundation could impact the stability of the soil and increase potential for infiltration into pipes. Approximately 6,067 LF of Corridor D pipeline is within a SFHA, compared with 3,017 LF in Corridor A and 2,081 LF in Corridor G.

3.5 BIOLOGICAL RESOURCES

3.5.1 Flora

3.5.1.1 EXISTING SETTING

The entire East Interceptor System area has been intensively disturbed by a myriad of activities, notably agriculture and urbanization. The East Interceptor System runs along the shorelines of Pearl Harbor’s East, Middle, and West Lochs. Portions of this waterfront have been developed with industrial facilities, transportation infrastructure, and other urban uses. Other lands have been set aside as landscaped and maintained park and recreation facilities, managed wildlife sanctuaries and refuges, and undeveloped pockets of common non-native naturalized upland and wetland vegetation.

The United States Fish and Wildlife Service (USFWS) has advised that the following federal and state endangered plant species may be present within Honouliuli Sewer Basin:

- Ko’oloa’ula (*Abutilon menziesii*)
- ‘Ewa hinahina (*Achyranthes splendens* var. *rotundata*)
- ‘Ōhai (*Sesbania tomentosa*)

Ko’oloa’ula is a long-lived perennial shrub in the Malvaceae (mallow) family. USFWS estimates that sixty (60) individuals of this species occur on the Island of O’ahu. A few wild plants can be found in Kapolei and three (3) to nine (9) individuals were documented at Lualualei in 2011. As part of recovery efforts, plants have been propagated and outplanted at Diamond Head State Park, Honouliuli Refuge, and Pouhala Marsh; as well as an additional site in Kahuku and a small population established at ‘Ewa Villages Golf Course (USFWS 2018). No critical habitat has been designated for this species.

‘Ewa hinahina or round-leaved chaff-flower is a short-lived shrub found in arid and semi-arid coastal lowlands. This species was formerly found on the islands of O’ahu, Moloka’i, and Lana’i, but now occurs only on the island of O’ahu. Subpopulations of this species have been documented at Ka’ena Point, Mākaha, the ridge between Mākaha and Wai’anae Kai, Barbers Point (Kaomi Loop/Campbell Industrial Park), and the USFWS Kalaeloa Unit of the O’ahu National Wildlife Refuge Complex (USFWS 2009). Critical habitat has been designated for this species in coastal units at Ka’ena Point and Kalaeloa (Barbers Point) where the species is known to occur, as well as several lowland dry units in these areas and dry cliff units in the Waianea Range that are not occupied by this species but have been determined to be essential for its conservation and recovery (USFWS 2012). There are no reported occurrences of this species in the vicinity of the proposed improvements. The nearest designated critical habitat for this species is located between Kalaeloa Airport and Hoakalei Country Club (Lowland Dry Unit 11) approximately 3.5 miles from the east terminus of the proposed Waipahu WWPS FMs Rehabilitation and the Waipahu WWPS FM (New), and further away from other proposed improvements.

‘Ōhai is a short-lived perennial shrub or small tree in the Fabaceae (pea family). On O‘ahu this species is found on cliff faces, broken basalt, sand dunes, coastal dry shrublands, and mixed grasslands between sea level and 500 feet elevation. Critical habitat has been designated for this species at Ka‘ena Point and Kaohikaipu Island, where the species is known to occur, as well as thirteen (13) other coastal units on O‘ahu that are not occupied by this species but have been determined to be essential for its conservation and recovery (USFWS 2012). There are no reported occurrences of this species in the vicinity of the proposed improvements. The nearest designated critical habitat for this species is located at Kalaeloa Regional Park (Coastal Unit 16) over 6 miles from the east terminus of the proposed Waipahu WWPS FMs Rehabilitation and the Waipahu WWPS FM (New), and further away from other proposed improvements.

Projects Common to Both East Interceptor Conveyance Options

The Waipahu WWPS FM (New) and the existing dual Waipahu FMs that are proposed to be rehabilitated run along the eastern shoreline of the Waipi‘o Peninsula, crossing under Pearl Harbor West Loch to the ‘Ewa Plain. Along the Waipi‘o Peninsula these FM alignments run parallel to Waipahu Depot Street and Kapakahi Stream near Pouhala Marsh Wildlife Sanctuary. This alignment continues through fallow lands between Waipi‘o Peninsula Soccer Complex and the West Loch shoreline to Intrepid Point. The Pouhala Marsh is the largest remaining wetland in Pearl Harbor. The wetland is dominated by invasive wetland plants, including red mangroves (*Rhizophora mangle*) and non-native pickleweed (*Batis maritima*) (Department of Land and Natural Resources Division of Forestry and Wildlife (DOFAW) 2018). However, habitat restoration efforts are underway at this site, including the recent outplanting of the endangered ko‘oloa‘ula. The uplands surrounding the wetland and along the undeveloped FM corridors are dominated by common non-native naturalized upland species such as kiawe (*Prosopis pallida*), koa haole (*Leucaena leucocephala*), saltbush (*Atriplex suberecta*), finger grass (*Chloris virgata*), pili grass (*Heteropogon contortus*), and Guinea grass (*Megathyrsus maximus*). The dominant species along the banks of Kapakahi Stream include California grass (*Brachiaria mutica*), pickleweed, saltbush, and sourbush (*Pluchea carolinensis*). The vegetation at Waipi‘o Peninsula Soccer Complex consists of open maintained lawn areas and common landscaped trees such as monkeypods (*Samanea saman*).

The existing Pearl City Trunk Sewers, which may be rehabilitated or replaced with a new proposed Pearl City Trunk Sewer following a parallel alignment, is located along the northwest shoreline of the Pearl Harbor East Loch. The corridor for these trunk sewers runs through the Lehua Community Park and Elementary School; previously disturbed undeveloped lands south of Interstate H-1 Freeway; Pearl City Stream (also known as Waimanu Stream), a Taro and Watercress Farm; the Hawaiian Electric Company, Inc. (HECO) Waiiau Power Plant and power plant ponds. Vegetation at the Lehua Community Park and Elementary School consists of maintained lawn areas and common landscaped trees such as monkeypod trees and palm trees. Undeveloped lands south of the Interstate H-1 Freeway and along Pearl City Stream support thick mats of non-native California grass, 3 to 5 feet tall, as well as scattered

stands of koa haole, castor bean (*Ricinis communis*), and sourbush, all common introduced shrubs (HECO 2016).

The proposed Waimalu WWPS FM (New) follows an alignment parallel to Kamehameha Highway near the HECO Waiau Power Plant to the Waimalu WWPS at Neal S. Blaisdell Park. Vegetation at the park consists of maintained lawn areas and common landscaped trees such as monkeypod trees, royal poinciana (*Delonix regia*), kou (*Cordia subcordata*), milo (*Thespesia populnea*), and palm trees. Makai of the park and Pearl Harbor Bike Path are non-native pickleweed and mangrove wetlands and mudflats. The existing and proposed replacement Waimalu WWPS are located at Neal S. Blaisdell Park adjacent to Waimalu Stream. The banks of this section of Waimalu Stream are overgrown with dense stands of invasive red mangroves.

The Waimalu Trunk Sewers proposed to be replaced or rehabilitated are located in a corridor along the northeastern shoreline of the Pearl Harbor East Loch. These trunk sewers run from Waimalu WWPS at Neal S. Blaisdell Park to Aloha Stadium. The alignment parallels Kamehameha Highway, passing developed areas with big box retailers and car dealerships; Pearl Kai Shopping Center; Mc Grew Point military housing; 'Aiea Bay State Recreation Area; 'Aiea Stream; and Richardson Field. Vegetation in the upland areas at 'Aiea Bay State Recreation Area includes maintained lawn areas with monkeypod and kiawe trees. Non-native pickleweed, red mangrove saplings, and sourbush grown in the low-lying areas along the edges of 'Aiea Stream and 'Aiea Bay. Non-native naturalized trees including kiawe, monkeypod, and Manila tamarind (*Pithecellobium dulce*) grown in a small gorge between 'Aiea Bay State Recreation Area and Richardson Field. Richardson field consists of a maintained athletic field. The parking lot at Aloha Stadium where the Waimalu FM connects to the proposed Hālawā WWPS FM (New) is landscaped with monkeypod trees.

The proposed Hālawā WWPS FM (New) runs from the main parking lot of Aloha Stadium under Hālawā Stream to the existing Hālawā WWPS in the Lower Hālawā Parking Lot of Aloha Stadium. The main parking lot of Aloha Stadium is landscaped with monkeypod trees. Hālawā Stream is concrete lined; however, some vegetation has established in the cracks and deposited sediment within the lined channel. This includes common non-native ruderal species such as Guinea grass and California grass. The Lower Hālawā Parking Lot is not landscaped with the exception of a few trees near the Hālawā WWPS and perimeter of the parking lot. The alternative Hālawā gravity sewer alignment is located within Salt Lake Boulevard, which is paved.

The existing Hālawā WWPS would be reconstructed or replaced. The location of the WWPS would either remain the same, within Lower Hālawā Parking Lot adjacent to Salt Lake Boulevard and Hālawā Stream, or would be relocated approximately 500 feet to the south corner of the Lower Hālawā Parking Lot near the intersection of Salt Lake Boulevard and Kahuapaani Street. A few landscaped trees including monkeypod trees and eucalyptus (*Eucalyptus* sp.) are located in this southern corner of the parking lot.

East Interceptor Conveyance Options

No-Tunnel

The existing Waipahu WWPS to be rehabilitated is located near the intersection of Waipahu Depot Street and the Pearl Harbor Bike Trail; on the opposite side of Waipahu Depot Street from Kapakahi Stream and Pouhala Marsh Wildlife Sanctuary. Trees surrounding the WWPS include kiawe and shower trees (*Cassia* sp.)

The Pearl City WWPS FM (New) and the existing Pearl City dual FMs that are proposed to be rehabilitated follow the same alignment along the Pearl Harbor Bike Path from the existing Waipahu WWPS, past the Ted Makalena Golf Course, the Waiawa Unit of the Pearl Harbor National Wildlife Refuge, and Waiawa Stream, to the existing Pearl City WWPS. The 25-acre Waiawa Unit of the Pearl Harbor National Wildlife Refuge includes open ponds, mudflats, and wetlands. USFWS in partnership with other groups is undertaking removal of invasive red mangroves to restore the intertidal mudflats at the Waiawa Unit of the Pearl Harbor National Wildlife Refuge. Guinea grass is the dominant vegetation along this section of Waiawa Stream.

Three (3) adjacent alternative sites are proposed for the reconstruction/replacement of the existing Pearl City WWPS. Two (2) of these sites are on the east side of Lehua Avenue in a densely vegetated area including naturalized monkeypod trees, mango trees, kiawe, and Guinea grass. The other proposed site is in maintained lawn area at Lehua Community Park.

Hybrid

Two (2) tunnel options are proposed for the Pearl City-Waipahu Trunk Sewer. Both options would run from the Pearl City WWPS to the Waipahu WWPS. The microtunnel follows a similar alignment along the Pearl Harbor Bike Path as the Pearl City WWPS FM (New) and Pearl City dual FMs described above and would pass through the same types of vegetation. The Deep Tunnel also passes under the Waiawa Unit of the Pearl Harbor National Wildlife Refuge and Ted Makalena Golf Course but circumvents a section of the Pearl Harbor shoreline by tunneling under Pearl Harbor Middle Loch.

Two (2) adjacent alternative sites are proposed for the Waipahu WWPS No. 2. Both sites are adjacent to the existing Waipahu WWPS. Landscaped trees at both sites include kiawe and shower trees. These sites are on the opposite side of Waipahu Depot Street from Kapakahi Stream and Pouhala Marsh Wildlife Sanctuary, described above.

The existing Pearl City WWPS, proposed for demolition under the Hybrid option, is surrounded by dense vegetation including naturalized monkeypod trees, mango trees, kiawe, and Guinea grass.

Waiawa Area Conveyance Options

The proposed Corridor A gravity sewer would run from undeveloped land in the Waiawa Ridge Development area, following Waihona Street running parallel to

Waiawa Stream, to Kamehameha Highway then intercepting Lehua Avenue to the Pearl City WWPS. Koa haole scrublands dominate the Waiawa Ridge Development area. Vegetation along Waihona Street and Waiawa Stream consists of koa haole, kiawe, and Guinea grass.

The proposed Corridor D gravity sewer would run from undeveloped koa haole scrublands in the Waiawa Ridge Development area, following Waihona Street running parallel to Waiawa Stream which is dominated by koa haole, kiawe, and Guinea grass, to Kamehameha Highway; then crossing under the H-1 Highway and following an alignment parallel to the Pearl Harbor Bike Path and adjacent undeveloped lands near the Waiawa Unit of the Pearl Harbor National Wildlife Refuge.

The proposed Corridor G gravity sewer would run from undeveloped koa haole scrublands in the Waiawa Ridge Development area, following Waihona Street running parallel to Waiawa Stream which is dominated by koa haole, kiawe, and Guinea grass, then crossing under Kamehameha Highway, the H-2 and H-1 freeways, and Farrington Highway to the proposed Pearl City to Waipahu WWPS Tunnel along the Pearl Harbor Middle Loch shoreline.

3.5.1.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Most of the vegetation along the corridors of the proposed wastewater conveyance facility improvements is common non-native introduced species. Upland vegetation is primarily comprised of naturalized koa haole, kiawe, and Guinea grass. Landscaped and naturalized trees include monkeypods, mango, royal poinciana, kiawe, shower trees, palm trees, kou, and milo. Both kou and milo are native Hawaiian trees commonly used for landscaping at parks and other areas. Wetland vegetation along these corridors consists of non-native species including pickleweed, red mangroves, California grass, and sourbush. Based on the composition of vegetation along the corridors significant impacts to native vegetation would not be expected.

Ko'oloa'ula (an endangered shrub) has been outplanted at Pouhala Marsh. While wastewater conveyance facility improvements are proposed along Waipahu Depot Road and areas near to Pouhala Marsh, no construction activities would take place within this marsh or areas where ko'oloa'ula has been reintroduced. The Endangered Species Recovery Plans, USFWS 5-year Reviews, and Federal Register Notices of critical habitat designations, identify locations of designated critical habitat as well as known occurrences of listed plant species. These documents were reviewed for ko'oloa'ula, 'ewa hinahina, and 'ōhai. No critical habitat or reported occurrences of these species was identified within the corridors, or directly adjacent to the proposed wastewater conveyance facility improvements. There is still potential for these and other threatened and endangered plant species to be present in or colonize areas where construction activities for wastewater conveyance facility improvements are proposed. CCH will work with DOFAW and USFWS as needed to identify potential locations with threatened and endangered plant species that could be affected by proposed improvements, and perform surveys for these species as needed and recommended by DOFAW and USFWS. Any locations where vegetation

is disturbed would be restored to existing conditions or better. Where appropriate, native plant species would be selected for soil stabilization and replanting efforts.

3.5.1.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Operation and maintenance of the proposed facilities is not anticipated to affect flora, regardless of the options implemented. If maintenance activities include the use of construction equipment, trimming of trees, and or the clearing of vegetation then appropriate mitigation measures including coordination with DOFAW and USFWS and plant surveys may be required. Any locations where vegetation is disturbed would be restored to existing conditions. Where appropriate, native plant species would be selected for soil stabilization and replanting efforts.

3.5.2 Fauna

3.5.2.1 EXISTING SETTING

USFWS and DOFAW have stated that the following state and federally threatened and endangered wildlife species may be present within Honouliuli Sewer Basin:

- Hawaiian hoary bat or 'ōpe'ape'a (*Lasiurus cinereus semotus*) – state and federally endangered
- Green sea turtle or honu (*Chelonia mydas*) – state and federally endangered
- Hawaiian coot or 'alae kea (*Fulica alai*) – state and federally endangered
- Hawaiian moorhen or 'alae 'ula (*Gallinula galeata sandwicensis*) – state and federally endangered
- Hawaiian stilt or ae'o (*Himantopus mexicanus knudseni*) – state and federally endangered
- Hawaiian duck or koloa maoli (*Anas wyvilliana*) – state and federally endangered
- Band-rumped storm-petrel or 'akē'akē (*Oceanodroma castro*) – state and federally endangered
- Hawaiian petrel or 'ua'u (*Pterodroma sandwichensis*) – state and federally endangered
- Newell's shearwater or 'a'o (*Puffinus auricularis newelli*) – state and federally threatened
- O'ahu 'elepaio (*Chasiempis ibidis*) – state and federally endangered
- O'ahu tree snails (*Achatinella* spp.) – state and federally endangered
- White tern or manu-o-kū (*Gygis alba*) – state threatened
- Hawaiian short-eared owl or pueo (*Asio flammeus sandwichensis*) – state endangered

Hawaiian hoary bat

The state and federally endangered Hawaiian hoary bat has the potential to occur in the vicinity of the project area. 'Ōpe'ape'a roost in both exotic and native trees over 15 feet in height. The bat birthing and pup rearing season is from June 1 through September 15; during which time hoary bat pups that cannot yet fly may be present in roost trees.

Green sea turtle

Green sea turtles of the Central North Pacific distinct population segment are state and federally threatened. These turtles are frequently observed in the waters of Pearl Harbor. The shoreline areas where East Interceptor System improvements are proposed lack sandy beaches suitable for sea turtle nesting.

Endangered Hawaiian waterbirds

Federal and state endangered Hawaiian waterbirds found on the island of O'ahu include the Hawaiian coot, Hawaiian moorhen, and Hawaiian stilt (Figure 3-13). The Hawaiian duck is also a federal and state endangered Hawaiian waterbird. However, on O'ahu this species has extensively hybridized with feral mallards (Figure 3-13). It can be difficult to distinguish between Hawaiian ducks, female mallards, and hybrids based on physical appearance alone (USFWS 2011). Hawaiian waterbird habitat generally consists of wetlands, streams, and ponds. These birds utilize both fresh and brackish water habitats. Stilts often nest and forage on mudflats and in bare dirt. Coots and moorhen generally prefer sites with a combination of thick emergent vegetation and open water. All three (3) species are regularly observed in the shoreline areas, wetlands, mudflats, and streams surrounding Pearl Harbor where East Interceptor System improvements are proposed.

Threatened and endangered Hawaiian seabirds

Threatened and endangered Hawaiian seabirds include the band-rumped storm-petrel, Hawaiian petrel, and Newell's shearwater. These seabirds are also protected under the federal Migratory Bird Treaty Act (MBTA). All species nest in colonies, generally in excavated burrows, at high elevation on the steep slopes of extinct volcanos. These birds are believed to potentially nest in the Wai'anae and Ko'olau Ranges. No Hawaiian petrel or band-rumped storm-petrel colonies have been identified on O'ahu. However, downed Newell's shearwaters have been recovered on O'ahu and their calls have been recorded in the Wai'anae Mountains, near Mount Ka'ala (Young and VanderWerf 2016).

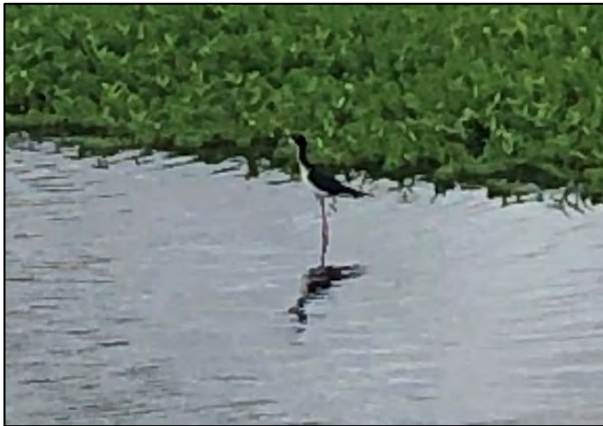
Figure 3-13. Endangered Hawaiian Waterbirds in Project Area



Endangered Hawaiian coots in Kapakahi Stream, adjacent to Waipahu Depot Street, the proposed Waipahu WWPS No. 2, Waipahu Third FM, and rehabilitation of the exiting Dual Waipahu FMs.



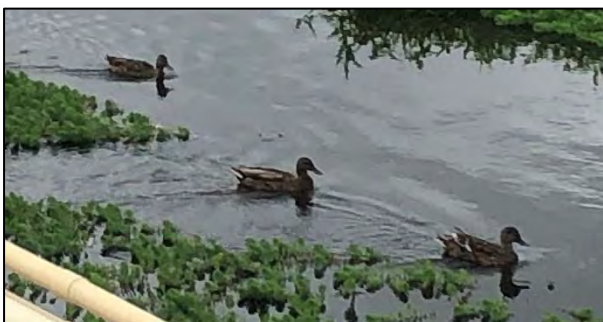
Endangered Hawaiian moorhen in Kapakahi Stream, adjacent to Waipahu Depot Street, the proposed Waipahu WWPS No. 2, Waipahu Third FM, and rehabilitation of the exiting Dual Waipahu FMs.



Endangered Hawaiian silt at the HECO Waiau Power Plant Pond; along the alignment for the Pearl City Trunk Sewer and Waimalu FM.



Endangered Hawaiian moorhen at the HECO Waiau Power Plant Pond; along the alignment for the Pearl City Trunk Sewer and Waimalu FM.



Koloa-mallard hybrid ducks at HECO Waiau Power Plant Pond; along the alignment for the Pearl City Trunk Sewer and Waimalu FM.

Hawaiian seabirds may traverse the project area at night during their breeding season, from March 1 to December 15. Outdoor lighting has been shown to result in seabird disorientation, fallout, and injury or mortality. Seabirds are attracted to lights and after circling the lights may become exhausted and collide with nearby wires, buildings, or other structures, or they may land on the ground. Downed seabirds are subject to increased mortality due to collision with automobiles, starvation, and predation by dogs, cats, and other predators. Young birds (fledglings) on their first flight from their mountain nesting areas to the sea, between September 15 and December 15, are particularly vulnerable.

O'ahu 'elepaio

The O'ahu 'elepaio is a federal and state endangered Hawaiian forest bird. The current range of this species is restricted to the forests of the Wai'anae and Ko'olau Ranges. While the Honouliuli Sewer Basin includes portions of both the Wai'anae and Ko'olau Ranges no wastewater conveyance system improvements are proposed in these forests. O'ahu 'elepaio would not be expected to be present in the vicinity of proposed improvements.

O'ahu tree snails

All forty-one (41) species of O'ahu tree snail (*Achatinella* spp.) are federally and state listed as endangered. Of these forty-one (41) species endemic to O'ahu, twenty-two (22) species are believed to be extinct and eighteen (18) are near extinction. The most abundant species, *Achatinella mustelina*, is restricted to the Wai'anae Range. O'ahu tree snails are only found in the Wai'anae and Ko'olau Mountains at elevations over 1,300 feet above mean sea level. While the Honouliuli Sewer Basin includes portions of both the Wai'anae and Ko'olau Ranges no wastewater conveyance system improvements are proposed in these forests. O'ahu tree snails would not be expected to be present in the vicinity of proposed improvements.

White tern

The white tern or manu-o-kū, also known as fairy tern, is listed as threatened by the State of Hawai'i and is also federally protected under the MBTA. While most of Hawai'i's white tern population is located in the Northwestern Hawaiian Islands, O'ahu is the only Main Hawaiian Island where these birds are found (Mitchell et al. 2005). This seabird specifically nests in urban and suburban areas of the City of Honolulu. In 2007, Mayor Mufi Hanneman designated the white tern the Official Bird of CCH (Morgan 2007). This species is known to nest in the vicinity of the project area from the Pearl City Dual FM to the Hālawā FM.

White terns breed year-round, but the most active part of their breeding season is from January through June, with a major peak in March. These birds do not construct traditional nests, instead they lay a single egg directly onto a tree branch. Some of their preferred nesting trees include but are not limited to kukui (*Aleurites moluccanus*), monkeypod, shower trees, mahogany (*Swietenia* sp.), and banyans (*Ficus* sp.).

Hawaiian short-eared owl

The state endangered Hawaiian short-eared owl or pueo has the potential to occur in the vicinity of the project area. The pueo is considered endangered on the island of O‘ahu. Pueo are a crepuscular species, most active at dusk and twilight. The pueo is most commonly found in open habitats such as grasslands, shrublands, and montane parklands, including urban areas and those actively managed for conservation. They feed on small introduced mammals, as well as small birds, and insects. Their nests consist of a simple scrape in the ground lined with grasses and feathers. Little is known about their breeding biology, but nests have been found throughout the year. Pueo may forage in the parks, wildlife reserves, wetlands, and shoreline areas along East Interceptor System corridor. However, nesting within this corridor is unlikely. DOFAW has advised that the pueo has the potential to occur on the ‘Ewa Plain from the Honouliuli Wastewater Treatment Plant (WWTP) Influent to West Loch.

Other Migratory Bird Treaty Act protected species

In addition to the seabirds (petrels, shearwater, and tern) described above other birds protected under the federal MBTA may be present in the project area. These include but are not limited to the Pacific golden-plover or kōlea (*Pluvialis fulva*) and black-crowned night-heron or ‘auku‘u (*Nycticorax nycticorax hoactli*).

The Pacific golden-plover may forage in the parks, open lawn areas, golf courses, wetlands, mudflats and other areas along the East Interceptor System corridor. This migratory species winters in the Hawaiian Islands and breeds in Siberia and westernmost Alaska (Munro 1971). While this species may be found year-round in the North Western Hawaiian Islands they are most commonly seen in the Main Hawaiian Islands between August and May (Mitchell et al. 2005). They are generally observed foraging for insects, such as cockroaches, moths, caterpillars, and earwigs, in crop fields, pastures, coastal salt marshes, mudflats, beaches, mangroves, grassy areas at airports, cemeteries, athletic fields, parks, residential lawns, golf courses, and roadsides.

Black-crowned night-heron are often observed foraging in shallow water habitats along the shoreline of Pearl Harbor, including streams, wetlands, and *lo‘i kalo* (ponded taro field). They have a diverse diet including insects, fish, frogs, mice, and the young of other native waterbirds. Little is known about breeding in Hawai‘i. They nest in colonies and in North America breeding occurs from December to August (Mitchell et al. 2005). Their nests are constructed of bulky sticks placed low in vegetation.

Aquatic Biological Resources

According to the Department of Land and Natural Resources Division of Aquatic Resources, the East Interceptor System project area traverses a number of potentially sensitive habitats that encompass a broad spectrum of aquatic environments including streams, Pearl Harbor, and the shoreline area in ‘Ewa. Pearl Harbor is a large, sheltered nursery area for a number of species of marine fish.

Non-Native Wildlife

Feral mammals found in the project area include Indian mongoose, mice, rats, dogs and cats. Common non-native introduced bird species found in the project area including cattle egrets (*Bubulcus ibis*), red-crested cardinals (*Paroaria coronata*), spotted doves (*Streptopelia chinensis*), zebra doves (*Geopelia striata*), rock doves (*Columba livia*), red-vented bulbuls (*Pycnonotus cafer*), common mynas (*Acridotheres tristis*), Java sparrows (*Lonchura oryzivora*), house sparrows (*Passer domesticus*), and Japanese white-eyes (*Zosterops japonicas*).

3.5.2.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Construction activities have the potential to impact threatened and endangered species and other protected wildlife in the project area. Measures that should be taken to avoid and minimize these potential impacts are described below.

Hawaiian hoary bat

To avoid inadvertent harm or mortality to young bats that cannot yet fly, trees and other woody plants greater than 15 feet in height should not be removed or trimmed during the Hawaiian hoary bat birthing and pup rearing season from June 1 to September 15. If this cannot be avoided, DOFAW should be consulted. DOFAW has noted that bats can become entangled in barbed wire. The use of barbed wire fencing should be avoided where possible, or alternatively, barbed wire strands may be replaced with plain wire, or plants that attract bats for habitat or foraging may be removed from the vicinity of fencing. With the implementation of these mitigation measures, potential impacts to Hawaiian hoary bats from construction activities would be reduced.

Green sea turtle

Should a sea turtle be observed within or near the construction area all work within 150 feet of the individual should stop. Work should not resume until the turtle leaves the area on its own accord. Appropriate sediment and erosion control and spill prevention best management practices should be implemented to avoid water quality impacts that could affect sea turtles in Pearl Harbor. With the implementation of these mitigation measures potential impacts to green sea turtles from construction activities would be reduced.

Endangered Hawaiian waterbirds

Prior to undertaking construction activities or vegetation clearing within 100 feet of locations with habitat suitable for Hawaiian waterbirds (e.g., streams, wetlands, ponds, *lo'i kalo*) the area should be surveyed for Hawaiian waterbird nests. A 100-foot buffer should be established and maintained around all active nests and/or chicks until the chicks have fledged. If a nest is discovered, DOFAW should be contacted. Should a Hawaiian waterbird be observed within or near the work area all work within 100 feet of the individual should cease. Work should not resume until the waterbird leaves the area on its own accord. Appropriate sediment and erosion control and spill prevention best management practices should be implemented to avoid water quality impacts that could affect Hawaiian waterbirds. With the

implementation of these mitigation measures potential impacts to Hawaiian waterbirds from construction activities would be reduced.

Threatened and endangered Hawaiian seabirds

Lighting from night construction can result in disorientation, resulting in collision with manmade artifacts or grounding of seabirds. If nighttime construction work is required all construction lighting should be downward facing and fully shielded to avoid and minimize impacts. In addition, nighttime construction work that requires outdoor lighting should be avoided during the seabird fledging season from September 15 through December 15. With the implementation of these mitigation measures potential impacts to Hawaiian seabirds from construction activities would be avoided.

O‘ahu ‘elepaio

O‘ahu ‘elepaio are restricted to the forests of the Wai‘anae and Ko‘olau Ranges. No construction activities are proposed in these areas. Therefore, there is no potential for impacts to ‘elepaio from construction activities.

O‘ahu tree snails

O‘ahu tree snails are restricted to the forests of the Wai‘anae and Ko‘olau Ranges. No construction activities are proposed in these areas. Therefore, there is little potential for impacts to O‘ahu tree snails from construction activities.

White tern

The trimming and or removal of trees can result in impacts and mortality to white tern eggs and chicks. The eggs and chicks can also be easily dislodged by construction equipment that nudges trees. Trees should be surveyed for the presence of white terns prior to trimming, removal, or any other action that could disturb the tree. If a nest is discovered, DOFAW should be notified. With the implementation of these mitigation measures potential impacts to white terns from construction activities would be reduced.

Hawaiian short-eared owl

Within the East Interceptor System corridor, pueo has the greatest potential to occur on the ‘Ewa Plain from the Honouliuli WWTP Influent to West Loch. The only proposed improvements in this area would be the proposed Waipahu Third FM and rehabilitation of the Waipahu Duel FMs between the intersection of Iroquois Road and West Loch Drive and the Pearl Harbor West Loch shoreline. Prior to vegetation clearing in this area twilight pre-construction pueo surveys should be performed by a qualified biologist. If a pueo nest should be discovered, in this area or any other part of the project area, a 50-foot buffer zone should be established in which no vegetation clearing or construction activities occur until nesting ceases. DOFAW should be notified of the nest discovery. With the implementation of these mitigation measures potential impacts to Hawaiian short-eared owls from construction activities would be reduced.

Other Migratory Bird Treaty Act protected species

Construction activities could disturb the active nests of black-crowned night heron and other native birds. Construction activities would not disturb the nests of Pacific golden-plover or other migratory shorebirds (e.g., turnstones and sanderling) as these species do not nest in Hawai'i. The federal MBTA makes it illegal for anyone to "take, possess, import, export, sell, purchase, barter, or offer for sale, purchase, or barter, and migratory bird, or the parts, nests, or eggs of such bird except under the terms of a valid permit issued pursuant to Federal regulations" (16 United States Code 703-712). In addition, Hawai'i Administrative Rules Title 13, Chapter 124 states, "no person shall remove, damage, or disturb the nest of any indigenous, endangered, or threatened species..." Should the nest of a black-crowned night heron or other native bird species be discovered during construction, a buffer zone should be established in which no vegetation clearing or construction activities occur until nesting ceases. With the implementation of these mitigation measures potential impacts to MBTA protected from construction activities would be reduced.

Aquatic Biological Resources

Construction activities could result in water quality impacts that affect fish and other aquatic life. Appropriate sediment and erosion control and spill prevention best management practices should be implemented to avoid water quality impacts that could affect aquatic biological resources. Potential construction water quality impacts and mitigation measures are discussed further in Section 3.3.

Non-Native Wildlife

Food waste, trash, and debris left uncontained at construction sites can support and foster the expansion and spread of invasive mammal populations, such as rats, cats, and mongoose. Appropriate good housekeeping, waste management, and disposal practices, including the covering of trash receptacles and regular off-haul and disposal of waste should be followed to prevent the expansion and spread of invasive mammals.

3.5.2.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Operation and maintenance of the proposed facilities is not anticipated to effect wildlife, regardless of the options implemented. If maintenance activities include the use of construction equipment, trimming of trees, or the clearing of vegetation, the appropriate mitigation measures described above for potential construction impacts should be implemented.

3.5.3 Wetlands and Other Water of the United States

3.5.3.1 EXISTING SETTING

The United States Army Corps of Engineers (USACE) has regulatory jurisdiction of dredged and fill activities in wetlands and other Waters of the United States under Section 404 of the Clean Water Act. USACE also has regulatory jurisdiction of proposed structures in, over, and under navigable Waters of the United States under Section 10 of the Rivers and Harbors Act. According to the USACE *Wetlands Delineation Manual* (1987), wetlands are defined as those areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The types of wetlands in the project area include estuarine and marine deepwater, estuarine and marine wetland, freshwater emergent wetland, freshwater pond and freshwater forested/shrub wetland. Figure 3-14 illustrates wetlands within the project area as

identified by the United States Fish and Wildlife Service's (USFWS') National Wetland Inventory.

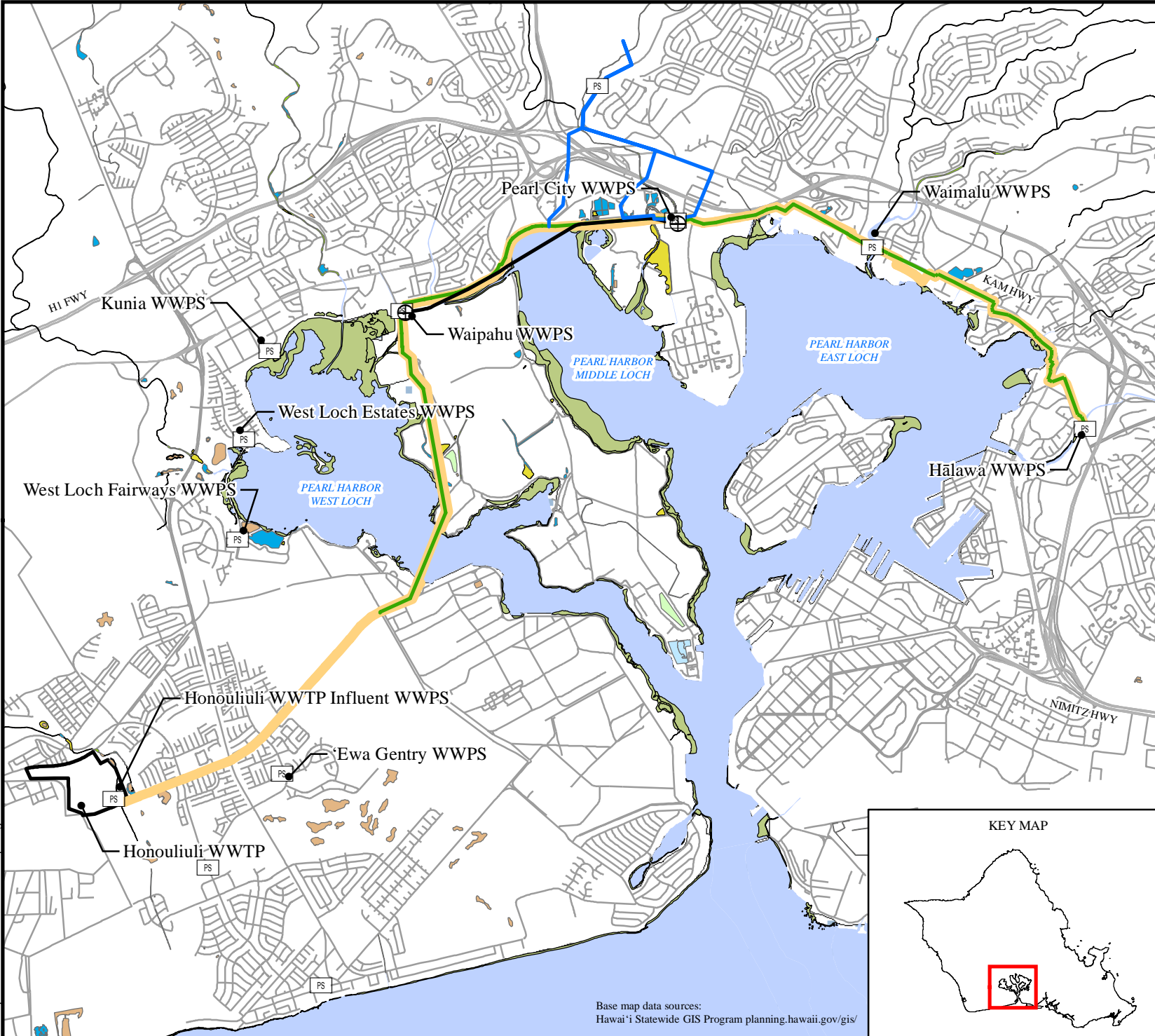
Nearly the entire margin of Pearl Harbor is identified as a wetland under the National Wetland Inventory. The largest and most biologically significant of the Pearl Harbor wetlands is the 70-acre Pouhala Marsh, which lies at the West Loch between the terminal reaches of Waikele and Kapakahi streams. Additional significant wetland habitats adjacent to the areas affected by the proposed construction include the Waiawa Unit of the Pearl Harbor National Wildlife Refuge.

3.5.3.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Proposed construction activities may result in temporary and permanent loss of wetlands and other Waters of the United States. All options follow similar alignments around Pearl Harbor and the adjacent wetlands, and would result in similar impacts. To the extent practical construction access and staging areas should be selected that avoid wetlands and other Waters of the United States. As options are selected and moved forward to design and permitting the precise boundaries of wetlands should be delineated for review and approval by USACE. A Department of the Army permit would be sought for all dredge and fill activities in wetlands and other Waters of the United States and all structures in, over, and under navigable Waters of the United States. At all locations where wetlands are temporarily impacted, they would be restored to existing conditions. If the Proposed Action results in the permanent loss of wetlands, mitigation would be required. In this context mitigation means the restoration, creation, or enhancement of wetlands to compensate for the permitted wetland losses. The details of this mitigation (if required) would be negotiated with USACE during the permitting process.

City and County of Honolulu

HONOLULU/ WAIPAHA/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES



Legend

- Honouliuli WWTP
 - Existing WWPS
 - Hybrid Tunnel Shaft
 - East Interceptor
 - Hybrid Option Alignment
 - Waiawa Conveyance Corridors (Options A, D, and G)
 - New and/or Rehabilitated Force Mains and Trunk Sewers
 - Streets
- Wetland Type
- Estuarine and Marine Deepwater
 - Estuarine and Marine Wetland
 - Freshwater Emergent Wetland
 - Freshwater Forested/Shrub Wetland
 - Freshwater Pond
 - Lake
 - Other
 - Riverine

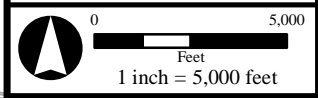
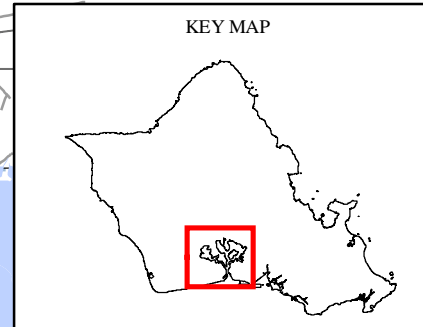


FIGURE 3-14
WETLANDS



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Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

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1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813

3.5.3.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Operation and maintenance of the proposed facilities would not result in impacts to wetlands and would not require mitigation.

3.6 ARCHAEOLOGICAL, HISTORIC AND CULTURAL RESOURCES

3.6.1 Archaeological and Historic Resources

3.6.1.1 EXISTING SETTING

Archaeological and historic resources may include subsurface and above-ground archaeological sites, historic properties such as buildings, structures, or districts, and other places of cultural and architectural importance. Archaeological and historic resources are protected under the National Historic Preservation Act and the Hawai'i Revised Statutes (HRS) Chapter 6E.

There are twelve (12) *ahupua'a* (traditional Hawaiian land divisions) around Pearl Harbor in the 'Ewa *moku* (traditional Hawaiian land district): west to east, they are Honouliuli, Ho'ae'ae, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, 'Aiea, and Hālawā. The boundaries of these are shown on Figure 3-15.

In the pre-contact and early post-contact period, the margins of Pearl Harbor were highly productive and well populated lands, owing to the availability of marine and riparian resources, well-watered bottom lands for *lo'i kalo* (ponded taro field) cultivation and other forms of agriculture, and the generally sheltered conditions. Traditional Hawaiian resources in the project area vicinity include fishponds, springs, habitation sites, and other types of resources. Intact subsurface cultural deposits, features, and/or human skeletal remains have been identified in undisturbed subsoils beneath fill sections associated with the construction of Kamehameha Highway and development of the surrounding area. Traditional Hawaiian archaeological sites and features include ponds and *lo'i*; *kuāuna* (embankments) that served as boundaries of ponds or *lo'i*; and buried land surfaces containing midden, artifacts, or hearth features. Some named areas such as Kukuiahu, the home of Chiefess Kalamānuia, are identified as archaeological sites where foundations or other remnants have been found in the past. The likelihood of such finds is suggested to be higher in the vicinity of known Land Commission Awards, and in close proximity to streams, springs, and the coast.

However, according to the Archaeological Literature Review and Field Inspection (LRFI) Report drafted for this project area in November 2019 by Bennicas et al. (2019), the "study area has a remarkable absence of previously identified traditional Hawaiian or early post-Contact historic properties. This is at odds with the historic evidence...that suggests very intensive and extensive native Hawaiian land use within the project area." This may be due to the extensive ground disturbance through the post-contact period. The LRFI Report is presented as Appendix B.



City and County of Honolulu

**HONOULIULI/
WAIPAHAU/ PEARL CITY
WASTEWATER
CONVEYANCE
FACILITIES**

- Legend**
- 'Ahupuaa
 - Honouliuli Sewer Basin

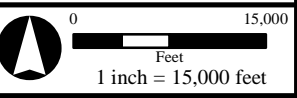


FIGURE 3-15
MAP OF AHUPUA'A
AROUND PEARL
HARBOR IN THE
'EWA MOKU

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Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

The lands surrounding Pearl Harbor attracted post-contact settlement by various ethnic groups that immigrated to Hawai'i in the nineteenth (19th) and early twentieth (20th) centuries. Historic post-contact period resources are found throughout the project area vicinity; these represent nineteenth (19th) and twentieth (20th) century contexts such as the plantation era, World War II military development, and mid-century architecture. Resource types include post-contact archaeological composed of isolated artifacts, trash pits, privies, and building foundations or other subsurface structural features. Resources also include buildings and structures, such as bridges, military facilities, commercial buildings, and residences. In addition, historic districts in the project area vicinity encompass groups of resources. The largest historic resource in the project area vicinity is the Pearl Harbor National Historic Landmark District.

One (1) historic-period resource that extends through much of the project area is the former right-of-way of the Oahu Railway & Land Company (OR&L) Railroad, which historically extended from Hālawā to Nānākuli. The western end of the right-of-way from approximately 'Ewa Villages extending in the Kapolei direction, is listed in the National Register of Historic Places (NRHP). In the project area, the right-of-way is not NRHP listed but is recorded in the State Inventory of Historic Properties (SIHP) as SIHP #50-80-12-9714. In the project area, the former rail alignment is currently mostly occupied by the Pearl Harbor Bike Path.

The November 2019 Draft LRFI Report (Bennicas et al. 2019) provides the main source of the more detailed archaeological and historic resource information that follows. It summarizes numerous previous archaeological surveys and identifies specific sites. In addition, current information regarding NRHP and Hawai'i Register of Historic Places (HRHP) listed properties was retrieved online from the Hawai'i State Historic Preservation Division (SHPD).

Overall archaeological sensitivity was summarized in the November 2019 Draft LRFI Report (Bennicas et al. 2019) as follows:

“Moving from west to east, the Honouliuli portion and Waipi'o Peninsula of the study area appear to have a generally low sensitivity. Closer to the margins of West loch the sensitivity is suggested to be moderate due both to traditional patterns of Hawaiian harvesting of marine resources and the development of military infrastructure. Where the study corridor turns east near the Waipahu WWPS it enters a band of traditional Hawaiian habitation and agriculture skirting the edge of Pearl Harbor all the way to 'Aiea Bay. At least where archaeologists have looked, the archaeological evidence of this habitation and agriculture has been remarkably absent which is attributed to the history of massive modern land alteration. Most of the mauka portions of the study area have a lower level of archaeological sensitivity with exceptions being the western portion of Kamehameha Highway near Waihona Street and the Lehua Avenue area due to the [Land Commission Awards] pattern and early post-Contact development. The east end of the study area in Hālawā appears to have low sensitivity, possibly a little higher on the immediate banks of the traditional Hālawā Stream alignment.” (Bennicas et al. 2019)

In the LRFI Report, Bennicas et al. (2019) concluded that the overall project area intersects eleven (11) previously identified historic properties and two (2) archaeological sites. Of these thirteen (13) sites, four (4) were re-identified during the pedestrian survey field inspection (SIHP #50-80-12-9714, #50-80-13-5597, #50-80-13-7796, and the 'Aiea Cemetery). Additionally, the field inspection documented sixty (60) additional potential historic properties including some features that are not believed to have been previously identified. This includes military structures and infrastructure related to the World War II era development of Naval Magazine Pearl Harbor (West Loch); additional features of a previously identified post-Contact irrigation complex (SIHP #50-80-13-5597 and 50-80-13-7796); transportation infrastructure (railroad alignment, bridges, culverts); a fire station; and two (2) active agricultural operations with potentially historical origins.

Archaeological and historic resources located along the alignment of specific project options are discussed below.

Projects Common to Both East Interceptor Conveyance Options

No historic properties were identified in the Waimalu WWPS Force Main new or reconstruct/replace alignments or the Hālawā WWPS reconstruct/replace alignment.

The Waipahu WWPS Force Main projects cross a portion of Pearl Harbor Naval Complex National Historic Landmark District, including Naval Magazine Pearl Harbor (West Loch) and a portion of the Waipi'o Peninsula. SIHP resources not listed in the NRHP or HRHP along this alignment are the OR&L Railroad right-of-way, including a steel railroad bridge; and SIHP #50-80-13-5597 and 50-80-13-7796, which together form a historical irrigation complex. A fishpond site called "Fresh Pond" (no SIHP #) was also identified on the Waipi'o Peninsula overlain by the irrigation complex.

Bennicas et al. (2019) identified several potential historic resources along this alignment in the 2019 Field Inspection as part of the Draft LRFI, although these resources have not been formally evaluated for HRHP or NRHP eligibility. They included various military related structures within and possibly related to the NHL; mortared culverts and retaining walls; an overgrown concrete walkway; and additional features associated with the historical irrigation complex.

Sites in the area of the Pearl City Trunk Sewers – Rehabilitation/Replacement project include a small historic-period agricultural wall structure (SIHP #50-80-09-08778) of undetermined significance; a portion of the non-NRHP-listed former OR&L Railroad right-of-way; as well as a potential but unevaluated site identified by Cultural Surveys Hawai'i, Inc. (CSH) as actively cultivated *lo'i kalo*.

The Waimalu Trunk Sewers – Rehabilitation/Replacement project area also encompasses portions of the Waimalu Shopping Center (98-020 Kamehameha Highway), a mid-twentieth-century commercial building listed in the HRHP; the former OR&L Railroad right-of-way; and historic bridges at Kalauao Stream, Kalauao Spring, and 'Aiea Stream. The Kalauao Spring and Kalauao Stream bridges are identified as NRHP-eligible in the Hawai'i State Historic Bridge Inventory (MKE

Associates LLC and Fung Associates, Inc. 2013). The ‘Aiea Stream bridge is not identified as eligible. This area also includes the ‘Aiea Cemetery, and may include additional remnant fishponds, such as Loko Kunaloko. CSH identified potential, unevaluated historic resources including Sumida Watercress Farm and a previously undocumented culvert. In addition, the site of Kukuiahu (an early post-contact chiefess’ home) is located along the boundary of the project area.

One (1) potential historic property was identified in the Hālawa WWPS Force Main (New) project area: the Salt Lake Blvd. Bridge over Hālawa Stream.

East Interceptor Conveyance Options

All of the Tunnel, No-Tunnel, and Hybrid option projects for the East Interceptor Conveyance intersect the former OR&L Railroad right-of-way (SIHP inventoried but not NRHP listed). In their field inspection, CSH also identified an unevaluated, potential historic resource (an overgrown concrete walkway) in the area of Waipahu WWPS No. 2.

Waiawa Area Conveyance Options

The Waiawa Area Conveyance Options all intersect the OR&L Railroad right-of-way and one (1) unevaluated but potentially historic culvert. CSH identified in their Field Inspection that Corridor A project area includes an unevaluated but potentially historic fire station (Honolulu Fire Department Station 20, Pearl City), and Corridor G includes the Waiawa Stream Bridge along Kamehameha Highway, which is HRHP listed and is identified as a “typical post-war bridge” in the Hawai‘i State Historic Bridge Inventory (MKE Associates LLC and Fung Associates, Inc. 2013). Corridor A and D project areas overlap the inventoried area of the individually NRHP-eligible Naval Aviation Supply Depot Quonset Hut 33 at Waiawa Gulch (SIHP #50-80-09-08044).

3.6.1.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

The assessment of both construction and operational impacts considers the potential effects to the NRHP eligibility status of a historic property, based on the standard significance and integrity criteria set out in HRS Chapter 6E and the NRHP. Actions that diminish or destroy the integrity of historic properties are considered to have an adverse impact. Actions that restore, repair, and sustain historic properties are considered to have beneficial impacts.

Temporary and permanent impacts to known and as-yet unidentified archaeological and historic properties in the project area could occur from construction-period activities including open trenching, microtunneling and horizontal drilling using shafts, demolition and construction of pump stations, and temporary activities such as the creation and use of construction staging areas and access routes.

Open trenching has the potential to result in the greatest impacts to archaeological and historic resources, as it involves linear areas of disturbance in the layers of soil and subsoil that typically hold cultural materials associated with subsurface archaeological sites. Tunneling, microtunneling, and horizontal drilling all involve less disturbance of the soils closer to the surface that may contain cultural materials;

these would primarily result in impacts from the construction of shafts, which represent a smaller footprint of ground disturbance than open trenching.

Demolition and construction of pump stations would involve some localized ground disturbance with the potential for negligible to minor impacts to archaeological and historic resources. Likewise, construction staging and access represent temporary activities that could damage archaeological or historic resources; for example, accommodating heavy equipment access across an archaeological site, fishpond area, or historic bridge has the potential to result in damage to the resource.

Mitigation for construction activities under all alternatives would include development of an archaeological monitoring program for ground-disturbing activities. Consultation would be undertaken with SHPD as appropriate throughout the planning process. Mitigation plans would also outline limitations for staging and access in the areas of potentially sensitive historic and archaeological resources, specifying best practices to avoid or minimize impacts to the resources during construction.

Mitigation plans for construction activities under all alternatives would define protocols for any inadvertent discoveries of archaeological or cultural resources. Project construction personnel would be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities would cease and SHPD would be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* (human remains, ancestral bones) are identified, all earth moving activities in the area would stop, the area would be cordoned off, and SHPD and the Honolulu Police Department (HPD) would be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, a burial treatment plan would be completed in compliance with HAR §13-300 and HRS §6E-43.

In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents would consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance.

3.6.1.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Potential for impacts to archaeological and historic resources is greatest during the construction period due to ground disturbing activities. Once construction is completed and the conveyance systems are operational, the operation and maintenance of the proposed facilities is not anticipated to affect archaeological and historic resources regardless of the options implemented. If maintenance activities include the use of construction equipment in the vicinity of identified historic and archaeological resources, or any ground disturbance, mitigation measures identified in Construction Impacts section above should be implemented.

3.6.2 Cultural Resources

3.6.2.1 EXISTING SETTING

Cultural resources are defined for the purposes of this DEIS as those associated with cultural practices and traditions. Cultural practices are activities imbued with cultural or spiritual meaning; they can be traditional or modern. They may include traditional Hawaiian practices, but also the cultural practices of other communities and ethnic groups. Assessment of project impacts on cultural practices, per HRS 343, HRHP Criterion E, and Act 50, consider effects on cultural practitioners' ability to access the locations and resources needed to undertake cultural practices. Also, considered here are the *wahi pana* (storied places) that are imbued with cultural significance through their appearance in *mo'olelo* (stories), *mele* (songs), *oli* (chants), and other oral history traditions.

There exists a myriad of *wahi pana* in the 'Ewa *moku*. Trails, resting places, fishponds, and *heiau* (temples) were of particular importance. Several *mo'olelo* associate places in the project area vicinity with the gods Kāne and Kanaloa, the pig god Kamapua'a, the Hina family, and with the sisters of the Hawaiian volcano goddess Pele (Kamakau 1991b:111; Pukui et al. 1974:200, both cited in Tanaka and Hammatt 2019). The 'Ewa coastal plain was known as a place of spiritual significance, as it was associated with the *ao kuewa*, the realm of the homeless souls.

The *ahupua'a* (traditional Hawaiian land divisions) of the 'Ewa *moku* were traditionally known as *momona* (fat, fertile, or rich) lands in reference to the well-watered bottom lands at the mouths of the many streams suitable for *lo'i kalo*, and for the wealth of marine resources that could be acquired from the many fishponds, fish traps, and the protected waters of the lochs of Pearl Harbor. Other ethnic communities, including Japanese and Filipino, have also developed and maintained their cultural traditions in the project area vicinity.

Under all Proposed Action options, nearly all of the proposed construction would be along or near existing roadway easement and utility corridors. The vast majority of the East Interceptor System project area has been affected by more than a century of commercial agriculture and urban and suburban development.

Despite modern urban development, it is still possible that traditional cultural practices occur in the area, and that historically associated places remain. Within the project area vicinity, resources associated with past cultural traditions include the following, as described in the August 2019 Draft Cultural Impact Assessment (CIA) for this Proposed Action (Tanaka and Hammatt 2019) (see Appendix C). It is possible that more such places will be identified in the course of informant interviews as the CIA is completed, and these will be added to the Final Environmental Impact Statement (FEIS).

- **Fishponds.** The 'Ewa District had more fishponds than any other district on O'ahu, indicating that agricultural and aquacultural intensification was a direct link to the chiefs who resided there and to the increasing needs of the population. While all but a few of the ponds have been filled or destroyed over

the past century, their locations and names are known and many include some remains in an archaeological context.

- Pit caves. In traditional Hawaiian times, the ‘Ewa *moku* included extensive areas of exposed coral (Pleistocene limestone) outcrops with characteristic dissolution “pit caves” (Myroie and Carew 1995, in Tanaka and Hammatt 2019), commonly referred to as “sink holes” (Halliday 2005, in Tanaka and Hammatt 2019). According to McAllister (1933, in Tanaka and Hammatt 2019), holes and pits in the coral were generally accessed for water, while larger pits, often containing soil, were used for cultivation.
- Heiau. There were numerous *heiau* (pre-Christian place of worship) within the *moku* of ‘Ewa. While the majority were well *mauka* (inland), it is believed that the Ahuena Heiau once stood in the project area vicinity. However, like many *heiau* sites, its precise location is not known today.
- Trails and associated resting places. There were several pre-Contact/early historic trails across ‘Ewa, connecting the communities and resource areas in the district and also serving as part of an island-wide transportation network. None remain intact above-ground today; however, the history of these trails is recounted in the CIA (Tanaka and Hammatt 2019). Along the coastal trail connecting Honolulu to Wai‘anae was a small waterfall called Kahuawai (or Kahuewai) (water gourd container) (Soehren 2009, in Tanaka and Hammatt 2019) along Kalauao Stream, which ‘Ī‘Ī (1959:95, in Tanaka and Hammatt 2019) stated was once a favorite resting place for travelers, exclusively for ali‘i (royalty). Along the coastal trail connecting Honolulu to Wai‘anae, ‘Ī‘Ī (1959:95, in Tanaka and Hammatt 2019) mentioned two (2) resting places in Hālawa for travelers, Napehā and Kauwamoa. Napehā was a pool where people went diving. The pool was said to have been named for the chief, Kūali‘i, who stopped there for a drink (‘Ī‘Ī 1959:95, in Tanaka and Hammatt 2019). Kauwamoa was also a diving place where people liked to gather, said to be a favorite spot of Pe‘ape‘a, son of Kamehamehanui of Maui (‘Ī‘Ī 1959:95, in Tanaka and Hammatt 2019).
- Agricultural and aquacultural resources. In addition to the fishponds discussed above, other cultivation practices were associated with Pu‘uloa (Pearl Harbor) and its tributaries, including fisheries in the lochs, numerous springs, and irrigated lands along the streams. These rich resources attracted ali‘i and made the area a political center as well as a prized resource area (Tanaka and Hammatt 2019). In the nineteenth (19th) century, the native Hawaiian population declined due to introduced epidemics. As the demand for kalo (taro) declined and importation of Chinese laborers to the west coast of California and Hawai‘i increased, a market for rice developed. Lo‘i (irrigated taro patches) lands were ideal for growing rice, and as these lands lay in disuse and became more available, the Chinese farmers quickly purchased these lots. By the mid-1860s, much of the lo‘i on O‘ahu had been transformed into rice fields.
- Resources associated with other ethnic groups. In the last half of the nineteenth (19th) century, large agricultural enterprises such as the Ewa Plantation Company were established, enlisting laborers from outside Hawai‘i to support cultivation of sugar cane and other cash crops. Chinese, Japanese, Portuguese, and Filipino

workers arrived with their own cultural traditions and beliefs that shaped life in the plantation camps and villages of ‘Ewa.

In the project area vicinity there are also resources associated with current cultural practices. These include, but are not limited to:

- *Lo‘i kalo* in active use at Waikele Stream, and along Pearl Harbor coastline as well as upstream in Waipahu Cultural Garden Park.
- Fishponds. Current cultural activities include the reestablishment of traditional aquaculture activities, such as the restoration of Loko Pa‘aiāu. This project is a partnership of the Navy and community groups (Naval Facilities Engineering Command Hawaii, Public Affairs Office 2016).

There are likely other cultural practices that occur in the area. Consultation with knowledgeable local cultural practitioners is currently in progress as part of the CIA, and interviews are expected to identify additional resources associated with cultural practices and traditions.

3.6.2.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

It is the policy of the State of Hawai‘i under HRS Chapter 343 to require an evaluation of project impacts to cultural practices and cultural features in order to promote and preserve the cultural beliefs, practices, and resources of Native Hawaiians and other ethnic groups. Consultations are being conducted as part of the CIA to identify whether resources or practices relating to Native Hawaiian or other ethnic practices for subsistence, medicinal, religious and cultural purposes are present or on-going in the project area vicinity. Additional identification of impacts, as well as recommendations for mitigation measures are pending the results of the community consultation process.

Temporary and permanent impacts to resources associated with cultural traditions and practices in the project area could occur from construction-period activities. Construction-period activities are anticipated to include trenching, microtunneling and horizontal drilling, demolition and construction of pump stations, limiting public access into and through active construction areas for safety reasons, and the creation and use of construction staging areas and access routes.

As described above under Archaeological and Historic Resources, activities such as open trenching and creation of shafts, as well as construction staging and access, could threaten cultural resources. For resources associated with cultural practices and traditions, access to cultural practitioners and users of the resource is a critical aspect. The implementation of construction fencing, location of access and staging areas, and presence of linear trenches that could function as barriers have the potential to cause temporary loss of access to some resources. This could have adverse impacts to cultural resources. For example, interruption of the access for taro farmers to their *lo‘i* could result in impacts such as crop loss, with the farmers having to re-establish crops that fail for lack of timely care (which for taro can be a multi-year process). Cultural practitioners may require access to sites for ceremonial or community activities, and people who practice subsistence gathering of resources

may require access to vegetation or water resource areas associated with their practice, even in the developed urban area.

To mitigate impacts, once cultural resources are identified, outreach to the practitioners and users would aim to coordinate with their needs for access, with communication about needs and timing for both ongoing cultural practices and construction activities. A point of contact on the project team would be established so that cultural practitioners and resource users could communicate about any concerns, impacts, or coordination issues.

Mitigation plans for construction activities would define protocols for any inadvertent discoveries of cultural resources. Project construction personnel would be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential cultural resources are identified during construction activities, all activities would cease and SHPD would be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* are identified, all earth moving activities in the area would stop, the area would be cordoned off, and SHPD and HPD would be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, a burial treatment plan would be completed in compliance with HAR §13-300 and HRS Chapter 6E-43.

In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents would consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance.

3.6.2.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Potential for impacts to resources associated with cultural beliefs, practices, and traditions is greatest during the construction period due to the potential for access limitations in areas with construction activity that must be closed or limited to the public for safety reasons. Once construction is completed and the conveyance systems are operational, the operation and maintenance of the proposed facilities is not anticipated to affect cultural resources regardless of the options implemented. Any maintenance activities involving accessing or limiting access to these resources would be mitigated through communication with practitioners and users as identified in the Construction Activities section above.

3.7 AIR QUALITY

3.7.1 Existing Setting

Air quality is defined as a measurement of pollutants in the air and the health and safety effects of those pollutants to humans and the environment, including plants and animals. Air pollution refers to chemical substances, particulates, biological materials, or other harmful materials that degrade the quality of the atmosphere. Ambient concentrations of air pollutants are determined by the amount of emissions released by pollutant sources and the ability of the atmosphere to transport and disperse such emissions. Sources relevant to the proposed action include mobile

sources, such as vehicles, and construction equipment, as well as stationary sources, such as pump station generators.

The United States Environmental Protection Agency (EPA), under the requirements of the CAA, established National Ambient Air Quality Standards (NAAQS) for six (6) contaminants. These contaminants, referred to as criteria pollutants, are as follows:

- Carbon monoxide
- Nitrogen dioxide
- Ozone
- Particulate matter
- Lead
- Sulfur dioxide

The NAAQS include primary and secondary standards. The primary standards were established to protect human health, including the health of sensitive populations, such as asthmatics, children, and the elderly. Primary air quality standards are applicable to the general outdoor atmosphere accessible by the public. The secondary air quality standards set limits to protect the environment, including plants and animals, from adverse effects associated with pollutants in the air. The State of Hawai'i has adopted many NAAQS as the state standards and established its own standards for several pollutants. Table 3-5 presents the state and national standards.

Table 3-5. National and State Ambient Air Quality Standards

Air Pollutant	Averaging Time	Standards		
		Hawai'i State Standard	Federal Primary Standard ^a	Federal Secondary Standard ^b
Carbon Monoxide	1-hour	9 ppm	35 ppm	None
	8-hour	4.4 ppm	9 ppm	
Nitrogen Dioxide	1-hour	---	0.100 ppm	---
	Annual	0.04 ppm	0.053 ppm	0.053 ppm
PM ₁₀	24-hour	150 µg/m ³	150 µg/m ³	---
	Annual ^c	50 µg/m ³	---	---
PM _{2.5}	24-hour	---	35 µg/m ³	35 µg/m ³
	Annual	---	12 µg/m ³	15 µg/m ³
Ozone	8-hour	0.08 ppm	0.070 ppm	0.070 ppm
Sulfur Dioxide	1-hour	---	0.075 ppm	---
	3-hour	0.5 ppm	---	0.5 ppm
	24-hour	0.14 ppm	---	---
	Annual	0.03 ppm	---	---

Air Pollutant	Averaging Time	Standards		
		Hawai'i State Standard	Federal Primary Standard ^a	Federal Secondary Standard ^b
Lead	Rolling 3-month	1.5 µg/m ³ ^d	0.15 µg/m ³	0.15 µg/m ³
Hydrogen Sulfide	1-hour	0.025 ppm	None	None

Source: DOH, State of Hawai'i Annual Summary 2015 Air Quality Data, December 2016.

^a Primary Standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children and the elderly.

^b Secondary Standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

^c Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, EPA revoked the annual PM10 standard effective December 17, 2006. However, the state still has an annual standard.

^d The state standard is based on calendar quarter.

ppm - parts per million.

µg/m³ - Micrograms per cubic meter.

An area where the ambient air concentration of a criteria pollutant is less than the relevant NAAQS and is not contributing to a nearby area that does not meet the NAAQS is designated as being "in attainment" for that pollutant per the CAA. An area where the ambient air concentration equals or exceeds the NAAQS or is contributing to a nearby area that does not meet the NAAQS is designated as being in "nonattainment." A "maintenance area" is an area that has been re-designated from nonattainment status to attainment status and has an approved maintenance plan under §175 of the CAA. The State of Hawai'i has been designated as an attained area for each criteria pollutant.

The DOH Clean Air Branch has four (4) air monitoring stations within, and adjacent to, the Honouliuli sewer basin. The air monitoring stations in the sewer basin are Kapolei, Pearl City, Honolulu, and Sand Island. Sources of air pollution in the sewer basin mainly consists of industrial activities and vehicular traffic. Table 3-6 summarizes the most recent published air quality data at the four (4) monitoring stations in the year 2015. The data shows that there were no occurrences exceeding the standards in 2015, and the monitored ambient air quality conditions are consistent with the attainment status of the state.

Table 3-6. 2015 Air Quality Data at the Air Monitoring Stations

Monitoring Station	Location	Monitoring Objective	Land Use	24-hr PM ₁₀ (µg/m ³)	24-hr PM _{2.5} (µg/m ³)	1-hr CO (ppm)	8-hr CO (ppm)	3-hr SO ₂ (ppm)	24-hr SO ₂ (ppm)	1-hr NO ₂ (ppm)
Kapolei	2052 Lauwiliwili Street	Population Exposure	Suburban	32	17.4	2.4	1.7	0.015	0.004	0.031
Pearl City	860 4th Street	Population Exposure	Urban and Center City	46	14.0	-	-	-	-	-
Honolulu	1250 Punchbowl Street	Population Exposure	Urban and Center City	36	17.3	1.4	1.0	0.007	0.003	-
Sand Island	1039 Sand Island Pkwy	Maximum Concentration (O ₃) Transport (PM _{2.5})	Urban and Center City	-	15.7	-	-	-	-	-

Source: State of Hawai'i Annual Summary 2015 Air Quality Data (December 2016)

µg/m³ - Micrograms per cubic meter

PM₁₀ - Particulate matter that is 10 microns or less in aerodynamic diameter

PM_{2.5} - Particulate matter that is 2.5 microns or less in aerodynamic diameter

ppm - parts per million

3.7.2 Construction Impacts and Mitigation Measures

Emissions from on-site construction equipment and on-road construction-related vehicles, as well as dust generating construction activities, have the potential to affect air quality.

Regardless of the options selected, short-term impacts to air quality would result from the proposed project either directly or indirectly because of project construction. Anticipated construction impacts to air quality include, but are not limited to, increases in particulate matter or dust from vehicle movement on the construction site and trucks on road, excavation activities, spoils removal activities, and emissions from construction vehicles and equipment.

The major and common construction components under the two (2) proposed East Interceptor conveyance options would include various construction phases or elements for each project as appropriate:

- Site preparation and grading.
- WWPS force main or gravity sewer line trenching and construction using excavators, backhoes, loaders, etc.
- Tunnel/shaft construction using excavators, crane, TBM, etc.
- Material/muck transporting using loaders and trucks.
- WWPS renovation and construction.

Within East Interceptor conveyance options, the No-Tunnel option involves a more traditional approach utilizing gravity sewers, WWPSs, and force mains. For the

Hybrid option, a GST would be constructed and certain existing (and/or rehabilitated) No-Tunnel facilities would continue operation.

Adverse air quality impacts would occur along force mains or trunk sewer lines to be trenched under the No-Tunnel option as compared to more concentrated impacts around the GST shaft sites under the Hybrid option. However, since the majority of tunnel work is underground, tunnel construction-related air emissions would not be airborne with exception of those activities including muck truck operations around the shaft sites. Therefore, no adverse air quality impact would occur in the neighborhoods along the tunnel alignment under the Hybrid option excluding shaft sites.

The above impact trend would also be applicable to Waiawa area conveyance corridor options through a combination of cut and cover and microtunneling construction where microtunneling alignment impacts would be similar to the Hybrid option under the East Interceptor conveyance options. Alignment G would likely experience the greater tunnel boring activities given the requirement of tunnel depth and the number of deep manholes as compared to Alignments A and D.

In contrast to operational activities, construction activities are relatively short in duration, resulting in temporary air quality effects. However, the impacts of construction vehicle and equipment emissions from large-scale construction activities occurring over many years at a specific local site could cause relatively long-term adverse air quality effects and may need to be quantitatively addressed.

Construction period localized air quality impacts are typically considered for localized pollutants, such as CO, PM₁₀, and PM_{2.5}, through hot spot analyses. According to CFR 93.123(c)(5), “CO, PM₁₀, and PM_{2.5}, hot spot analyses are not required to consider construction-related activities which cause temporary increases in emissions. Each site which is affected by construction-related activities shall be considered separately, using established ‘Guideline’ methods. Temporary increases are defined as those which occur only during the construction phase and last five (5) years or less at any individual site.”

Based on the project construction schedule for individual projects as summarized in Tables 2-4 and 2-5 for the East Interceptor conveyance options, each project would last less than five (5) years at a specific local site during the project construction duration. Therefore, the project temporary construction activities would not warrant a quantitative hot spot analysis resulting in less than significant air quality impacts. While the construction schedule for the Waiawa area conveyance corridor options is not known at this time, it is also anticipated that construction of the preferred option would also last less than five (5) years.

Construction activities shall comply with HRS, Chapter 342B, Air Pollution Control, the HAR, and CCH laws and regulations. State air pollution controls prohibiting visible emissions of fugitive dust from construction activities at the property line would be followed by the contractor. Other BMPs would also be incorporated into design plans, as appropriate, for implementation by the contractor. Implementation of

BMPs and compliance with state air pollution controls should minimize the potential for adverse effects.

To minimize the potential for impacts to air quality during construction, CCH would implement the following emission control measures as appropriate, particularly in the areas where sensitive receptors are in close proximity:

- *Dust Control.* Necessary measures would be implemented to suppress construction-related dust emissions. For example, truck routes within the site would be watered as needed to avoid the re-suspension of dust. All trucks hauling soils, debris, or spoils would be equipped with tight-fitting tailgates and their loads covered prior to leaving the construction site. Water sprays would be used to dampen materials as necessary to avoid the suspension of dust into the air.
- *Idling Restriction.* To restrict unnecessary vehicle idling on roadways, on-site vehicle idle time would be restricted to limited minutes for all equipment and vehicles that are not using their engines to operate a loading, unloading, or processing device (e.g., concrete mixing trucks) or otherwise required for the proper operation of the engine.

Additional emissions reduction measures, such as using newer equipment and implementing best available tailpipe reduction technologies, such as diesel particulate filters to non-road diesel engines during construction, would be also considered to the extent reasonably feasible.

Overall, the emission reduction measures described above are expected to minimize air pollutant emissions related to temporary construction activities, resulting in minimal adverse air quality impacts due to construction sources.

3.7.3 Operational Impacts and Mitigation Measures

After the completion of each project associated with the Proposed Action, potential long-term emissions from each WWPS—particularly from new WWPSs to be constructed—could have the potential to affect air quality conditions in the neighborhood from operating new generators to be installed for emergency use. Pump station emergency generators are exempt from air quality permitting requirements pursuant to HAR 11-60.1-62(d)(8).

The State of Hawai'i has established a significance threshold of 10 tons per year for net increase in hydrogen sulfide (H₂S) emissions in §11-60.1-1. It is unlikely that any of the WWPSs under the Proposed Action would exceed this threshold.

The Proposed Action includes an alternative under the No-Tunnel option to relocate the Pearl City WWPS and construct a third FM to convey flow to the Waipahu WWPS. Odor control measures would be implemented if the Pearl City WWPS relocation option is elected to result in minimal odor impacts to neighboring uses and sensitive receptors including the Lehua Elementary School and Lehua Community Park.

Consequently, the proposed action would result in less than significant air quality impacts and no mitigation measures would be warranted.

3.8 NOISE

3.8.1 Existing Setting

An acoustic study was conducted by Y. Ebisu & Associates to identify the potential risks of adverse noise impacts for the various Proposed Action options. The study compares the potential noise levels to the daytime background noise levels at the noise sensitive receptor locations closest to the alignment options of force mains and truck sewers constructed through the conventional open trench method, and the locations of WWPSs and bored tunnel and microtunnel shafts. The study is attached as Appendix D and is summarized below.

DOH has limits on the level of noise allowed in different zoning districts. Table 3-7 shows the maximum permissible sound levels in Hawai'i. Noise levels shall not exceed the maximum permissible sound levels for more than 10 percent of the time within any 20 minute period, at any time except by permit or variance.

Table 3-7. Maximum Permissible Sound Levels in dBA

Zoning Districts	Zoning Equivalent	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Class A	Residential, Conservation, Preservation, Public Space, Open Space, or Similar Type	55	45
Class B	Multi-family Dwellings, Apartment, Business, Commercial, Hotel, Resort, or Similar Type	60	50
Class C	Agriculture, Country, Industrial, or Similar Type	70	70

Source: HAR Title 11, DOH, Chapter 46 Community Noise Control

The maximum permissible sound levels are expressed using an “A-weighted” decibel scale that filters out very low and very high frequencies in order to replicate human sensitivity. It is common to add the letter “A” to the unit of measurement (dBA) in order to identify that the measurement has been made with this filtering process. Human hearing ranges from approximately 20 dBA (the threshold of hearing) to between 130 and 140 dBA (the threshold of pain).

DOH limits for impulsive sounds, such as from sheet pile driving, that exceed 120 impulses in any 20 minute period are 10 decibels above the limits for non-impulsive sounds in Table 3-7. If impulsive sounds do not exceed 120 impulses in any 20 minute time period, there are no regulatory limits on their sound levels under the department regulations.

The United States Department of Housing and Urban Development uses the day-night average sound level (or DNL) descriptor in evaluating acceptable noise levels at noise sensitive locations. The DNL descriptor incorporates a 24-hour average of daytime and nighttime noise levels, with the nighttime noise levels increased by 10 decibels prior to computing the 24-hour average. The department considers a noise level of 65 DNL to be acceptable for noise sensitive uses.

DOH regulates noise from construction activities through the issuance of permits for allowing excessive noise during limited time periods. The limited time periods normally permitted are the daytime hours on weekdays and Saturdays, with noisy construction activities not permitted on Sundays and holidays. Where construction work is required during the evening or nighttime hours, or on Sundays or holidays, the granting of a noise variance is possible from the department whenever the broader public interests are served by the variance.

There are currently many sources of noise in the project area associated with vehicular traffic, industrial facilities, and residential activities. Existing background noise levels are typically controlled by traffic noise at those receptor locations located near major roadways, and by the sounds of natural and human activities, distant and local traffic, and aircraft at those receptor locations not located near major roadways. Traffic noise levels tend to be highest during the daytime hours, increasing rapidly during the morning commuting period, remaining relatively constant during the daytime hours, increasing slightly during the afternoon commuting period, and decreasing during the evening and nighttime period to its lowest level at 3:30 to 4:30 am. Therefore, background noise levels during the daytime tend to be higher, with intermittent excursions to the 80 or 90 dBA level during intermittent noise events. Background noise levels during the nighttime tend to be lower and drop to levels below 40 dBA during the quietest periods at the quietest locations.

3.8.2 Construction Impacts and Mitigation Measures

Regardless of the options selected, construction activity is expected to generate the most significant source of potential noise impacts associated with the Proposed Action. Construction activities would be carried out in accordance with HRS Chapter 342F, Noise Pollution, HAR Title 11, Chapter 46, Community Noise Control and all federal, state, and CCH laws and regulations.

Regardless of the options selected, construction noise likely would be audible at the sensitive receptors closest to the construction activities. Construction noise levels may intermittently exceed existing daytime background noise levels by 10 to 45 dBA without sheet pile driving, and potentially by as much as 60 dBA with sheet pile driving. In the few locations where force mains or trunk sewers would be constructed through the conventional open trench method within 20 feet of noise sensitive receptors, extremely high construction noise levels could result. However, at the sensitive receptors closest to the work areas, typical levels of construction noise inside naturally ventilated and air conditioned structures are approximately 10 and 20 dBA less, respectively, than the expected exterior noise levels.

Regardless of the East Interceptor option, potential noise impacts during construction would occur along the alignments of force mains and truck sewers constructed through the conventional open trench method, as well as in the vicinity of new WWPSs. Construction using the conventional open trench method would be more extensive for the No-Tunnel option than for the Hybrid option, increasing the extent of potential adverse noise impacts. Under the Hybrid option, potential noise impacts from construction of the Pearl City-Waipahu trunk sewer would occur in the vicinity of the launch shaft and tunnel boring machine retrieval shaft if a bored tunnel is constructed, or in the vicinity of the estimated fifteen (15) shafts if a microtunnel is constructed. For the Waiawa Area conveyance options, which would employ a combination of conventional open trench method and microtunneling, potential noise impacts accordingly would occur along the sections of gravity sewer constructed through the conventional open trench method and near shafts where microtunneling is used.

The potential impacts of Proposed Action construction would vary substantially depending on the combination of East Interceptor option and Waiawa Area option constructed.

It is expected that construction noise impacts would be minimized by compliance with all DOH construction noise permit and variance requirements throughout construction. Mitigation of construction noise impacts is administered by the department through the issuance of construction noise permits and through a curfew system that limits noisy construction activities to normal work hours weekdays and Saturdays. For construction work that could generate very high noise levels at the closest sensitive receptors, such as sheet pile driving, DOH may include additional curfew restrictions on early morning and late afternoon work hours to further minimize risks of adverse construction noise impacts.

Mitigation of construction noise to inaudible levels would not be practical in all cases due to the intensity of construction noise and relatively short setback distances to the closest sensitive receptors. However, the following mitigation measures may be specified in the project construction documents and employed to minimize adverse noise impacts during construction:

- Specifying sound attenuation treatments for all steady, continuous noise sources that operate during the normally permitted daytime hours so that their noise levels do not exceed an 8-hour average value of 69 dBA at the closest sensitive receptor.
- Specifying sound attenuation treatments for fixed machinery that operate continuously 24-hours per day to reduce their maximum noise levels at the boundaries that adjoin or face sensitive receptors to the nighttime limits of 45 or 50 dBA.
- Requiring use of broadband backup alarms for all mobile equipment and vehicles that operate on construction sites in place of the more commonly used high-frequency beeper backup alarms.

- Considering use of HECO electrical service drops at tunnel shafts in place of portable generators and engine driven equipment if prolonged periods of work are required during the non-permitted (or noise variance) hours.
- Maximizing the separation distances between sensitive receptors and the heavy truck routes to and from the construction sites that are used for materials delivery or spoils removal.
- Disclosing in advance and coordinating with affecting parties in scheduling work in locations with very small buffer distances between the work areas and noise sensitive receptors.

3.8.3 Operational Impacts and Mitigation Measures

The adverse noise impacts resulting from the Proposed Action may include increased stationary noise resulting from equipment at the new and rehabilitated facilities. However, it is expected that noise impacts from operation of pump stations and other conveyance facilities would be minimized by compliance with DOH property line noise limits for fixed machinery. These limits are applicable to any existing facility and any new facility following construction. Compliance with the department noise limits at or beyond the facility property lines would be a design goal during design of all new and rehabilitated facilities and would mitigate potential adverse noise impacts.

3.9 TRANSPORTATION

3.9.1 Existing Setting

Several roadways, pedestrian and bike facilities, and public transit facilities are near, and could potentially be affected by, the East Interceptor conveyance options. Most of these facilities are in the Kamehameha Highway corridor between Salt Lake Boulevard and the H1 Freeway overpass in Waimalu. Other roadways that could be affected include Lehua Avenue, Waipi’o Point Access Road, and Waipahū Depot Street. Pedestrian facilities along Kamehameha Highway could also be affected. The Pearl Harbor Bike Path is a major multi-use path that would be affected. Existing public transit routes that utilize Kamehameha Highway and their associated bus stops could also be affected during construction of projects.

Existing roadways potentially affected by the Waiawa Area conveyance options include Kamehameha Highway, Lehua Avenue, and Waihona Street. Pedestrian facilities along Kamehameha Highway and the Pearl Harbor Bike Path could also be affected. Existing public transit routes that utilize Kamehameha Highway and their associated bus stops could also be affected during construction of projects. City bus Route 73 could be affected by the Waiawa Area conveyance options that utilize Lehua Avenue.

The transportation impact assessment report (TIAR) prepared for the Proposed Action and provided in Appendix E documents these roadways and facilities. A summary of potential construction and operational impacts and mitigation measures are provided below. Additional detail is included in Appendix E.

3.9.2 Construction Impacts and Mitigation Measures

Construction of the proposed East Interceptor and Waiawa Area conveyance options has the potential to temporarily impact the various transportation modes in the project area. Identifying these temporary impacts helps to organize and sequence the proposed improvements in a manner that minimizes their disruption during construction.

Tables 3-8 and 3-9 summarize the construction impacts and mitigation measures for the proposed East Interceptor conveyance options and Waiawa Area conveyance options, respectively.

3.9.3 Operational Impacts and Mitigation Measures

Implementation and operation of Proposed Action would have minimal operational transportation impacts regardless of the option. Once the sewer mains/tunnels and WWPSs are constructed, there would be only minor interaction between them and multimodal transportation. Most of the facilities are underground, and emergency repair and maintenance work that may impact transportation conditions are expected to be infrequent events. Therefore, no operational mitigation measures would be required.

3.10 VISUAL AND AESTHETIC RESOURCES

3.10.1 Existing Setting

Visual and aesthetic resources within the project area include view planes of the Ko'olau and Wai'anae Ranges, located to the northeast and northwest of the project area, respectively; the Pearl Harbor East, Middle, and West Lochs, Māmala Bay, and the Pacific Ocean, and various other natural landmarks, preserves, and parks. Scenic resources also include historic and cultural resources, such as Ford Island.

The project area includes a wide range of buildings, neighborhoods, and public utilities, such as high-rise apartments, single family homes, commercial buildings, industrial areas, a university campus, agricultural farmland, military property, multiple WWPSs, Aloha Stadium, and HECO power plant. There is a great deal of planned development in the 'Ewa and Kapolei areas; therefore, additional structures are anticipated in the project area.

Table 3-8. Summary of Transportation Construction Impacts and Mitigation Measures - East Interceptor Conveyance Options

Transportation Analysis Segment	Impact/Mitigation	Roadways	Pedestrian	Bicycle	Transit
East Interceptor - Aloha Stadium to Pearl City Peninsula and Waipi'o Peninsula to 'Ewa	Potential Impacts	<ul style="list-style-type: none"> Lane closures: Kamehameha Hwy, Salt Lake Blvd, Lehua Ave, and Waipahu Depot St Access to adjacent properties Aloha Stadium access and parking 	<ul style="list-style-type: none"> Disruption of Sidewalks and crosswalks along Kamehameha Hwy and Salt Lake Blvd Disruption of Pearl Harbor Bike Path 	<ul style="list-style-type: none"> Disruption of Future bike lanes on Kamehameha Hwy Disruption of Pearl Harbor Bike Path 	<ul style="list-style-type: none"> Delay to City bus routes on Kamehameha Hwy Potential bus stop and HART rail station multimodal access issues
	Mitigation Measures	<ul style="list-style-type: none"> Minimize closures during peak AM and PM travel periods Maintain access to properties Robust public information program 	<ul style="list-style-type: none"> Maintain alternative pedestrian paths Temporary alternative paths for pedestrians 	<ul style="list-style-type: none"> Robust public information program Do not close bike lanes and Pearl Harbor Bike Path simultaneously Temporary alternative paths for bikes 	<ul style="list-style-type: none"> High level coordination with appropriate transit agencies Maintain multimodal access to rail station
East Interceptor - Pearl City Peninsula to Waipi'o Peninsula, No-Tunnel Option	Potential Impacts	<ul style="list-style-type: none"> Waipi'o Point Access Rd crossing 	<ul style="list-style-type: none"> Waipi'o Point Access Rd crossing Disruption of Pearl Harbor Bike Path 	<ul style="list-style-type: none"> Waipi'o Point Access Rd crossing Disruption of Pearl Harbor Bike Path 	<ul style="list-style-type: none"> City bus routes not impacted
	Mitigation Measures	<ul style="list-style-type: none"> Minimize closures during peak travel periods Robust public information program 	<ul style="list-style-type: none"> Minimize closures during peak travel periods Temporary alternative paths for pedestrians 	<ul style="list-style-type: none"> Minimize closures during peak travel periods Temporary alternative paths for bikes 	<ul style="list-style-type: none"> NA
East Interceptor - Pearl City Peninsula to Waipi'o Peninsula - Hybrid Option (Microtunnel)	Potential Impacts	<ul style="list-style-type: none"> Potential Waipi'o Point Access Rd crossing depending on construction method 	<ul style="list-style-type: none"> Potential Waipi'o Point Access Rd crossing depending on construction method Disruption of Pearl Harbor Bike Path 	<ul style="list-style-type: none"> Potential Waipi'o Point Access Rd crossing depending on construction method Disruption of Pearl Harbor Bike Path 	<ul style="list-style-type: none"> City bus routes not impacted

Transportation Analysis Segment	Impact/Mitigation	Roadways	Pedestrian	Bicycle	Transit
	Mitigation Measures	<ul style="list-style-type: none"> Select least disruptive construction method if feasible Minimize closures during peak travel periods Robust public information program 	<ul style="list-style-type: none"> Select least disruptive construction method if feasible Minimize closures during peak travel periods Temporary alternative paths for pedestrians 	<ul style="list-style-type: none"> Select least disruptive construction method if feasible Minimize closures during peak travel periods Temporary alternative paths for bikes 	<ul style="list-style-type: none"> NA
East Interceptor - Pearl City Peninsula to Waipi’o Peninsula - Hybrid Option (Deep Tunnel)	Potential Impacts	<ul style="list-style-type: none"> Roadways not impacted by this option 	<ul style="list-style-type: none"> Pearl Harbor Bike Path partially impacted by tunnel boring pits 	<ul style="list-style-type: none"> Pearl Harbor Bike Path partially impacted by tunnel boring pits 	<ul style="list-style-type: none"> City bus routes not impacted
	Mitigation Measures	<ul style="list-style-type: none"> NA 	<ul style="list-style-type: none"> Temporary alternative paths for pedestrians 	<ul style="list-style-type: none"> Temporary alternative paths for bikes 	<ul style="list-style-type: none"> NA

Notes:

- East Interceptor: Aloha Stadium to Pearl City WWPS and Pearl City WWPS to Waipahū WWPS No-Tunnel option would be likely be installed via open trench construction.

- East Interceptor: Hybrid option GST would use either microtunneling or deep tunnel methods.

WWPS = wastewater pump station, GST = gravity sewer tunnel

NA = not applicable

Table 3-9. Summary of Transportation Construction Impacts and Mitigation Measures - Waiawa Area Conveyance Options

Proposed Option	Impact/Mitigation	Roadway	Pedestrian	Bicycle	Transit
Waiawa Area - Corridor A	Potential Impacts	<ul style="list-style-type: none"> Traffic congestion on Kamehameha Hwy, Lehua Ave, and Waihona St due to potential lane closures 	<ul style="list-style-type: none"> Sidewalks and crosswalks along Kamehameha Hwy, Lehua Ave, and Waihona St. Pearl Harbor Bike Path at connection to East Interceptor 	<ul style="list-style-type: none"> Future Kamehameha Hwy Bike Lanes Pearl Harbor Bike Path at connection to East Interceptor 	<ul style="list-style-type: none"> Delay to City bus routes on Kamehameha Hwy Waimano Home Rd to Waihona St and to City Bus Route 73 on Lehua Ave Disruption of multimodal access to Waiawa Rail Station
	Mitigation Measures	<ul style="list-style-type: none"> Minimize closures during peak travel periods Robust public information program 	<ul style="list-style-type: none"> Maintain alternative pedestrian paths Provide temporary alternative path around construction 	<ul style="list-style-type: none"> Robust public information program Maintain alternative path for bikes Provide temporary alternative path around construction 	<ul style="list-style-type: none"> High level coordination with appropriate transit agencies Maintain multimodal access to the Waiawa rail station
Waiawa Area - Corridor D	Potential Impacts	<ul style="list-style-type: none"> Traffic congestion on Kamehameha Hwy and Waihona St due to potential lane closures 	<ul style="list-style-type: none"> Sidewalks/ crosswalks: Kamehameha Hwy, Waihona St Pearl Harbor Bike Path at connection to East Interceptor 	<ul style="list-style-type: none"> Pearl Harbor Bike Path-connection to East Interceptor 	<ul style="list-style-type: none"> Delays to City bus routes on Kamehameha Hwy: Pearl Highlands Center to Waihona St Disruption of multimodal access to Waiawa Rail Station
	Mitigation Measures	<ul style="list-style-type: none"> Minimize closures during peak travel periods Robust public information program 	<ul style="list-style-type: none"> Maintain alternative pedestrian paths Provide temporary alternative path around construction 	<ul style="list-style-type: none"> Provide temporary alternative path around construction 	<ul style="list-style-type: none"> High level coordination with appropriate transit agencies Maintain multimodal access to the Waiawa rail station

Proposed Option	Impact/ Mitigation	Roadway	Pedestrian	Bicycle	Transit
Waiawa Area - Corridor G	<ul style="list-style-type: none"> Potential Impacts 	<ul style="list-style-type: none"> Traffic congestion on Waihona Street due to tunnel pit 	<ul style="list-style-type: none"> Pearl Harbor Bike Path at connection to East Interceptor. 	<ul style="list-style-type: none"> Pearl Harbor Bike Path at connection to East Interceptor 	<ul style="list-style-type: none"> Potential Deep tunnel impacts to Waiawa Rail Station and ROC
	Mitigation Measures	<ul style="list-style-type: none"> Minimize closures during peak travel periods Robust public information program 	<ul style="list-style-type: none"> Provide temporary alternative path around construction 	<ul style="list-style-type: none"> Provide temporary alternative path around construction 	<ul style="list-style-type: none"> Studies to confirm feasibility of deep tunnel below Waiawa Rail Station and ROC

Notes: - Waiawa Area Corridors A and D would be constructed using a combination of open trenches and microtunneling.
 - Waiawa Area Corridor G would be implemented using deep tunnel construction and would only be implemented with the East Interceptor Hybrid option deep tunnel.
 ROC = Rail Operations Center
 NA = not applicable

3.10.2 Construction Impacts and Mitigation Measures

Construction of the proposed conveyance system improvements may have some short-term impact on the visual aesthetics in the area. Regardless of the options selected, construction activities would be visible. Any construction impacts regarding visual aesthetics are expected to be short-term and would cease after construction. The following mitigation measures may be employed to minimize any impacts on visual and aesthetic resources during construction:

- During construction, fencing surrounding construction sites would be provided as needed to provide a visual screen of the project site and materials.
- Construction would be scheduled and phased to minimize the duration of construction.
- If nighttime lighting is required, lights would be shielded to minimize glare and impact on areas outside of the construction zone.

Projects Common to Both East Interceptor Conveyance Options

The following temporary and minimal impacts may result from construction activities associated with projects that are common to both East Interceptor conveyance options.

- Waipahu WWPS FMs Rehabilitation and construction of the Waipahu WWPS FM (New) would likely have a temporary impact on the visual and aesthetic resources along the Pearl Harbor Bike Path and from the bike path south to the West Loch. During construction, there would be limited and temporary impacts to views of the mountain ranges.
- Construction of the Pearl City Trunk Sewers may result in limited and temporary impacts to views of the East Loch and Pearl Harbor National Wildlife Refuge.
- The proposed Waimalu FM (New) is located in developed areas. Scenic qualities at the adjacent Neal S. Blaisdell Park may be temporarily impacted during construction. Similarly, views south from the Kamehameha Highway may be temporarily impacted during construction. To the east, the proposed influent trunk sewer runs adjacent to Kamehameha Highway to Aloha Stadium. During construction, temporary and limited impacts to visual resources such as East Loch may occur. From the highway, views of the Ko'olau and Wai'anae Ranges are limited and already obscured by existing development on either side of the highway.
- Construction of the proposed Hālawā WWPS FM (New) may result in temporary impairments to the view of Each Loch.
- The proposed location of a new Hālawā WWPS is at the south end of a large stadium parking lot and surrounded by development. Therefore, construction is likely to have very limited impact on the aesthetic quality of the area.

East Interceptor Conveyance Options

No-Tunnel Option

No-Tunnel option projects include rehabilitation of the Waipahu WWPS, construction of new and rehabilitation of existing Pearl City FMs, and construction or rehabilitation of the Pearl City WWPS. The following impacts may occur:

- Rehabilitation of the Waipahu WWPS includes installation of new pumps and motors in the existing station.
- Rehabilitation and installation of new Pearl City WWPS FMs may result in temporary impacts to views of resources such as Pearl Harbor Middle Loch and Pearl Harbor National Wildlife Refuge from the Pearl Harbor Bike Path.
- During construction or rehabilitation of the Pearl City WWPS, the aesthetic quality of Lehua Community Park may be impacted, particularly if the Alternative Pearl City WWPS No. 2 location is selected. Construction of a new WWPS at any of the alternative locations and rehabilitation of the existing facility would be visible from the Pearl Harbor Bike Path. Additional impacts to the scenic resources include obstruction of views of adjacent agricultural and forested land.

Hybrid Option

The Hybrid option may result in the following impacts:

- Construction of the Pearl City-Waipahu trunk sewer would involve tunneling rather than laying pipes using open trench methods. As a result, construction impacts would be limited to locations where pipes enter and exit the tunnel.
- Construction of Waipahu WWPS No. 2 would result in temporary impacts such as stockpiling materials and construction equipment.
- Demolition of the Pearl City WWPS would have temporary impacts, including visibility of materials, debris, and equipment, on the viewshed while the structure is removed.

Waiawa Area Conveyance Options

While materials and construction equipment would be visible while the project is developed, it is not anticipated that construction of either corridor would have significant impacts on visual resources. The duration of construction of the Waiawa Area conveyance options is not yet known but anticipated to be completed within a five year timeframe.

- Corridor A traverses a combination of neighborhoods, commercial development, and highway.
- Corridor D follows the existing collection system adjacent to Leeward Community College and through commercial areas.
- Corridor G is proposed to be constructed by either microtunneling or deep tunneling. The construction of microtunnel shafts for Corridor G are proposed in

non-traveled areas to the west of Leeward Community College and, thus, Corridor G may have less impact on visual resources than A and D.

3.10.3 Operational Impacts and Mitigation Measures

Regardless of the options selected, new above-grade facilities would be constructed, including the Waimalu and Hālawā WWPSs. The area around the new facilities is likely to be landscaped, and the structures themselves are not expected to substantially affect scenic vistas and view planes in the area. New and rehabilitated force mains and trunk sewers are subsurface and therefore would not impact the visual and aesthetic resources.

Anticipated indirect impacts to visual aesthetics are associated with increased capacity in the collection system to allow future developments (residential, commercial, and industrial) in the sewer basin to connect to the existing wastewater system. These future developments are expected to result in a more urbanized look in the area of the East Interceptor system.

Projects Common to Both East Interceptor Conveyance Options

The existing Waimalu WWPS is located to the east of Neal S. Blaisdell Park. The proposed alternative location is setback farther from Kamehameha Highway in an undeveloped area on the edge of the park. In the existing streetside location, the WWPS creates a transition from park to an urban environment. The proposed alternative location may have a greater impact on the visual and aesthetic quality for park users. However, the structure is relatively small and, provided it is appropriately landscaped, should have a minimal impact on the overall viewshed of the area.

The proposed location for a new Hālawā WWPS is located in a developed urban area on the edge of a parking lot. However, significant development is proposed in this area as part of the Halawa Area Transit-Oriented Development (TOD) Plan. The impact of the WWPS on visual and aesthetic resources can be minimized through landscaping and architectural detail that complements existing and future development.

East Interceptor Conveyance Options

No-Tunnel Option

The No-Tunnel options include the following above-grade projects:

- Rehabilitation/upgrade of the existing Waipahu WWPS.
- Reconstruction/replacement of the Pearl City WWPS. Three (3) alternative Pearl City WWPS locations are identified.

Rehabilitation of the existing Waipahu WWPS is anticipated to result in an overall improvement to the aesthetic quality of the structure and landscaping. It is not expected to result in new, negative impacts on aesthetic and visual resources.

Similarly, rehabilitation of the existing Pearl City WWPS would improve the aesthetics in the vicinity of the project. If instead a new structure is built, impacts to the view plane may occur due to the presence of a new structure. In particular, the Alternative Pearl City WWPS No. 2 location, which is proposed in Lehua Park, would impact the scenic qualities of the park.

Hybrid Option

Under the Hybrid option, the Pearl City WWPS would be demolished, which would benefit the visual aesthetics. The GST of the hybrid option would be underground, therefore it is not anticipated to have a visual impact after construction. Also, under the Hybrid option, a new Waipahu WWPS would be required, resulting in a new structure. The proposed location of Waipahu WWPS No. 2 is in an area of existing development. It is not anticipated to have a significant impact on the aesthetics in the project vicinity.

Waiawa Area Conveyance Options

The Waiawa Industrial Park WWPS and possibly the Pacific Palisades WWPS would be removed as part of the Waiawa area conveyance improvements, therefore improving the visual resources in the project vicinity.

3.11 SOCIOECONOMICS

The socioeconomic region of influence (ROI) is the geographic area that would be most affected by the proposed upgrading and/or expanding of the existing East Interceptor System of the Honouliuli sewer basin. The ROI is selected as the basis on which social and economic impacts of the Proposed Action are analyzed, as it encompasses the expected residency distribution of ENV and contractor employees who would be involved directly in Proposed Action construction and operation, and persons residing or working within the sewer basin, as well as their commuting patterns, and the location of businesses providing goods and services to those residents and workers.

The ROI for the socioeconomic environment comprises the following O’ahu planning regions, or development plan areas (DPAs), and census county divisions (CCDs), which are subdivisions of Honolulu County recognized by the United States Census Bureau (USCB):

DPAs	CCDs
• ‘Ewa	• ‘Ewa
• Central O’ahu	• Wahiawā
• Primary Urban Area	• Honolulu
• East Honolulu	

The ROI, depicted in Figure 3-16, encompasses a land area of approximately 294 square miles, representing about 48.9 percent of the County land area (USCB 2019a). The figure shows both the boundaries of the DPAs and those of the

CCDs, as well as the overall extent of the ROI. Throughout this section, socioeconomic data for the ROI are presented by DPAs or CCDs interchangeably, depending on the data source. Data for Honolulu County are provided as needed in lieu of data available for the DPAs and CCDs and for context and comparison, and data for the State of Hawai'i are provided as relevant for context and general comparison.

3.11.1 Demographics and Economics

3.11.1.1 POPULATION AND HOUSING

USCB conducts a census of the United States every 10 years, in years ending in zero, to count the population and housing units for the entire United States. The most recent decennial census was conducted in 2010. Table 3-10 presents population statistics for the ROI. Population data were derived based on the 2000 Census and the 2010 Census.


The East Interceptor System is located in a relatively densely-populated and robust region. In 2010, ROI population density was about 2,570 persons per square mile; substantially higher than the approximately 1,590 persons per square mile population density of Honolulu County and the 210 persons per square mile density of the State of Hawai'i (USCB 2019a). In addition to the land areas presented in Table 3-10, 'Ewa CCD encompasses a water area of approximately 77 square miles, Wahiawā CCD encompasses a water area of approximately 0.5 square miles, and Honolulu CCD encompasses a water area of approximately 1,127 square miles (USCB 2019a).

Population growth from 2000 to 2010 was slower in Honolulu County than the statewide average, as it has been for several decades (SMS Research & Marketing Services, Inc. 2016). The population within the ROI increased approximately 11 percent from 2000 to 2010; similar to the 12 percent increase in population of the State of Hawai'i during that time period. 'Ewa CCD was the fastest growing area among the geographic areas of comparison, growing approximately 19 percent between 2000 and 2010.

**City and County
of Honolulu**

**HONOULIULI/
WAIPAHU/ PEARL CITY
WASTEWATER
FACILITIES PLAN**


Legend

 Development Plan Areas

Census County Divisions

 'Ewa

 Honolulu

 Wahiawa

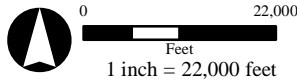


FIGURE 3-16

**SOCIOECONOMIC
REGION OF
INFLUENCE**

AECOM

1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813

Table 3-10. Population, 2000 and 2010, and Population Density, 2010

Geographic Area	Land Are (square miles)	Population			2010 Density (persons per square mile) ¹
		2000	2010	Percent Change 2000-2010 ¹	
‘Ewa CCD	164.7	272,328	323,118	18.6	1,962
Wahiawā CCD	39.9	38,370	41,216	7.4	1,032
Honolulu CCD	88.92	372,279	390,738	5.0	4,394
ROI ¹	293.5	682,977	755,072	10.6	2,572
Honolulu County	600.6	876,156	953,207	8.8	1,587
Hawai‘i	6,422.2	1,211,537	1,360,301	12.3	212

Sources: USCB 2019a; USCB 2019b, DP-1, Profile of General Demographic Characteristics, 2000 Census, and DP-1, Profile of General Population and Demographic Characteristics, 2010 Census.

¹Values were calculated based on USCB estimates.

More recent USCB population data are shown in Table 3-11, presented across three (3) age categories: children under 18 years, adults 18 to 64 years, and adults 65 years and over. Analysis of the data reveals that the proportions of the total population represented by adults 18 to 64 years are similar in the ROI, Honolulu County, and the state, approximately 62.3 percent, 62.1 percent, and 61.6 percent, respectively; as well as across the ROI, ranging from 61.8 percent in ‘Ewa CCD to 62.7 percent in both Wahiawā CCD and Honolulu CCD. However, the population in Wahiawā CCD is substantially younger than the populations in the other geographic areas, having both a larger proportion of its total population in the under 18 years category and a smaller proportion in the 65 years and over category. Approximately 28.6 percent of the population in Wahiawā are children under 18 years, compared to 20.9 percent in the ROI overall; and only about 8.7 percent of the Wahiawā population are adults 65 years and over, compared to 16.8 percent in the ROI overall.

Table 3-11. Population and Age, 2013-2017

Geographic Area	Total Population	Under 18 Years	18 to 64 Years¹	65 Years and Over
‘Ewa CCD	344,153	81,699	212,787	49,667
Wahiawā CCD	45,685	13,062	28,627	3,996
Honolulu CCD	402,452	71,092	252,252	79,108
ROI¹	792,290	165,853	493,666	132,771
Honolulu County	990,060	212,210	615,270	162,580
Hawai‘i	1,421,658	307,583	875,949	238,126

Source: USCB 2019b, S0101, Age and Sex, 2013-2017 American Community Survey 5-Year Estimates.

¹Values were calculated based on USCB estimates.

Table 3-12 provides population projections for Honolulu County and the State of Hawai‘i prepared by the Department of Business, Economic Development and Tourism (DBEDT) (DBEDT 2018). Based on DBEDT population projections, the resident population of Honolulu County will be about 1,062,100 in 2035, an approximately 7.0 percent cumulative increase over the 19 years from 2016 or about 0.4 percent annually. For the State of Hawai‘i, DBEDT estimates an approximately 11.5 percent cumulative increase between 2016 and 2035, or about a 0.6 percent annual increase. This rate of increase for the state is higher than the anticipated increase in Honolulu County.

Table 3-12. Population Projections, 2016-2035

Geographic Area	2016¹	2025²	2035²	2045²
<i>Resident Population</i>				
Honolulu County	992,605	1,032,700	1,062,100	1,073,800
Hawai‘i	1,428,557	1,514,700	1,592,700	1,648,600
<i>De Facto Population</i>				
Honolulu County	1,048,965	1,094,000	1,125,900	1,139,400
Hawai‘i	1,583,139	1,695,200	1,792,100	1,866,500

Source: DBEDT 2018.

¹July 2016 estimates by USCB.

²DBEDT projections.

Due to the important role of tourism in Hawai‘i, DBEDT also reports the de facto population, which counts those who are physically present in a given geographic area at a given time. The de facto population is calculated by adding to the resident population visitors who stayed in the geographic area and subtracting residents who were temporarily away from home in a typical day of the year (DBEDT 2018). As shown in Table 3-12, the de facto populations for both Honolulu County and the state are higher than the resident populations. As tourism is projected to grow faster than the rate of resident population growth, the de facto population is projected to grow slightly faster than the resident populations in both Honolulu County and the State of Hawai‘i, at cumulative rates of 7.3 percent and 13.2 percent, respectively.

The City and County of Honolulu Department of Planning and Permitting (DPP) prepares socioeconomic projections, including resident population projections, for the DPAs in O‘ahu (DPP 2009). Table 3-13 presents the resident population projections to 2035¹ for the DPAs in the ROI. Based on DPP projections, the resident population of the ROI will be about 842,500 in 2035, an approximately 12.7 percent cumulative increase over the 20 years from 2015 or about 0.6 percent annually. This rate of increase for the ROI is higher than the anticipated total increase for O‘ahu, where the resident population is projected to increase approximately 10.2 percent cumulatively or about 0.5 percent annually between 2015 and 2035.

Table 3-13. Resident Population Projections, 2010-2035

Geographic Area	2000	2008	2015¹	2025¹	2035¹
‘Ewa DPA	68,696	90,872	107,234	137,721	164,556
Central O‘ahu DPA	148,208	158,606	161,999	171,595	181,423
Primary Urban Center DPA	419,333	416,049	427,429	437,818	447,715
East Honolulu DPA	46,735	49,063	51,119	50,400	48,843
ROI	682,972	714,591	747,781	797,534	842,537
O‘ahu Total	876,156	904,292	941,847	994,632	1,038,317

Source: DPP 2009, Socioeconomic Projections, 2000 to 2035. September 2009.

¹DPP projections.

²Values were calculated based on DPP estimates and projections.

Based on the CB American Community Survey five-year estimates for 2013-2017, the number of housing units in the ROI totaled about 285,100, as shown in Table 3-14. In recent years, housing demand in Hawai‘i has increased due to population growth, the conversion of homes to visitor use due a limited supply of hotel rooms (especially on O‘ahu), and the shifting of military forces to Hawai‘i (DBEDT 2014). Approximately 5.3 percent of the housing units in the ‘Ewa CCD, 7.2 percent of the units in the

¹ According to the DPP’s Research and Statistical Information webpage (<http://www.honoluludpp.org/Planning/ResearchStatistics.aspx>), the department is preparing revised projections based on the state projections; however, DPP has not yet released the updated projections.

Wahiawā CCD, and 13.5 percent of the units in the Honolulu CCD were vacant. The comparable vacancy rate for Hawai‘i was substantially higher, at 15.0 percent.

Table 3-14. Housing Units, 2013-2017

Geographic Area	Total Housing Units	Occupied Housing Units	Vacant Housing Units	Percent Vacant¹
‘Ewa CCD	102,725	97,277	5,448	5.3
Wahiawā CCD	12,949	12,018	931	7.2
Honolulu CCD	169,422	146,553	22,869	13.5
ROI ¹	285,096	255,848	29,248	10.3
Honolulu County	346,374	311,451	34,923	10.1
Hawai‘i	535,543	455,502	80,041	15.0

Source: USCB 2019b, DP04, Selected Housing Characteristics, 2013-2017 American Community Survey 5-Year Estimates.

¹Values were calculated based on USCB estimates.

As shown in Table 3-15, a large proportion of vacant housing units in Hawai‘i and the ROI are unavailable to the resident housing market, representing approximately 65.8 percent and 66.3 percent of the respective vacant housing units. Units that are held for seasonal, recreational, or occasional use are the largest component of the state’s unavailable housing units, comprising approximately 44.1 percent of vacant housing units and 67.1 percent of unavailable housing units in the state. In the ROI, approximately 47.8 percent of the unavailable housing units in ‘Ewa CCD and 63.2 percent of the unavailable units in Honolulu CCD are vacant for seasonal, recreational, or occasional use. Only approximately 8.1 percent of the unavailable housing units in Wahiawā CCD are vacant for this reason.

Table 3-15. Vacant Housing Units, 2013-2017

Geographic Area	Vacant Housing Units	Vacant and Available^{1,2}	Not Available¹	For Seasonal, Recreational, or Occasional Use	Not Available Percent Seasonal¹
‘Ewa CCD	5,448	2,411	3,037	1,452	47.8
Wahiawā CCD	931	152	779	63	8.1
Honolulu CCD	22,869	7,304	15,565	9,844	63.2
ROI¹	29,248	9,867	19,381	11,359	58.6
Honolulu County	34,923	11,214	23,709	14,358	60.6
Hawai‘i	80,041	27,362	52,679	35,324	67.1

Source: USCB 2019b, B25004, Vacancy Status, 2013-2017 American Community Survey 5-Year Estimates.

¹Values were calculated based on USCB estimates.

²Vacant and available housing units comprise units that are for rent, rented but not occupied, for sale only, and sold but not occupied.

3.11.1.2 EMPLOYMENT AND INCOME

Based on estimates by the United States Bureau of Economic Analysis (USBEA), total employment in Honolulu County was approximately 613,460 jobs in 2012 and 659,070 jobs five (5) years later, in 2017, as shown in Table 3-16. The number of nonfarm jobs increased by approximately 45,400, or about 7.4 percent, between 2012 and 2017. The industries that provided the most jobs in the County in 2017 were accommodations and food services (10.6 percent), state and local government (10.5 percent), health care and social assistance (9.4 percent), retail trade (9.2 percent), and the military (7.9 percent). Construction provided approximately 33,220 jobs, contributing about 5.0 percent of total employment in Honolulu County.

Table 3-17 presents estimates of civilian jobs by sector in Honolulu County in 2016 based on USBEA data, and DBEDT civilian job projections through 2045. Between 2016 and 2045, overall employment is projected to expand by approximately 113,690 jobs, an approximately 18.8 percent cumulative increase or about 0.6 percent annually. Employment in Honolulu County is projected to grow most rapidly in health services, business services, utilities, educational services, and professional services, with estimated cumulative expansions over 29 years of about 38.4, 32.6, 30.4, 29.6, and 28.7 percent, respectively.

Table 3-16. Honolulu County Civilian Employment by Industry, 2012-2017

Industry	2012	2017	Change ¹	
			Number	Percent
Farm employment	2,582	2,793	211	8.2
Nonfarm employment	610,882	656,277	45,395	7.4
Private nonfarm employment	457,684	504,365	46,681	10.2
Forestry, fishing, and related activities	1,020	1,050	30	2.9
Mining, quarrying, and oil and gas extraction	675	642	-33	-4.9
Utilities	2,533	3,421	888	35.1
Construction	27,734	33,225	5,491	19.8
Manufacturing	12,975	14,242	1,267	9.8
Wholesale trade	16,587	16,448	-139	-0.8
Retail trade	59,184	60,589	1,405	2.4
Transportation and warehousing	21,488	28,068	6,580	30.6
Information	8,238	8,905	667	8.1
Finance and insurance	23,785	25,231	1,446	6.1
Real estate and rental and leasing	24,697	28,506	3,809	15.4
Professional, scientific, and technical services	34,365	35,687	1,322	3.8
Management of companies and enterprises	7,071	8,669	1,598	22.6
Administrative and support and waste management and remediation services	41,461	43,442	1,981	4.8
Educational services	15,832	16,071	239	1.5
Health care and social assistance	56,232	61,926	5,694	10.1
Arts, entertainment, and recreation	12,559	13,924	1,365	10.9
Accommodation and food services	59,747	69,666	9,919	16.6
Other services (except government and government enterprises)	31,501	34,653	3,152	10.0
Government and government enterprises	153,198	151,912	-1,286	-0.8
Federal civilian	32,074	30,692	-1,382	-4.3
Military	54,361	52,182	-2,179	-4.0
State and local	66,763	69,038	2,275	3.4
State government	54,525	56,565	2,040	3.7
Local government	12,238	12,473	235	1.9

Source: USBEA 2018b, Regional Economic Accounts CAEMP25N.

¹Values were calculated based on USBEA estimates.

Table 3-17. Honolulu County Civilian Jobs by Sector, 2016-2045

Geographic Area	2016	2020	2025	2030	2035	2040	2045
Agriculture	3,710	3,690	3,670	3,680	3,660	3,670	3,670
Mining and construction	34,950	37,180	39,300	41,150	42,030	42,640	43,010
Food processing	5,600	5,610	5,640	5,690	5,730	5,760	5,790
Other manufacturing	8,820	8,830	8,830	8,890	8,890	8,900	8,900
Transportation	25,450	26,400	27,400	28,350	29,180	29,860	30,560
Information	8,730	8,760	8,820	8,970	9,070	9,300	9,520
Utilities	2,960	3,160	3,390	3,560	3,720	3,800	3,860
Wholesale trade	18,480	18,600	18,720	18,910	18,920	18,960	18,960
Retail trade	60,920	61,930	63,260	64,540	65,400	66,430	67,440
Finance and insurance	23,650	24,160	24,800	25,370	25,830	26,190	26,520
Real estate and rentals	27,630	29,000	30,440	31,730	32,900	33,910	34,910
Professional services	36,280	38,160	40,350	42,470	44,150	45,460	46,690
Business services	53,930	57,160	60,950	64,230	67,260	69,430	71,530
Educational services	17,170	18,030	19,060	20,010	20,880	21,580	22,250
Health services	62,030	65,150	69,150	73,320	77,350	81,600	85,880
Arts and entertainment	13,410	13,760	14,150	14,410	14,620	14,720	14,800
Accommodation	18,570	18,730	18,920	19,170	19,380	19,590	19,860
Eating and drinking	48,110	50,110	52,460	54,550	56,410	57,780	59,060
Other services	34,730	35,600	36,690	37,560	38,330	38,980	39,660
Government	99,200	100,800	102,290	103,410	104,330	104,780	105,130
Total Civilian Jobs	604,300	624,800	648,270	669,980	688,030	703,350	717,990

Source: DBEDT 2018, DBEDT 2045 Series Appendix Tables (spreadsheet).

Unemployment rates in Honolulu County decreased over the last five (5) years, as shown in Table 3-18, decreasing by approximately 42 percent from 2014 to 2018. The unemployment rates for the State of Hawai'i also decreased over the 5-year period, although the rates for the state consistently were higher than the rates for Honolulu County. For the County and the state, the unemployment rates plateaued during 2017 and 2018 at lows of approximately 2.3 percent and 2.4 percent, respectively.

Table 3-18. Annual Average Labor Force, 2009-2013

Geographic Area	2014	2015	2016	2017	2018
Honolulu County					
Labor Force	460,906	466,639	470,086	469,395	465,193
Employed	442,173	451,044	457,073	458,568	454,330
Unemployed	18,733	15,595	13,013	10,827	10,863
Unemployment Rate (%)	4.1	3.3	2.8	2.3	2.3
Hawai'i					
Unemployment Rate (%)	4.4	3.6	3.0	2.4	2.4

Source: United States Bureau of Labor Statistics 2019.

Table 3-19 summarizes earnings by industry for Honolulu County for 2012 and 2017. Total earnings in the County, including both farm and nonfarm earnings, were approximately \$34.7 billion in 2012 and \$40.9 billion five (5) years later, in 2017. Nonfarm earnings increased by approximately \$6.2 billion, or about 18.1 percent, between 2012 and 2017. Total personal income in the County increased by approximately 18.9 percent from 2012 to 2017, and per capita personal income increased by 17.4 percent, reaching approximately \$56,730 in 2017 (USBEA 2018a, Regional Economic Accounts CAINC5N).

Government and government enterprises are prominent in the economy of Honolulu County. The two (2) industries that provided the highest earnings in the County in 2017 were state and local government (12.0 percent) and the military (11.2 percent), and federal civilian (8.6 percent) was the fourth ranked industry. Third in rank was health care and social assistance (10.5 percent) and construction (7.8 percent) was fifth, contributing approximately \$3.2 billion in earnings to the economy.

Table 3-19. Honolulu County Civilian Earnings by Industry, 2012-2017

Industry	Earnings (thousands of dollars)		Change ¹	
	2012	2017	Value	Percent
Farm employment	111,358	84,020	-27,338	-24.5
Nonfarm employment	34,584,969	40,844,195	6,259,226	18.1
Private nonfarm employment	22,563,381	27,838,859	5,275,478	23.4
Forestry, fishing, and related activities	20,959	38,858	17,899	85.4
Mining, quarrying, and oil and gas extraction	27,449	26,725	-724	-2.6
Utilities	298,955	375,456	76,501	25.6
Construction	2,307,456	3,191,639	884,183	38.3
Manufacturing	658,476	784,691	126,215	19.2
Wholesale trade	971,431	1,142,431	171,000	17.6
Retail trade	2,001,349	2,185,203	183,854	9.2
Transportation and warehousing	1,331,109	1,868,940	537,831	40.4
Information	569,790	640,964	71,174	12.5
Finance and insurance	1,203,607	1,427,480	223,873	18.6
Real estate and rental and leasing	965,527	1,265,881	300,354	31.1
Professional, scientific, and technical services	2,275,581	2,559,397	283,816	12.5
Management of companies and enterprises	716,465	904,026	187,561	26.2
Administrative and support and waste management and remediation services	1,537,278	1,845,232	307,954	20.0
Educational services	633,480	637,150	3,670	0.6
Health care and social assistance	3,425,786	4,288,876	863,090	25.2
Arts, entertainment, and recreation	261,728	388,423	126,695	48.4
Accommodation and food services	2,050,582	2,710,427	659,845	32.2
Other services (except government and government enterprises)	1,306,373	1,557,060	250,687	19.2
Government and government enterprises	12,021,588	13,005,336	983,748	8.2
Federal civilian	3,231,015	3,501,031	270,016	8.4
Military	4,853,073	4,594,739	-258,334	-5.3
State and local	3,937,500	4,909,566	972,066	24.7
State government	3,027,153	3,748,929	721,776	23.8
Local government	910,347	1,160,637	250,290	27.5

Source: USBEA 2018a, Regional Economic Accounts CAINC5N.

¹Values were calculated based on USBEA estimates.

3.11.1.3 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

The Proposed Action would rehabilitate, upgrade, and/or expand the existing East Interceptor System to accommodate flows through 2050 and would cost an estimated \$784 million to \$888 million to complete, depending on the East Interceptor and Waiawa Area options constructed (AECOM 2016b, 2018). This total construction cost is inclusive of the costs of rehabilitating or upgrading the East Interceptor Conveyance System and the costs of constructing a new Waiawa Area Conveyance System. As detailed in Appendix F, Economic and Fiscal Impacts, the construction expenditures would result in one-time increases in economic output, employment, and earnings, and one-time increases in fiscal revenues of the state. The economic impacts of Proposed Action construction would include the impact of expenditures on construction materials, and on earnings of construction workers and professional service providers during the construction period, as well as the impacts of those changes on the overall economy of the CCH.

The estimated impacts of Proposed Action construction vary substantially depending on the combination of East Interceptor option and Waiawa Area option constructed. For example, there is an approximately \$221 million or 13 percent difference in one-time economic output between the combination with the lowest construction cost and the combination with the highest cost; East Interceptor No-Tunnel option with Waiawa Area Corridor A and East Interceptor Hybrid option with Waiawa Area Corridor G, respectively. However, the variability is due primarily to the difference in cost between the East Interceptor No-Tunnel and Hybrid options, with the Waiawa Area options contributing nominally to the variation, representing only approximately \$20 million or 9 percent of the overall cost variation.

If the East Interceptor No-Tunnel option is constructed along with any of the Waiawa Area options, on a one-time basis, Proposed Action construction would have an estimated total economic impact of approximately \$1.7 billion in output, supporting a total of approximately 9,800 jobs, earnings of \$550 million, and fiscal revenues of \$110 million (Table 3-20). Construction of the East Interceptor Hybrid option would have a higher economic and fiscal impact, with an estimated total economic impact of \$1.9 billion in output, supporting a total of approximately 11,000 jobs, earnings of \$610 million to \$620 million, and fiscal revenues of \$120 million. These estimated increase in jobs, as well as the associated increases in earnings and fiscal revenues, includes the initial increase in the construction sector and additional jobs created due to indirect and induced effects of the initial change.

Table 3-20. One-Time Economic and Fiscal Impacts of Construction

	Output (Million \$)	Earnings (Million \$)	Employment (Jobs)	State Tax (Million \$)
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor A</i>				
Direct/Indirect Impact				
Hard Construction Costs	974	327	5,162	69
Soft Construction Costs	186	82	1,085	15
Total	1,159	409	6,246	83
Induced Impact				
Hard Construction Costs	412	111	2,810	21
Soft Construction Costs	103	27	706	5
Total	515	139	3,515	26
Total Impact				
Hard Construction Costs	1,385	438	7,971	90
Soft Construction Costs	289	110	1,790	20
Total	1,674	548	9,762	110
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor D</i>				
Direct/Indirect Impact				
Hard Construction Costs	977	328	5,182	69
Soft Construction Costs	186	83	1,089	15
Total	1,164	411	6,271	84
Induced Impact				
Hard Construction Costs	413	112	2,821	21
Soft Construction Costs	104	28	708	5
Total	517	139	3,529	26
Total Impact				
Hard Construction Costs	1,391	440	8,003	90
Soft Construction Costs	290	110	1,797	20
Total	1,681	550	9,801	110
<i>East Interceptor Hybrid Option with Waiawa Area Corridor A</i>				
Direct/Indirect Impact				
Hard Construction Costs	1,091	366	5,786	77
Soft Construction Costs	208	92	1,216	16
Total	1,299	458	7,001	93

	Output (Million \$)	Earnings (Million \$)	Employment (Jobs)	State Tax (Million \$)
Induced Impact				
Hard Construction Costs	461	124	3,149	23
Soft Construction Costs	116	31	791	6
Total	577	155	3,940	29
Total Impact				
Hard Construction Costs	1,553	491	8,935	100
Soft Construction Costs	324	123	2,007	22
Total	1,876	614	10,941	123
<i>East Interceptor Hybrid Option with Waiawa Area Corridor D</i>				
Direct/Indirect Impact				
Hard Construction Costs	1,095	367	5,805	77
Soft Construction Costs	209	93	1,220	16
Total	1,304	460	7,025	94
Induced Impact				
Hard Construction Costs	463	125	3,160	24
Soft Construction Costs	116	31	794	6
Total	579	156	3,954	30
Total Impact				
Hard Construction Costs	1,558	492	8,965	101
Soft Construction Costs	325	123	2,014	22
Total	1,883	616	10,979	123
<i>East Interceptor Hybrid Option with Waiawa Area Corridor G</i>				
Direct/Indirect Impact				
Hard Construction Costs	1,102	370	5,845	78
Soft Construction Costs	210	93	1,228	17
Total	1,313	463	7,073	94
Induced Impact				
Hard Construction Costs	466	126	3,182	24
Soft Construction Costs	117	31	799	6
Total	583	157	3,981	30
Total Impact				
Hard Construction Costs	1,569	496	9,027	101
Soft Construction Costs	327	124	2,027	23
Total	1,896	620	11,054	124

Construction expenditures and therefore the resulting effects would vary from year to year. However, for the East Interceptor Hybrid option with Waiawa Area Corridor G, the combination of options with the highest impact, the estimated total economic impact translates to an average annual economic impact of about \$120 million, which would support approximately 690 jobs, earnings of \$40 million, and fiscal revenues of \$7.8 million per year. Providing each job or employee represents one household and assuming the current average household size of 3.06 people in Honolulu County (USCB 2019), direct, indirect, and induced jobs provided by Proposed Action construction would support approximately 2,110 residents on average during construction.

The current ROI construction labor force might not be sufficient to fill the jobs, although the construction industry in Hawai'i is projected to be generally stable, both on the short-term and on the long-term (Table 3-18), with the mining and construction sector expected to contract approximately 0.5 percent between 2016 and 2020 and an additional 0.8 percent between 2020 and 2035 (DBEDT 2012). As shown in Table 3-16, unemployment rates for Honolulu County and for the State of Hawai'i decreased over the last five (5) years to lows of approximately 2.3 percent and 2.4 percent, respectively. Although economic impacts likely would disproportionately benefit Honolulu County residents, impacts would accrue to local, county, and off-island residents to varying degrees, depending on the relative capacities of the ROI, Honolulu, and Hawai'i construction labor forces.

Employment growth is beneficial to an economy, and expansion of the industry base results in economic benefits on the region. Socioeconomic concerns would materialize if expansion occurs in a short time frame or if other aspects of the economy also undergo a rapid expansion during the same time period. Possible labor shortages could occur, resulting in a rise in labor costs and ultimately a rise in overall construction costs. However, the market would respond to a shortage with new workers entering the construction industry from other industries or new workers coming from outside the region to fill available jobs. If new workers were to enter the region in response to a construction labor shortage, the households that relocate to the ROI would need a supply of housing, to which the local economies likely would respond by increasing the supply.

3.11.1.4 OPERATIONAL IMPACTS AND MITIGATION MEASURES

With operation of the Proposed Action, no increase in ENV personnel is anticipated. However, annual expenditures from operations of the Proposed Action would result in ongoing increases in economic output, employment, and earnings, and ongoing increases in fiscal revenues. Projected operations costs were used to estimate economic and fiscal impacts during the operation of the improved East Interceptor System (Appendix F). The annual operating expenditures for the conveyance system improvements are estimated to range between approximately \$1.4 million and \$1.6 million, depending on the East Interceptor and Waiawa Area options constructed (AECOM 2016a).

If the East Interceptor No-Tunnel option is constructed along with any of the Waiawa Area options, on an ongoing basis, pump station, force main, and trunk sewer operation related to improving the East Interceptor System would result in an estimated annual impact of \$2.4 million in output, supporting an estimated seven (7) jobs, earnings of \$0.3 million, and fiscal revenues of approximately \$86,000 (Table 3-21). Operation of the East Interceptor Hybrid option would have a higher economic and fiscal impact, with an estimated annual economic impact of \$2.6 million in output, supporting an estimated eight (8) jobs, earnings of \$0.3 million, and fiscal revenues of approximately \$93,000. Providing each job represents one (1) household and assuming the current average household size of 3.06 people in Honolulu County (USCB 2019b, B25010, Average Household Size of Occupied Housing Units by Tenure, 2013-2017 American Community Survey 5-Year Estimates), direct, indirect, and induced jobs provided by these operations would support approximately 20 residents on average.

Table 3-21. Ongoing Economic and Fiscal Impacts of Operations

	Output (Million \$)	Earnings (Million \$)	Employment (Jobs)	State Tax (\$)
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor A</i>				
Direct/Indirect Impact	2.1	0.2	5	70,000
Induced Impact	0.3	0.1	2	16,000
Total Annual Impact	2.4	0.3	7	86,000
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor D</i>				
Direct/Indirect Impact	2.1	0.2	5	70,000
Induced Impact	0.3	0.1	2	16,000
Total Annual Impact	2.4	0.3	7	86,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor A</i>				
Direct/Indirect Impact	2.3	0.3	6	75,000
Induced Impact	0.3	0.1	2	17,000
Total Annual Impact	2.6	0.3	8	93,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor D</i>				
Direct/Indirect Impact	2.3	0.3	6	75,000
Induced Impact	0.3	0.1	2	17,000
Total Annual Impact	2.6	0.3	8	93,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor G</i>				
Direct/Indirect Impact	2.3	0.3	6	75,000
Induced Impact	0.3	0.1	2	17,000
Total Annual Impact	2.6	0.3	8	92,000

Both construction and operation effects from the Proposed Action would be beneficial, providing regional economic benefits from construction spending and labor, as well as long-term positive effects on employment and income in the region.

3.11.2 Environmental Justice and Protection of Children

3.11.2.1 ENVIRONMENTAL JUSTICE

In the United States, environmental justice (EJ) minority populations are comprised of any races that are not white. However, the racial composition of Hawai'i is different than that of the United States as a whole, with whites comprising the majority of the population (approximately 73 percent) in the United States, but no group comprising a majority in Hawai'i. In Hawai'i, the largest racial group is Asian, accounting for approximately 38 percent of the population (USCB 2019b, DP05, ACS Demographic and Housing Estimates, 2013-2017 American Community Survey 5-Year Estimates). Because the populations on Hawai'i and O'ahu are so racially diverse, EJ minority populations in the vicinity of the East Interceptor System were identified using an approach based on the methodology developed by the O'ahu Metropolitan Planning Organization (O'ahuMPO) and DPP (2004), as recommended in the *Hawai'i Environmental Justice Initiative Report* (Kahihikolo 2008). The objective of the O'ahuMPO methodology is to determine where EJ is a concern by taking into account the unique Asian population and the racially diverse areas on O'ahu (O'ahuMPO and DPP 2004).

To identify areas where EJ could be a concern in the immediate vicinity of the East Interceptor System — hereafter referred to as the affected area — racial population data for Census block groups were analyzed. Minority populations in block groups located adjacent to and including the affected area were compared to minority populations in all block groups throughout Honolulu County. Each minority group was evaluated separately to identify those areas in the County where each minority population is concentrated in a disproportionate way. Consistent with the O'ahuMPO methodology, disproportionality was defined as exceeding one (1) standard deviation above the mean relative concentration of a minority group, with the relative concentration for each block group normalized for the areal size of the block group. If this threshold was exceeded for any of the race categories evaluated, an EJ population was determined to be present.

Based on this analysis, of the 54 block groups in the affected area, 39 or approximately 72 percent are EJ minority populations (Table 3-22, Figure 3-17), compared to about 53 percent of the block groups in Honolulu County that are EJ minority populations.

Table 3-22. Adjusted Percentage Minority, 2010

Geographic Area	White	Black or African American	American Indian and Alaskan Native	Asian	Native Hawaiian and Other Pacific Islander	Other	Hispanic or Latino
Calculated Honolulu County Threshold	40.6	6.3	0.7	65.2	19.4	2.6	16.0
Block Group 1, Census Tract 74	67.2	12.7	0.1	8.7	0.3	4.2	14.8
Block Group 1, Census Tract 75.03	10.1	0.0	0.0	65.7	2.1	1.4	5.0
Block Group 2, Census Tract 75.03	18.5	0.6	0.0	46.4	9.3	0.0	10.5
Block Group 1, Census Tract 75.04	7.6	1.1	0.0	32.3	32.3	1.4	14.6
Block Group 2, Census Tract 75.04	2.3	3.2	0.0	22.2	35.4	1.6	16.8
Block Group 1, Census Tract 75.05	15.6	0.0	0.0	61.9	4.5	1.6	2.4
Block Group 2, Census Tract 75.05	8.6	0.3	0.0	55.1	1.8	5.7	15.3
Block Group 3, Census Tract 75.05	21.8	16.5	0.0	38.9	0.9	1.2	7.8
Block Group 1, Census Tract 77.01	6.1	2.3	0.0	51.1	5.6	1.1	18.4
Block Group 2, Census Tract 77.01	9.2	0.0	0.0	64.6	3.3	1.4	10.6
Block Group 3, Census Tract 77.01	56.1	0.0	0.0	25.7	3.7	0.0	10.0
Block Group 1, Census Tract 77.02	3.0	0.0	0.0	66.1	0.0	0.0	0.7
Block Group 2, Census Tract 77.02	17.5	0.3	0.0	42.7	14.1	1.1	10.4
Block Group 3, Census Tract 77.02	14.3	0.3	0.0	56.5	3.4	0.0	5.2
Block Group 1, Census Tract 78.04	3.2	0.0	0.5	59.8	8.7	0.3	11.7
Block Group 1, Census Tract 78.05	6.9	0.7	0.0	56.2	4.9	4.4	15.4
Block Group 2, Census Tract 78.05	15.8	0.4	0.0	47.9	4.0	4.4	9.0
Block Group 1, Census Tract 78.07	26.3	11.9	0.0	61.7	0.0	0.0	0.0
Block Group 2, Census Tract 78.07	17.7	10.5	0.0	27.4	4.4	0.0	7.1

Source: USCB 2019b, B03002, Hispanic or Latino Origin by Race, 2013-2017 American Community Survey 5-Year Estimates.

Bold red values indicate population percentages of EJ minority populations.

Geographic Area	White	Black or African American	American Indian and Alaskan Native	Asian	Native Hawaiian and Other Pacific Islander	Other	Hispanic or Latino
Block Group 3, Census Tract 78.07	18.7	4.4	2.1	42.8	11.7	0.0	14.6
Block Group 4, Census Tract 78.07	27.0	3.5	0.0	51.2	2.3	1.0	1.9
Block Group 5, Census Tract 78.07	36.7	6.4	0.0	33.8	0.0	2.5	15.4
Block Group 6, Census Tract 78.07	10.9	0.0	0.0	67.2	0.0	6.0	2.9
Block Group 1, Census Tract 78.08	9.7	1.5	0.0	45.7	16.0	1.5	18.9
Block Group 2, Census Tract 78.08	13.9	1.3	0.0	31.3	18.1	2.3	18.2
Block Group 2, Census Tract 78.09	6.0	0.0	0.0	66.3	0.8	1.5	11.8
Block Group 1, Census Tract 78.11	8.1	1.8	0.0	62.9	4.6	0.0	5.9
Block Group 2, Census Tract 78.11	23.3	3.6	0.0	49.2	4.1	1.0	9.2
Block Group 1, Census Tract 80.01	10.8	0.5	0.0	58.6	12.4	0.0	15.1
Block Group 2, Census Tract 80.01	4.5	0.0	0.0	38.3	26.7	0.0	4.6
Block Group 1, Census Tract 80.02	8.9	0.6	0.0	57.4	13.7	0.6	6.9
Block Group 2, Census Tract 80.02	10.8	1.9	0.0	66.2	7.1	1.8	7.9
Block Group 1, Census Tract 80.03	36.6	0.8	0.0	25.4	8.4	3.6	32.7
Block Group 2, Census Tract 80.03	14.9	0.9	0.0	42.9	10.1	0.1	9.0
Block Group 1, Census Tract 80.06	1.0	10.4	0.0	50.0	11.5	0.0	1.4
Block Group 2, Census Tract 80.06	2.6	0.0	0.0	69.8	2.1	0.0	0.9
Block Group 2, Census Tract 80.07	4.4	0.0	1.3	59.3	1.8	0.0	3.7
Block Group 1, Census Tract 83.01	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Block Group 1, Census Tract 87.01	2.7	0.0	0.0	79.5	2.0	0.0	10.4
Block Group 2, Census Tract 87.01	2.2	2.7	0.0	46.6	30.6	0.0	12.7

Source: USCB 2019b, B03002, Hispanic or Latino Origin by Race, 2013-2017 American Community Survey 5-Year Estimates.

Bold red values indicate population percentages of EJ minority populations.

Geographic Area	White	Black or African American	American Indian and Alaskan Native	Asian	Native Hawaiian and Other Pacific Islander	Other	Hispanic or Latino
Block Group 3, Census Tract 87.01	1.1	0.0	0.0	79.5	2.0	0.0	9.7
Block Group 4, Census Tract 87.01	4.2	0.0	0.0	80.6	6.1	0.0	3.7
Block Group 1, Census Tract 87.02	2.5	0.0	0.0	70.3	14.3	0.3	6.7
Block Group 2, Census Tract 87.02	0.5	0.0	0.0	67.9	23.0	0.0	2.5
Block Group 2, Census Tract 87.03	5.1	0.0	0.0	17.7	59.2	0.0	8.5
Block Group 4, Census Tract 87.03	7.0	0.0	0.0	30.5	42.8	0.6	2.6
Block Group 2, Census Tract 88	5.9	1.6	0.0	79.6	4.8	0.0	7.0
Block Group 1, Census Tract 89.12	3.2	0.0	0.0	75.1	1.0	1.0	10.2
Block Group 1, Census Tract 89.21	8.3	0.2	0.0	63.6	6.4	1.6	13.5
Block Group 3, Census Tract 89.22	11.2	4.5	0.0	47.3	0.0	0.0	16.3
Block Group 2, Census Tract 89.31	16.0	2.8	3.0	9.9	11.7	0.0	22.0
Block Group 1, Census Tract 114	0.0	0.0	0.0	100.0	0.0	0.0	0.0
Block Group 2, Census Tract 114	68.8	8.1	0.0	4.5	4.2	0.7	7.6
Block Group 3, Census Tract 114	57.8	15.2	0.3	4.3	1.3	3.9	24.4

Source: USCB 2019b, B03002, Hispanic or Latino Origin by Race, 2013-2017 American Community Survey 5-Year Estimates.

Bold red values indicate population percentages of EJ minority populations.

City and County of Honolulu

HONOULIULI/ WAIPAHAU/ PEARL CITY WASTEWATER FACILITIES PLAN

Legend

- Hybrid Option
- Common Options
- No-Tunnel Option
- Waiawa Area Conveyance Corridors
- Streets
- Block Group
- EJ Minority Population

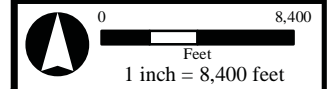
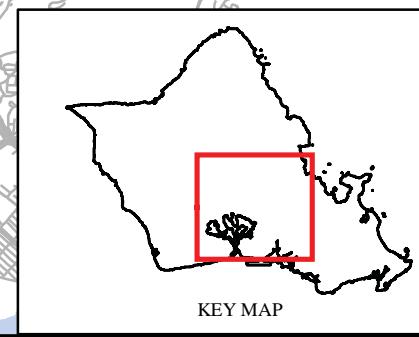
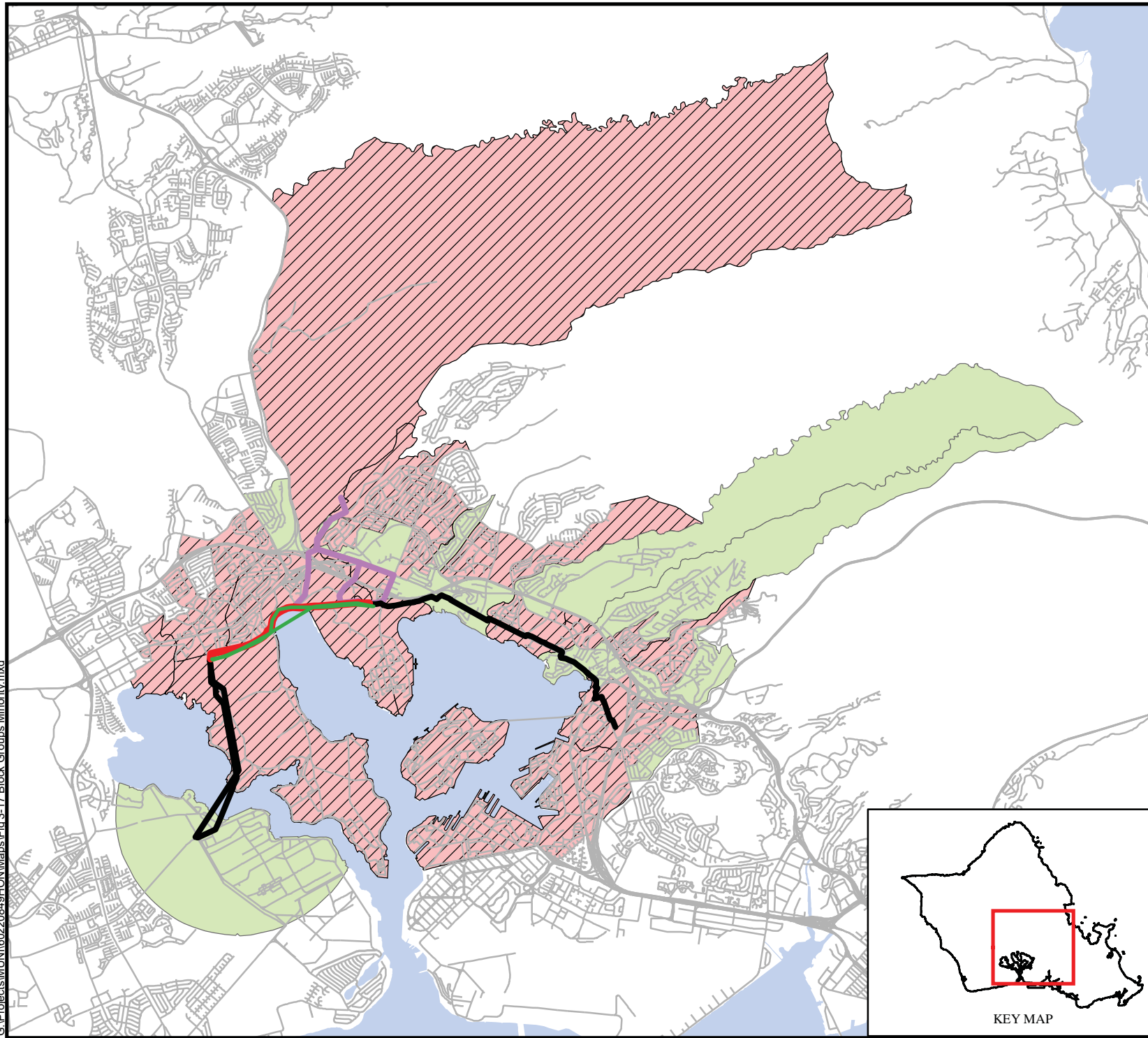


FIGURE 3-17

BLOCK GROUPS WITH ENVIRONMENTAL JUSTICE MINORITY POPULATIONS

AECOM

1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813



G:\Projects\MUNI\160220849\HON\Maps\Fig 3-17 Block Groups Minority.mxd

EJ minority populations within the 39 block groups with EJ minority populations are associated with disproportionately large populations of all six minority groups relative to the average for block groups in Honolulu County. Within fourteen (14) of the block groups with EJ minority populations, EJ minority populations are associated with disproportionately large Asian populations relative to the average. Whereas thirty-three (33) of the block groups with EJ minority populations are associated with disproportionately large populations of only one minority group, six (6) are associated with disproportionately large populations of more than one (1) minority group.

USCB determines poverty status by using a set of dollar-value thresholds that vary by family size and composition (USCB 2019b, Glossary). If a family's total income is less than the dollar value of the appropriate threshold, then that family and every individual in it are considered to be in poverty. Similarly, if an unrelated individual's total income is less than the appropriate threshold, then that individual is considered to be in poverty. The poverty thresholds do not vary geographically. They are updated annually to allow for changes in the cost of living (inflation factor) using the Consumer Price Index.

As recent, applicable data at the block group level were not available, census tract-level data were used to identify low-income populations. Table 3-23 presents the 2013-2017 American Community Survey 5-year estimates for the population in the affected area whose annual income was below the poverty level. The percentage of low-income individuals in Census Tract 87.03, at 18.2 percent, is by far the highest in the affected area. Four additional tracts in the affected area also have percentages of low-income individuals higher than in Honolulu County, as well as higher than in 'Ewa CCD.

Environmental justice will be assessed for low-income populations in these five (5) census tracts (Figure 3-18). The five (5) census tracts represent approximately 18 percent of the 27 tracts in the affected area, compared to about 35 percent of the census tracts in Honolulu County with low-income populations.

3.11.2.2 PROTECTION OF CHILDREN

For the purposes of this analysis, census tracts located in the immediate vicinity of the East Interceptor System were considered the areas potentially most affected by the proposed upgrading and/or expansion of the existing system. The number and percentage of children under 18 years within census tracts, the CCDs within the ROI, and Honolulu County were determined based on 2013-2017 American Community Survey 5-Year Estimates data (Table 3-24).

The percentage of children under 18 years in 14, or approximately 53 percent, of the census tracts in the affected area was higher than the percentage of children under 18 in Honolulu County overall, as well as higher than in Honolulu CCD. Therefore, a concentration of children is present in the 14 census tracts highlighted in Table 3-24 (Figure 3-19). For the 249 census tracts in Honolulu County, about 41 percent of the tracts had percentages of children under 18 years that were higher than the percentage of children under 18 in the County overall.

Table 3-23. Percentage Low Income, 2008-2012

Geographic Area		Low-Income Population (percent)
Area of Comparison	Honolulu County	9.1
Socioeconomic ROI	‘Ewa CCD	6.1
	Wahiawā CCD	9.4
	Honolulu CCD	10.6
	Census Tract 87.03	18.2
Affected Area	Census Tract 89.31	2.6
	Census Tract 78.05	6.1
	Census Tract 87.01	6.9
	Census Tract 74	6.0
	Census Tract 80.02	5.0
	Census Tract 89.22	3.0
	Census Tract 78.09	1.6
	Census Tract 80.07	2.3
	Census Tract 83.01	5.6
	Census Tract 77.01	9.4
	Census Tract 89.12	5.7
	Census Tract 80.06	8.0
	Census Tract 78.04	1.4
	Census Tract 87.02	13.6
	Census Tract 80.01	9.1
	Census Tract 89.21	8.3
	Census Tract 75.04	16.1
	Census Tract 114	11.8
	Census Tract 78.11	2.2
	Census Tract 78.08	6.2
	Census Tract 75.03	3.7
	Census Tract 88	9.1
	Census Tract 75.05	6.8
	Census Tract 80.03	7.1
Census Tract 78.07	7.2	
Census Tract 77.02	2.8	

Source: USCB 2019b, S1701, Poverty Status in the Past 12 Months, 2013-2017 American Community Survey 5-Year Estimates.

Bold red values indicate population percentages of EJ low-income populations.

City and County of Honolulu

HONOULIULI/ WAIPAHU/ PEARL CITY WASTEWATER FACILITIES PLAN

Legend

- Common Options
- No-Tunnel Option
- Hybrid Option
- Waiawa Area Conveyance Corridors
- Streets
- Census Tract
- EJ Low-Income Population

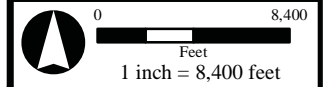


FIGURE 3-18
CENSUS TRACTS
WITH
ENVIRONMENTAL
JUSTICE
LOW-INCOME
POPULATIONS

AECOM

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HONOLULU, HAWAII 96813

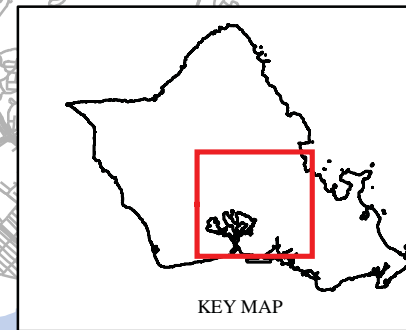
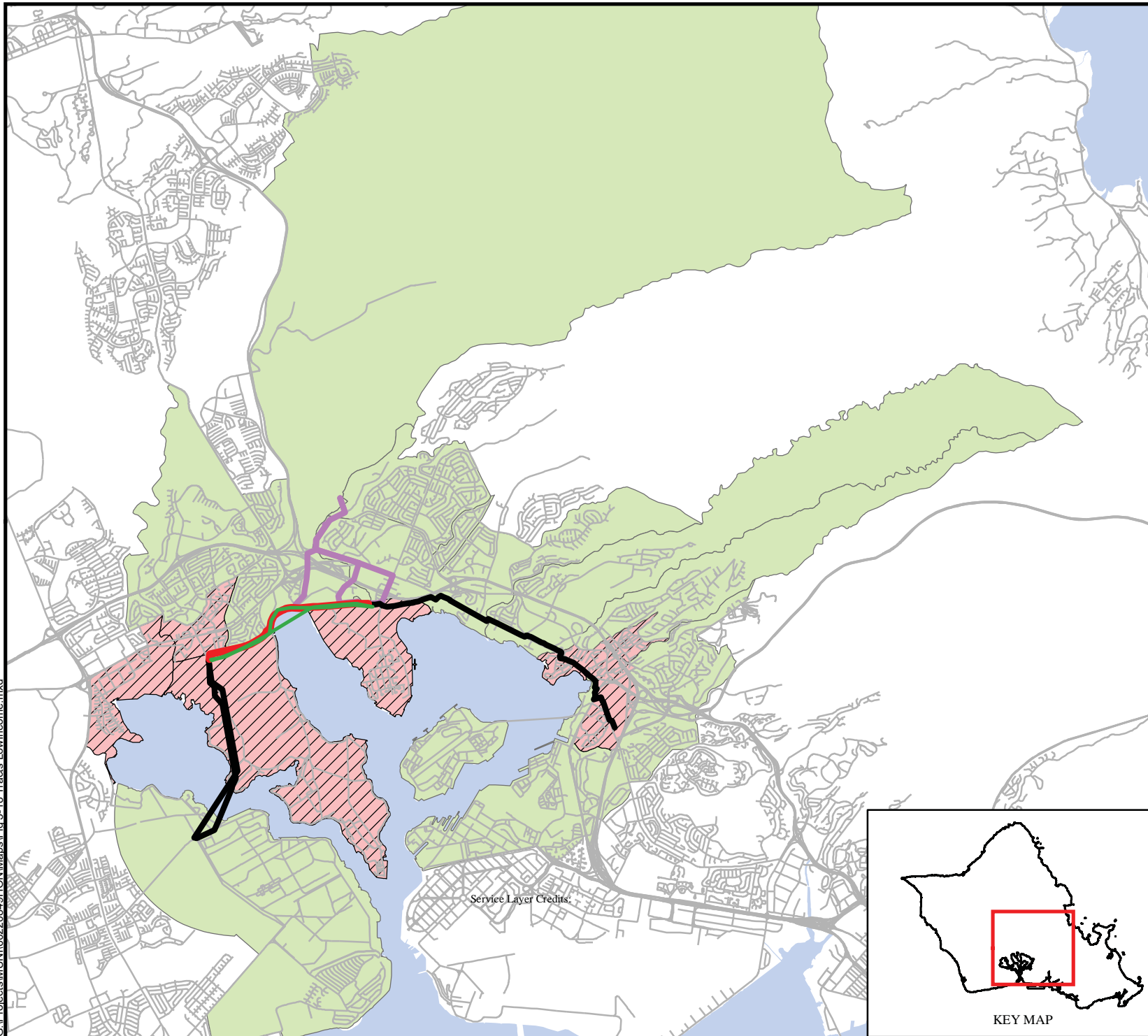


Table 3-24. Number and Percentage Children, 2010

Geographic Area		Children Under 18	
		Number	Percent
Area of Comparison	Honolulu County	212,210	21.4
Socioeconomic ROI	‘Ewa CCD	81,699	23.7
	Wahiawā CCD	13,062	28.6
	Honolulu CCD	71,092	17.7
Affected Area	Census Tract 87.03	1,993	28.1
	Census Tract 89.31	1,068	31.2
	Census Tract 78.05	919	19.0
	Census Tract 87.01	1,641	18.9
	Census Tract 74	1,150	22.4
	Census Tract 80.02	405	14.2
	Census Tract 89.22	1,648	22.1
	Census Tract 78.09	834	22.8
	Census Tract 80.07	1,038	17.9
	Census Tract 83.01	1,734	34.3
	Census Tract 77.01	1,081	24.7
	Census Tract 89.12	492	17.5
	Census Tract 80.06	891	19.2
	Census Tract 78.04	408	18.4
	Census Tract 87.02	1,372	23.0
	Census Tract 80.01	437	21.7
	Census Tract 89.21	444	17.7
	Census Tract 75.04	1,066	30.3
Affected Area (continued)	Census Tract 114	856	23.4
	Census Tract 78.11	668	14.6
	Census Tract 78.08	953	27.1
	Census Tract 75.03	721	14.9
	Census Tract 88	2,049	20.9
	Census Tract 75.05	875	15.0
	Census Tract 80.03	1,277	28.2
	Census Tract 78.07	663	13.1
	Census Tract 77.02	1,126	22.7

Source: USCB 2019b, S0101, Age and Sex, 2013-2017 American Community Survey 5-Year Estimates.

Bold red values indicate population numbers and percentages of concentrations of children higher than in Honolulu County overall.

City and County of Honolulu

HONOULIULI/ WAIPAHAU/ PEARL CITY WASTEWATER FACILITIES PLAN

Legend

- Hybrid Option
- Common Options
- No-Tunnel Option
- Waiawa Area Conveyance Corridors
- Streets
- Census Tract
- Concentration of Children

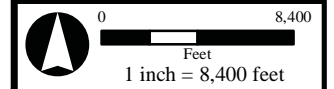
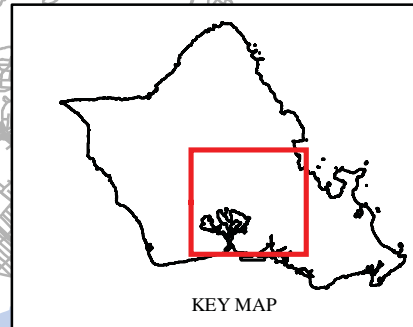
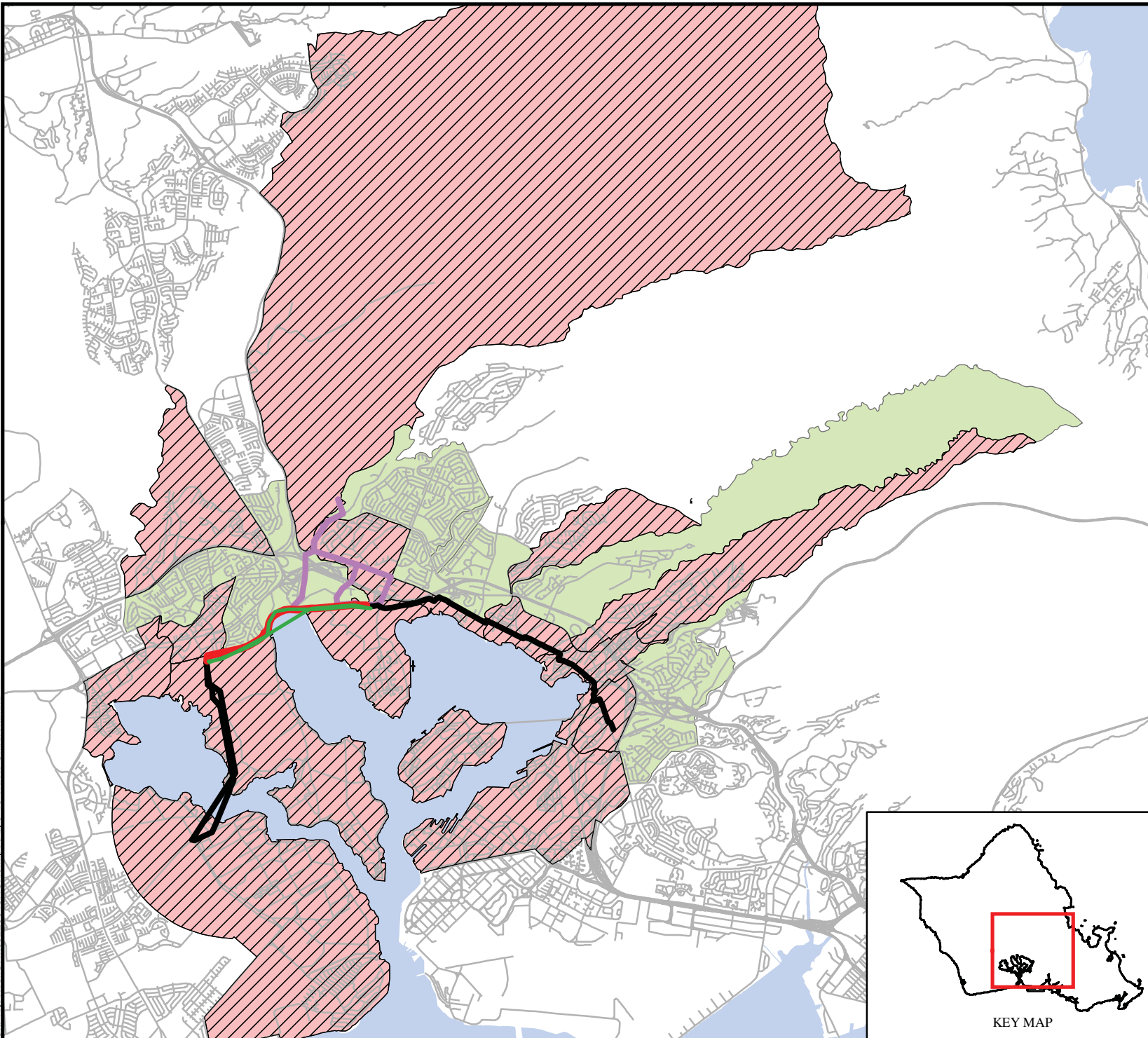


FIGURE 3-19
CENSUS TRACTS
WITH
CONCENTRATIONS
OF CHILDREN

AECOM

1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813



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3.11.2.3 IMPACTS AND MITIGATION MEASURES

Although EJ populations and concentrations of children are present in the affected area, based on the analyses presented in this DEIS, the Proposed Action would have less than significant adverse human health or environmental impacts regardless of the selected option. Negative impacts on the population in the Proposed Action vicinity are not anticipated, and the action would minimize the potential for SSOs and protect public health and safety. The Proposed Action would increase the capacity of the existing Honouliuli East Interceptor System to safely and efficiently accommodate projected future flows through the 2050 planning period, and provide an adequate wastewater system to support the needs of the population and economy in the service area.

With respect specifically to children, as described in Section 3.13.2 Public Schools, there are fifteen (15) public schools in the vicinity of the project area. Among these, Lehua Elementary and Pearl City Elementary in Pearl City, and Waipahu High School in Waipahu are within approximately 1,000 feet of at least one of the options. During construction, there may be additional noise and traffic at or near the schools. Construction near schools is summarized by option as follows:

- Projects common to both East Interceptor conveyance options – The Pearl City Trunk sewer would be constructed adjacent to the Lehua Elementary School.
- No-Tunnel option – The existing dual Pearl City WWPS Force Mains would be rehabilitated and the new third Pearl City WWPS Force Main would be constructed adjacent to the Waipahu High School. Replacement location Alternatives No. 1 and No. 2 for a relocated Pearl City WWPS would be constructed near Lehua Elementary School. For the Hybrid option, the entrance to a GST also would be located near Lehua Elementary School.
- Waiawa Area conveyance options – Corridor A would be constructed adjacent to Lehua Elementary School and Pearl City Elementary School.

The effects of implementing the Proposed Action would not be appreciably more severe or greater in magnitude in minority or low-income communities, or in communities with high concentrations of children. Therefore, no disproportionately high and adverse human health or environmental effects on minority populations and low-income populations would occur. Likewise, implementation of the Proposed Action would not pose disproportionate environmental health or safety risks to children. The Proposed Action would not negatively impact EJ populations, and would not negatively impact children. There could possibly be direct and indirect benefits to these population groups as a result of additional job opportunities.

3.12 INFRASTRUCTURE AND UTILITIES

3.12.1 Water

3.12.1.1 EXISTING SETTING

The emergency fire and potable water supply for the island of O‘ahu is provided by the City and County of Honolulu Board of Water Supply (BWS), which is a semi-

autonomous agency that constructs, operates, and maintains the pumping stations and associated distribution network throughout the project area. BWS relies solely on groundwater for potable water supply. As the groundwater resources are dependent on recharge from rainfall, BWS monitors groundwater levels to track the effects of varying rainfall and pumping trends.

BWS operates the Honouliuli Water Recycling Facility in ‘Ewa that recycles wastewater for irrigation and industrial uses. BWS also operates three (3) non-potable water distribution systems, two (2) of which are in the project area, in Hālawā and ‘Ewa.

3.12.1.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Construction drawings would be submitted to BWS for review as part of the building permit application process to confirm if there are any conflicts with existing BWS water infrastructure and the new sewers meet the clearances specified in BWS standards. BWS has indicated that an additional fire hydrant would be required at the Alternative No. 3 Pearl City WWPS. The estimate of water required during construction and availability of the water would be confirmed during the review and approval of the building permit application.

3.12.1.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

The reconstructed and new above-grade structures may require additional potable water service and/or non-potable emergency and landscaping water service during operation. Above-grade structures include the Waimalu WWPS and Hālawā WWPS regardless of the East Interceptor conveyance option, the Pearl City WWPS for the No-Tunnel option, and the Waipahu WWPS for the Hybrid option. No above-grade structure is required for any of the Waiawa Area conveyance options.

The availability of any additional water required during operation would be confirmed with BWS during the review and approval of the building permit application. BWS recommends the use of drought tolerant/low water use facilities and xeriscaping principles for all landscaping and installation of an efficient irrigation system, such as drip irrigation, incorporating moisture sensors to avoid the operation of the system in the rain and if the ground has adequate moisture. These recommendations would be implemented for the Proposed Action, regardless of the options selected.

3.12.2 Wastewater

3.12.2.1 EXISTING SETTING

The existing wastewater infrastructure in the project area is described in Section 1.2.2. Improvement of the existing wastewater collection system is the focus of the ongoing evaluation and the subject of this DEIS. Wastewater is collected throughout the Honouliuli sewer basin and conveyed by gravity sewers and pumping to the Honouliuli WWTP, where it is treated and discharged through the Barbers Point Deep Ocean Outfall, located approximately 1.7 miles offshore at a depth of 200 feet.

3.12.2.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

The Honouliuli East Interceptor System would continue to operate during construction activities, which are anticipated to continue for several years. The Proposed Action would result in short-term impacts to the existing wastewater collection system during construction of the proposed improvements and rehabilitation activities, including potential temporary interruptions to service to connect new structures and facilities to the existing system, and temporary pumping and piping may be required to maintain wastewater service.

3.12.2.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

Ultimately, implementation of the Proposed Action would result in rehabilitation of the existing wastewater infrastructure and increase capacity of the Honouliuli East Interceptor System to address future flows through the planning period.

3.12.3 Solid Waste Disposal

3.12.3.1 EXISTING SETTING

ENV Refuse Division provides collection, disposal, and recycling services to the island of O‘ahu. ENV or private haulers transport municipal solid waste, which excludes construction and demolition debris, to the H-Power (Honolulu Program of Waste Energy Recovery) waste-to-energy facility at the Campbell Industrial Park in Kapolei, to recycling centers, to composting centers, or directly to the Waimānalo Gulch Sanitary Landfill in Kahe Valley. According to ENV (2019), O‘ahu generates more than 1.2 million tons of municipal solid waste annually, but diverts approximately 80 percent of this waste from the landfill by employing both recycling and waste-to-energy.

O‘ahu generates approximately 1 million tons of construction and demolition debris annually (ENV 2019). Private haulers transport construction debris to the PVT Land Company Integrated Solid Waste Management Facility, located in Nānākuli. The facility recycles up to 80 percent of the debris it receives, with only about 20 percent disposed of in the facility landfill, the only construction and demolition landfill on O‘ahu (PVT Land Company 2019).

3.12.3.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

During construction, both the No-Tunnel and Hybrid options, as well as the Waiawa Area conveyance options, would have some impact on solid waste disposal within the project area. Replacing or constructing new force mains, trunk sewers, and WWPSs would entail excavation. Most material excavated for new structures and facilities would be used as backfill on site. However, excess excavated material that could not be kept on site would require offsite disposal.

Coordination with local landfills and recycling centers for the disposal of construction debris and/or hazardous materials may be required. Disposal would be in accordance with appropriate regulations and standards.

3.12.3.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

The proposed wastewater system additions and modifications are expected to have minimal long-term impact on the solid waste disposal operations within the project area.

3.12.4 Electrical and Communication Services

3.12.4.1 EXISTING SETTING

HECO supplies electricity to the majority of O‘ahu. One (1) of HECO’s major facilities, the Waiau Power Plant, is located within the Honouliuli East Interceptor sewer basin (Figure 3-20). Regardless of the East Interceptor conveyance option, the proposed alignments of the new Pearl City trunk sewer and new Waimalu WWPS force main are located adjacent to the power plant and along Kamehameha Highway, which borders the plant. The Waiau Power Plant is fueled with oil and has a firm (continuously available) generation capacity of 500 megawatts (HECO 2019).

Telephone and internet services within the project area are provided by Hawaiian Telcom and Spectrum (Oceanic Time Warner Cable). Spectrum also provides cable services within the project area.










Electrical and communication services are transmitted through underground and aerial lines located in the project area. HECO owns approximately 3,000 miles of electrical transmission and distribution lines, of which more than 40 percent are underground (HECO 2019b). Although overhead lines are more vulnerable to adverse weather conditions and objects contacting lines, underground lines are more vulnerable to damage from water penetration and construction excavation. Hawai‘i state law, Revised Statutes Chapter 269E, requires that excavators provide notice at least five (5) working days prior to beginning planned excavation and prohibits the use of mechanized equipment within 30 inches of a marked utility, requiring hand digging within this *tolerance zone* (Hawai‘i One Call Center 2010).

The Honolulu Authority for Rapid Transportation (HART) is currently building stations and relocating utilities along Kamehameha Highway through Pearl City and ‘Aiea for the Honolulu Rail Transit Project. As part of this project, HART will be relocating the HECO 138-kV overhead power line along Kamehameha Highway between the Waiau Power Plant and Aloha Stadium. This relocation could involve a combination of overhead and underground alignments, and could end up in close proximity to the proposed Pearl City Influent Trunk Sewer, Waimalu Force Main, Waimalu Influent Trunk Sewer, and/or other facilities. HART intends to complete construction of this facility by 2025 and requests further coordination regarding potential alignments and planned construction phasing, in order to optimize overall project delivery for the City.

City and County of Honolulu

HONOLULU/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

-  Honouliuli WWTP
-  Existing WWPS
-  Hybrid Tunnel Shaft
-  East Interceptor
-  Hybrid Option Alignment
-  Waiawa Conveyance Corridors (Options A, D, and G)
-  New and/or Rehabilitated Force Mains and Trunk Sewers
-  Power Plants
-  Streets

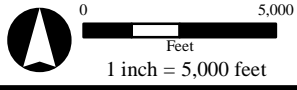
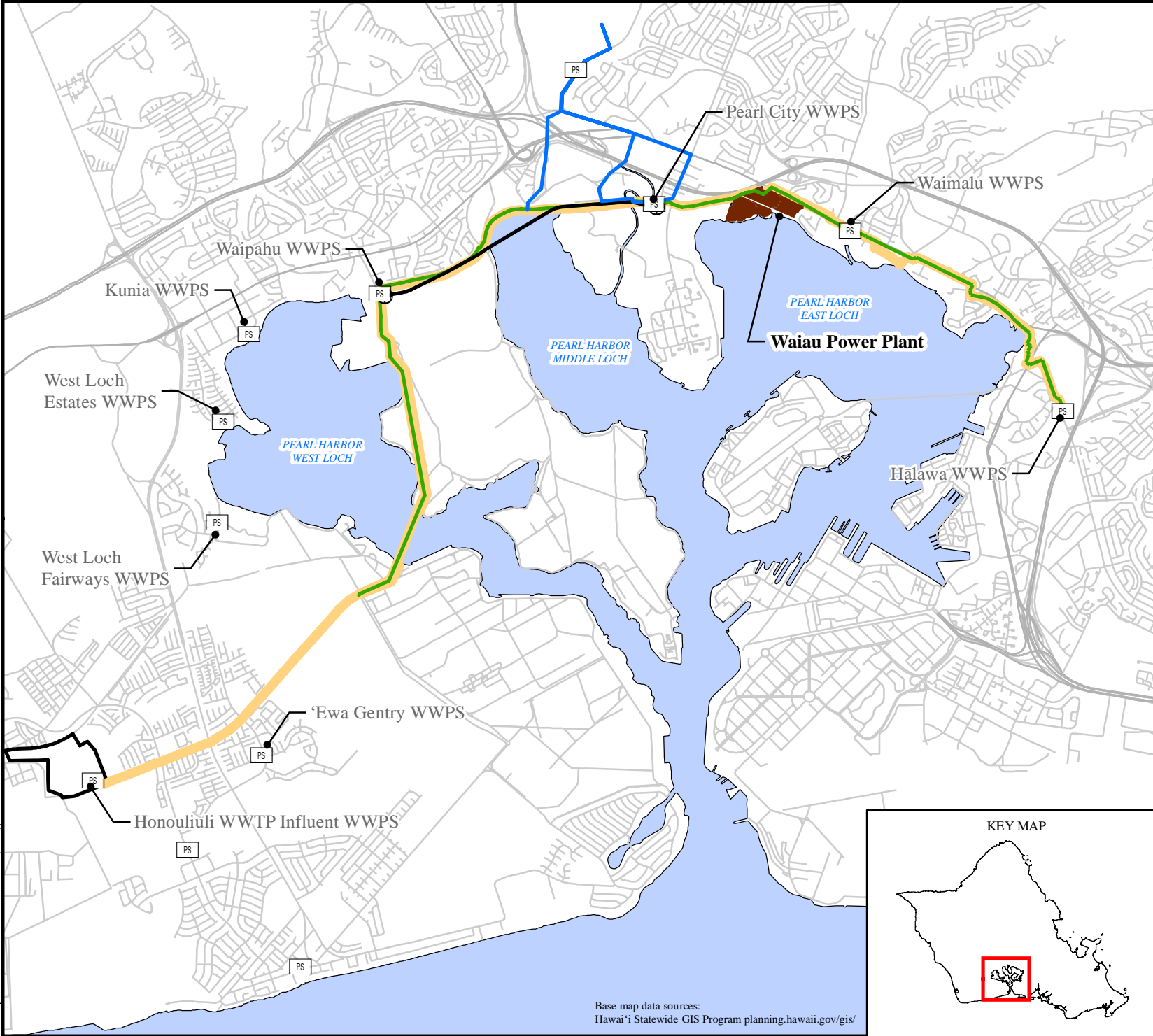
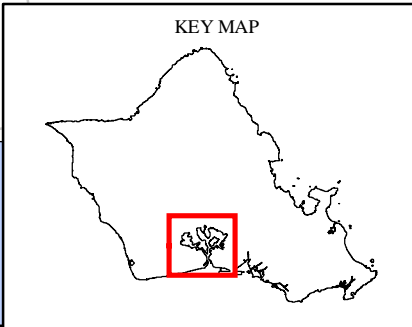


FIGURE 3-20
POWER PLANTS



Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

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3.12.4.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, coordination with HECO, Hawaiian Telcom, and Spectrum would be conducted to minimize and/or avoid potential conflicts with any underground and overhead utility lines in the project area. With respect to the relocation of the HECO 138-kV overhead power line along Kamehameha Highway, ENV will continue to coordinate with HART on the proposed improvements and upgrades to the existing East Interceptor System of the Honouliuli sewer basin as well as the implementation schedule to minimize potential conflicts. If construction occurs after HART's construction of the HECO facilities, ENV will coordinate with HECO.

Proposed improvements, including staging areas, would be designed to avoid significant impacts to existing electrical and communication lines, or otherwise include appropriate mitigation measures. Construction of the Proposed Action would require electricity mostly generated by the burning of fossil fuels and imported fuels for powering equipment and vehicles during construction.

Regardless of the East Interceptor conveyance option, and for both the No-Tunnel and Hybrid options, proposed force mains and trunk sewers would cross or enter the State Energy Corridor in O'ahu. For the Waiawa Area conveyance options, construction of any of the three (3) corridors also would require crossing or entering the corridor. The State Energy Corridor was established by the Hawai'i Department of Transportation under HRS 277. HRS 277 authorizes the department to establish energy corridors for the transporting of sources of energy, including oil, its derivatives, and natural gas, by pipeline or other means. To avoid conflict with the intended use of the corridor, an approval letter from the Department of Transportation Harbors Division must be obtained to perform construction activities to cross or enter the State Energy Corridor.

3.12.4.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

The proposed improvement options, comprising the upgrade, relocation, or construction of wastewater facilities, may require additional electrical power consumption and/or communication services for operation. Electricity would be consumed during operation of the WWPSs.

Regardless of the East Interceptor conveyance option, the estimated annual electrical demand is approximately 394,000 kilowatt hours for the Waimalu WWPS and approximately 249,000 kilowatt hours for the Hālawā WWPS (AECOM 2016a). For the No-Tunnel option, approximately 1,804,000 additional kilowatt hours of electricity would be required annually to operate the rehabilitated/upgraded Waipahu WWPS. Additionally, annually operation of the Pearl City WWPS would require approximately 680,000 kilowatt hours whether the existing pump station is reconstructed or replaced. For the Hybrid option, approximately 2,158,000 kilowatt hours of electricity would be required for the new Waipahu Combined Flow WWPS, but the Pearl City WWPS would be removed.

Comparing options, the No-Tunnel option would consume approximately 15 percent more electricity annually than would the Hybrid option.

3.12.5 Gas

3.12.5.1 EXISTING SETTING

Hawai'i Gas maintains an underground utility pipeline system that runs from Kapolei to Hawai'i Kai and serves commercial and residential customers in the project area (Hawai'i Gas 2019). As noted in Section 3.12.4.1, Hawai'i state law requires that excavators provide notice at least five (5) working days prior to beginning planned excavation and prohibits the use of mechanized equipment within 30 inches of a marked utility, requiring hand digging within this tolerance zone (Hawai'i One Call Center 2010).

3.12.5.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Regardless of the options selected, coordination with Hawai'i Gas during construction would be necessary to minimize and/or avoid potential conflicts with the existing gas utilities.

3.12.5.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

The proposed improvement options, comprising the upgrade, relocation, or construction of wastewater conveyance facilities, are not likely to require natural gas as a fuel source for operation. The new standby generators to be installed at the WWPSs for emergency use would use diesel fuel.

3.13 PUBLIC SERVICES AND FACILITIES

3.13.1 Police and Fire Protection Services

3.13.1.1 EXISTING SETTING

HPD and the Honolulu Fire Department (HFD) provide emergency services to the island of O'ahu. As of April 2019, HPD has approximately 1,890 sworn officers and 470 civilian personnel (HPD 2019). HPD has divided the island into eight (8) patrol districts with five (5) district stations. The Pearl City district station is located within the project area and the Honolulu Police Training Academy is located south of the Waipahu WWPS.

HFD has a force of over 1,100 fire fighters (HFD 2019). The island of O'ahu is divided into five (5) battalions, together containing 44 fire stations. Fire stations within the project area are located in Waikele, Pearl City, Waiau, and 'Aiea.

3.13.1.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

Coordination with HPD during construction would be necessary to manage traffic congestion and promote public safety. In those instances when traffic control cannot be provided by the contractor employees alone, off-duty police officers would be scheduled and hired. As noted above, the Honolulu Police Training Academy is

located south of the Waipahu WWPS, where work is proposed as part of the Proposed Action. As HPD has plans for expansion of the academy, ENV would coordinate with the department as needed to avoid conflicts.

Coordination with HFD for the safe design of new or upgraded structures would also be necessary. Plans would be submitted to HFD for review and approval during the design phase. Based on the *National Fire Protection Association 1: Fire Code, 2018 Edition*:

- A fire apparatus access road would be provided for every facility, building, or portion of building within HFD jurisdiction when any portion of the structure is more than 150 feet from a fire apparatus access road.
- A fire department access road would extend to within 50 feet of at least one (1) exterior door that can be opened from the outside and that provides access to the interior of the building.
- Onsite fire hydrants and mains capable of supplying the required fire flow would also be provided when any portion of a facility or building is in excess of 150 feet from a water supply. The proposed Alternative No. 3 Pearl City WWPS location would require installation of a new fire hydrant.

The water supply would also be provided as approved by the County in terms of supplying the required fire flow for fire protection.

3.13.1.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

The operation of the proposed wastewater system improvements is expected to have minimal impact on HPD and HFD.

3.13.2 Public Schools

3.13.2.1 EXISTING SETTING

There are fifteen (15) public schools in the vicinity of the project area, including:

- Aiea Elementary School
- Aiea High School
- Aiea Intermediate School
- Alvah A. Scott Elementary School
- August Ahrens Elementary School
- Ewa Elementary School
- Holomua Elementary School
- Lehua Elementary School
- Keone‘ula Elementary School
- Pearl City Elementary School
- Pearl Ridge Elementary School
- Waimalu Elementary School
- Waipahu Elementary School
- Waipahu High School
- Waipahu Intermediate School

Figure 3-21 shows the public schools within and adjacent to the project area. Of the fifteen (15) public schools listed, only Lehua Elementary and Pearl City Elementary in Pearl City, which serve students from kindergarten to sixth grade, and Waipahu High School in Waipahu, which serves grades 9 to 12, are within approximately 1,000 feet of at least one (1) of the options. Table 3-25 presents 2017-2018 school year enrollment, staffing, and classroom data for these three schools.

Table 3-25. School Enrollment, Staffing, and Classrooms, 2017-2018 School Year

School	Fall Enrollment	Total Staff ¹	Classrooms
Lehua Elementary School	234	28	30
Pearl City Elementary School	416	33	37
Waipahu High School	2,554	175.5	124

Sources: Hawai'i State Department of Education 2018a, 2018b, and 2018c.

¹Full-time equivalent teaching, administrative, and student services staff.

3.13.2.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

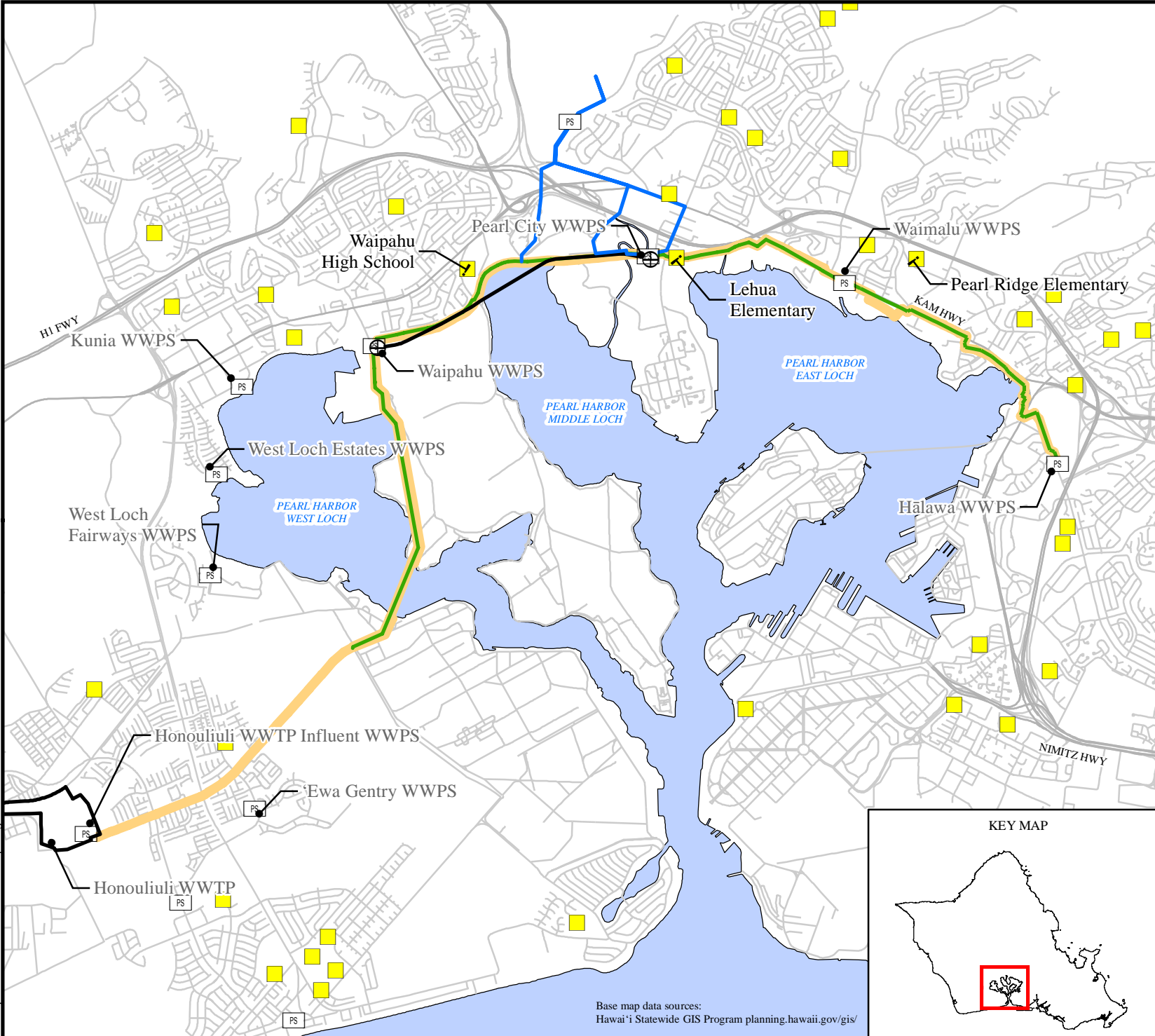
State Department of Education and the individual schools in the area would be consulted to coordinate work in the vicinity from inception to construction and so that all parties concur with the Proposed Action. During construction, there may be additional noise and traffic at or near the schools. Construction traffic would be scheduled to avoid conflict with school traffic.

Regardless of the East Interceptor conveyance option, the new Pearl City Trunk sewer would be constructed adjacent to the Lehua Elementary School.

For the No-Tunnel option, the existing dual Pearl City WWPS Force Mains would be rehabilitated and the new third Pearl City WWPS Force Main would be constructed adjacent to the Waipahu High School. Replacement location Alternatives No. 1 and No. 2 for a relocated Pearl City WWPS would be constructed along Lehua Avenue, near Lehua Elementary School. For the Hybrid option, the launch shaft required for the tunnel boring machine used to construct the GST also would be located near Lehua Elementary School.

City and County of Honolulu

HONOLULUI/ WAIPAHA/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES



Legend

- Honouliuli WWTP
- Existing WWPS
- Hybrid Tunnel Shaft
- East Interceptor
- Hybrid Option Alignment
- Waiawa Conveyance Corridors (Options A, D, and G)
- New and/or Rehabilitated Force Mains and Trunk Sewers
- Public School
- Streets

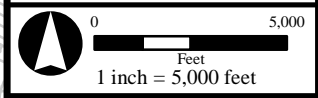
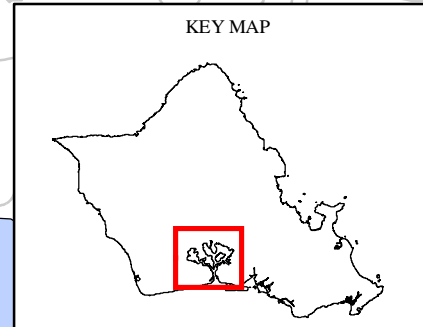


FIGURE 3-21
PUBLIC SCHOOLS



Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

G:\Projects\MUNI\0220849\HON\Maps\Fig 3-21 Public School.mxd

For the Waiawa Area conveyance options, Corridor A would be constructed along Lehua Avenue and adjacent to the Lehua Elementary School, and along Kamehameha Highway fronting Pearl City Elementary School.

Construction related impacts would be short-term and are not anticipated to have significant impacts.

3.13.2.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

No operational effects to schools are anticipated, other than periodic inspection and/or maintenance of proposed wastewater management facilities located on or near school property.

Odor control measures would be implemented at WWPS locations to minimize odor impacts to neighboring uses, including schools.

3.13.3 Parks and Recreational Areas

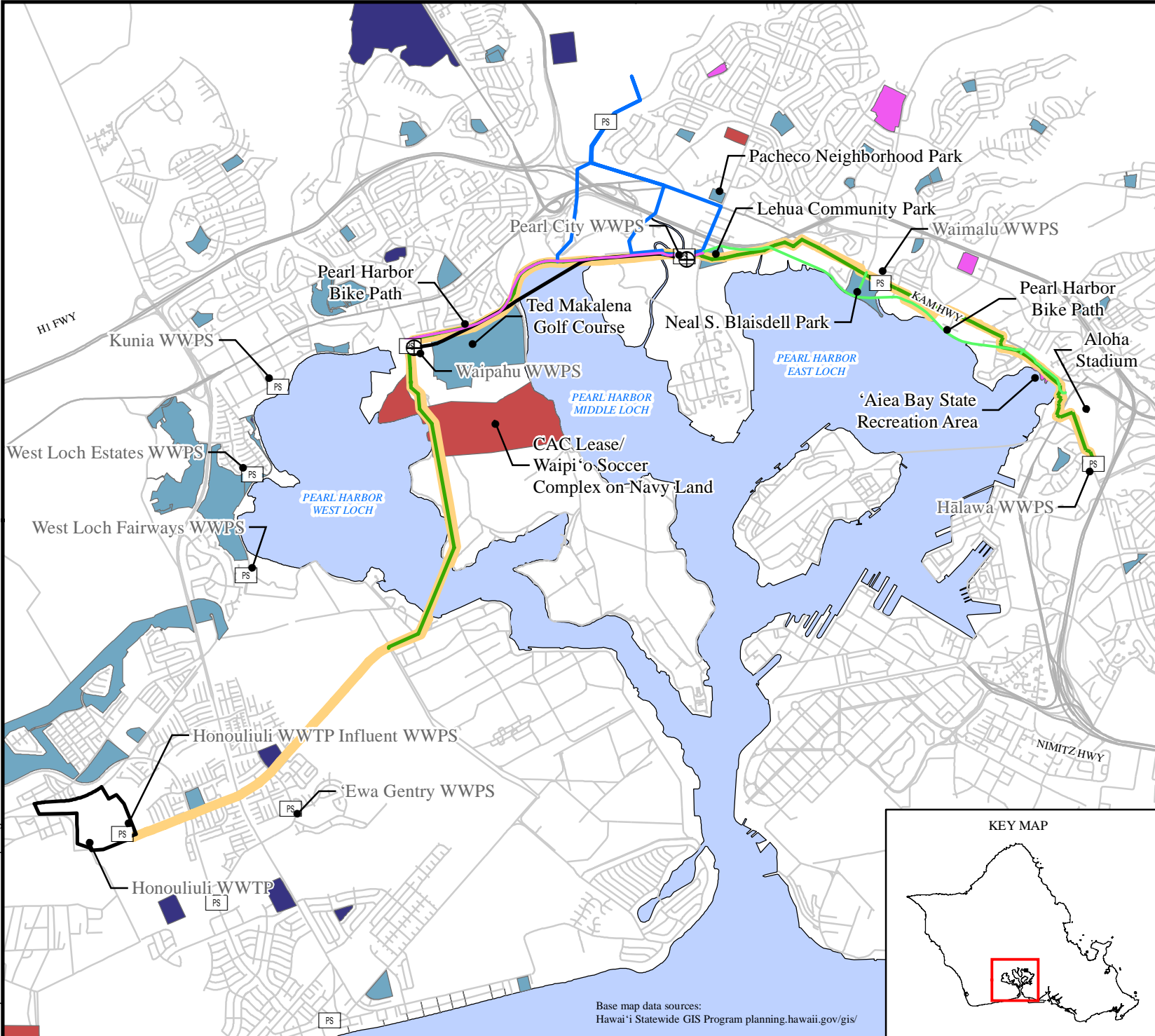
3.13.3.1 EXISTING SETTING

There are numerous parks and recreational areas in the vicinity of the project area. Only the following recreational facilities are expected to be directly or indirectly affected by at least one (1) of the options (Figure 3-22):

- Waipi’o Peninsula Soccer Complex in Waipahu, encompassing 288 acres with 21 regulation fields, including a 5,000-seat stadium with lights for evening events
- Ted Makalena Golf Course in Waipahu, an 18-hole, public course
- Pearl Harbor Bike Path, an approximately 5-mile-long paved, linear bike path
- Pacheco Neighborhood Park in Pearl City, with a baseball field, softball field, basketball court, and volleyball court
- Lehua Community Park in Pearl City, with eight (8) tennis courts with lights for evening play, two (2) basketball courts, two (2) volleyball courts, a softball field, and a play structure
- Neal S. Blaisdell Park in Waimalu, along Pearl Harbor’s East Loch, with walking/jogging and bicycle paths, a play structure, and picnic sites
- ‘Aiea Bay State Recreation Area in ‘Aiea, along ‘Aiea Bay in Pearl Harbor’s East Loch, with picnic sites
- Aloha Stadium in Hālawā, the largest outdoor arena in Hawai‘i, home to the University of Hawai‘i Rainbow Warriors football team, and the site of the Swap Meet open air market.

City and County of Honolulu

HONOLULUI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES



Legend

- Hybrid Tunnel Shaft
- Existing WWPS
- Waiawa Conveyance Corridors (Options A, D, and G)
- Hybrid Option Alignment
- New and/or Rehabilitated Force Mains and Trunk Sewers
- Honouliuli WWTP
- East Interceptor

Park Owner

- City
- County
- State
- Federal
- Private
- Other

Streets

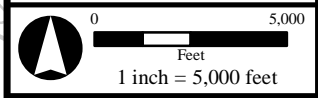
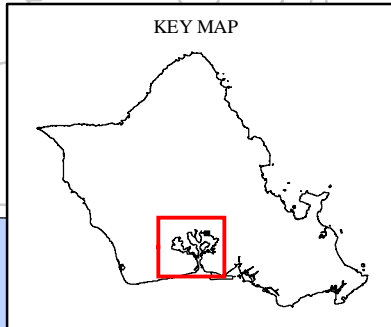


FIGURE 3-22
PARKS AND RECREATIONAL AREAS



Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

AECOM
1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813

G:\Projects\MUNI\020849\HON\Maps\Fig 3-22 Park and Rec Areas.mxd

3.13.3.2 CONSTRUCTION IMPACTS AND MITIGATION MEASURES

One program objective is to avoid impairment of public use of the existing parks or to replace in-kind taking of park land to the maximum extent feasible. This continues to be a planning and design objective. Unavoidable impacts would be reviewed in consultation with the Department of Parks and Recreation for acceptability before proceeding further. The Division of State Parks of the Hawai'i Department of Land and Natural Resources and the City and County of Honolulu Department of Parks and Recreation would be consulted to coordinate work in the vicinity of potentially affected park land.

During construction, there may be additional noise and traffic at or near the parks and recreational areas. These construction-related impacts would be short-term and are not anticipated to have any significant impacts.

Any option that involves Neal S. Blaisdell Park or Aloha Stadium may be subject to National Park Service 6(f) restrictions pursuant to a Land Water Conservation Grant to the City in 1990. Section 6(f)(3) of the Land and Water Conservation Fund Act of 1965 as amended contains the following provision to protect grant-assisted areas from conversions:

“No property acquired or developed with assistance under this section shall, without the approval of the Secretary, be converted to other than public outdoor recreation uses. The Secretary shall approve such conversion only if he finds it to be in accord with the then existing comprehensive statewide outdoor recreation plan and only upon such conditions as he deems necessary to assure the substitution of other recreation properties of at least equal fair market value and of reasonably equivalent usefulness and location.”

However, an exception to the conversion restriction is the installation of an underground utility providing the change does not impact recreation use. Under all options, long-term impairment of public use of Neal S. Blaisdell Park and Aloha Stadium, as well as all existing parks, has been avoided to the extent possible, although temporary interference with recreational activities during construction and permanent conversion of park land are anticipated.

Regardless of the East Interceptor conveyance option, several projects would directly impact parks or recreational areas or temporarily interfere with recreational activities:

- Construction of the Pearl City Trunk Sewer would entail work in Lehua Community Park and would temporarily interfere with the Pearl Harbor Bike Path.
- The Waimalu WWPS Force Main and Waimalu WWPS would be constructed in Neal S. Blaisdell Park. The park is subject to National Park Service 6(f) restrictions, requiring the approval of the Secretary of the Interior for conversion to uses other than public outdoor recreation. Construction activities may temporarily impose aesthetic nuisances (excavating park land, construction noise, traffic, etc.) on park users. Mitigation measures would be required.

- The Waimalu Trunk Sewer would be constructed in the Aloha Stadium Kam parking lot and the grounds of the Swap Meet. The stadium is subject to National Park Service 6(f) restrictions, requiring the approval of the Secretary of the Interior for conversion to uses other than public outdoor recreation. Construction of the sewer would temporarily interfere with the Pearl Harbor Bike Path and ‘Aiea Bay State Recreation Area.
- The Hālawā WWPS Force Main would be constructed on the grounds of the Aloha Stadium Swap Meet. The approval of the Secretary of the Interior may be required for conversion to uses other than public outdoor recreation. Mitigation measures would be required to address conflicts involving usage, parking, traffic, and noise. The alternate Hālawā gravity sewer alignment would follow Salt Lake Boulevard and minimize this potential impact.
- The Hālawā WWPS would be constructed in the Aloha Stadium Lower Hālawā parking lot. The approval of the Secretary of the Interior may be required for conversion to uses other than public outdoor recreation. Mitigation measures would be required to address conflicts involving usage, parking, traffic, and noise.

As noted, several of these projects — Waimalu WWPS Force Main, Waimalu WWPS, Waimalu Trunk Sewer, Hālawā WWPS Force Main, and Hālawā WWPS — would be constructed in Neal S. Blaisdell Park or at Aloha Stadium, depending on the alternative selected. As these projects would require conversion of park lands that may be subject to National Park Service 6(f) restrictions, CCH should begin the approval process early so that the land would be available within the necessary construction timeframe.

For the No-Tunnel option, construction of the Pearl City WWPS Force Main would temporarily interfere with the Pearl Harbor Bike Path. Replacement location Alternative No. 3 for a relocated Pearl City WWPS also would require temporary interference with the Pearl Harbor Bike Path, as may replacement location Alternative No. 1, which would be constructed along Lehua Avenue across the street from Lehua Community Park. Replacement location Alternative No. 2 would be constructed in Lehua Community Park, along Lehua Avenue.

For the Hybrid option, construction of the Pearl City-Waipahu Trunk Sewer would result in temporary interference with the Pearl Harbor Bike Path near the bored tunnel boring machine retrieval shaft location (at the existing Pearl City WWPS), multiple microtunnel shafts, and tunnel construction staging areas.

For the Waiawa Area conveyance options, construction of any of the three (3) corridors would temporarily interfere with the Pearl Harbor Bike Path.

3.13.3.3 OPERATIONAL IMPACTS AND MITIGATION MEASURES

No operational long-term impacts to park land are anticipated, other than periodic inspection and/or maintenance of adjacent proposed facilities.

For the No-Tunnel option, there are public concerns regarding odor control due to the proximity of the Pearl City WWPS replacement location alternatives to Lehua

Community Park. To address these concerns, if the option to relocate the Pearl City WWPS is elected, additional odor control measures would be implemented at the WWPS to result in minimal odor impacts to neighboring uses, including Lehu Community Park.

3.14 LAND OWNERSHIP

3.14.1 Existing Setting

The project area is located in Tax Map Key (TMK) Zone 9 Sections 1 through 4 and 6 through 9, and spans multiple properties. Figure 3-23 shows government land ownership within and adjacent to the existing system utilities and the Proposed Action including state, State Department of Hawaiian Home Lands, County, and federal lands.

3.14.2 Construction Impacts and Mitigation Measures

Regardless of the selected option, the majority of the proposed construction would be along or near existing roadway easements and utility corridors associated with the East Interceptor. However, construction of the proposed Pearl City-Waipahu Trunk Sewer and Waiawa conveyance corridors may require new permanent easements. In addition, temporary easements and right-of entry would most likely be required throughout the project area during construction.

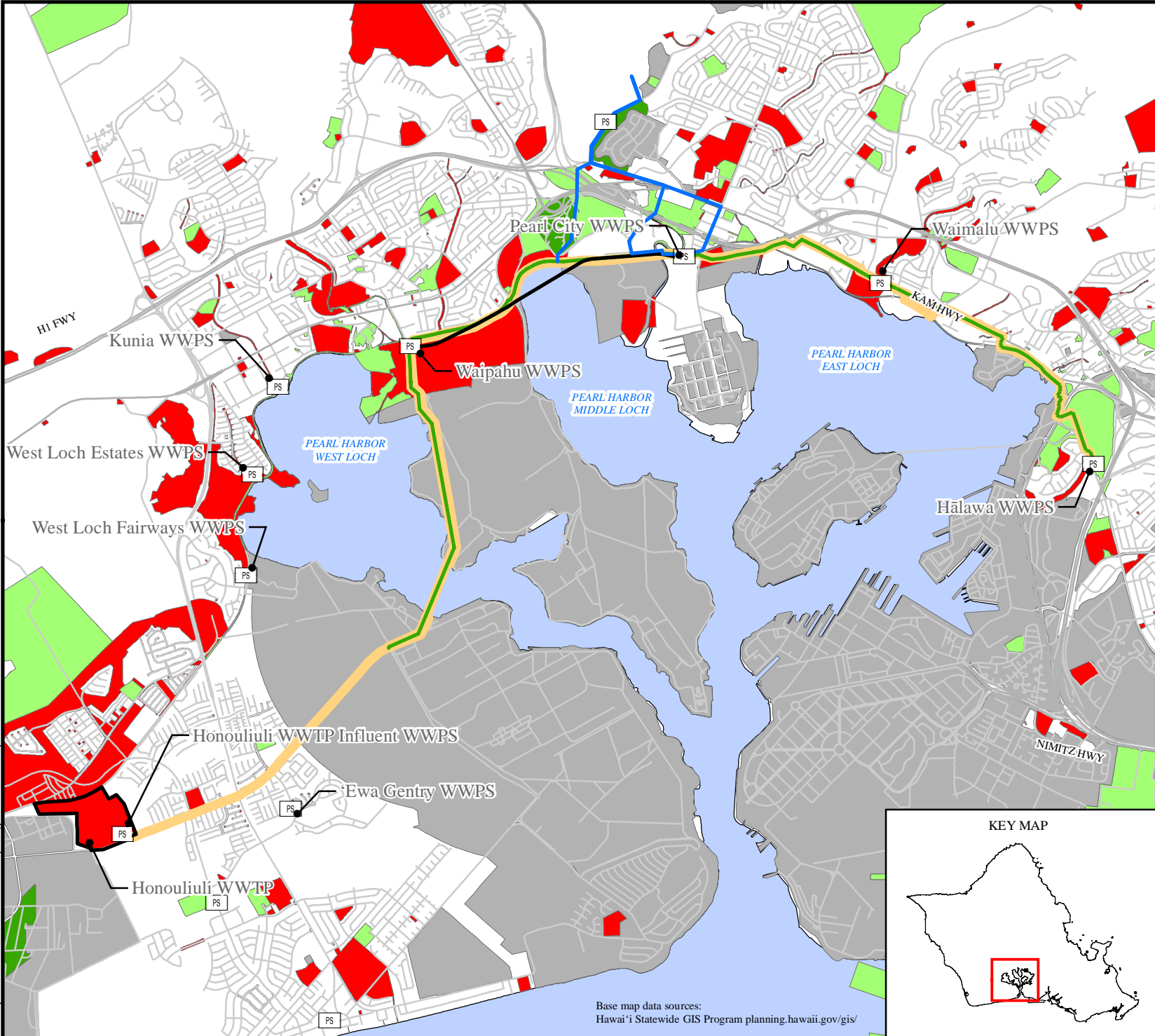
The new gravity lines and new manholes would, to the extent possible, be located in public rights-of-way on CCH-owned parcels and existing easements. Where CCH land or easements are not available, CCH may need to acquire new sewer easements. Where possible, these proposed easements would be located along parcel boundaries.

All collection system projects would entail land and easement negotiations with other city, state, federal, and private entities. These include the following land owners along the East Interceptor:

- City and County of Honolulu: Neil S. Blaisdell Park, Geiger Road
- State of Hawai'i: Pouhala Marsh, Aloha Stadium, Kamehameha Highway, Roosevelt Avenue
- United States Navy: Pearl Harbor
- Private: HECO, Kamehameha Schools

City and County of Honolulu

HONOLULULI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES



Legend

- Honouliuli WWTP
- Existing WWPS
- East Interceptor
- Hybrid Option Alignment
- Waiawa Conveyance Corridors (Options A, D, and G)
- New and/or Rehabilitated Force Mains and Trunk Sewers
- Streets

Government Land Ownership

- State
- State DHHL
- County
- Federal

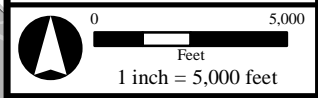
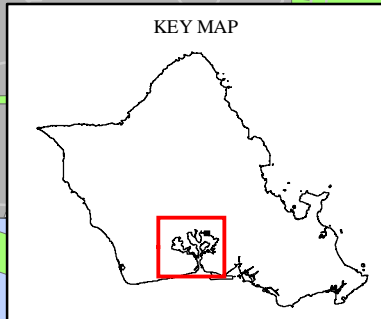


FIGURE 3-23
GOVERNMENT
LAND
OWNERSHIP



Base map data sources:
Hawai'i Statewide GIS Program planning.hawaii.gov/gis/

G:\Projects\MUNI\020849\HON\Maps\Fig 3-23 Ownership.mxd

The Pearl City Trunk Sewer would require land and easement negotiations with the state (Kamehameha Highway) and federal (Navy) entities, and the Waimalu Trunk Sewer would require a new easement within a state right-of-way.

The Hālawā WWPS, if relocated, would be constructed in the Aloha Stadium Lower Hālawā parking lot. The approval of the Secretary of the Interior may be required for conversion to uses other than public outdoor recreation, and land and easement negotiations would be required with the state (Aloha Stadium Authority).

For the No-Tunnel option, the Pearl City WWPS Force Main would be constructed within an existing 25-foot permanent easement or, alternatively, in a new parallel easement. Relocation of the Pearl City WWPS would require land and easement negotiations with federal entities. For the Hybrid option, the Waipahu WWPS No. 2 or Combined Flow WWPS would require coordination with City entities.

Among the Waiawa Area conveyance options, Corridor A would avoid private and federal lands. However, both Corridor D and Corridor G would require construction in private/federal lands and easements to be granted by the United States Navy.

3.14.3 Operational Impacts and Mitigation Measures

The operation of the proposed wastewater system improvements is expected to have minimal impact on land ownership.

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4.0 CUMULATIVE AND SECONDARY IMPACTS

According to Hawai'i Administrative Rules (HAR) Chapter 200, cumulative impact is the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

The Proposed Action, when considered in conjunction with past, present and reasonably foreseeable future actions to the environment, may result in cumulative impacts. Below is a summary of known conceptual and underway development. A review of potential cumulative and secondary impacts of the Proposed Action and other development is also provided.

4.1 CONCEPTUAL, PLANNED, AND UNDERWAY DEVELOPMENT

This section summarizes several larger-scale development projects in the project area that have the potential to contribute to cumulative impacts.

Koa Ridge Urban Design Plan

The Koa Ridge Urban Design Plan is located in Central O'ahu on the west side of the H-2 Freeway. The site is 576 acres. The project includes 3,500 residences, 29 acres of regional retail, a 28-acre healthcare district, light industrial space, 17 acres of mixed-use, including a 150-room hotel, a 12-acre elementary school site, and 14-acre public park. The project is under construction and estimated to be complete by 2029 (City and County of Honolulu Department of Planning and Permitting (DPP) 2018). The project is located approximately three quarters of a mile northwest of the northern end of Waiawa Area Corridor A.

Ho'opili

The Ho'opili development is an approximately 1,500-1,600 acre development in 'Ewa. Phase I includes 151 single family homes and duplexes and 142 townhouses. Zoning includes: 144 acres of business mixed-use; 219 acres of apartment mixed-use; 48 acres zoned P-2 General Preservation; 223 acres zoned AG-1 restricted agricultural business; and 159 acres zoned for farming. The project also includes a 15-acre middle school, 45-acre high school, 34 acres for three (3) elementary schools, and 8 acres of community gardens. Ho'opili is under construction and estimated to be completed in 2026 (Shimogawa 2016; Group 70 International, Inc. 2018). The development is located approximately 0.6 miles from the location of the Waipahu Wastewater Pump Station (WWPS).

Live Work Play ‘Aiea

The proposed Live Work Play ‘Aiea development includes 1,500 residential units in five towers, as well as offices, restaurants, retail shops, a hotel, a neighborhood market and public spaces (Shimogawa 2018). The project has experienced delays and construction schedule is unknown (Pacific Business News 2017). The project would be located at the corner of Moanalua Road and Kaonohi Street approximately 0.5 miles east of the location of the Waimalu WWPS and 600 feet north of the proposed Waimalu Influent Trunk Sewer.

Aiea-Pearl City Neighborhood TOD Plan

The Aiea-Pearl City Neighborhood Transit-Oriented Development (TOD) Plan comprises a community vision for the neighborhoods surrounding the Leeward Community College, Pearl Highlands, and Pearlridge rail stations. The Plan is conceptual in nature. The TOD plan anticipates development occurring in the near (0-10 years), mid (10-20 years), and long-term (20-30 years) (Van Meter Williams Pollack, LLP et al. 2014).

Leeward Community College Station Plan

Existing site is 27.3 acres with 48,000 square feet (SF) of institutional space. Proposed development includes 820 residential units and 88,000 SF of institutional and commercial (retail/office/industrial) space. A new bike path, proposed street pattern, and new surface parking would improve transportation. A one-acre neighborhood minipark is proposed to enhance views of the harbor (Van Meter Williams Pollack, LLP et al. 2014). Waiawa Area Corridors D and G lie adjacent to and within the proposed development area for Leeward Community College Station.

Pearl Highlands Station Area Plan

The existing site is 100 acres and includes 90 residential units and 985,000 SF of commercial space. The proposed program for Pearl Highlands includes 1,500 residential units and 1,105,000 SF of commercial (retail/office/industrial) space. This area is proposed to serve as a major park-and-ride along the rail transit line. A total of 1,600 parking spaces and a bus transit facility are proposed. The plan includes multi-use pathways, new and enhanced open spaces, new miniparks, and a new transit plaza (Van Meter Williams Pollack, LLP et al. 2014). The Pearl City Highlands Center, located on the west side of the project, is adjacent to Waiawa Area Corridor A.

Pearlridge Station Area Plan

The existing Pearlridge site is 180 acres and includes 460 residential units and 2,900,000 SF of commercial space. The proposed TOD plan includes 3,900 residential units and 2,990,000 SF of commercial (retail/office/industrial) space. Proposed improvements include a bus transit facility, bicycle and pedestrian path and facility improvements, and preservation and enhancement of views of the harbor (Van Meter Williams Pollack, LLP et al. 2014). The proposed Waimalu Influent Trunk Sewer lies within planned redevelopment of the Pearlridge Station Area.

Waipahu Neighborhood TOD Plan

The Waipahu Neighborhood TOD Plan focuses on two proposed transit stations at the intersections of Farrington/Mokula Streets and Farrington/Leoku in an area that is projected to continue to grow faster than the rest of O’ahu. The TOD plan is conceptual in nature. Five (5) phases are identified starting with the opening of the transit stations and continuing through the final phase, which is anticipated to occur within 20-25 years of the station opening (Van Meter Williams Pollack, LLP 2014).

Farrington/Mokula Streets

The Farrington/Mokula Station Area Plan includes a new transit center and transit plazas, parks, mini parks, and restoration of the Kapakahi Stream. Proposed uses include mixed-use residential, mixed-use commercial, retail, employment, civic, and structured parking. The following is proposed by 2030 (Van Meter Williams Pollack, LLP 2014):

- There will be a net increase of approximately 1,520 residential units.
- The existing inventory of commercial and industrial space will be replaced with new building and the amount of space will remain unchanged at approximately 971,000 SF.
- Approximately 70 percent of newly developed space will be for residential uses, and 30 percent will be for commercial/industrial uses.
- Farrington and Mokula Streets are located approximately 2,000 feet north of the location of the proposed new Pearl City Third force main (FM) and the location of the Waipahu WWPS.

Farrington/Leoku Streets

The Farrington/Leoku Station Area Plan proposes to concentrate development adjacent to the transit station and create landmark buildings to serve as a gateway to Waipahu. Parks and open spaces are proposed to help create a green network and enhance connectivity to Pearl Harbor. The Plan also includes restoration of the drainage channel between Waipahu Street and Pearl Harbor and strengthening the link between the station area to the Pearl Harbor Historic Trail/bike path. By 2030, the following is proposed (Van Meter Williams Pollack, LLP 2014):

- A net increase in residential units of approximately 3,000 residential units
- A net increase of approximately 49,000 SF of commercial/industrial space in new buildings, with a 3:1 ratio of commercial to industrial uses.

Farrington and Leoki Streets are located approximately 1.25 miles west of the location of the Waipahu WWPS.

Halawa Area TOD Plan

The Halawa Area TOD Plan proposes redevelopment of the 100-acre Aloha Stadium Site into a mixed-use community surrounding a downsized (30,000- to 40,000-seat) stadium. The Plan includes 5.2 million SF of potential new residential, commercial, and office space, as well as infrastructure improvements. The capacity of water,

storm, and wastewater systems are generally sufficient now but would need to be expanded to accommodate growth in the area. The Plan is conceptual in nature and would take 20-40 years to implement (CallisonRTKL et al. 2017). Three (3) alternative scenarios associated with this plan are summarized in Table 4-1.

Table 4-1. Alternative Scenarios Considered in the Halawa Area TOD Plan

	Alternative Scenarios		
	The Grid	The Crescent	Corridors
Residential Units (#)	1,930	1,450	1,600
Retail/restaurant (SF)	75,000	180,000	220,000
Office/institutional (SF)	50,000	380,000	430,000
Hotel rooms (#)	180	270	200
Entertainment/cultural (SF)	100,000	100,000	100,000
Aloha Stadium seats (#)	30,000-40,000	30,000-40,000	30,000-40,000

Source: CallisonRTKL et al. 2017

Additional development sites include the 13-acre Aiea Elementary School site; 12-acre Puuwai Momi site; 17-acre Stadium Marketplace; and 7-acre Stadium Mall site (CallisonRTKL et al. 2017). The existing and alternative locations of the Hālawa WWPSs are located within the proposed redevelopment site. The proposed Hālawa FM is located adjacent to the site. The alternate Hālawa gravity sewer alignment along Salt Lake Boulevard is located adjacent to the Aloha Stadium Transit Station.

4.2 POTENTIAL CUMULATIVE AND SECONDARY IMPACTS

4.2.1 Infrastructure and Utilities

The Proposed Action may contribute cumulative and secondary impacts to water resources, water and wastewater infrastructure, and solid waste disposal. The increase wastewater infrastructure that the Proposed Action would provide would enable increased growth, which would increase the demand for water and the burden on drinking water infrastructure. The Proposed Action would increase capacity of the wastewater conveyance system and result in increased discharge wastewater effluent and generation of wastewater solids. During construction of the Proposed Action, the volume of construction waste would increase.

The expanded infrastructure would also potentially have greater maintenance, repair, and replacement costs. While the Proposed Action would improve the integrity of the aging system, the addition of more infrastructure may increase the risk of leakage.

More infrastructure and capacity would require more power. Thus, the Proposed Action would likely increase greenhouse gas (GHG) emissions. GHG emissions

associated with the Proposed Action would be analyzed based on the specific projects chosen for implementation.

4.2.2 Increased Development and Population

Increased population growth, population density, and development are anticipated long-term, and there could be cumulative impacts associated with increased wastewater capacity provided by the Proposed Action and increased future demand associated with planned and conceptual development.

Increased development would result in increased impervious surfaces, which may increase nonpoint source pollution and stream temperature. Buildings and paved surfaces could also contribute to the urban heat island effect, impacting localized air temperature. While the proposed footprint of the WWPS alternatives would not create a significant amount of increased impervious surface area, the WWPSs would require stormwater management. At a regional scale, the effect of supporting greater development and associated impervious surfaces may impact flood vulnerability in both coastal and inland areas.

Secondary impacts of greater population density and infrastructure include increased potential damage to property and risk of injury or death during an earthquake, tsunami, or other storm or extreme weather event. Increased coastal development in areas that are vulnerable to sea level rise and coastal hazards would likely result in an increase in economic impacts associated with flood damage to properties.

Increased development may have long-term, cumulative impacts to aesthetic and visual resources. Dense development may impact views of surrounding mountain ranges and the lochs.

While increased population density and development would increase stress on natural systems, the Proposed Action is located within and adjacent to areas that are already urbanized, thus limiting the pressure to develop forests and agricultural land. Furthermore, there are limited impacts to open space associated with the Proposed Action. The TOD plans, which would drive much of the major future development within the vicinity of the Proposed Action, call for increased parks, miniparks, and other open space.

4.2.3 Transportation

The impact of additional development would have implications for transportation infrastructure. Increased development would increase the number of trips, miles traveled on roadways, and demand for new transportation infrastructure. As a result, there could be increased transportation construction and maintenance needs and costs.

4.2.4 Socioeconomic Impacts

The Proposed Action would support development of new housing options, commercial and industrial space, transportation options, and recreational and

cultural amenities. Thus, it is anticipated that the overall impact of the Proposed Action and other proposed development would have a positive impact on local socioeconomic conditions.

Ongoing construction in the region would provide local jobs to construction workers. As discussed in Section 3.11, the existing labor force may not be sufficient to support all proposed development in the region. If new workers were to enter the region in response to a construction labor shortage, the households that relocate to the region of influence would need a supply of housing, to which the local economies likely would respond by increasing the supply.

Both construction and operation effects from the Proposed Action would be beneficial, providing regional economic benefits from construction spending and labor, as well as long-term positive effects on employment and income in the region.

Although environmental justice populations and concentrations of children are present in the affected area, based on the analyses presented in this Draft Environmental Impact Statement (DEIS), the Proposed Action would have less than significant adverse human health or environmental impacts regardless of the selected option. Negative impacts on the population in the project vicinity are not anticipated, and the Proposed Action would minimize the potential for sanitary sewer overflows (SSOs) and protect public health and safety. The Proposed Action would increase the capacity of the existing Honouliuli East Interceptor System to safely and efficiently accommodate projected future flows through the 2050 planning period and provide an adequate wastewater system to support the needs of the population and economy in the service area. Refer to Section 3.11 for additional information.

5.0 RELATIONSHIP OF ACTION TO LAND USE PLANS AND POLICIES

Development within the State of Hawai'i is guided through a combination of land use plans, policies, and controls set at the State level and tiered down to the City and County of Honolulu (CCH) level. This section addresses the various guidance documents, rules, and regulations that were analyzed in the preparation of this Draft Environmental Impact Statement (DEIS). This DEIS assesses the consistency of the Proposed Action options with development, plans, zoning, and special management area goals and requirements. The project area includes potential development activity within three (3) of the eight (8) planning areas of O'ahu: 'Ewa, Central O'ahu, and the Primary Urban Center (PUC).

5.1 STATE OF HAWAI'I

The State of Hawai'i maintains a statewide planning system that includes State and County Land Use Plans, Policies and Controls to provide standards and guidelines for development. At the State level, this DEIS assesses the Proposed Action's compliance and consistency with the Hawai'i State Plan, State Functional Plans, Hawai'i 2050 Sustainability Plan, Coastal Zone Management (CZM) Program, Ocean Resources Management Plan (ORMP), and State Land Use Classification. Appropriate Plans, Policies, and Controls to assist in evaluating the options to best meet future needs are referenced below.

5.1.1 Hawai'i State Plan

5.1.1.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

The Hawai'i State Planning Act was adopted in 1978 and is codified under Hawai'i Revised Statutes (HRS) Chapter 226. The Act sets forth the Hawai'i State Plan, revised in 1986. The Hawai'i State Plan identifies overall goals, objectives, policies, and priorities for the State to guide future long-range development. This DEIS evaluates the Honouliuli wastewater system to maintain basic public health and sanitation standards, plan to accommodate the needs of Hawai'i's people through coordination of facility systems, and to promote the adequate development of sewerage facilities that complement planned growth.

The purpose of the Hawai'i State Plan, as defined in HRS Chapter 226, is to:

- Serve as a guide for the future long-range development of the State;
- Identify the goals, objectives, policies, and priorities for the State;
- Provide a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources;
- Improve coordination of federal, state, and county plans, policies, programs, projects, and regulatory activities;

- Establish a system for plan formulation and program coordination to provide for an integration of all major state, and county activities (HRS Title 13, Chapter 226).

The overall theme of the plan establishes community or social well-being as a principal and value that is generally accepted by both individuals and groups as an integral part of society. As stated in Chapter 226-3(3):

Community or social well-being is a value that encompasses many things. In essence, it refers to healthy social, economic, and physical environments that benefit the community as a whole. A sense of social responsibility, of caring for others and for the well-being of our community and of participating in social and political life, are important aspects of this concept. It further implies the aloha spirit-attitudes of tolerance, respect, cooperation and unselfish giving, within which Hawaii's society can progress (HRS Title 13, Chapter 226).

State goals identified in Chapter 226-4 are pertinent to the Proposed Action. These include:

(1) A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.

(2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people (HRS Title 13, Chapter 226).

The following objectives and policies related to liquid waste facility systems are particularly relevant to wastewater facility planning:

Chapter 226-14 Objective and policies for facility systems – in general

(a) Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.

(b) To achieve the general facility systems objective, it shall be the policy of this State to:

(1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with state and county plans.

(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.

(3) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.

(4) Pursue alternative methods of financing programs and projects and cost-saving techniques in the planning, construction, and maintenance of facility systems (HRS Title 13, Chapter 226).

Chapter 226-15 Objectives and policies for facility systems – solid and liquid wastes

(a) Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives:

- (1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.*
- (2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility, and other areas.*

(b) To achieve solid and liquid waste objectives, it shall be the policy of this State to:

- (1) Encourage the adequate development of sewerage facilities that complement planned growth.*
- (2) Promote reuse and recycling to reduce solid and liquid wastes and employ a conservation ethic.*
- (3) Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes (HRS Title 13, Chapter 226).*

5.1.1.2 DISCUSSION

The Proposed Action is consistent with the above objectives and policies of the Hawai'i State Plan. The Proposed Action aligns with the Hawai'i State Plan values of community well-being and goals of a viable economy and clean environment. The Proposed Action would address rehabilitation needs of existing wastewater infrastructure and minimize the potential for sanitary sewer overflows. The proposed wastewater infrastructure improvements are necessary for maintaining basic sanitation standards that are critical to public health and safety and protection of groundwater and other natural resources and the environment. Additionally, the wastewater improvements would result in adequate sewerage facilities to support current and future economic activities. New conveyance infrastructure would serve planned development and growth in the wastewater tributary area, including proposed development in the Waiawa area, which aligns with the State Plan objectives and policies for liquid waste facility systems. The Proposed Action aligns with the facilities and infrastructure objectives of proactive wastewater planning in the PUC, 'Ewa, and Central O'ahu Development and Sustainable Communities Plans.

5.1.2 State Functional Plans

5.1.2.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

State Functional Plans provide the framework for implementation of the Hawai'i State Plan by establishing policies and guidelines for specific activities. State Functional Plans are developed by the agency responsible for the functional area, including agriculture, conservation lands, education, energy, higher education, health, historic preservation, housing, recreation, tourism, and transportation. Objectives and policies of Chapter 226-5 through 226-27 and the priority guidelines

of Chapter 226-102 through 226-107 were reviewed for their applicability to the Proposed Action.

5.1.2.2 DISCUSSION

Chapters 226-14 and 226-15, excerpted above, are applicable to the Proposed Action. The Proposed Action accommodates needs through coordination of facility systems and capital improvement priorities consistent with state and county plans. The Proposed Action conforms with the Hawai'i State Plan's facility planning objective for solid and liquid wastes by maintaining basic public health sanitation standards and providing adequate sewerage facilities for physical and economic activities that complement planned growth. As discussed in Section 5.2.2, it supports development in areas that are targeted for growth by providing additional capacity. The Proposed Action is consistent with the objectives and policies for facility systems, in general, and those of solid and liquid wastes as described in Chapters 226-14 and 226-15.

5.1.3 Hawai'i 2050 Sustainability Plan

5.1.3.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

Act 8 Special Session Laws of Hawai'i 2005 established the Hawai'i Sustainability Task Force and directed the Task Force to develop a Hawai'i 2050 Sustainability Plan to address the vital needs of Hawai'i through the year 2050 and beyond.

The Hawai'i 2050 Sustainability Plan was published in 2008 by the State Auditor and the Hawai'i 2050 Sustainability Task Force and served as a long-range plan for Hawai'i to prepare for global warming, climate impact planning, and sustainability planning. The plan encourages the use of renewable energy, reducing Hawai'i's greenhouse gases, promoting water conservation and reuse, advocating for waste reduction, increasing Hawai'i's food security, supporting clean transportation, promoting pedestrian and bicycle accessibility, encouraging smart-growth, planning for sea level rise, stressing the need for affordable housing, encouraging a diversified economy, and supporting our indigenous Native Hawaiian culture.

Hawai'i 2050 creates a long-term action agenda for achieving sustainability. The Plan defines a sustainable Hawai'i as a Hawai'i that:

- Respects the culture, character, beauty, and history of our state's island communities;
- Strikes a balance among economic, social and community, and environmental priority;
- Meets the needs of the present without compromising the ability of future generations to meet their own needs;
- Plan has five (5) goals;
- Living sustainably is part of our daily practice in Hawai'i;

- Our diversified and globally competitive economy enables us to meaningfully live, work and play in Hawai‘i;
- Our natural resources are responsibly and respectfully used, replenished and preserved for future generations;
- Our community is strong, healthy, vibrant and nurturing, providing safety nets for those in need;
- Our Kanaka Maoli and island cultures and values are thriving and perpetuated (Hawai‘i Sustainability Task Force 2008, Hawai‘i Office of Planning 2018).

5.1.3.2 DISCUSSION

Hawai‘i 2050 recognizes that public infrastructure, including wastewater systems, is essential to building a strong economy, protecting the environment, and enhancing quality of life. The Proposed Action conforms to this objective by maintaining aging infrastructure and reducing potential sewer overflows, which threaten surface and groundwater resources. The Proposed Action supports economic development and growth. It targets growth in and adjacent to urban areas rather than undeveloped land and encourages density in areas targeted for development. The Proposed Action also supports transit-oriented development (TOD), which would lead to reduced dependence on fossil fuels, usage of personal vehicles, and would increase housing options. This aligns with the plan’s objectives of efficiently using infrastructure dollars and adopting smart growth polices to guide decision-making.

5.1.4 Coastal Zone Management Program

5.1.4.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

The purpose of the Hawai‘i CZM Program is to “provide for the effective management, beneficial use, protection, and development of the coastal zone”. Hawai‘i’s CZM Program was established through HRS Chapter 205A and is administered by the Hawai‘i Office of Planning. 205A requires compliance with CZM objectives and policies outlined in Chapter 205A-2(b). A review of the objectives and policies of Chapter 205A-2(b) and discussion of how the Proposed Action conforms with Chapter 205A-2(b) follows (HRS Title 13, Chapter 205A).

5.1.4.2 RECREATIONAL RESOURCES

Objective:

Provide coastal recreational opportunities accessible to the public.

Policies:

- (A) *Improve coordination and funding of coastal recreational planning and management; and*
- (B) *Provide adequate, accessible, and diverse recreational opportunities in the coastal zone management area by:*
 - (i) *Protecting coastal resources uniquely suited for recreational activities that cannot be provided in other areas;*
 - (ii) *Requiring replacement of coastal resources having significant recreational value including, but not limited to surfing sites, fishponds, and sand beaches, when such resources will be unavoidably damaged by development; or requiring reasonable monetary compensation to the State for recreation when replacement is not feasible or desirable;*
 - (iii) *Providing and managing adequate public access, consistent with conservation of natural resources, to and along shorelines with recreational value;*
 - (iv) *Providing an adequate supply of shoreline parks and other recreational facilities suitable for public recreation;*
 - (v) *Ensuring public recreational uses of county, state, and federally owned or controlled shoreline lands and waters having recreational value consistent with public safety standards and conservation of natural resources;*
 - (vi) *Adopting water quality standards and regulating point and nonpoint sources of pollution to protect, and where feasible, restore the recreational value of coastal waters;*
 - (vii) *Developing new shoreline recreational opportunities, where appropriate, such as artificial lagoons, artificial beaches, and artificial reefs for surfing and fishing; and*
 - (viii) *Encouraging reasonable dedication of shoreline areas with recreational value for public use as part of discretionary approvals or permits by the land use commission, board of land and natural resources, and county authorities; and crediting such dedication against the requirements of section 46-6 (HRS Title 13, Chapter 205A).*

Discussion

Parks that are anticipated to be directly affected by at least one (1) of the Proposed Action options include Lehua Community Park, Pacheco Neighborhood Park, Neil S. Blaisdell Park, Waipi'o Peninsula Sports Complex, 'Aiea Bay State Recreation Area, Pearl Harbor Bike Path, and Ted Makalena Golf Course. The following impacts to recreation may result:

- The proposed Waimalu WWPS FM (New) runs along and adjacent to Route 99. It is proposed to cross into the northeast edge of Neil S. Blaisdell Park, which may result in temporary impacts during construction.

- The replacement location for the Waimalu Wastewater Pump Station (WWPS) is in Neal S. Blaisdell Park. The presence of the WWPS would have a minimal impact on the area of park space available for recreation.
- The proposed Pearl City WWPS FM (New) and the proposed Pearl City FM Rehabilitation are located along the existing Pearl City dual force mains (FMs), which run along the north side of the Ted Makalena Golf Course, Pearl Harbor Middle Loch, and the Pearl Harbor National Wildlife Refuge. These areas may experience temporary impacts during construction.
- The Alternative Pearl City WWPS No. 2 location is within Lehua Community Park. The presence of the WWPS would have a minimal impact on the area of park space available for recreation.
- If the Hybrid option is implemented, tunneling may result in impacts to water recreation in Pearl Harbor during construction. Tunneling may also temporarily increase turbidity.

One (1) of the primary objectives of the Proposed Action is to avoid impairment of public use of existing parks or to replace in-kind taking of park land. No operational long-term impacts to park lands are anticipated other than periodic inspection and/or maintenance of adjacent proposed facilities. Short-term impacts during construction include additional noise and traffic at or near the parks and recreational areas. Short-term transportation impacts may include inconvenience to bicyclists, pedestrians, and joggers.

Treatment has no anticipated impacts on offshore waters at the Barbers Point Deep Ocean Outfall discharge location; however, the Proposed Action may result in future increase in effluent discharged to Māmala Bay.

5.1.4.3 HISTORIC RESOURCES

Objective:

Protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture.

Policies:

- (A) *Identify and analyze significant archaeological resources;*
- (B) *Maximize information retention through preservation of remains and artifacts or salvage operations; and*
- (C) *Support state goals for protection, restoration, interpretation, and display of historic resources (HRS Title 13, Chapter 205A).*

Discussion

As discussed in Section 3.6, historic resources such as artifacts, trash pits, privies, and building foundations or other subsurface structural features, bridges, military facilities, commercial buildings, and residences are found throughout the project area. There are also historic districts, such as the Pearl Harbor National Historic Landmark District that encompass groups of resources.

Temporary and permanent impacts to known and as-yet unidentified archaeological and historic properties in the project area could occur from construction activities, including open trenching, microtunneling and horizontal drilling using shafts, demolition and construction of pump stations, and temporary activities such as the creation and use of construction staging areas and access routes. Mitigation of potential construction impacts are described in Section 3.6.1.2. Once construction is completed and the conveyance systems are operational, the operation and maintenance of the proposed facilities is not anticipated to affect archaeological and historic resources regardless of the options implemented. If maintenance activities include the use of construction equipment in the vicinity of identified historic and archaeological resources, or any ground disturbance, mitigation measures identified for construction in Section 3.6.1.2 would be implemented.

5.1.4.4 SCENIC AND OPEN SPACE RESOURCES

Objective:

Protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.

Policies:

- (A) *Identify valued scenic resources in the coastal zone management area;*
- (B) *Ensure that new developments are compatible with their visual environment by designing and locating such developments to minimize the alteration of natural landforms and existing public views to and along the shoreline;*
- (C) *Preserve, maintain, and, where desirable, improve and restore shoreline open space and scenic resources; and*
- (D) *Encourage those developments that are not coastal dependent to locate in inland areas (HRS Title 13, Chapter 205A).*

Discussion

The Proposed Action is not anticipated to have significant adverse visual effects. The Proposed Action is located primarily within existing roadway and utility easements. New pump stations would be designed to be compatible with the existing surrounding built environment. The viewshed in the vicinity of the Proposed Action would be temporarily altered by presence of construction equipment and personnel. During construction, public access may be limited or restricted for safety purposes.

5.1.4.5 COASTAL ECOSYSTEMS

Objective:

Protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.

Policies:

- (A) *Exercise an overall conservation ethic, and practice stewardship in the protection, use, and development of marine and coastal resources;*
- (B) *Improve the technical basis for natural resource management;*
- (C) *Preserve valuable coastal ecosystems, including reefs, of significant biological or economic importance;*
- (D) *Minimize disruption or degradation of coastal water ecosystems by effective regulation of stream diversions, channelization, and similar land and water uses, recognizing competing water needs; and*
- (E) *Promote water quantity and quality planning and management practices that reflect the tolerance of fresh water and marine ecosystems and maintain and enhance water quality through the development and implementation of point and nonpoint source water pollution control measures (HRS Title 13, Chapter 205A).*

Discussion

The Proposed Action is expected to result in a positive impact on coastal water by minimizing the potential for sanitary sewer overflows (SSOs) from the existing conveyance. The Proposed Action may result in increased effluent discharged to Māmala Bay; however, all effluent would be treated to required National Pollutant Discharge Elimination (NPDES) permit standards. A portion of the effluent would be discharged to Malama Bay and the remainder would be reclaimed for reuse for irrigation and industry.

5.1.4.6 ECONOMIC USES

Objective:

Provide public or private facilities and improvements important to the State's economy in suitable locations.

Policies:

- (A) *Concentrate coastal dependent development in appropriate areas;*
- (B) *Ensure that coastal dependent development such as harbors and ports, and coastal related development such as visitor industry facilities and energy generating facilities, are located, designed, and constructed to minimize adverse social, visual, and environmental impacts in the coastal zone management area; and*
- (C) *Direct the location and expansion of coastal dependent developments to areas presently designated and used for such developments and permit reasonable long-term growth at such areas, and permit coastal dependent development outside of presently designated areas when:*
 - (i) *Use of presently designated locations is not feasible;*

- (ii) Adverse environmental effects are minimized; and*
- (iii) The development is important to the State's economy (HRS Title 13, Chapter 205A).*

Discussion

The Proposed Action would support development in areas targeted for growth, including transit-oriented development. The Proposed Action would cost an estimated \$784 million to \$888 million to complete, depending on the East Interceptor and Waiawa Area options constructed (AECOM Technical Services, Inc. (AECOM) 2016b, 2018).

Depending on the options selected, the Proposed Action would provide up to an estimated average annual impact of about \$120 million, which would support 690 jobs, earnings of \$40 million, and fiscal revenues of \$7.8 million per year. Provided each job or employee represents one household and assuming the current average household size of 3.06 people in Honolulu County (United States Census Bureau (USCB) 2019), direct, indirect, and induced jobs provided by project construction would support approximately 2,110 residents, on average, during project construction. Although this estimate assumes that the economic impacts would benefit Honolulu County residents, impacts would accrue to local, county, and off-island residents to varying degrees, depending on the relative capacities of the ROI, Honolulu, and Hawai'i construction labor forces. Refer to Section 3.11 of this DEIS and Appendix G for additional information about the economic impact of the Proposed Action.

A majority of the Proposed Action would be below-grade and, thus, would have limited post-construction visual impacts. Above-grade project components (i.e., WWPSs) would be designed to blend into the surrounding development and would be appropriately screened. The WWPSs have a relatively small footprint and are not anticipated to have significant impacts to the surrounding coastline.

Construction and post-construction stormwater management would be implemented to mitigate any potential adverse impacts associated with runoff during construction or impervious surfaces. Overall, the Proposed Action have a positive impact on the environment by minimizing the risk of leaks and overflows associated with older infrastructure, and providing capacity for new development to connect to the wastewater system.

5.1.4.7 COASTAL HAZARDS

Objective:

Reduce hazard to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution.

Policies:

- (A) Develop and communicate adequate information about storm wave, tsunami, flood, erosion, subsidence, and point and nonpoint source pollution hazards;*

- (B) *Control development in areas subject to storm wave, tsunami, flood, erosion, hurricane, wind, subsidence, and point and nonpoint source pollution hazards;*
- (C) *Ensure that developments comply with requirements of the Federal Flood Insurance Program; and*
- (D) *Prevent coastal flooding from inland projects (HRS Title 13, Chapter 205A).*

Discussion

Coastal areas are vulnerable to hazards including hurricanes, tsunamis, storm surge, erosion, flooding, and sea level rise. The potential for the Proposed Action to be impacted by climate change, hazards, and other coastal threats is evaluated in Section 3 of this DEIS.

To mitigate the potential impacts of strong wind and flooding, projects would be designed according to 2012 State Building Code standards for the appropriate wind exposure rating, and critical electrical and mechanical infrastructure would be located above 100-year floodplain elevations.

Projects would be designed in accordance with CCH special flood hazard area (SFHA) standards for stormwater and water quality to reduce the potential for non-point source pollution during and post-construction. Back-up power would be installed at WWPSs to allow continued operations and reduce risk of sewer overflow or leak in the event of a power outage. It is not anticipated that the Proposed Action would have a significant adverse impact on coastal flooding.

During and post-construction, construction works and facility operators would adhere to evaluation and warning alerts for earthquakes, tsunamis, and other severe weather. There are no habitable structures proposed as part of the Proposed Action; however, the City and County of Honolulu Department of Environmental Services (ENV) would coordinate with City and County of Honolulu Department of Emergency Management to implement evacuation procedures as needed.

Overall, the Proposed Action would improve the integrity and capacity of the wastewater system, thus reducing the potential for leaks and overflows that may cause pollution.

5.1.4.8 MANAGING DEVELOPMENT

Objective:

Improve the development review process, communication, and public participation in the management of coastal resources and hazards.

Policies:

- (A) *Use, implement, and enforce existing law effectively to the maximum extent possible in managing present and future coastal zone development;*
- (B) *Facilitate timely processing of applications for development permits and resolve overlapping or conflicting permit requirements; and*
- (C) *Communicate the potential short and long-term impacts of proposed significant coastal developments early in their life cycle and in terms*

understandable to the public to facilitate public participation in the planning and review process (HRS Title 13, Chapter 205A).

Discussion

The Proposed Action would adhere to local, state, and federal regulations. Refer to a list of permits required for the Proposed Action in Section 5.3 of this DEIS. All of Hawai'i is located in the CZM area; however, it is not anticipated that the coastal zone would be adversely impacted by the Proposed Action.

5.1.4.9 PUBLIC PARTICIPATION

Objective:

Stimulate public awareness, education, and participation in coastal management.

Policies:

- (A) *Promote public involvement in coastal zone management processes;*
- (B) *Disseminate information on coastal management issues by means of educational materials, published reports, staff contact, and public workshops for persons and organizations concerned with coastal issues, developments, and government activities; and*
- (C) *Organize workshops, policy dialogues, and site-specific mediations to respond to coastal issues and conflicts (HRS Title 13, Chapter 205A).*

Discussion

Public participation during the environmental review process benefits all parties involved. HRS Chapter 343 establishes a system of environmental review that allows environmental concerns to be given appropriate consideration in decision making along with economic and technical considerations. During the public comment period associated with filing the DEIS, public comments will be received and considered. All permits required as part of the Proposed Action would be subject to governmental agency and public review as well, as required by law.

5.1.4.10 BEACH PROTECTION

Objective:

Protect beaches for public use and recreation.

Policies:

- (A) *Locate new structures inland from the shoreline setback to conserve open space, minimize interference with natural shoreline processes, and minimize loss of improvements due to erosion;*
- (B) *Prohibit construction of private erosion-protection structures seaward of the shoreline, except when they result in improved aesthetic and engineering solutions to erosion at the sites and do not interfere with existing recreational and waterline activities;*
- (C) *Minimize the construction of public erosion-protection structures seaward of the shoreline;*

- (D) *Prohibit private property owners from creating a public nuisance by inducing or cultivating the private property owner's vegetation in a beach transit corridor; and*
- (E) *Prohibit private property owners from creating a public nuisance by allowing the private property owner's unmaintained vegetation to interfere or encroach upon a beach transit corridor (HRS Title 13, Chapter 205A).*

Discussion

The shoreline areas where East Interceptor System improvements are proposed lack sandy beaches. It is not anticipated that the Proposed Action would result in any impacts to beaches, natural shoreline processes, or public use and recreation provided by beaches.

5.1.4.11 MARINE RESOURCES

Objective:

Promote the protection, use, and development of marine and coastal resources to assure their sustainability.

Policies:

- (A) *Ensure that the use and development of marine and coastal resources are ecologically and environmentally sound and economically beneficial;*
- (B) *Coordinate the management of marine and coastal resources and activities to improve effectiveness and efficiency;*
- (C) *Assert and articulate the interests of the State as a partner with federal agencies in the sound management of ocean resources within the United States exclusive economic zone;*
- (D) *Promote research, study, and understanding of ocean processes, marine life, and other ocean resources to acquire and inventory information necessary to understand how ocean development activities relate to and impact upon ocean and coastal resources; and*
- (E) *Encourage research and development of new, innovative technologies for exploring, using, or protecting marine and coastal resources (HRS Title 13, Chapter 205A).*

Discussion

The Proposed Action is located within the coastal zone but involves little use of marine resources. Water treated at the Honouliuli Wastewater Treatment Plant (WWTP) would be discharged in through the Barbers Point Deep Ocean Outfall, approximately 1.7 miles offshore at a depth of 200 feet. Risks and potential impacts stormwater impacts to coastal waters would be mitigated through National Pollutant Discharge Elimination System (NPDES) permits. The Proposed Action is anticipated to have a positive impact on coastal water by minimizing the potential for SSOs from the existing conveyance system.

5.1.5 Ocean Resources Management Plan

5.1.5.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

The Hawai'i ORMP is a statewide plan mandated by HRS, Chapter 205A. The Hawai'i CZM Program in the State Office of Planning, Department of Business, Economic Development and Tourism (DBEDT), is charged with reviewing and periodically updating the ORMP, as well as coordinating its overall implementation. Developed in collaboration with government agencies, and with input from non-governmental organizations, private sector, community groups, and other stakeholders, the ORMP calls for substantive changes in the State's approach to natural and cultural resources management. It recommends an integrated approach to managing natural and cultural resources, building on traditional Hawaiian management principles, that considers the impacts of land based activities on ocean resources and fosters collaboration and stewardship (Hawai'i CZM Program 2013).

The ORMP vision for Hawai'i's ocean resources is for a healthy, productive, and sustainable ocean ecosystem that foster economic growth while preserving and protecting Hawai'i's values and needs. The eleven (11) management priorities of the ORMP are designed to strengthen ongoing efforts to manage ocean resources and demonstrate new integrated management approaches. These management priorities are organized under three perspectives to provide a focused framework for action: Perspective 1, Connecting Land and Sea; Perspective 2, Preserving Our Ocean Heritage; and Perspective 3, Promoting Collaboration and Stewardship (Hawai'i CZM Program 2013).

5.1.5.2 DISCUSSION

The Proposed Action conforms with the following strategy and action under Perspective 1:

Perspective 1 Connecting Land and Sea: Careful and appropriate use of the land is required to maintain the diverse array and economic benefits we derive from the sea.

Strategy 1.3: Improve and ensure maintenance and appropriate use of environmental infrastructure.

Action 5: Reduce the number of individual wastewater systems and illegal stormwater discharges to the wastewater system while inspecting and maintaining sewer collections systems, especially in the coastal environment.

- Develop appropriately scaled wastewater treatment systems in coastal areas with planned growth (Hawai'i CZM Program 2013).

The Proposed Action aligns with this strategy and action because it would result in rehabilitation of the existing wastewater infrastructure and increase capacity of the Honouliuli East Interceptor System to address future flows through the planning period.

The Plan specifies that *future population growth and accompanying growth in urbanization need to be properly managed to preserve the state’s natural resources while allowing necessary economic growth*. It recognizes that *polluted surface water runoff, combined with an aging sewer system incapable of handling systems overloads, is threatening coastal water quality* (Hawai’i CZM Program 2013). The Proposed Action furthers these objectives by replacing aging infrastructure and providing added sewer capacity for a planned development that is located in an upland area that is not directly vulnerable to coastal erosion or sea level rise. This aligns with the Plan’s policy to site projects appropriately. Future upland development may provide a suitable receiving area for residents who relocate in conjunction with a managed retreat program, which is among the strategies identified in the ORMP.

The wastewater would be treated at the Honouliuli WWTP and discharged through the Barbers Point Deep Ocean Outfall, located approximately 1.7 miles offshore at a depth of 200 feet. It is not anticipated to impact reef systems. The Proposed Action does not directly involve wastewater recycling; however, a portion of the effluent from the Honouliuli WWTP is reclaimed to provide R-1 water, as defined in Hawai’i Administrative Rules (HAR) Title 11, Chapter 62², and reverse osmosis water for irrigation and industrial uses.

During construction, stormwater management best management practices would be implemented to mitigate the potential for stormwater runoff to impact coastal waters.

5.1.6 State Land Use Classification

5.1.6.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

The Hawai’i Land Use Commission administers the statewide zoning law as outlined in Chapter 205 of the HRS and HAR Chapter 13-5. The purpose of the commission is to designate all lands in the state into one (1) of four (4) land use districts: Urban, Rural, Agricultural, and Conservation to preserve, protect and encourage development and preservation of lands for those uses to which they are best suited in the interest of public health and welfare of the people (Hawai’i Land Use Commission 2019). The project area extends over portions of land within three (3) of the four (4) land use districts:

- Urban District - areas with “city-like” concentrations of people, structures and services and vacant areas for future development. Jurisdiction lies with the respective county through ordinances and rules.
- Agricultural District – includes lands for cultivation of crops, aquaculture, raising livestock, wind energy facility, timber cultivation, agriculture support activities and land with significant potential for agriculture uses. Uses permitted within the district are based on the Land Study Bureau’s productivity categories. Lands

² HAR Title 11, Chapter 62 defines R-1 water as “recycled water that has been oxidized, filtered, and disinfected to meet the corresponding standards set in this chapter.”

in the highest productivity categories (A or B) are governed by statute and uses in the lower categories (C, D, E, or U) are established by the commission stated in HRS 205-4.5.

- Conservation District – lands comprised of existing forest and water reserve zones and area necessary to protect watersheds and water resources, scenic and historic areas, parks, wilderness, open space, recreational areas, habitats of endemic plants, fish and wildlife, and all submerged lands seaward of the shoreline. These areas are governed by the State Department of Land and Natural Resources (Hawai'i Land Use Commission 2019).

Permissible Uses within each district are defined in HAR Title 15, Chapter 15, Subchapter 3.

5.1.6.2 DISCUSSION

The project area extends over portions of land within three (3) of the four (4) land use districts, with a majority of the project area within urban and agricultural districts (see Figure 5-1):

Section 15-15-24 Permissible Uses Within the “U” Urban District:

Any and all uses permitted by the counties may be allowed in the U district subject to any conditions imposed by the commission pursuant to section 205-4(g), HRS. Uses that are permitted by CCH are described in Land Use / Zoning (Section 5.2.3) (HAR Title 15, Chapter 15 Land Use Commission Rules).

Section 15-15-25 Permissible Uses Within the “A” Agricultural District:

Portions of the Proposed Action are located within the agricultural district in areas that are classified as B, C, D, and E. Permissible uses within the agricultural district on land with soil classified by the land study bureau's detailed land classification as overall (master) productivity rating class A or B shall be those uses set forth in Section 205-4.5, HRS.

Permissible uses within the agricultural district on land with soil classified by the land study bureau's detailed land classification as overall (master) productivity rating class of C, D, E, and U shall be those uses as set forth in Sections 205-2, 205-4.5, and 205-5, HRS, and also uses compatible to the activities described in 205-2(d), HRS.












As identified by Section 205-4.5(7), the following use is permitted in the A and B classified areas within the agricultural district, as well as in the C, D, E, and U classified areas:

- 205-4.5(7) Public, private, and quasi-public utility lines and roadways, transformer stations, communications equipment buildings, solid waste transfer stations, major water storage tanks, and appurtenant small buildings such as booster pumping stations, but not including offices or yards for equipment, material, vehicle storage, repair or maintenance, treatment plants, corporation yards, or other similar structures (HAR Title 15, Chapter 15 Land Use Commission Rules).

City and County of Honolulu

HONOULIULI/ WAIPAHAU/ PEARL CITY FACILITIES PLAN

Legend

- PS Existing WWPS
 -  Hybrid Tunnel Shaft
 -  Honouliuli WWTP
 -  Special Mgmt Area
 -  Waiawa Conveyance Corridors (Options A, D, and G)
 -  Hybrid Option Alignment
 -  New and/or Rehabilitated Force Mains and Trunk Sewers
 -  East Interceptor
 -  Streets
- State Landuse District
-  Agricultural
 -  Conservation
 -  Urban

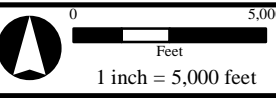
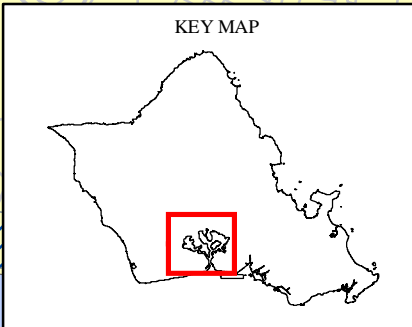
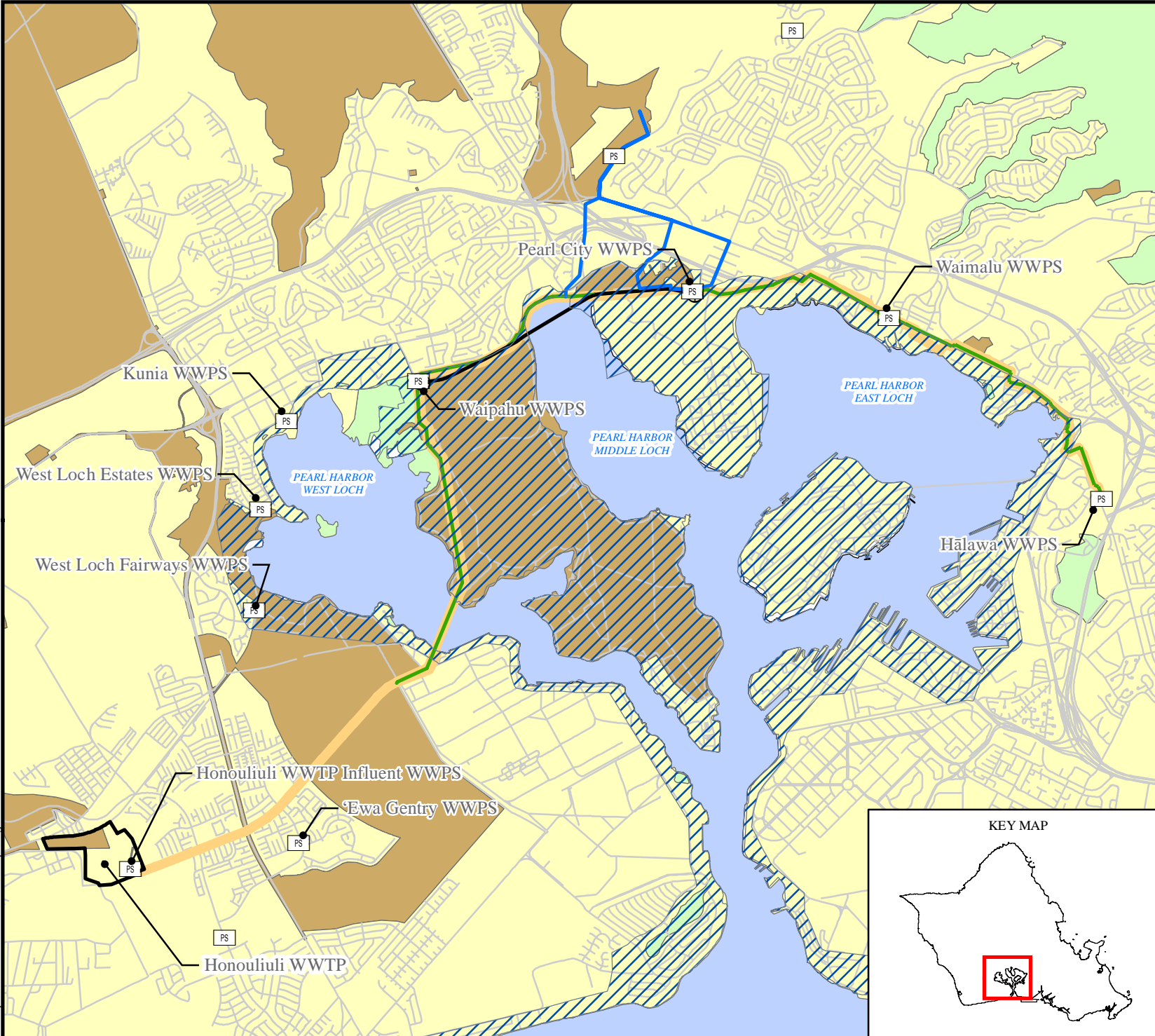


FIGURE 5-1

LAND USE DISTRICT AND SPECIAL MANAGEMENT AREA



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Section 15-15-26 Permissible Uses Within the “C” Conservation District:

A portion of the new conveyance facilities would be located within or adjacent to land within a conservation district near the Waipahu WWPS. Uses of land within a conservation district are governed by the rules of the State Department of Land and Natural Resources, Title 13, and Chapter 183c, HRS. New and rehabilitated force mains and trunk sewers along the existing East Interceptor are located within a conservation district near the Waipahu WWPS. Approximately 300 feet of the proposed Waipahu Dual Force Main Replacement lies on the edge of the protective subzone of the conservation district. The exact boundary of this subzone would need to be determined to verify that the FM does coincide with this subzone as the pipe would be located less than 10 feet inside the protective subzone boundary. Approximately 1,250 square feet (SF) of the limit of work of the existing Waipahu WWPS is also located within the protective subzone.

This portion of the Proposed Action would qualify as a public purpose use (D-1). This type of land use requires a permit from the Board of Land and Natural Resources per Section 13-5-22 (HAR Title 15, Chapter 15 Land Use Commission Rules).

In summary, the Proposed Action is permissible within the Urban District and the Agricultural District, however work within the conservation district would require a permit.

5.2 CITY AND COUNTY OF HONOLULU

The City and County of Honolulu Department of Planning and Permitting (DPP) manages anticipated future population and land use growth through policies, planning principles, guidelines and regulations set forth in the O’ahu General Plan, Development and Sustainable Community Plans, and implementing ordinances and regulations. This DEIS assesses the Proposed Action’s compliance consistency with the CCH General Plan, Development Plans, Land Use Ordinance / Zoning, Special Management Area, and Shoreline Setback. General Plan.

5.2.1 General Plan

5.2.1.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

The General Plan was adopted in 1977 with subsequent amendments leading to the 2017 Proposed Revised O’ahu General Plan. The General Plan is a comprehensive statement of objectives and policies that sets forth the long-range aspirations of O’ahu’s residents and the strategies to achieve them. The City’s planning process has three tiers:

1. The General Plan, which establishes policy guidance for O’ahu as a whole
2. Eight (8) regional Development Plans and Sustainable Communities Plans
3. Specific mechanisms to implement the two (2) higher levels of the planning hierarchy, including implementing ordinances and regulations, special area plans, and functional plans (CallisonRTKL 2017).

A review of the Proposed Action’s consistency with each of these planning tiers is below.

5.2.1.2 GENERAL PLAN SECTION V: TRANSPORTATION AND UTILITIES

Section V of the Proposed Revised General Plan pertains to Transportation and Utilities and is therefore relevant to the Proposed Action. Following are the objectives and policies pertaining to wastewater:

- Objective B: To provide an adequate supply of water and environmentally sound systems of waste disposal for O’ahu’s existing population and for future generations.
- Policy 6: Provide safe, reliable, efficient, and environmentally sound waste-collection and waste-disposal services that consider the impact of climate change during the siting and construction of new facilities.
- *Objective C: To ensure reliable, cost-effective and responsive service for all utilities.*
 - *Policy 1: Maintain and upgrade existing utility systems to avoid major breakdowns and service interruptions.*
 - *Policy 2: Provide improvements to utilities in existing neighborhoods to reduce substandard conditions.*
 - *Policy 3: Facilitate the timely and orderly expansion of utility systems*
- Objective D: To maintain transportation and utility systems which support O’ahu as a desirable place to live and visit.
- Policy 2: Evaluate the social, cultural, economic, and environmental impact of additions to the transportation and utility systems before they are constructed.
- Policy 5: Evaluate impacts of sea level rise on existing public infrastructure, especially sewage treatment plants, roads, and other public and private utilities along or near O’ahu’s coastal areas (DPP 2017).

Discussion

The Proposed Action aligns with the General Plan objectives of providing environmentally-sound systems of wastewater disposal for the current and future population. The Proposed Action would improve aging infrastructure, minimize potential for sanitary sewer overflows, reduced unscheduled maintenance, and increase capacity to serve planned development.

Consistent with Objective B, Policy 6, initial planning and design of the Proposed Action has taken into account the threats posed by climate change, including sea level rise and changes in precipitation. Several proposed WWPS alternatives involve relocation of the facility outside the 100-year floodplain. The existing Pearl City WWPS is located within the 100-year floodplain. The Alternative Pearl City WWPS No. 2 location is outside of the floodplain and therefore statistically less vulnerable to flooding than the existing structure. Similarly, the existing Waipahu WWPS is located partially within the floodplain, whereas Alternative Waipahu WWPS No. 1 location is not. Neither the existing nor the proposed Hālawā WWPS locations coincide with the 100-year floodplain.

Siting of infrastructure outside of areas that are vulnerable to flooding is consistent with the General Plan; however, not all of the proposed pump station locations are outside of the 100-year floodplain. The following WWPSs are located within or partially within the 100-year floodplain:

- Alternative Waimalu WWPS
- Alternative Pearl City WWPS No. 1 and No. 3
- Waipahu WWPS No. 2.

Critical mechanical and electrical components of WWPS that are located within the extent of the 100-year floodplain should be elevated during rehabilitation and construction of existing and new facilities. Building entrances should also be raised.

Rehabilitation of the existing Pearl City WWPS was also evaluated and included elevating critical mechanical and electrical components above the 100-year flood elevation by remodeling or constructing a new electrical building and raising building entrances.

The Proposed Action advances the City’s objective to maintain reliable service. It would upgrade the existing system to accommodate future flows that are projected through the planning period of 2050. Rehabilitation of the existing system, including replacement of force mains and pump stations would improve service to existing neighborhoods. The Proposed Action is timely in that it would accommodate planned growth, including the Waiawa Ridge Development. A primary purpose of the Proposed Action is to obtain the most favorable long-term life-cycle expenditures, considering both capital and operations and maintenance costs.

The Proposed Action aligns with Objective D by improving basic services that support quality of life. This supports making O’ahu a desirable place to live and visit. Further, the policies of this objective are supported through the preparation of this DEIS.

5.2.1.3 GENERAL PLAN SECTION VII: PHYSICAL DEVELOPMENT AND URBAN DESIGN

Section VII of the General Plan contains objectives and policies for physical development and urban design. The following are relevant to the Proposed Action:

- Objective A: To coordinate changes in the physical environment of O’ahu to ensure that all new developments are timely, well-designed, and appropriate for the areas in which they will be located.
 - *Policy 1: Provide infrastructure improvements to serve new growth areas, redevelopment areas, and areas with badly deteriorating infrastructure.*
 - *Policy 2: Coordinate the location and timing of new development with the availability of adequate water supply, sewage treatment, drainage, transportation, and other public facilities and services.*
 - *Policy 6: Facilitate transit-oriented development in rail transit station areas to create live/work/play multi-modal communities that reduce travel and traffic congestion.*

- *Policy 11: Encourage siting and design solutions that seek to reduce exposure to natural hazards, including those related to climate change and sea level rise (DPP 2017).*

Discussion

The Proposed Action supports objectives and policies of Section VII that relate to physical development. The Proposed Action has been designed to increase capacity of the existing Honouliuli East Interceptor System to address future flows through the 2050 planning period. The system would serve existing development and provide new conveyance infrastructure to several planned development and growth areas, including those related to TOD and proposed development in the Waiawa area. The planned improvements would benefit communities within the wastewater service area by providing reliable service. As described above, the Proposed Action involves relocation of certain WWPSs to less vulnerable locations outside the 100-year floodplain. ENV intends to work with other CCH and State agencies in the future as the guidance and policies to address climate change are further developed. Required adaptation measures (floodproofing, elevation of critical facilities, etc.) would be identified during project specific planning and design phases. As described above, critical infrastructure is located at elevations greater than the 100-year floodplain. Refer to Section 3.4 for a discussion of the proposed measures to adapt to climate change.

5.2.2 Development Plans and Sustainable Communities Plans

5.2.2.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

Development Plans and Sustainable Communities Plans (referred to as Development Plans or DPs) are required by CCH Charter. Together with the General Plan, they guide O’ahu’s population growth and land use development over a 20+ year time span. The future growth and plans for the areas of ‘Ewa, Central O’ahu, and the PUC are a vital element in determining the appropriate alternative for the upgrade and expansion of the Honouliuli wastewater system. A major revision to these plans was completed in 2004, and the revised plans are reviewed every 5 years to revalidate the overall goals and make appropriate adjustments. The PUC Revised DP was initiated in September 2017 and is ongoing as of June 2019. The ‘Ewa Revised Development Plan was adopted in July 2013. The Central O’ahu Revised Sustainable Communities Plan was considered by the Planning Board in July 2017 and transmitted to the CCH Council with recommendation for approval with three (3) amendments. The existing Central O’ahu plan is discussed in this section.

The development plans for ‘Ewa and the PUC are directed toward considerable growth and significant progress to provide a Secondary Urban Center for O’ahu, centered in the Kapolei area, and to guide development decisions and actions needed to support the growth. The goals of the Central O’ahu SCP are directed toward public actions to support the existing population.

Future projects described in these community plans include but are not limited to the TOD program to expand the transit system in the ‘Aiea-Pearl City, East Kapolei and Waipahu Neighborhoods; pedestrian ways and bike paths, and community

centers; and master-planned new communities in Royal Kunia, Koa Ridge Makai, and Waiawa.

An evaluation of the system upgrades and expansion in conjunction with the Revised Community Plans and projects follows.

5.2.2.2 PRIMARY URBAN CENTER DEVELOPMENT PLAN

The Primary Urban Center Development Plan (PUC Development Plan) was approved in 2004 and as of June 2019 is undergoing an update. The PUC planning region is characterized by *a large and diverse mix of neighborhoods, businesses, and industries, as well as health, education, and cultural centers*. The Vision for the PUC includes the following key elements:

- Honolulu’s natural, cultural, and scenic resources are protected and enhanced
- Livable neighborhoods have business districts, parks and plazas, and walkable streets
- The PUC offers in-town housing choices for people of all ages and incomes
- Honolulu is the Pacific’s leading city and travel destination
- A balanced transportation system provides excellent mobility (DPP 2004).

Chapter 4 Infrastructure and Public Facilities

Chapter 4 of the PUC Development Plan addresses infrastructure and public facilities. The purpose of the chapter is to *give direction to long-range functional and facility plans* to ensure coordination of the *planning and construction of infrastructure improvements so that: (1) services are available when needed, and (2) construction impacts to neighborhoods are minimized*. Section 4.2 pertains to the wastewater system. Policies and Guidelines of this section follow:

4.2.2 Policies

- Implement wastewater collection system improvements to provide adequate service and sound facilities to existing neighborhoods and timely increases in system capacity to areas planned to undergo improvement or change in use.
- Implement adequate and timely upgrades/expansion of wastewater treatment facilities to meet the growth demands of the PUC (DPP 2004).

4.2.3 Guidelines

- Complete current projects needed to correct currently identified service or facility inadequacies for neighborhoods where change in service demand is not anticipated.
- In consultation with adjacent communities, implement the recommendations of the East and West Māmala Bay Wastewater Facilities Plans to upgrade treatment and collection systems to serve projected increases in service demands on a timely basis, as such demand increases become identified (DPP 2004).

Discussion

The Proposed Action aligns with PUC Policies and Guidelines for the wastewater system. The Proposed Action is a wastewater collection system improvement that provides a timely increase in system capacity to areas planned for development, including those located in and outside of the PUC area. The increase in capacity of the wastewater system would allow for future development in the sewershed, as approved in the PUC and 'Ewa DPs. It would also allow the connection of currently unsewered areas on individual wastewater systems into the City's wastewater system, consistent with the future growth and development approved in the PUC and 'Ewa DPs. It would support expansion of the transit system in the 'Aiea-Pearl City neighborhood. The Proposed Action addresses rehabilitation needs of the existing infrastructure and provides new conveyance infrastructure to serve planned development and growth, including that related to TOD. It would increase capacity of the existing Honouliuli East Interceptor System to address future flows through the 2050 planning period. The Proposed Action does not target improvements in service to or to facilities in specific existing neighborhoods.

Chapter 5 Implementation of Public Facilities Investments

Chapter 5 of the PUC Development Plan addresses implementation of public facilities investments. This section recognizes the importance of planning infrastructure improvements, including wastewater system improvements. The following development priorities are identified:

Section 5.2 Development priorities include projects that:

- Involve land acquisition and improvements for public projects which are consistent with the Development Plan vision, policies, and guidelines, and
- Involve applications for zoning and other land use permits that are consistent with the Development Plan vision, policies, and guidelines (DPP 2004).

Discussion

The improvements to public sewer infrastructure associated with the Proposed Action are consistent with the PUC Development Plan's objective to proactively manage infrastructure.

Chapter 5 Functional Planning

Section 5.4 of the PUC also includes a discussion of functional planning, or the process City agencies determine needs, assign priorities, phase projects, and propose project financing to implement the vision that is articulated in the Development Plan:

- Functional planning is the process through which various City agencies determine needs, assign priorities, phase projects, and propose project financing to implement the vision articulated in the Development Plan. This process may take a variety of forms, depending upon the missions of the various agencies involved, as well as upon requirements imposed from outside the City structure, such as federal requirements for wastewater management planning. Typically, functional planning occurs as a continual or iterative activity within each agency.

Through the functional planning process, City agencies responsible for development and maintenance of infrastructure and public facilities, and the provision of City services review existing functional planning documents and programs. As a result of these reviews, the agencies then update existing plans or prepare new long-range functional plans that address facilities and service system needs. Updates of functional planning documents are also conducted to assure that agency plans will serve to implement the Development Plan as well as to provide for coordination of plans and programs among the various agencies.

The number and types of functional planning documents will vary from agency to agency, as will the emphases and contents of those documents. A typical agency may develop a set of core documents such as:

- A resource-constrained long-range capital improvement program. A "resource-constrained" program is one that identifies the fiscal resources that can be reasonably expected to be available to finance the improvements.
- A long-range financing plan, with identification of necessary new revenue measures or opportunities.
- A development schedule with top priorities for areas designated for earliest development.
- Service and facility design standards, including level of service guidelines for determining adequacy (DPP 2004).

Discussion

The Proposed Action is consistent with functional planning for wastewater systems. The Proposed Action includes several alternative WWPS locations, tunnel, and pipe options designed to rehabilitate aging infrastructure and expand capacity to accommodate planned growth. Upgrades of existing WWPSs, interceptor sewer construction, and collection system storage at major WWPSs were included in the recommendations of the 2001 *West Māmala Bay Facilities Plan* (Wilson Okamoto & Associates, Inc. and Brown and Caldwell Consultants), which was developed to fulfill requirements of the 1995 Consent Decree. This Consent Decree was replaced in 2010 by a Consent Decree, which recognized the need to reevaluate the projects remaining from the *Final Sewer Infiltration and Inflow (I/I) Plan* (Fukunaga and Associates, Inc. 1999), including sewer line and WWPS capacity upgrades. The Proposed Action further enhances requirements of the Consent Decree and the 2012 Amended Consent Decree and helps to satisfy future wastewater needs in the project area.

Chapter 3 Parks and Recreational Open Spaces

Additional policies that are relevant to the Proposed Action include Policy 3.1.3.6 Parks and Recreational Open Spaces:

- *Recognizing that it is difficult to acquire additional park land in the PUC, develop innovative approaches to make optimum use of existing parks and recreation resources (DPP 2004).*

Discussion

The Alternative Pearl City WWPS No. 2 location is proposed in Lehua Community Park. The Alternative Waimalu WWPS location is within Neal S. Blaisdell Park. Although the footprint of the WWPS is minimal, the impact of new construction in these parks would result in a loss of available park space and, thus, would not be considered an optimum use existing parks and recreational resources.

5.2.2.3 'EWA DP

'Ewa serves as the second urban center for O'ahu, provides a range of master planned residential areas to relieve development pressures on O'ahu's rural areas and housing options not prevalent in the PUC, and protects and proposed diversified agriculture on prime agricultural lands. The Plan's vision to 3025 includes significant growth, including the following:

- Population growth from 68,700 in 2000 to over 164,000;
- Addition of over 35,000 new homes to the 20,800 homes in 'Ewa in 2000;
- Job growth from 16,400 non-construction jobs in 2000 to over 87,000;
- Growth of the City of Kapolei to include over 8,000 residents and provide almost 20,000 private and public non-construction jobs;
- Development of the University of Hawai'i West O'ahu campus to serve 7,600 students and employ 1,040 staff and faculty by 2025;
- Resort development at Ko 'Olina and at Ocean Pointe to include over 7,200 visitor units (DPP 2013).

Chapter 4 Public Facilities and Infrastructure Policies and Guidelines

Section 4.3 of the 'Ewa DP addresses wastewater treatment public facilities and infrastructure policies and guidelines. The 'Ewa DP and the *West Māmala Bay Facilities Plan* (Wilson Okamoto & Associates, Inc. and Brown and Caldwell Consultants 2001) call for increased treatment/disposal capacity at the Honouliuli Wastewater Treatment Plant to meet projected population and economic growth in 'Ewa and Central O'ahu resulting from implementation of the DPs. The 'Ewa DP also recognizes that the capacity of specific sewer lines and pump stations will need to be increased. General policies for wastewater treatment include:

- Require all wastewater produced by new developments in 'Ewa to be connected to a regional or municipal sewer service system.
- Where feasible, use recycled water recovered from wastewater effluent for irrigation and other uses below the Underground Injection Control (UIC) line of the State Department of Health and the "No-Pass" Line of the Board of Water Supply.
- Locate wastewater treatment plants in areas shown as planned for industrial use and away from residential areas shown on the Urban Land Use Map in Appendix A. Existing treatment plants are shown on the Urban Land Use Map and the Public Facilities Map in Appendix A.

- Use a City review and approval process, which provides adequate public notice and input, complete technical analysis of the project by the Department of Planning and Permitting, and approval by the City Council, for any major new private wastewater treatment plant. Other system elements, such as pump stations and mains, should not require such comprehensive review and policy approval (DPP 2013).

Discussion

The Proposed Action would provide added wastewater capacity needed for future planned developments. Thus it aligns with the policy that new developments be connected to sewer service systems. The increase in capacity of the wastewater system would allow for future development in the sewershed, as approved in the PUC and ‘Ewa DPs. It would also allow the connection of currently unsewered areas on individual wastewater systems into the City’s wastewater system, consistent with the future growth and development approved in the PUC and ‘Ewa DPs.

Chapter 5 Phasing of Development

Section 5.1.2 of ‘Ewa DP addresses phasing public facility investment priorities. In addition to specific, targeted residential and non-residential development that would be supported by the Proposed Action, significant capital improvement projects of highest priority include:

- Expanded wastewater treatment plant capacity, and recycling of non-potable water reclaimed from wastewater effluent at the Honouliuli WTP (DPP 2013).

Discussion

The Proposed Action aligns with public facility investment priorities because it would increase capacity within the sewershed and allow for growth in urban areas.

The Proposed Action does not directly involve wastewater recycling; however, a portion of the effluent from the Honouliuli WWTP is reclaimed to provide R-1 water, as defined in HAR Title 11, Chapter 62³, and reverse osmosis water for irrigation and industrial uses.

5.2.2.4 THE CENTRAL O’AHU REVISED SUSTAINABLE COMMUNITIES PLAN

The Central O’ahu DP was adopted in 2002. The Central O’ahu DP is designated as a Sustainable Community Plan to highlight the intent that the region is not to be heavily developed and that special qualities of the region should be sustained and improved. The region’s role in O’ahu’s development pattern includes promoting diversified agriculture and pineapple; providing a variety of housing types in master planned suburban residential communities and mixed-use centers in Waipahu; and providing new employment in new and existing commercial areas.

³ HAR Title 11, Chapter 62 defines R-1 water as “recycled water that has been oxidized, filtered, and disinfected to meet the corresponding standards set in this chapter.”

The plan’s vision to 2025 includes:

- Population growth from 149,000 in 2000 to over 173,000 in 2025
- Addition of 11,000 new housing units to the existing 45,000 homes in Central O’ahu in 2000
- Increase of jobs from almost 39,000 jobs in 2000 to over 65,000 in 2025
- Master planned residential developments at Mililani Mauka, Royal Kunia, Koa Ridge Makai, and Waiawa
- Long-term protection for agricultural and preservation lands (DPP 2002)

Chapter 4 Public Facilities and Infrastructure Policies and Guidelines

Section 4.3 of the Central O’ahu DP addresses wastewater treatment. The plan recognizes that treatment and disposal capacity at the Honouliuli WWTP will need to increase and the capacity of specific sewer lines and pump stations will need to be increased to meet projected population and economic growth in ‘Ewa and Central O’ahu resulting from implementation of the DPs. It is the policy of the plan that all wastewater produced by new developments in Central O’ahu should be connected to a regional or municipal sewer service system (DPP 2002).

Discussion

The Proposed Action would provide added wastewater capacity needed for future development within the region, thus aligns with the policy that new developments be connected to sewer service systems. It would support the policy of connecting new development to the municipal sewer service system.

Chapter 5 Implementation

Section 5.1.2 of the Central O’ahu DP addresses the phasing of urban expansion. The plan supports projects if:

- Adequate infrastructure will be available to meet the demand resulting from the project (DPP 2002).

Discussion

The Proposed Action would provide added capacity to the wastewater infrastructure system, thus supporting future expansion.

5.2.3 Neighborhood and Transit-Oriented Development (TOD) Plans

5.2.3.1 HALAWA AREA TOD PLAN

Synopsis of Plan and Relevant Components

The Draft Final Halawa Area TOD Plan was prepared in 2017. The Halawa Area TOD Plan presents a community vision for the neighborhoods surrounding the Aloha Stadium Station. One of 21 planned rail stations along the rail corridor, the Aloha Stadium Station is ¼-mile away from Aloha Stadium. It provides a unique, one-of-a-kind opportunity in Honolulu to create a synergy between the rail station, Hawai‘i’s

largest sports venue, and the top visitor attraction, Pearl Harbor/Arizona Memorial (CallisonRTKL 2017).

The goal of the plan is to create more diverse, more compact livable communities that take full advantage of the benefits of transit – specifically creating new transportation options while encouraging economic growth and attractive redevelopment.

Among the constraints identified for proposed development in the Hālawā area includes the adequacy of the wastewater system. As identified in the plan:

Infrastructure upgrades and expansion of capacity, particularly sewer capacity, is inadequate to support a greater density of redevelopment. Increased capacity will have to be absorbed into future projects.

With regard to impacts of the development proposed in the plan, the following is identified:

The analysis of the existing waste water system indicates limited capacity for additional waste water flow, regardless of the scale of additional development. Capacity is limited by pipes with shallow slopes and fixed capacity of the existing pump stations at the Hālawā, Waimalu, and Pearl City WWPSs. These deficiencies can lead to restrictions on additional sewer connections and/or the potential for sewer overflows. To accommodate the additional capacities that TOD may bring, additional infrastructure related to extra pump stations, pipe sizes and proper grading must be created. The improvements will meet the City's waste water quality requirements (CallisonRTKL 2017).

Discussion

The Proposed Action includes rehabilitation and replacement of aging infrastructure and WWPS that would support increased capacity within the Honouliuli WWTP service area. The Honouliuli WWTP services Hālawā. The Proposed Action includes a new force main or alternate gravity sewer along Salt Lake Boulevard and reconstruction/replacement of the Hālawā WWPS. The proposed new Hālawā WWPS would have a capacity of 5.5 million gallons per day. The proposed TOD plan may require additional infrastructure related to extra pump station, pipe sizes, and property grading.

The construction schedule for this WWPS is proposed to occur between 2034 and 2040, depending on which conveyance option (No-Tunnel or Hybrid) is selected. Construction would affect traffic and parking at or near the Aloha Stadium. The TOD plan may take 20-40 years to implement. The existing and proposed Hālawā WWPS are located in the area designated as *Phase 5: Stadium Site Infill* in the TOD plan. The alternate gravity sewer along Salt Lake Boulevard would minimize potential conflict with the proposed Aloha Stadium redevelopment.

5.2.3.2 AIEA-PEARL CITY NEIGHBORHOOD TOD PLAN

Synopsis of Plan and Relevant Components

The 2014 Aiea-Pearl City Neighborhood TOD Plan presents a community vision for the existing neighborhoods surrounding the Leeward Community College, Pearl Highlands, and Pearlridge rail stations. The plan is intended as both an overall framework for growth and a guide for local decision making in the three station areas. The goal of the plan is to foster more livable communities that take full advantage of the benefits of transit—specifically, creating new transportation options while encouraging economic growth and attractive redevelopment (Van Meter Williams Pollack, LLP 2014).

With regard to infrastructure, the TOD plan states:

Existing water and sewer infrastructure in the TOD areas is sized for current zoning, which is approximately equal to the proposed commercial and residential projections for TOD. Exceptions include the Leeward Community College station area, which is zoned AG-2, however, the proposed growth in this area is modest. Another exception is the Pearlridge station area where a modest increase in sewer flow will occur, and because of this, trunk sewers should be expected in the TOD overlay area to absorb additional flows (Van Meter Williams Pollack, LLP 2014).

Discussion

The Proposed Action would increase capacity to serve future development. The TOD plan *will take decades to be fully realized* and will be implemented through *investment in infrastructure improvements*. The Proposed Action supports growth and development around transit.

5.2.3.3 WAIPAHU NEIGHBORHOOD TOD PLAN

Synopsis of Plan and Relevant Components

The 2014 Waipahu Neighborhood TOD Plan focuses on two (2) proposed transit stations at the intersections of Farrington/Leoku and Farrington/Mokuola Streets. The overall theme of the Waipahu TOD Neighborhood Plan is to “Celebrate Waipahu!” This theme reflects Waipahu’s unique role and character in the overall Honolulu region and recognizes that TOD has the potential to improve the public’s general perception of Waipahu through the emphasis of existing cultural and natural resources, economic development, neighborhood improvements and strengthening the quality of residential developments (Van Meter Williams Pollack, LLP 2014).

The plan’s phasing and implementation strategy includes the following wastewater improvement relative to the Proposed Action:

- Major renovation of the Waipahu Pumping Station and an additional force main or replacement force main to convey sewage from the pumping station to the Honouliuli WWTP (Van Meter Williams Pollack, LLP 2014).

Discussion

The Proposed Action would provide added capacity within the vicinity of the Waipahu Neighborhood TOD Plan and supports development around transit.

5.2.4 Land Use Ordinance / Zoning**5.2.4.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS**

The Land Use Ordinance, Chapter 21, also referred to as the Zoning Ordinance, regulates land to encourage orderly development in accordance with policies including the O’ahu General Plan and development plans. Figure 5-2 shows zoning in the project area based on mapping available during the preparation of this DEIS. Zoning in the project area may be different in the future, such as the proposed zoning change to the Aloha Stadium area (including where the existing Hālawā WWPS is located) from R-5 (Residential District) to BMX-3 (Community Business Mixed Use).

The proposed pump stations are located in two zoning districts. Proposed Waipahu WWPS Alternatives No. 1 and No. 2, Alternative Waimalu WWPS, and Pearl City Alternative No. 2 are located in the P-2 General Preservation District. Pearl City WWPS Alternatives No. 1 and No. 3 are located in the F-1 Federal and Military Preservation District, which is the district that the existing Pearl City WWPS is located in. Portions of the tunnels and pipes proposed to be rehabilitated or constructed cross 11 zoning districts, which are listed in Table 5-1.

City and County of Honolulu

HONOLULU/ WAIPAHU/ PEARL CITY FACILITIES PLAN

Legend

- Existing WWPS
- Honouliuli WWTP
- Hybrid Tunnel Shaft
- Waiawa Conveyance Corridors (Options A, D, and G)
- Hybrid Option Alignment
- New and/or Rehabilitated Force Mains and Trunk Sewers
- East Interceptor
- Streets

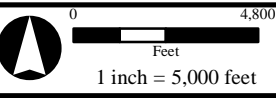
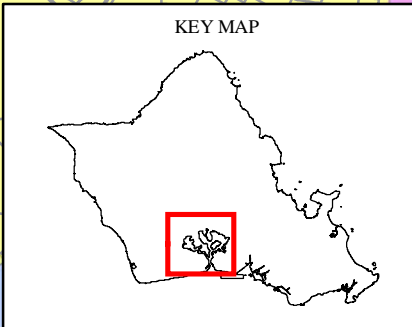
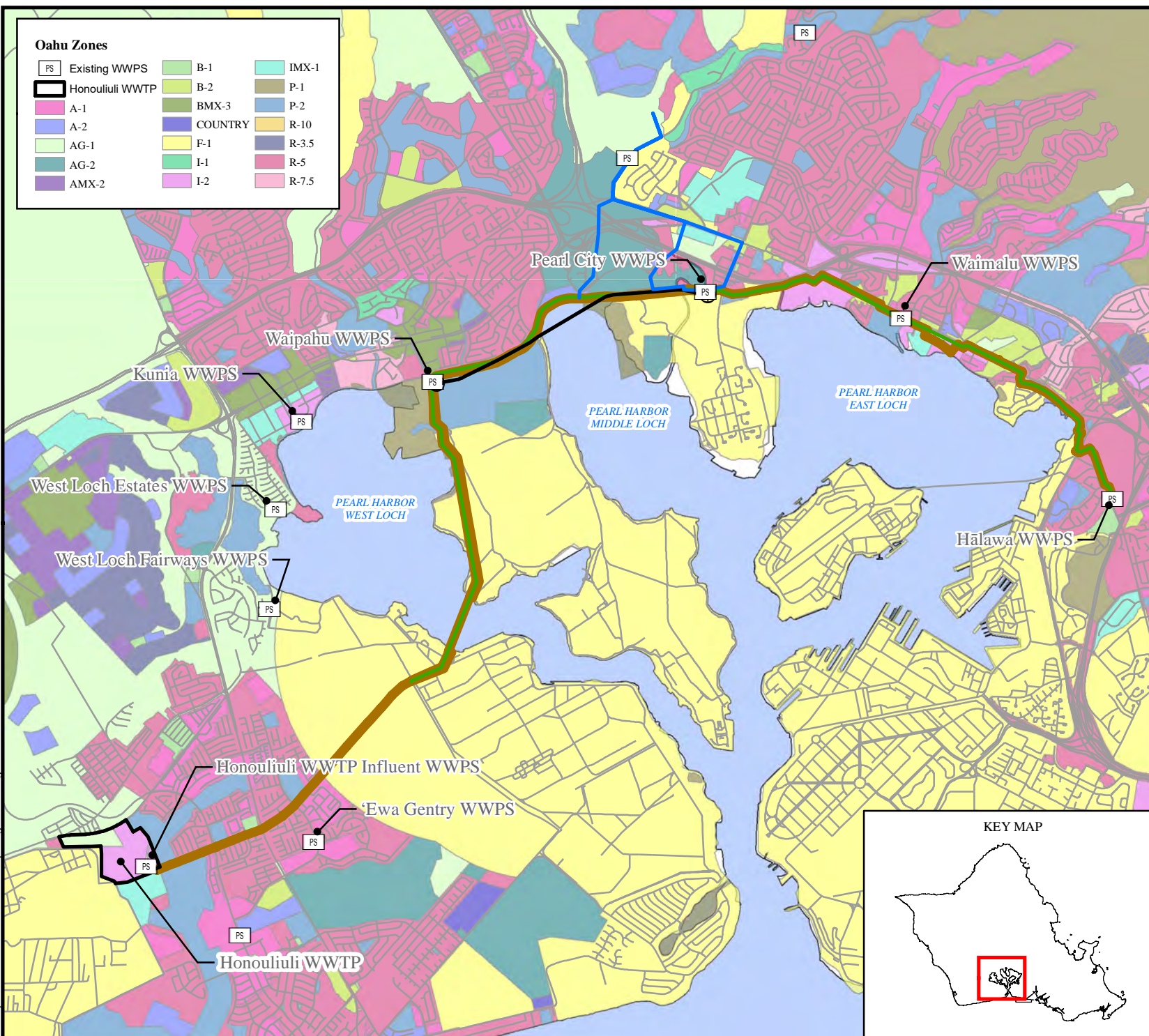


FIGURE 5-2
CITY AND COUNTY OF HONOLULU ZONING

AECOM
1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813

Oahu Zones		
Existing WWPS	B-1	IMX-1
Honouliuli WWTP	B-2	P-1
A-1	BMX-3	P-2
A-2	COUNTRY	R-10
AG-1	F-1	R-3.5
AG-2	I-1	R-5
AMX-2	I-2	R-7.5



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Table 5-1. Zoning Districts Located within the Proposed Action

Map Designation	Description	Proposed Use: Utility installation, Type A^a
A-2	Medium-Density Apartment District	Permitted use subject to the standards in Chapter 21 Article 5
AG-1	Restricted Agriculture District	Permitted use subject to the standards in Chapter 21 Article 5
AG-2	General Agriculture District	Permitted use subject to the standards in Chapter 21 Article 5
B-1	Neighborhood Business District	Permitted use subject to the standards in Chapter 21 Article 5
B-2	Community Business District	Permitted use subject to the standards in Chapter 21 Article 5
F-1	Federal and Military Preservation District	-
I-2	Intensive Industrial District	Permitted use subject to the standards in Chapter 21 Article 5
IMX-1	Industrial Mixed Use District	Permitted use subject to the standards in Chapter 21 Article 5
P-1	Restricted Preservation District	Permitted use subject to the standards in Chapter 21 Article 5
P-2	General Preservation District	Permitted use subject to the standards in Chapter 21 Article 5
R-5	Residential District	Permitted Use

Source: O'ahu Zoning 2018 GIS data. State of Hawai'i Office of Planning; Chapter 21.

Notes:

- a. Permissibility of use per Table 21-3.

The purpose and intent of preservation districts is stated in Section 21-3.40: *To preserve and manage major open space and recreation lands and land of scenic and other natural resource value.* P-2 General Preservation District includes lands that are designated urban by the state but provide visual relief and contrast to the City's built environment or serve as outdoor space for public enjoyment. The F-1 Federal and Military Preservation District was created to permit the full range of military or federal government activities (City and County of Honolulu Office of Council Services 2019).

ENV's interpretation is that the Proposed Action would be classified as a "Utility Installation Type A" land use. This use is defined as:

"Utility installations, Types A and B," means uses or structures, including all facilities, devices, equipment, or transmission lines, used directly in the distribution of utility services, such as water, gas, electricity, telecommunications other than broadcasting antennas, and refuse collection other than facilities included under waste disposal and processing...Type A utility installations are those with minor impact on adjacent

land uses and typically include: 46 kilovolt transmission substations, vaults, water wells and tanks and distribution equipment, sewage pump stations, telecommunications antennas (except as provided in the paragraph below on Type B utility installations), and other similar uses (City and County of Honolulu Office of Council Services 2019).

Table 5-1 displays the permissibility of the proposed use within each zoning district that the Proposed Action is located in. Within the P-2 district “Utility Installations, Type A” are a permitted use subject to standards in Chapter 21 Article 5.

Per Section 21.3.40-1(b), all military and federal uses and structures are permitted in the F-1 district (City and County of Honolulu Office of Council Services 2019). CCH does not have jurisdiction over the F-1 district. The proposed use would not be considered a military or federal use.

The development standards for the P-2 district are summarized in Table 5-2.

Table 5-2. Development Standards of the P-2 General Preservation District

		P-2
Minimum Lot Area (acres)		5
Minimum Lot Width and Depth (feet)		200
Yards (feet)	Front	30
	Side and Rear	15
Maximum Building Area (% of zoning lot)		5
Maximum Height (feet)		15-25 ^a
Height Setback		Per Sec. 21-3.40-1(c) ^b

Source: Chapter 21 of the Revised Ordinances of Honolulu.

Notes:

- a. The maximum height may be increased from 15 to 25 feet if height setbacks are provided.
- b. Any portion of a structure exceeding 15 feet shall be set back from every side and rear buildable area boundary line one foot for each two feet of additional height above 15 feet.

Discussion

The proposed WWPS are permitted uses within the P-2 General Preservation District.

The proposed use is not a federal or military use, therefore a variance would be required for the Alternative Pearl City WWPS No. 1 or No.3 locations on the west side of Lehua Avenue.

With the exception of the Alternative Pearl City WWPS No. 2 location, the proposed WWPS alternatives are located on lots that conform with the minimum lot size of the underlying district:

- The proposed Alternative Waimalu WWPS is located on a lot (Tax Map 198007008) approximately 21.4 acres in size.
- The proposed Alternative Waipahu WWPS No. 1 and No. 2 locations are on a lot (Tax Map 193002009) approximately 57.5 acres in size.
- The proposed Alternative Pearl City WWPS No. 1 location is partially on a nonconforming lot (Tax Map 197017001) of approximately 1.5 acres in size. The limit of work extends into an adjacent right-of-way.
- The proposed Alternative Pearl City WWPS No. 2 location is on a lot (Tax Map 197017002) approximately 11.2 acres in size.
- The proposed Alternative Pearl City WWPS No. 3 location is on a lot (Tax Map 197016001) approximately 66.4 acres in size.
- The proposed Alternative Hālawā WWPS location is on a lot (Tax Map 99003061) approximately 88.7 acres in size.

Per Section 21-2.130, a waiver of the strict application of development or design standards may be granted by the director for utility installations. Entitlements from DPP that may be required include:

- Zoning waiver(s) for proposed WWPSs if the development standards, including the lot size, minimum lot width and depth, yard setbacks, maximum building area, maximum height, and height setback are not met.

Development of Alternative Pearl City WWPS No. 1 and No. 3 in the F-1 district is regulated by individual federal military installations.

5.2.5 Special Management Area

5.2.5.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

Portions of the project area lie within the Special Management Area (SMA) pursuant to HRS Chapter 205A. The SMA is the land extending inland from the shoreline, as established in Chapter 25 of the revised Ordinance of Honolulu and delineated on the maps established by the City council of the CCH. Regulations and procedures within the SMA are further defined in Chapter 25 to preserve and protect the natural resources of the coastal zone of Hawai'i. No development shall be allowed in any county within the special management area without obtaining a permit in accordance with HRS 205A-28.

The following activities qualify as development as defined by Chapter 25:

- 25(1)(B) Grading, removing, dredging, mining or extraction of any materials.
- 25(1)(E) Construction, reconstruction, demolition or alteration of the size of any structure (Revised Ordinance of Honolulu Chapter 25).

The following activities are not considered development by Chapter 25:

- 25(2)(D) The repair and maintenance of underground utility lines, including but not limited to water, sewer, power and telephone and minor appurtenant structures such as pad mounted transformers and sewer pump stations.

However, whenever the authority finds that any use, activity, or operation excluded in 25(2)(D) is or may become part of a larger project, the cumulative impact of which may have a significant environmental or ecological effect on the special management area, that use, activity, or operation constitutes development (Revised Ordinance of Honolulu Chapter 25).

Section 25-3.2 contains review guidelines for developments proposed in the special management area that must be followed. These guidelines and a discussion of the Proposed Action's compliance with guidelines are included in the discussion section below.

A summary of Proposed Action project components located within the SMA follows. The boundaries of the SMA are shown in Figure 5-1.

East Interceptor Conveyance

Proposed Waipahu WWPS FMs Rehabilitation and the proposed Waipahu WWPS FM (New) coincide with the SMA in the vicinity of Arizona Road and on Waipi'o Peninsula. The proposed location of the rehabilitated FM is sited parallel and adjacent to existing lines to the greatest extent possible.

The existing Waipahu WWPS and the Alternative Waipahu WWPS No. 1 and No. 2 locations are within the SMA.

The existing Pearl City WWPS and Alternative Pearl City WWPS No. 1, No. 2, and No. 3 locations are within the SMA.

The existing and proposed alternative Waimalu WWPS are located within the SMA.

A majority of existing and proposed influent trunk sewer and FMs are located within the SMA.

East Interceptor Conveyance - No-Tunnel Option

The existing Pearl City FM and Pearl City to Waipahu gravity sewer tunnel cross the shoreline area parallel to Awanei and Awamoku Streets, at the northern end of Middle Loch, and at unnamed tidal stream to the west of the Hawaiian Electric Company, Inc. (HECO) Waiiau Power Plant.

East Interceptor Conveyance - Hybrid Option

The Hybrid option alignment is located within the SMA in the vicinity of the north side of the Ted Makalena Golf Course.

The Pearl City-Waipahu trunk sewer proposed alignment hybrid option includes the option to either a bored tunnel (96-inch diameter about 10,900 feet long with an

invert at elevation -52.0 at the Waipahu WWPS and elevation -40.0 at the upstream end), or a microtunnel 72-inch diameter about 11,500 feet long and an invert at elevation -35.0 at Waipahi WWPS and -23.0 At Pearl City WWPS. The deep tunnel alignment would coincide with the SMA on either side of Pearl Harbor Middle Loch and on the Waipo Peninsula.

Waiawa Area Conveyance Options

Three (3) corridors have been identified by ENV to serve the proposed Waiawa Ridge Development. The southern end of Corridors A, D, and G each intersect the SMA. Approximately 325 feet of Corridor A, 125 feet of Corridor D, and 215 feet of corridor G intersect the SMA.

5.2.5.2 DISCUSSION

SMA Permit and Relevant Guidelines

It is anticipated that due to the cumulative impact of rehabilitation of existing sewer infrastructure, construction of new pump stations and/or rehabilitation or deconstruction of existing pump stations, as well as the development of new pipeline and tunnels that the Proposed Action would require permits for individual projects from DPP before construction. Where costs for individual projects exceed \$500,000, a Special Management Area Use Permit would be required.

Guidelines

(a) All development in the special management area shall be subject to reasonable terms and conditions set by the council to ensure that:

- 1) Adequate access, by dedication or other means, to publicly owned or used beaches, recreation areas and natural reserves is provided to the extent consistent with sound conservation principles;*
- 2) Adequate and properly located public recreation areas and wildlife preserves are reserved;*
- 3) Provisions are made for solid and liquid waste treatment, disposition and management which will minimize adverse effects upon special management area resources; and*
- 4) Alterations to existing land forms and vegetation; except crops, and construction of structures shall cause minimum adverse effect to water resources and scenic and recreational amenities and minimum danger of floods, landslides, erosion, siltation or failure in the event of earthquake (Revised Ordinance of Honolulu Chapter 25).*

Discussion

A traffic and pedestrian management plan would be prepared for CCH Department of Transportation Services and State Department of Transportation staff review and approval to promote access and safety during construction. Post-construction procedures include restoring access to recreation areas and trails.

The Proposed Action includes rehabilitation of existing and construction of new wastewater infrastructure. Proposed alternative WWPS locations are located in close proximity to the existing WWPS. Wildlife preserves would not be affected by the project activities or WWPS operations. The alternative Waimalu WWPS is located in Neal S. Blaisdell Park, resulting in a loss of recreational space. However, the footprint of this structure would be minimal and it is not anticipated that the WWPS would detract from recreational opportunities at the park. Avoiding impairment or public use of the existing parks, and replacement in-kind taking of park land is a Proposed Action objective. Any unavoidable impacts would be reviewed in consultation with the Department of Parks and Recreation and State DLNR Division of Parks prior to proceeding. During construction, there may be additional noise and traffic at or near the parks and recreational areas. No operational long-term impacts to park land are anticipated, aside from periodic inspection and/or maintenance of adjacent proposed facilities.

The proposed locations for new WWPSs are located adjacent to existing WWPSs. The visual impact of the Proposed Action would be minimal; most of the work would occur below-grade. New WWPSs would be designed to blend into the surroundings.

Rehabilitation of the existing Pearl City WWPS was also evaluated and included elevating critical mechanical and electrical components above the 100-year flood elevation by remodeling or constructing a new electrical building and raising building entrances.

Structures would be designed to current regulatory standards to protect from earthquakes, natural hazards.

Guidelines

(b) No development shall be approved unless the council has first found that:

- 1) The development will not have any substantial, adverse environmental or ecological effect except as such adverse effect is minimized to the extent practicable and clearly outweighed by public health and safety, or compelling public interest. Such adverse effect shall include, but not be limited to, the potential cumulative impact of individual developments, each one of which taken in itself might not have a substantial adverse effect and the elimination of planning options;*
- 2) The development is consistent with the objectives and policies set forth in Section 25 3.1 and area guidelines contained in HRS Section 205A 26;*
- 3) The development is consistent with the county general plan, development plans and zoning. Such a finding of consistency does not preclude concurrent processing where a development plan amendment or zone change may also be required (Revised Ordinance of Honolulu Chapter 25).*

Discussion

The Proposed Action is not anticipated to result in substantial environmental degradation. Ultimately, the Proposed Action would reduce the potential for water

quality contamination due to sewer overflows. It is not anticipated that the Proposed Action would result in significant cumulative impacts. The limit of work of the proposed WWPS has a limited footprint and the majority of sewer infrastructure would be located adjacent to existing pipelines. The Proposed Action would not result in the elimination of planning options. Chapter 3 of this DEIS includes a discussion of environmental impacts.

The objectives and policies set forth in Section 25 3.1 and area guidelines contained in HRS Section 205A 2 pertain to CZM. Refer to Section 5.1.4 for a discussion of compliance with objectives and policies for the CZM Plan.

The Proposed Action conforms with the following relevant sections of the County General Plan, as discussed in Section 5.2.1 of this DEIS:

- General Plan Section V Transportation and utilities.
- General Plan Section VII Physical Development and Urban Design.

The Proposed Action's conformance with the 'Ewa DP, PUC Development Plan, and Central O'ahu Revised Sustainable Communities Plan is discussed in Section 5.2.2.

The Proposed Action's conformance with zoning is discussed in Section 5.2.4.

Guidelines

(c) The council shall seek to minimize, where reasonable:

- 1) Dredging, filling or otherwise altering any bay, estuary, salt marsh, river mouth, slough or lagoon;*
- 2) Any development which would reduce the size of any beach or other area usable for public recreation;*
- 3) Any development which would reduce or impose restrictions upon public access to tidal and submerged lands, beaches, portions of rivers and streams within the special management area and the mean high tide line where there is no beach;*
- 4) Any development which would substantially interfere with or detract from the line of sight toward the sea from the state highway nearest the coast; and*
- 5) Any development which would adversely affect water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, or potential or existing agricultural uses of land (Revised Ordinance of Honolulu Chapter 25).*

Discussion

The Proposed Action does not involve dredging, filling or altering any bay, estuary, salt marsh, river mouth, slough, or lagoon. The Proposed Action would not reduce the size of any beach. There are numerous parks and recreational areas in the vicinity of the project area. Only Lehua Community Park, Pacheco Neighborhood Park, Neal S. Blaisdell Park, Waipi'o Peninsula Sports Complex, 'Aiea Bay State Recreation Area,

Pearl Harbor Bike Path, and Ted Makalena Golf Course are expected to be directly affected by at least one of the options. The Proposed Action would be designed to minimize impacts and permeant loss of recreational land.

The Proposed Action would not result in limiting public access to tidal and submerged lands, beaches, portions of rivers and streams within the SMA and the mean high tide line where there is no beach. It is not anticipated that proposed new WWPSs would interfere with the viewshed of the sea from the state highway. It is not anticipated that the development would adversely affect water quality, existing areas of open water free of visible structures, existing and potential fisheries and fishing grounds, wildlife habitats, or potential or existing uses of lands. Environmental impacts of the Proposed Action are discussed in Section 3.0 of this DEIS.

5.2.6 Shoreline Setback

5.2.6.1 SYNOPSIS OF PLAN AND RELEVANT COMPONENTS

Portions of the project area lie within the shoreline setback pursuant to HRS Chapter 205A. Regulations and procedures within the shoreline setback are further defined in Chapter 23 of the Revised Ordinances of Honolulu to protect and preserve the natural shoreline and to reduce hazards to property from coastal floods.

Structures and activities, defined in Chapter 23 as any grubbing or any grading or stockpiling of earth materials, are prohibited within the shoreline area. The following is exempt from this and allowed within the shoreline area:

Minor structures and activities permitted under rules adopted by the department [of land utilization] which do not affect beach processes or artificially fix the shoreline and do not interfere with public access, public views or open space along the shoreline. If, due to beach erosion or other cause, the director determines that a minor structure permitted under this section may affect beach processes or public access or has become located seaward of the shoreline, the director or other governmental agency having jurisdiction may order its removal (Revised Ordinance of Honolulu Chapter 23).

5.2.6.2 DISCUSSION

A GIS analysis of the limit of work of the Proposed Action has determined that alternative locations for the Waipahu WWPS No. 1 and No. 2, Waimalu WWPS, and Hālawa WWPS are not within 40 feet of the mean high water line. The proposed alternative location for the Waimalu WWPS is approximately 10 feet from the shoreline setback. A survey may be necessary to confirm that the structure is not within the shoreline area and that a variance is not required.

In several areas, existing and proposed pipes and tunnels cross the shoreline setback, as summarized below. Installation of new pipes or rehabilitation of existing pipes may impact the shoreline setback during construction. A shoreline setback variance or minor shoreline structure approval would be required prior to construction for activity within 40 feet of the shoreline.

East Interceptor Conveyance

- Proposed Waipahu WWPS FMs Rehabilitation and the proposed Waipahu WWPS FM (New) cross the shoreline area in the vicinity of Arizona Road and to the west of Waipahu Drive on Waipi’o Peninsula. The proposed location of the rehabilitated FM is parallel and adjacent to existing lines as much as possible.
- The existing East Interceptor crosses the shoreline area to the east of Neal Blaisdell Park, and the eastern extent of the mean high water line of Kalauao Stream near Route 99.
- The Waimalu influent trunk sewer crosses the shoreline area of the eastern extent of the mean high water line of Kalauao Stream near Route 99. It crosses Waimalu Street along Route 99. The Waimalu influent trunk sewer is recommended for upgrade/replacement.

East Interceptor Conveyance - No-Tunnel Option

- The existing Pearl City FM and Pearl City to Waipahu gravity sewer tunnel cross the shoreline area parallel to Awanei and Awamoku Streets, at the northern end of Middle Loch, and at unnamed tidal stream to the west of the HECO Waiau Power Plant.

East Interceptor Conveyance - Hybrid Option

The Pearl City-Waipahu trunk sewer proposed alignment hybrid option includes the option for either a bored tunnel (96-inch diameter about 10,900 feet long with an invert at elevation -52.0 at the Waipahu WWPS and elevation -40.0 at the upstream end), or a microtunnel 72-inch diameter about 11,500 feet long and an invert at elevation -35.0 at Waipahu WWPS and -23.0 At Pearl City WWPS. The deep tunnel alignment would cross the shoreline setback on either side of Pearl Harbor Middle Loch. The GIS analysis shows that the microtunnel would likely cross into the shoreline setback around the north end of the Middle Loch.

Waiawa Area Conveyance Options

Three (3) corridors have been identified by ENV to serve the proposed Waiawa Ridge Development. The southern end Corridor G intersects the shoreline setback area at the north end of the Middle Loch.

5.3 LIST OF NECESSARY APPROVALS

The following is a list of the permits and approvals that may be required for the Proposed Action prior to construction.

5.3.1 Federal

- U.S. Army Corps of Engineers
 - *Department of the Army Permit (Clean Water Act Section 404; Rivers and Harbors Act Section 10)*
- U.S. Coast Guard
 - *Section 9 Permit Applicability Guidance*

- U.S. Environmental Protection Agency
 - *NPDES Form 2A – Discharge of Municipal Wastewater from New and Existing Publicly Owned Treatment Works*
 - *Clean Water Act Section 301(h) Review*
 - *Southern Oahu Basal Aquifer Review*
- U.S. Fish and Wildlife Service and National Oceanic and Atmospheric Administration National Marine Fisheries Services
 - *Endangered Species Act Section 7 Consultation*
 - *Magnuson-Stevens Fishery Conservation and Management Act Consultation*
 - *Conservation and Management Act Essential Fish Habitat Consultation*
- U.S. Navy
 - *Real Estate License*
 - *Explosive Safety Submission Determination Request*
 - *Site Approval Request*
 - *Dig Permit*
 - *Waiver Request to the Joint Base Pearl Harbor-Hickam Green Waste Disposal Policy*
 - *Toning Equipment Clearance*
 - *Defense Biometric Identification System*
- National Park Service
 - *6(f) requirements for Blaisdell Park and Aloha Stadium*

5.3.2 State of Hawai‘i

- Department of Business, Economic Development and Tourism, Office of Planning (DBEDT)
 - *Coastal Zone Management Consistency Determination*
- Department of Health (DOH)
 - *Air Pollution Control Permits (Covered Source Permit and/or Noncovered Source Permit)*
 - *Noise Variance Permit*
 - *Individual NPDES – Discharge of Municipal Wastewater from New and Existing Publicly Owned Treatment Works (modification)*
 - *NPDES Notice of Intent for General Permit Form C – Storm Water Discharges Associated with Construction Activities*
 - *NPDES Notice of Intent Form F – Discharges Associated with Hydrotesting Waters*
 - *NPDES Notice of Intent Form G – Discharges Associated with Construction Activity Dewatering*
 - *Section 401 Water Quality Certificate*
- Department of Land and Natural Resources Office of Conservation and Coastal Lands

- *Conservation District Use Permit*
- Department of Land and Natural Resource Commission on Water Resource Management
 - *Stream Channel Alteration Permit*
- Department of Land and Natural Resources Historic Preservation Division
 - *Chapter 6E, HRS Historic Preservation Review*
- Department of Transportation
 - *Highways – Permit to Perform Work within State Highways*
 - *Construction Plan Review and Approval*
 - *Harbors – Work within the Energy Corridor*
- Disability and Communications Access Board review

5.3.3 City and County of Honolulu

- Board of Water Supply (BWS)
 - *Water and Water System Requirements*
 - *Construction Plan Review and Approval*
- Department of Environmental Services
 - *Environmental Impact Statement (EIS) Approval*
 - *Permission to Discharge into Sanitary Sewer*
- Department of Facility Maintenance
 - *Permission to Discharge into CCH Storm Drain System (Required for DOH Clean Water Branch NPDES permits)*
- Department of Planning and Permitting (DPP)
 - *Building Permit*
 - *Construction Plan Review and Approval*
 - *Development Plan Public Facilities Map Amendment*
 - *Dewatering Permit*
 - *Electrical Permit*
 - *Grading and Erosion Control Plan Review*
 - *Grading, Grubbing, and Stockpiling Permit*
 - *Plumbing Permit*
 - *Shoreline Setback Variance*
 - *Sidewalk/Driveway Work Permit*
 - *Special Management Area Use Permit for Areas in the Special Management Zone: Waipahu, Pearl City, and Waimalu WWPSs*
 - *Zoning waiver(s)*
- Department of Transportation Services
 - *Review for CCH Right-Of-Way*
- Honolulu Fire Department (HFD)

- *Review for Diesel Tanks, Hydrants, Sprinkler Systems*

5.3.4 Other

- Utility Companies
 - *Utility Service Requirements*
 - *HECO*
 - *Hawai'i Gas*
 - *Permit regarding Work on Utility Lines*

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6.0 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

6.1 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Short-term uses associated with construction of the Proposed Action include use of water, energy, fuel, and other resources. The impact associated with use of these resources is anticipated to be minimal. Short-term uses and long-term productivity of water resources, flora and fauna, and health, safety, and well-being are summarized below.

Water Resources

Minimal consumption of surface or groundwater is required to construct the Proposed Action. The Proposed Action would reduce potential for sanitary sewer overflows (SSOs), which would improve long-term viability of surface and groundwater resources.

Temporary impacts to the floodplain are anticipated during construction. Fill in the floodplain would result in long-term loss of productivity. Depending on the alternative selected, the limit of work of wastewater pump stations (WWPSs) located in the 100-year floodplain ranges from 8,104 to 43,280 square feet (SF). This area is likely to incur temporary impacts during construction. The footprint of the WWPSs and any areas that require fill would cause permanent impacts to the floodplain. The floodplain would also be temporarily impacted by construction as pipes are laid and tunnels constructed.

The proposed construction activities may result in temporary and permanent loss of wetlands and other waters of the United States. All options follow similar alignments around Pearl Harbor and the adjacent wetlands, and would result in similar impacts. If temporary impacts to wetlands are mitigated through restoration, no long-term impacts to productivity are anticipated. Operation and maintenance of the proposed facilities would not result in impacts to wetlands and would not require mitigation.

Flora and Fauna

Most of the vegetation along the corridors of the proposed wastewater conveyance facility improvements is common non-native introduced species. Based on the composition of vegetation along the corridors, significant impacts to native vegetation would not be expected. Any locations where vegetation is disturbed would be restored to existing conditions or better. Where appropriate, native plant species would be selected for soil stabilization and replanting efforts. Operation and maintenance of the proposed facilities is not anticipated to effect flora, regardless of the options implemented. As a result, no significant loss of productivity is anticipated.

Operation and maintenance of the proposed facilities is not anticipated to effect wildlife regardless of the options implemented and, therefore, a loss of productivity is not anticipated.

Health, Safety, and Well-being

During construction, adjacent neighborhoods may experience nuisances including noise, dust, and traffic. It is not anticipated that these impacts would present a significant threat to health, safety, and well-being. Operation of the wastewater system would have a positive impact on health, safety, and well-being by reducing the potential for leaks and pollution.

Short-term impacts also include employment of construction workers and expenditures on materials, both of which are anticipated to have a positive impact.

6.2 FUTURE OPTIONS

It is not anticipated that the Proposed Action would result in foreclosure of future options or narrow the range of beneficial uses of the environment. The location of the Proposed Action in a developed region avoids loss of undisturbed, forest, and agricultural land. The location of existing development and Honouliuli Wastewater Treatment Plant (WWTP) necessitates that additional infrastructure be constructed within proximity to the coast and coastal resources. However, the Proposed Action avoids beaches and is not anticipated to cause erosion. The alternative location for the Waimalu WWPS location is within Neal S. Blaisdell Park. It is possible that some loss of long-term recreational value of this park could result from the siting this structure in the park.

7.0 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Irreversible and irretreivable resource commitments are related to the use of non-renewable resources and the effects that the use of those resources have on future generations. Irretreivable resource commitments involve the loss in value of an affected resource (e.g., extinction of a threatened or endangered species or the disturbance of a cultural site). The Proposed Action would constitute an irreversible or irretreivable commitment of non-renewable or depletable resources for the materials, time, money, and energy expended during activities implementing the projects and for the land areas used for new proposed above-grade facilities.

In the short-term, construction activities would require the consumption of fossil fuel and energy, as construction requires equipment that would use fuel, either gasoline or diesel, to operate. Irreversible and irretreivable commitments to resources would be unavoidable (i.e., resulting emissions would contribute to overall air quality of the region) but would be minor and temporary.

The proposed clearing of trees and vegetation in the areas proposed for new above-grade facilities would constitute an irreversible and irretreivable loss of natural resources. However, proposed landscaping plans are recommended to include native vegetation plantings throughout the project area to minimize this loss. Also, vegetation would be restored at sites of existing above-grade facilities that would be demolished as part of the Proposed Action.

Construction activities would require the manufacturing and use of materials. Following construction, unused materials would be reused or recycled whenever possible. Materials that cannot be recycled at the end of the project lifetime would become an irreversible and irretreivable commitment of resources. However, no supplies are considered scarce and thus would not limit other unrelated construction activities in the region. The packaging of construction materials that cannot be reused or recycled, as well as other waste generated during construction activities, would result in an irreversible and irretreivable allocation of landfill or other solid waste disposal capacity.

It is anticipated that the Proposed Action would have both beneficial effects on development and employment in the area. The Proposed Action would create demand for construction materials and services, and hence direct and indirect (mostly construction- and industrial-related) employment in the project area. The Proposed Action would also result in adequate sewerage facilities to support current and future economic activities and planned development and growth in the wastewater tributary area.

In the long-term, fossil fuels would be required to operate back-up generators at the proposed wastewater pump stations (WWPSs). However, new and reconstructed WWPSs would be constructed with modern equipment that incorporates greater efficiencies than those achieved at the existing facilities. Therefore, although irreversible and irretrievable commitments of resources are unavoidable (i.e., using oil for energy production), these impacts are anticipated to be minimal.

8.0 PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Adverse impacts can be defined as short- and long-term effects relative to the construction and implementation of a specific use. Short-term impacts are usually construction-related impacts that would occur during construction and cease upon completion of a project. Long-term impacts generally result from the implementation of a project.

8.1 SHORT-TERM EFFECTS

The Proposed Action would result in some unavoidable short-term impacts, as described below. These potential impacts are generally minor and would be further minimized through the implementation of best management practices (BMPs).

8.1.1 Soils

Trench excavation (i.e., force main and trunk sewer rehabilitation / replacement), excavation of the entry and exit shafts for tunneling, and reconstructing or replacing wastewater pump stations (WWPSs) would result in unavoidable short-term soil disturbance and in soil loss during construction. Depending on the option selected, construction may include the removal of soils and excavation material in the area, and disposal of the excavation material (tunnel muck) would be a substantial part of construction if the Hybrid option is implemented. Disposal methods may include use as fill material for other projects, temporary stockpiling, or final disposal to a landfill. Construction activities could impact sewer lines or force mains, potentially resulting in localized contamination of soils. Accidental release of construction equipment fluids (e.g., oil and grease) also could contaminate soils.

To minimize the potential for impacts to soil, construction methods to preserve the integrity of existing utility lines would be implemented and construction equipment would be maintained in good working condition to reduce the potential for accidental spills. Mitigation measures such as erosion and sedimentation controls would be implemented, and a drainage and erosion control plan would be prepared by an engineer and submitted for approval to City and County of Honolulu Department of Planning and Permitting.

8.1.2 Groundwater

Construction activities could potentially impact groundwater if encountered during the proposed work. Also, dewatering may be necessary for construction below the groundwater table, which would be conducted in accordance with applicable regulations. For the Hybrid option, drilling and tunneling could alter groundwater dynamics and quality in the event that tunneling encounters artesian water currently flowing to the surface.

Construction activities would be designed to avoid adverse impacts to groundwater, including avoiding affecting existing sewer lines or force mains, and preventing the accidental release of construction equipment fluids that could contaminate groundwater. Mitigation measures would be implemented during construction activities to preserve the integrity of existing utility lines and keep construction equipment in good working condition to prevent accidental spills. For drilling and tunneling work, the water flow in and near the tunneling activities would be monitored and, if any potentially detrimental changes occur, the problem would be addressed as quickly as possible. In addition, appropriate BMPs (e.g., silt fences, proper storage and movement of spoil) and careful site preparation would be utilized to minimize adverse impacts.

8.1.3 Surface Water and Coastal Waters

Regardless of the options selected, excavation and land disturbance may contribute to sedimentation and runoff into nearby streams and Pearl Harbor, and accidental release of construction equipment fluids also could contaminate surface and coastal waters. For the Hybrid option and Waiawa Area conveyance options Corridors D and G, tunneling beneath waterbodies could result in potential draining of or interruptions to surface water supplies. Tunneling also could result in the release of drilling mud through fractured bedrock toward the surface, with the risk of sediments being suspended in the water column, adversely affecting turbidity.

Construction controls required by National Pollutant Discharge Elimination System (NPDES) permits would reduce the risk of sediment and construction-related contaminants reaching surface and coastal waters. For construction using the conventional open trench method, shoring and dewatering techniques would be employed to mitigate potential impacts. For tunneling, specific mitigation measures would be employed to minimize effects of drilling mud entering surface and coastal waters, including the deployment of silt curtains to contain any turbidity plumes.

8.1.4 Flood Hazard

Demolition, regrading, excavating and backfilling trenches, and stockpiling of excavated materials in the special flood hazard area (SFHA) would result in temporary impacts to the SFHA during construction, and construction access points and staging areas could result in local increases in stormwater runoff to the SFHA due to a decrease in surface permeability and removal of vegetation. Depending on the options selected, the following impacts to flood zones are anticipated:

- Regardless of the options selected, construction activities associated with force mains, trunk sewers, and the Waimalu WWPS would temporarily impact SFHA.
- For the No-Tunnel option, construction activities associated with force mains, and the Waipahu and Pearl City WWPSs would temporarily impact SFHA.
- For the Hybrid option, depending on the location and finish grade of the entry and exit shafts, tunneling could temporarily impact SFHA.
- For the Waiawa Area conveyance options, excavation and backfilling trenches, and, to a lesser extent, tunneling could temporarily impact SFHA, with Corridor

D having the most, Corridor A having moderate, and Corridor G having the least potential impact.

Development of new WWPSs would increase impervious surfaces and therefore may have an impact on local flooding and stormwater management. Depending on the options selected, the following impacts to flooding are anticipated:

- Regardless of the options selected, the proposed alternative location for the Waimalu WWPS may have a negative, long-term impact on flooding.
- For the No-Tunnel option, proposed Alternative Waipahu WWPS No. 1 and all three (3) Pearl City WWPS alternatives may have a net positive, long-term impact on flooding.
- For the Hybrid option, proposed Waipahu WWPS No. 2 and demolition of the Pearl City WWPS may have a net positive, long-term impact on flooding.

8.1.5 Flora and Fauna

Construction activities would temporarily disturb and for above-grade structures permanently displace existing vegetation and associated wildlife. Maintenance activities that include the use of construction equipment, trimming of trees, or the clearing of vegetation would temporarily disturb or permanently displace vegetation and wildlife.

Any locations where vegetation is disturbed would be restored to existing conditions or better. Where appropriate, native plant species would be selected for soil stabilization and replanting efforts.

8.1.6 Wetlands and Other Waters of the United States

Proposed construction activities may result in temporary and permanent loss of wetlands and other Waters of the United States. All options follow similar alignments around Pearl Harbor and the adjacent wetlands, and would result in similar impacts.

A Department of the Army permit would be sought for all dredge and fill activities in wetlands and other Waters of the United States and all structures in, over, and under navigable Waters of the United States. At all locations where wetlands are temporarily impacted they would be restored to existing conditions or better and, if the project results in the permanent loss of wetlands, mitigation would be required.

8.1.7 Air Quality

Regardless of the options selected, construction would result in short-term impacts to air quality, including increases in particulate matter or dust from vehicle movement on the construction site and trucks on road, excavation activities, and spoils removal activities, and emissions from construction vehicles and equipment. For the No-Tunnel option, adverse air quality impacts would occur along force mains or trunk sewer lines to be trenched. However, for the Hybrid option, since the majority of tunnel work is underground, no adverse air quality impact would occur in the neighborhoods along the tunnel alignment under the Hybrid option excluding shaft sites. For the Waiawa Area conveyance options, microtunneling alignment

impacts would be similar to the Hybrid option under the East Interceptor conveyance options, and Corridor G would likely experience the greater tunnel boring activities and associated air quality impacts as compared to Corridors A and D.

State air pollution controls prohibiting visible emissions of fugitive dust from construction activities at the property line would be followed by the contractor. Other BMPs would also be incorporated into design plans, as appropriate, for implementation by the contractor. The City and County of Honolulu (CCH) would implement dust control measures and idling restrictions, and additional emission reduction measures would also be considered to the extent reasonably feasible. Overall, emission reduction measures are expected to minimize air pollutant emissions, resulting in minimal adverse air quality impacts due to construction sources.

8.1.8 Noise

Construction noise would be unavoidable during the duration of the respective project construction periods. Short-term increases in noise levels would result from construction activities, vehicles and equipment. The use of muffled equipment, noise barriers, and restrictions on construction hours, as well as adherence to State of Hawai'i Department of Health (DOH) regulations on noise mitigation, would minimize construction and traffic-related noise. For construction work to be performed at night or on weekends and holidays, a community noise variance permit from DOH would be required if it exceeds regulatory noise levels.

8.1.9 Transportation

Regardless of the options selected, construction would result in temporary impacts to the various transportation modes in the project area including roadways, pedestrian and bike facilities, and public transit facilities near the Proposed Action. Impacts would include lane closures, disruption of sidewalks and crosswalks, disruption of the Pearl Harbor Bike Path, and potential delays to traffic and City bus routes. Mitigation measures would include preparation of a transportation management plan, minimizing closures during peak travel periods, and providing alternative paths for pedestrians and bicyclists.

8.1.10 Visual and Aesthetic Resources

Regardless of the options selected, construction of the proposed conveyance systems may have short-term and local, adverse impacts on the visual aesthetics in the project area. Since construction of the Pearl City-Waipahu trunk sewer would involve tunneling rather than laying pipes using open trench methods, potential adverse impacts for the Hybrid option would be geographically more restricted than for the No-Tunnel option.

The following mitigation measures may be employed to minimize any impacts on visual and aesthetic resources during construction:

- During construction, fencing surrounding construction sites may be provided as needed to provide a visual screen of the project site and materials.

- Construction would be scheduled and phased to minimize the duration of construction.
- If nighttime lighting is required, lights would be shielded to minimize glare and impact on areas outside of the construction zone.

8.1.11 Wastewater

Regardless of the options selected, the Proposed Action would result in short-term impacts to the existing wastewater collection system during construction of the proposed improvements and rehabilitation activities, including potential temporary interruptions to service to connect new structures and facilities to the existing system, and temporary pumping and piping may be required.

8.1.12 Solid Waste Disposal

During construction, although most material excavated for new force mains, trunk sewers, and WWPSs would be used as backfill on site, excess excavated material that could not be kept on site would require offsite disposal. Coordination with local landfills and recycling centers for the disposal of construction debris and/or hazardous materials may be required. Disposal would be in accordance with appropriate regulations and standards.

8.1.13 Public Schools

During construction, there may be additional noise and traffic at or near the schools, regardless of the options selected. Construction traffic would be scheduled to avoid conflict with school traffic.

8.1.14 Parks and Recreational Areas

During construction, there may be additional noise and traffic at or near parks and recreational areas, regardless of the options selected. Under all options, long-term impairment of public use of Neal S. Blaisdell Park and Aloha Stadium, where conversion of park lands may be subject to National Park Service 6(f) restrictions, as well as all existing parks, has been avoided to the extent possible. However, temporary interference with recreational activities during construction and permanent conversion of park land are anticipated.

8.2 LONG-TERM EFFECTS

The following unavoidable long-term impacts may result from implementation of the Proposed Action.

8.2.1 Groundwater

Regardless of the options selected, there is the potential for leakage and breakage in sewer lines that would result in impacts to groundwater. Mitigation measures for the operational impacts include proper operation and maintenance of the proposed facilities. Additionally, the Proposed Action is being implemented to reduce the

potential of sanitary sewer overflows (SSOs) by increasing capacity to the existing conveyance and treatment system for current and future needs.

8.2.2 Air Quality

Potential long-term emissions from each WWPS—particularly from new WWPSs to be constructed—could have the potential to affect air quality conditions in the neighborhood from operating pump engines powered by the new generators to be installed for power shaving or emergency uses. Pump station emergency generators are exempt from air quality permitting requirements pursuant to HAR 11-60.1-62(d)(8).

The State of Hawai'i has established a significance threshold of 10 tons per year for net increase in hydrogen sulfide (H₂S) emissions in §11-60.1-1. It is unlikely that any of the WWPSs under the Proposed Action would exceed this threshold.

For the No-Tunnel option, odor control measures would be implemented for the Pearl City WWPS replacement location alternatives to minimize odor impacts to neighboring uses and sensitive receptors, including the Lehua Elementary School and Lehua Community Park.

8.2.3 Visual and Aesthetic Resources

Regardless of the options selected, new above-grade facilities likely would be landscaped and are not expected to substantially affect scenic vistas and view planes in the area, although increased capacity in the collection system is expected to result, over time, in a more urbanized look in the area of the East Interceptor system.

8.2.4 Public Schools, Parks, and Recreation

For the No-Tunnel option, there are public concerns regarding odor control due to the proximity of the Pearl City WWPS replacement location alternatives to Lehua Elementary School and Lehua Community Park. To address these concerns, if the option to relocate the Pearl City WWPS is elected, additional odor control measures would be implemented at the WWPS to result in minimal odor impacts to neighboring uses, including the school and park.

9.0 SUMMARY OF UNRESOLVED ISSUES

Unresolved issues are invariably associated with projects in the planning and conceptual design stages, as is the case for this Proposed Action. Consequently, the various planning processes being pursued by the City and County of Honolulu (CCH), including the preparation of this Draft Environmental Impact Statement (DEIS) and community outreach efforts, are based on the best available information and expertise of those knowledgeable in the design and construction of the proposed types of facilities. The unresolved issues for the Proposed Action at the time of this DEIS submittal are summarized below along with a discussion of how the issues will be resolved prior to commencement of the project construction and/or operation.

9.1 SELECTION OF PREFERRED OPTIONS

As discussed in Section 2 of this DEIS, there are multiple proposed options to rehabilitate, upgrade and/or expand the existing Honouliuli major sewer conveyance system (East Interceptor System) to accommodate flows through 2050. Two (2) East Interceptor conveyance options are being considered: No-Tunnel and Hybrid. There are a number of common project components between these two (2) options; however, specific wastewater pump station (WWPS) locations have not been selected from the alternative locations that are being considered. Furthermore, the two (2) East Interceptor conveyance options present different options for pipe layout, depth, location, and associated construction method. The Proposed Action also includes three (3) alternative Waiawa Corridor options. The final option has not yet been selected. Identification of preferred options and alignments will be informed by the findings of this DEIS and community outreach efforts.

9.2 DESIGN OF PREFERRED OPTIONS

The Proposed Action design and layout is conceptual at this stage. It is anticipated that some adjustments will be made to conceptual designs and site layout during the design phase after preferred options and alignments have been identified.

9.3 PROJECT-SPECIFIC HRS CHAPTER 343 DOCUMENTS

This DEIS is intended to provide environmental considerations that may assist the City and County of Honolulu Department of Environmental Services (ENV) in its decision-making. With the planning level of information currently available, the DEIS evaluation is considered programmatic. When sufficient design details are available, separate project-specific Hawai'i Revised Statutes (HRS) Chapter 343 documents will be prepared as appropriate and compliance with special laws (e.g., HRS Chapter 6E Historic Preservation) will be demonstrated.

9.4 GREENHOUSE GAS EMISSIONS

Greenhouse gas (GHG) impacts and mitigation measures are not included in this DEIS. A study of whether the Proposed Action may emit substantial GHGs directly or

as an indirect or cumulative impact will be conducted for individual projects as designs progress.

9.5 SHORELINE SETBACK

A survey may be necessary to confirm the specific location of the shoreline setback and to verify that project components are or are not located within this area. The proposed alternative location for the Waimalu WWPS is approximately 10 feet from the shoreline setback. A survey may be necessary to confirm that the structure is not within the shoreline area and that a variance is not required.

9.6 WETLANDS

Wetland delineations would be necessary in order to verify the location of wetlands.

9.7 IMPACTS TO SPECIFIC SPECIES

Observation of nesting birds or other species at the time of construction would be necessary in order to verify that no endangered or threatened species are present.

10.0 CONSULTATION

Pursuant to Hawai'i Revised Statutes (HRS), Chapter 343 and Hawai'i Administrative Rules (HAR) Title 11, Chapter 200, consultation with agencies and other stakeholders prior to and during the preparation of the Environmental Impact Statement (EIS) is required to inform the affected area of the Proposed Action and solicit input in scoping the analyses to be conducted to evaluate potential impacts and identify required mitigation measures. Following below is a list of federal, state, and City and County of Honolulu (CCH) agencies and other stakeholders and organizations that were consulted during the publication of the Environmental Impact Statement Preparation Notice (EISPN) and that are being consulted during the publication of this Draft Environmental Impact Statement (DEIS). This list is not final, and additional stakeholders may be identified and consulted with as part of the review process.

The EISPN was published in the Office of Environmental Quality Control's (OEQC's) *The Environmental Notice* on May 8, 2019. A total of 13 comment letters were received during the EISPN 30-day public comment period, and an additional three comment letters were received after the official public comment period closed. Stakeholders who submitted a comment letter are designated with a “*”. Stakeholders who were not consulted during the publication of the EISPN but who will be consulted during the publication of the DEIS are denoted with a “**”. Copies of the written comment letters received and the respective response letters that were sent are included in Appendix G.

10.1 FEDERAL

- United States Congressional Delegates (senators and representatives)
- Federal Aviation Administration**
- Federal Transit Administration**
- NAVFAC Hawaii
- United States Army Corp of Engineers
- United States Coast Guard, 14th C.G. District
- United States Environmental Protection Agency
- United States Geological Survey Pacific Islands Water Science Center**
- United States National Ocean and Atmospheric Administration, Pacific Islands Regional Office
- United States Fish and Wildlife Service, Pacific Division*
- United States National Marine Fisheries Service
- United States National Parks Service Pacific Islands Support Office**
- United States Natural Resources Conservation Services
- United States Navy, Joint Base Pearl Harbor-Hickam

10.2 STATE OF HAWAI‘I

- Department of Agriculture
- Department of Accounting and General Services (Director and Stadium Authority)*
- Department of Business, Economic Development and Tourism (DBEDT) (Director, Hawai‘i Housing Finance and Development Corporation, Office of Planning, Energy Office, and Research Division Library)*
- Department of Defense
- Department of Education
- Department of Hawaiian Home Lands
- Department of Health (Clean Water Branch, Environmental Management Division, OEQC, Wastewater Branch, Environmental Health Administration)
- Department of Human Services
- Department of Labor and Industrial Relations
- Department of Land and Natural Resources (Commission on Water Resource Management, Division of Boating and Ocean Recreation, Division of State Parks, Office of Conservation and Coastal Lands, Land Division, State Historic Preservation Division, Division of Forestry and Wildlife, Division of Aquatic Resources)*
- Department of Transportation (Director and Right-of-Way Branch)*
- Hawai‘i Interagency Council for Transit-Oriented Development
- Hawai‘i State Library**
- Legislative Reference Bureau Library**
- Office of Hawaiian Affairs
- University of Hawai‘i (Environmental Center, Water Resources Research Center, Thomas H. Hamilton Library, Edwin H. Mookin Library**, Maui College Library**, Kaua‘i Community College Library**)
- Elected Officials (House of Representatives Districts 30-44 and Senate Districts 14-20 and 22)

10.3 CITY AND COUNTY OF HONOLULU

- Board of Water Supply (BWS)*
- Department of Customer Services**
- Department of Design and Construction*
- Department of Enterprise Services
- Department of Facility Maintenance
- Department of Land Management

- Department of Parks and Recreation*
- Department of Planning and Permitting (DPP)*
- Department of Transportation Services
- Fire Department
- Honolulu Authority of Rapid Transit*
- Police Department*
- Emergency Services Department
- Office of the Mayor
- City Council (Districts 1, 2, 5, 6, 7, 8, and 9)
- Neighborhood Boards:
 - *‘Aiea Neighborhood Board No. 20*
 - *Āliamanu/Salt Lake/Foster Village Neighborhood Board No. 18*
 - *‘Ewa Neighborhood Board No. 23*
 - *Makakilo/Kapolei/Honokai Hale Neighborhood Board No. 34*
 - *Mililani Mauka/Launani Valley Neighborhood Board No. 35*
 - *Mililani/Waipi‘o/Melemanu Neighborhood Board No. 25*
 - *Pearl City Neighborhood Board No. 21*
 - *Waipahu Neighborhood Board No. 22*

10.4 **NONGOVERNMENTAL ORGANIZATIONS AND GENERAL PUBLIC**

- ‘Ahahui Siwila Hawai‘i O Kapolei
- Coral Creek Golf Course
- ‘Ewa Beach Community Association
- ‘Ewa by Gentry Community Association
- ‘Ewa Beach Lions Club
- ‘Ewa Task Force
- Hawai‘i Gas
- Hale Pono - Boys & Girls Club, formerly ‘Ewa Beach Boys & Girls Club
- Hawaii Audubon Society
- Hawaiian Electric Company*
- Hawai‘i Farm Bureau Federation
- Hawai‘i Natural Heritage Program
- Hawai‘i Tribune Herald**
- Hawaiian Railway Society*

- Hawaiian Telecom Company
- Hawaii’s Thousand Friends
- Honolulu Star Advertiser**
- Kamehameha Schools
- Kapolei Chamber of Commerce
- Mau’i News**
- Molokai Dispatch**
- Par Hawai’i
- Pearl City Public Library**
- Outdoor Circle
- Save Ewa Field
- Spectrum
- The Garden Island**
- Waipahu Community Association
- West Hawai’i Today**
- West O’ahu Economic Development Association

11.0 PREPARERS OF THE DEIS

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Appendix A: Delegation of Authority Memorandum

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MAYOR

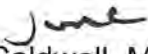


ROY K. AMEMIYA, JR.
MANAGING DIRECTOR
GEORGETTE T. DEEMER
DEPUTY MANAGING DIRECTOR

October 26, 2017

MEMORANDUM

TO: Lori M. K. Kahikina, P.E.
Director

FROM: The Honorable Kirk Caldwell, Mayor 

SUBJECT: Environmental Impact Statements for the City's Wastewater Program and
Projects, Oahu, Hawaii

I hereby delegate authority to the Department of Environmental Services (ENV) to act as the Accepting Authority on behalf of the Mayor of the City and County of Honolulu for the Environmental Impact Statements (EIS's) which the City and County of Honolulu undertakes for its Wastewater Program and Projects. The undertaking of each EIS shall be in accordance with applicable law, rules and recommended practices. It is understood that this delegation will allow for a more efficient work process for the EIS's to the benefit of the Wastewater Program and Projects.

cc: Department of Planning and Permitting
Department of Design and Construction

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**Appendix B: Archaeological
Literature Review and Field
Inspection Report**

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Draft
Archaeological Literature Review and Field Inspection
Report to Support Consultation with SHPD for the
Honouliuli Waipahu Pearl City Wastewater Collection
System Improvement Project,
Honouliuli, Waikele, Waipi‘o, Waiawa, Mānana, Waimano,
Waiau, Waimalu, Kalauao, ‘Aiea, and Hālawa Ahupua‘a,
‘Ewa District, O‘ahu
TMKs: [1] 9-1, 3, 4, and 6–9; multiple plats

Prepared for
AECOM

Prepared by
Alexandra Bennicas, B.A.,
David W. Shideler, M.A.,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.
Kailua, Hawai‘i
(Job Code: HONOULIULI 175)

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Management Summary

Reference	Archaeological Literature Review and Field Inspection Report to Support Consultation with SHPD for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement Project, Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiiau, Waimalu, Kalauao, and Hālawā Ahupua'a, 'Ewa District, O'ahu, TMKs: [1] 9-1, 3, 4, and 6-9, multiple plats (Bennicas et al. 2019)
Date	November 2019
Project Number(s)	Cultural Surveys Hawai'i, Inc. (CSH) Job Code: HONOULIULI 175
Investigation Permit Number	CSH completed the fieldwork component of this study under archaeological fieldwork permit number 19-07, issued by the Hawai'i State Historic Preservation Division (SHPD) per Hawai'i Administrative Rules (HAR) §13-282.
Agencies	SHPD, City and County of Honolulu
Land Jurisdiction	City and County of Honolulu, State of Hawai'i, Federal Government, Private
Project Proponent	City and County of Honolulu Department of Environmental Service
Project Funding	City and County of Honolulu Department of Environmental Service
Project Location	The study area is located within Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiiau, Waimalu, Kalauao, and Hālawā Ahupua'a, 'Ewa District, O'ahu, TMKs: [1] 9- 1, 3, 4, and 6-9, multiple plats. The western portion of the study area originates in 'Ewa near the intersection of Iroquois Road and West Loch Drive at the Naval Magazine Pearl Harbor (West Loch). The study area extends north across West Loch until converging with the Pearl Harbor Bike Path near Waipi'o Point Access Road where it continues to follow the bike path until it nears the intersection with Kamehameha Highway in Waiiau Ahupua'a. The study area then follows the alignment of Kamehameha Highway until diverging along Salt Lake Boulevard near the Aloha Stadium and terminating at the intersection of Salt Lake Boulevard and Kahuapa'ani Street in Hālawā Ahupua'a. A secondary portion of the corridor also runs in alignment with Kamehameha Highway, <i>mauka</i> (toward the uplands, north) of Pearl City Peninsula within Waiawa and Mānana Ahupua'a, and intermediary corridors run northeast to southwest between the <i>mauka</i> corridor and the main corridor. A portion of the study area also extends from the <i>mauka</i> corridor up Waihona Street in Waiawa Gulch. The project area also includes the Waipahu Wastewater Pumping Station (WWPS) and two adjacent alternative locations, the Pearl City WWPS and an adjacent alternative location, the Waimalu WWPS and an adjacent alternative location, and the Halawa WWPS and an adjacent alternative location. The study area is depicted on a portion of the 1998 and 1999 U.S. Geological Survey

	(USGS) 7.5-minute topographic Waipahu and Pearl Harbor quadrangles.
Project Description	The project's proposed action aims to rehabilitate, upgrade, and/or expand the existing Honouliuli major sewer conveyance system (East Inceptor System) to accommodate flows through 2050. The affected area includes areas with current wastewater flows going to the Honouliuli Wastewater Treatment Plant (WWTP) as well as potential future flows from areas including but not limited to Hālawā, 'Aiea, Pearl City, Waipi'o, Waikele, Waipahu, 'Ewa, Kapolei, and Mililani.
Project Acreage	714.59 acres (289.18 hectares); approximately 12 miles in length
Document Purpose	This investigation was designed—through detailed historical, cultural, and archaeological background research and a field inspection of the study area—to determine the likelihood that historic properties may be affected by the proposed project and, based on findings, consider cultural resource management recommendations. This document is intended to facilitate the project's planning and support the project's historic preservation and environmental review compliance. This investigation does not fulfill the requirements of an archaeological inventory survey investigation, per HAR §13-276. Consequently, this report cannot be used to make formal recommendations for SHPD review and acceptance.
Fieldwork Effort	CSH archaeologists Alexandra Bennicas, B.A., Thomas Martel, B.A., and David W. Shideler, M.A., conducted fieldwork between 29 May 2019 and 27 June 2019 under the general supervision of Principal Investigator Hallett H. Hammatt, Ph.D. This work required approximately 10 person-days to complete.
Results Summary	The literature review of the study area resulted in the identification of 12 previously identified historic properties and two archaeological sites within the study area. This includes State Inventory of Historic Places (SIHP) # 50-80-13-9992, U.S. Navy Base, Pearl Harbor Historic District; # 50-80-12-9714, the OR&L Railroad; SIHP # 50-80-13-5597, a sugar irrigation complex; SIHP # 50-80-13-7796, an irrigation complex; SIHP # 50-80-09-00123, Loko Eo; McAllister Site 122, the former Ahuena Heiau; SIHP # 50-80-09-06764, 'Ewa Junction Navy Fuel Drum Site; SIHP # 50-80-09-00119, Loko Kuhialoko; SIHP # 50-80-09-7571, a post-Contact cultural deposit; SIHP # 50-80-09-7150, a subsurface <i>lo'i</i> (taro terrace) deposit; SIHP # 50-80-09-8144, a historical subsurface trash deposit; SIHP # 50-80-13-0109, Loko Paakea; "Fresh Pond" Hawaiian fishpond; and historical 'Aiea Cemetery. Of these 14 sites, only five were re-identified during the current pedestrian survey field inspection (SIHP #s -9992, -9714, -5597, -7796, and the 'Aiea Cemetery). Additionally, the field inspection resulted in the documentation of 60 newly identified potential historic properties and/or features. This includes military structures and

	<p>infrastructure related to the 1930s to 1950s development of Naval Magazine Pearl Harbor (West Loch) (SIHP # -9992), features of the previously identified post-Contact irrigation complex (SIHP #s -5597 and -7796), historical infrastructure related to the development of transportation, a fire station, and two active agricultural operations with potentially historical origins.</p>
Recommendations	<p>The present study area is of corridors 400-feet wide and hence is much larger (wider) than the area of ground disturbance/impact that is likely expected in the actual buildout of the project. As there are numerous potential archaeological historic properties within the larger study area, a more defined project area would better inform regarding the potential impacts to historic properties. It is expected that these may include architectural historic properties (bridges, buildings, structures, etc.) as well as archaeological (sites), and possibly human burials. Therefore, as the project area is narrowed, and the potential impacts are clarified, it is recommended that consultation with the SHPD Architecture, Archaeology, and History and Culture Branches be conducted for the proposed project to determine appropriate historic preservation requirements.</p>

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Section 1 Introduction

1.1 Project Background

At the request of AECOM, and on behalf of the City and County of Honolulu Department of Environmental Services (ENV), Cultural Surveys Hawai'i, Inc. (CSH) has prepared this archaeological literature review and field inspection report (LRFI) for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement Project, Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a, 'Ewa District, O'ahu, TMKs: [1] 9-1, 3, 4, and 6-9, multiple plats. This archaeological LRFI study is intended to inform the Environmental Impact Statement (EIS) being prepared by the ENV to evaluate the potential impacts from the proposed improvements and upgrades to historic properties as may be present. In order to evaluate impacts to any traditional and customary practices, CSH is conducting a companion cultural impact assessment (CIA) (Tanaka and Hammatt 2019) also under contract to AECOM, the City ENV's prime contractor for the EIS.

The main corridor of the study area stretches roughly 19.3 km (12 miles) from 'Ewa, extending from the southwest shore of the West Loch of Pearl Harbor northeast across West Loch to the west side of Waipi'o Peninsula, north up the west side of Waipi'o Peninsula, to where it follows the Pearl Harbor Bike Path east along the inland extent of the Waipi'o Peninsula and the Pearl City Peninsula until intersecting with Kamehameha Highway in Waiawa Ahupua'a. From there the study area corridor follows the highway alignment to the Aloha Stadium where the study area diverges along Salt Lake Boulevard until its eastern termination point at Kahuapa'ani Street in Hālawā Ahupua'a.

The study area also has a secondary *mauka* (toward the uplands, typically north for this study) northwest/southeast trending corridor following the Kamehameha Highway alignment from the H-2 Freeway on-ramp in Waiawa Ahupua'a to Waimano Home Road in Mānana Ahupua'a, and three intermediary corridors aligned northeast to southwest between the main and secondary corridor (only the easternmost follows a road alignment [Lehua Avenue]). An additional offshoot from the western extent of the secondary *mauka* Kamehameha Highway corridor follows Waihona Street up Waiawa Gulch in Waiawa Ahupua'a for approximately 1,000 m.

The project area also includes the Waipahu Wastewater Pumping Station (WWPS) and two adjacent alternative locations, the Pearl City WWPS and an adjacent alternative location, the Waimalu WWPS and an adjacent alternative location, and the Halawa WWPS and an adjacent alternative location.

A general corridor width of 400-feet (ft) was used to define the LRFI study area. The study area is depicted on a portion of the 1998 Waipahu and 1999 Pearl Harbor U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1 through Figure 4), tax map key section maps (Figure 5 through Figure 11), and 2016 ESRI Aerial Imagery/2017 Hawaii Orthos aerial photographs (Figure 12 through Figure 15).

The project's proposed action aims to rehabilitate, upgrade, and/or expand the existing Honouliuli major sewer conveyance system (East Inceptor System) to accommodate flows through 2050 (Figure 16). The affected area includes areas with current wastewater flows to the Honouliuli Wastewater Treatment Plant (WWTP) as well as potential future flows from areas including but

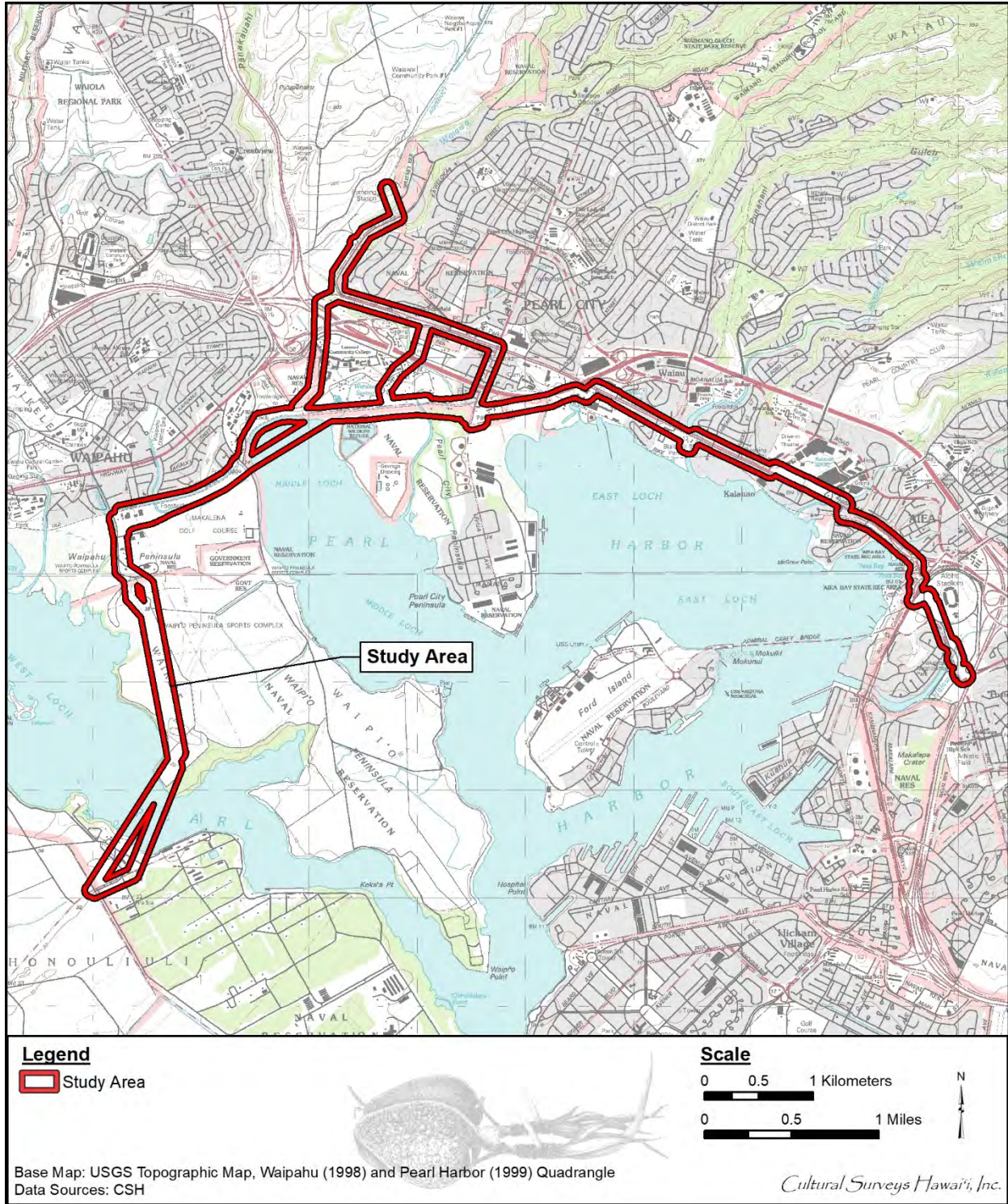


Figure 1. Portion of the 1998 Waipahu and 1999 Pearl Harbor USGS topographic quadrangles showing location of the study area

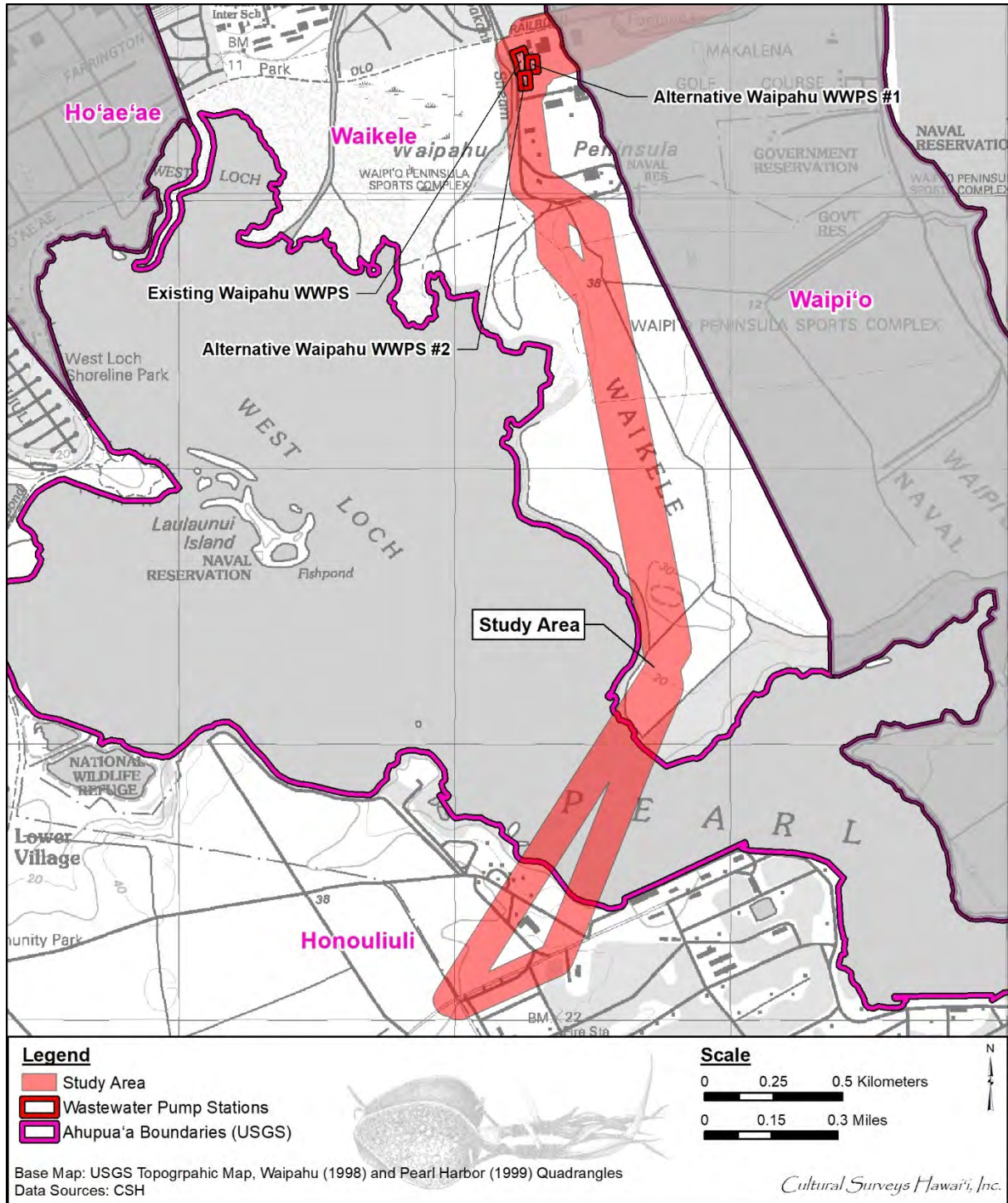


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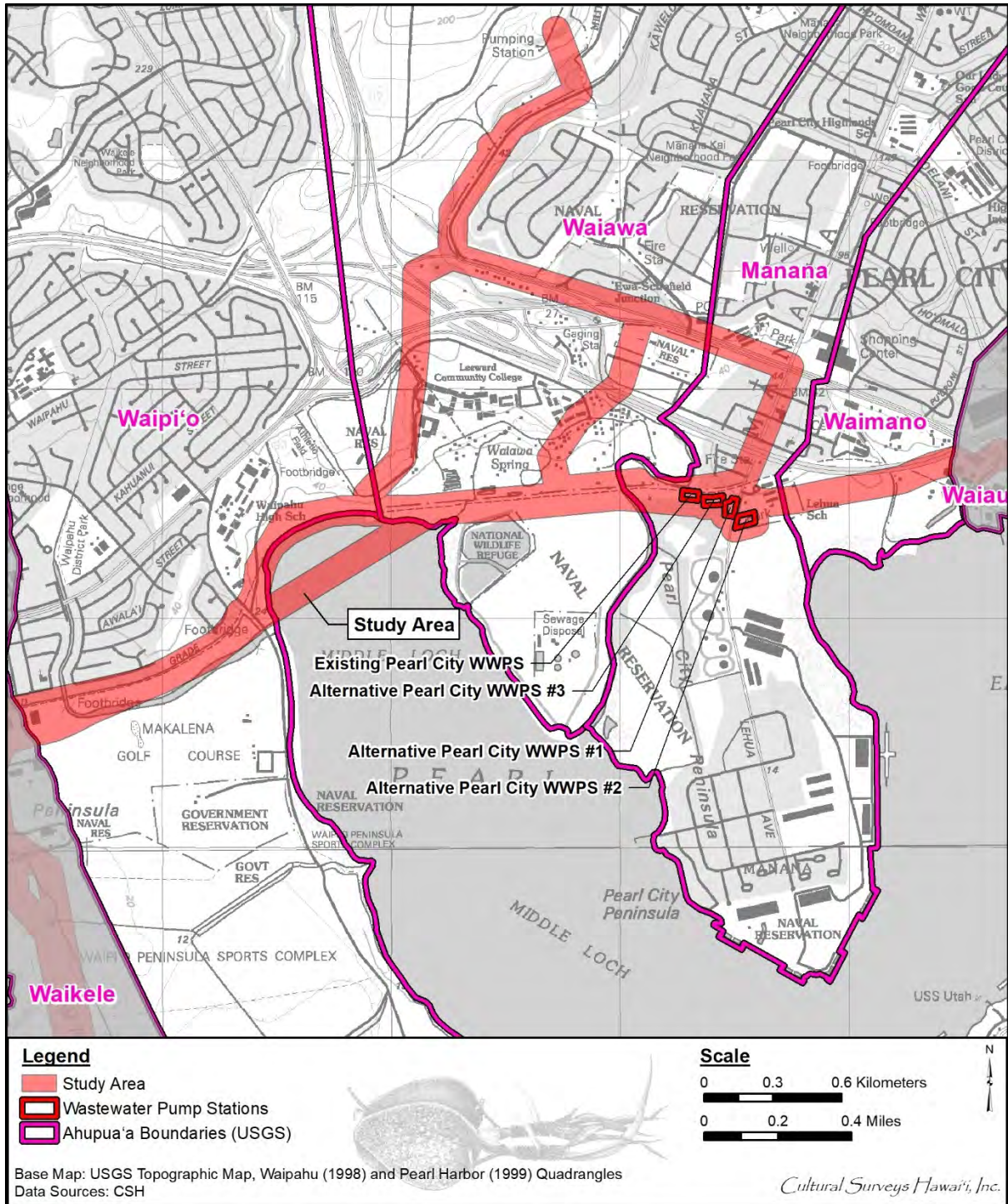


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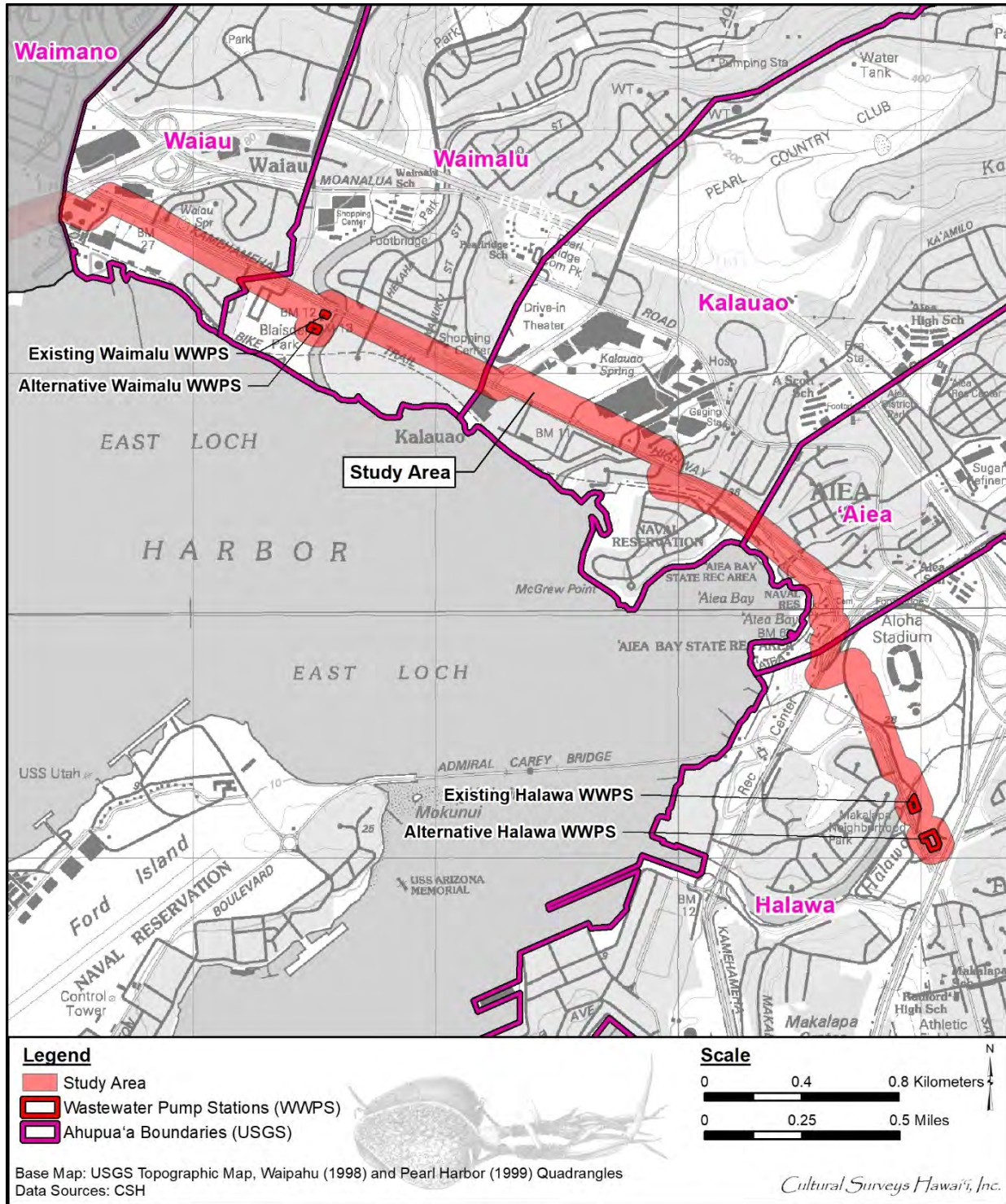


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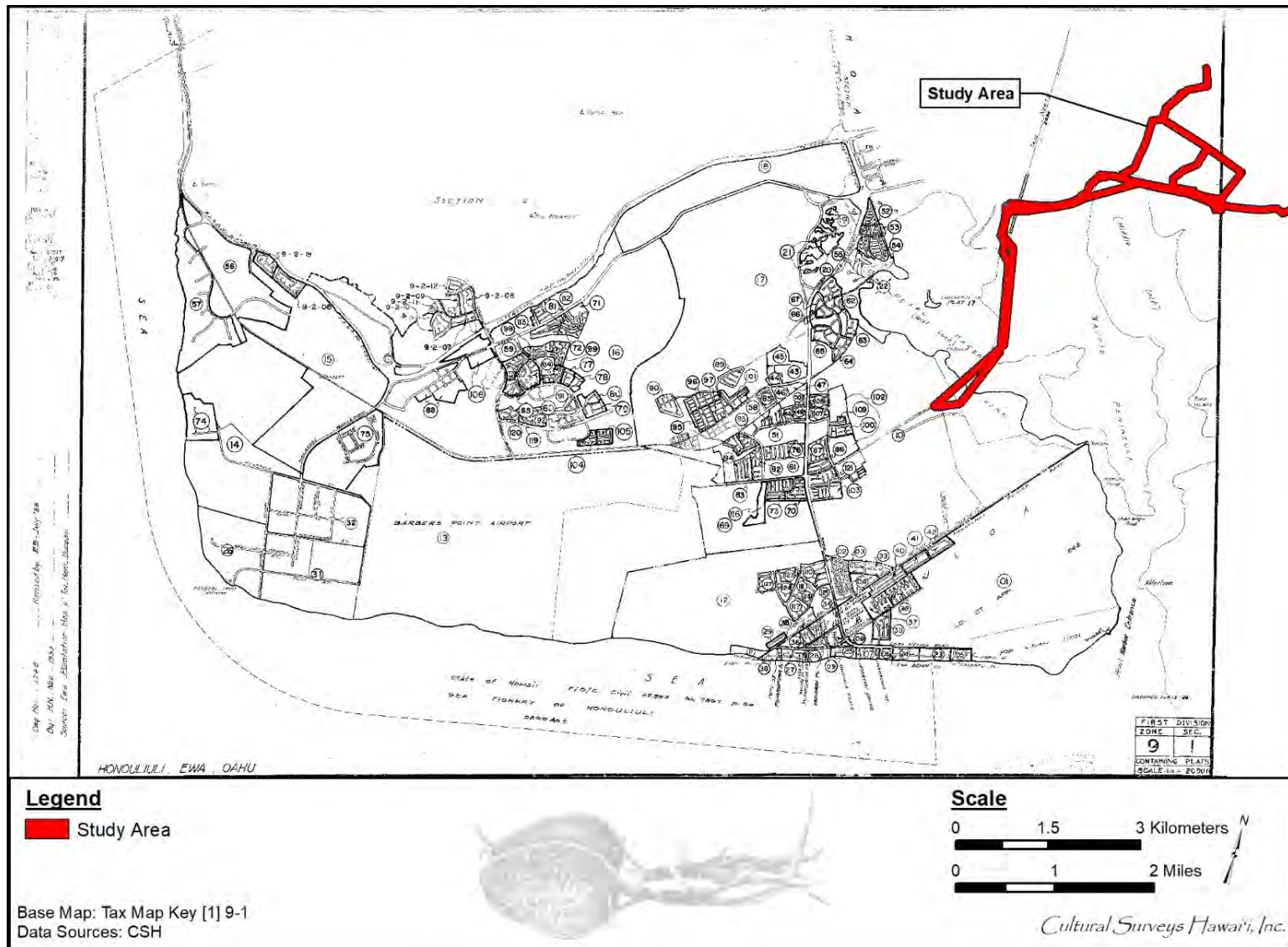


Figure 5. Tax Map Key (TMK) [1] 9-1 section map showing the western portion of the study area (Hawai'i TMK Service 2014)

LRFI for Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, ‘Ewa, O‘ahu

TMKs: [1] 9-1, 3, 4, and 6-9, multiple plats

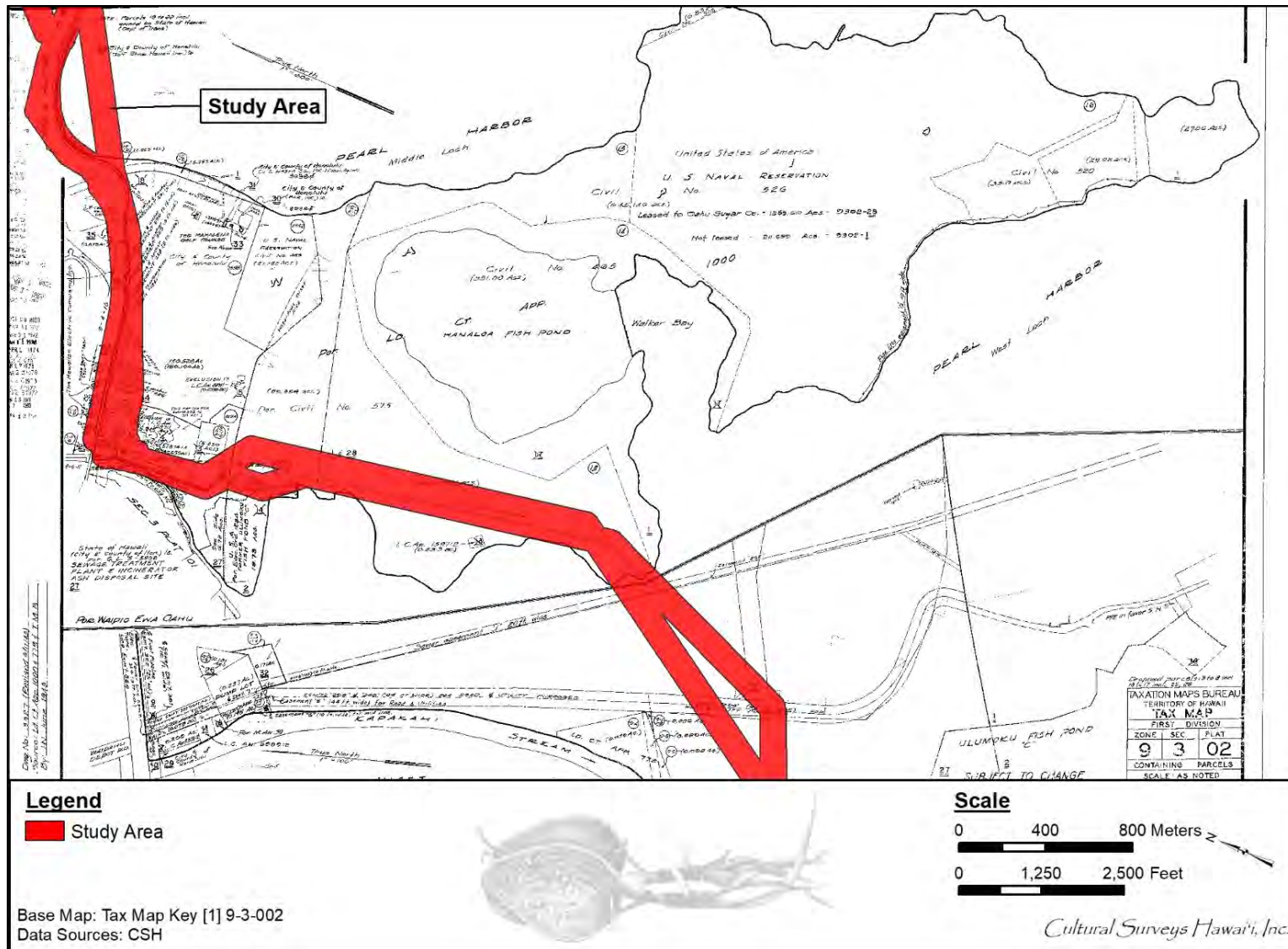


Figure 6. TMK: [1] 9-3-002 showing the western portion of the study area (Hawai'i TMK Service 2014)

LRFI for Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, ‘Ewa, O‘ahu

TMKs: [1] 9-1, 3, 4, and 6-9, multiple plats

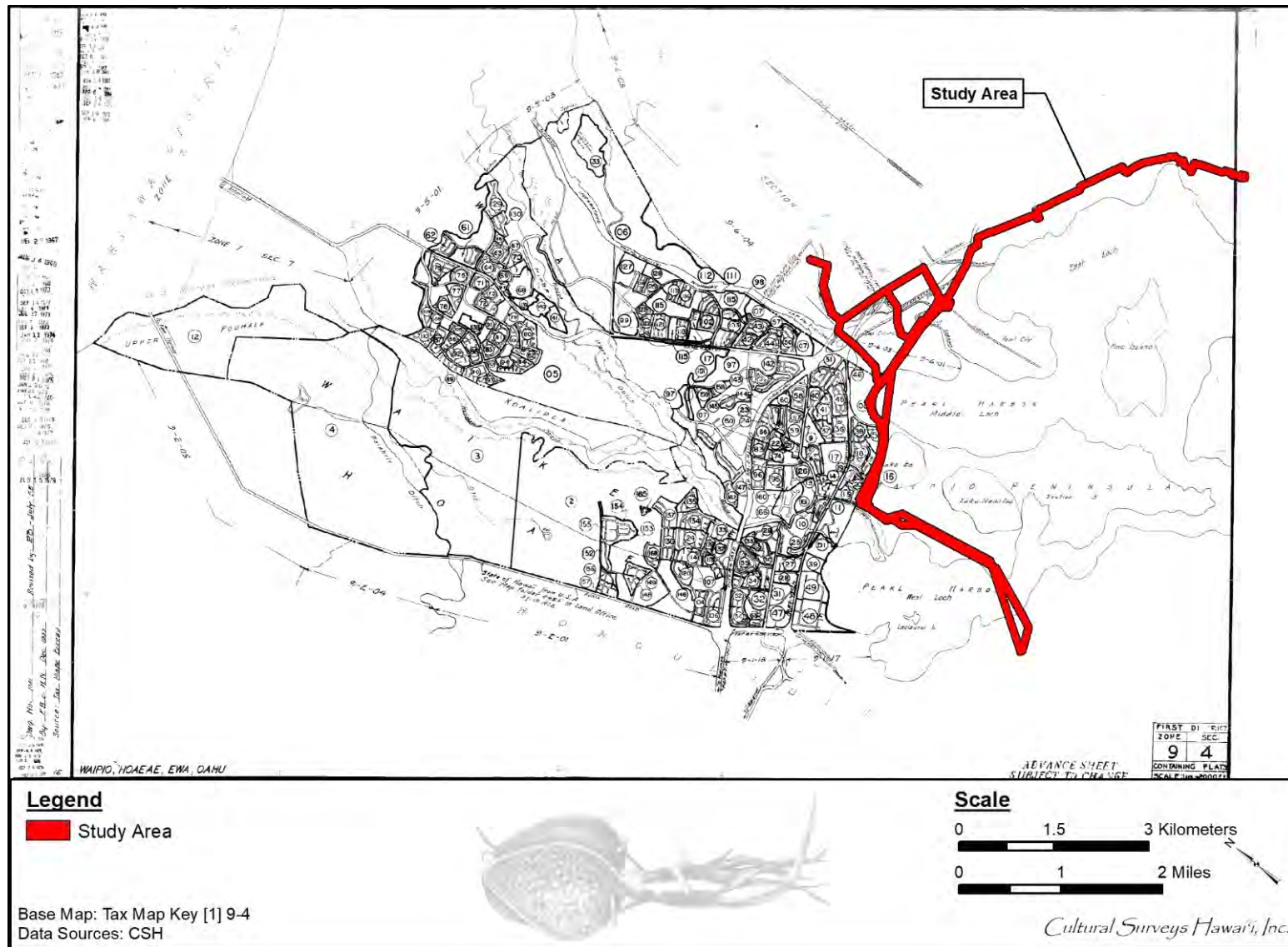


Figure 7. TMK: [1] 9-4 section map showing the western and center portion of the study area (Hawai'i TMK Service 2014)

LRFI for Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, ‘Ewa, O‘ahu

TMKs: [1] 9-1, 3, 4, and 6-9, multiple plats

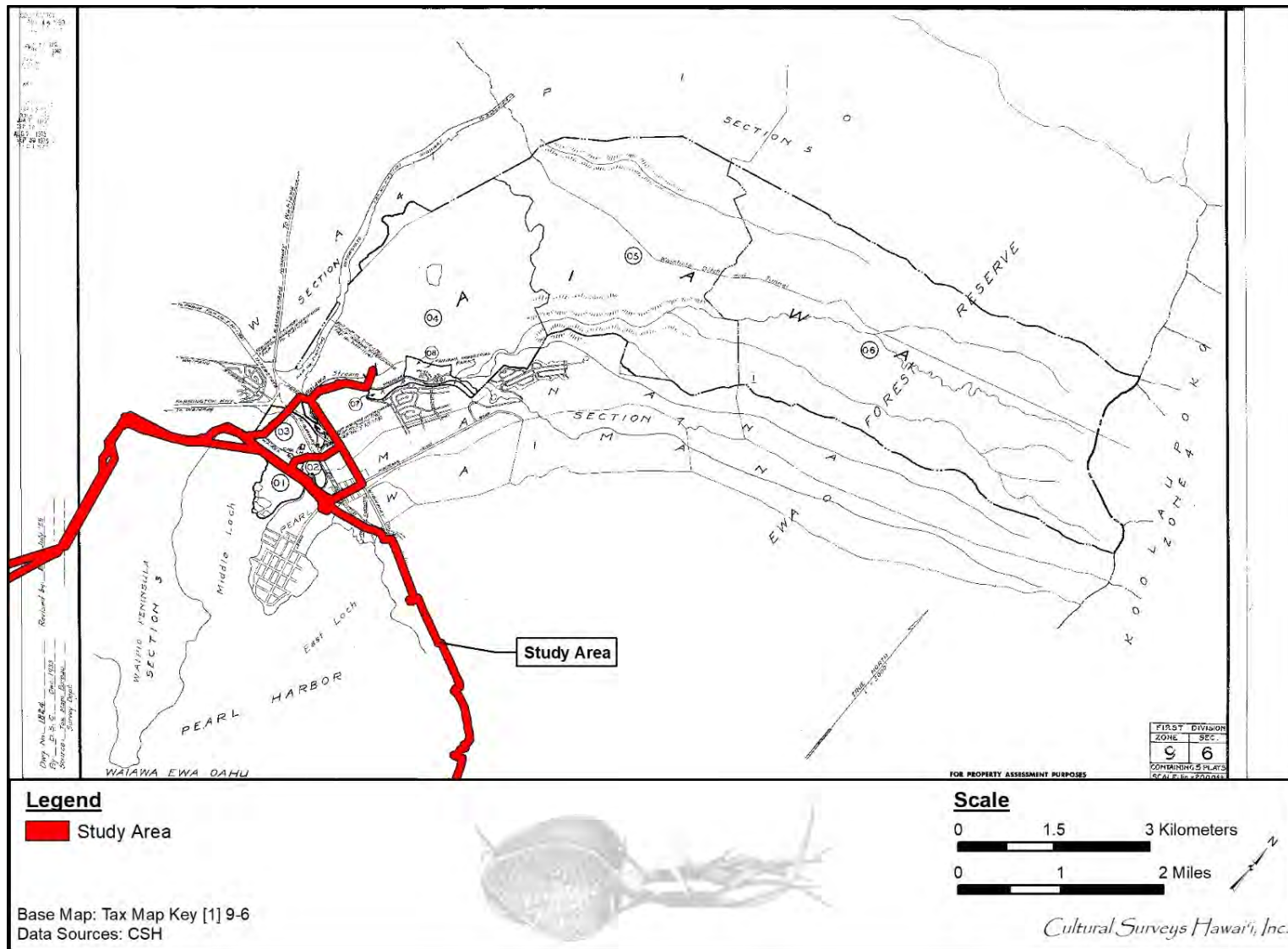


Figure 8. TMK: [1] 9-6 section map showing the central portion of the study area (Hawai'i TMK Service 2014)

LRFI for Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, ‘Ewa, O‘āhu

TMKs: [1] 9-1, 3, 4, and 6-9, multiple plats

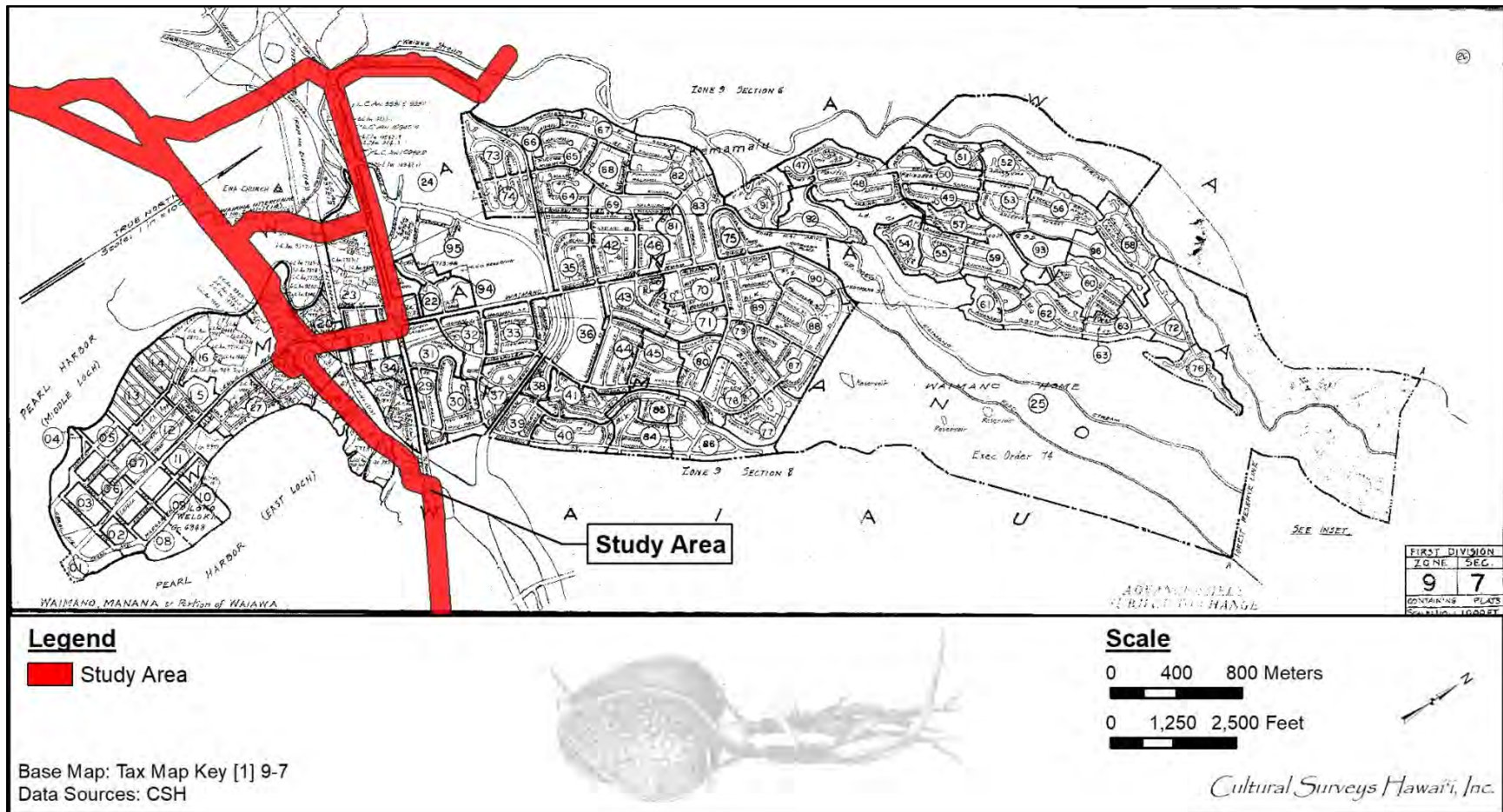


Figure 9. TMK: [1] 9-7 section map showing the central portion of the study area (Hawai'i TMK Service 2014)

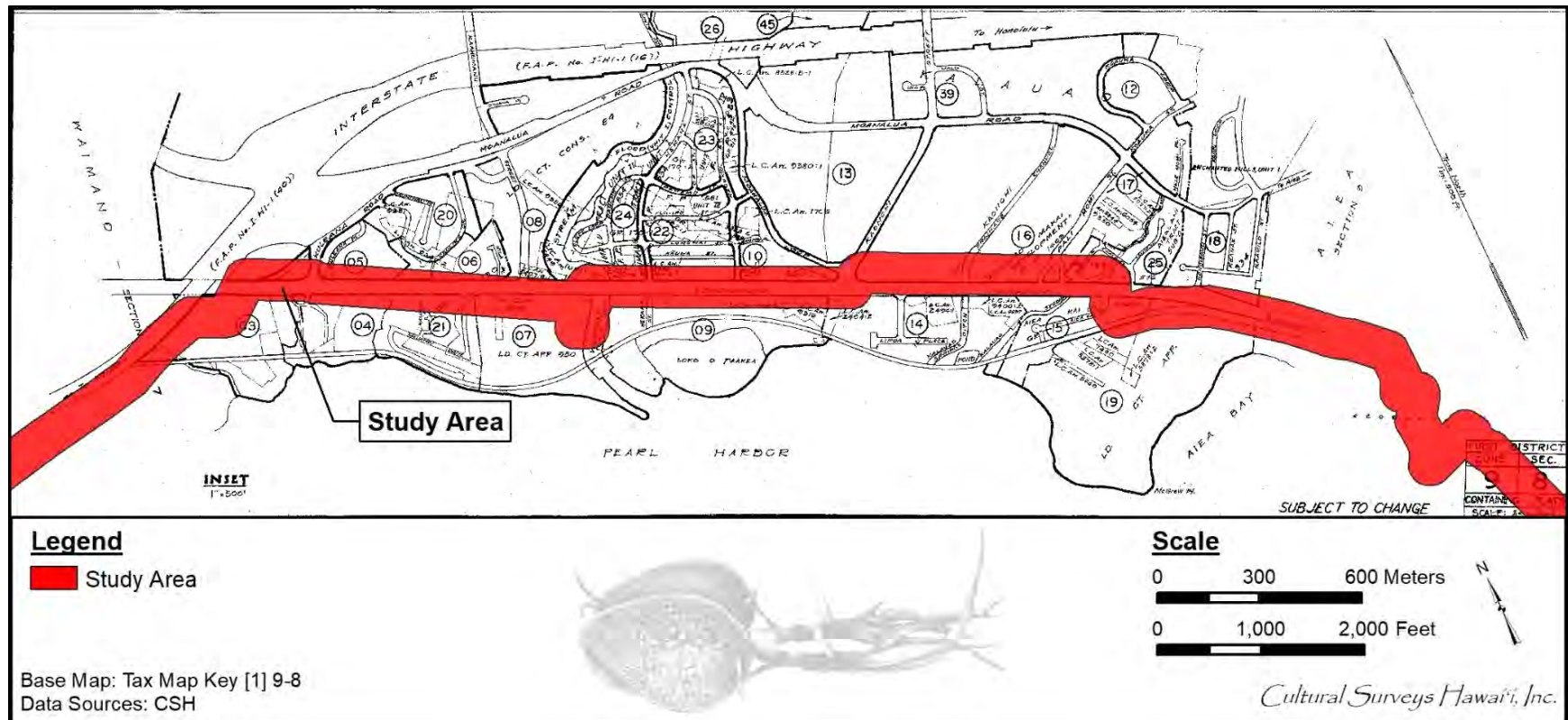


Figure 10. TMK: [1] 9-8 section map showing the eastern portion of the study area (Hawai'i TMK Service 2014)

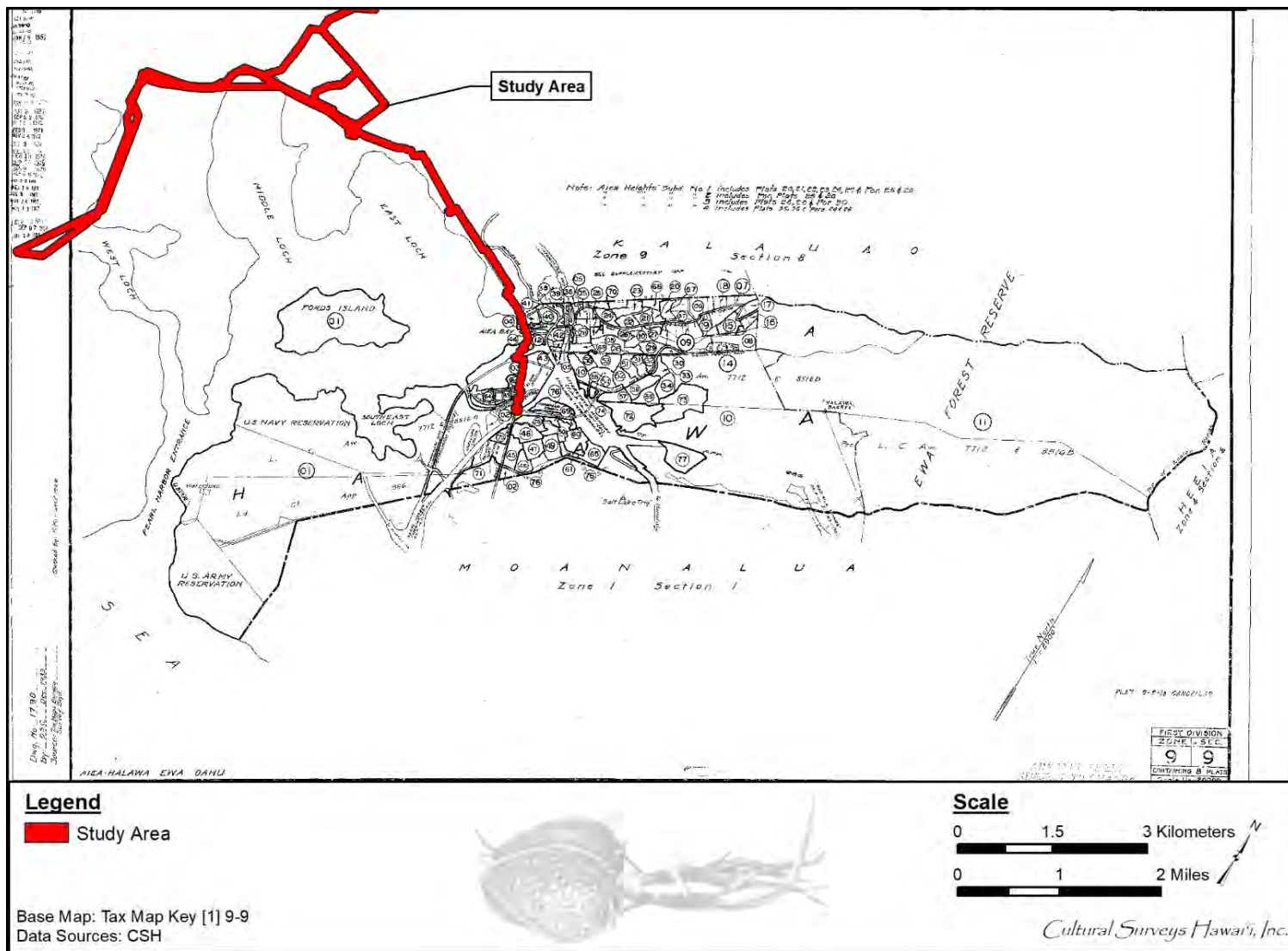


Figure 11. TMK [1] 9-9 section map showing the eastern portion of the study area (Hawai'i TMK Service 2014)

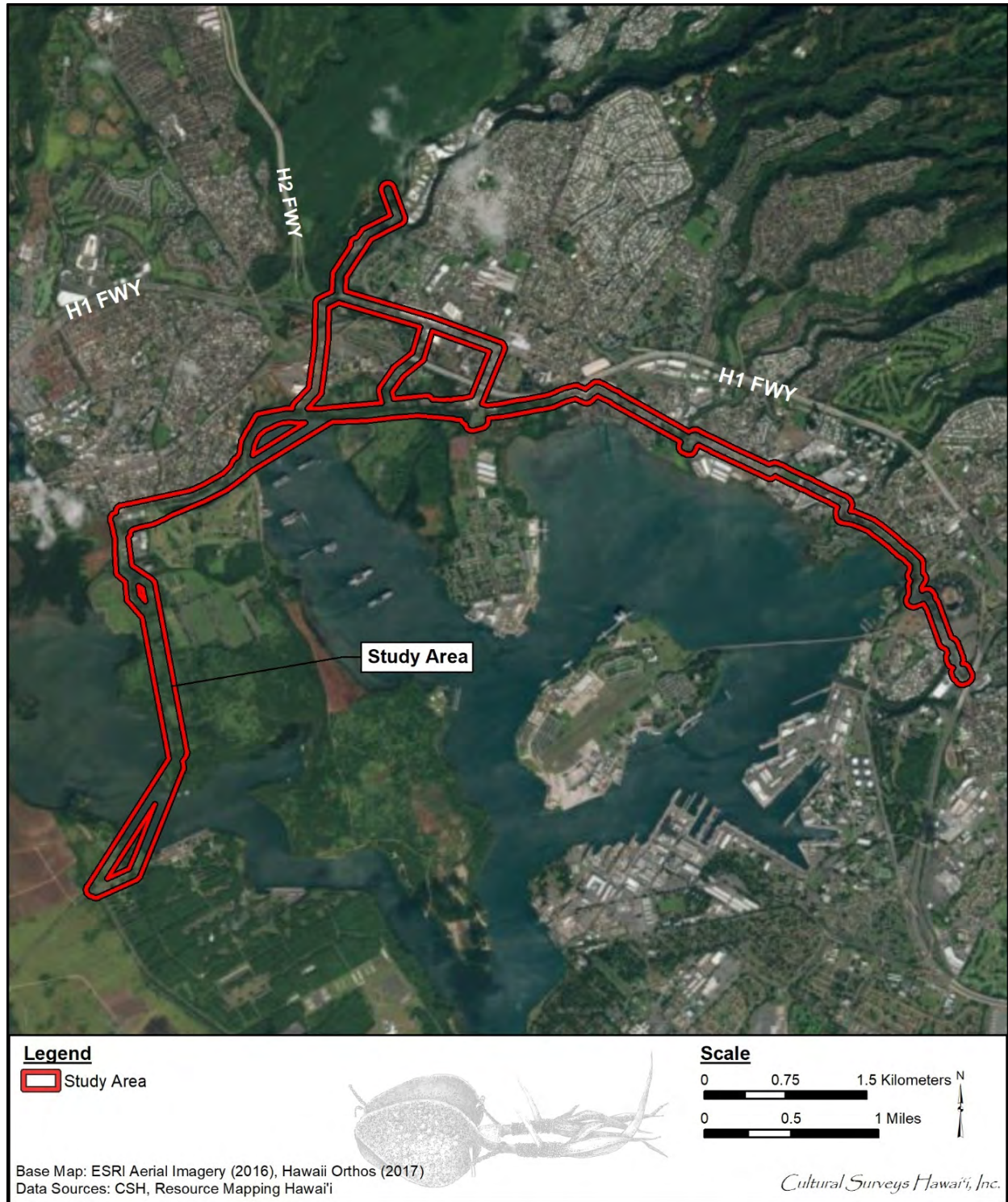


Figure 12. 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photograph showing location of the study area

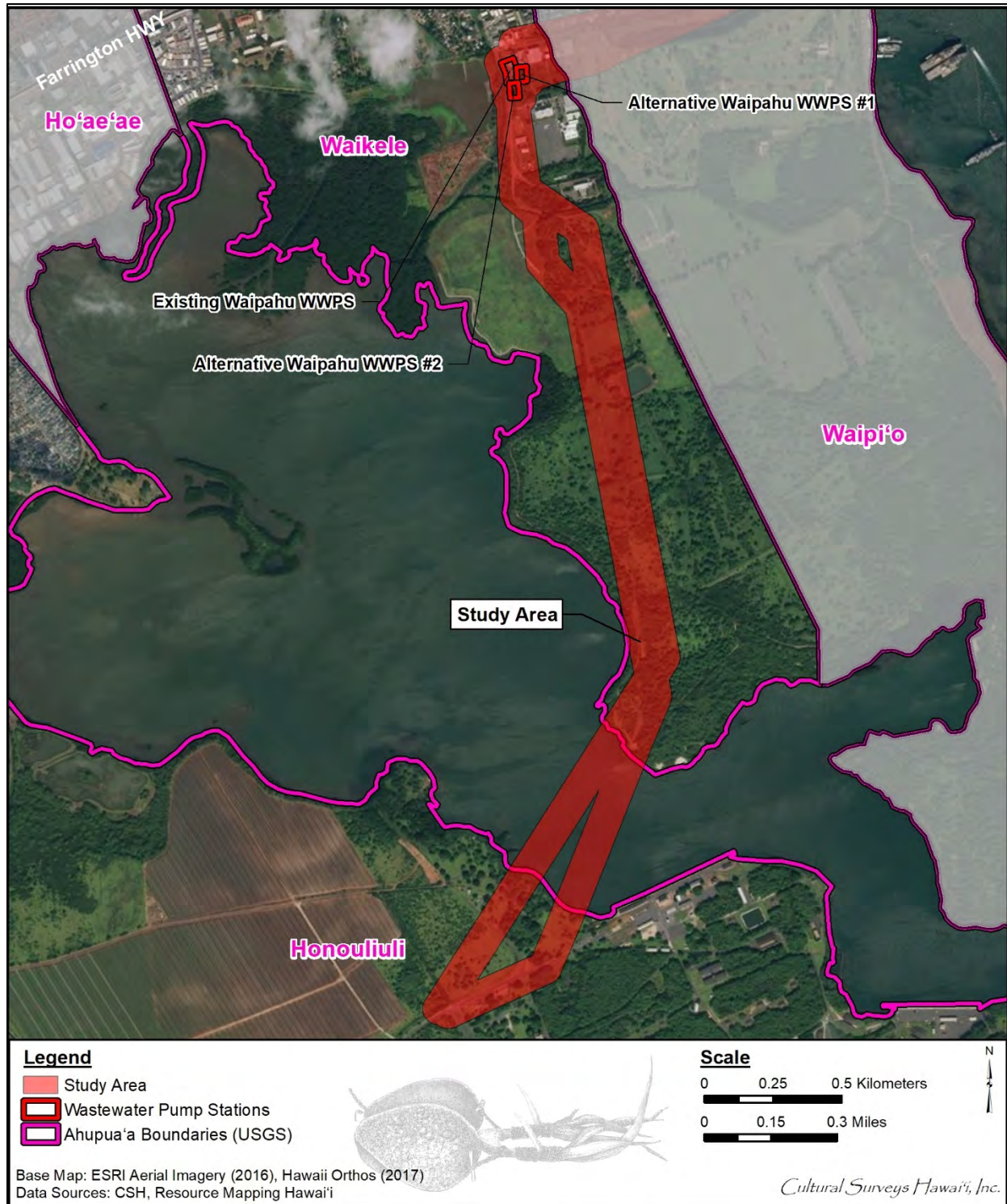


Figure 13. 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photograph showing the location of the western section of the study area



Figure 14. 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photograph showing the location of the central portion of the study area



Figure 15. 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photograph showing the location of the eastern portion of the study area

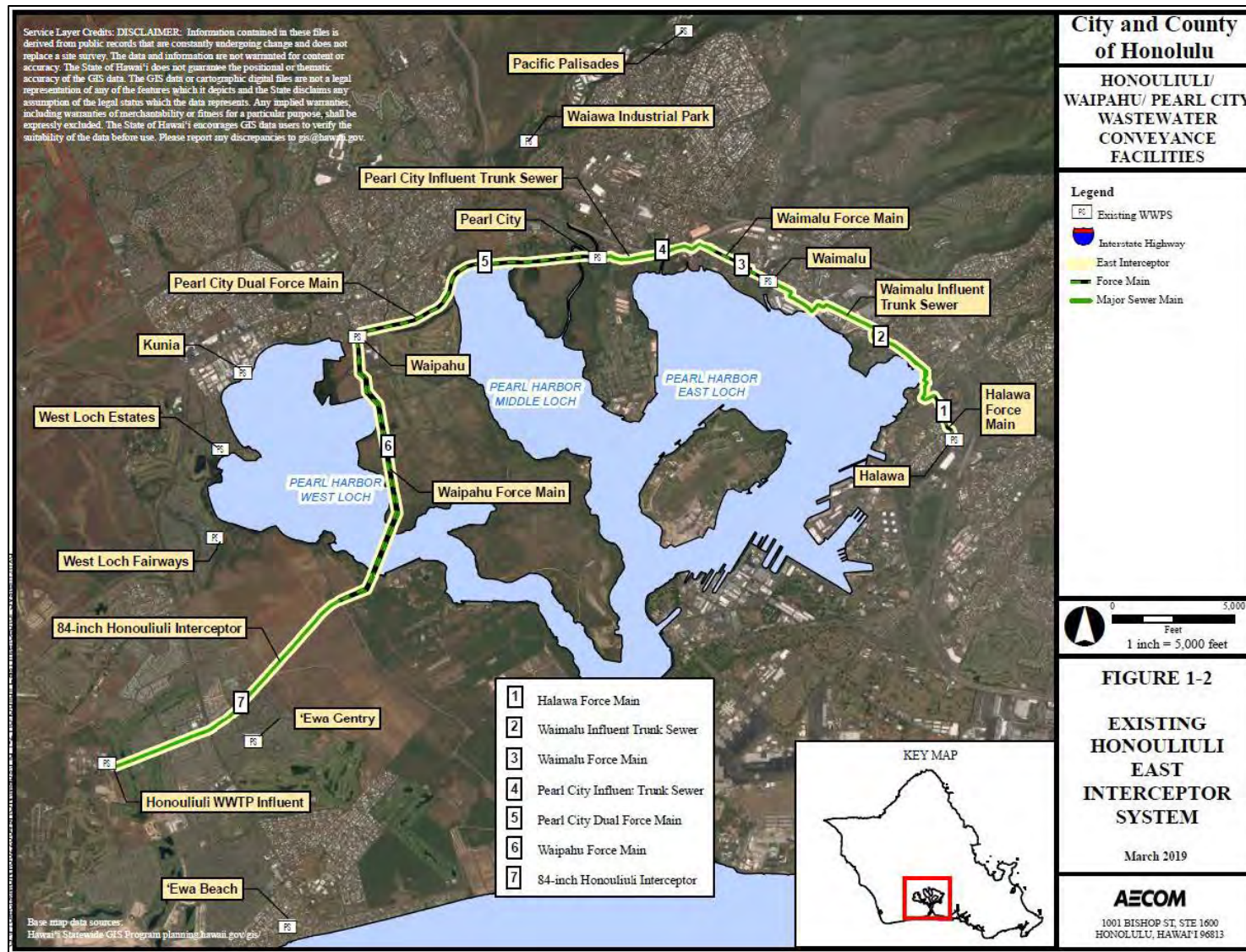


Figure 16. Figure showing the existing Honouliuli East Inceptor System (courtesy of client)

LRFI for Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, ‘Ewa, O‘ahu

TMKs: [1] 9-1, 3, 4, and 6-9, multiple plats

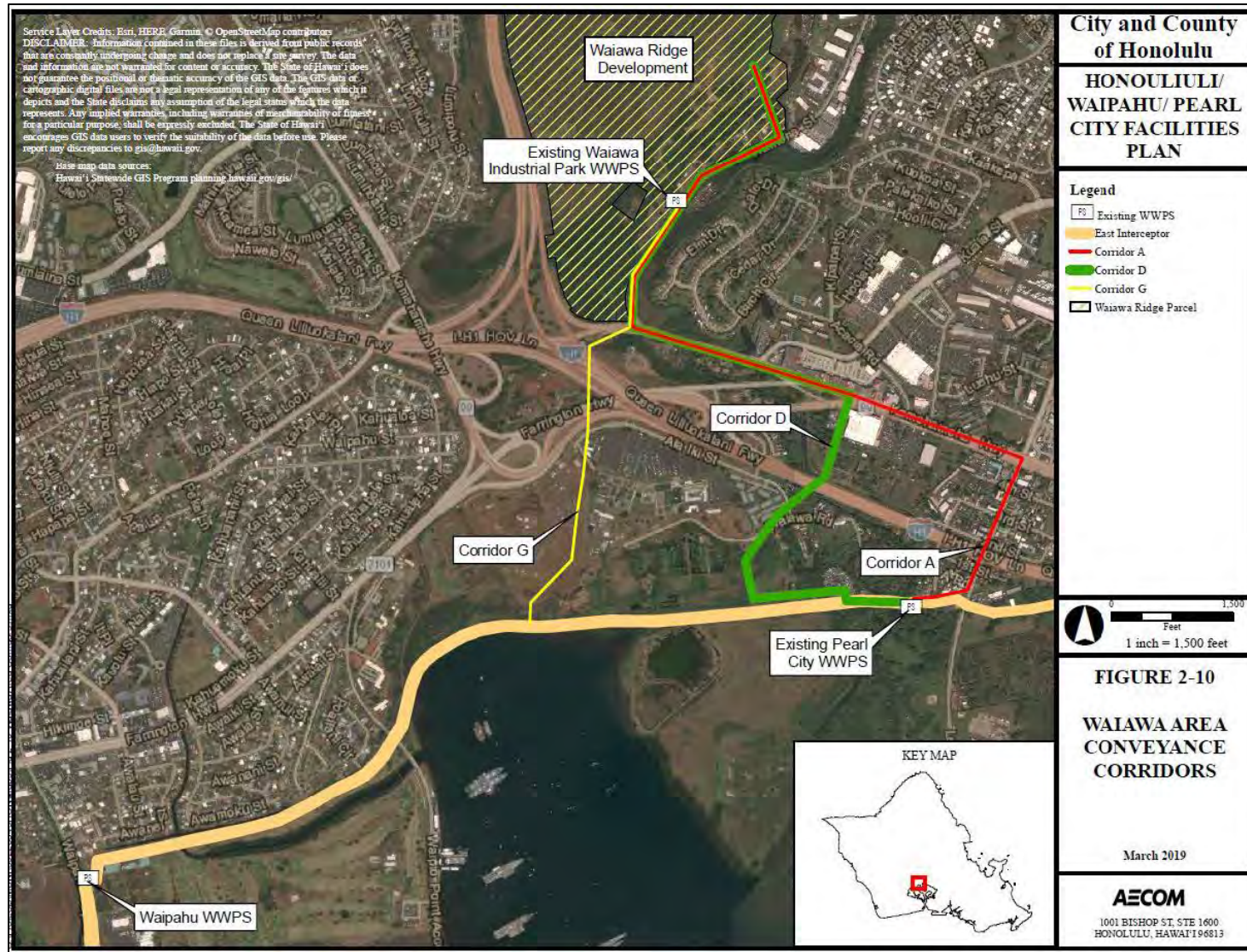


Figure 17. Figure showing the Waiawa Area Conveyance Corridors (courtesy of client)

not limited to Hālawā, ‘Aiea, Pearl City, Waipi‘o, Waikele, Waipahu, ‘Ewa, Kapolei, and Mililani. The proposed action includes portions of coastal Honouliuli, Waikele, Waipi‘o, Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, ‘Aiea, and Hālawā Ahupua‘a, ‘Ewa District, O‘ahu Island, TMKs: [1] 9- 1, 4, and 6–9, multiple plats.

1.2 Document Purpose

This investigation was designed—through detailed historical, cultural, and archaeological background research and a field inspection of the study area—to determine the likelihood that historic properties may be affected by the proposed project and, based on findings, consider cultural resource management recommendations. This document is intended to facilitate the project’s planning and support the project’s historic preservation and environmental review compliance.

1.3 Environmental Setting

1.3.1 Natural Environment

The western section of the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement project LRFI study area extends from the ‘Ewa Plain southwest of West Loch across West Loch and *mauka* (north) along the west side of Waipi‘o Peninsula from the eastern shores of Honouliuli Ahupua‘a to the eastern boundary of Waikele Ahupua‘a. The ‘Ewa Plain is a Pleistocene (>38,000 years old) reef platform overlain by alluvium. The terrain consists of limestone and alluvial deposits, which overlie flows of the Wai‘anae volcanic series (MacDonald et al. 1983:423). In pre-Contact Hawai‘i, this project section would have been covered by lowland dry shrub and grassland, but this area has been extensively disturbed and transformed by human activity; it is now dominated by a variety of exotic grasses, weeds, and shrubs. The natural elevations within this section vary slightly and gradually increase toward the *mauka* (north) most portion from approximately 1 m (3.28 ft) to 11 m (36.08 ft) above sea level.

Rainfall at representative locations is reported as follows: Field 62 Os Station on the west side of West Loch at 556 mm (21.9 inches), Field 310 Station on the mid portion of Waipi‘o Peninsula at 566 mm (22.3 inches), and Waipio-O Sugar Station at the northeast corner of Waipi‘o Peninsula at 614 mm (24.2 inches) (Giambelluca et al. 2019). This would typically not be enough rainfall to support non-irrigated agriculture. No major waterways flow through this western section of the project area.

The central and eastern sections of the study area extend across the inland edge of Waipi‘o Peninsula, then eastward 0 to 2.15 km (1.33 miles) inland of the West and Middle Lochs of Pearl Harbor. The terrain in the *makai* (seaward) portions of the study area is fairly level with elevations between 1 m (3.28 ft) and 12 m (39.37 ft) above sea level. The *mauka* portion (center section only) gradually increases in elevation heading inland and includes hill/cliff sides reaching elevations of 18 m (59.05 ft) above sea level near and along Waihona Street.

Rainfall at representative locations is reported as follows: Field 610 Station in Pearl City 832 mm (32.8 inches), Aiea Station 917 mm (36.1 inches), and Fleet Weather C Station 652 mm (25.7 inches) (Giambelluca et al. 2019). This level of rainfall is marginal at best for non-irrigated agriculture.

There are six perennial streams in these central and eastern sections including Waiawa, Waimalu, Kalauao, 'Aiea, and Hālawā streams. Three smaller, non-perennial streams and three fresh water springs also intersect these study area sections: Kapakahi and Makalena streams between West and Middle lochs, Waiawa Spring near the northeast bank of Middle Loch, Waiāu Stream and Waiāu Spring in Waiāu Ahupua'a, and Kalauao Spring in Kalauao Ahupua'a. With the exception of the low energy springs, these waterways drain a "large expanse of lateritic soils of fine particle size [and therefore] the water would have appeared muddy in prehistoric times even during periods of normal flow" (Hammatt and Borthwick 1988). The permanent streams form steep gulches that cut through layers of interbedded thick basalt flows and thinner layers of weathered alluvium, which consist of loosely consolidated saprolitic pebbles and cobbles with occasional boulders.

Sediments found within the study area, according to USDA soil survey data (Foote et al. 1972), are shown on Figure 18 through Figure 20 and are listed in Table 1. Soils are of the Ewa (EmA and EmB), Hanalei (HnB), Helemano (HLMG), Honouliuli (HxA and HxB), Kaloko (Kfb) Kawaihapai (KIA), Keaau (KmbA), Makalapa (mDB), Mamala (MnC), Molokai (MuB and MuC), Pearl Harbor (PH), Tropaquepts (TR), and Waipahu Series (WzA, WzB, and WzC). Additional symbols on the soils maps are CR (Coral Outcrop), Fd (Fill Land), FL (Fill Land, Mixed), and W (Water).

The Ewa series (EmA and EmB) consists of deep, well-drained soils that formed in alluvium weathered from basaltic rock. They are found on alluvial fans and terraces and have slopes of 0 to 12%. The soils were formerly used for sugarcane cultivation and for pasture. Common vegetation is *kiawe* (*Prosopis pallida*), *klu* (*Acacia farnesiana*), *koa haole* (*Leucaena glauca*), fingergrass (*Chloris* sp.), and bristly foxtail (*Setaria verticillata*) (Foote et al. 1972).

Fill Land (Fd and FL) consists of areas filled with material from dredging, excavation from adjacent uplands, garbage, and trash from sugar mills. This material is generally dumped in low-lying areas of coastal flats, coral sand, coral limestone, or areas of shallow soil over bedrock. The soil is used for pasture or for urban development (Foote et al. 1972).

The Hanalei series (HnB) consists of somewhat poorly drained to poorly drained soils that formed in alluvium derived from basic igneous rock. Hanalei soils are on bottom lands and have slopes of 0 to 6%. Most of the soils are used for taro and vegetable cultivation and for pasture. Common vegetation is Java plum (*Eugenia cumunii*), sensitive plant (*Mimosa pudica*), *honohono* (*Commelina diffusa*), and California grass (*Panicum purpurascens*) (Foote et al. 1972).

The Helemano series (HLMG) consists of very deep, well drained soils that formed in alluvium from basic igneous rock. They are found on gulch sides with slopes of 30 to 90%. The soils are used mainly for pasture and woodland. Common vegetation is *koa haole*, Formosa *koa* (*Acacia confusa*), Java plum, guava (*Psidium guajava*), Christmas berry (*Schinus terebinthifolius*), and Bermuda grass (*Cynodon dactylon*) (Foote et al. 1972).

The Honouliuli series (HxA and HxB) consists of deep, well drained soils that formed in alluvium weathered from basic igneous rock. They are found on lowlands and have slopes of 0 to 6%. The soils were once used primarily for irrigated sugarcane, and are now used for truck crops, orchards, and pasture. Common vegetation is *kiawe*, *klu*, *koa haole*, sensitive plant, bristly foxtail (*Setaria verticillata*), fingergrass (*Chloris* sp.), and Bermuda grass (Foote et al. 1972).

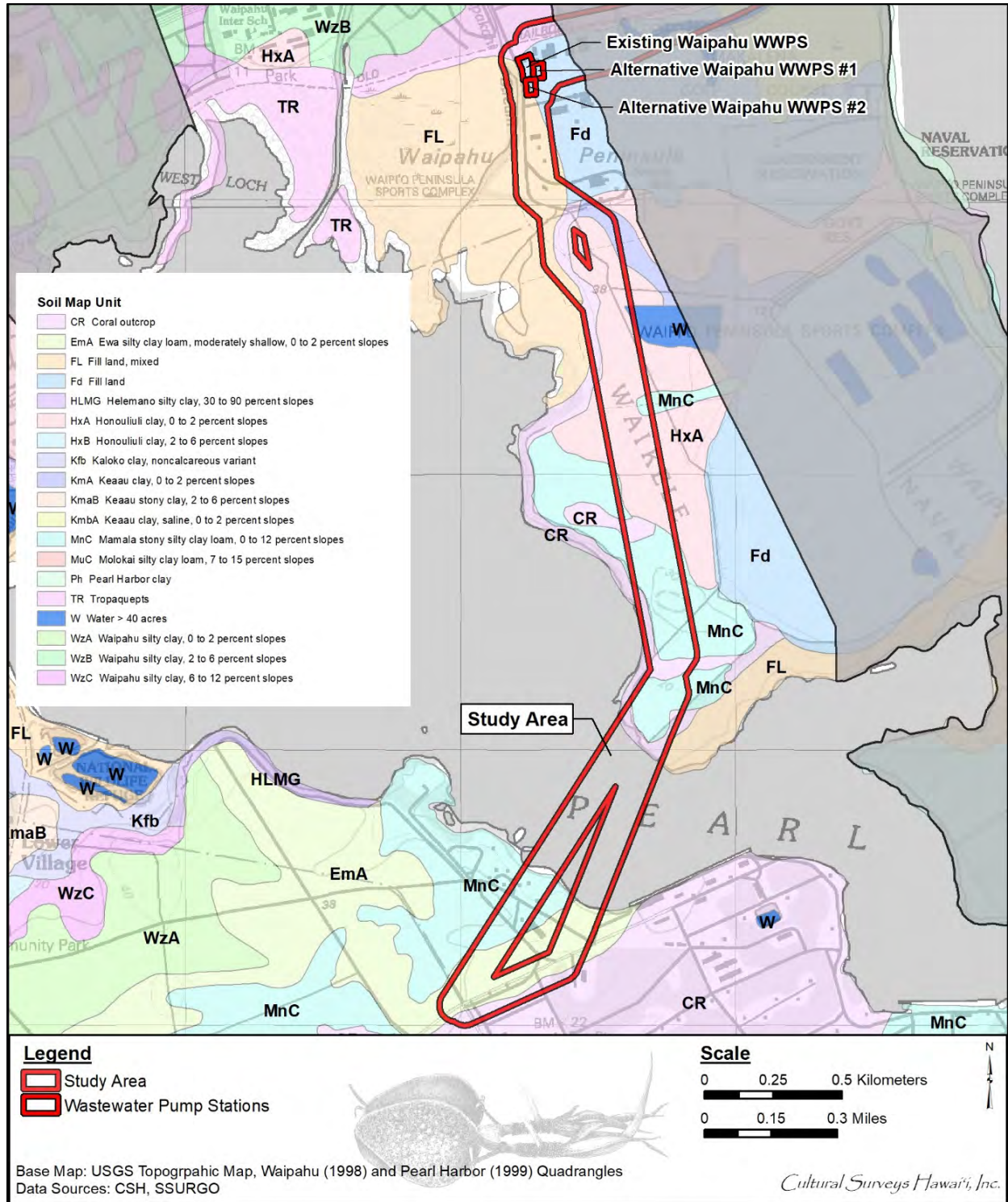


Figure 18. Overlay of *Soil Survey of the State of Hawaii* (Foote et al. 1972; USDA SSURGO 2001), indicating soil types within and surrounding the western section of the study area

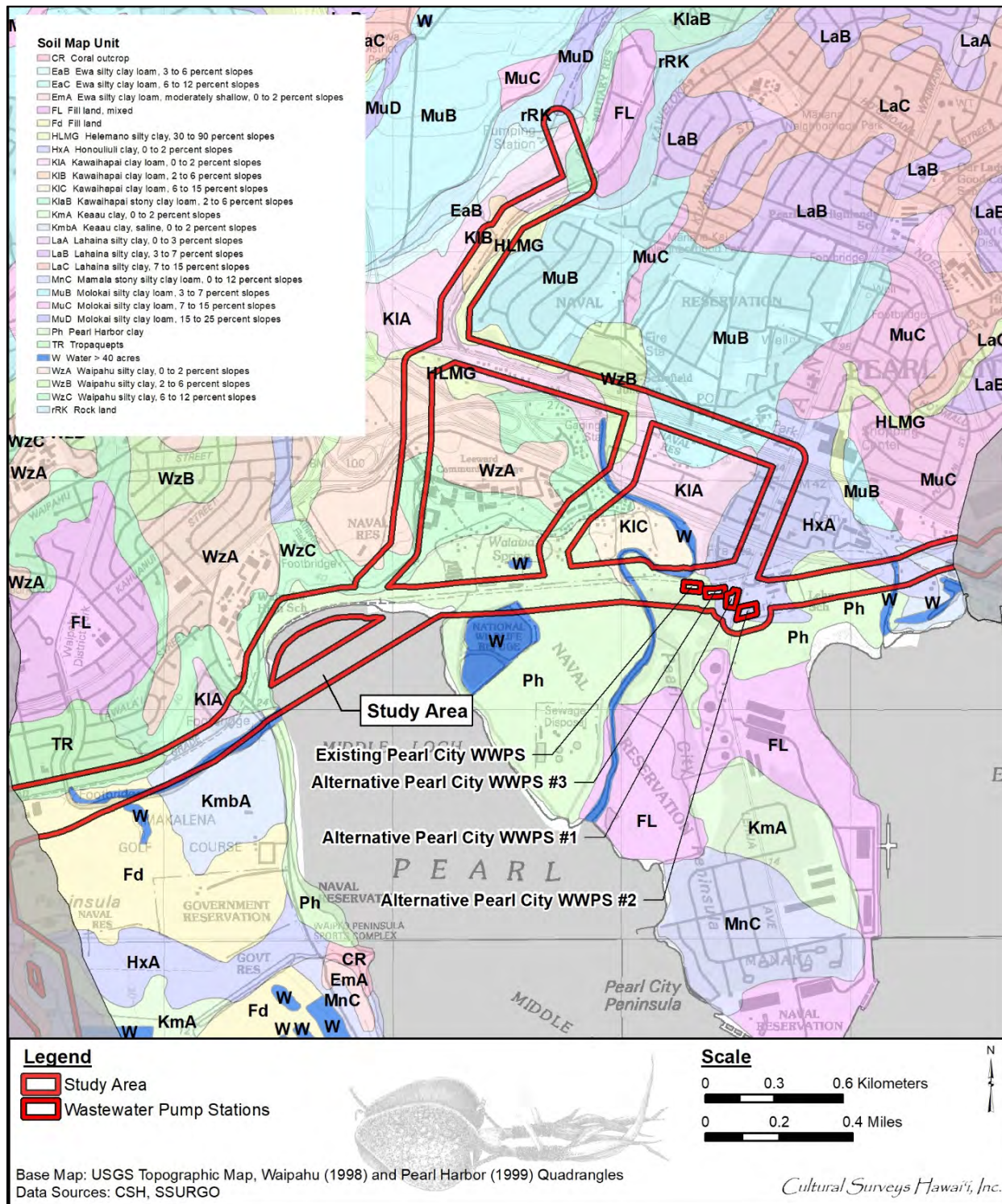


Figure 19. Overlay of *Soil Survey of the State of Hawaii* (Foote et al. 1972; USDA SSURGO 2001), indicating soil types within and surrounding the central section of the study area

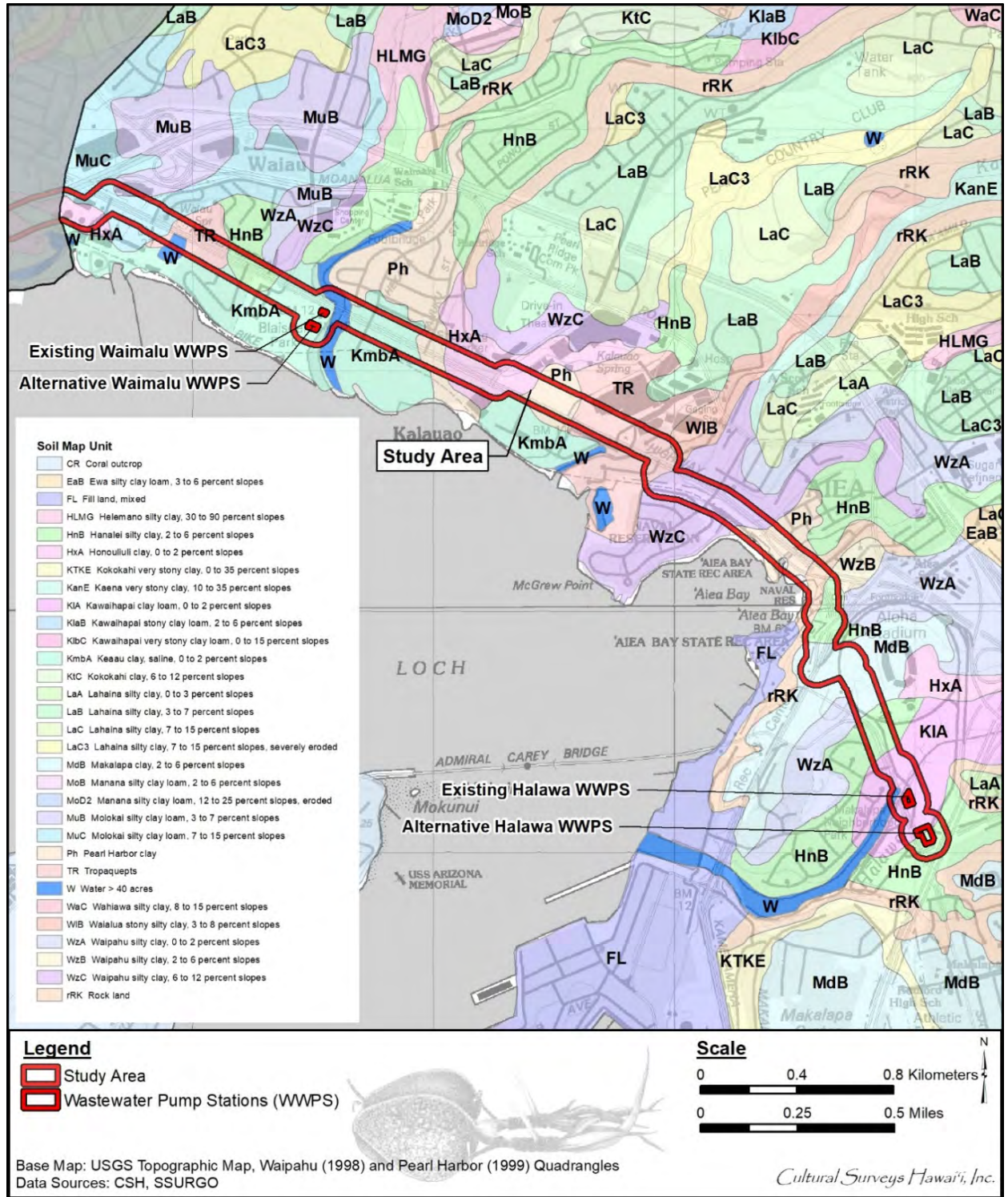


Figure 20. Overlay of *Soil Survey of the State of Hawaii* (Foote et al. 1972; USDA SSURGO 2001), indicating soil types within and surrounding the east section of the study area

Table 1. Soil types within the study area

Code	Soil Name
CR	Coral Outcrop
EmA	Ewa Silty Clay Loam, moderately shallow, 0 to 2% Slopes
EmB	Ewa Silty Clay Loam, moderately shallow, 6 to 12% Slopes
Fd	Fill Land
FL	Fill Land, Mixed
HnB	Hanalei Silty Clay, 2 to 6% Slopes
HLMG	Helemano Silty Clay, 30 to 90% Slopes
HxA	Honouliuli Clay, 0 to 2% Slopes
HxB	Honouliuli Clay, 2 to 6% Slopes
Kfb	Kaloko Clay, Noncalcareous Variant
KIA	Kawaihapai Clay Loam, 0 to 2% Slopes
KmbA	Keaau Stony Clay, 2 to 6% Slopes
MdB	Makalapa Clay, 2 to 6% Slopes
MnC	Mamala Stony Silty Clay Loam, 0 to 12% Slopes
MuB	Molokai Silty Clay Loam, 3 to 7% Slopes
MuC	Molokai Silty Clay Loam, 7 to 15% Slopes
Ph	Pearl Harbor Clay
TR	Tropaquepts
W	Water
WzA	Waipahu Silty Clay 0 to 2% Slopes
WaB	Waipahu Silty Clay 2 to 6% Slopes
WzC	Waipahu Silty Clay 6 to 12% Slopes

The Kaloko Series (Kfb) consists of poorly drained soils that formed in alluvium underlain with marly lagoon sediments. They are found on coastal plains from 1 to 20 ft in elevation. The soils were used to cultivate sugarcane.

The Kawaihapai series (KIA) consists of well-drained soils that formed in alluvium derived from basic igneous rock in humid uplands. They are in drainageways and on alluvial fans on the coastal plains and have slopes of 0 to 15%. The soils were used for sugarcane, truck crops, and pasture. Common vegetation is guava, *kiawe*, *koa haole*, lantana (*Lantana camara*), bristly foxtail, Bermuda grass, and feather fingergrass (*Chloris virgata*) (Foote et al. 1972).

The Keaau series (KmbA) consists of deep, poorly drained soils that formed in alluvium weathered from basic igneous rock. They are on coastal plains and have slopes of 0 to 6%. All of the soil was once cultivated in sugarcane (Foote et al. 1972).

The Makalapa series (MdB) consists of moderately deep, well-drained soils that formed in material weathered from volcanic tuff. They are found in uplands at slopes of 2 to 20%. These soils areas have been used for military reservations, urban development, and pasture. Common vegetation is *kiawe*, *koa-haole*, lantana, dwarf koa (*Acacia koaia*), fingergrass, and bermudagrass.

The Mamala series (MnC) consists of shallow, well-drained soils that formed from alluvium deposited over coral limestone and consolidated calcareous sands. They are found on coastal plains at slopes of 0 to 12%. The soils were used for the cultivation of truck crops and irrigated sugarcane, and for pasture. Common vegetation is *kiawe*, *koa-haole*, *klu*, bristly foxtail, and fingergrass.

The Molokai series (MuB and MuC) consists of very deep, well-drained soils that formed in material weathered from basic igneous rock. They are found on uplands and have slopes of 0 to 25%. The soils were used for the pineapple cultivation, irrigated sugarcane and pasture. Common vegetation is *kiawe*, lantana, *'ilima* (*Sida cordifolia*), pitted beardgrass (*Bothriochloa barbinodis perforatus*), feather fingergrass, and buffelgrass (*Cenchrus ciliaris*) (Foote et al. 1972).

The Pearl Harbor series (PH) consists of deep, very poorly drained soils that formed in alluvium worked from material weathered from basic igneous rock and deposited over and mixed with muck. They are found on coastal flats and have slopes of 0 to 2%. Most of this soil area is now urbanized or in pasture, but some is used for taro, bananas, and sugarcane cultivation. Common vegetation is panicum, sedges, cattails, and mangrove trees (Foote et al. 1972).

Tropaquepts (TR) are poorly drained soils periodically flooded by irrigation in order to grow crops that thrive in water. They occur as nearly level flood plains on the islands of O'ahu and Maui. Elevations range from sea level to 200 ft. Tropaquepts are used for production of taro, rice, and watercress on flooded paddies

The Waipahu series (WzA, WzB, and WzC) consists of deep, well drained soils that formed in old alluvium weathered from basic igneous rock. They are on dissected terraces and have slopes of 0 to 12%. The soils are now used mainly for urban development, with some areas once used for irrigated sugarcane (Foote et al. 1972).

1.3.1 Built Environment

The study area corridor that encompasses the Honouliuli East Inceptor System, existing and proposed waste water pump station locations, proposed improvements, and proposed Waiawa Area Conveyance Corridors varies throughout, generally becoming more densely developed from west

to east. The western section of the study area, which contains the Waipahu Force Main, Waipahu WWPS locations, and a portion of the Pearl City Dual Force Main, is largely undeveloped in the modern sense. The portion on the west shores of West Loch consists of decommissioned and remnant military facilities related to Naval Magazine Pearl Harbor (West Loch) and the Waipi'o Peninsula portion is mostly comprised of an overgrown, out-of-use agricultural complex. Moving inland along Waipi'o peninsula toward the eastward bend of the study area corridor, public, commercial, and residential development increases to include the Honolulu Police Training Academy, the existing Waipahu WWPS, various small businesses, and a residential community.

The central section of the study area is more diverse as it includes areas of both urban and rural development within the greater urban developed area of Pearl City. The *makai* corridor of this section follows the modern undeveloped alignment of the Pearl Harbor Bike Path, which was occupied by numerous homeless encampments at the time of the field inspection. The *makai* corridor also runs adjacent to rural residential communities with active agricultural plots. The *mauka* corridor of the center section follows Kamehameha Highway and the built environment is typical of Pearl City, including many commercial developments surrounded by industrial development and residential neighborhoods. The eastern section of the study area follows the parallel alignment of the Pearl Harbor Bike Path and Kamehameha Highway until diverging south along Salt Lake Boulevard. As these are major thoroughways, the areas adjacent to the roads are densely developed with residential neighborhoods, large shopping complexes, hospitals and schools, office buildings, military installations, and other structures/areas.

Section 2 Methods

2.1 Field Methods

CSH completed the fieldwork component of this study under archaeological fieldwork permit number 19-07, issued by the SHPD pursuant to Hawai'i Administrative Rules (HAR) §13-282. CSH archaeologists Alexandra Bennicas, B.A., Thomas Martel, B.A., and David W. Shideler, M.A., conducted fieldwork between 29 May 2019 and 27 June 2019 under the general supervision of Principal Investigator Hallett H. Hammatt, Ph.D. This work required approximately 10 person-days to complete.

In general, fieldwork included pedestrian inspection of the study area, the taking of representative photographs, and GPS data collection. The pedestrian inspection of the study area was undertaken for the purpose of historic property identification and documentation.

2.2 Research Methods

Background research included a review of previous archaeological studies on file at the SHPD; review of documents at Hamilton Library of the University of Hawai'i, the Hawai'i State Archives, the Mission Houses Museum Library, the Hawai'i Public Library, and the Bishop Museum Archives; study of historic photographs at the Hawai'i State Archives and the Bishop Museum Archives; and study of historic maps at the Survey Office of the Department of Land and Natural Resources. Historic maps and photographs from the CSH library were also consulted. In addition, Māhele records were examined from the Waihona 'Aina database (Waihona 'Aina 2000).

This research provided the environmental, cultural, historic, and archaeological background for the study area. The sources studied were used to formulate a predictive model regarding the expected types and locations of historic properties in the study area.

Section 3 Historical Background

3.1 Pre-Contact to the Mid-Nineteenth Century

The reader is referred to the companion cultural impact assessment study (Tanaka and Hammatt 2019) for this project for an overview of legendary and traditional history (*mo'olelo*) and a review of storied places (*wahi pana*).

3.1.1 Traditional Settlement and Agricultural Patterns

Various Hawaiian legends and early historical accounts indicate 'Ewa was once widely inhabited by pre-Contact populations, including the Hawaiian *ali'i* (chiefly class). This would be attributable for the most part to the plentiful marine and estuarine resources available at the coast, along which several sites interpreted as permanent habitations and fishing shrines have been located. Other attractive subsistence-related features of the district include irrigated lowlands suitable for wetland taro cultivation, as well as the lower forest area of the mountain slopes for the procurement of forest resources. Handy and Handy (1972) report the following:

The lowlands, bisected by ample streams, were ideal terrain for the cultivation of irrigated taro. The hinterland consisted of deep valleys running far back into the Ko'olau range. Between the valleys were ridges, with steep sides, but a very gradual increase of altitude. The lower part of the valley sides were excellent for the cultivation of yams and bananas. Farther inland grew the 'awa for which the area was famous. [Handy and Handy 1972:429]

In addition, breadfruit, coconuts, *wauke* (paper mulberry, *Broussonetia papyrifera*, used to make *kapa* for clothing), bananas, and *olonā* (*Touchardia latifoli*, used to make cordage), and other plants were grown in the interior. 'Ewa was known as one of the best areas to grow gourds and was famous for its *māmaki* (*Pipterus* spp.; used to make *kapa* for clothing). It was also famous for a rare taro called the *kāi o 'Ewa*, which was grown in mounds in marshy locations (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the saying:

Ua 'ai i ke kāi-koi o 'Ewa. He has eaten the Kāi-koi taro of 'Ewa.

Kāi is O'ahu's best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of 'Ewa, who, like the Kāi taro, is not easily forgotten. [Pukui 1983:305]

The lochs of Pearl Harbor were ideal for the construction of fishponds and fish traps. Forest resources along the slopes of the Wai'anae Range probably acted as a viable subsistence alternative during times of famine and/or low rainfall (Handy 1940:211; Handy and Handy 1972:469–470). The upper valley slopes may have also been a resource for sporadic quarrying of basalt used in the manufacturing of stone tools.

3.1.2 Māweke and Overview of the Reign of *Ali'i* in 'Ewa

There are many documented references stating that chiefs resided in 'Ewa and that it was a political center in its day. Oral accounts of *ali'i* recorded by noted Hawaiian historian Samuel Kamakau date back to at least the twelfth century.

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

In the mid-eleventh century, Māweke, a direct lineal descendant of the illustrious Nanaulu (ancestor of Hawaiian royalty), was a chief of O'ahu (Fornander 1996:47). Keaunui, the second of his three sons, became the head of the powerful 'Ewa chiefs. Tradition tells of him cutting of a navigable channel through the Pearl River using his canoe. Keaunui's son, Lakona, became the progenitor of the 'Ewa chiefs around 1400 (Fornander 1996:224–226). Chiefs within his line, the Māweke-Kumuhonua line, reigned until about 1520-1540, with their major royal center in Līhu'e in 'Ewa (Cordy 2002:24). Haka was the last chief of the Māweke-Kumuhonua line. He was slain by his men at the fortress of Waewae near Līhu'e (Kamakau 1991:54; Fornander 1996:88). Power shifted among the chiefs of different districts from the 1500s until the early 1700s, when Kūali'i achieved control of all of O'ahu by defeating the Kona chiefs. He then defeated the 'Ewa chiefs and expanded his control on windward Kaua'i. Peleihōlani, the heir of Kūali'i, gained control of O'ahu about 1740, and later conquered parts of Moloka'i. He ruled O'ahu until his death in about 1778 when Kahahana, of the 'Ewa line of chiefs, was selected as the ruler of O'ahu (Cordy 2002:24–41). Somewhere between 1883 and 1885, Kahahana was killed by Kahekili of Maui. The subsequent rebellion amongst the chiefs resulted in a near genocide of the line of monarchy on O'ahu. Oral reports also tell of how the stream of Hō'ai'ai in 'Ewa was choked with the bodies of the slain (Fornander 1996:224–226). Kahekili and the Maui chiefs retained control of O'ahu until the 1790s. Kahekili died at Waikīkī in 1794. His son, Kalanikūpule, was defeated the following year at the Battle of Nu'uaniu by Kamehameha (Kamakau 1992:376–377). Thus, the supremacy of the 'Ewa chiefs came to a final end.

3.1.3 Mā'ilikūkahi and the Battle of Kīpapa

The rich resources of Pu'uloa—the fisheries in the lochs, the shoreline fishponds, the numerous springs, and the irrigated lands along the streams—made 'Ewa a prize for competing chiefs. Battles were fought for the 'Ewa lands, sometimes by competing O'ahu chiefs and invading chiefs from other islands.

Mā'ilikūkahi, who was born *ali'i kapu* at the birthing stones of Kūkaniloko (Kamakau 1991:53), became *mō'ī* of O'ahu between 1520-1540 (Cordy 2002:19). Mā'ilikūkahi was popular during his reign and was remembered for initiating land reforms, which brought about peace, and for encouraging agricultural production, which brought about prosperity. He also prohibited the chiefs from plundering the *maka'āinana* (common people), a prohibition punishable by death (Kamakau 1991:55).

Upon consenting to become *mō'ī* (supreme chief) at the age of 29, Mā'ilikūkahi was taken to Kapukapuākea Heiau at Pa'ala'akai in Waialua to be consecrated. Soon after becoming king, Mā'ilikūkahi was taken by the chiefs to live at Waikīkī. He was probably one of the first chiefs to live there, as the chiefs had previously always lived at Waialua and 'Ewa. Under his reign, the land divisions were reorganized and redefined (Pukui et al. 1974:113).

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

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

Mā'ilikūkahi's peaceful reign was interrupted by an invasion that changed 'Ewa forever. Fornander describes the Battle of Kīpapa (to be paved [with the corpses of the slain]) at Kīpapa Gulch in Waipi'o Ahupua'a by Fornander:

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

The location of the Battle of Kīpapa (and any attendant burial of war dead) remains unknown. It is understood that Kīpapa Stream is a tributary of Waikele Stream entering West Loch a kilometer southwest of the Waipahu WWPS so that may be a non-issue for this project.

3.1.4 Ka'ihikapu and Chiefly Rivalry

Around 1600-1620, the entire island of O'ahu was united under the rule of one woman, an *ali'i* named Kala'imanuia (Cordy 2002:30). Before her death, she divided her kingdom among four of her children. She gave the districts of Kona and Ko'olaupoko to Kū-a-Manuia; the *ahupua'a* of Kalauao, 'Aiea, Moanalua, and Hālawa to Ka'ihikapu-a-Manuia; the districts of 'Ewa and Wai'anae to Ha'o; and the districts of Wai'alua and Ko'olauloa to her daughter Kekela. To Kū, she passed on her title of *mō'ī* so that the other three were still subject to their eldest brother. Kū, however, was greedy and began to try to take the lands allotted to his siblings away from them. Ha'o joined with his brother Ka'ihikapu in a battle defending against an attack by Kū, a battle in which Kū was slain. Ka'ihikapu then became *mō'ī* and was a benevolent king, taking care of his subjects and making frequent tours around the island to observe the people. On one of these circuits, he visited his brother Ha'o at his court in Waikele and grew jealous of the riches of his brother's home in 'Ewa. Ka'ihikapu sent the carcass of a large man-eating shark that had been caught near his court in Waikīkī to his brother as a gift so that Ha'o could use it as a sacrifice to dedicate to the gods at his *heiau* (pre-Christian place of worship) in Waikele. Ka'ihikapu's forces attacked Ha'o and his priests at the temple, as they were unarmed and busy with the dedication ceremonies (Fornander 1996:270–271).

There are other versions of this *mo'olelo* that describe the shark as similar to the gift of the Trojan Horse, but Fornander (1996:271) believes these "embellishments" may have been made in

the post-Contact period. In one version of this *mo'olelo* (Pukui 1983:191), Ka'ihikapu took Ha'o's lands from him.

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

There is a saying concerning this rivalry between the two brothers, "*Ke one kuilima laula o 'Ewa*. The sand on which there was a linking of arms [kuilima] on the breadth of 'Ewa" (Pukui 1983:191).

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

O'ahu was unified once more when Ka'ihikapu's son, Kākuhihewa, married his aunt's (Kekela) daughter, Nāpūlanahu. Kākuhihewa had royal residences at Waikīkī, Kailua, and 'Ewa. His descendants lost most of this unified power to the district chiefs over the next three generations (Cordy 2002:31).

3.1.5 Kūali'i's Defeat of the 'Ewa *Ali'i*

In the first half of the eighteenth century, the island of O'ahu was ruled by the chief Kūali'i, who consolidated his supreme power over the entire island by defeating the Kona chiefs and then the 'Ewa chiefs in battle (Cordy 2002:32). Kūali'i met 'Ewa's competing army on the plains of Keahumoa, but the 'Ewa chiefs surrendered when they saw Kūali'i's overwhelming forces, and they ceded the lands of Ko'olauloa, Ko'olaupoko, Waialua, and Wai'anae to him (Fornander 1917:2:366, 400).

3.1.6 The Overthrow of Kahahana and the Rule of Kahekili

O'ahu was ruled by Kūali'i's son and grandson, and then by Kahahana, the son of the 'Ewa chief Elani and the sister of Kūali'i's son Peleiōhalani (Fornander 1919:6[2]:282). Kahahana had been raised in the court of the powerful Maui chief, Kahekili.

Thomas Thrum (1998:203–214) translates the legend of the *kahuna* Ka'ōpuluhulu, who lived in Waimea. Kahekili, the king of Maui, sent his foster son Kahahana to rule O'ahu, around the year 1779 (Cordy 2002:42). Kahahana set up his royal compound in Waikīkī and commanded the

priest Ka'ōpuluhulu to attend him there. At first Kahahana valued the wisdom of this wise priest, but after several years, Kahahana began to be cruel to the people, and in protest Ka'ōpuluhulu left Waikīkī to return to his home in Waimea. This angered the king, who sent messengers to order Ka'ōpuluhulu and his son Kahulupue to come to Wai'anae where Kahahana then resided. They were placed into a special grass hut, one tied to the end post and one tied to the corner post of the house. The next day, Kahahana ordered his men to torture the son, stabbing his eyes and stoning him while his father watched. When Ka'ōpuluhulu saw this, he commanded his son to flee into the sea, saying these words, which contained a prophecy.

E nui ke aho, e ku'u keiki, Take a deep breath, my son, and lay
a moe i ke kai, no ke kai la yourself in the sea, for then the land
ho 'i ka 'āina. shall belong to the sea.
 [Pukui 1983:44]

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

Upon the arrival here at Oahu of Kahekili, Kahahana fled, with his wife Kekuapoi, and friend Alapai, and hid in the shrubbery of the hills. They went to Aliomanu, Moanalua, to a place called Kinimakalehua; then moved along to Keanapuaa and Kepookala, at the lochs of Puuloa, and then from there to upper Waipio; thence to Wahiawa, Helemano, and on to Lihue [upper plain of Honouliuli, Hō'ae'ae, and Waipi'o]; thence they came to Poohilo, at Honouliuli, where they first showed themselves to the people and submitted themselves to their care. [Thrum 1998:213–214]

Through treachery, Kahahana was induced to leave Pō'ohilo, Honouliuli and was killed on the plains of Hō'ae'ae. While hiding in Pō'ohilo, and 'ili of Honouliuli:

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

son Kahulupue, 'This land is the sea's,' was in keeping with the famous prophetic vision of Kekiopilo that 'the foreigners possess the land,' as the people of Hawaii now realize. [Manu 1904:112–113]

Sometime between 1883 and 1885, Kahahana was killed by Kahekili of Maui. Kahahana's father, 'Elani, along with other O'ahu chiefs, plotted to kill Kahekili and his chiefs who were residing at Kailua, O'ahu, as well as his chiefs residing at 'Ewa and Wai'alua. The plot was discovered by Kahekili, and a messenger was sent to warn Hū'eu at Wai'alua. For some reason, the messenger never reached Hū'eu and he and his retinue were killed. The murderers of Hū'eu were found in Waipi'o, "therefore Ewa became famed as a land of deadly plots" (*Ka Nūpepa Kū'oko'a*, 5 December, 1868, translated in Sterling and Summers 1978:3). This slaughter became known as the Waipi'o *kīmopō*, or the Waipi'o assassination, because it originated there. Kahekili avenged the death of Hū'eu by pillaging and destroying the districts of Kona and 'Ewa. It is said that the streams of Makaho and Niuhelewai in Kona, as well as Hō'ae'ae in 'Ewa were "choked with the bodies of the slain, and their waters became bitter to the taste, as eyewitnesses say, from the brains that turned the water bitter" (Kamakau 1992:138). It was during this time that the O'ahu chiefly lines were nearly exterminated. It is said that one of the Maui chiefs, Kalaihoa, used the bones of the slain to build a wall around his house at Lapakea in Moanalua. The house was known as Kauwalua and could be seen as one passed by the "old upper road to 'Ewa" (Fornander 1996:290). Hō'ae'ae Stream, associated with war dead in the account above, is just to the west of Waipi'o Peninsula and is not an issue for this project.

3.1.7 The Battle of Kūki'iahu in Kalauao and Refuge in Hālawa

Kahekili and the Maui chiefs retained control of O'ahu until the 1790s. In 1794, Kahekili died at Waikīkī. His heir and son, Kalanikūpule, retained supremacy over Maui and O'ahu, but Kā'eokulani, the half-brother of Kahekili, ruled Kaua'i. After fighting against the Hawaiian chief Kamehameha on Hawai'i, Kā'eokulani began sailing his canoe fleet to Kaua'i, but dissension among his followers made him to decide to land on O'ahu and challenge his brother's rule by joining with the Wai'alua and Wai'anae chiefs. In this battle, Kalanikūpule gained the support of a foreign ship captain named Captain Brown. On the opposing side, Kā'eokulani was aided by a foreign gunner called Mare Amara. Fornander has suggested the last name is actually the Hawaiian corruption of the English title "Armourer" (Fornander 1996:241). Four battles were fought in 'Ewa, and in the fourth, the Kaua'i chief was defeated.

The Hawaiian historian Samuel M. Kamakau gives the following account of the battles in 'Ewa fought in 1794, including the last, which was fought in Kalauao.

A battle was fought on the plains of Pu'unahawele in which some foreigners were killed by Mare Amara. Natives also fell, and Ka-lani-ku-pule was forced to retreat. Some six days later another battle was fought in which Ka-'eo was again victorious. This gain he followed up by approaching further upon 'Ewa, hoping to push on to Waikiki which was at that time the center of government. On December 12, 1794, a great battle was fought on the ground of Ka-lani-manuia between Kalauao and 'Aiea in 'Ewa. The heights of Kuamo'o, Kalauao, and 'Aiea were held by the right wing of Ka-lani-ku-pule's forces commanded by a warrior named Koa-lau-kani; the shore line of Malie [was held] by the left wing under the command of Kamohomoho, Ka-lani-ku-pule himself with the main army held the middle ground

between 'Aiea and the taro patches; Captain Brown's men were in boats guarding the shoreline. Thus surrounded Ka-'eo found his men fighting at close quarters and cut off by Koa-lau-kani between Kalauao and Kuamo'o, he was hemmed in on all sides and compelled to meet the onset, which moved like the ebb and flow of the tide. Shots from guns and cannon, thrusts of the sword and spear fell upon his helpers. Ka-'eo with six of his men escaped into a ravine below 'Aiea and might have disappeared there had not the red of his feather cloak been seen from the boats at sea and there shots drew attention to those on land. Hemmed in from above, he was killed fighting bravely. His wives were killed with him, and his chiefs and warriors. This war called Kuki'iahu, was fought from November 16 to December 12, 1794 at Kalauao in 'Ewa. [Kamakau 1992:169]

The battle was given the name of Kūki'iahu as the battle was fought near the former residence (called Kūki'iahu) in Kalauao of the chiefess Kala'imanuia, who ruled O'ahu in the seventeenth century. Kamakau (1992:169–170) said the dead bodies were gathered up and taken to Pā'aiau (an 'ili and fishpond in Kalauao) where they were piled in a great heap. Among the piled-up bodies was Kahulunuika'aumoku, daughter of Kū'ohu, a Kaua'i *kahuna* who had been slain with Ka'eokūlani. Late at night an owl woke her up by flying over and beating its wings on her head. The owl flew *makai* and she crawled after it until reaching the sea. She then swam to the other side at 'Aiea where the owl appeared once more and led her up to the mountains in Hālawa valley. There, she took shelter in a cave and fell into an unconscious sleep. The owl flew to a former *kahu* (caretaker) of hers who “knew the country well around Hālawa.” This *kahu* brought her food and nursed her back to health. (Kamakau 1992:169–170) The general location of this “great heap” of war dead in the battle of Kūki'iahu is understood as on the west side of McGrew Point (just southeast of the Pearl Ridge shopping center). The location is not known. Perhaps it was *makai* of the study corridor.

During the construction of the H-3 freeway, Mālama o Hālawa protesters used this story as basis for claiming Hālawa's importance to women. They maintained that Hālawa was an important and special healing site for women in times past and that it was also home of the protective 'aumakua (guardian), the *pueo* (owl).

3.1.8 Kamehameha's Conquest of O'ahu

Kalanikūpule was defeated the following year at the battle of Nu'uaniu when the Hawai'i Island chief, Kamehameha, invaded O'ahu and conquered the opposing forces. Kamehameha distributed the O'ahu lands among his favorite followers, which resulted in the displacement of many families: “Land belonging to the old chiefs was given to strange chiefs and that of old residents on the land to their companies of soldiers, leaving the old settled families destitute” (Kamakau 1992:376–377).

The main battle was fought from the Honolulu shore past the forts of Pūowaina (Punchbowl) and into the valley of Nu'uaniu. By tradition, one warrior with Kamehameha fought a series of one-man battles from Honolulu to Wai'anae. This individual, Makaioulu, killed a champion of O'ahu in Waikīkī by standing in front his companion who threw a spear at him, then dodging at the last second so the spear killed his opponent instead. In Kalauao, he met a party of men, and shamed them into fighting him one at a time rather than as a group. He defeated and killed each warrior. He then killed a robber at Kapolei in Honouliuli and two women famed for bone-breaking in

Mākua in the *moku* (district) of Wai‘anae (Fornander 1919:5[2]:488). There is no direct connection between the invasion of Kamehameha in 1795 and the present study area.

3.1.9 Observations of Early Explorers and Visitors

Captain James Cook landed in the Hawaiian Islands in 1778, and ten years later the first published description of Pearl Harbor appeared. Captain Nathaniel Portlock, observing the coast of Honolulu for Great Britain, recorded the investigation of a “fine, deep bay running well to the northward” around the west point of “King George’s Bay” in his journal (Portlock 1789:74). Portlock’s description matches the entire crescent-shaped shoreline from Barbers Point to Diamond Head.

Captain George Vancouver made three voyages to the Hawaiian Islands between 1792 and 1794. In 1793, the British captain recorded the name of the harbor opening as “O-poo-ro-ah” and sent several boats across the sand bar to venture into the harbor proper (Vancouver 1798:884). The area known as “Pu‘u-loa” was comprised of the eastern bank at the entrance to Pearl River. George Vancouver anchored off the entrance to West Loch in 1793, and the Hawaiians told him of the area at “a little distance from the sea, [where] the soil is rich and all the necessaries of life are abundantly produced” (Vancouver 1798, in Sterling and Summers 1978:36). Mr. Whitbey, one of Vancouver’s crew, observed, “from the number of houses within the harbor it should seem to be very populous; but the very few inhabitants who made their appearance were an indication of the contrary” (Vancouver 1798, in Sterling and Summers 1978:36).

Captain Vancouver sailed by Kalaeloa (Barbers Point) in 1792, and recorded his impression of the small coastal village of Kualaka‘i and the arid Honouliuli coast.

The point is low flat land, with a reef round it . . . Not far from the S.W. point is a small grove of shabby cocoa-nut trees, and along these shores are a few struggling fishermen’s huts. [Vancouver 1798:1:167]

. . . from the commencement of the high land to the westward of Opooroah [Pu‘uloa], was composed of one very barren rocky waste, nearly destitute of verdure, cultivation or inhabitants, with little variation all the way to the west point of the island [Vancouver 1798:2:217]

. . . This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of fertility; although we were told that at a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced . . . [Vancouver 1798:3:361–363]

During the first decades of the nineteenth century, several western visitors described the ‘Ewa landscape near Pearl Harbor. Archibald Campbell, an English sailor, spent some time in Hawai‘i during 1809-1810. He had endured a shipwreck off the Island of Sannack on the northwest coast of America. As a result, both his feet became frost-bitten and were amputated. He spent over a year recuperating in the Hawaiian Islands. His narrative is considered noteworthy because it describes life before the missionaries arrived. During part of his stay, he resided with King Kamehameha I, who granted him 60 acres in Waimano Ahupua‘a in 1809. Campbell described his land:

In the month of November the king was pleased to grant me about sixty acres of land, situated upon the Wymummee [traditional Hawaiian name for Pearl River], or Pearl-water, an inlet of the sea about twelve miles to the west of Hanaroora [Honolulu]. I immediately removed thither; and it being Macaheite time [Makahiki], during which canoes are tabooed, I was carried on men's shoulders. We passed by footpaths winding through an extensive and fertile plain, the whole of which is in the highest state of cultivation. Every stream was carefully embanked, to supply water for taro beds. Where there was no water, the land was under crops of yams and sweet potatoes. The roads and numerous houses are shaded by coconut trees, and the sides of the mountains are covered with wood to a great height. We halted two or three times, and were treated by the natives with the utmost hospitality. My farm, called Wymannoo [Waimano], was upon the east side of the river, four or five miles from its mouth. Fifteen people with their families resided upon it, who cultivated the ground as my servants. There were three houses upon the property; but I found it most agreeable to live with one of my neighbours, and get what I wanted from my own land. This person's name was William Stevenson a native of Borrowstouness. [Campbell 1967:103–104]

Of the Pearl River area, Campbell wrote,

Wymumme, or Pearl River, lies about seven miles farther to the westward. This inlet extends ten or twelve miles up the country. The entrance is not more than a quarter of a mile wide, and is only navigable for small craft; the depth of water on the bar, at the highest tides, not exceeding seven feet; farther up it is nearly two miles across. There is an isle in it, belonging to Manina, the king's interpreter, in which he keeps a numerous flock of sheep and goats. (Campbell 1967:114) The flat land along shore is highly cultivated; taro root, yams, and sweet potatoes, are the most common crops; but taro forms the chief object of their husbandry, being the principal article of food amongst every class of inhabitants. [Campbell 1967:115]

The botanist F.J.F. Meyen, visiting in 1831, confirms the abundant vegetation described by Campbell in the vicinity of Pearl Harbor:

At the mouth of the Pearl River the ground has such a slight elevation that at high tide the ocean encroaches far into the river, helping to form small lakes which are so deep, that the long boats from the ocean can penetrate far upstream. All around these water basins the land is extraordinarily low but also exceedingly fertile and nowhere else on the whole island of Oahu are such large and continuous stretches of land cultivated. The taro fields, the banana plantations, the plantations of sugar cane are immeasurable. [Meyen 1981:63]

A contrasting picture of 'Ewa is recorded in the missionary William Ellis' description from 1823-1824 of the 'Ewa lands away from the coast:

The plain of Eva is nearly twenty miles in length, from the Pearl River to Waiarua, and in some parts nine or ten miles across. The soil is fertile, and watered by a number of rivulets, which wind their way along the deep water-courses that intersect its surface, and empty themselves into the sea. Though capable of a high

state of improvement, a very small portion of it is enclosed or under any kind of culture, and in travelling across it, scarce a habitation is to be seen. [Ellis 1963:7]

The Malden map of the South Coast of O'ahu (Figure 21) is one of the first detailed maps depicting the study area. Malden was clearly focused on the hydrology of Pearl Harbor and may in fact have been the first to use the West Loch, Middle Loch, East Loch terminology used to this day. Thus he may have had only secondary interest in depicting developments on the coast. Given the early date, it is no surprise that the map's accuracy is not spot-on and hence the overlay of the present study area is only approximate. Malden depicts no human enterprise on the southwest (Honouliuli) side of West Loch and virtually none on Waipi'o Peninsula. Pretty clearly the freshwater stream with associated houses he calls out on the west side of the base of Waipi'o Peninsula is the mouth of Waikele Stream which is actually a kilometer west of the study area. Pretty clearly the fishpond he calls out on the east side of the base of the Waipi'o Peninsula is Loko Eo. Approximately five houses are shown at the north end of Middle Loch. Basically no enterprise is depicted in coastal Waiawa and Mānana (east side of Middle Loch and the Pearl City Peninsula). From the east side of the Pearl City Peninsula (Waimano Ahupua'a) to the east extensive agricultural fields (*lo'i kalo*) appear to be depicted. A continuous line of houses along the coast appears to be depicted in Waimalu and Kalauao (the east *mauka* side of East Loch). The only traditional Hawaiian place name offered is "Krow-wow"—which is pretty certainly Kalauao. This suggests the importance of Kalauao, also suggested by its relatively great width compared to the smaller neighboring Waiawa, Waimalu, and 'Aiea *ahupua'a*. Basically no development is shown within Hālawā Ahupua'a and the east end of the study corridor.

3.1.10 Missionary Stations and the Population Census

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

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

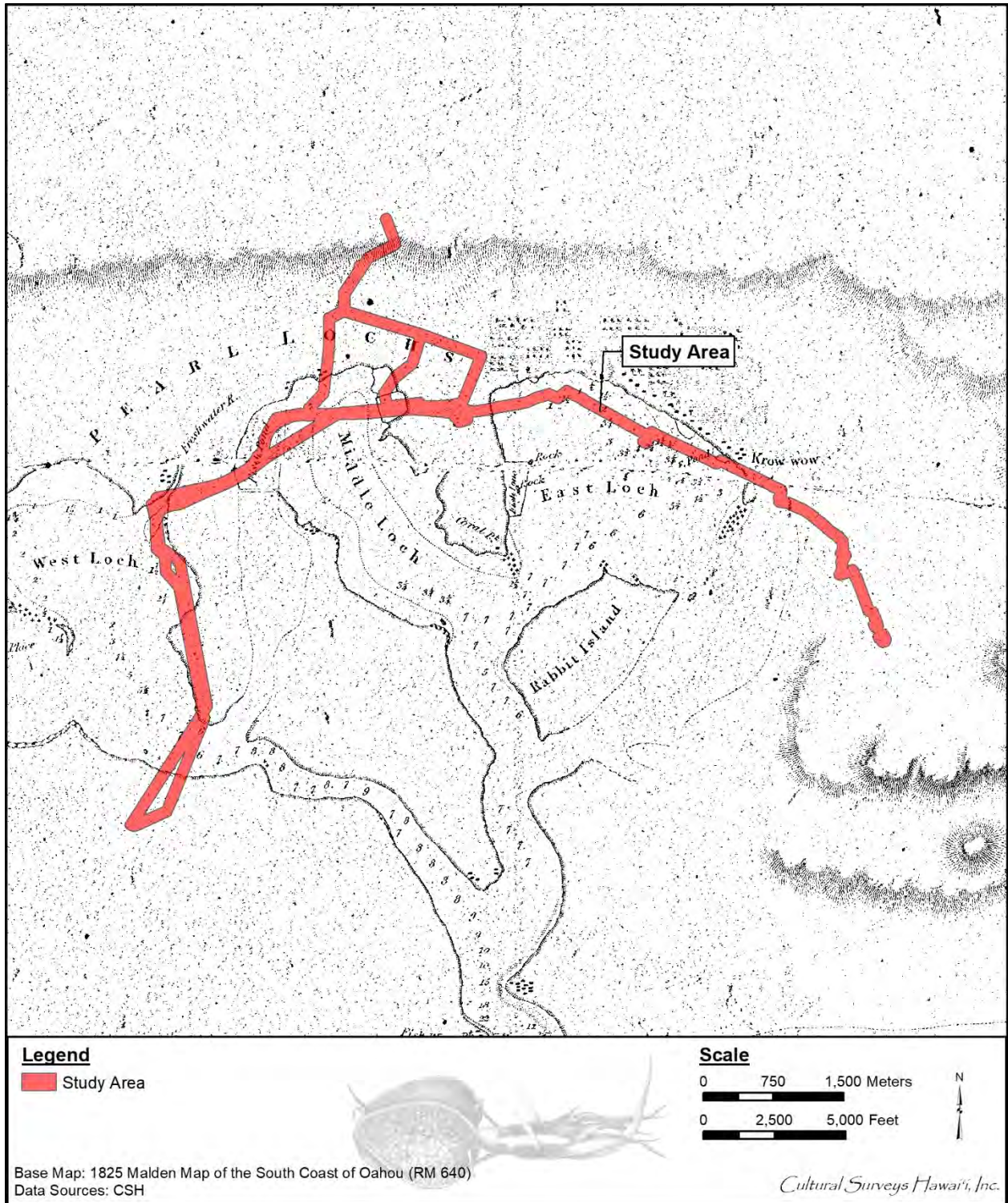


Figure 21. 1825 Malden map of the South Coast of O'ahu showing the study area (best fit of study area is shown; this early map is imprecise)

In the following years, the Protestant missionaries established smaller churches in outlying areas, sometimes presided over by a foreign missionary or led by a Hawaiian convert, with periodical visits by a visiting pastor from one of the main churches. The first mission in 'Ewa was established in 1834 in Waiawa. Two missionaries, Lowell and Abigail Smith, were assigned to the station and were in charge of building a church and a house for themselves. [Hawaiian Mission Children's Society 1969:3-9]

The *ali'i*, Kīna'u, daughter of Kamehameha I and an early Christian convert, offered the missionaries to "settle upon her land, will build us a house and do anything to promote our happiness" (letter from Lowell Smith 1833, in Frear 1934:69). Citing his wife's poor health, the Smiths went to Moloka'i instead. But at the General Meeting of the missionaries in June and July 1834, the board decided the Smiths should be transferred to 'Ewa to a place 3 miles from the king's favorite country seat (Frear 1934:93). Lowell selected the site for the new church on a hill called Haupū (built-up hill) that was elevated 200 ft above the 'Ewa plain. This 'Ewa Church was in many ways the foci for 'Ewa District for decades.

The reports left by Artemas Bishop of the Ewa Protestant Station in Waiawa sheds light on the massive impact disease was having on the Hawaiian people in the 'Ewa District. The 1831-1832 census of O'ahu recorded a population of 4,015 within the 'Ewa District. Four years later, in 1836, the 'Ewa population had dropped to 3,423 (Schmitt 1973:9, 36), "a decrease of 592 in 4 years" (Ewa Station Report 1836). Reverend Lowell Smith noted in 1836:

The people of Ewa are a dying people. I have not been able to obtain an exact count of all the deaths & births since the last general meeting. But my impression is that there have been as many as 8 or 10 deaths to one birth. I have heard of but 4 births on Waiawa during the year, & all of these children are dead. I have attended about 20 funerals on that one land, & 16 of these were adults. [Ewa Station Report 1836]

The population stabilized in the 1830s and early 1840s. In January 1849, the population was 2,386 people, but the population dropped with a measles epidemic in October 1849. Although Bishop made an attempt to vaccinate as many individuals as possible, the smallpox epidemic of 1853-1854 killed upwards of 400 people in the 'Ewa District. The comments of Artemas Bishop reflect the destitution people were suffering district wide:

It is not necessary that I go into detail of that season of sorrow and trial which we passed through, and from which I did not myself escape without feeling its influence in my own person. Let it suffice here, that not a house or family in Ewa escaped. In many cases, whole families were cut off. Husbands and wives parents and children, were separated by death. The whole state of society became disorganized, almost every family was broken up. In the whole district between July and October inclusive, upwards of half of the people died and of those who escaped, many are still enfeebled in consequence. In the church we have lost upwards of 400 members, including several of my best men. We feel ourselves very much crippled in consequence. Many sad and affected feelings, mingled with discouragement have followed my labors through the year, and that to a degree far beyond what I ever before suffered. [Ewa Station Report 1854]

Sereno Bishop also remembered his father's efforts to save his congregation, but with limited success in 'Ewa.

The greatest destruction of Hawaiian population took place in the summer of 1853, by an invasion of small-pox. This broke out in Honolulu. Rev. A. Bishop immediately procured a supply of vaccine matter, which proved to be spurious. He then proceeded to inoculate the people with small-pox, thus saving hundreds of lives, and himself coming down with varioloid, having formerly been vaccinated. But more than half of the population of Ewa perished in a few weeks. The earliest cases were pathetic. A young woman in Kalauao was visiting in Honolulu, and contracted the malady. She hastened home in terror and summoned her friends and kindred from all the villages of Ewa to bid her farewell. They all came and kissed her, then returned to their homes and all died. The young woman herself recovered. [Bishop 1916:46]

In 1860, Artemas Bishop reported,

The people of the district are rapidly diminishing, and whole neighborhoods where in former years were numerous families and cultivated lands, there are now no inhabitants, and the land is left to run to waste. The fathers have died off, and the children wander into other parts, and there are none to fill their places. [Ewa Station Report 1860]

Sereno Bishop, recollecting his life at the mission station in 'Ewa in the mid-eighteenth century, commented on the population decline: "Throughout the district of Ewa the common people were generally well fed. Owing to the decay of population great breadths of taro marsh had fallen into disuse, and there was a surplus of soil and water for raising food" (Bishop 1916:44).

At Contact, the most populous *ahupua'a* on the island was Honouliuli, with the majority of the population centered on Pearl Harbor. In 1832, a missionary census of Honouliuli recorded the population as 1,026. Within four years, the population was down to 870 (Schmitt 1973:19, 22). In 1835, there were eight to ten deaths for every birth (Kelly 1991:157–158). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages. In 1853, the population of 'Ewa and Wai'anae combined was 2,451 people. In 1872, it was 1,671 (Schmitt 1968:71). The inland area of 'Ewa was probably abandoned by the mid-nineteenth century, due to population decline and consolidation of the remaining people in the towns of Honouliuli, Waipahu, and Waiawa.

3.2 Mid-Nineteenth Century, the Māhele and Kuleana Act

In 1845, the Board of Commissioners to Quiet Land Titles, also called the Land Commission, was established "for the investigation and final ascertainment or rejection of all claims of private individuals, whether natives or foreigners, to any landed property" (Chinen 1958:8). This led to the Māhele, the division of lands among the king of Hawai'i, the *ali'i* (chiefs), and the common people, which introduced the concept of private property into the Hawaiian society. Kamehameha III divided the land into four categories: Crown Lands reserved for the king and the royal house; Government Lands set aside to generate revenue for the government; Konohiki Lands claimed by *ali'i* and their *konohiki* (supervisors); and *kuleana*, habitation and agricultural plots claimed by the common people (Chinen 1958:8–15).

In 1848, the crown and the *ali'i* received their land titles, known as Land Commission Awards (LCA). Members of the royal family were awarded entire *ahupua'a*, while high-ranking *ali'i* were awarded entire *'ili* (land section within an *ahupua'a*), and lesser *konohiki* were awarded half of an *'ili* (Kame'eiehiwa 1992:269, 279). Title to an *ahupua'a* or *'ili* typically included ownership of the area's fishpond and offshore fishing rights (Devaney et al. 1982:143). The lands awarded as Crown Lands and Konohiki Lands, as well as lands designated as Government Lands, were "subject to the rights of native tenants." The Kuleana Act of 1850 "authorized the Land Commission to award fee simple titles to all native tenants who occupied and improved any portion of Crown, Government, or Konohiki Lands" (Chinen 1958:29). It is through records for LCAs generated during the Māhele that the first specific documentation of life in 'Ewa, as it had evolved up to the mid-nineteenth century, come to light. The LCA parcels adjacent to the west portion of the current study area are shown on Figure 22, and an overview of the neighboring LCA pattern is discussed by *ahupua'a*.

3.2.1 Honouliuli and the Division of Lands

Only a small portion of the southwest end of the present study area (southwest of West Loch) lies in Honouliuli Ahupua'a (see Figure 2). In AD 1795, 17 years after Captain James Cook made the first Western Contact with the Hawaiian Islands, the great Hawaiian warrior Kamehameha completed his conquest of the island of O'ahu and then went on to consolidate his rule over all of the Hawaiian Islands. He gave the *ahupua'a* of Honouliuli to Kalanimōkū, an early supporter, as part of the *panalā'au*, or conquered lands, with the right to pass the land on to his heirs rather than having it revert to Kamehameha (Kame'eiehiwa 1992:58, 112). Kalanimōkū subsequently gave the *ahupua'a* to his sister, Wahinepi'o.

In 1855, the Land Commission awarded all of the unclaimed lands in Honouliuli, 43,250 acres, to Miriam Ke'ahikuni Kekau'ōnohi (LCA 11218), a granddaughter of Kamehameha I, and the heir of Kalanimōkū (Indices of Awards 1929; Kame'eiehiwa 1992). Kekau'ōnohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu'u Kahalai'a, governor of Kaua'i (Kelly 1985:21). Subsequently, Kekau'ōnohi ran away with Queen Ka'ahumanu's stepson, Keli'iahonui, and then became the wife of Chief Levi Ha'alelea. Upon her death on 2 June 1851, all her property passed on to her husband and his heirs. In 1863, the owners of the *kuleana* lands deeded their lands back to Ha'alelea to pay off debts owed to him (Frierson 1972:12). In 1864, Ha'alelea died, and his second wife, Anadelia Amoe, transferred ownership of the land to her sister's husband John Coney.

During the Māhele of 1848, 96 individual claims were made and 72 individual claims in the *ahupua'a* of Honouliuli were registered and awarded by King Kamehameha III to commoners (Tuggle and Tomonari-Tuggle 1997:34). The 72 *kuleana* awards were almost all made in the former rich taro lands adjacent to Honouliuli Gulch, which contained fishponds and irrigated taro fields. They awards ranged in size from 0.1 to 5.5 acres in size.

None of the LCA *kuleana* claims within Honouliuli Ahupua'a (west of West Loch) was near the present study area (see Figure 22). The study area within Honouliuli Ahupua'a was within the *ahupua'a* award to Kekau'ōnohi.

The absence of LCA claims in the Honouliuli Ahupua'a portion of the study area indicates a lower likelihood of traditional Hawaiian cultural properties in that area.

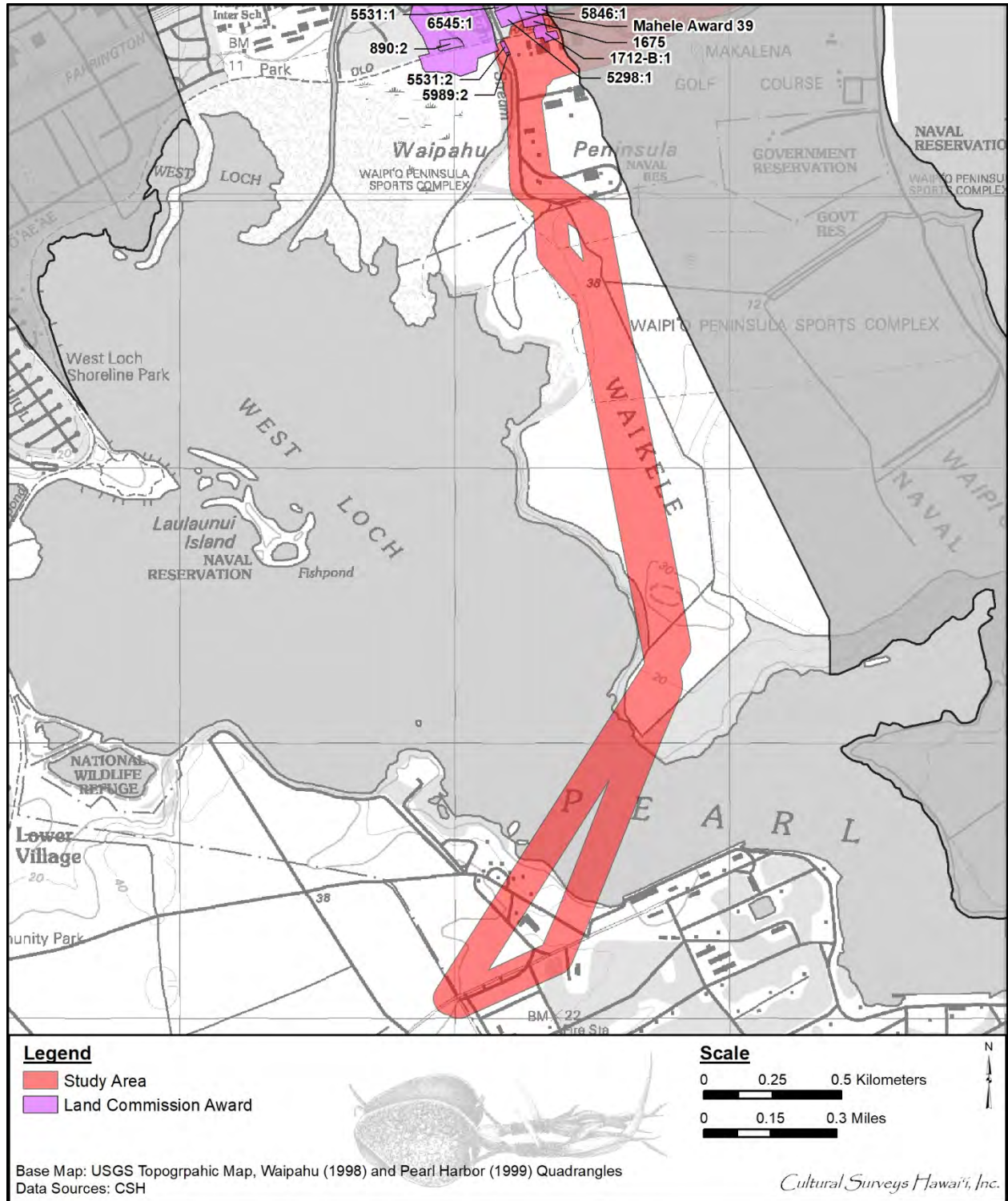


Figure 22. Locations of Land Commission Awards near the west portion (Honouliuli, and Waikele Ahupua‘a) of the study area

3.2.2 Waikele and the Division of Lands

The study area traverses Waikele Ahupua'a on the west side of the Waipi'o Peninsula (see Figure 2). In the Māhele, the *ahupua'a* of Waikele was awarded to the *ali'i* Nahuina; he returned it to the government as a commutation fee to pay for the lands he kept for himself. Much of the most productive agricultural lands were awarded to several *ali'i* as *'ili* awards, such as the 199-acre award of the *'ili* of Auiole to Nāmāhana and Maawe, the 252-acre award for the *'ili* of Koalipea to Nāmākehā, and the 2,829-acre award of Pouhala 'Ili to Lūlūhiwalani. In all, 119 claims were made for the *ahupua'a* and 73 of these were awarded. As shown in Table 2, nine LCA parcels in Waikele Ahupua'a are adjacent to the study area (see Figure 22). Information in the award records indicates the *makai* region contained agricultural land used most often for growing taro, pasturelands, abundant *loko* (fishponds), sand dunes, *'auwai* (ditches), and *muliwai* (estuary or river mouth).

The *kuleana* LCA pattern in Waikele Ahupua'a (see Figure 22) notably does not extend down Waipi'o Peninsula suggesting a lower probability of traditional Hawaiian occupation on the west side of the peninsula. Conversely, a high probability of traditional Hawaiian occupation is indicated at the base of Waipi'o Peninsula where the study area takes a right angle turn to the east. Thus while the LCA density is quite low along the study area in Waikele Ahupua'a, it is notably high in the immediate vicinity of the existing Waipahu WWPS and the two neighboring alternative Waipahu WWPS locations.

Table 2. Land Commission Awards in Waikele

LCA	Awardee	'Ili	LCA	Awardee	'Ili
39 MA	Kauliokamoa	Kapakahi	5531:1-2	Keawe	Kapakahi
890:2	Kuhano	Ohua	5846:1	Kalou	Kapakahi, Kapuna
1675	Mahoe	Kamohai	5989:2	Makole	Kapakahi
1712b:1	Hopu	Kaokai	6545:1	Haalilio, Hana Hupa	Ohua
5298:1	Puhi	Kapakahi			

3.2.3 Waipi'o and the Division of Lands

The study area traverses Waipi'o Ahupua'a as it crosses the eastern half of the base of Waipi'o Peninsula (see Figure 3). The *ahupua'a* of Waipi'o was awarded to John Papa 'I'i in the Māhele (LCA 8241) comprising approximately 20,540 acres. In addition four *'ili* were awarded to *ali'i* as *konohiki* awards. Two of the *ali'i* kept all of their lands, and two returned half of their *'ili* awards to the government. 'I'i, who was born in Waipi'o, was a companion to the young Liholiho (Kamehameha II). He was an early Christian convert, a member of the house of nobles during the Kamehameha III reign, and an early chronicler of Hawaiian customs and history (Day 1984:55). In all, 121 claims were made for land in Waipi'o, but only 80 were awarded. Including the *ahupua'a* award to John Papa 'I'i, 20 LCA awards in Waipi'o are adjacent to the present study area (Table 3 and Figure 23).

The majority of awarded land parcels were located in the *makai* portions of Waipi'o, at or just above the Waipi'o Peninsula. Predominant among the claimed land usages in Waipi'o are 312 *lo'i*

Table 3. Land Commission Awards in Waipi'o

LCA	Awardee	'Ili	LCA	Awardee	'Ili
1616:2	Kaluahinenui	Homaikaia	8241- GO:1	Kawahinelawaia	Keio
5606:1	Kapela	Homaikaia, Hanaloa	8241-H:1	Kamaka	Lepau, Kauakahiki
5647:1	Kaia	Kalualaea, Eo, Hanaloa	8241K:1	Kuhiwahiwa	Homaikaia, Hanaloa
5998- B:1	Puou	Homaikaia	8241- L.K.:2	Kaholohana	Hanaupouli
6076:1	Humehume	Puopae	8241LN:1	Nahua	Kaakaulani, Kanonoukuono, Nakumei, Waihaka
8241- BS:1	Kahuailana	Kukina,waihaka	8241-M:1	Kupokii	Eo
8241- CB:1	Keawekolohe	Homaikaia, Hanaloa	8241- S.S.:2	Kauhiohewa	Hanapouli
8241- DO:1	Hana	Pakikakika, Puopae, Eo	8241- US:1	Nahola	Homaikaia
8241-F:1	Kaumiumi	Hoomaikaia, lepau, Keakiula	11193:1	Kailianu	Lepau, <i>Kanakahiloko</i>
8241G:1	Ope	Homaikaia, Lepau	11199:1	Kauaila	Kalualaa, Puuopae

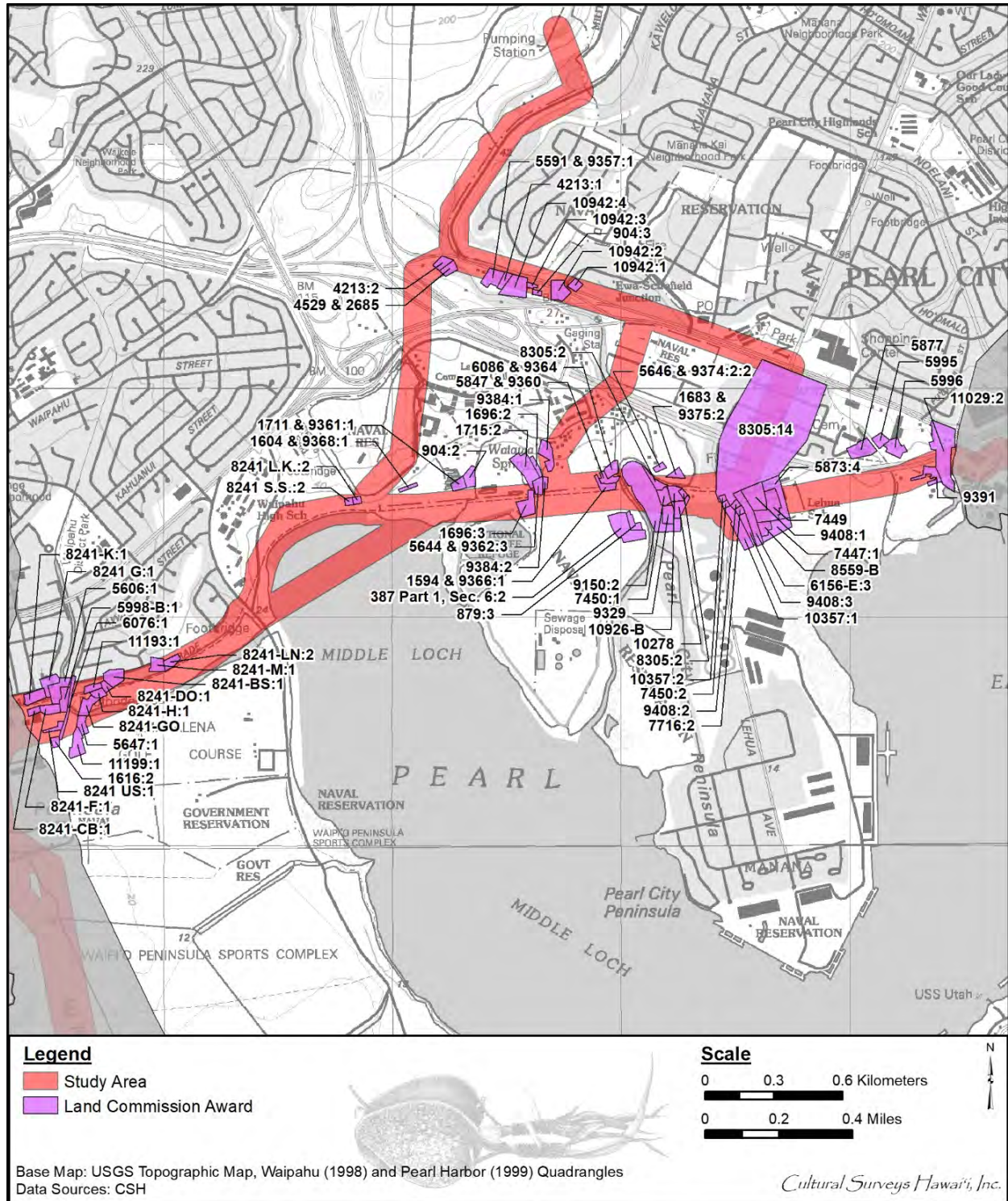


Figure 23. Locations of LCA parcels adjacent to the central portion (Waipi'o, Waiawa, Mānana, Waimano, Ahupua'a) of the study area

(irrigated taro patches) of various sizes. Wetland taro cultivation was the primary agricultural pursuit within the *ahupua'a* during the mid-nineteenth century, and likely reflects a long history of taro farming. At the coast, four fishponds were claimed.

In the *mauka* reaches of Waipi'o, 53 claims were made for portions of *kula* (pasture land) and 25 for "*okipu*" (forest clearings). The fact that several claims were made in the *mauka* regions suggests Waipi'o residents had particular locales they traveled to regularly. This also confirms other accounts (Handy and Handy 1972:469–470) suggesting this area had especially abundant and diverse uplands. *Kula* land is a general term for open fields, pastures, uncultivated fields, or fields for cultivation, and upland (drier), which is distinct from meadow or wetland (Lucas 1995:60). *Kula* lands were often used for opportunistic plantings such as bananas, sugarcane, sweet potatoes, dry land taro, and other crops that did not depend on a consistent source of water. *Okipu* is defined as a forest clearing (Lucas 1995:82), a place presumably used to gather forest products and medicinal herbs or for pasture.

In contrast to the well-populated *makai* lands of Waipi'o, the *mauka* regions were often described in nineteenth century accounts as virtually uninhabited. The missionary William Ellis described the interior regions of 'Ewa in 1823-1824:

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

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

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

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

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

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

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

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

Our family made repeated trips to the home of Rev. John S. Emerson at Waialua during those years. There was then no road save a foot path across the generally smooth upland. We forded the streams. Beyond Kīpapa Gulch the upland was dotted with occasional groves of Koa trees. On the high plains the *ti* plant abounded, often so high as to intercept the view. No cattle then existed to destroy its succulent foliage. According to the statements of the natives, a forest formerly covered the whole of the then nearly naked plains. It was burned off by the natives in search of sandalwood, which they detected by its odor burning. [Bishop 1901 in Sterling and Summers 1978:89]

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

The pattern of *kuleana* LCA parcels is again somewhat clumped on the west side of the study area within Waipi‘o Ahupua‘a (adjacent to the clump of LCA parcels in the neighboring portion

of Waikele Ahupua'a to the west) (see Figure 23). The portion of the study area on the northwest edge of Middle Loch is relatively free of *kuleana* LCAs. In general terms, an attendant pattern in any archaeological evidence of traditional Hawaiian occupation would be expected, with a higher probability in the west portion where the study area crosses Waipi'o Ahupua'a and a lower probability in the east portion where the study area crosses Waipi'o Ahupua'a.

3.2.4 Waiawa and the Division of Lands

Coastal Waiawa Ahupua'a extends from approximately the middle of the north side of Middle Loch to approximately the middle of the Pearl City Peninsula (see Figure 3). During the Māhele in 1848, Waiawa Ahupua'a was awarded to Princess Victoria Kamāmalu (sister of Kamehameha IV and V) as part of LCA 7713. During the second half of the nineteenth century, Waiawa passed on to successive members of the *ali'i*: Victoria Kamāmalu died in 1866 at the age of 27. Her entire estate was inherited by her father, Mataio Kekūanao'a, who died two years later and the estate went to Kekūanao'a's son Lota Kapuāiwa, who by that time reigned as Kamehameha V. Kapuāiwa died intestate in 1872, whereupon Ruta Ke'elikōlani, Kapuāiwa's half-sister, petitioned for and received in 1873 the entire estate. By 1883, Ruta Ke'elikōlani died, leaving all of her estate to her cousin Bernice Pauahi Bishop (Kame'eleihiwa 1992:309–310). The Kamehameha Schools (Bernice Pauahi Bishop Estate) presently retains ownership of most of the *ahupua'a*.

Fifty-seven *kuleana* claims were made and 31 were awarded, ranging in size from 0.2 to 3.9 acres in size. One of these was an award to the ABDFM: LCA 387 comprised 4.13 acres in the *makai* portion of Waiawa and included a salt pond, a *mo'o* (land strip) for the church, and a house lot. Making the application was Artemis Bishop, the Protestant missionary stationed at 'Ewa from 1836–1856. Another claim by a non-Hawaiian was made by William Wallace in LCA 10942, which comprised 3.2 acres including a house lot, two *mo'o*, and six *lo'i*. The remaining 50 claims (for individual *'āpana* or lots) by 29 claimants in Waiawa were for *kuleana*; the claims included 28 house lots, 176 taro *lo'i*, 20 fishponds, 23 *kula* or pasture, eight *paukū 'auwai* (length of ditch), and seven banana *kula*. Modern tax maps show the 31 claims actually awarded all located in the *makai* portion of the *ahupua'a*. While the uplands of Waiawa were probably used for the procurement of resources, we have no evidence anyone actually lived there permanently in traditional Hawaiian times. Twenty-nine LCA parcels in Waiawa, including the *ahupua'a* award to Victoria Kamāmalu, are within the study area, as shown on the previous Figure 23 and summarized in Table 4.

The pattern of *kuleana* LCAs within the Waiawa Ahupua'a portion of the study area (see Figure 23) is of a lower density on the west side (north of the north end of Middle Loch) and higher closer to the “reverse S” bend of Waiawa Stream. This pattern continues on both sides, with a relatively low density of *kuleana* LCA parcels in the eastern Waipi'o Ahupua'a portion of the study area abutting a relatively lower density in west Waiawa Ahupua'a and a higher density in east Waiawa abutting a relatively high density in west Mānana Ahupua'a (on the east side of the “reverse S” bend of Waiawa Stream). The archaeological potential would be expected to reflect this.

Most of the *mauka* extension corridors in the present study area are in Waiawa Ahupua'a including the western and central *mauka* extensions (on either side of Leeward Community College [LCC]), most of the alignment along Kamehameha Highway and the northern extension up Waihona Street. The *mauka* extensions within Waiawa Ahupua'a are relatively free of LCA

Table 4. Land Commission Awards in Waiawa

LCA	Awardee	'Ili	LCA	Awardee	'Ili
387 Part 1 sec. 6:2	ABCFM	Beretania St., Punahou, Kawaihoa, Kukuluaeo, Kamakapili	5646	Kaionio	Panaio
879:3	Puakai	Panaio, Kapuaihalulu	6086	Makanui	Hanakehau, Ananakehau
904:2-3	Naheana, Noa	Panio, Kahoaiia, Kuhia, Panaio	8305:2	Kanoa, Paulo	Muliwai
1594	Keawe	Honokehau	9357:1	Kekua	Kahoaee
1604	Kakoo	Kuhiawaho	9360	Kapaa	Hanekehau
1683	Peahi	Panaio	9361:1	Hanamaulu	Kuhiawaho
1696:2-3	Namomoku		9362:2	Kamalii	Kuhia
1711	Hanamaulu	Kuhiawaho	9364	Makanui	Hanakehau, Ananakehau
1715:2	Haa	Kuhouloko	9366:1	Keawe	Honokehau
2685	Ohia	Holopiapia, Kapuaihalulu	9368:1	Waiawa	Kuhiawaho
4213:1-2	Kauhi	Holopiapia, Kahoaiia, Kapuaihalulu, Kalona	9374:2:2	Kaionio	Panaio
4529	Ohia	Holopiapia, Kapuaihalulu	9375:2	Peahi	Panaio
5591	Kekua	Kahoaee	9384:1-2	Nahalepili	Kapoupou
5847	Kapaa	Hanakehau	10942:1- 4	Wallace	Kahoaiia
5644	Kamalii	Kuhia			

parcels (and attendant heightened concern for traditional Hawaiian archaeological resources) with the exceptions being near the *makai* end of the central *mauka* corridor (near Waiawa Spring) and the western portion of the Kamehameha Highway corridor within Waiawa Ahupua'a

3.2.5 Mānana and the Division of Lands

The study area crosses a narrow neck of Waiawa Ahupua'a between the "reverse S" bend of Waiawa Stream on the west and north of East Loch (just east of Lehua Avenue) (see Figure 3). The existing Pearl City WWPS and the three alternative Pearl City WWPS are all in Mānana Ahupua'a as is the eastern, *mauka* alignment extending north along Lehua Avenue.

Prior to the Māhele, it was documented that Mānana was retained as one of the few O'ahu *'āina* (land holdings) of Ruth (Ruta) Ke'elikōlani, a great-granddaughter of Kamehameha. Ke'elikōlani became one of the largest landholders up to the time of her passing in 1883. Subsequently her heir, Bernice Pauahi Bishop, endowed Kamehameha Schools (Kame'eleihiwa 1992:246).

The productivity of the land of Mānana is indicated in the Māhele records, as a large number of *'ili* were awarded to various *ali'i* as Konohiki Lands. The *'ili* of Kaholona, Kalanihale, Paauau, Weloka, and Keahua were all awarded and retained by members of the *ali'i*, in addition to the large awards of the entire *'ili* of Poupouwela to Victoria Kamāmalu (sister of Kamehameha IV and V) and the entire *'ili* of Mānana Nui to Ruth Ke'elikōlani, the great-granddaughter (or great grandniece) of Kamehameha I and half-sister of Kamāmalu.

Forty-eight claims were made for land in the Māhele, and 33 were awarded, including seven *'ili* awards to the *ali'i*. Fourteen of these awards in Mānana are adjacent to the wastewater study area, as summarized in Table 5 and shown on the previous Figure 23.

Table 5. Land Commission Awards in Mānana

LCA	Awardee	'Ili	LCA	Awardee	'Ili
5873:4	Kahanaumaikai	Keahua	8559-B	William C. Lunalilo	Kamoku, Pau, Kalauakou, Laiwai, Laiemaloo
6156-E:3	Naue	Lole, Kaholana	9150:2	Kupa	Paauau
7447:1	Kuheleloa	Kamuliwai, Kaohai	9329	Nuka	Paanau
7449	Kaooua	Keahua	9408:1-3	Kauhale	Lohe, Lolei
7450:1-2	Kawaakaukahi	Kaholona	10278	Makole	Maewaiena
7716:2	Keelikolani, Ruth	Manana	10357:1-2	Naheana	Kaolana
8305:2,14	Kanoa, Paulo	Kahonola	10926-B	Kanana, Maria	Kaholona

3.2.6 Waimano and the Division of Lands

The study area crosses the narrow coastal portion of Waimano Ahupua'a north of the western portion of East Loch (see Figure 3).

The *ahupua'a* of Waimano was awarded to Victoria Kamāmalu during the Māhele as part of LCA 7713. The *'ili* of Kūkona was awarded to John Stevenson (LCA 11029) as a *konohiki* award, but he returned a portion to the government. Only 12 claims were made in Waimano (including the *konohiki* awards) and only nine were awarded. LCA 5662 and portions of the awards of Kamāmalu and Stevenson in Waimano are adjacent to the study corridor, as shown on the previous Figure 23 and summarized in Table 6.

Table 6. Land Commission Awards in Waimano

LCA	Awardee	'Ili	LCA	Awardee	'Ili
5877	Kamauoha	Pulehua	8305:14	Kanoa, Paulo	Kahonola
5995	Laanui	Kaihuaakapuaa, Kukaemoa	9391	Keo	Lopa, Kahapapa
5996	Lua	Kahapapa	11029:2	Stevenson, John	Kukona
7713	Victoria Kamāmalu	<i>Ahupua'a</i>			

3.2.7 Waiau and the Division of Lands

The study area crosses the narrow coastal portion of Waiau Ahupua'a crossing through the HECO Waiau Powerplant (see Figure 4).

Victoria Kamāmalu (LCA 7713, 'Āpana 35) was awarded almost all of the land in Kumu'ulu, a large 'ili which seems to include the entire inland section of Waiau from the government road to the Ko'olau Mountains. Originally the 'ili of Kauhīhau, Nāono, Nālima, and Ka'ākauwaihau in Waiau were all awarded to the *ali'i* Puihī as part of LCA 3834, but he returned three of the 'ili to the government to pay the commutation fees for the Waiau land he kept, which was an 11.94-acre 'ili of Ka'ākauwaihau (Barrère 1994:542). Another Māhele award (MA 18) was to the *konohiki* Paewahine, who claimed the 'ili of Kalua'ōlohe, kept half (3.25 acres; R.P. 4526), and returned the remaining half to the government. The largest claim of 35.7 acres went to Iona (Jonah) Pi'ikoi, a high Kaua'i chief who was a childhood retainer to Liholiho (Kamehameha II). He had first married the Hawaiian chiefess Kekahili, which made him the brother-in-law to the father of the future monarch David Kalākaua. His second wife was the chiefess Kamake'e, with whom he shared LCA 10605. This award included a claim in the 'ili of Kalua'o'opu in Waiau and large awards in other sections of O'ahu, Kaua'i, and Maui. The remaining land in Waiau became government land. Twenty-three claims by commoners were made for Waiau, and 17 were awarded. Including the Kumu'ulu 'Ili claim to Victoria Kamāmalu, 12 LCA *kuleana* parcels in Waiau are adjacent to the study area, as shown on Figure 24 and summarized in Table 7.

Coastal Waiau had a relatively high density of *kuleana* LCA parcels probably owing at least in part to the presence of coastal Waiau Spring. All things being equal, a relative richness of archaeological resources relating to traditional Hawaiian habitation might be anticipated.

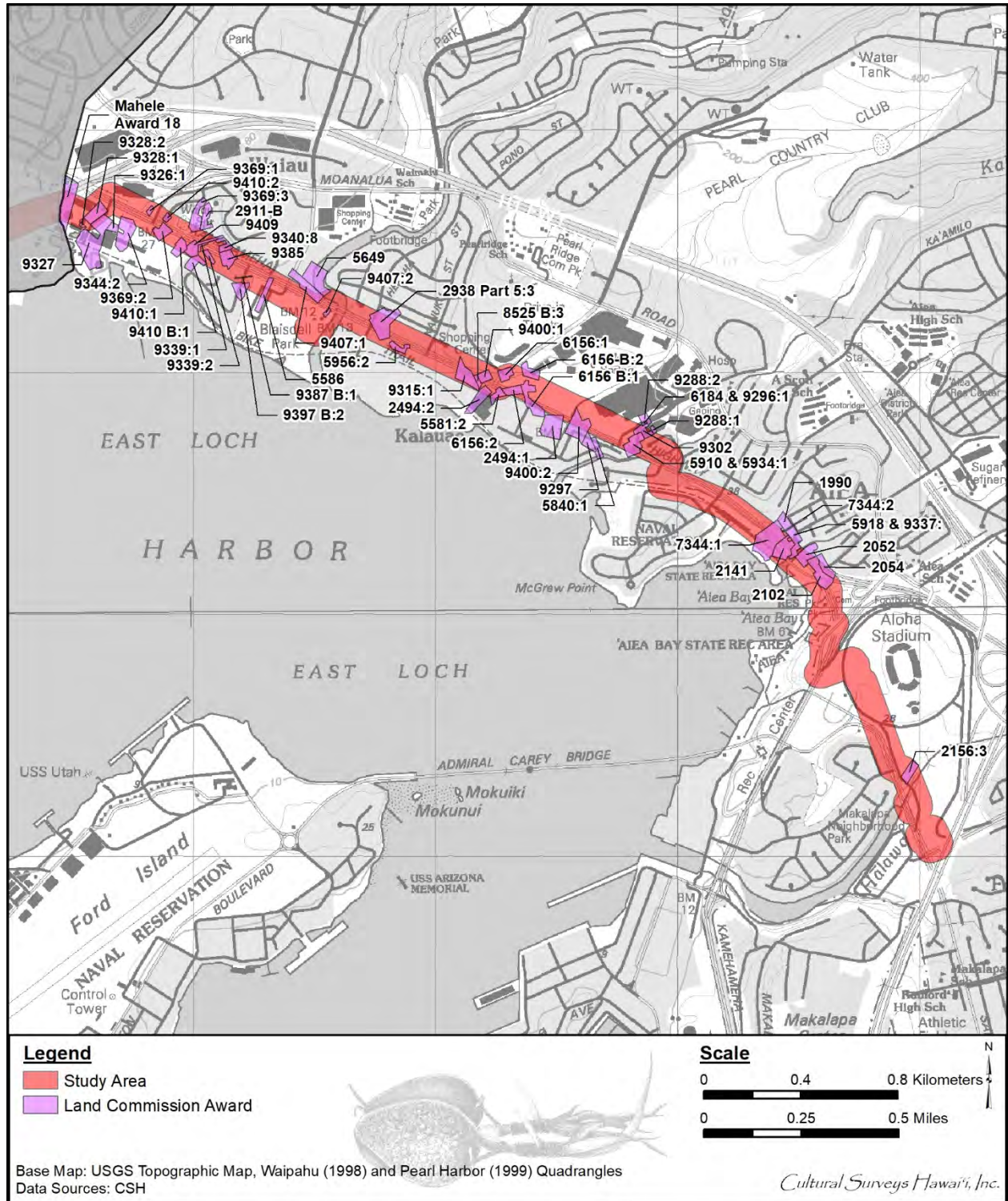


Figure 24. Locations of Land Commission Awards adjacent to the east portion (Waiiau, Waimalu, Kalaa'ua, 'Aiea, and Hālawā Ahupua'a) of the study area

Table 7. Land Commission Awards in Waiau

LCA	Awardee	'Ili	LCA	Awardee	'Ili
18 MA	Paewihine	Kalua'ōlohe	9344:2	Liliu	Honokōwailani
2911-B	Kauluokeahi-amoku	Kumu 'ulu	9369:1-3	Kanealii	Kumu 'ulu, Hahapo
LCA 7713, 'Āpana 35	Victoria Kamāmalu	Ahupua'a	9385	Palea	Kauhihau
9326:1	Kekaina	Kalua'o'opu	9409	Puhiki	Ka 'akauwaihau
9328:1-2	Kaeka	Kalua'o'opu	9410:1-2	Hema	Ka'ākauwaihau Waikowaha
9339:1-2	Nonoaea	Nāono	9410 B:1	Wahaolelo	Ka'ākauwaihau (ap. 1-2); Kumu'ulu ('āp. 3)
9340:8	Kekalohi	Kauhihau			

3.2.8 Waimalu and the Division of Lands

The study area crosses the narrow coastal portion of Waimalu Ahupua'a that includes the lower reaches of Waimalu Stream and modern Neal S. Blaisdell Park and the existing Waimalu WWPS and proposed alternative WWPS (see Figure 4).

Waimalu was awarded to the *ali'i* Miriam Kekau'ōnohi in the Māhele (LCA 11216). Biographical information on this *ali'i* was discussed in the Honouliuli Māhele section of this report. Fifteen other *'ili* (or half an *'ili*) were awarded to *ali'i* as *konohiki* awards, but only ten were retained. In all, 93 people claimed land in Waimalu, and 63 claims were awarded. Nine LCA parcels in Waimalu are within the study area, as shown on the previous Figure 24 and summarized in Table 8. Waimalu Ahupua'a had a moderate to high density of *kuleana* LCA parcels.

Table 8. Land Commission Awards in Waimalu

LCA	Awardee	'Ili	LCA	Awardee	'Ili
2938 Part 5:3	Huanu, Heirs of Lahilahi	Pohakupu 1	9387 B:1	Keaula	9387 B:1
5586	Kahiki	Pipio	9397 B:2	Kekaula	Pipio
5649	Kahanaipuaa	Kumupali, Aipuaa	9407:1-2	Kuaalu	Pipio
5956:2	Makaike	Paukea, KaloKola, Waieli	11216	Miriam Kekau'ōnohi	Ahupua'a
9315:1	Haki	Waieli			

3.2.9 Kalauao and the Division of Lands

Kalauao Ahupua'a has a relatively wide frontage on the East Loch of Pearl Harbor and includes the Pearl Ridge Shopping Center, McGrew Point Navy housing, and the northwest side of 'Aiea Bay (see Figure 4).

In the Māhele land division of 1848 and the subsequent Kuleana Act, 36 LCAs were granted within Kalauao Ahupua'a. Seven of these were *konohiki* awards to *ali'i*, some of them for half or an entire 'ili. Virtually all of the *konohiki* and *kuleana* LCA parcels were located within 500 m of the coast. The awards ranged from 0.1 to 5.0 acres in size. Ten LCA awards in Kalauao are within the present study area, as shown on the previous Figure 24 and summarized in Table 9.

Table 9. Land Commission Awards in Kalauao

LCA	Awardee	'Ili	LCA	Awardee	'Ili
2494:1-2	Julia Kekoa	Ka'ōnohi	6184	Ino	Ka'ōnohi
5581:2	Kalaimanuia	Ka'ōnohi	8525 B:3	Kauwa, J.A.	Waieli, Kainakoi
5840:1	Kuahao	Ka'ōnohi	9288:1-2	Kaina	Ka'ōnohi
5910	Piko	Ka'ōnohi	9296:1	Ino	Ka'ōnohi
5934:1	Piko	Ka'ōnohi	9297	Kanikela	Ka'ōnohi
6156:1-2	Nua	Ka'ōnohi	9302	Aluli(Kukai)	Ka'ōnohi
6156 B:1-2	Mahoe	Ka'ōnohi	9400:1-2	Hilo for Kaoio	Ka'ōnohi

The largest award in Kalauao (LCA 5524; 1603 acres), for half the 'ili of Ka'ōnohi, went to Laura Konia, the ninth largest landholder in the Kingdom. She was a daughter of Pā'uli Ka'ōleiokū, reputed *po'olua* (child with "two fathers") son of Kamehameha I and Kalaniōpu'u by Kānekapolei (Kame'eiehiwa 1992:228). Thus, she was either a granddaughter or grandniece of Kamehameha the Great. She was also the mother of Bernice Pauahi Bishop, who inherited the lands at her mother's death.

She received 22 *ahupua'a*-sized lands in the Hawaiian Islands, of which she relinquished 11 back to the Kingdom by way of taxes. She was given the west side of the large 'ili of Ka'ōnohi (Barrerè 1994:372), which stretched from the coastal trail to the *mauka* boundary of Kalauao at the Ko'olau Mountains. The fact that she retained her Kalauao lands suggests she may have regarded them as particularly good lands.

The second largest landholder at Kalauao was John Meek, an important merchant involved in the early sandalwood trade, who was awarded a long narrow strip of 1,300 acres on the east side of Kalauao Ahupua'a (Kuykendall 1967:435). This is presumably the eastern section of the large 'ili of Ka'ōnohi, although this is not labeled on any available historic map. Little data are supplied in association with Meek's claim, but it appears he resided there from 1824 to 1853. The Native Register account supporting his Kalauao lands claim is given below:

N.R. 768v3 No. 591, John Meek, Parcel 6

I, Kamehameha III, the King of the Hawaiian Islands, do hereby give a certain parcel of land, bounded as follows: The stream in the middle of Kalauao is the

boundary on the west, there also it adjoins the leased land of John Meek. The division between Kalauao and Aiea is the boundary on the east. The highway is the makai boundary and the mountain is the mauka boundary. The length measured from the highway is one hundred and ninety six fathoms. To John Meek and his heirs born under the King of Hawaii and living in these islands. This land shall not be conveyed to a foreigner, nor shall spirit be distilled or vended on said land, but he shall live on it in righteousness under the law of the land. In witness whereof I set my hand in Honolulu on this day.

KAMEHAMEHA III (seal)

Only one other land award at Kalauao was greater than 5 acres. This land, LCA 5365, was awarded to Colonel William Stevens. His claim follows:

No. 5365, K.U. Giwini /William Stevens/ February 2, 1848 N.R. 44-45v5 To the Honorable and Esteemed Land Commissioners, Greetings: I, Colonel William Stevens, have thought of telling you correctly of my claim for land, in accordance with the law which designated Ministers for the Government and which says for claimants to petition for their land claims. Therefore, I hereby petition for my land claim which was from King Kamehameha III, as follows: Paaiau 'Ili in the Ahupua'a of Kalauao, Ewa, Island of Oahu, described as follows: North, Kauapooli and Keahua, along the Muliwai, south, the edge of the sea of Kapaeli and the edge of the sea of Kapuai, east, Kauapoi and the kula from thence to the far upland of the pali [cliff] of Koolau, south, the edge of the kula of Aiea, north, the edge of the kula of Kalauao. The nature of the kula on the west of Paaiau, is that the people must wade in the sea outside the western boundary of this 'ili. Colonel William Stevens N.T. 428v10 No. 5365, Wm. E. Stevens (he is U.K. Guvini) Wm. Stevens land distribution. Paaiau 'Ili for Kalauao, Ewa, Oahu [Kalauao] True Copy Honolulu, 11 November 1854 A.G. Thurston, Chief Clerk [Award 5365; R.P. 5687; Paaiau Kalauao Ewa; 1 'āp.; 62.15 Acs]. [Native Testimony 1847]

William Poomuku Stevens claimed Pā'aiau, an 'ili of Kalauao, as his Māhele award. Kame'eiehiwa (1992:280) lists Stevens as a mid-level *ali'i*. Of his award, Stevens notes, "The nature of the *kula* on the west of Paaiau is that the people must wade in the sea outside the western boundary of this 'ili" (Barrerè 1994:554).

Most of these early landowners probably planted taro and other crops along the streams and springs and used the *kula* as pasture. It has already been noted that John Meek used his land in Kalauao as a cattle ranch. In addition, Lincoln McCandless imported Angora goats to Hawai'i in 1898 and put them with some other goats to improve his stock on some land he owned in Kalauao, but "his purpose was foiled by the destruction brought about by dogs, who used to get into the pens at night, as many as 50 goats being killed in one night" (Marques 1906:52).

Kalauao Ahupua'a had a relatively high density of *kuleana* LCAs within the west half of the study area with a notably lower density north and east of McGrew Point (see Figure 24). All things being equal the archaeological resources relating to traditional Hawaiian occupation might be expected to reflect this.

3.2.10 'Aiea and the Division of Lands

'Aiea Ahupua'a had a relatively narrow coastal exposure limited to the northeast side of 'Aiea Bay of East Loch (see Figure 4)

The *ahupua'a* of 'Aiea was initially awarded to Charles Kana'ina, a friend of Kamehameha I and the father of Lunalilo (Kamehameha IV). He returned this land to the Crown. Thirty claims were made in 'Aiea, and 20 were awarded. All of these were small claims ranged from 0.56 to 2.67 acres in size. Eight LCA parcels in 'Aiea are within the study corridor, as shown on the previous Figure 24 and summarized in Table 10.

The northeast side of 'Aiea Bay in 'Aiea Ahupua'a had a notable density of *kuleana* LCA parcels; all things being equal, the archaeological resources relating to traditional Hawaiian occupation might be expected to reflect this.

Table 10. Land Commission Awards in 'Aiea

LCA	Awardee	'Ili	LCA	Awardee	'Ili
1990	Naihe	Kepoho	2141	Keapoahiwa	Kapakai
2052	Kekoanui	Kapalakai	5918	Pua	Kealapii
2054	Kaapuni	Kalawaha	7344:1-2	Kulani	Kaomuoiki, Waihiluna
2102	Kaohe	Kalokopaoa	9337:	Pua	Kealapii

3.2.11 Hālawa and the Division of Lands

The north boundary of Hālawa Ahupua'a lies along the northwest side of Aloha Stadium and the portion of the study area to the southeast end of the study corridor. The existing Halawa WWPS and the proposed Halawa WWPS lie within Hālawa.

Sometime after Kamehameha conquered O'ahu in the battle of Nu'uaniu in 1795, he gave his most trusted foreign advisors, Isaac Davis and John Young, some lands as a reward for their loyal service to him. As part of this award, each one received half of the *ahupua'a* of Hālawa. As was the usual custom at the time, the king divided the land among his chiefs who supported him throughout his conquests of the islands.

These lesser chiefs (Young and Davis) were allowed to work the land as long as they lived. But, as was the traditional custom, upon their death the land reverted back to the *ali'i nui*. This rule held true even for these two most faithful advisors. John Young tried to make his lands inheritable by requesting that his children, and those of Isaac Davis, whom he had adopted, be allowed to retain the lands given to him by the king upon his death. Even by the late date of 1834, Kamehameha III refused to honor Young's request. It is interesting to note that even though his request was denied, in the Māhele, John Young's children were allowed to keep lands as *'āina ho'olina* or inherited lands. Lilikalā Kame'eleihiwa notes that in all of the Buke (book) Māhele, these were the only lands given under this designation (Kame'eleihiwa 1992:60).

Prior to John Young's death in 1835, he attempted to make his lands inheritable by willing Hālawa to his daughter, Grace Kama'iku'i. His will states,

. . . in behalf of my deceased friend Isaac Davis and for his children as he died without will, the King Kamehameha gave me all the said Isaac Davises [Davis'] lands to take care of them and his children until the children came of age, and now they are come of age so I think it right to leave my last wishes and will that the King, Ka'ahumanu, Adams and Rooke and all the Chiefs will let Isaac Davises children keep their father's lands that King Kamehameha gave to him as a reward for assisting the King in his wars in conquering the islands of Hawai'i, Maui, Molokai, and O'ahu, and which we have an undoubted right to leave to our children, which I hope in God our young king will fulfill the wishes of his honored father. My own lands, I wish my children to enjoy as I have done, likewise my wife . . . [Claim: #595 F.R. 67-72 V2]

Kekūanaō'a ended up with Davis' Hālawa portion (LCA 7712) at the end of the Māhele and Grace Kama'iku'i Young Rooke (John Young's daughter) retained the John Young portion (LCA 8516-B). Isaac Davis' portion of Hālawa passed from Kekūanaō'a to Ruth Ke'elekōlani and on to Bernice Pauahi Bishop. Upon Bernice's death, her lands become part of the Bishop Estate Trust.

In 1852, Kekūanaō'a wrote a letter to the Minister of Interior requesting that a list of the *kapu* (forbidden) fish for Victoria Kamāmalu's lands on O'ahu be published in the newspaper. The *kapu* fish for Hālawa was the 'anae or full-sized mullet (Kekūanaō'a 1852).

In 1862, Mataio Kekūanaō'a and Kama'iku'i Rooke (John Young's daughter) leased a portion of *ahupua'a* of Hālawa to a Manuel Paiko of Honolulu for the purpose of cattle ranching (Boundary Commission Liber 9:174-179).

In 1866, Kama'iku'i willed to her sister, Fanny Na'ea, her interest in her portion of Hālawa.

In 1879, Fanny gave her interest of Hālawa to her daughter, Emma Kaleleonālani Na'ea Rooke, Queen of Kamehameha IV, by way of a deed, which stated,

. . . the undivided ½ interest of and in to the Ahupua'a of Hālawa situate in 'Ewa, Island of Oahu, and more fully described in Royal Patent 6717 to Grace Kamaikui and being the same premises devised to me the said Fanny Young Kaleleonalani by the said Grace Kamikui. [Boundary Commission, Liber 59:285]

Fanny died one year later in 1880. A listing of *konohiki* lands on the island of O'ahu reflects the joint tenancy of Hālawa. Both Ruth Ke'elekōlani and Queen Emma are listed as owners. The document also lists the lands on O'ahu that abut the ocean, including the length and whether the land is a lagoon, reef or open sea. The length of the land abutting the sea at Hālawa is 8.52 miles and it is listed as being a reef and a lagoon (Interior Department Letters, Document No. 15). Five years later, Queen Emma died in 1885, leaving no heirs. All of her lands became part of the Queen Emma legacy.

Throughout the years, there seems to have been dispute over the joint tenancy of Hālawa between the families of Kekūanaō'a and Young. In 1888, after a new survey was completed, Sanford B. Dole settled the matter by giving the northern portion of Hālawa to the Bishop Estate and the southern portion to the Queen Emma Trust. From this time on, the boundaries have been distinct and the two portions recognized independently of each other.

Besides the two *konohiki* awards to Kekūanaō‘a and Grace Kama‘iku‘i Young Rooke, 26 commoner lands were claimed in Hālawā and 19 were awarded. The *kuleana* awards ranged from 0.16 to 3.9 acres in size. There is only one *kuleana* LCA award in Hālawā within the study corridor as depicted in the previous Figure 24 and summarized in Table 11.

This low density of LCA awards within this portion of the study area suggests an attendant low density of archaeological resources relating to traditional Hawaiian occupation.

Table 11. Land Commission Awards in Hālawā

LCA	Awardee	‘Ili
2156:3	Opunui	Kaloiki, Piomoewai

3.3 Ranching

The development of the huge sugarcane plantations that would come to dominate life in the study area was actually later than many might think. The Ewa Plantation Company was founded in 1890 (last date 1970) and the Oahu Sugar Company was founded in 1898 (last date 1994) (Dorrance and Morgan 2000:41). While rice cultivation was earlier, and of surprisingly large extent, it tended to be a relatively compact crop along the stream-fed coastal margins of ‘Ewa. The uplands of Ewa, and most of the lands of ‘Ewa, were in ranching for most of the 1800s.

3.3.1 Ranching in Lower Honouliuli

While most ranch lands were at least a little upslope, Honouliuli Ahupua‘a (including the west end of the study area) included many areas of ranch land on the flat coastal ‘Ewa plain.

In 1871, John Coney rented the lands of Honouliuli to James Dowsett and John Meek, who used the land for cattle grazing. In 1877, James Campbell purchased most of Honouliuli Ahupua‘a—except the ‘ili of Pu‘uloa—for a total of \$95,000. He then drove off 32,347 head of cattle belonging to Dowsett, Meek, and James Robinson, and constructed a fence around the outer boundary of his property (Bordner and Silva 1983:C-12). He let the land rest for one year and then began to restock the ranch, so that he had 5,500 head after a few years (Dillingham 1885 in Frierson 1972:14).

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

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

undisturbed because they kill the growth of mimosa bushes, which would otherwise overrun the country and destroy the pasturage for cattle. [Briggs 1926:62–63]

In 1880-1881, the Honouliuli ranch was described as follows:

. . . Acreage, 43,250, all in pasture, but possessing fertile soils suitable for agriculture; affords grazing for such valuable stock. The length of this estate is no less than 18 miles. It extends to within less than a mile of the sea coast, to the westward of the Pearl River inlet. . . . There are valuable fisheries attached to this estate . . . [Bowser 1880:489]

From Mr. Campbell's veranda, looking eastward, you have one of the most splendid sights imaginable. Below the house there are two lochs, or lagoons, covered with water fowl, and celebrated for their plentiful supply of fish, chiefly mullet. . . . Besides Mr. Campbell's residence, which is pleasantly situated and surrounded with ornamental and shade trees, there are at Honouliuli two churches and a school house, with a little village of native huts. [Bowser 1880:495]

Most of Campbell's lands in Honouliuli were used exclusively for cattle ranching. At that time, one planter remarked "the country was so dry and full of bottomless cracks and fissures that water would all be lost and irrigation impracticable" (Ewa Plantation Company 1923:6–7). In 1879, Campbell brought in a well-driller from California to search the 'Ewa plains for water, and the well, drilled to a depth of 240 ft near Campbell's home in 'Ewa, resulted in "a sheet of pure water flowing like a dome of glass from all sides of the well casing" (The Legacy of James Campbell n.d. in Pagliaro 1987:3). Following this discovery, plantation developers and ranchers drilled numerous wells in search of the valuable resource.

3.3.2 Ranching in the Uplands of 'Ewa

Between 1861 and 1873, parcels of Waiawa were leased to Valdemar Knudsen for use as grazing lands for livestock. A 50-year lease and leaseholds were granted to James Robinson in 1868. After James Robinson's death in 1890, his son, Mark P. Robinson, acquired a 25-year lease. Overwritten on the lease was the "permission granted to assign the lease to the Oahu Railway and Land Company" (Hawai'i Bureau of Land Conveyances 115:496). This lease was subleased from Oahu Railway and Land Company to the Oahu Sugar Company for 43 years on 1 January 1897. It is probable that much of the upper grasslands of Hō'ae'ae, Waikele, Waipi'o, and Waiawa were all used for cattle pasture.

Sereno Bishop stated that his father was the first to bring cows to 'Ewa:

Waiawa valley above us lay knee deep with the richest of grass, where our cows rioted. Out goats took to the higher ground, where they flourished, being driven in and penned at night. . . . The herd gradually multiplied and in a few years became large. [Bishop 1916:42]

These herds contributed to the deforestation of the upper valley, as noted by Bishop:

There was a very passable road down Ewa and Waianae way. Once while making the trip down to Waialua, to which there was a good horse trail, I discovered that even at that early day [ca. 1858] that cattle had made great inroads into the forests

of ti plants which had theretofore clad the foothills and upland pasturages, even to the highest tracts. [Bishop 1916:60]

Subsequent to Western Contact in the area, the landscape of the 'Ewa plains was adversely affected by the removal of the sandalwood forest, and the introduction of domesticated animals and new vegetation species. Domesticated animals, including goats, sheep and cattle, were brought to the Hawaiian Islands by Vancouver in the early 1790s, and allowed to graze freely about the land for some time after. It is unclear when the domesticated animals were brought to O'ahu; however, L.A. Henke reports the existence of a longhorn cattle ranch in Wai'anae by at least 1840 (Frierson 1972:10). During this same time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the logging of sandalwood forest and eroded by animal grazing. Within the current study area, the majority of the (non-cultivated) vegetation is comprised of introduced species, mainly grasses.

A long narrow strip of 1,300 acres on the east side of Kalauao Ahupua'a was awarded to John Meek in the Māhele. John Meek was an important merchant involved in the early sandalwood trade (Kuykendall 1967:435). He and his brother Thomas Meek were Massachusetts ship captains who ran the early trade route between the Northwest Coast and China. They traded furs and other products from the Pacific Coast for luxury goods such as silk and ceramics in China and made stops at Hawai'i for water, food, and salt, and other supplies. Sandalwood, whose fragrant wood was used for boxes and incense, was one of the few products the Chinese would accept in trade for their goods. When it was discovered that there were large stands of the trees in Hawai'i, the islands became not only a resupply stop, but also a place where goods could be gathered and sold.

John Meek's first trip to Hawai'i was in 1809, and there are accounts of him trading directly with Kamehameha I. In 1819, Meek was a captain of the *Peddler*, which was owned by the fur trader John Jacob Astor. He landed in 1820 in Honolulu with a cargo of "gin, brown sugar, cloth and other goods" and left the islands with a cargo of 191 piculs (wood measurement) of sandalwood obtained by trade with the king of Kaua'i (Bockstoe 2005:32). John Meek decided to make Hawai'i his home in 1824, and eventually he became a pilot and harbor master of Honolulu Harbor (Joerger 1982:75–76). He married two Hawaiian women, Elizabeth Kaluapapohana Betsy Kamsi and Kepookalani, daughter of Unualoha and Kaikainalii (Kane 2009). Betsy (Elizabeth) may have been a daughter of the Spaniard Don Francisco de Paula Marin (Gast and Conrad 1973:144), another early friend of Kamehameha I, who was awarded a large land claim in Waipi'o in 'Ewa. Meek was one of several early ship captains who settled in Hawai'i and were given large land awards for their service to the Hawaiian government and for their friendships with early Hawaiian monarchs.

Meek brought a bull and three heifers to Hawai'i in 1832, the nucleus for a cattle ranch on his land, and in the 1850s brought in sheep, which were probably bought from the Hudson Bay's holding at Puget Sound (Lomax 1940:44). Meek was known for his hospitality and maintained friendships with members of the royal family. He was known as "The Lord of Lihue Ranch" (Taylor 1922:221). In addition to owning lands in Kalauao, he also leased land in the uplands of 'Ewa and Wahiawā. In 1856, he rented the 2,829.20-acre award given to the *ali'i* Luluhiwalani (Māhele Award 4) in Waikele, and used the land as part of his ranch. His main ranch house was in the uplands of Honouliuli and is marked on several early maps. There is no corresponding house

site shown on maps for his Kalauao lands, so it is possible he used his Kalauao estate mainly as grazing land for his cattle and horses.

In 1858, King Liholiho and Queen Emma stopped at Meek's ranch during a 13-day trip to 'Ewa. They had taken a steamer to Pearl Harbor and then rode in carriages or on horses on the 8-mile trip to Meek's ranch house in Honouliuli. The next day they rode 25 miles to Kahuku on the windward side of the island to the home of Francisco de Paula Marin (Kanahale 1999:83). These royal excursions were often accompanied by women *pā'ū* (skirt worn by women horseback riders) riders, in their colorful split skirt riding outfit. As one author remembered,

This recalls the days when Captain Meek controlled Lihue and Wahiawa on Oahu under lease from the government. He raised thorough-bred horses and his daughters rode the finest in the land. The Meek animals were known all over the Islands, especially his white horse called 'Pu'a.' His oldest daughter Eliza was often seen riding the horse through the streets of Honolulu garbed in a wonderful pa-u, with a dozen or more followers riding behind her wearing the same color of garment. Eli Meek, his son, was a magnificent horseman and the beau of the day. His youngest daughter, Becky, married Horatio Crabbe, chamberlain of Kamehameha [I] and Lunalilo [Kamehameha II]. [Taylor 1922:223]

Meek is also noted as the man to bring the first turkey to the islands, to plant the first mango tree (Thrum 1900:60), and the first to bring a large land tortoise to the Islands, which he kept as a curiosity at his Honolulu home (Thrum 1904:73). He died and was buried in O'ahu Cemetery in 1875 (Kane 2009).

John Meek was 'noted for his probity of character and genial disposition,' was a friend and adviser of chiefs, and introduced improved breeds of cattle and horses to Hawaii. John Jacob Astor is said to have thought so highly of him as to build a ship especially for this command. [Kamakau 1992:251]

3.3.3 Ranching in Hālawā

In 1862 Kama'iku'i Rooke and Mataio Kekūanaō'a leased much of Hālawā to a Manuel Paiko, a Portuguese rancher (Klieger 1995:76). The lease document reads that the boundaries begin at "a small brook which forms the boundary between Hālawā and Moanalua" and continue "along the ridge of the mountain bordered on the north by 'Aiea and Kalauao, and on the west by Ko'olau, to the top of a peak called Aloheo; which forms the boundary between Moanalua and Hālawā." The leased area consisted of approximately 10,000 acres. However, excluded from the lease was the "sea, the lagoons, the fish and all ponds, the enclosed *kalo* lands, all kuleanas awarded by the Land Commission, and so much of the *kula* lands adjoining the pond Ka Waiaho." The lease was taken out for 15 years with a rent of \$500 per year (Boundary Commission, Liber 9:174–179). Manuel Paiko took on a business partner, James Dowsett of 'Ulupalakua Ranch fame. By 1870, their herd consisted of 1,400 head (Boundary Commission, Liber 29:239). James Dowsett and another partner, J.R. Williams, tried unsuccessfully to raise sugar. Due to lack of a railroad to haul cane and the mill burning down three times, they gave up trying to raise sugar in 1875. Altogether, about 100 acres had been planted in cane (Condé and Best 1973:327).

3.4 Rice Cultivation in Former Taro Fields

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

The Hawaiian Islands were well-positioned for rice cultivation. A market for rice in California had developed as increasing numbers of Chinese laborers immigrated there since the mid-nineteenth century. Similarly, as Chinese immigration to Hawai'i also accelerated, a domestic market opened.

Considerable effort has been made to induce the natives to be more industrious to cultivate the soil and particularly to try to [sic] the cultivation of rice . . . Foreigners too have begun the culture of rice in this district extensively and it was hoped their example would stimulate the natives to cultivate their own lands, but most of them choose to hire themselves to the foreigners at low wages and put their lands in the hands of the foreigners for a few dollars rather than cultivate or improve it themselves. [Mission Station Report 1862:1 in Devaney et al. 1982:49]

Following the completion of their plantation labor contracts, some Chinese immigrants began rice farming, to which they were accustomed in their native land (see Figure 26). Chinese rice farmers acquired lands by leasing small plots of land for individual farms, or by forming *hui* (partnerships) with other farmers and acquiring large tracts of land (Coulter and Chun 1937:17–18). During the height of rice cultivation (ca. 1880–1920), the industry was dominated by Chinese firms who controlled the growing and milling of rice (Devaney et al. 1982:49).

Damon in *The Friend* states that on O'ahu the rice plantations began a few miles west of Honolulu and formed a fringe bordering the shore for a long distance.

Every available inch of ground seemed to be utilized. At Ewa the Chinese had entered in most emphatically, to possess the land and their rice fields stretched in every direction. Towards Waianae there was one rice plantation after another. [Coulter and Chun 1937:20]

By 1885, 200 acres in Honouliuli were used for rice and 50 acres were used to grow bananas (*Pacific Commercial Advertiser*, 15 August 1885, summarized in Silva 1987:A-12). These rice fields were planted in former taro fields or in undeveloped swamps, such as those near the former Honouliuli Taro lands. The rice fields in 1882 were described by Frank Damon, during a tour of the area.

. . . Towards evening we reached Honouliuli, where the whole valley is leased to rice planters . . . This was one of the largest rice plantations we visited. Sometimes two or three men only, have a few fields which they cultivate for themselves, and

we often too came upon houses where there were eight or ten men working their own land. But the larger plantations are owned by merchants in Honolulu, who have a manager acting for them. . . . [Damon 1882:37]

Rice cultivation replaced much of the former taro lands and became widespread in the lowlands surrounding Pearl Harbor. By 1892, approximately 262 acres were under rice cultivation in Waiawa, Mānana, and Waiau, 135 acres in Waimalu, 76 acres in Kalauao and 'Aiea, and 117 acres in Hālawā (Figure 25 and Figure 26) (Coulter and Chun 1937:21). The ancient taro *lo'i* and *'auwai* (irrigation ditches) were modified and expanded to support rice cultivation:

The great demand for rice land brought disused taro patches into requisition—especially because water rights attached to them. Such was the desire of the Chinese to use every piece of land to its fullest extent for paddy that they cut away the paths which the Hawaiians had used between taro patches to strips so narrow that a man could walk along them only with difficulty . . . As the demand for rice continued, it became profitable to bring into use land hitherto unused. The land most easily rendered fit for rice cultivation was swamp or marsh land of which there was a large amount in the islands. Most of such land was at or near sea level—undrained areas at the mouths of streams: lowlands, which could be reclaimed without great expense . . . lands hitherto unused became fields of waving grain. [Coulter and Chun 1937:11]

The following account describes a visit to the rice fields of 'Aiea, ca. 1904:

On the morning of June 2nd, for instance, our destination was Aiea. At ten minutes past seven we boarded the first passenger train going towards Honolulu. For a distance of eight miles the road skirts the shore and then turns landwards or mauka through rice and sugar plantations, Ewa Mill, Waipahu, Pearl City. We reached Aiea at eleven minutes past eight. Like all rice fields in Hawaii, this one is worked entirely by Chinamen, they alone being able to endure the conditions of location and climate necessary for the cultivation of this cereal. On one side of the railroad track was the broad, muddy inland lake or bay of salt water, Pearl Harbor; on the other side were the terraced plots or fields, flooded to a depth of several inches with water and separated by narrow raised earthen ridges on which the careful Chinaman doubtless succeeded in walking, but which many times proved treacherous to our unsteady feet. A rice plantation, laid out as it generally is on the low flats at the foot of a valley, where mountain streams empty into the sea, is an ideal collecting ground for certain kinds of algae. [Tilden 1905:134]

By the early decades of the twentieth century rice farming in the Hawaiian Islands was in decline, beset by crop diseases and cheaper prices for mainland-grown rice. Commercial agriculture in 'Ewa became dominated by sugar with the development of the three sugar companies of 'Ewa (Nedbalek 1984:13).

3.5 History of the Oahu Railway and Land Company (OR&L)

In 1886, Campbell and B.F. Dillingham put together the “Great Land Colonization Scheme,” which was an attempt to sell Honouliuli land to homesteaders (Thrum 1887:74). This homestead idea failed; two factors for the failure were the lack of water and the distance from 'Ewa to

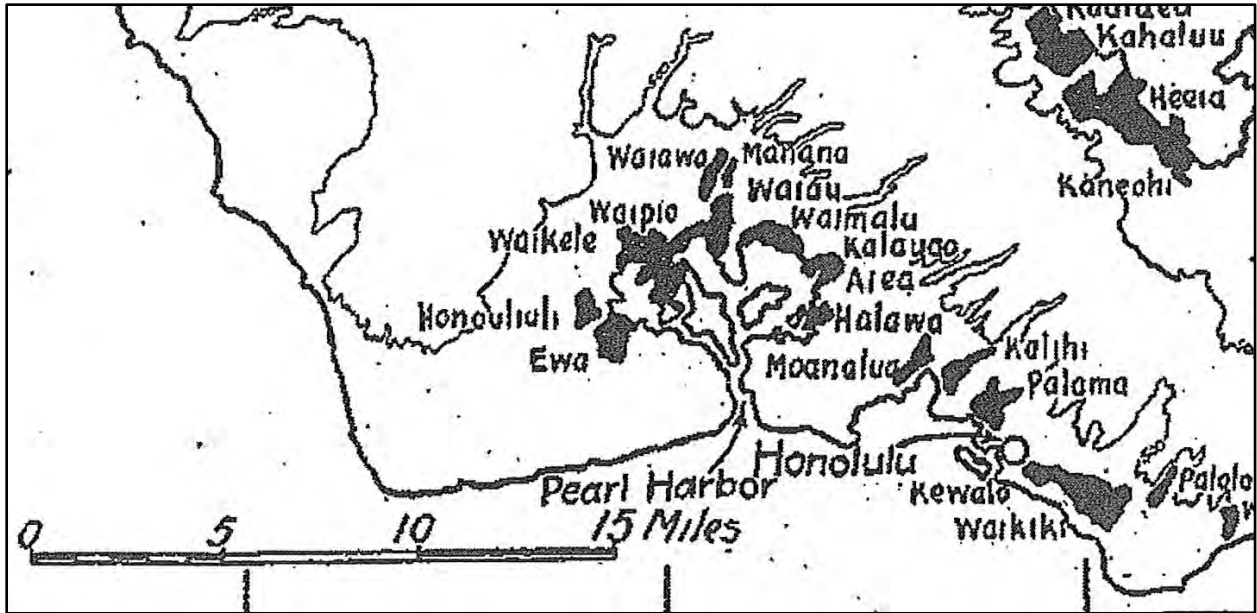


Figure 25. Rice farming districts on south O’ahu in 1892 including Honouliuli, Waikalele, Waipi’o, Waiawa, Mānana, Waiau, Waimalu, Kalauao, ‘Aiea, and Hālawā (adapted from Coulter and Chun 1937:12)



Figure 26. Waikalele rice fields below the Oahu Sugar Company Mill (n.d. Hawai’i State Archives)

Honolulu. The water problem was solved by the drilling of artesian wells, and Dillingham decided the area could be used instead for large-scale cultivation (Pagliaro 1987:4). The transportation problem was to be solved by the construction of a railroad, which B. Franklin Dillingham soon began to finance under the company name of the Oahu Railway and Land Company (OR&L).

During the last decade of the nineteenth century, the railroad would reach from Honolulu to Pearl City in 1890, to Wai'anae in 1895, to Wai'alua Plantation in 1898, and to Kahuku in 1899 (Kuykendall 1967:III, 100). The OR&L line was developed across the present study area very rapidly, mostly in 1890. Particularly in the east portion of the project area, from 'Aiea to Waipi'o, much of the OR&L alignment was developed smack on the coast as shown in Figure 27.

This railroad line eventually ran across the center of the 'Ewa Plain at the lower boundary of the sugar fields. To attract business to his new railroad system, Dillingham subleased all land below 200 ft to William Castle, who in turn sublet the area to the newly formed Ewa Plantation Company (Frierson 1972:15). Dillingham's Honouliuli lands above 200 ft that were suitable for sugarcane cultivation were sublet to the Oahu Sugar Company. Throughout this time, and continuing into modern times, cattle ranching continued in the area, and Honouliuli Ranch—established by Dillingham—was the “fattening” area for the other ranches (Frierson 1972:15).

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

In August 1945, the war ended and so did OR&L's heyday as a military transport line.

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

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

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



Figure 27. 1890 photograph of Pearl Harbor with OR&L railroad tracks along the coast (Honolulu Advertiser Archives)

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

3.6 The Study Area as Depicted on Mid- to Late 1800s Maps

The available assemblage of maps of the study area in the 1800s is something of a hodgepodge but presented collectively in chronological order they provide us with a wealth of detail about the changing study area moving through the last half of the 1800s.

The 1848 Rooke map of Hālawā (Figure 28) depicts the east end of the study area in Hālawā Ahupua'a (extending northwest into 'Aiea Ahupua'a). The stream shown is Hālawā Stream but no associated enterprise is depicted. Three place names are indicated at the mouth of Hālawā Stream, a kilometer west of the southeast end of the study area. The reference to the Loko Kunana fishpond is clear but the other somewhat illegible references ("Kuohou"?, "Keaeponi"?) are obscure (compare with Klieger 1995:61). At the 'Aiea boundary, the place name "Kohaku" is pretty clearly a reference to the Loko Kahakupōhaku fishpond but the reference to "Keinaleia" (spelling uncertain) is obscure. Aside from coastal fishponds no human enterprise is indicated.

The 1851 Bishop map of Waipi'o (Figure 29) depicts the Waipi'o portion of the project area (at the northeast base of Waipi'o Peninsula) and a bit of Waikele Ahupua'a to the west and Waiawa Ahupua'a to the east. The Loko Eo fishpond, crossed by the present study area, and the Loko Hanaloa fishpond, to the east and south of the study area, are prominent and well known landmarks. The seeming call-out of the sea of Waipi'o and the edge of the sea of Waipi'o and the reference ("Kui o He napouli"?) at the northwest corner of Middle Loch are not completely clear. The *Ala Aupuni* or government road is prominent, approximating the alignment of the present day Queen Lili'uokalani Freeway (H-1) west of Kamehameha Highway. Four houses are depicted *mauka* of the study area (three appear in the vicinity of present-day Waipahu District Park). This map depicts a large area for only showing four residences.

The 1872 Lyons map of Kalauao (Figure 30) appears to have been a delineation of the perimeter of this important *ahupua'a* and provides little detail. A place name "Kila" is indicated close to the study area at the Kalauao/'Aiea boundary and three place names are indicated at the coast (west to east, Kuapa, Nukumuliwai, and Kuaana). The meaning of "Kila" is unclear but it may refer to a high place or cliff at the 'Aiea/Hālawā boundary (near the 'Aiea Cemetery). The place name "Kuapa" suggests a *kuapā* or fishpond wall and this would seem to be the location of the Loko Opu fishpond. Nuku Muliwai is a reference to the mouth of Kalauao Stream. The place name "Kuaana" is on the southeast side of McGrew Point and the northwest side of 'Aiea Bay and may be a name for that place.

The 1873 Lyons map of Pearl Lochs and Puuloa Entrance (Figure 31) shows the entire study area. Like many maps of the Pearl Lochs (Pearl Harbor), the focus is much more on the harbor itself than the surrounding area. The fishpond known as "Fresh pond" on Waipi'o Peninsula is depicted but is not called out. An illegible word ("church"?), a path, and possibly two houses are

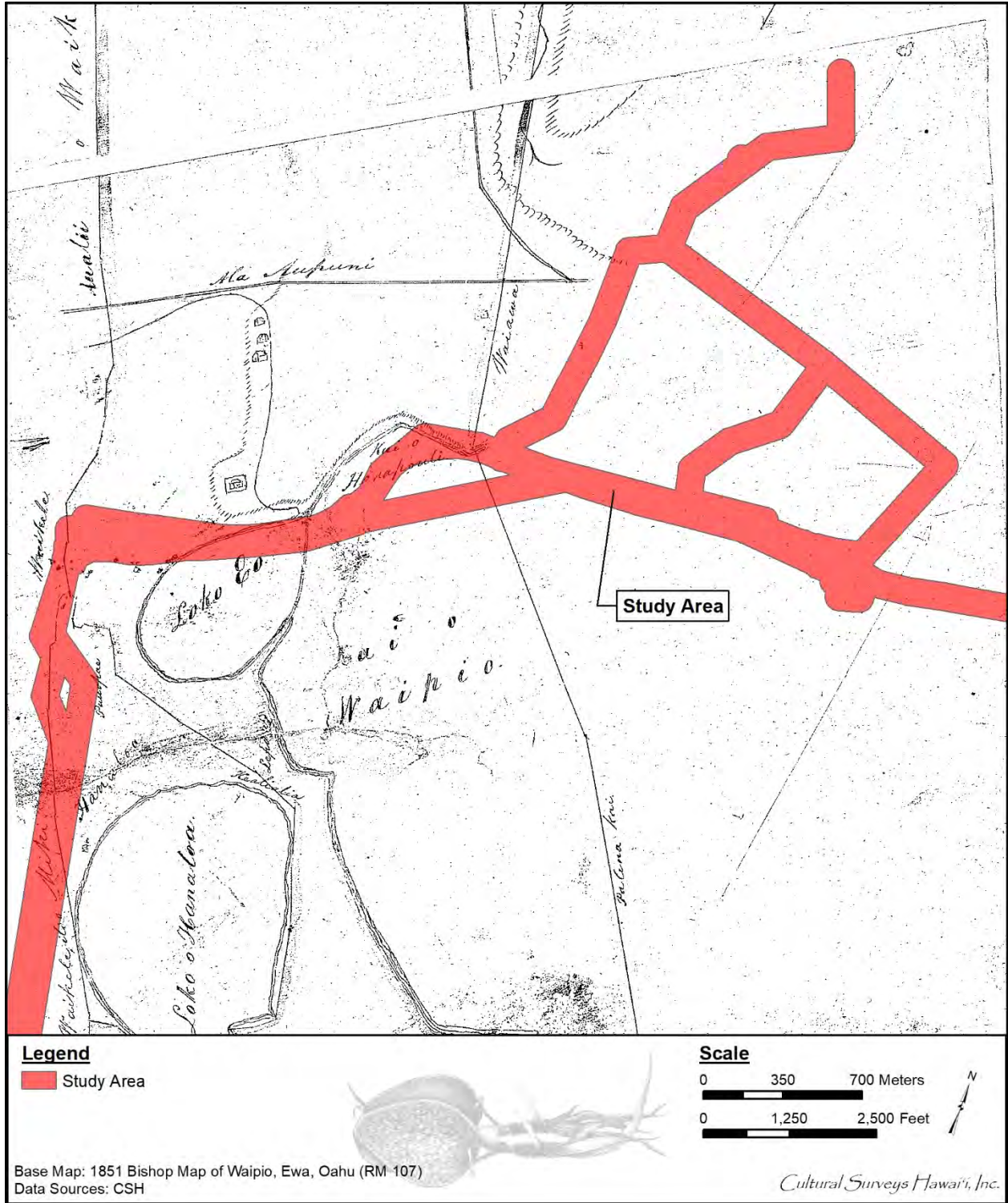


Figure 29. 1851 Bishop map of Waipio, Ewa, Oahu showing the central portion of the study area

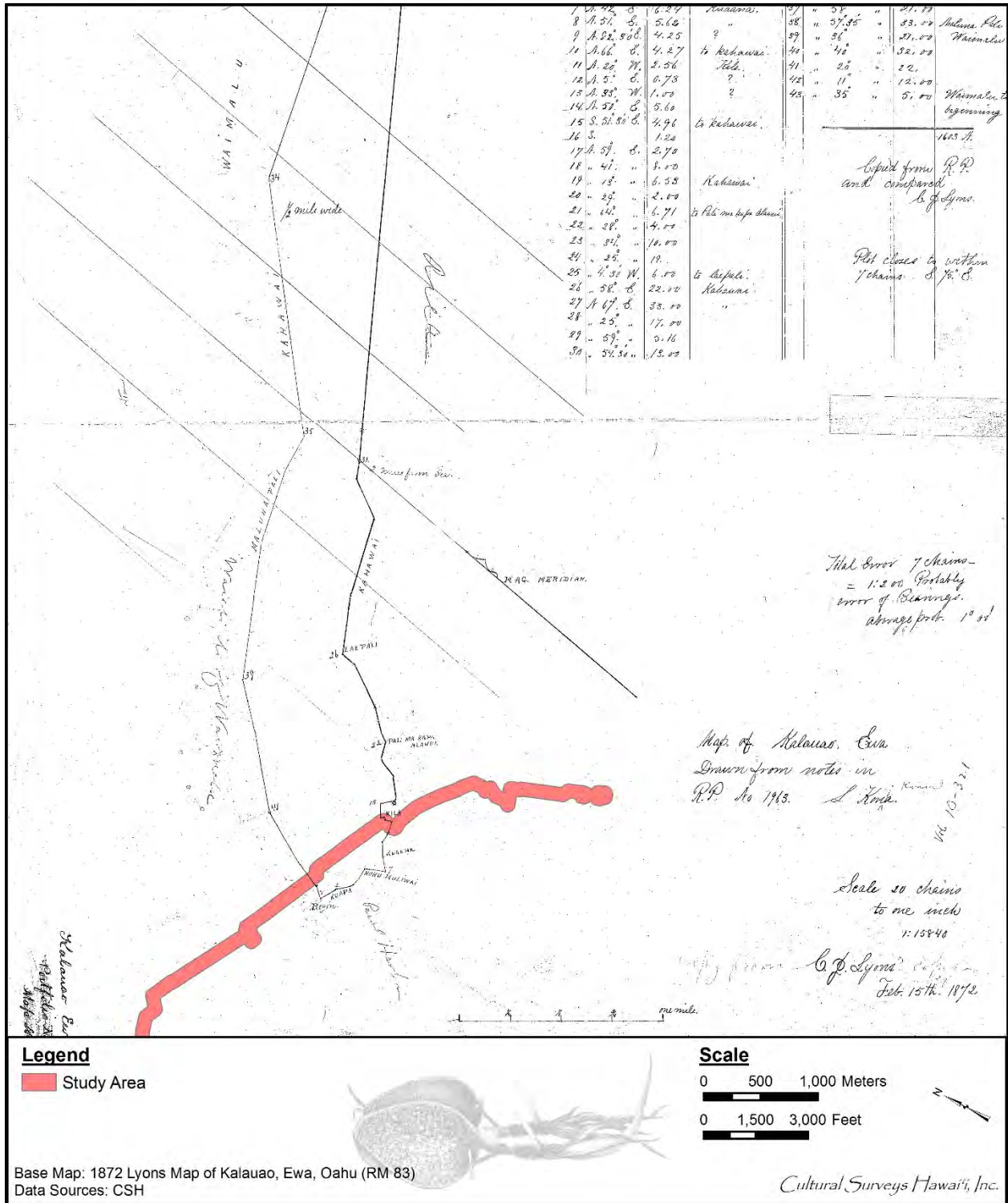


Figure 30. 1872 Lyons map of Kalauao, Ewa, Oahu showing the east end of the project area traversing Kalauao Ahupua'a

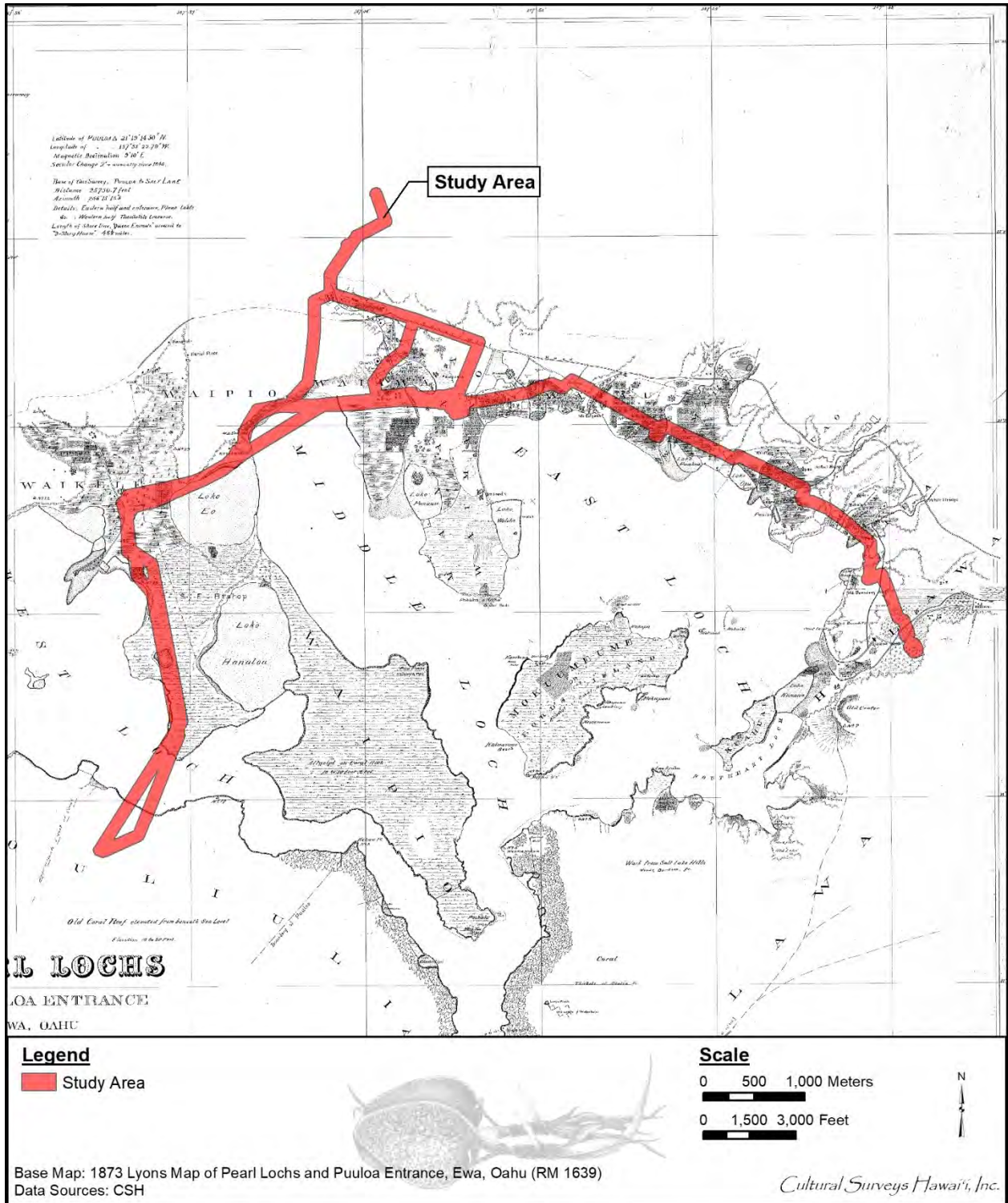


Figure 31. 1873 Lyons map of Pearl Lochs and Puuloa Entrance, Ewa, Oahu showing the study area

depicted near the Waipahu WWPS portion of the study area where it takes a 90° turn east. Loko Eo is prominent at the northeast corner of the Waipi'o Peninsula with taro *lo'i* (or salt pans?) indicated on the west margin of Loko Eo within the study corridor and a house or two (possibly one in the study area) are indicated at the northeast corner of Loko Eo. Houses and fields are indicated near that portion of the study area where Kamehameha Highway meets the *mauka* extension along Waihona Street and to the southeast along today's Kamehameha Highway. The main south shore trail of O'ahu is depicted as roughly following the Kamehameha Highway portion of the present study area. Development is indicated around the Ewa Church on the central of three *mauka* extensions (near the east side of today's LCC campus), and significant agriculture is indicated along the northeast side of East Loch from Waiau to 'Aiea. Again the Hālawa, southeast end of the study area appears to be without enterprise.

The 1873 Alexander map of Honouliuli (Figure 32) depicts the west and central portion of the study area. No enterprise is shown on the southwest (Honouliuli) side of West Loch. The "Fresh Water" pond is within the study corridor on Waipi'o Peninsula. The area west of Eo (Loko Eo) fishpond is shown as a marsh. The Ewa Church is a prominent landmark north of the Pearl City peninsula. The "Road," understood as the main east/west trending trail on the south shore of O'ahu, is depicted as roughly approximating the Kamehameha Highway portion of the study area.

The 1873 Sands map of Pearl Lochs (Figure 33) is somewhat "broad brush" and depicts much the same scene as described above. The Honouliuli portion of the study area is called out as "Coral Rocks Plateau" and lacks development. Waipi'o Peninsula is "Grazing Land." *Lo'i* (or salt pans) are prominent immediately west of Loko Eo. While a kilometer outside the project area, the call-out of a "Burial Ground" north of Loko Eo is of passing interest. A "School House" is called out on the east side of the Ewa Church near the central *mauka* corridor. Fields are indicated in Kalauao (at a place called out as "Kapau") and in 'Aiea (at a place called out as "Kalola"?)

The 1874 Alexander map of the lower part of Waimalu (Figure 34) provides good detail for a small area on the west bank of the Waimalu River in the immediate vicinity of today's Blaisdell Park and the Waimalu WWPS. The entire width of the project area is shown as in "Rice Fields" at that time. Almost certainly this specific area had been in taro cultivation in traditional Hawaiian times.

The 1874 Lyons map of 'Aiea (Figure 35) depicts fields and possibly one house where the study area crosses central 'Aiea Ahupua'a close to the sea. The "Road to Honolulu" approximates the present Queen Lili'uokalani Freeway (H-1) alignment.

The 1875 Alexander map of part of Waikele (Figure 36) provides good detail for the vicinity of the Waipahu WWTP and the adjacent east bank of Kapakahi Stream. Fields associated with the name "Kaohai" are indicated. "Kaokai" is understood as the name of an *'ili* at this location.

The 1877 Brown map of Waipi'o (Figure 37) lacks detail in its depiction of the central portion of the study area. Extensive wetlands are indicated extending *mauka* into the project area northwest of the Pearl City peninsula.

The 1879 Monsarrat map of Waipi'o taro land (Figure 38) provides a great deal of detail for where the present study area crosses Waipi'o Ahupua'a on the east side of Waipi'o Peninsula by Loko Eo. The relationship of the study area to Loko Eo is depicted in detail. The adjacent area to

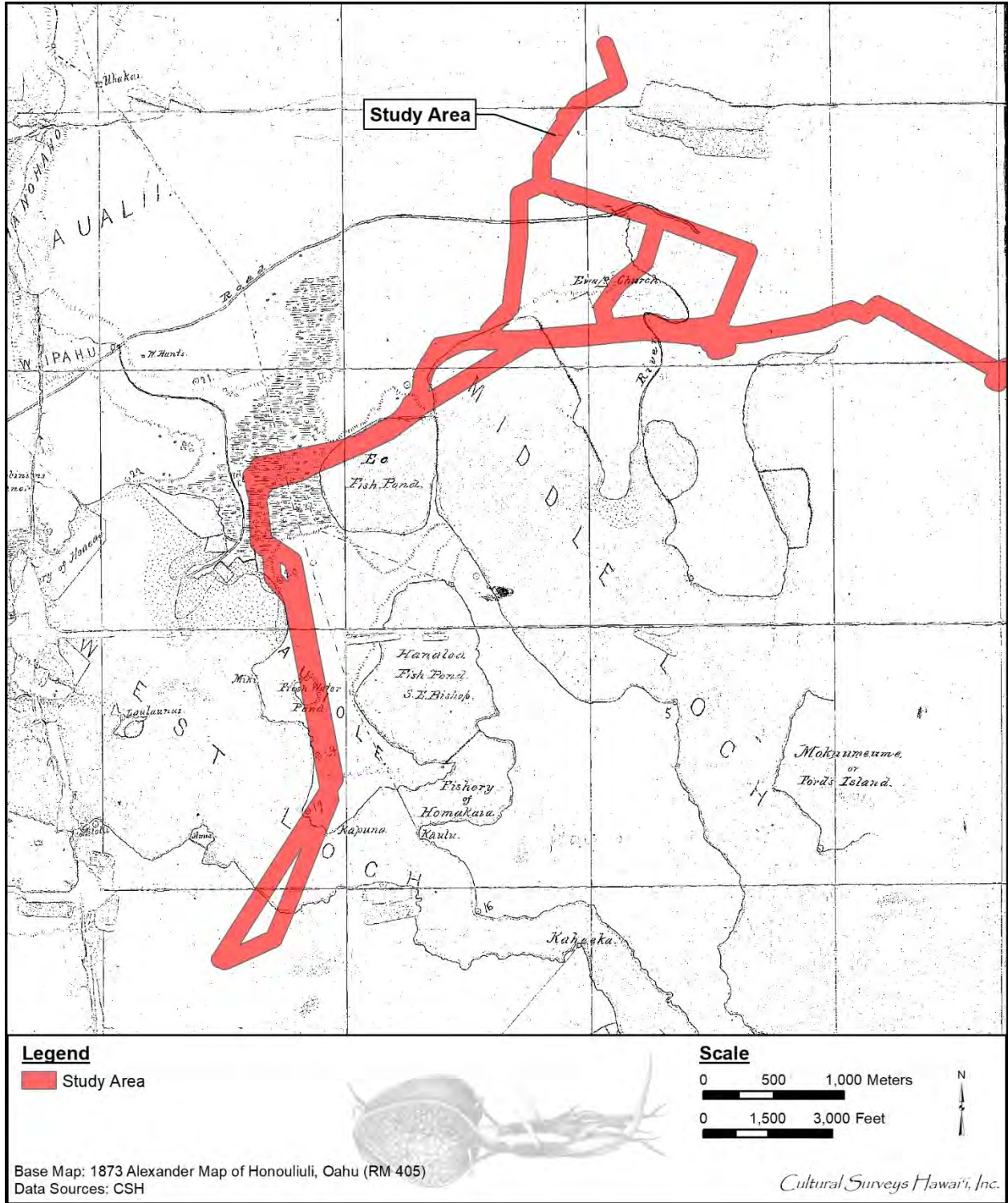


Figure 32. 1873 Alexander map of Honouliuli, Oahu showing the west and central portions of the study area

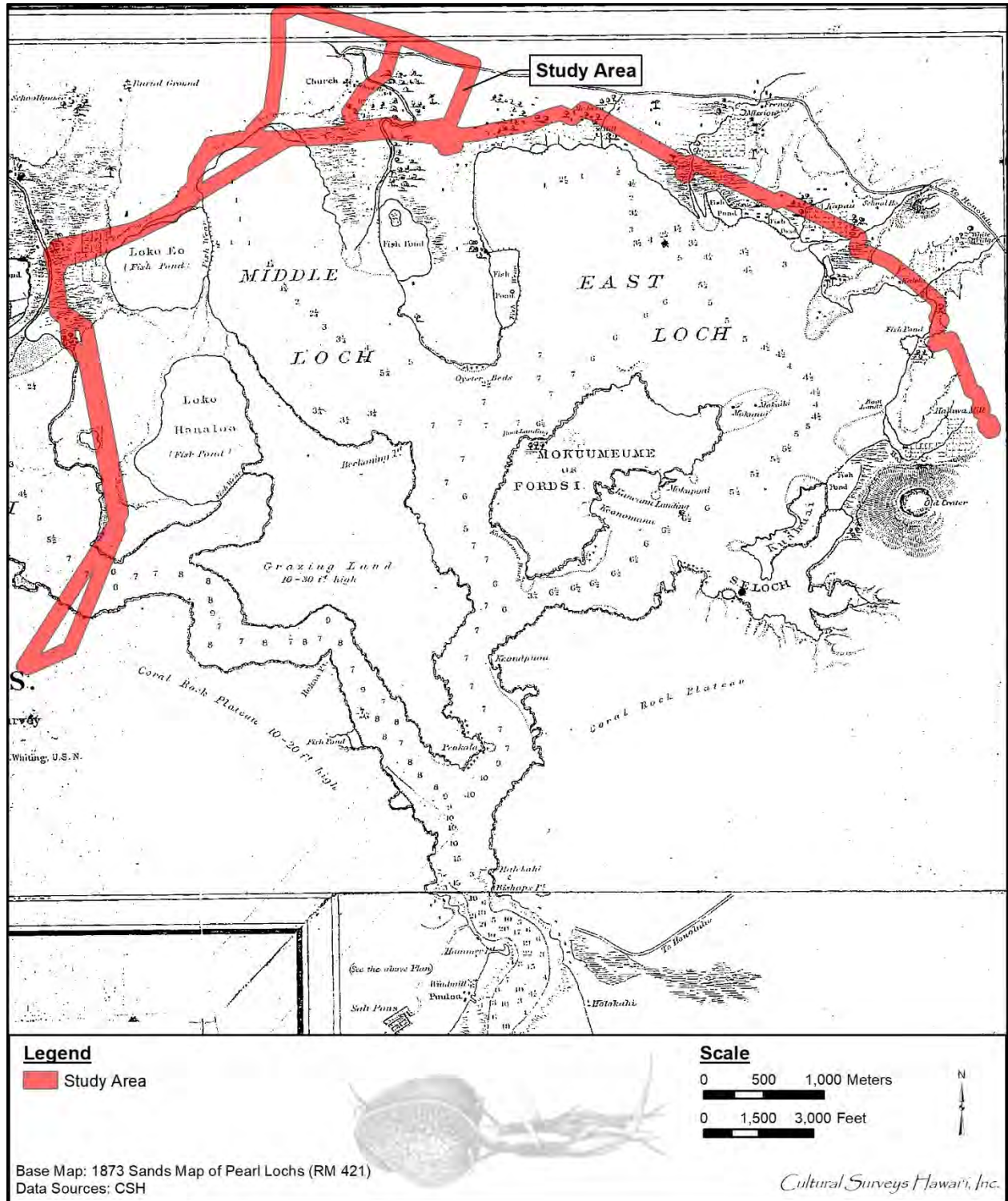


Figure 33. 1873 Sands map of Pearl Lochs showing the study area

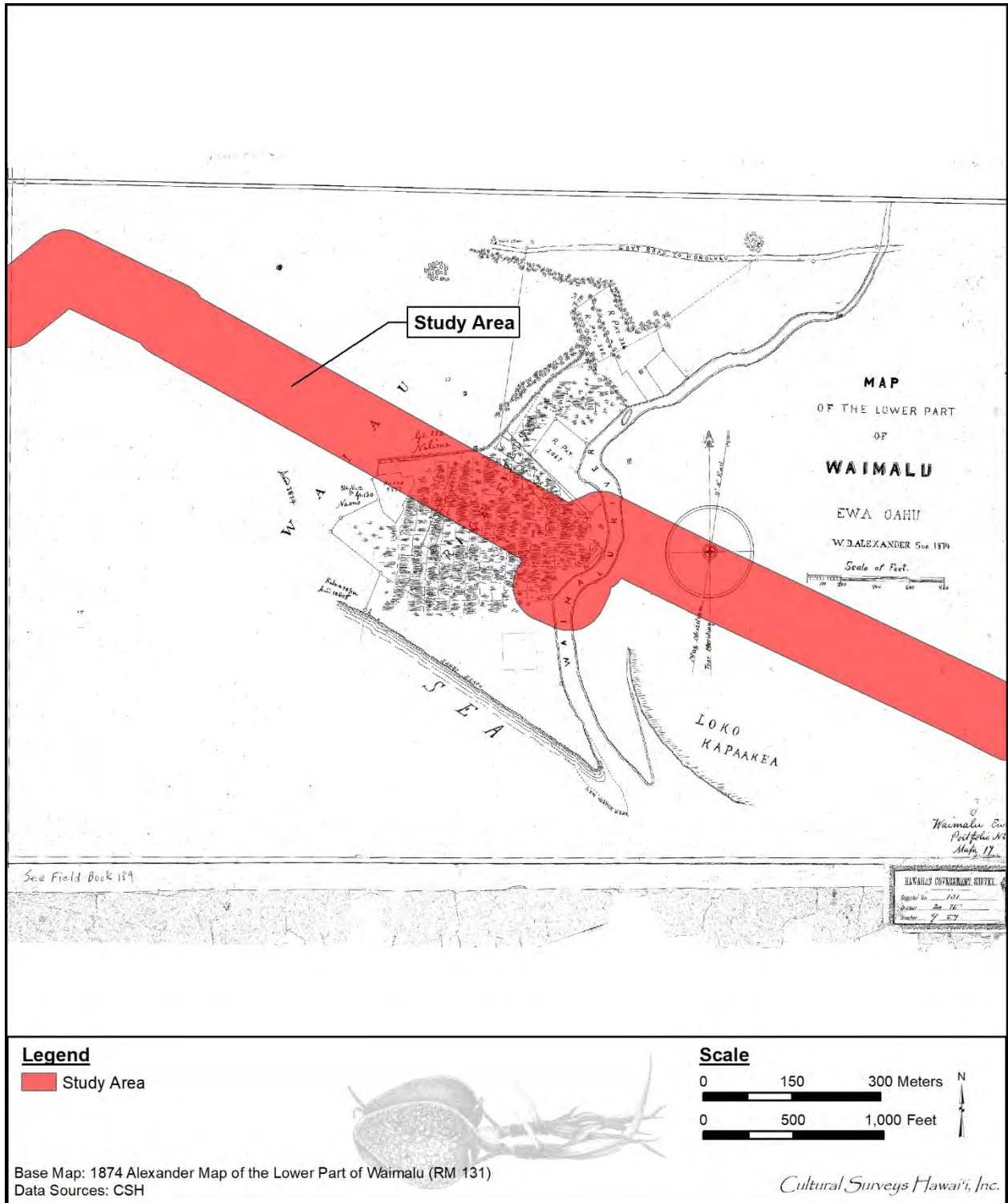


Figure 34. 1874 Alexander map of the Lower Part of Waimalu showing an east portion of the study area in the immediate vicinity of the Waimalu WWPS

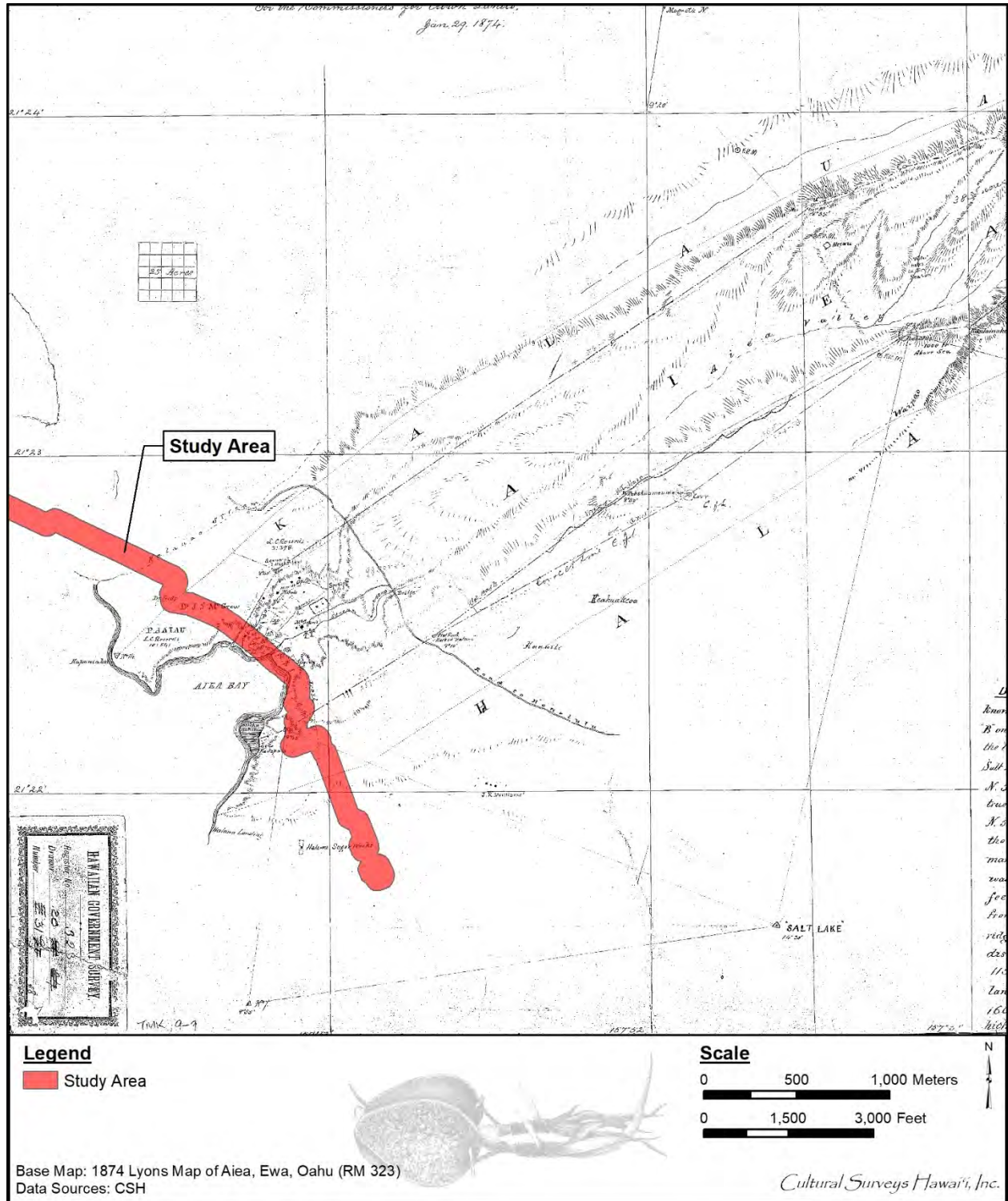


Figure 35. 1874 Lyons map of Aiea, Ewa, Oahu showing the east end of the study area

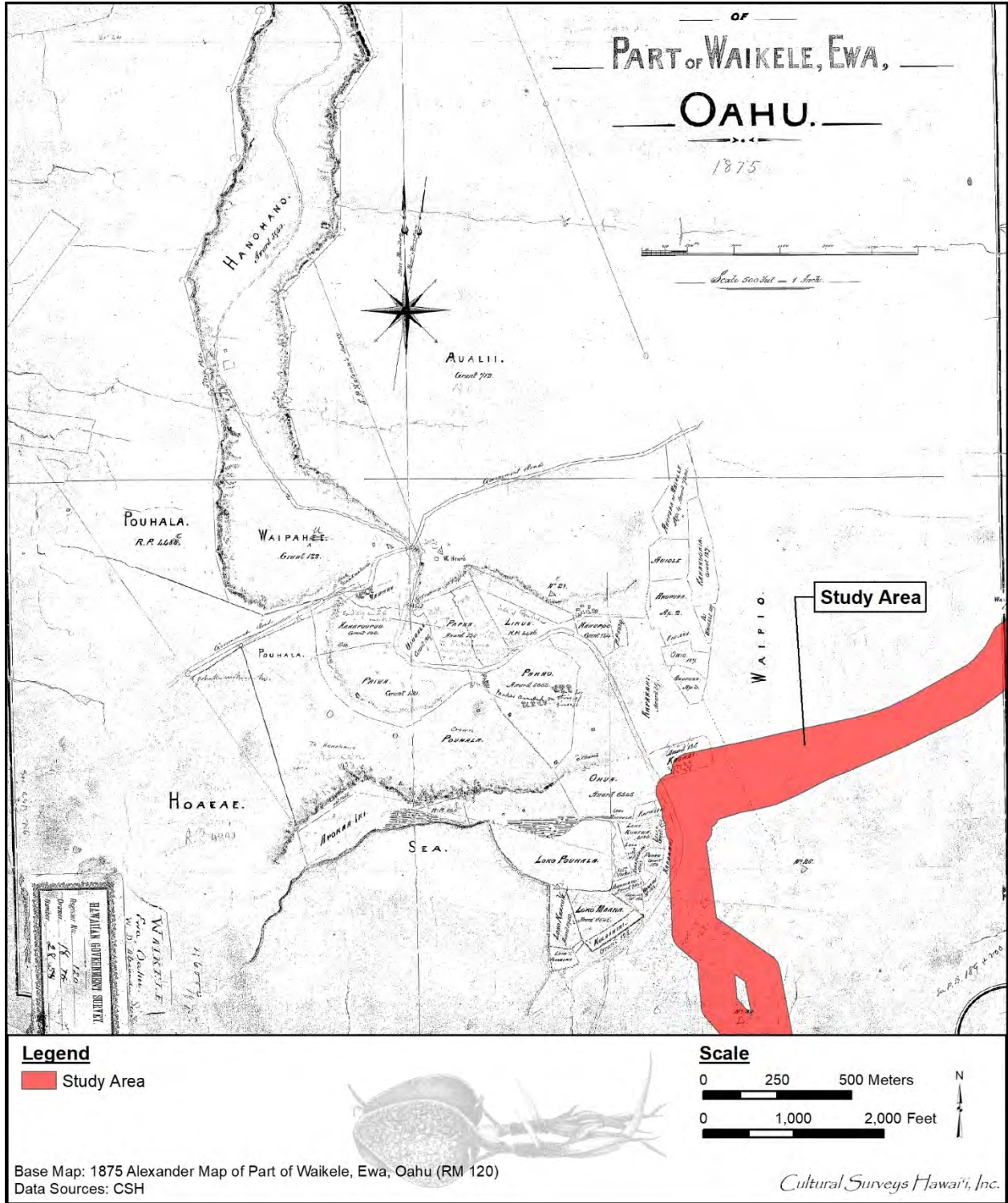


Figure 36. 1875 Alexander map of part of Waikele, Ewa, Oahu showing a west portion of the study area in the immediate vicinity of the Waipahu WWPS

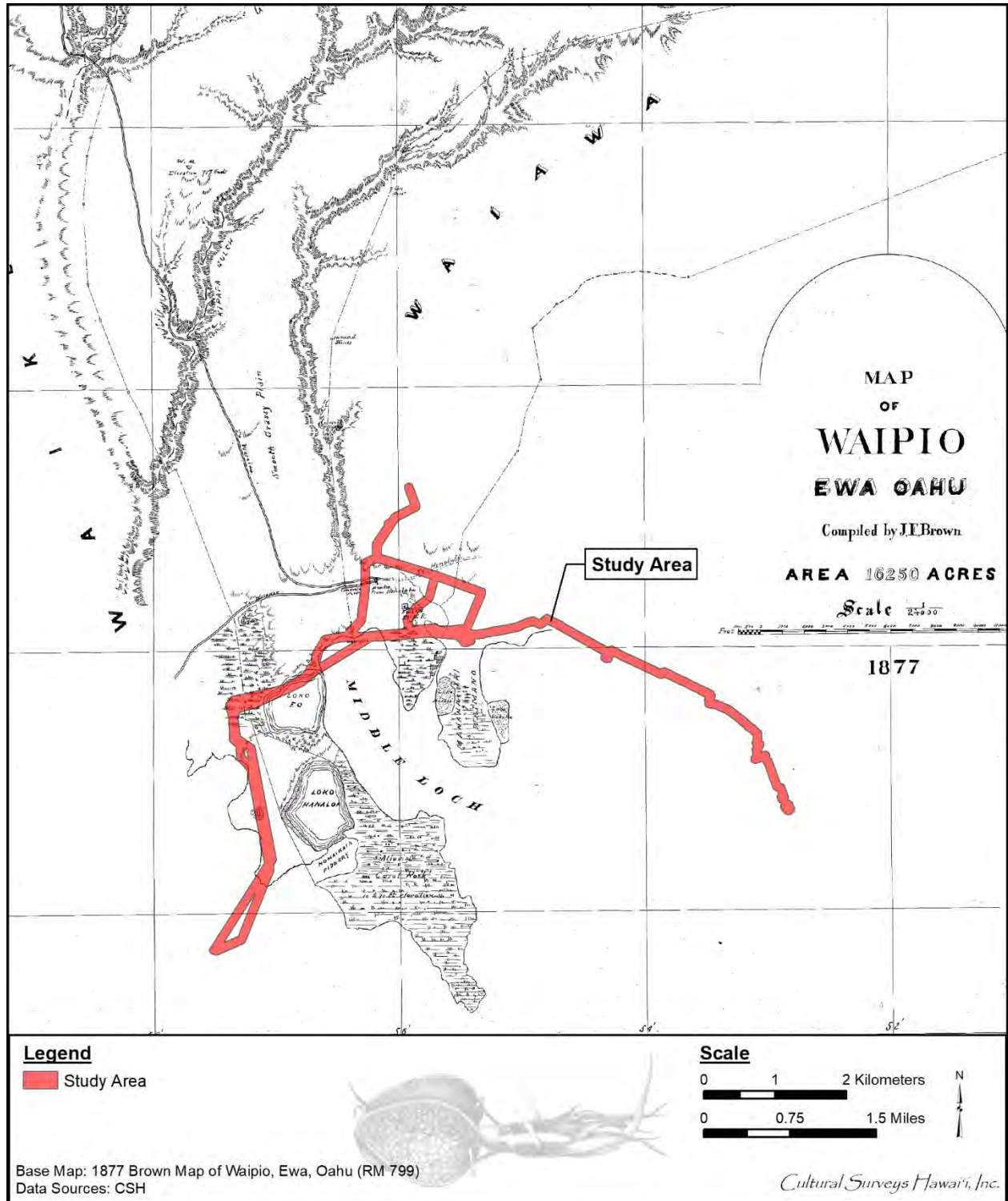


Figure 37. 1877 Brown map of Waipio, Ewa, Oahu showing the west and central portions of the study area

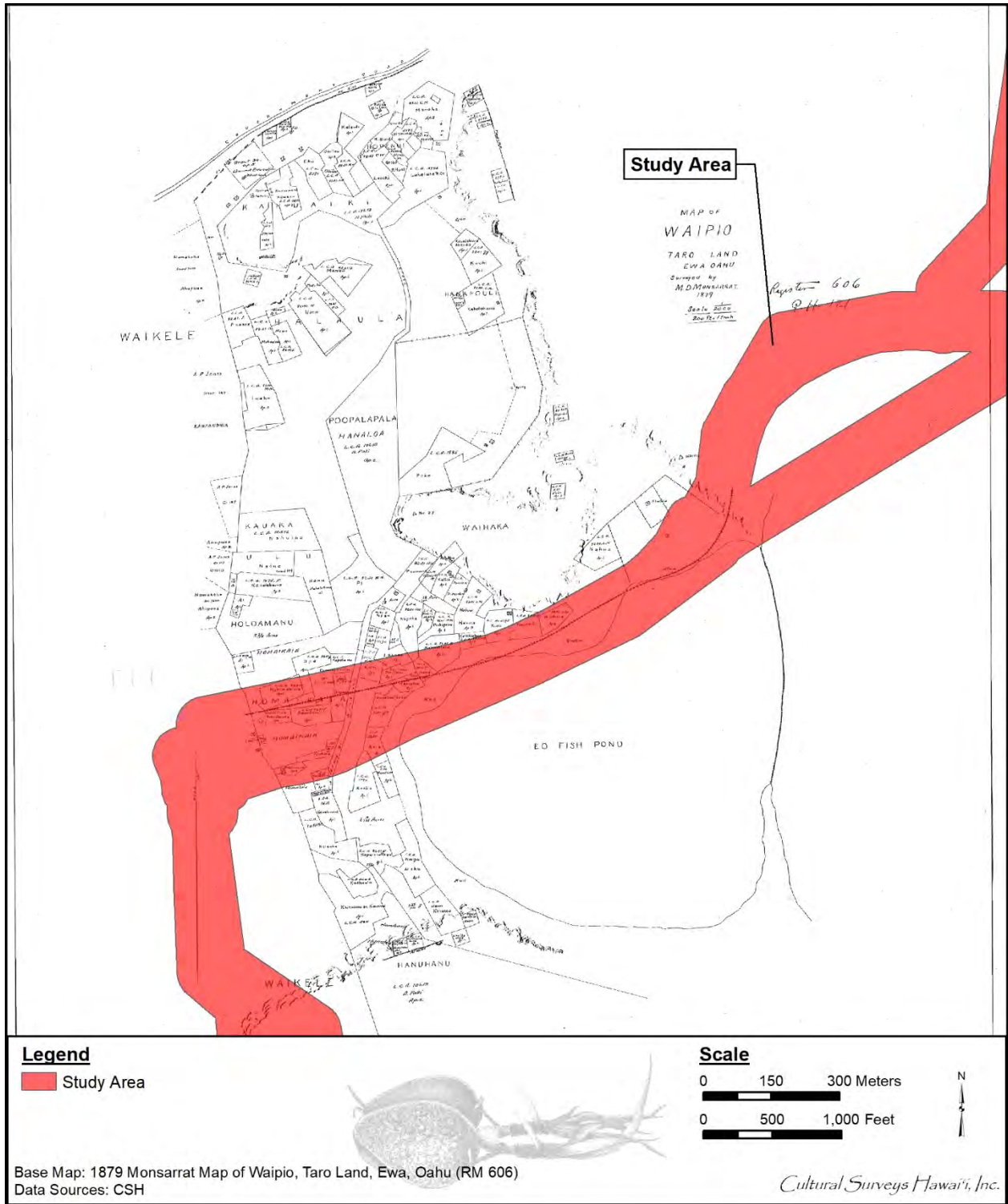


Figure 38. 1879 Monsarrat map of Waipio, Taro Land, Ewa, Oahu showing a central portion of the study area

the west shows a quilt of cultivated fields. The OR&L railroad is prominent extending along the middle of this portion of the project area.

The 1887 Bishop “Map of the Lower Lands of the Ahupuaas of Waiawa, Manana and a Part of Waimano” (Figure 39) provides wonderful detail for the central portion of the study area. Virtually the entirety of the study area within Waiawa and Mānana ahupua‘a is a quilt of fields. The relationship of the project corridor cutting across the middle of the large Loko Kuhia (Kuhialoko) fishpond is clear. The western *mauka* corridor (west of today’s LCC campus) is lacking in development but the central and eastern corridors have many fields. The western portion of the Kamehameha Highway alignment in the central portion of the study area is shown with extensive fields.

The 1887 Bishop map of the “Lower Lands of the Ahupuaas of Waimano and Waiau” (Figure 40) is really an eastern extension of the previously described map with a similar great depth of detail. The Waimano and Waiau *ahupua‘a* portions of the study area are a quilt of fields.

The 1888 Monsarrat map of Hālawā (Figure 41) offers hardly any detail but is of note for calling out rice cultivation at the extreme south end of the project area along Hālawā Stream. Of interest is the notation that further downstream was still “Kalo Land.”

The 1889 Bishop “Map of the Makai Part of the Ahupuaa of Waikele” (Figure 42) provides detail of the immediate vicinity of the existing Waipahu WWPS where the study area turns east at the base of the Waipi‘o Peninsula. This area appears to have been under intensive cultivation.

The 1890 “Oahu Railway and Land Co. Map of Pearl City” (Figure 43) is understood as a promotional map touting the creation of a new residential area to be known as Pearl City. The area depicted is within Mānana Ahupua‘a, in the central portion of the study area with the location of the existing Pearl City WWPS and three alternate WWPS locations on the west (left) side. Prominent features on this map include the northeast corner of the Pearl City Peninsula with the adjacent northwest corner of East Loch, the indicated Oahu Railway alignment approximating the study area with a “Pearl City Branch Oahu Railway” taking a right angle turn to the south to extend down the Pearl City Peninsula. Lehua Avenue is depicted extending north, as it does today, and several numbered streets are shown (First Street through Eighth Street), some of which exist to this day.

Both the Oahu Railway alignment and the town/city of Pearl City date to 1890. The “Great Land Colonization Scheme” of James Campbell and B.F. Dillingham was to have widespread impacts on the landscape of O‘ahu. For example, this “scheme” led to a new name “Pearl City” for the *makai* lands of Manana and adjacent areas. A contest was held starting on 9 May 1890 for “the best name for the town recently laid out at Ewa.” Submitted names included “Dillingham,” “Dillinghampton,” “Dillinghamsville,” “Dilinama,” “St. Dillingham Pearl,” “Dillingmania,” and “Manana” but on 16 May 1890 the award committee unanimously selected a submittal by Mr. J.M. McChesney, Edw. P. Olesen, and Fred Peterson that the town shall be called “Pearl City” (*Pacific Commercial Advertiser*, 17 May 1890). Pearl City as we know it is largely a result of this vision of James Campbell and B.F. Dillingham. Several of the brand new subdivisions of this “Great Land Colonization Scheme” are shown on Figure 43 including one along Lehua Avenue from the Oahu Railway alignment north to the Government Road that would become Kamehameha Highway.

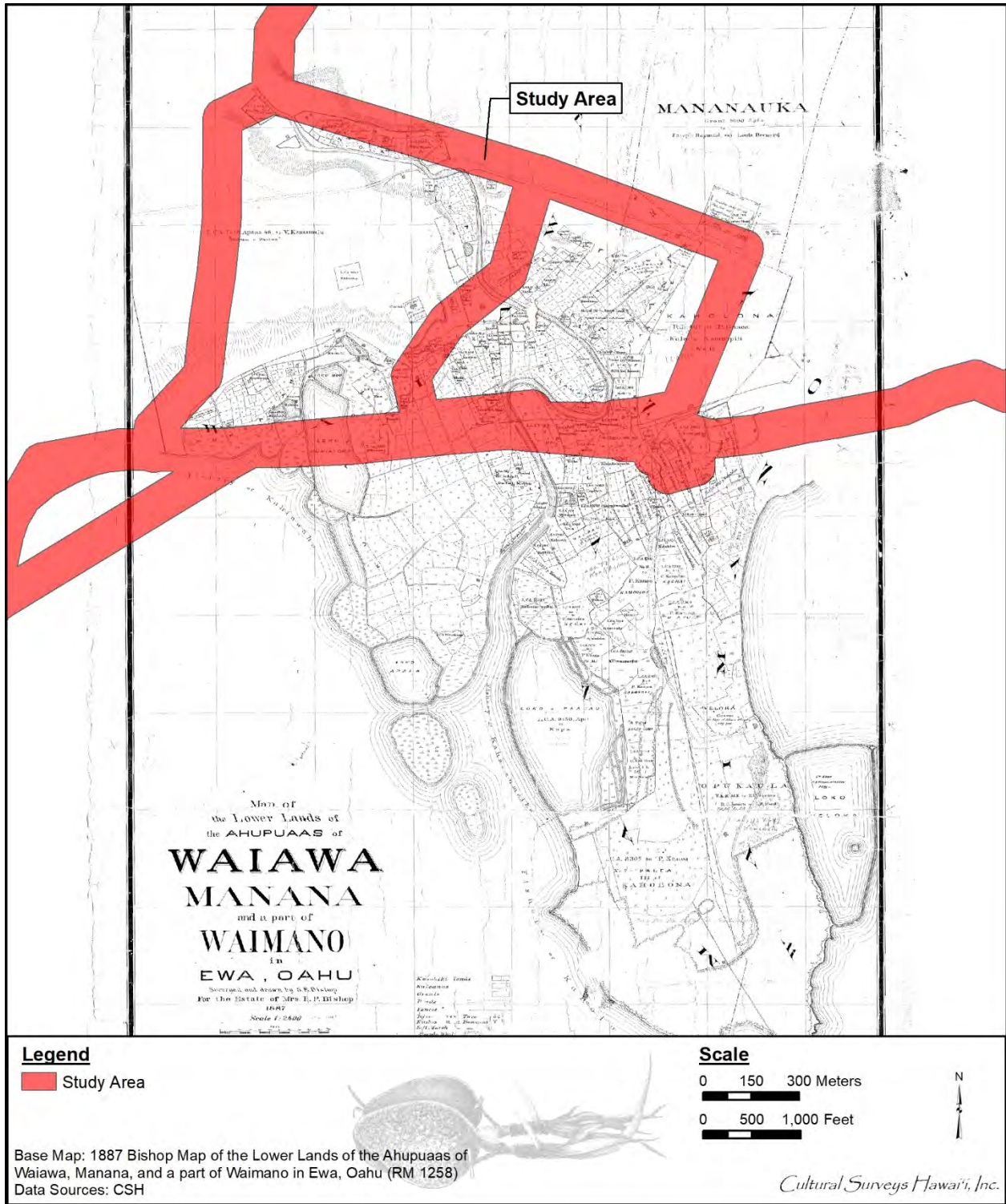


Figure 39. 1887 Bishop map of the Lower Lands of the *ahupua* ‘a of Waiawa, Manana and a part of Waimano in Ewa, Oahu showing a central portion of the study area

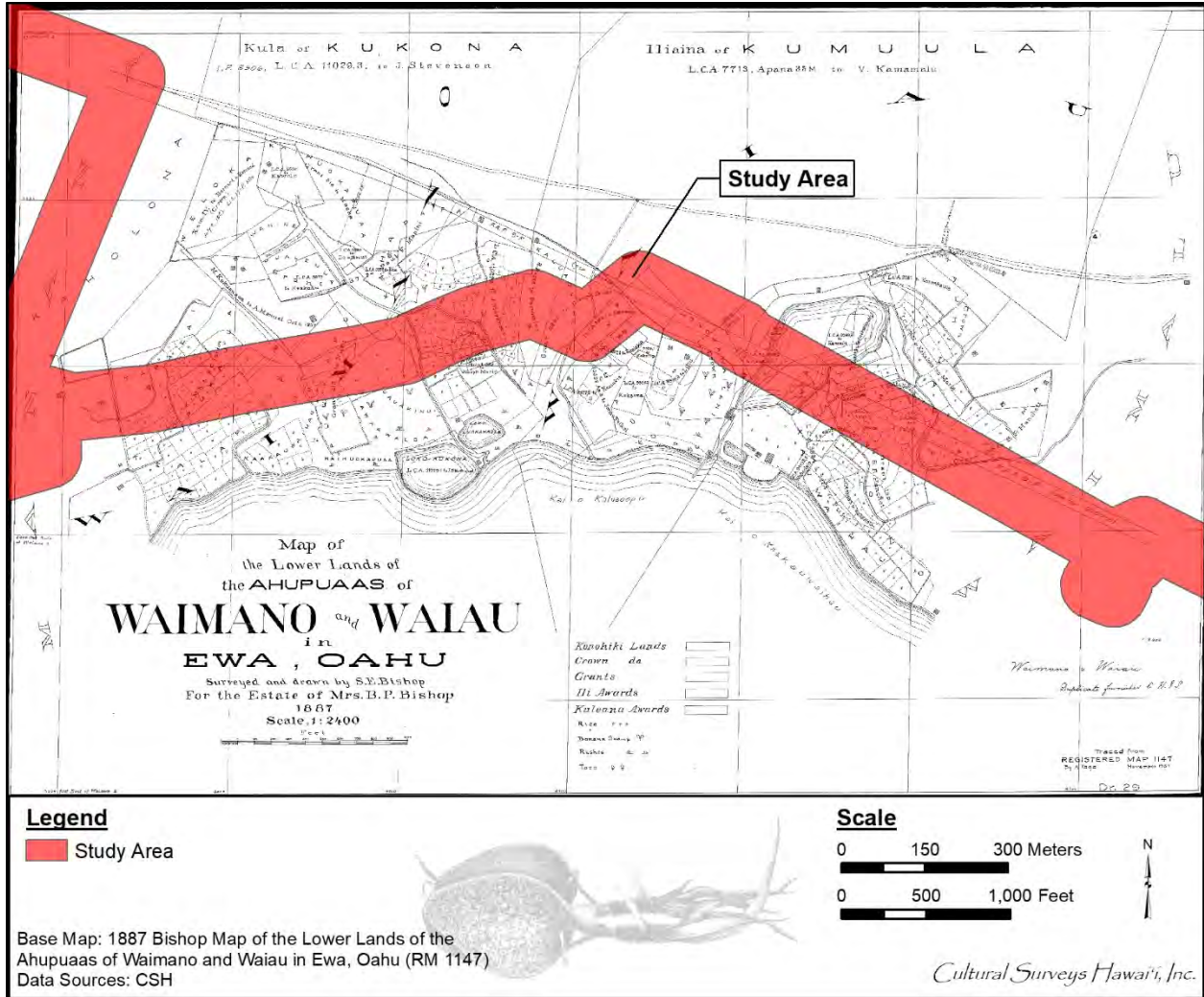


Figure 40. 1887 Bishop map of the Lower Lands of the Ahupuaas of Waimano and Waiau in Ewa, Oahu showing a central portion of the study area

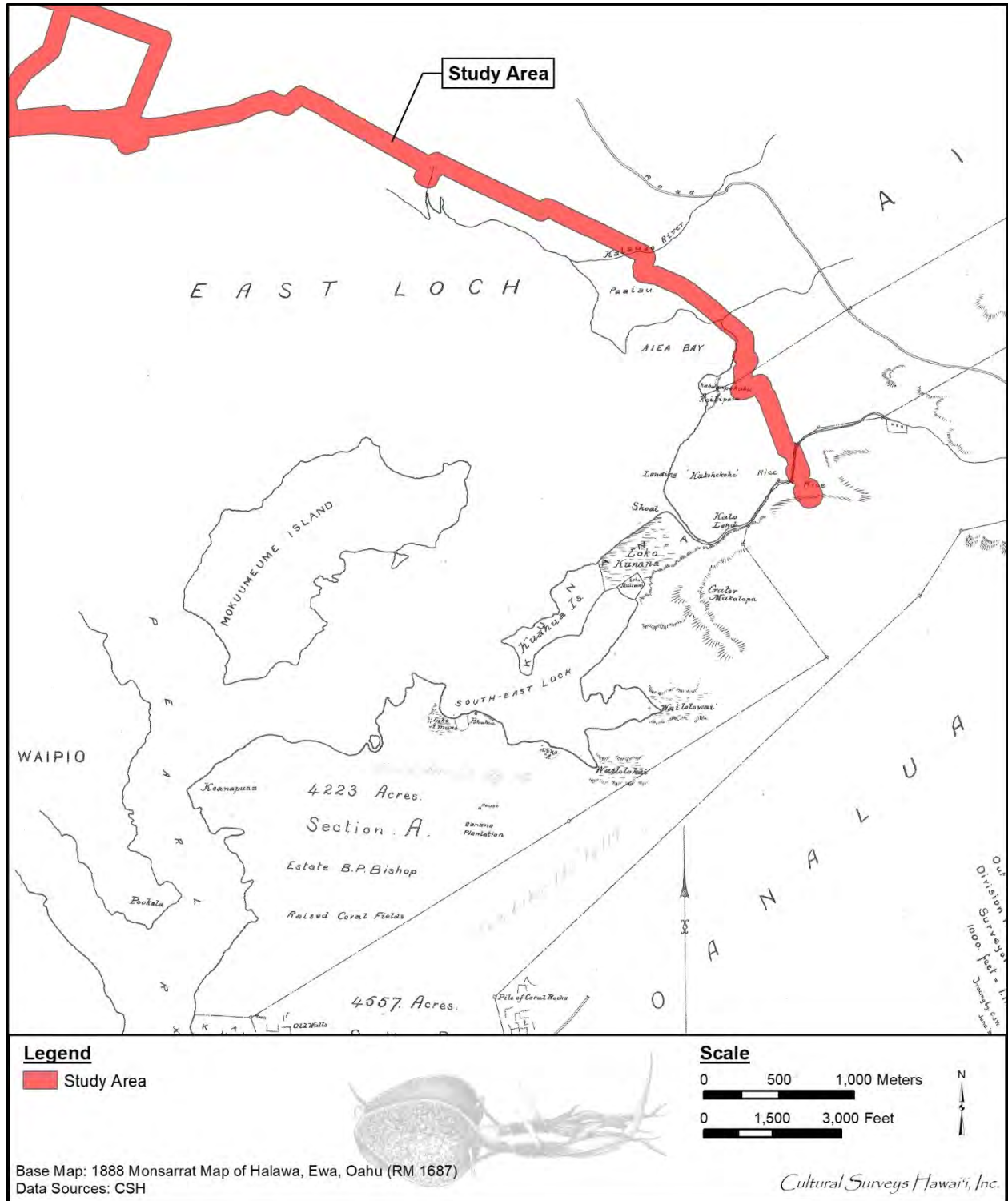


Figure 41. 1888 Monsarrat map of Halawa, Ewa Oahu showing the east end of the study area

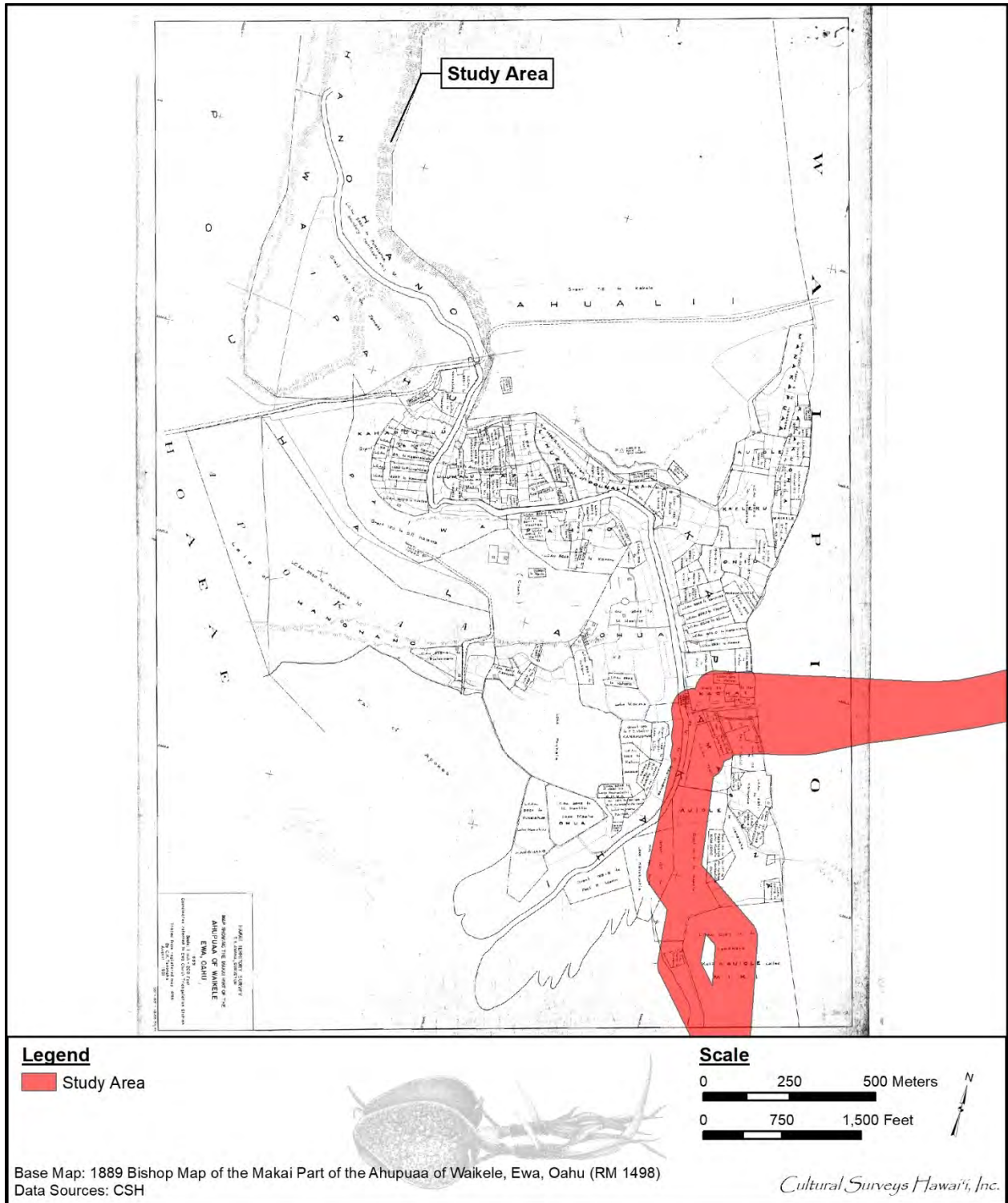


Figure 42. 1889 Bishop map of the *makai* part of the Ahupuaa of Waikele, Ewa, Oahu showing a west portion of the study area in the immediate vicinity of the Waipahu WWPS

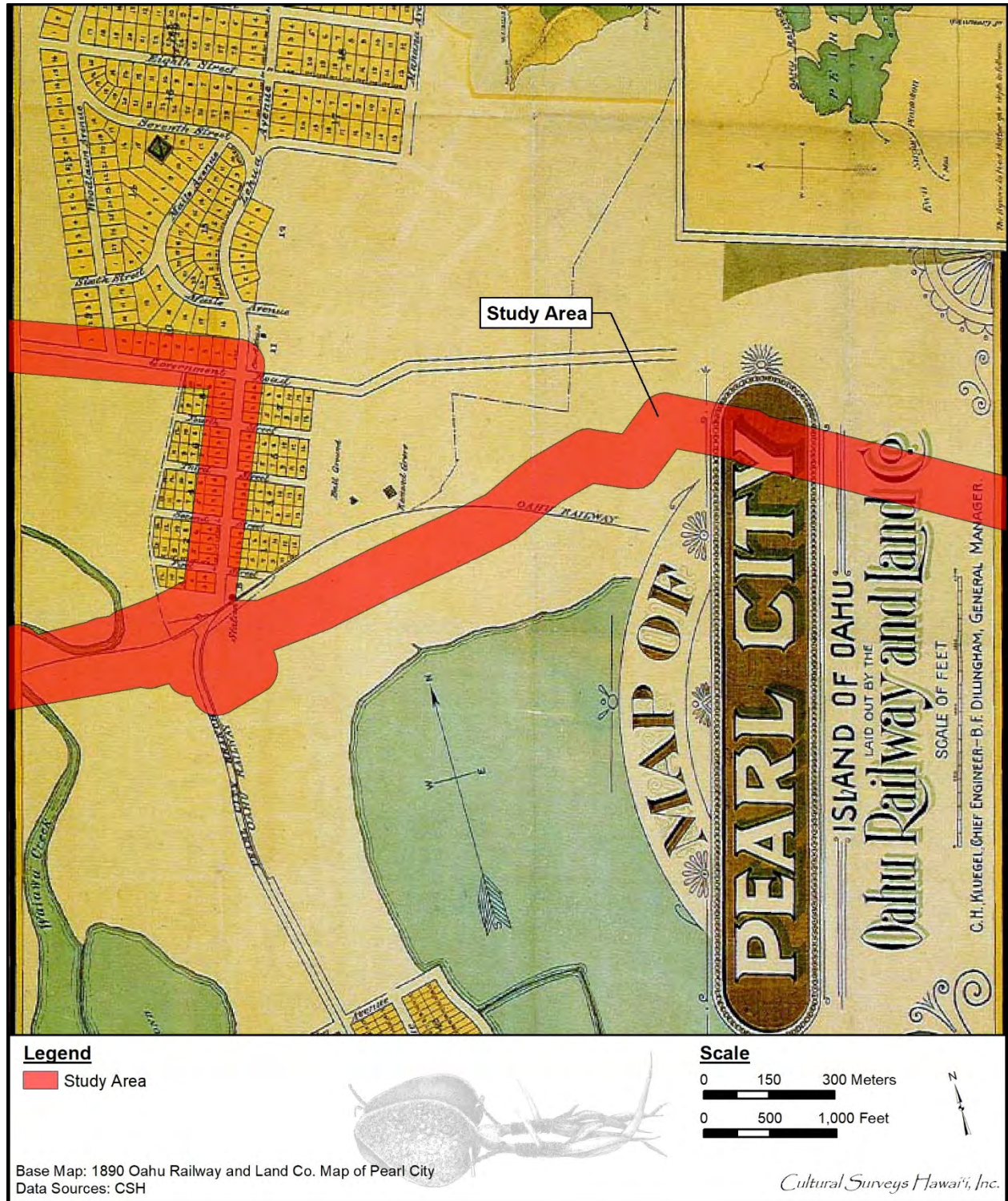


Figure 43. 1890 OR&L map of Pearl City showing a central portion of the study area

The 1894 Kananui map of Pearl Harbor (Figure 44) shows the entirety of the study area immediately following the overthrow of the Kingdom of Hawai'i. The "Road to Honolulu" arcs around Pearl Harbor approximating the alignment of present day Kamehameha Highway within the central portion of the study area. The extensive hatching within the study area along the coast from the Pearl City Peninsula (Mānana Ahupua'a) east to Aiea Ahupua'a is understood to indicate rice cultivation areas at that time.

The 1897 Nichols map of the Pearl River and Lochs (Figure 45; Figure 46 features a close-up of a portion of a different Nichols map of the same year) shows the entire study area on the eve of annexation. Superficially this appears to be pretty much an unmodified traditional Hawaiian landscape dominated by the coastal fishponds. The new Pearl City subdivisions depicted on Pearl City Peninsula and the Lehua Avenue portion of the study area (easternmost of the three *mauka* extensions) are certainly a harbinger of changes to come. The development of these subdivisions (and a new entity of Pearl City) appears to have been associated with a significant straightening of what is now Kamehameha Highway within the central portion of the study area. A big change is the many annotations of "Rice Fields" within the study area. A close-up of a portion of a different Nichols map of the same year in the vicinity of the Waipahu WWPS (see Figure 46) gives some feeling for how extensive the rice fields had become. The quilt of small independent Hawaiian taro patches shown on the 1879 (see Figure 38) and 1889 (see Figure 42) maps is being absorbed by Chinese rice agribusiness. In several locations rice fields are indicated in the study corridor.

The 1897 Nichols map (see Figure 45) clearly shows the new OR&L alignment. From the vicinity of the Waipahu WWPS east to where a spur runs south down the Pearl City Peninsula the railroad is within the study corridor. East of the Pearl City Peninsula spur, the railroad is depicted as only approximately paralleling the study area (typically running well *makai* of the study corridor) until it reaches 'Aiea where the railroad is again within the study corridor rounding 'Aiea Bay.

The 1898 Monsarrat map of 'Aiea taro lands (Figure 47) provides detail for a small portion of the study area in 'Aiea Ahupua'a, rounding 'Aiea Bay, depicting LCA parcels, a few houses, an old ditch, and areas of rice cultivation. The "Oahu Railroad" runs down the middle of the project corridor. Of interest is the call-out of a "hospital" as nineteenth century hospitals could be associated with burials. In this case unsuccessful cases may have ended up in the 'Aiea Cemetery which, although not depicted, should have been developed just to the southeast. While this is a map of "taro lands" there are a large number of call-outs of rice fields.

Monsarrat did another map of a portion of 'Aiea in 1898 (Figure 48) that also depicts the hospital as within the study corridor and shows a stable and a few other buildings near the Hālawa Ahupua'a boundary near where the OR&L follows the coastline *makai* (west, outside) of the study corridor.

3.7 History of the Sugar Plantations of 'Ewa

Although sugarcane was already being grown as far back as the early 1800s, the industry revealed its economic potential in 1879 when the first artesian well was drilled in 'Ewa (Ellis 1995:22). The availability of subsurface water resources enabled greater irrigation possibilities for expanding plantations besides the use of water diversions from the surrounding stream systems. This prompted the drilling of many other wells in the Hawaiian Islands, thereby commencing

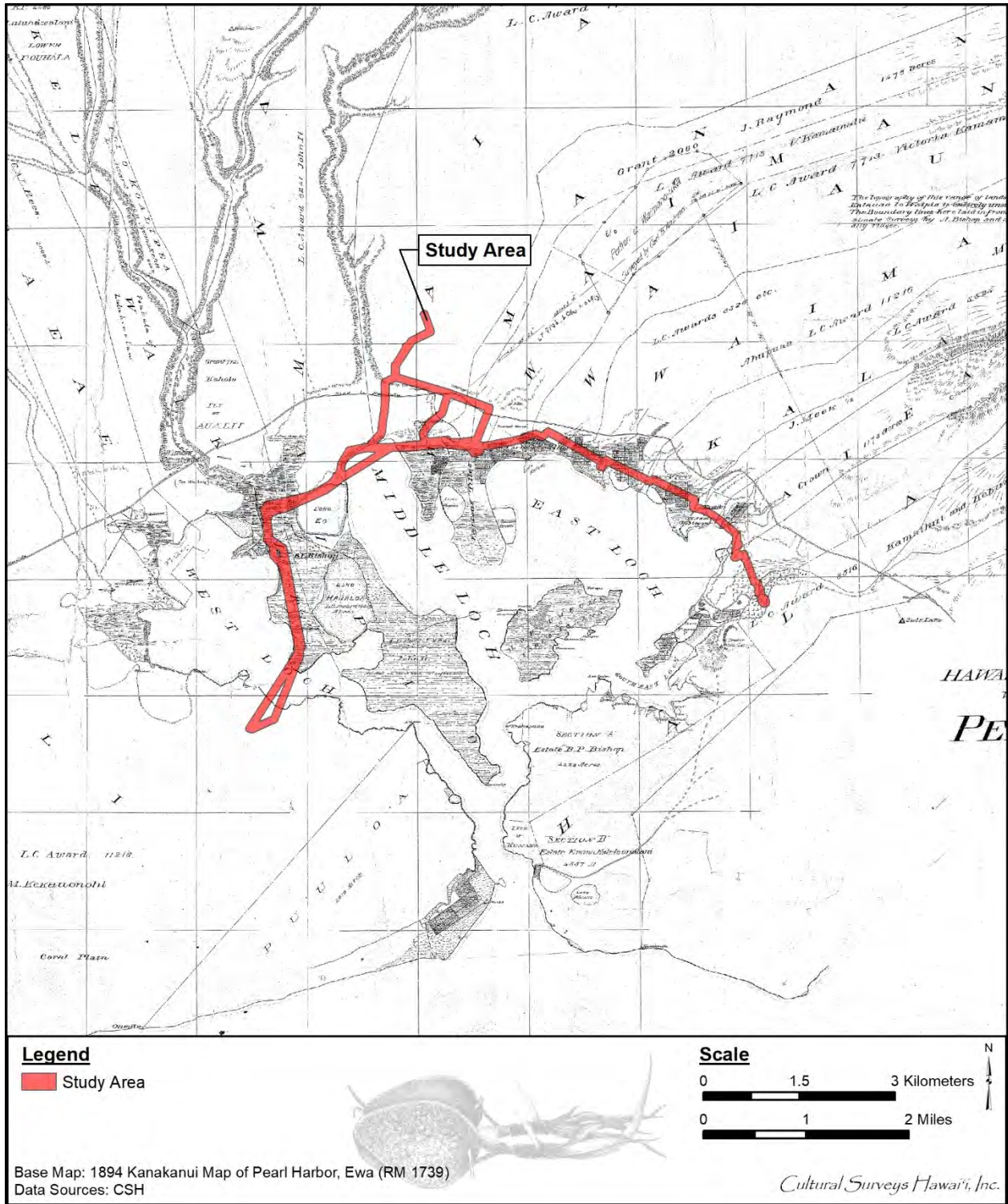


Figure 44. 1894 Kananui map of Pearl Harbor, Ewa showing the study area

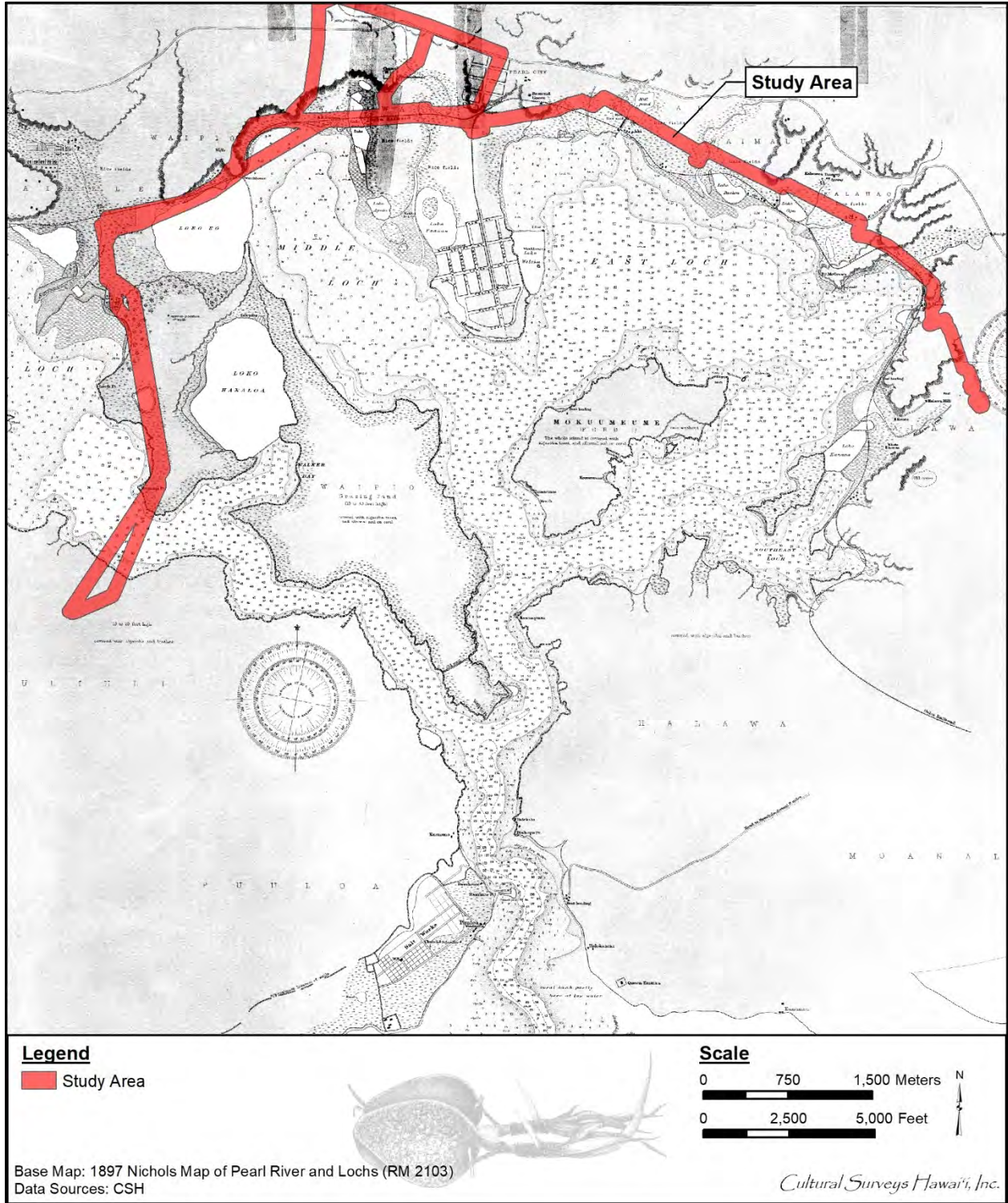


Figure 45. 1897 Nichols map of the Pearl River and Lochs showing the study area

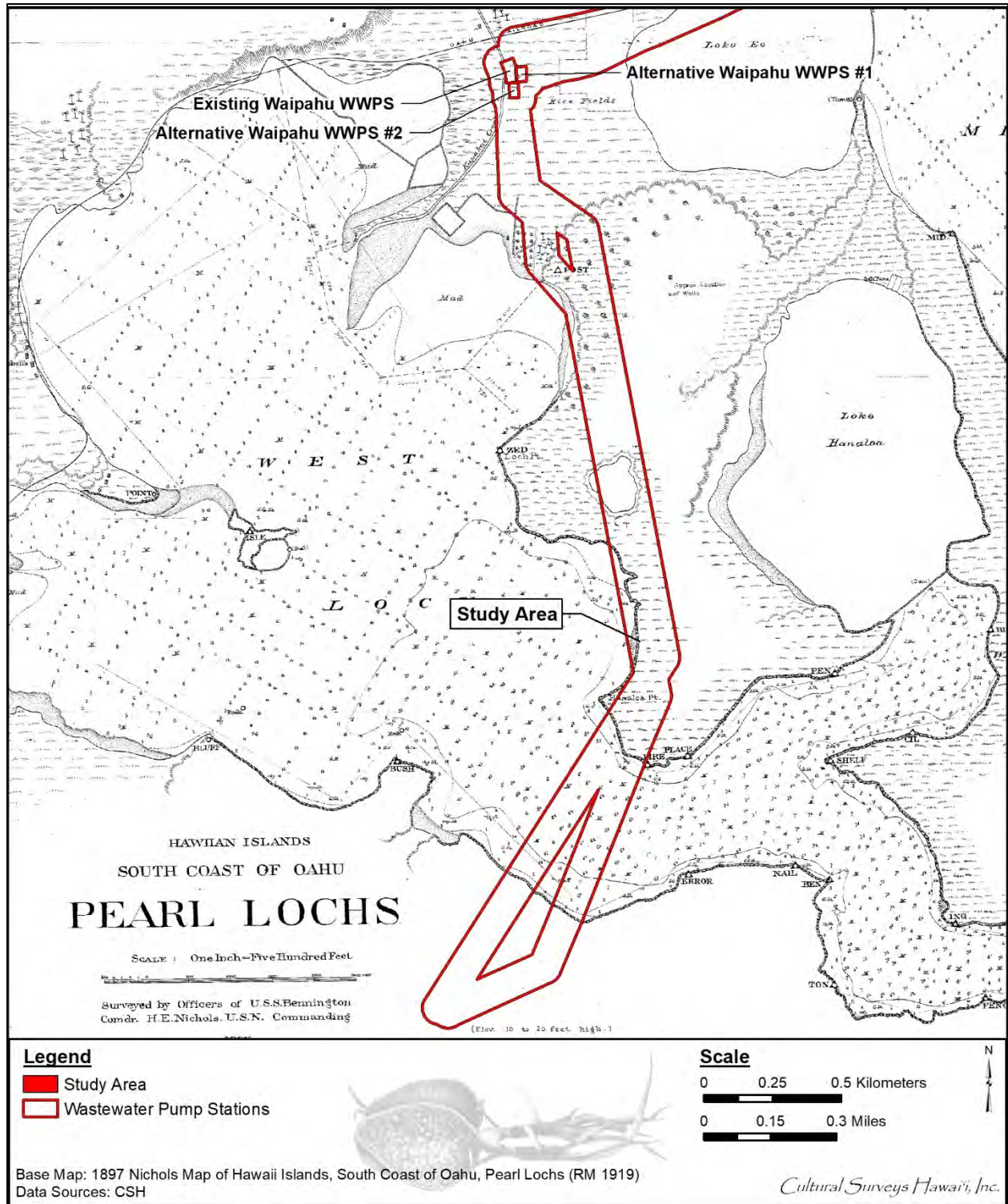


Figure 46. 1897 Nichols map of the South Coast of Oahu, Pearl Lochs, close-up of a portion of the map showing the west portion of the study area

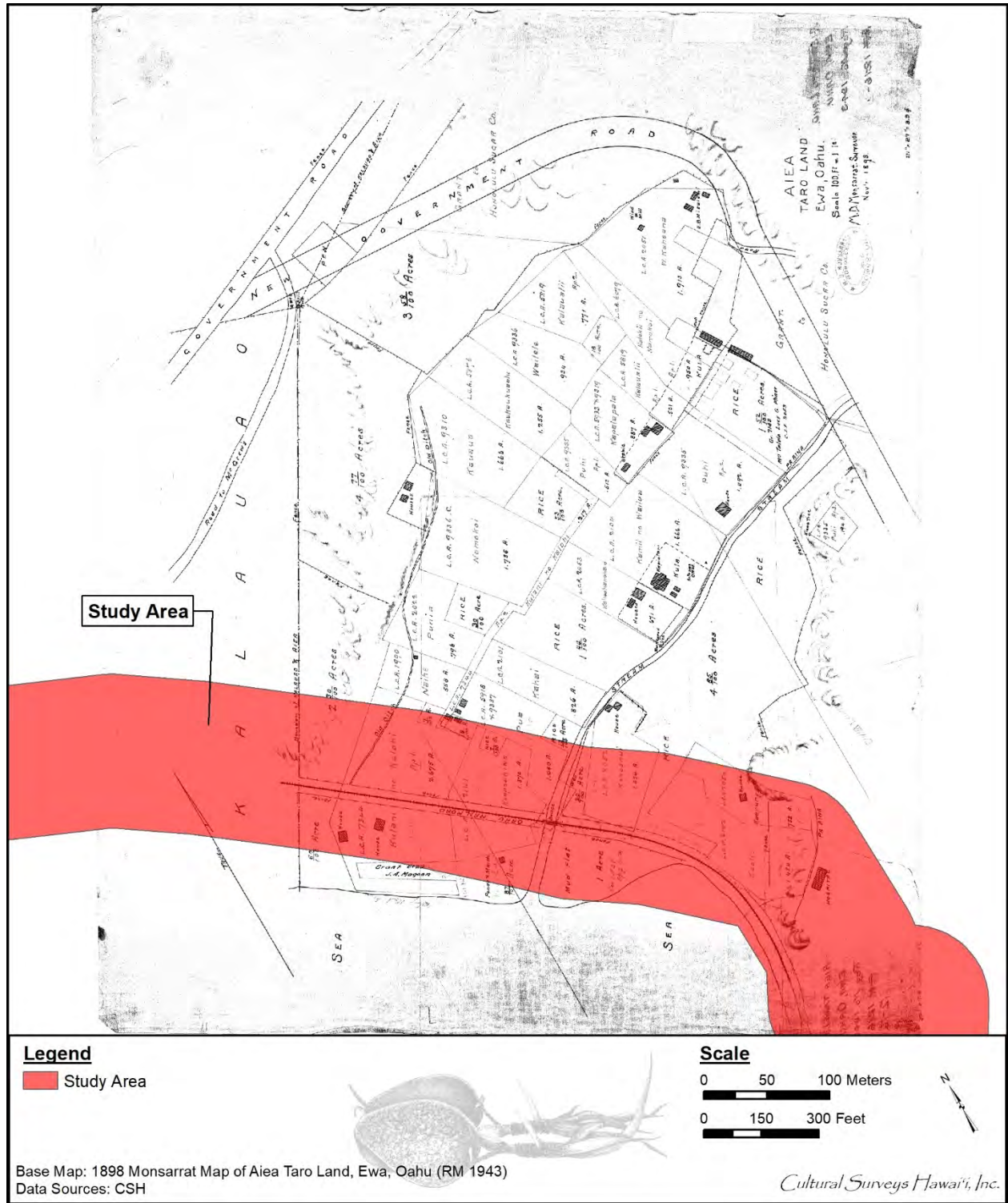


Figure 47. 1898 Monsarrat map of Aiea Taro Lands showing an eastern portion of the study area rounding 'Aiea Bay

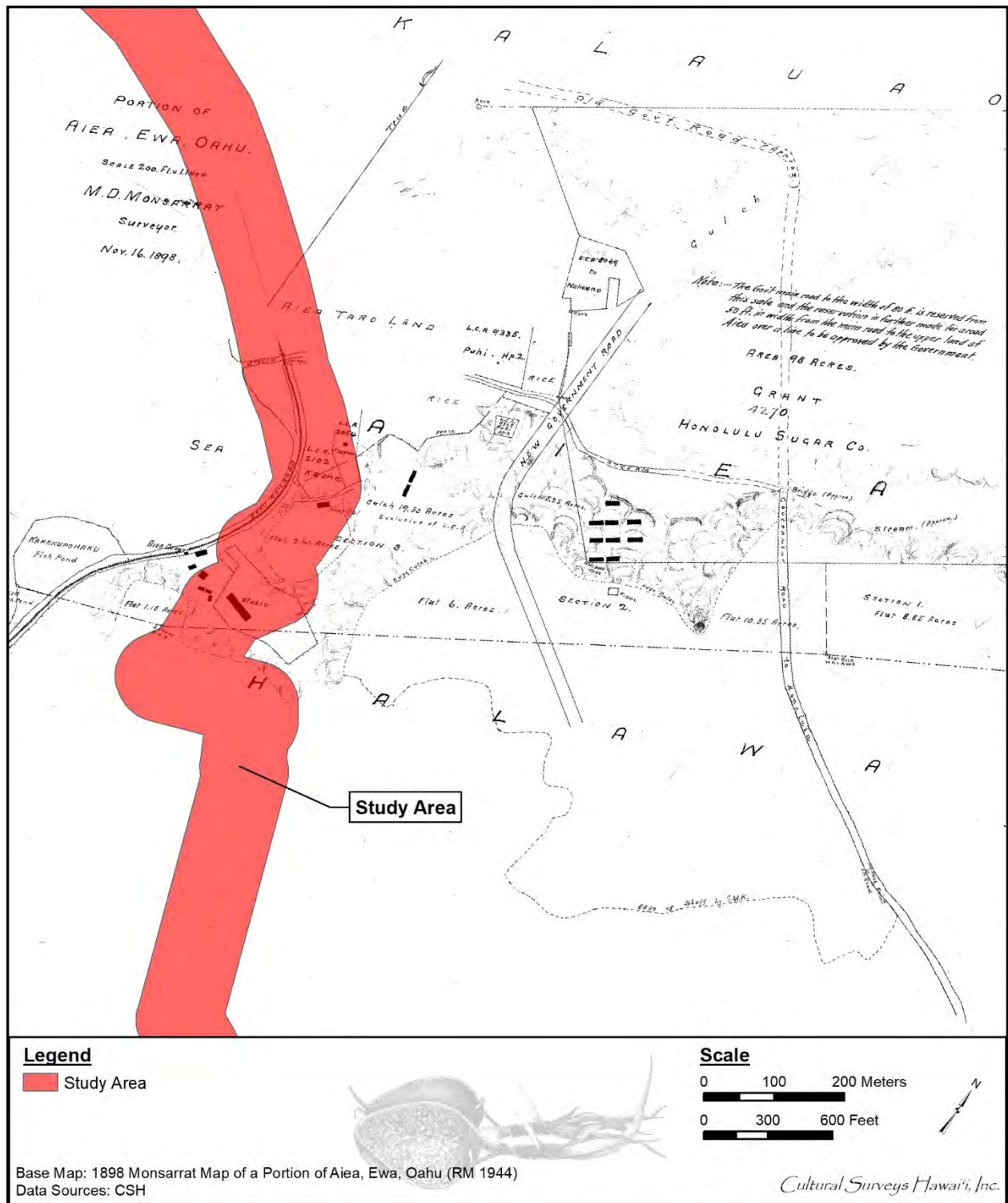


Figure 48. 1898 Monsarrat map of a portion of Aiea, Ewa, Oahu showing an eastern portion of the study area just northwest of today's Aloha Stadium

the Hawai'i sugar plantation era. By the early 1900s, all the main Hawaiian Islands had land devoted to the sugarcane production.

Agricultural field systems, railroads, and residential areas in 'Ewa were developed by three sugarcane companies: the Ewa Plantation, located largely in the *ahupua'a* of Honouliuli and Hō'ae'ae in the western section of the 'Ewa; the Oahu Sugar Company, extending in the areas upland of the Ewa Plantation in central 'Ewa, including a portion of the uplands of Waiawa; and the Honolulu Plantation Company, with fields extending through Mānana to Hālawā in the eastern section of 'Ewa.

3.7.1 The Ewa Plantation Company

The Ewa Plantation Company was incorporated in 1890 for sugarcane cultivation. The first crop, 2,849 tons of sugar, was harvested in 1892. Ewa Plantation was the first all-artesian plantation and it gave an impressive demonstration of the part artesian wells were to play in the later history of the Hawaiian sugar industry (Kuykendall 1967:3:69). As a means to generate soil deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Company installed ditches running from the lower slopes of the mountain range to the lowlands. When the rainy season began, they plowed ground perpendicular to the slope so that soil would be carried down the drainage ditches into the lower coral plain. After a few years, about 373 acres of coral wasteland were reclaimed in this manner (Immisch 1964:3). By the 1920s, Ewa Plantation was generating large profits and was the "richest sugar plantation in the world" (*Paradise of the Pacific*, December 1902:19–22 in Kelly 1985:171).

During the twentieth century, the Ewa Plantation continued to grow and by the 1930s it encompassed much of the eastern half of Honouliuli Ahupua'a. This growth impelled the creation of plantation villages to house the growing immigrant labor force working the fields. After the outbreak of World War II, which siphoned off much of the plantation's manpower, along with the changeover to almost complete reliance on mechanical harvesting in 1938, there was little need for the large multi-racial (Japanese, Chinese, Okinawan, Korean, Portuguese, Spanish, Hawaiian, Filipino, European) labor force that had characterized most of the early history of the plantation. The Oahu Sugar Company took control over the Ewa Plantation lands in 1970 and continued operations until 1995, when they decided to shut down sugarcane production in the combined plantation areas (Dorrance and Morgan 2000:45, 50).

3.7.2 The Oahu Sugar Company and the Waiahole Ditch

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

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

Prior to commercial sugar cultivation, these lands were described as being "of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project"

(Condé and Best 1973:313). Dillingham had successfully promoted the Ewa Plantation Company in 1890; the sprawling sugar company was just south of and adjacent to the OSCo. Artesian wells had converted those arid 'Ewa lands into a thriving plantation, and Dillingham recognized the same potential in the northern area.

Water to irrigate the upper cane fields was initially pumped to levels of 150 m (500 ft) by some of the "largest steam pumps ever manufactured" (Dorrance and Morgan 2000:49). The expense of pumping water to the high elevations of the plantation led to the proposal to transport water from the windward side of the Ko'olau Mountains. The Waiahole Water Company was formally incorporated in 1913 and was originally a subsidiary of the Oahu Sugar Company. The Waiahole Ditch was designed by engineer Jorgen Jorgensen, with recommendations by engineer J.B. Lippencott and assisted by W.A. Wall. When completed, the original system included 27 tunnels connecting with 37 stream intakes on the north side of the Ko'olau, with the main bore through Waiāhole Valley, then connecting it to the 14 tunnels on the southern side of the Ko'olau at Waiawa, and thence by ditch westward to Honouliuli, covering a total of 13.6 km (Condé and Best 1973:37). Upon its completion in 1916, the Waiahole Ditch was 35 km (21.9 miles long) and cost \$2.3 million. The 32 million gallons of daily water enabled the Oahu Sugar Company to grow to "some 20 square miles . . . ranging in elevation from 10 feet at the Waipio Peninsula . . . to 700 feet at the Waiahole Ditch" (Condé and Best 1973:313). The ditch system, with some modifications, is still in use. It is included on the state inventory of archaeological sites as State Inventory of Historic Places (SIHP) # 50-80-09-2268.

This ditch complex first passed through Hō'ae'ae, bringing much needed water to the area.

West of Waikakalaua Gulch, through Hoaeae and to the upper boundary of Oahu Plantation in Honouliuli, the conduit consists of 12,650 feet of cement-lined ditches, and three redwood pipes 5 feet in diameter, having an aggregate length of 2,830 feet. [Kluegel 1917:96]

The Waiahole Water Co. has taken over from the Oahu Sugar Co. the Ahrens Ditch in Waiawa, the Kipapa Ditch, the Waikakalaua Ditch in Waipio, and the Hoaeae Ditch. Two redwood pipes having a total length of 1,223 feet have been laid across two gulches on the line of Hoaeae Ditch, cutting out 2 1/4 miles of ditch. The water delivered by the Waiahole System is chiefly used on newly planted cane on land above the lift of the pumps. [Kluegel 1917:107]

3.7.3 The Honolulu Sugar Plantation

The eastern section of 'Ewa was largely developed by the Honolulu Plantation Company. Commercial sugarcane cultivation began in Waimalu and Hālawā in the 1850s, on the estate of Mr. J.R. Williams (Condé and Best 1973:327). The plantation was first known as the Honolulu Sugar Company. In 1900, along with a change in ownership, the name of the company was changed to the Honolulu Plantation Company. The plantation's mill and refinery were located in 'Aiea, with the plantation's fields stretching across the plains and foothills *mauka* of Pearl Harbor (see Figure 48). The expanse of the Honolulu Plantation Company lands seems to extend from 'Aiea westward as far as Mānana and Waiawa streams. Additionally, several land sections lay southeast of Pearl Harbor where the present Honolulu International Airport and Hickam Air Force Base are located. In 1914, the company harvested 19,000 tons of sugar. It was taken over by the Oahu Sugar Company in 1947 (Condé and Best 1973:313).

The increased productivity of the sugarcane industry relied heavily on transporting the raw product from the field to the mills, including the 'Aiea sugar mill, as well as then taking the processed sugar to port for loading onto ships (or to storage facilities). Railway lines, which were established in the Honolulu Plantation Company fields by OR&L in 1901, provided a means to transport material, workers, and goods in an adequate amount of time. By 1910, the network of railways circumnavigated the plantation with over 36 miles of main railroad, utilizing four locomotives and 500 cane cars. This transportation system greatly enhanced the plantation's product output and economic growth, having taken in 900 tons of raw sugar per week and producing 1,100 tons of processed sugar daily (Condé and Best 1973:328).

Despite its economic promise and gains, gradual land condemnation of Honolulu Plantation lands by the government caused declines in production and removal of rail lines. Continued pressure by the U.S. military proved to be too much. Large shares of Honolulu Plantation land were gradually turned over to the government for military use. In 1907, a sizeable portion was used for the expansion of the U.S. Naval Facilities at Pearl Harbor. In 1935, all of the Pu'uloa lands (approximately 15% of the plantation) were handed over for the construction of Hickam Air Field. The plantation lands were given up during World War II and post-war urbanization brought an end to the Honolulu Plantation Company in 1947. The plantation equipment and remaining land were sold to the neighboring Oahu Sugar Company, and the mill was dismantled and shipped to the Philippines. However, the refinery continued to operate, producing a liquid sugar product for canners and bottlers until the Hawai'i bottlers switched to corn syrup and the operation shut down in 1996. The refinery building is now the site of the Hawai'i Agriculture Research Center (Dorrance and Morgan 2000:50).

3.8 The Early Military Development of 'Ewa

3.8.1 Early Evaluations of Pearl Harbor

In 1891, Russian explorer Otto Von Kotzebue tried to observe Pearl River, but his group could not obtain a canoe. What he was told led him to speculate on the possible importance of Pearl Harbor to the future.

In the mouth of this river are several islands; it is so deep, that the greatest ship of the line can lie at anchor a few fathoms from the shore; and so broad, that a hundred vessels can conveniently find room in it. The entrance into the Pearl Rivers is in the same situation as the harbor of Hana-rura; but the windings between the reefs are, however, said to render a passage more difficult. If this place were in the hands of the Europeans, they would certainly employ means to make this harbour the finest in the world. [Kotzebue 1821:338–348]

The early missionary Levi Chamberlain was able to take an outrigger canoe trip to Pearl River, and noted the difficulty of access for larger ships.

Kawaa took passage in our canoe to go down the harbor to a place where oysters are abundant to give orders to his people to gather a mess. The sail down the harbor was delightful . . . The passage down the creek for a number of miles was very pleasant till we got down near the reef and our course altered. We then could sail no longer as the wind was against us. The sail was lowered the mast taken down

and secured across the outrigger and the rowers plied their paddles. (Chamberlain 1822-1849 in Sterling and Summers 1978:51)

The first foreign attempt to survey Pearl Harbor was made in 1840 during the U.S. Exploring Expedition, led by Charles Wilkes.

In this district is a large inlet of the sea, into which the river Ewa empties; at the entrance of this inlet is the village of Laeloa (at Kalaeloa Pont): the shore is known by the name of Pearl River or harbour, from the circumstance that the pearl oyster is found here; and it is the only place in these islands where it occurs.

The inlet has somewhat the appearance of a lagoon that has been partly filled up by alluvial deposits. At the request of the king, we made a survey of it: the depth of water at its mouth was found to be only fifteen feet; but after passing this coral bar, which is four hundred feet wide, the depth of water becomes ample for large ships, and the basin is sufficiently extensive to accommodate any number of vessels. If the water upon the bar should be deepened, which I doubt not can be effected, it would afford the best and most capacious harbour in the Pacific. . . . [Wilkes 1970:79]

Although Wilkes was impressed by the harbor, he was not at this time thinking of how this survey could benefit the American government in the future. In fact, Wilkes (1970:79) concluded, “As yet there is no necessity for such an operation, for the port of Honolulu is sufficient for all the present wants of the islands, and the trade that frequents them.”

Wilkes' low impression of the use of Pearl Harbor changed in less than 30 years. The U.S. Navy had tried to make a coaling station on Midway Island in 1869 by blasting through the coral reef to make a harbor, but the plan failed. In 1873, General Schofield presented a confidential report to the U.S. Secretary of war, recommending that Pearl Harbor should be available to the U.S. Navy. Schofield wrote,

In case it should become the policy of the Government of the United States to obtain the possession of this harbor for naval purposes, jurisdiction over all the waters of Pearl River with the adjacent shores to the distance of 4 miles from any anchorage should be ceded to the United States by the Hawaiian Government. . . .

The cession of Pearl River could probably be obtained by the United States in consideration of the repeal of the duty of Sandwich Island sugar. Indeed, the sugar—planters are so anxious for a reciprocity treaty, or so anxious rather for free trade in sugar with the United States, that many of them openly proclaim themselves in favor of annexation of these islands of the United States. [Sen. Ex. Docs, 52nd Cong. 2nd Sess. No. 77, pp. 150–154, reproduced in Judd 1971:Appendix 3]

3.8.2 The U.S. Military and the Development of Pearl Harbor

The reciprocity treaty was concluded in 1876 with the provision that Hawai'i would not “lease or relinquish sovereignty to another country or any harbor, etc.” In 1887, the treaty was renewed and amended and allowed the United States the “exclusive right to enter the harbor of Pearl River, in the Island of Oahu, at to establish and to maintain there a coaling and repair station for the use of vessels of the United States” (Judd 1971:128).

The most dramatic change affecting both the use of Pearl Harbor and the growth of the sugar industry in Hawai'i occurred 7 July 1898. Following years of diplomatic pressure from delegates to Washington, the Congress of the United States approved a joint resolution of annexation that established the Republic of Hawaii as a Territory of the United States. On 30 April 1900, President William McKinley signed the Organic Act for the Territory of Hawaii, which provided a government whose leaders were appointed by the United States and otherwise defined the political structure and powers of the newly established government (U.S. Department of the Interior 1900).

After annexation of the Islands to the United States in 1899, development of a Pacific base that could be used as a staging area for the Spanish-American war began (Coletta 1985:433). Early in the twentieth century, the U.S. Government began acquiring the coastal lands of 'Ewa for the development of a naval base at Pearl Harbor. In 1901, the U.S. Congress formally ratified the annexation of the Territory of Hawaii, and the first 1,356.01 acres of Pearl Harbor land were transferred to U.S. ownership. The U.S. Navy began a preliminary dredging program in 1901, which created a 30-ft deep entrance channel measuring 200 ft wide and 3,085 ft long. In 1908, money was appropriated for 5 miles of entrance channel dredged to an additional 35 ft down (Downes 1953) (Figure 49). Money for the funding of the construction of dry docks and other support facilities was also approved in 1908. In 1909, the government appropriated the entire Waipi'o peninsula from the 'I'i Estate for the Pearl Harbor Naval Station and Shipyard. Additional dredging to deepen and widen the channel was conducted in the 1920s. In 1931, the Navy built an ammunition depot at West Loch on a 213-acre parcel it had bought from the Campbell Estate. Construction of a new depot in Lualualei Valley and at West Loch Harbor began in 1931.



Figure 49. Dredging in Pearl Harbor ca. 1908 (Hawai'i State Archives)

In the early 1930s, the U.S. Navy leased 700 acres of the Campbell Estate to build Ewa Field in Honouliuli, a base with a mooring mast for Navy dirigibles. Although the mast was completed, the program was abandoned before the *Akron*, the designated airship for the mast, was built. In 1937, 18 miles of roads were built in the coastal Honouliuli area, and in 1939-1940 the U.S. bought 3,500 acres of land in this area (Landrum et al 1997:62–67) to build several other military camps and installations, including Barbers Point Naval Air Station, at the site of the old mooring mast.

In the 1930s an Army Air Corps airfield was established to the west of Rodgers Airport. The Hickam Air Force Base web site offers the following brief history of this military base's early development:

In 1934, the Army Air Corps saw the need for another airfield in Hawaii and assigned the Quartermaster Corps the job of constructing a modern airdrome from tangled brush and sugar cane fields adjacent to Pearl Harbor on the island of Oahu. The site consisted of 2,200 acres of ancient coral reef, covered by a thin layer of soil, located between Oahu's Waianae and Koolau mountain ranges, with the Pearl Harbor channel and naval reservation marking its western and northern boundaries, John Rodgers Airport to the east, and Fort Kamehameha on the south. The new airfield was dedicated May 31, 1935 and named in honor of Lt. Col. Horace Meek Hickam, a distinguished aviation pioneer killed Nov. 5, 1934, at Fort Crockett in Galveston, Texas.

Hickam AFB now consists of 2,850 acres of land and facilities valued at more than \$444 million. [Hickam Air Force Base 2010]

3.9 Pineapple Cultivation

In the early decades of the twentieth century, lands in the *mauka* portion of the central and eastern sections of 'Ewa were being acquired for pineapple cultivation. There is a record of attempted pineapple irrigation utilizing water from shallow wells in Waiawa Gulch in 1893. Later attempts were made in Waiawa and Honouliuli. James Dole founded the Hawaiian Pineapple Company in 1901. The previous year, Dole had purchased 61 acres of land in Waiawa for growing pineapple. Prior to 1913, most of the upland plateau areas in Waiawa were planted in pineapple (Goodman and Nees 1991:59). Small plots along gullies (not appropriate for sugarcane cultivation) in several 'Ewa *ahupua'a* were planted in pineapple. Many of these small plots were cultivated by independent farmers, who sold the crops at markets or to larger companies. In 1901, the Hawaiian Pineapple Company obtained 61 acres in Waiawa through public auction. Initially, most pineapple was shipped to California for packing. In an attempt to speed up processing, save money and produce a fresher product, a cannery was constructed in Waiawa. This cannery was constructed by the Pearl City Fruit Company but became a part of the Hawaiian Pineapple Company operations after the Pearl City Fruit Company went bankrupt. The cannery was in operation from 1905 to 1935.

A 1908 lease from the John 'Ī'ī Estate, Ltd. to Yoshisuke Tanimoto and Kintaro Izumi led to formation of the Waipio Pineapple Company, which cleared and cultivated approximately 223 acres in portions of Kīpapa Gulch. In 1909, the government appropriated the Waipi'o peninsula from the 'Ī'ī Estate. The land was valued at \$10,000 for purposes of fair compensation (DLNR 1909:228–235). In 1915, Libby, McNeill & Libby took over Waipio Pineapple Company's

leases and continued to cultivate pineapple in the area. By the late 1920s, James Dole's Hawaiian Pineapple Company, incorporated in 1901, was cultivating pineapple on thousands of acres leased from the 'Ī'ī Estate in the *mauka* area of Waipi'o.

Pineapples were handpicked, graded, boxed, and loaded into trucks before the introduction of machinery into the harvesting process. The introduction of the mechanical field fruit harvester in 1947 eliminated the labor-intensive process of grading, boxing, and loading. The pineapple industry employed both male and female Japanese and Filipino workers in the fields and in the cannery. Camps were set up throughout 'Ewa to house the workers and their families (Goodman and Ness 1991:165). In the 1920s, pineapple was abandoned and by 1935, much of the former pineapple lands were planted in sugarcane.

3.10 Other Agricultural Enterprises

Taro and other traditional plants continued to be cultivated in some areas. John Papa 'Ī'ī associated Waiawa, 'Ewa with the brewing of intoxicants in the early 1800s and gives an account of the making of *'ōkolehao*, an alcoholic drink made from brewing the roots of the native ti plant (*Cordyline fruticosa*).

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

An additional agricultural trial was conducted in the Honouliuli area for the cultivation of sisal, a plant used to make fibers for rope and other material. Some sisal was planted before 1898 and production continued until the 1920s (Frierson 1972:16). This was grown mainly on the coastal plain of Honouliuli in Kānehili, just *mauka* of Kualaka'i Beach (now Nimitz Beach). An article in the *Paradise of the Pacific* in 1902 described this venture in glowing terms.

. . . The venture was made and a tract of land containing a large percentage of disintegrated coral, in the neighborhood of Ewa Plantation, where nothing else would grow, was chosen for the planting. . . . The Hawaiian Fiber Co., which Mr. Turner organized, and of which he is now manager, has 755 acres under fence, two and a half miles of which is stone wall with good gates at convenient places. . . . In a large field containing 130 acres, *mauka* of the Oahu Railway & Land Co. track, the first harvest is to be gathered in a few months. . . . Out of this section of 130 acres the company has figured on securing 50 tons of clean fiber, for which it is offered eight cents per pound in Honolulu or nine cents per pound in San Francisco. [*Paradise of the Pacific* March 1902:17]

As in Honouliuli, the cultivation of sisal was attempted on other arid lands in 'Ewa. Thrum's *Hawaiian Almanac and Annual* speaks of the prospect of sisal cultivation glowingly from 1904 to 1913, but the greater profits to be made from sugarcane cultivation eventually led to the decline of this industry.

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

Besides sisal, cotton, and pineapples, other crops were grown in central 'Ewa, such as macadamia nuts (Thrum 1927).

3.11 Development of the Study Area as Reflected in Early Twentieth Century Maps

The 1900-1925 Taylor map of the property of the Honolulu Sugar Company, 'Aiea (Figure 50) shows continued straightening of the alignment of today's Kamehameha Highway within the central portion of the study area. The modern layout of the subdivisions of the new Pearl City in Manana Ahupua'a are in striking juxtaposition with the crazy quilt layout of traditional Hawaiian *kuleana* along the coast and within the study area to the east from Waimano Ahupua'a to 'Aiea Ahupua'a. Relatively little of the study area, really only the Hālawa Ahupua'a portion, is directly impacted by sugarcane cultivation. The study area within Hālawa is labeled as under (sugarcane) "Field 2" and "Seed Cane" of the Honolulu Sugar Company.

The 1913 Monsarrat map of O'ahu Fisheries (Figure 51) is something of a throw-back to an earlier time in documenting the boundaries of the various fisheries of Pearl Harbor. Not including fishponds, some 22 fisheries are called-out at Pearl Harbor. This attests to the wealth of marine resources that the Pearl Harbor lochs had long held for the people of 'Ewa District. These exclusive fisheries were of course just about to disappear under exclusive U.S. Navy control. This map shows the "Oahu Rail Road" as previously depicted but adds the detail of three "Depots" within the study corridor: in Kaohai, Waikele very close to the Waipahu WWPS; at Mānana, very close to the Pearl City WWPS; and at 'Aiea, approximately 200 m northwest of today's Aloha Stadium. Of passing note, a Waipio Ranch headquarters is indicated in the study area just north of Loko Eo.

A 1917 Kakanui and Sutton map of Waimalu Ahupua'a (Figure 52) provides details of a vanishing traditional Hawaiian pattern of land ownership in the immediate vicinity of the Waimalu WWPS.

The 1919 U.S. War Department fire control map of portions of Pearl Harbor, Barbers Point, and Honolulu Quadrangles (Figure 53) now depicts a *mauka* landscape in the uplands of Pearl Harbor dominated by plantation railroads and sugarcane cultivation symbols. A subtle change is that the former fishponds are now called-out as "Lakes." Urbanization is still largely restricted to Pearl City although a substantial plantation community is indicated at 'Aiea. The "Naval Reservation" call-out is largely restricted to the south side of East Loch.

The 1924 Evans map of 'Ewa and Waiahole Forest Reserves (Figure 54) provides a somewhat subtle presentation of just how extensive sugarcane plantations had become by 1924 with the annotation of "Upper Limits of Cane." The establishment of sugarcane plantations was associated with a new interest in the maintenance of forest reserves to safeguard a water supply for the thirsty cane fields. This map shows emerging communities at Waiau (within the study area) and at Waimalu (*mauka* of the study area). The 'Aiea plantation community, downslope from the mill (but *mauka* of the study area) is now substantial.

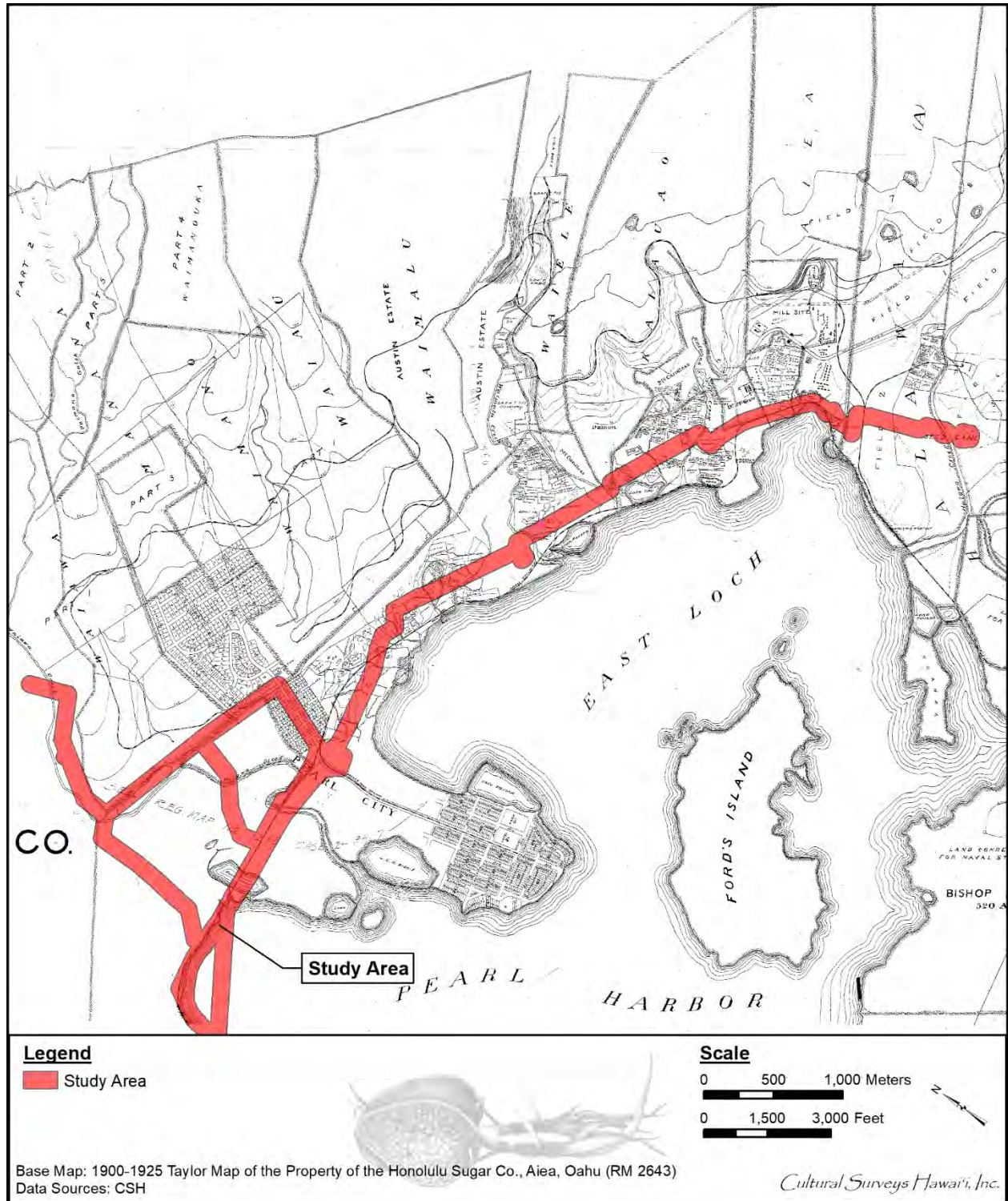


Figure 50. 1900-1925 Taylor map of the property of the Honolulu Sugar Company, Aiea, Oahu showing the central and east portions of the study area

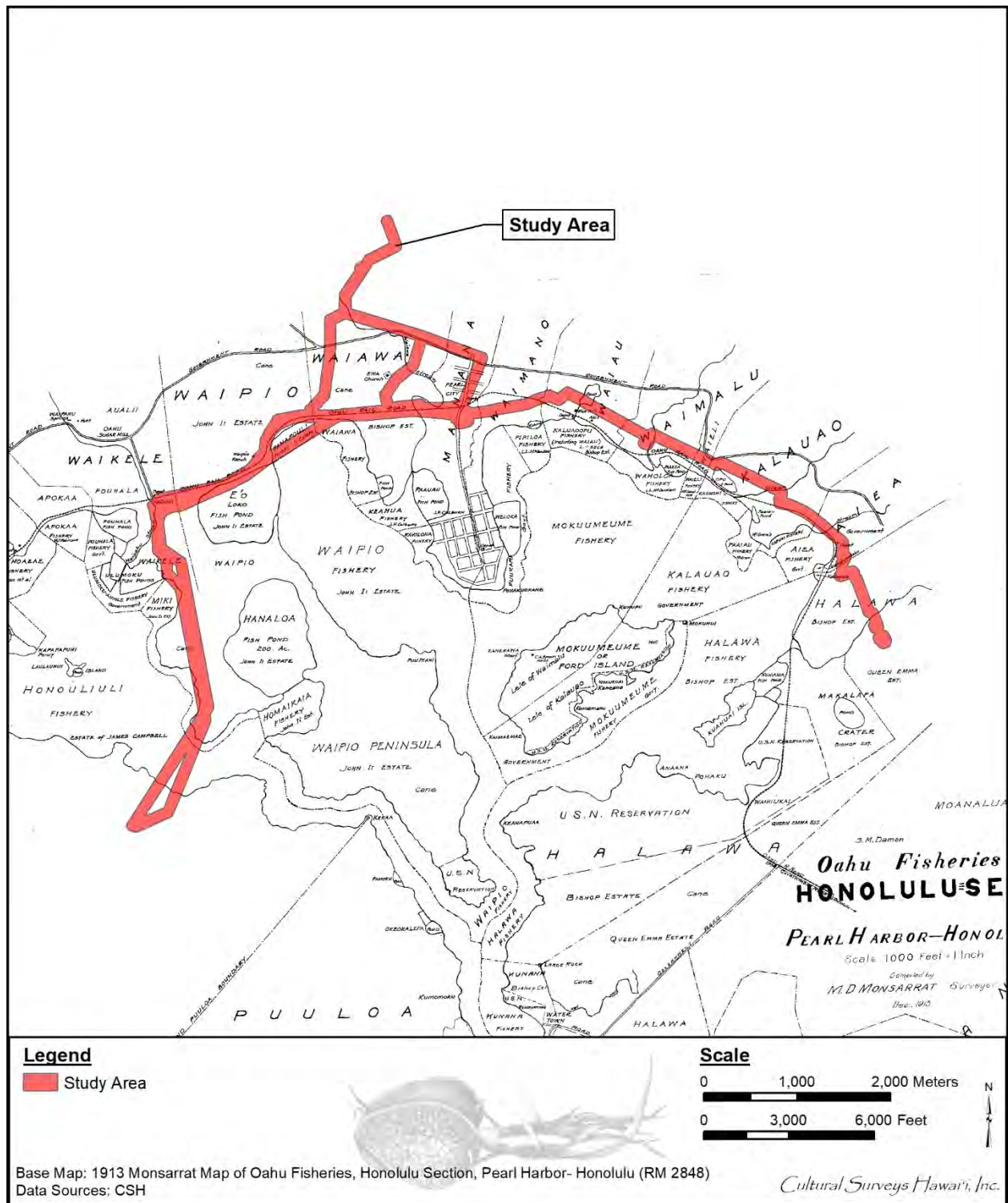


Figure 51. 1913 Monsarrat map of Oahu Fisheries, Honolulu Section, Pearl Harbor-Honolulu showing the study area

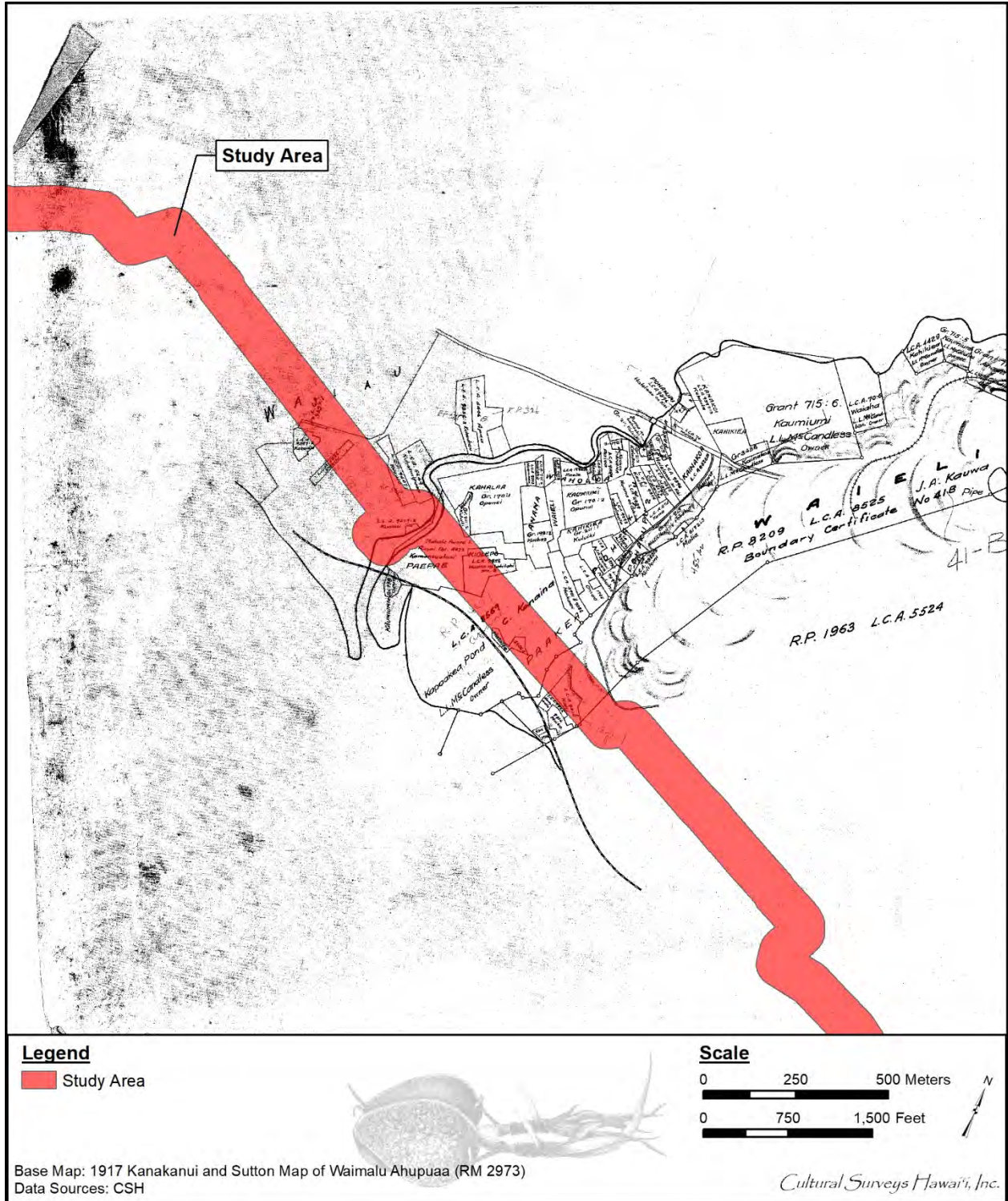


Figure 52. 1917 Kakanui and Sutton map of Waimalu Ahupuaa showing an east portion of the study area in the immediate vicinity of the Waimalu WWPS

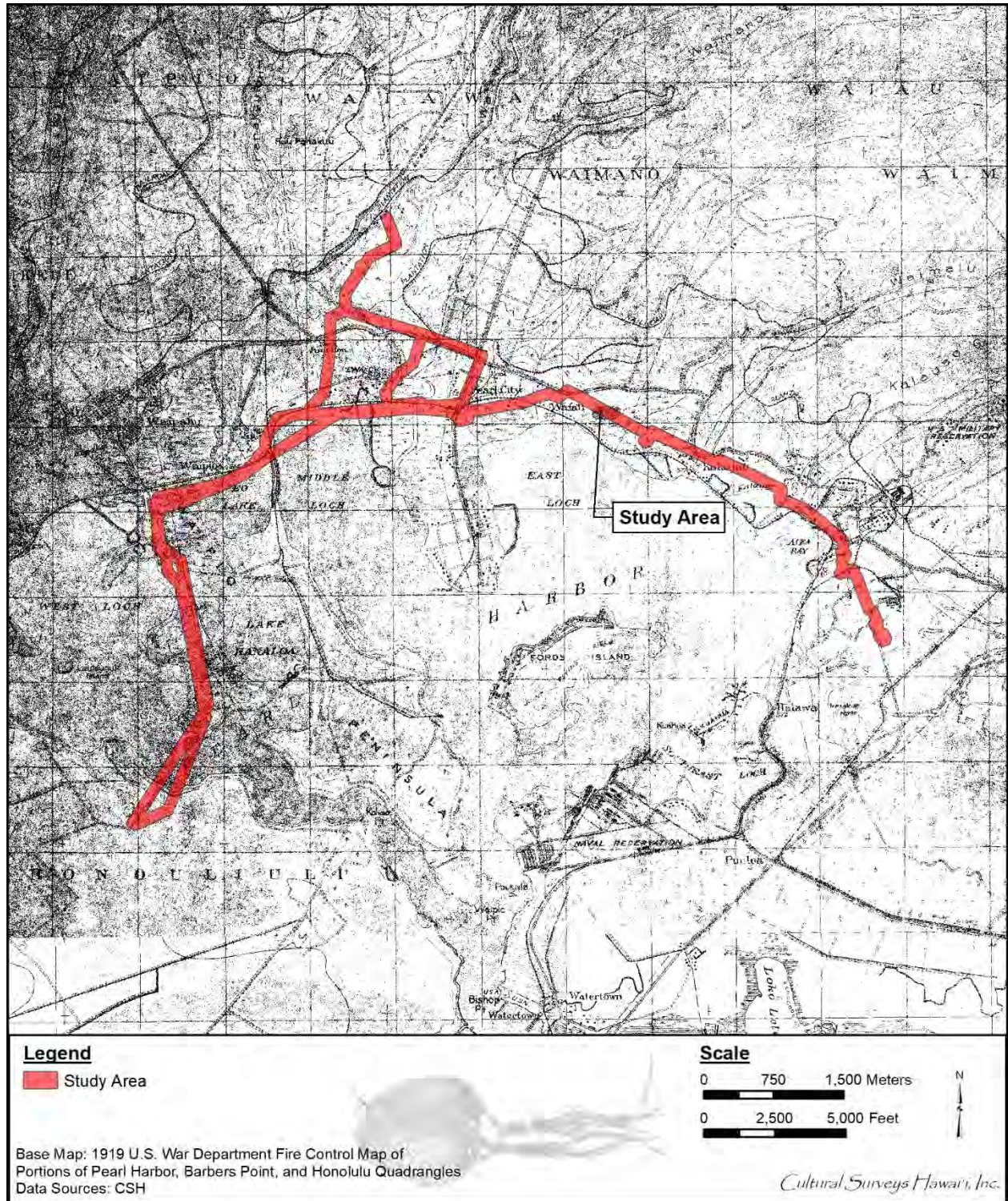


Figure 53. 1919 U.S. War Department fire control map of portions of Pearl Harbor, Barbers Point, and Honolulu Quadrangles showing the study area

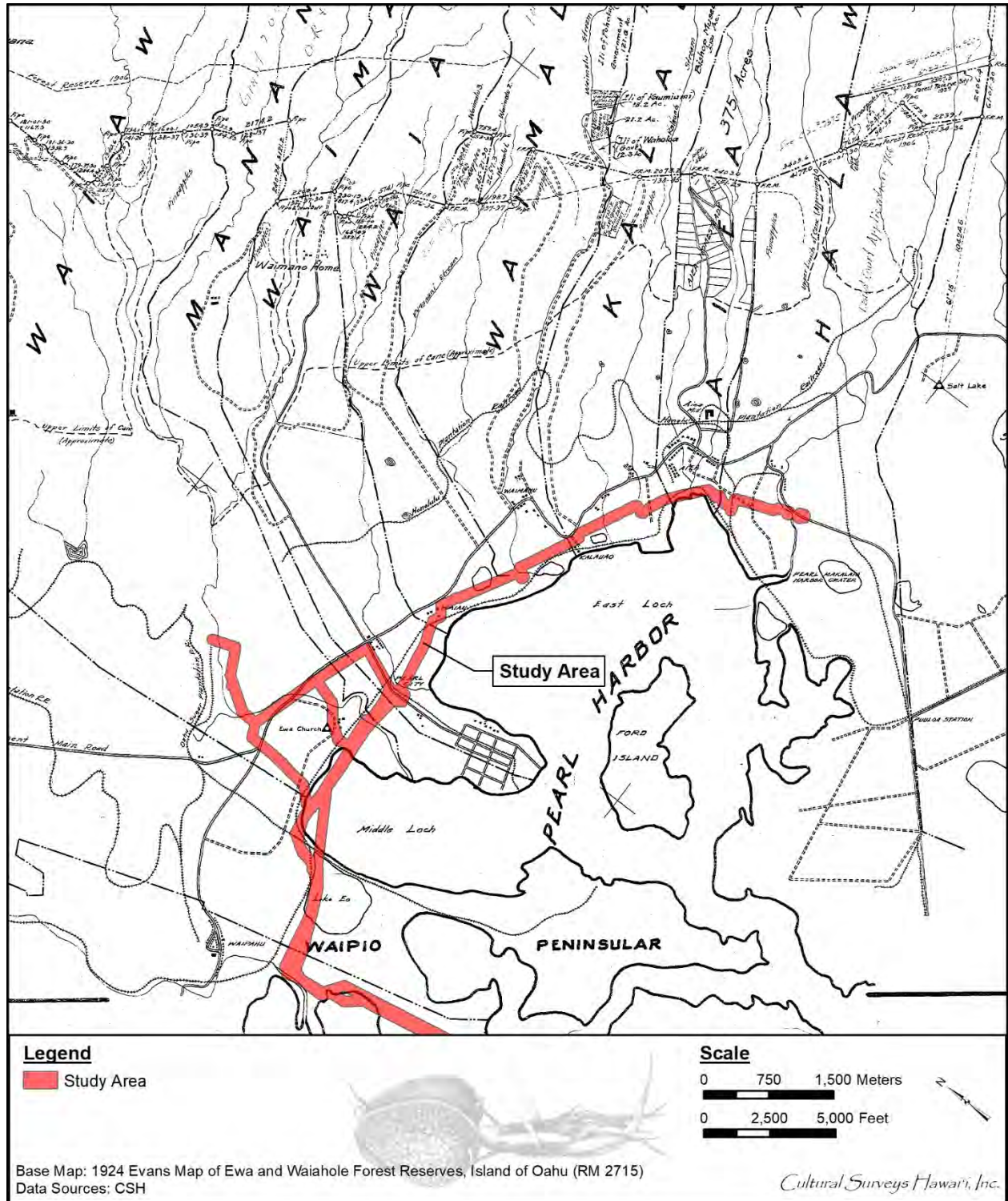


Figure 54. 1924 Evans map of Ewa and Waiahole Forest Reserves showing central and east portions of the study area (best fit, the map seems slightly off)

The 1928/1930 USGS topographic map, Waipahu (1928) and Ewa (1930) quadrangles (Figure 55) calls out Ewa Plantation commercial sugarcane fields and infrastructure in the west (Honouliuli) end of the study area (southeast of West Loch) and calls out Oahu Sugar Company fields and infrastructure on Waipi'o Peninsula. The OR&L railroad has three stations within the study area including the Waipahu Station (near the Waipahu WWPS), Waipio Station (on the northwest side of Loko Eo), and the Pearl City Station (near the Pearl City WWPS). OR&L stations to the east (Waiau Station, Kalauao Station) are along the track line *makai* of the study corridor.

The 1933/1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles (Figure 56; close-up views of the west, central and east portions of the study area in Figure 57, Figure 58, and Figure 59) provide a high level of detail of the study area.

In the west end of the study area in Honouliuli unimproved roads service Ewa Plantation fields (see Figure 57). A plantation company railroad appears to come within 100 m of the study area but is not clearly within the study corridor. Most of the study area southwest of West Loch appears to be in sugarcane fields. Of passing interest, an extensive "Salt Works" is noted just northwest up the coast of West Loch (outside the study area).

Within the study area on Waipi'o Peninsula a pipe line, flume, two reservoirs, an unimproved access road, Waipio Station, and several houses are indicated (see Figure 57). A spur Oahu Sugar Company railroad extends south down the Waipi'o Peninsula to the east but is not shown within the study area. The indication is that most of the Waipi'o Peninsula portion of the study area is under sugarcane cultivation at this time.

In the central portion of the study area (see Figure 58) Loko Eo is still shown as open water with the OR&L and its Waipio Station skirting the north side. A few houses are indicated at the northeast corner of Loko Eo within the study area. While the western *mauka* alignment is largely undeveloped, several houses are shown in the central *mauka* alignment and the eastern *mauka* alignment (Lehua Avenue) is quite developed. A few houses are shown at the extreme north tip of the study area near today's Waihona Street but these are seemingly accessed from the west and not the south. Scattered houses are shown in the study area east of the Pearl City peninsula (in Waimano Ahupua'a).

A big change in the east portion of the study area is that the contemporary coastal Kamehameha Highway is now shown (see Figure 59). Scattered houses are shown but the density is light except at 'Aiea where the plantation town now extends well south of the mill. The large 'Aiea Cemetery now takes up most of the width of the study area.

A sequence of high resolution aerial photos is available from 1939 of the east portion of the study area (Figure 60 through Figure 63), from the west side of the Pearl City Peninsula and Waiawa Ahupua'a across to the east end of the project area in Hālawa Ahupua'a. At least small portions of the study area in each of these *ahupua'a* (Waiawa, Mānana, Waiau, Waimalu, Kalauao, 'Aiea, and Hālawa) appear to be in sugarcane cultivation. It appears the land near the Waimalu WWPS/ Blaisdell Park was in sugarcane as was most of the east end of the study area in Hālawa Ahupua'a. A lot of the land in the eastern study area is now in homes and under the new Kamehameha Highway, a lot is in diversified agriculture (truck crops), and a lot is undeveloped.

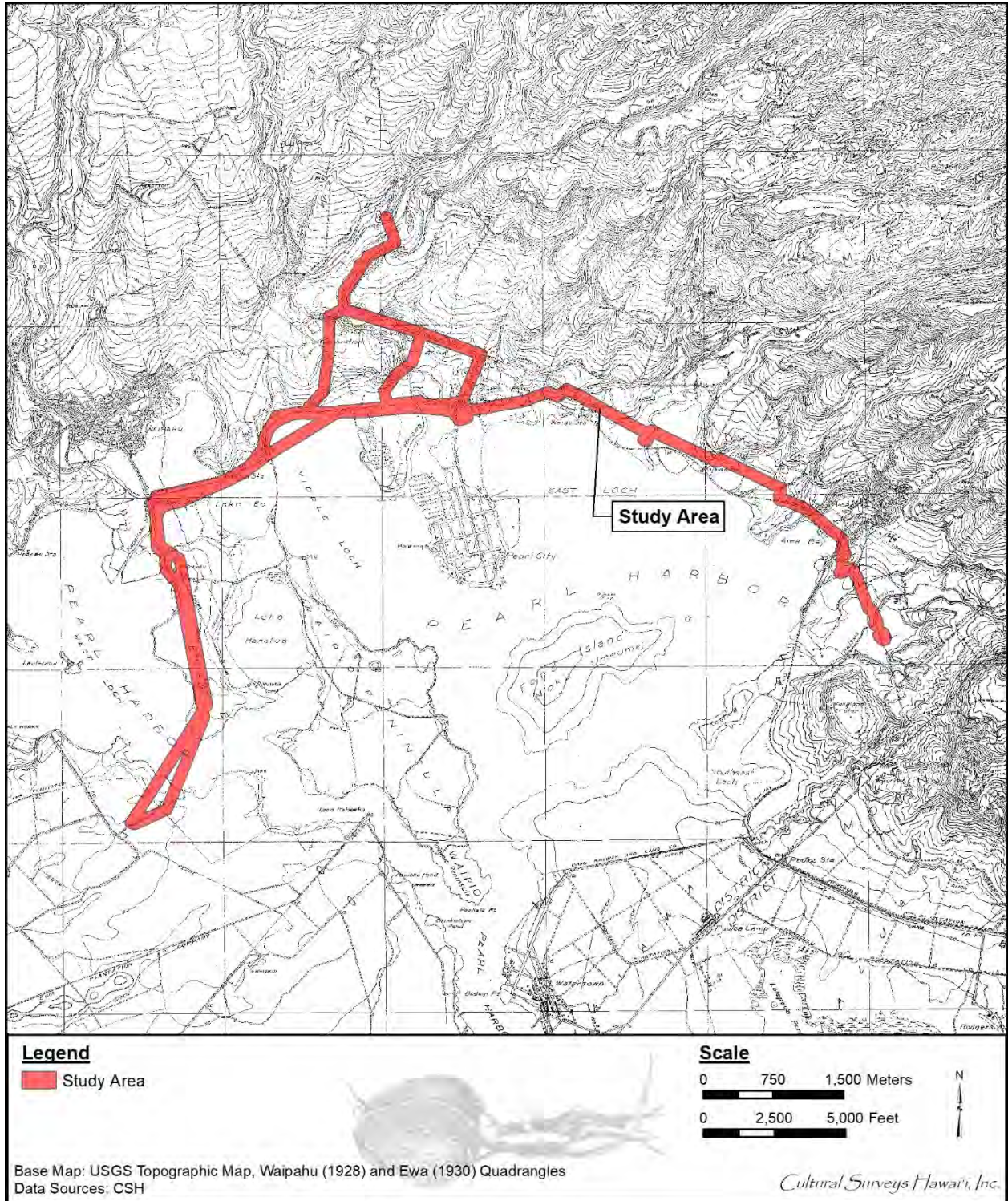


Figure 55. 1928 Waipahu and 1980 Ewa USGS topographic quadrangles showing the project area

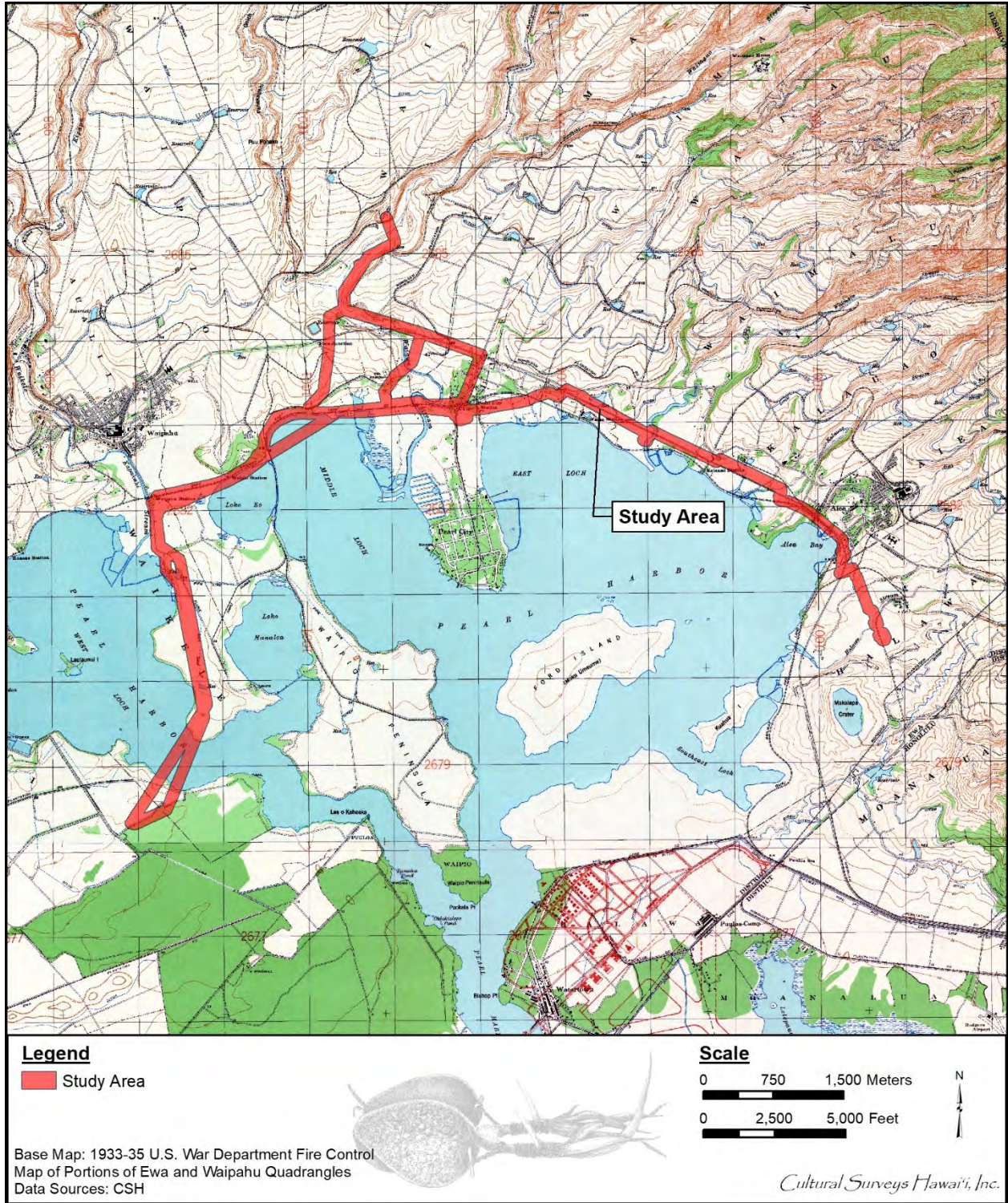


Figure 56. 1933-1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles showing the study area (see following figures for close-ups)

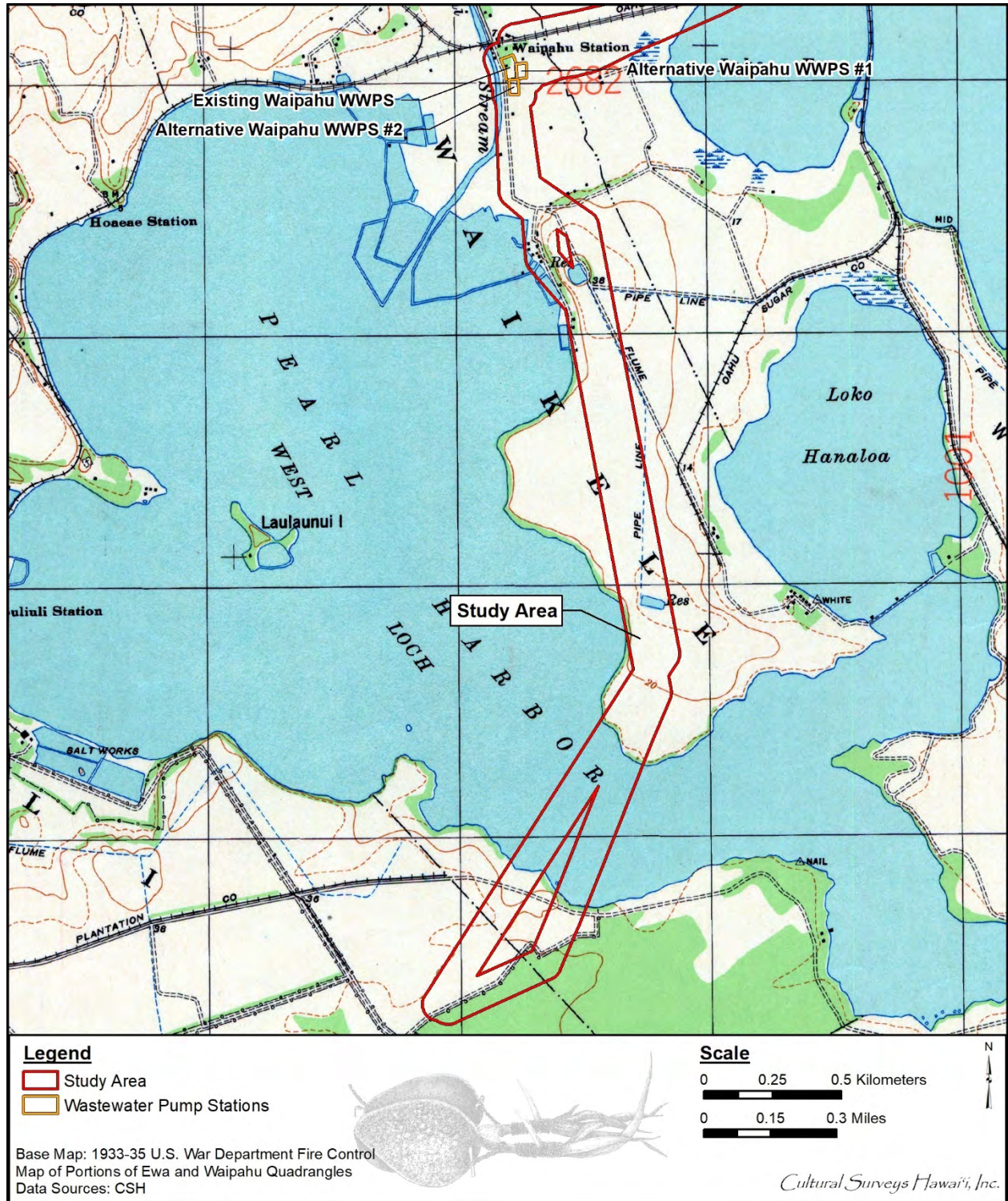


Figure 57. 1933-1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles showing the west portion of the study area

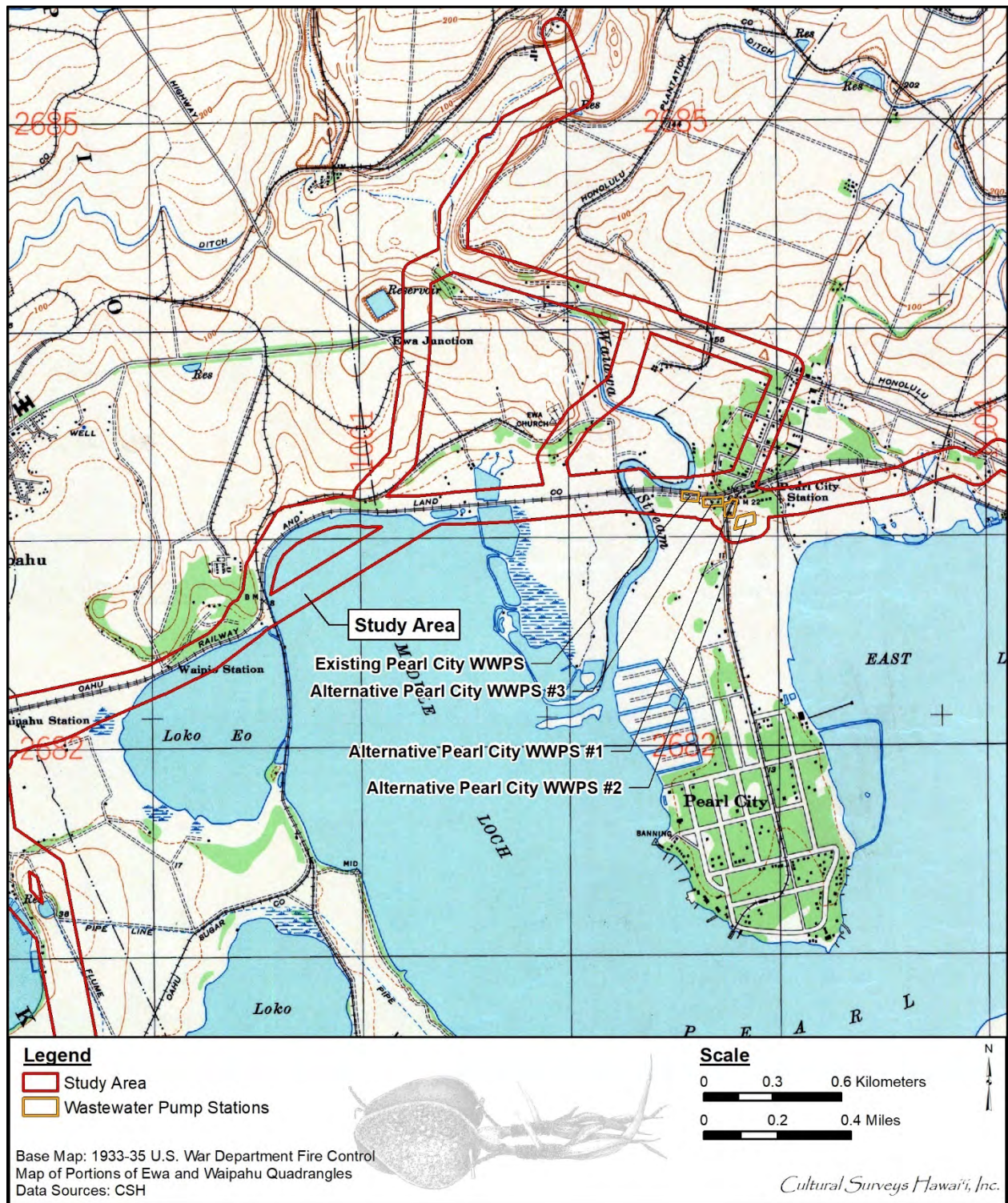


Figure 58. 1933-1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles showing the central portion of the study area



Figure 59. 1933-1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles showing the east portion of the study area

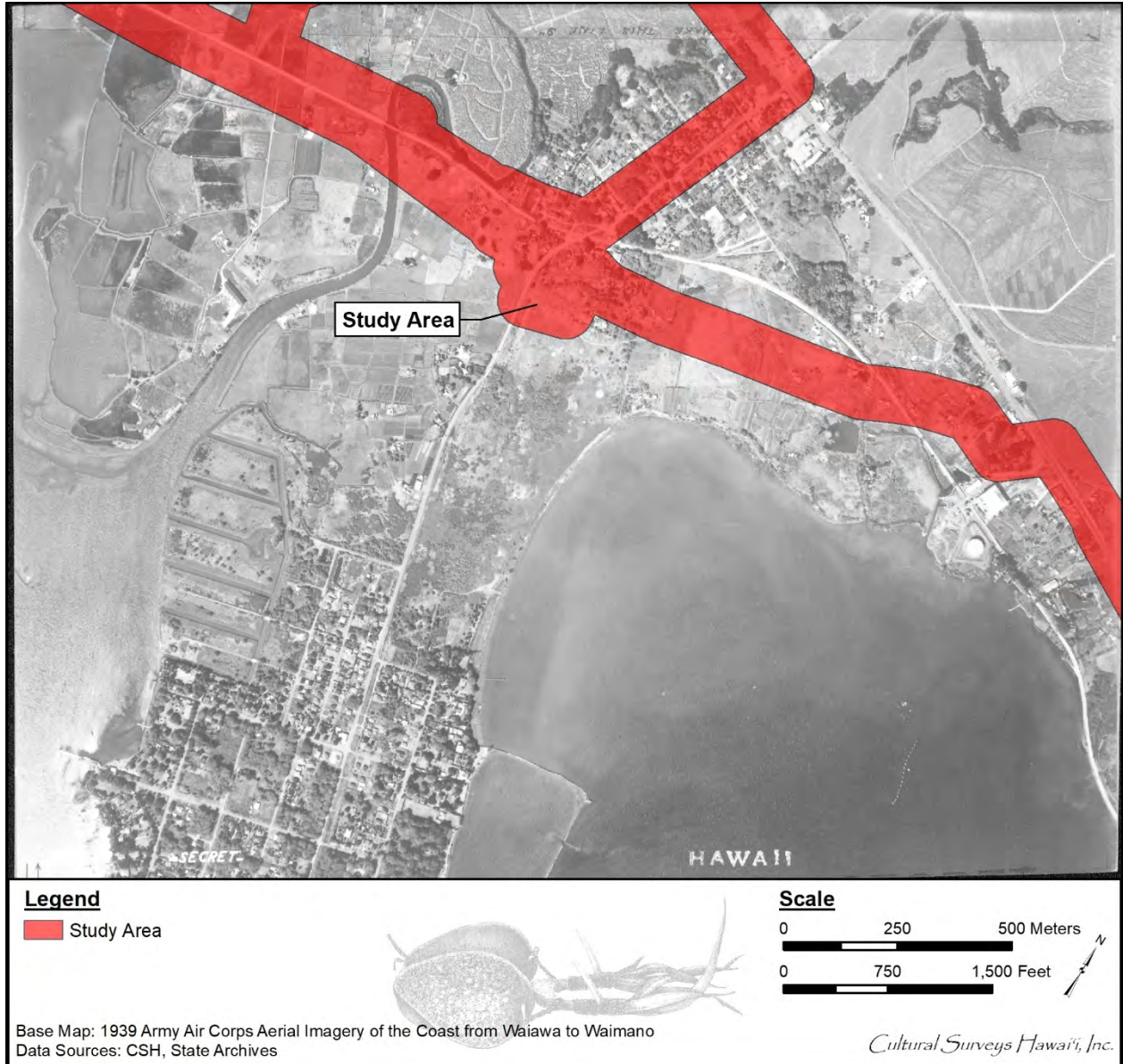


Figure 60. 1939 Army Air Corps Aerial Imagery of the coast from Waiawa to Waimano showing a portion of the central and eastern study area

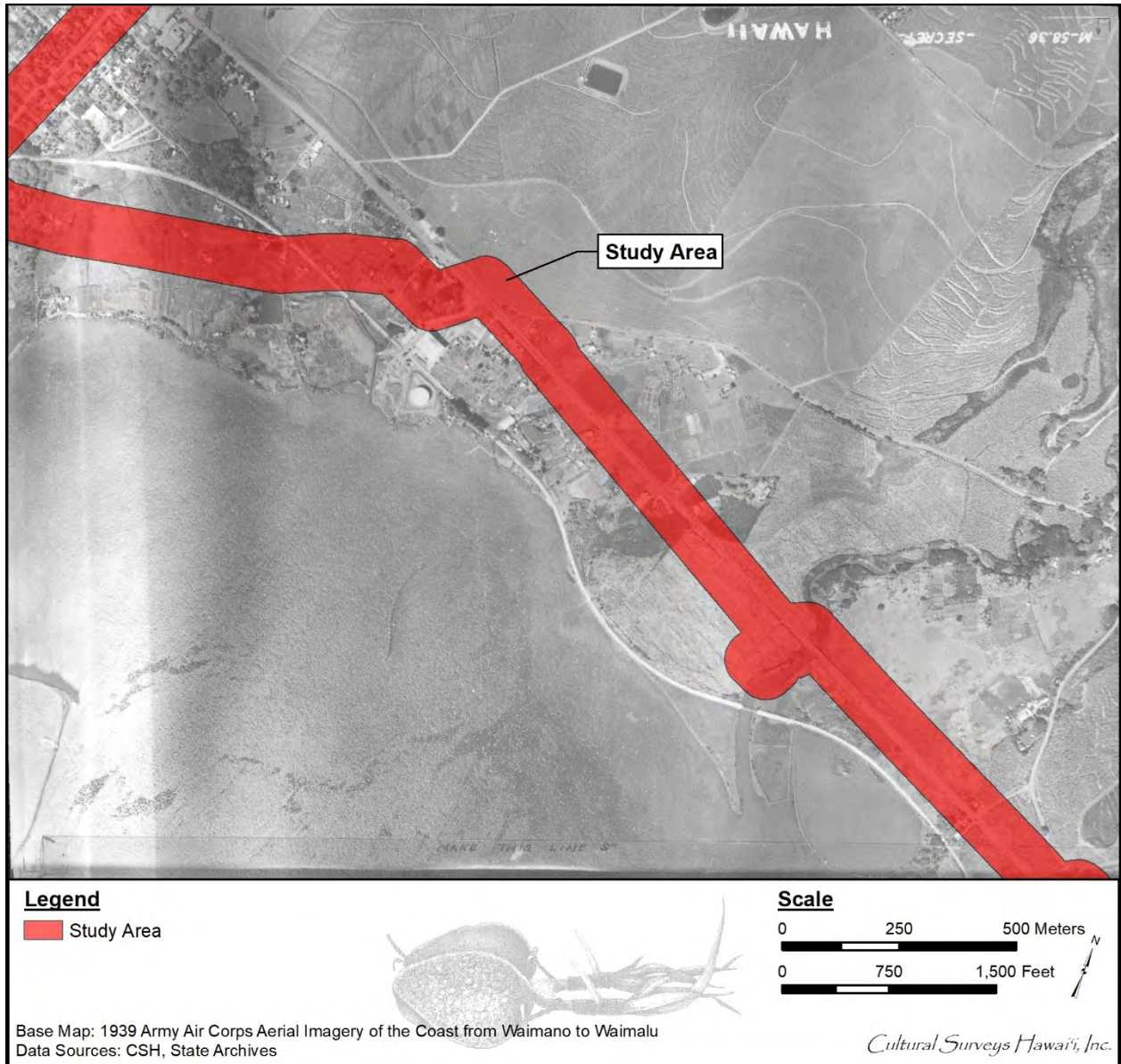


Figure 61. 1939 Army Air Corps Aerial Imagery of the coast from Waimano to Waimalu showing a portion of the central and eastern study area

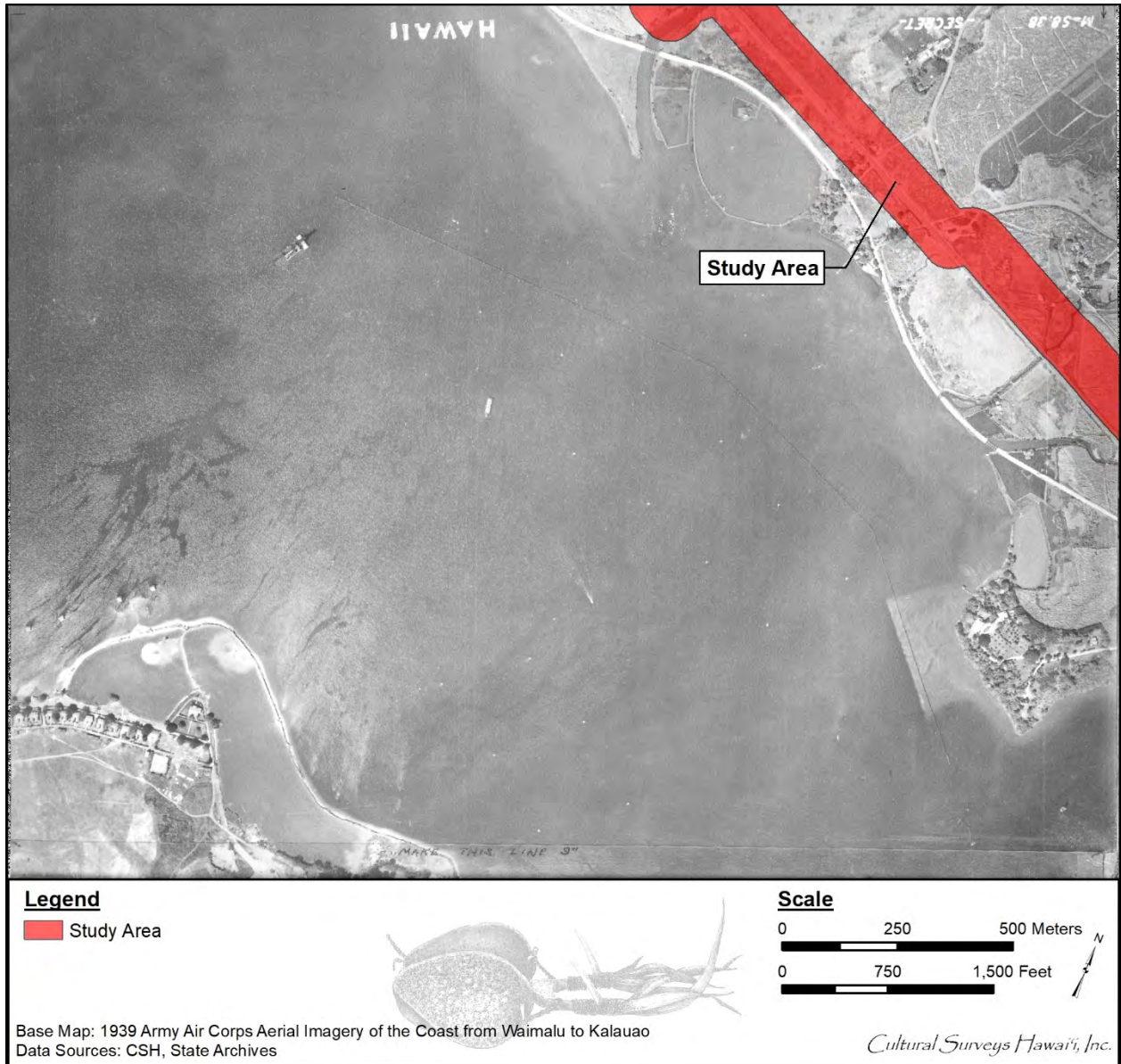


Figure 62. 1939 Army Air Corps Aerial Imagery of the coast from Waimalu to Kalauao showing a portion of the eastern study area

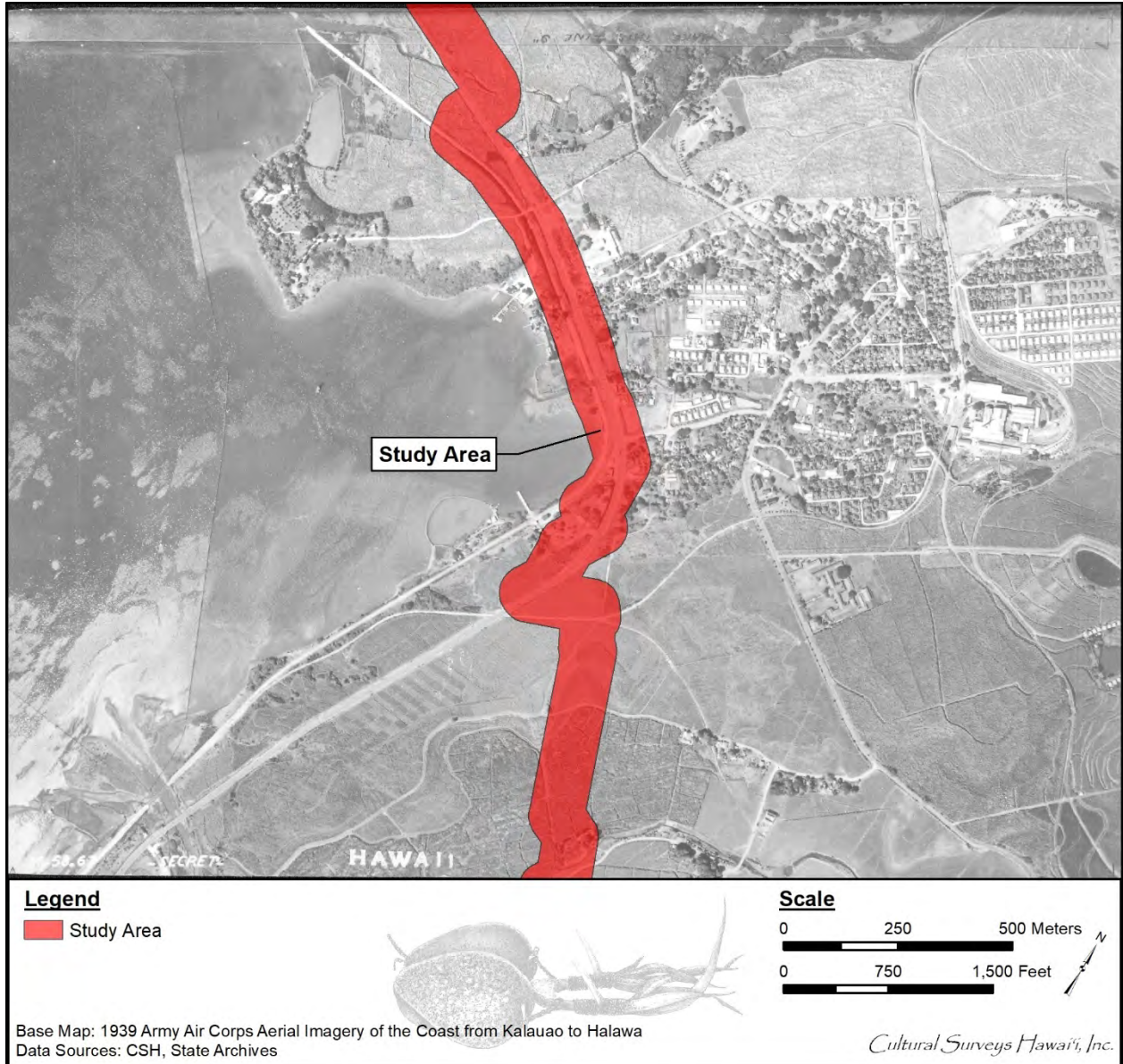


Figure 63. 1939 Army Air Corps Aerial Imagery of the coast from Kalauao to Halawa showing a portion of the eastern study area

3.12 World War II and the Military in 'Ewa

By 1941, Pacific Naval Air Bases expenditures for new construction at Pearl Harbor were in the hundreds of millions of dollars transforming Pearl Harbor (Figure 64; the new *mauka* Waihona Street alignment is shown in this map). The Japanese attack on Pearl Harbor, 7 December 1941, damaged or destroyed much of the new construction. Reconstruction was instituted to double the Pearl Harbor's war capacity. Military planners approved a new ammunition depot in the mountainside of Waipahu, a large new hospital in 'Aiea, and thousands of additional changes to the Navy Yard to accommodate the new aircraft carrier task forces (Woodbury 1946:342–343). During World War II, the military used the sugarcane rail system to “haul large quantities of ammunition” (Condé and Best 1973:315).

By 1943, over 24,000 people were working at Pearl Harbor. Navy Housing Areas 1 and 2 and Civilian Housing Area 3 had grown large enough to be considered separate cities. Barracks and temporary housing for workers filled every available piece of land for miles between Pearl Harbor and the outskirts of Honolulu. A ring of huge barrage balloons was set up for the protection of the once-quiet waters of Waimomi, which had since become one of the greatest Navy bases in the world (Downes 1953).

Before the war, the main Pearl Harbor Naval Yard was sufficient for a staging and storage area for the Pacific fleet, but after the Japanese attack and the beginning of World War II, additional areas were needed for supply depots and warehouses. The government procured additional land after the beginning of World War II to expand the functionality of the military bases. The Navy took all of the coastline area in eastern 'Ewa District from the coast inland of the OR&L railroad tracks (Ching 1996:24). Waipi'o Point, Waiawa Gulch, Pearl City (Mānana) Peninsula, Iroquois Point in Hālawa, and small areas in Honouliuli and Hō'ae'ae were taken over as supply depots and storage areas. The OR&L railroad had built a spur from the coast to Wahiawa in 1905, to haul cane and pineapples down to the coast and later to haul men and supplies from Pearl Harbor to Schofield Barracks in Wahiawa through Waikakalaua Gulch in Waikele. During the war, the military built a “secret railroad” from the railroad terminus at Waikakalaua Gulch to join the OR&L railroad coming around Ka'ena Point at Hale'iwa, thus providing a short cut from Pearl Harbor to Army facilities at Kahuku on the north shore of O'ahu (Kneiss 1957:11–12). By 1944, the Navy had claimed close to 2,400 acres of land in the Pearl Harbor and Pearl City areas within Mānana, Waiawa, and Hālawa for use as military staging areas in the war effort (Allen 1999:234).

Four main portions of Waiawa were used by the military—the Pearl City Peninsula *makai* of Kamehameha Highway, a storage area along Waiawa Stream *mauka* of the highway, a diesel drum storage area at Ewa Junction, and a military reservation in upland Waiawa used for communications and training (Allen 1999:234). The military reservation in Waiawa was 650.0 acres consisting of both gulch and plateau lands. From 1941 to 1945, the reservation was used as a training area for tanks and personnel and as an artillery impact area. The area was also used for the storage of munitions and supplies. The primary structure built by the military was a communications center. This center consists of four buildings and a tunnel system. The communications center is currently being used by the State of Hawai'i as a minimum security prison (Waiawa Correctional Facility).

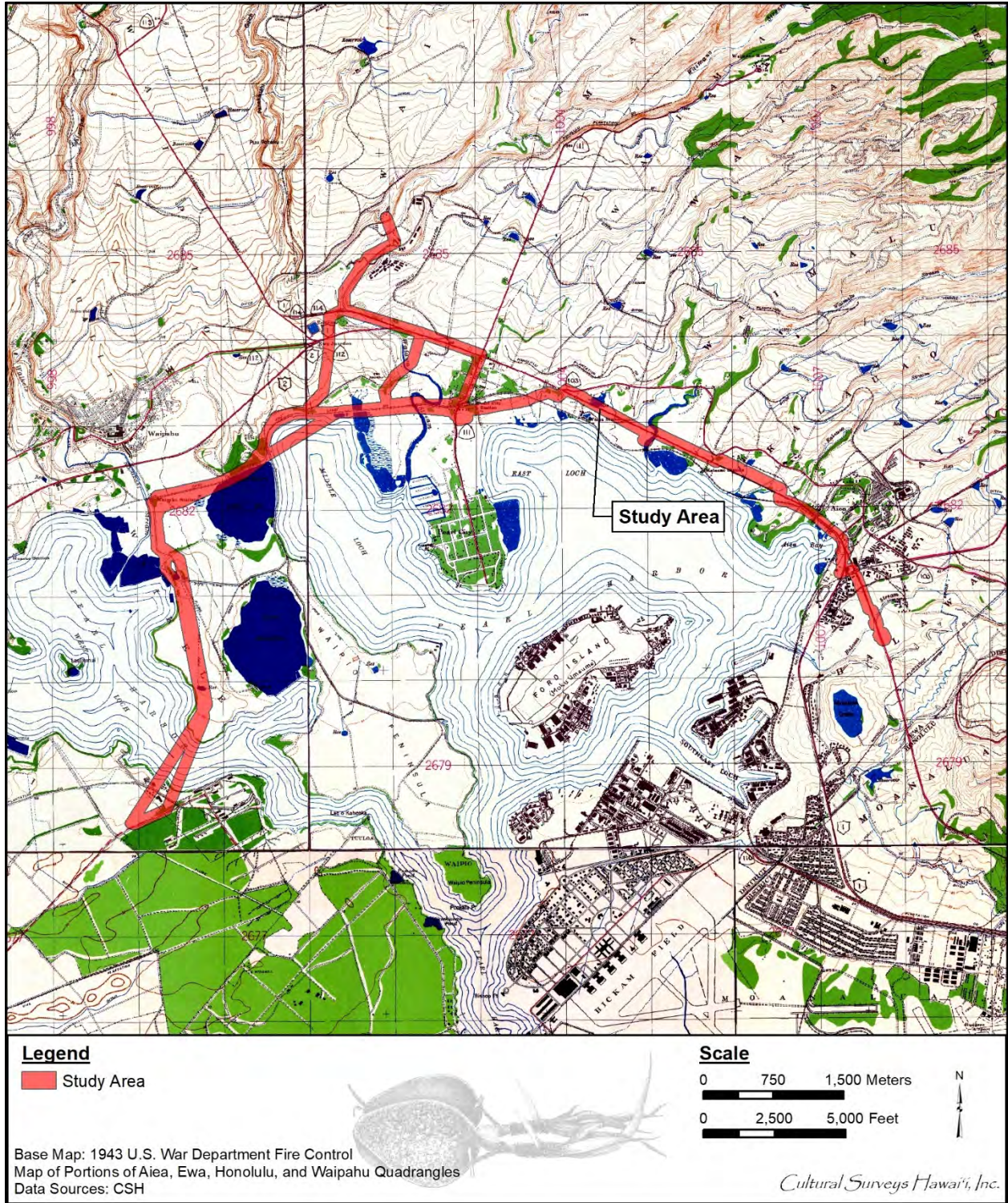


Figure 64. 1943 U.S. War Department fire control map of portions of Aiea, Ewa, Honolulu, and Waipahu quadrangles showing the study area

On the Pearl City Peninsula in Mānana, three large warehouses were built for a storage area. Other sections of the peninsula, including the Waiawa portion, were used for supply depot warehouses and spare part distribution centers. One of these was the U.S. Navy Mānana Supply Center, now known as the U.S. Navy Mānana Storage Area. A 25-acre portion of the former Supply Center on the Waiawa side of Mānana Peninsula was set aside in 1972 as a portion of the Pearl Harbor National Wildlife Refuge. This refuge for endangered wetland water birds was set up in the former area of Loko Kuhialoko and Loko Mo'ō. A non-contiguous section of the U.S. Navy Mānana Storage Area was located *mauka* of Kamehameha Highway. It began as an aviation supply depot on the border between Waiawa and Mānana. The Navy built 50 wood-frame structures and spaced open storage areas along the banks of Waiawa Stream for 2 miles (Allen 1999:238).

The Ewa Junction Fuel Drumming Facility was built on a 44-acre site in 1943 as a fuel drumming and transportation terminal at the site of the old OR&L railroad junction. Thus, it had railroad lines to the Pearl Harbor Shipyard and Hickam Air Field to the east, to Barbers Point Naval Air Station and other bases in Waianae to the west, and to Schofield Barracks and Wheeler Air Field Base to the north. The facilities consist of two 585,000-gallon fuel storage tanks, a fuel drumming building, and associated piping. The site has been inactive since the 1970s (Allen 1999).

Following World War II, much of the lower lands of Waiawa and Mānana remained part of the Naval Reservation and were used mainly as housing for military families and also sites for military warehousing. To this day, much of the Pearl City Peninsula remains in the custody of the U.S. Navy; however, in the late 1990s, much of the rest of the previous Pearl City regions were released to the state for public use (Allen 1999:239).

A supply depot for fuel drums called the Waiiau Drum Storage was also set up along the coast. This site is actually in Waimalu Ahupua'a. It was built on land the U.S. Navy purchased from the OR&L in 1942, and it was used to clean and store empty fuel drums. Between 1943 and 1963, waste oils were destroyed at the site (Dega and O'Rourke 2003:15). In 1963, the U.S. Navy gave the land to the City and County of Honolulu, which created the Neal Blaisdell Park on the property.

The peninsula on the west side of 'Aiea Bay is used for military housing. It currently consists of 140 single-unit, single-story homes, most of which were built in 1960. Upper 'Aiea, adjacent to the western border of Kalauao, was used as a base for the Aiea Anti-Aircraft Battery during World War II. 'Aiea Heights developed into a residential area in the 1930s, and the former battery area was converted into Nāpuanani Park (Dega and O'Rourke 2003:16).

Developments at Pearl Harbor during World War II were, as a sweeping generalization, focused on southeast East Loch, Ford Island, and the area of the Pearl Harbor entrance—away from the present study area. The most important event near the present study area was the West Loch Disaster of 21 May 1944 when 163 men lost their lives (estimates of deaths vary from 132 to 392), with another 400 injured (Figure 65 and Figure 66). Six Landing Ships, Tank (LSTs, 328 ft long) were destroyed, with two damaged beyond repair, and three Landing Craft Tank (LCTs, 152 ft long), lashed to the decks of sunken LSTs, were also lost, as were a number of Landing Vehicle Tracked (LVTs) parked nearby. Eleven wooden buildings on the shore were destroyed.

This incident occurred in the Waipi'o Peninsula side of West Loch which was a staging area for the invasion fleets of the Pacific. On the morning of 21 May, 29 LSTs readied themselves for



Figure 65. Smoke billows from ships at the Waipi'o Peninsula side of West Loch during the disaster of May 1944. The ships had been in the process of being loaded with the tanks in the foreground, which would be used for the retaking of the Mariana Islands during World War II.



Figure 66. The hull of the partially beached LST-480 was left on Waip'io Peninsula.

the invasion of Saipan by the Allied forces. They were to be a crucial part of Operation Forager, which was the Allied term for the Saipan invasion. A typical LST had 119 men and 200 marines, 80 to 100 drums of high-octane fuel, and its own magazine and fuel capacity of 200,000 gallons.

The disaster began at 3:08 pm, when an explosion happened on the deck of LST-353. The ammunition and fuel stores onboard were ignited. The blast originated near the bow of the LST-963, which was unloading mortar ammunition from the ship. These explosions also affected other ships berthed close nearby, igniting more explosions from the onboard ammunition. Firefighters could not reach the ships due to the high explosives and flames. Many members of the crews attempted to put out the flames but were unsuccessful. Other ships and the rescue boats suffered extreme damage from the explosions.

Eleven wooden buildings were destroyed and 20 more onshore buildings were severely damaged by the explosions that continued for 24 hours. The cause of this disaster is unknown to this day. The Navy undertook an inquiry almost immediately but issued no court-martials or reprimands. The affair was kept secret until 1960 and the relatives of dead crewmen were only informed that they were “missing.” Two major reasons are generally given for the cause of the explosions: either gasoline vapor or one or more mortar shells exploded while being handled.

The sailors effected were disproportionately African American. Particularly hard hit by the disaster was the 29th Chemical Decontamination Unit. Often asked to do hard or perilous tasks that other sailors did not want to do, the Unit was called to transfer ammunition on the LST-353. In a commemorative statement, the speaker claimed they were not properly trained on how to handle the mortar munitions and may have mishandled them due to Navy racism and lack of preparation.

Though the affair was classified top secret, the Navy did make recommendations in the wake of the disaster. It was recommended that they discontinue the policy of nesting ships close together to avoid explosions spreading. This was rejected by Admiral Chester Nimitz, who believed that nesting ships was the only option due to the lack of space. A later disaster in a different port caused permanent Navy changes regarding the handling of mortar shells and properly training Navy personnel.

The West Loch Disaster is understood to have been centered approximately 500 m east of where the project area crosses West Loch. Unexploded ordinance was almost certainly widely scattered in this disaster and may be present in the study area.

3.13 Development of the Study Area as Reflected in Late Twentieth Century Maps

The 1951 map of U.S. Naval Ammunition Depot, West Loch Branch (Figure 67) shows the extensive munitions storage area at the southwest end of the study area (in Honouliuli, southwest of West Loch). Because of the munitions storage and other military considerations, much of the Honouliuli and Waipi'o Peninsula portions of the project area remain remarkably restricted up to the present day. Thus, for example, the need for special access, a special photograph permit, and Navy review of all photographs prior to release for these areas in the present study.

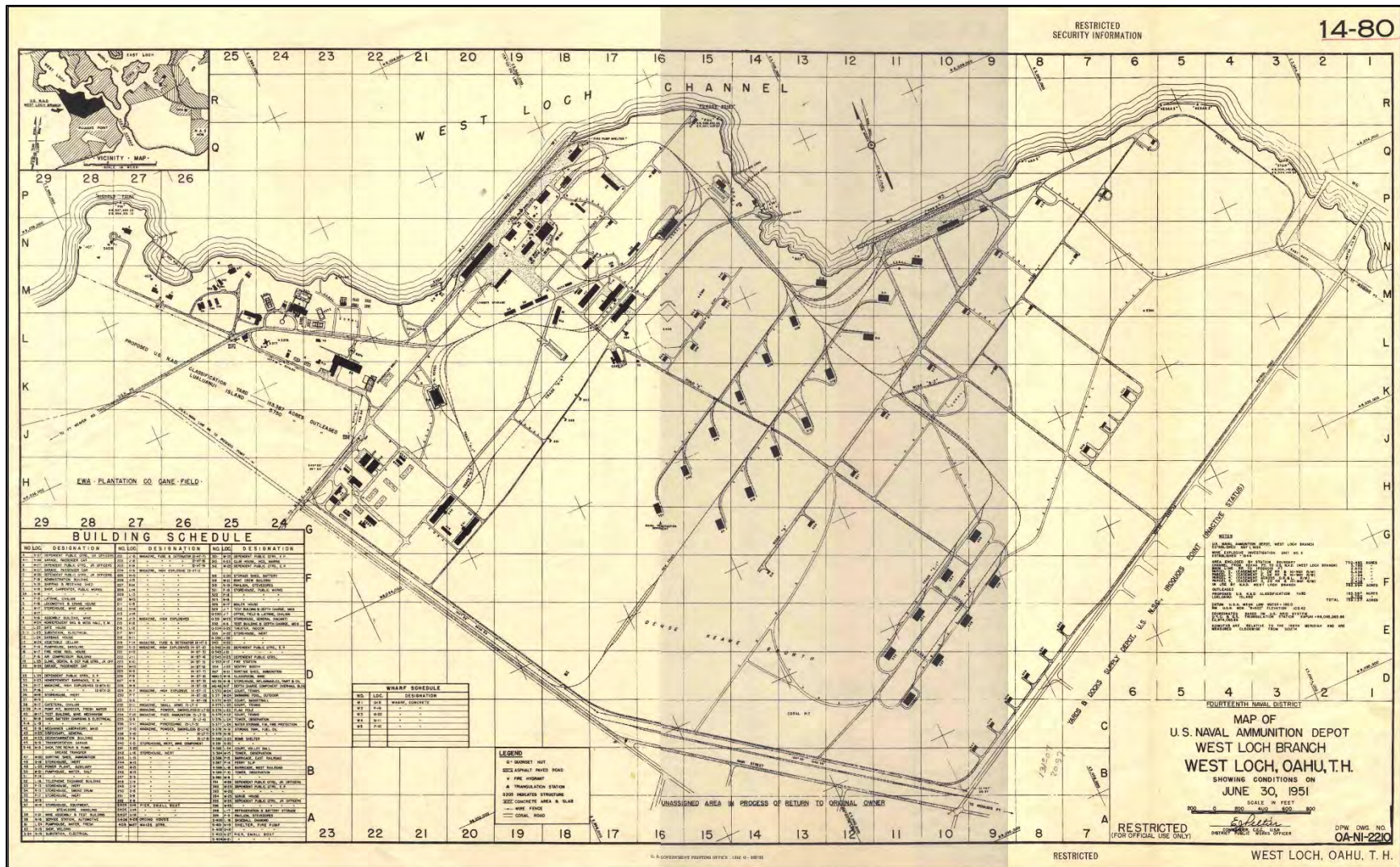


Figure 67. 1951 map of U.S. Naval Ammunition Depot, West Loch Branch, T.H. showing the area at the southwest end of the study area (in Honouliuli, southwest of West Loch)

A series of 1952 USGS high resolution aerial photos (Figure 68 through Figure 70) provide a good picture of the central and eastern portions of the study area at that time. The area north of Middle Loch and north of the Pearl City peninsula (see Figure 68) remains rather agrarian with the exception of Dillingham's Pearl City development in the vicinity of Lehua Avenue and a massive warehouse complex *mauka* of Kamehameha Highway in Waiawa and Mānana *ahupua'a*. The study area in Waiālu Ahupua'a has become quite built up on both sides of Kamehameha Highway but the Waimalu and Kalauao lands to the east are relatively undeveloped (see Figure 69). 'Aiea town is remarkably developed (see Figure 69 and Figure 70) but the Hālawā end of the study area is largely in sugarcane fields (see Figure 70).

A 1953/1954 U.S. Army Mapping Service topographic map, Puuloa (1953), Waipahu (1954) quadrangles (Figure 71) includes close-ups of the western, central, and eastern portions of the study area (Figure 72, Figure 73, and Figure 74). The complexities of the Naval Ammunition Depot (as shown on Figure 67) on the Honouliuli west end of the study area are apparent (see Figure 72). Waipi'o Peninsula is now called out as a "Naval Reservation." The peninsula remains relatively undeveloped except for the vicinity of a bifurcation of study area corridors where approximately 18 structures are shown (see Figure 72). A structure is shown at the Waipahu WWPS. Crossing the north side of Middle Loch there are few buildings but Pearl City to the east is sprawling (see Figure 73). Buildings are indicated at the existing Pearl City WWPS. Further to the east the present day Blaisdell Park and existing Waimalu WWPS are shown as another "Naval Reservation," as is the McGrew Point area (see Figure 74). A couple of houses are indicated at the east end of the project area but this vicinity remains relatively undeveloped (see Figure 74).

A pair of 1962 USDA high resolution aerial photos of Pearl Harbor (Figure 75 and Figure 76) provide a wealth of detail. A large blacked-out area south of the Honouliuli end of the study area and Waipi'o Peninsula south of the study area attest to Navy security concerns (see Figure 75). This is in an odd juxtaposition with the extensive sugarcane fields shown within the vicinity of this portion of the study area. The area north and northeast of Middle Loch remains quite undeveloped. Growth in the Pearl City, Waimalu, and 'Aiea areas has taken off following Statehood (see Figure 76).

The 1968 map series (Figure 77 through Figure 79) and the 1968 aerial photo series (Figure 80 through Figure 82) show the continuing pattern of urban growth. The Honouliuli and Waipi'o Peninsula portions of the study area are still largely in sugarcane fields (see Figure 77 and Figure 80). The area north of Middle Loch is still relatively undeveloped but Leeward Community College is being established in 1968 (see Figure 78 and Figure 81). Hālawā has finally become developed (see Figure 79 and Figure 82).

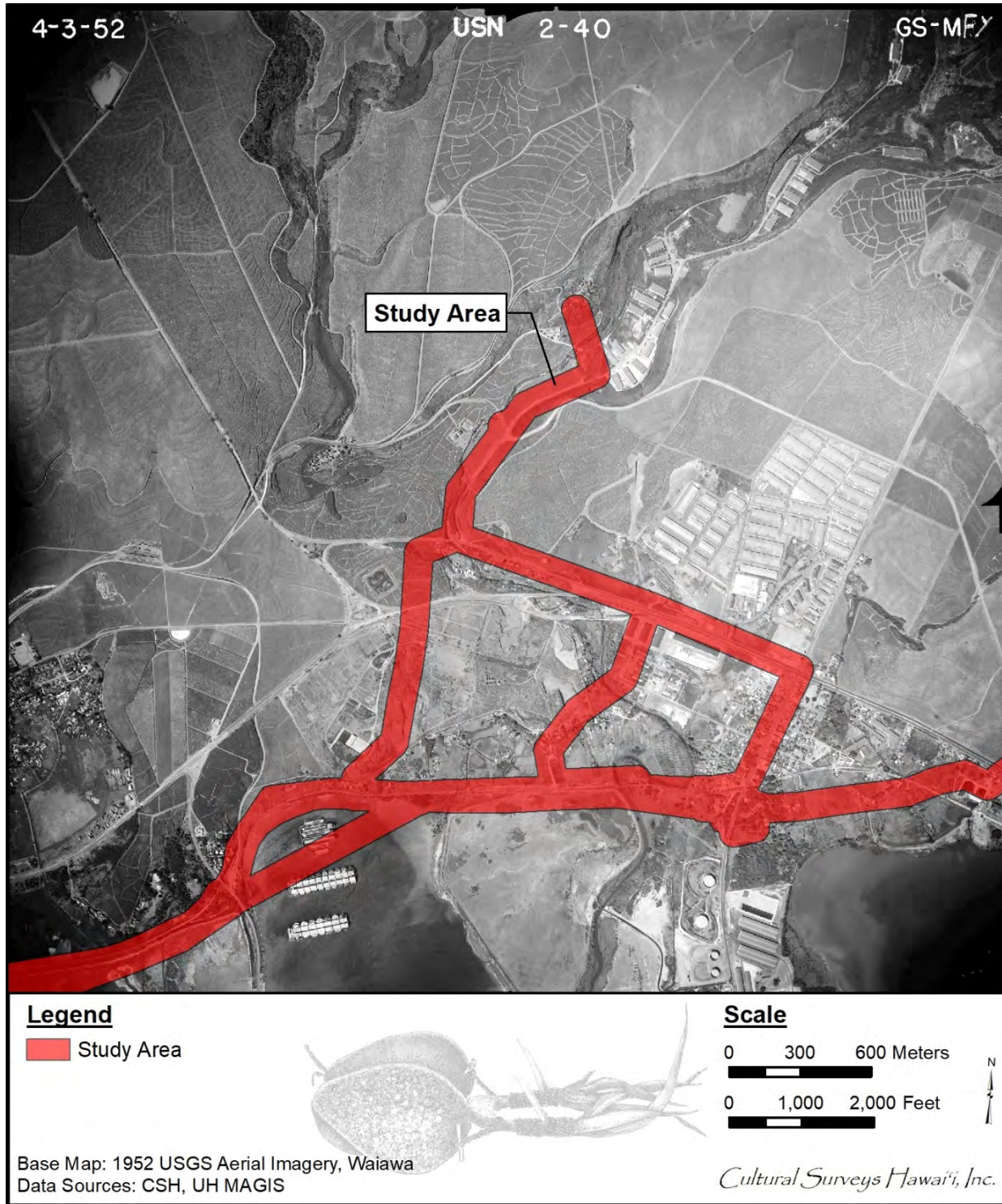


Figure 68. 1952 USGS Aerial Imagery, Waiawa photo showing the central portion of the study area

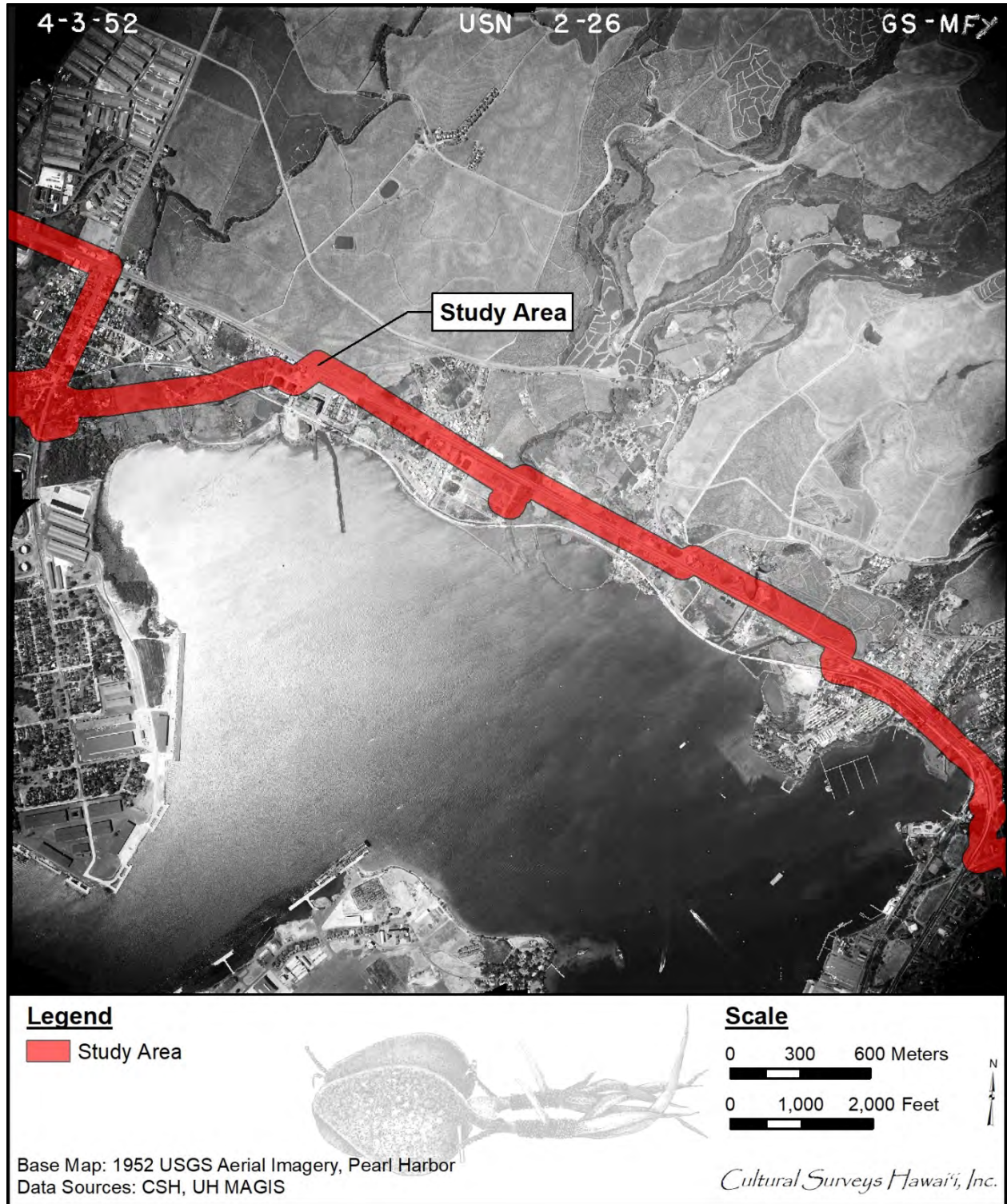


Figure 69. 1952 USGS Aerial Imagery, Pearl Harbor photo showing the east portion of the study area

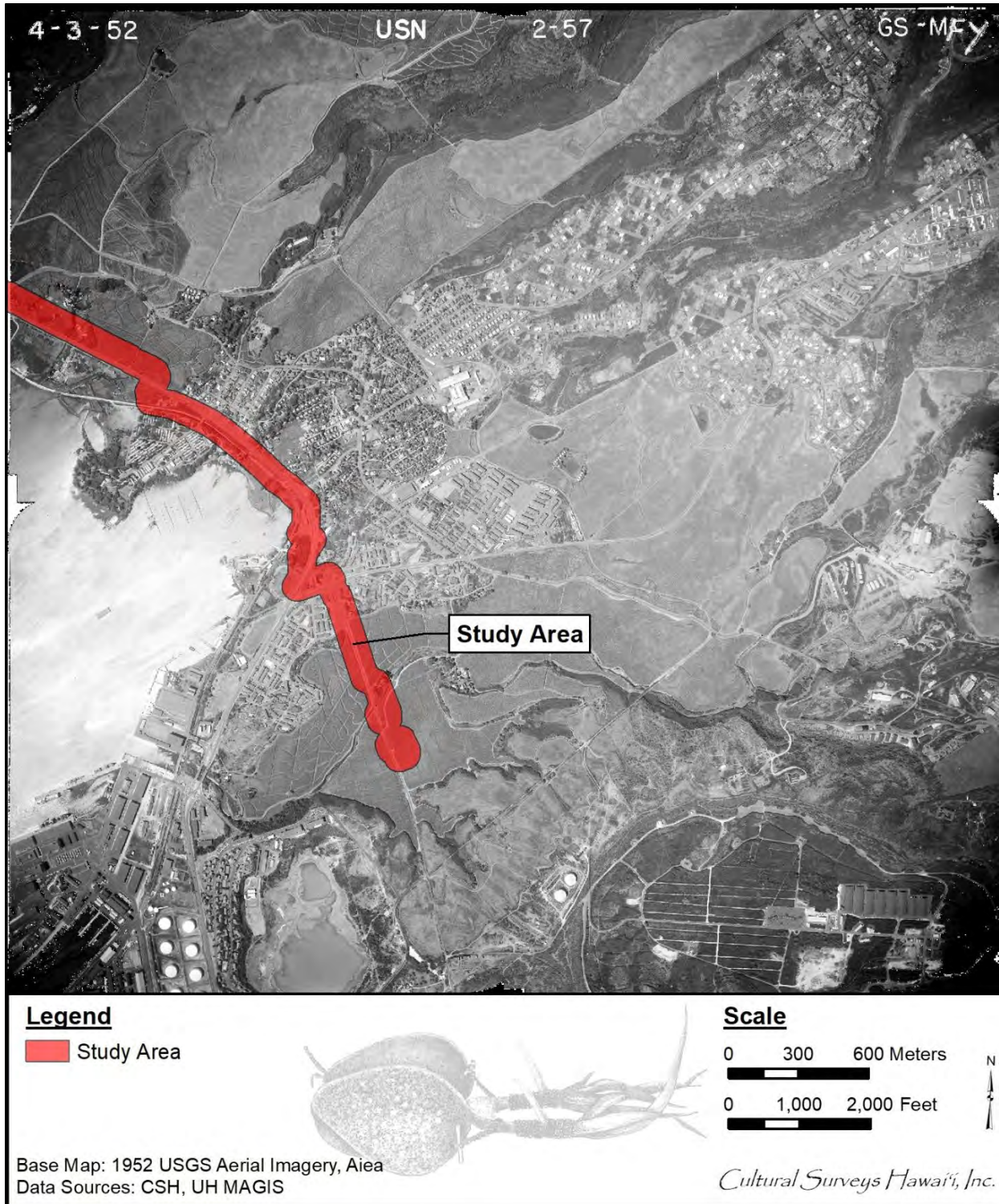


Figure 70. 1952 USGS Aerial Imagery, Aiea photo showing the east end of the study area

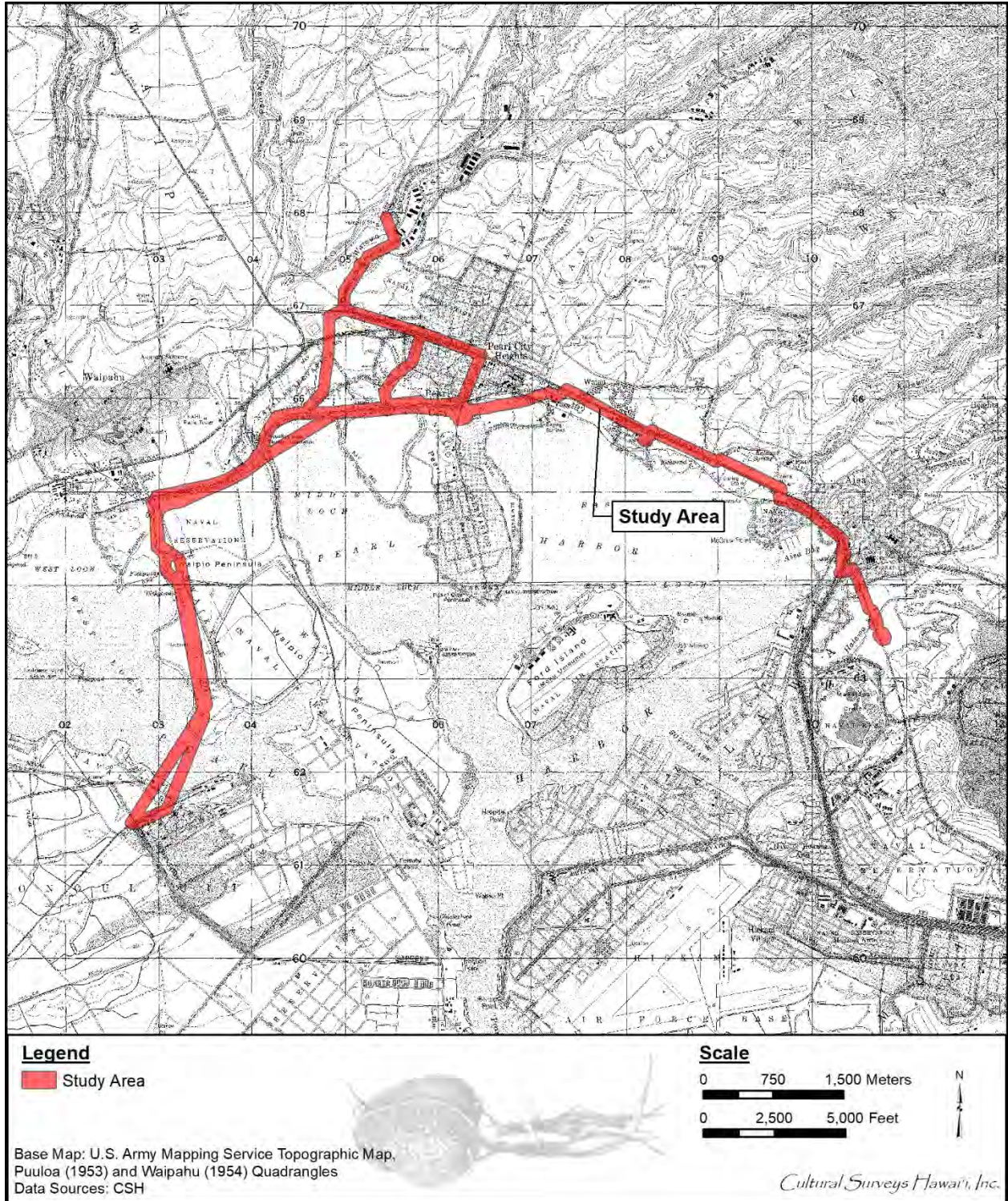


Figure 71. 1953 Puuloa and 1954 Waipahu U.S. Army Mapping Service topographic quadrangles showing study area

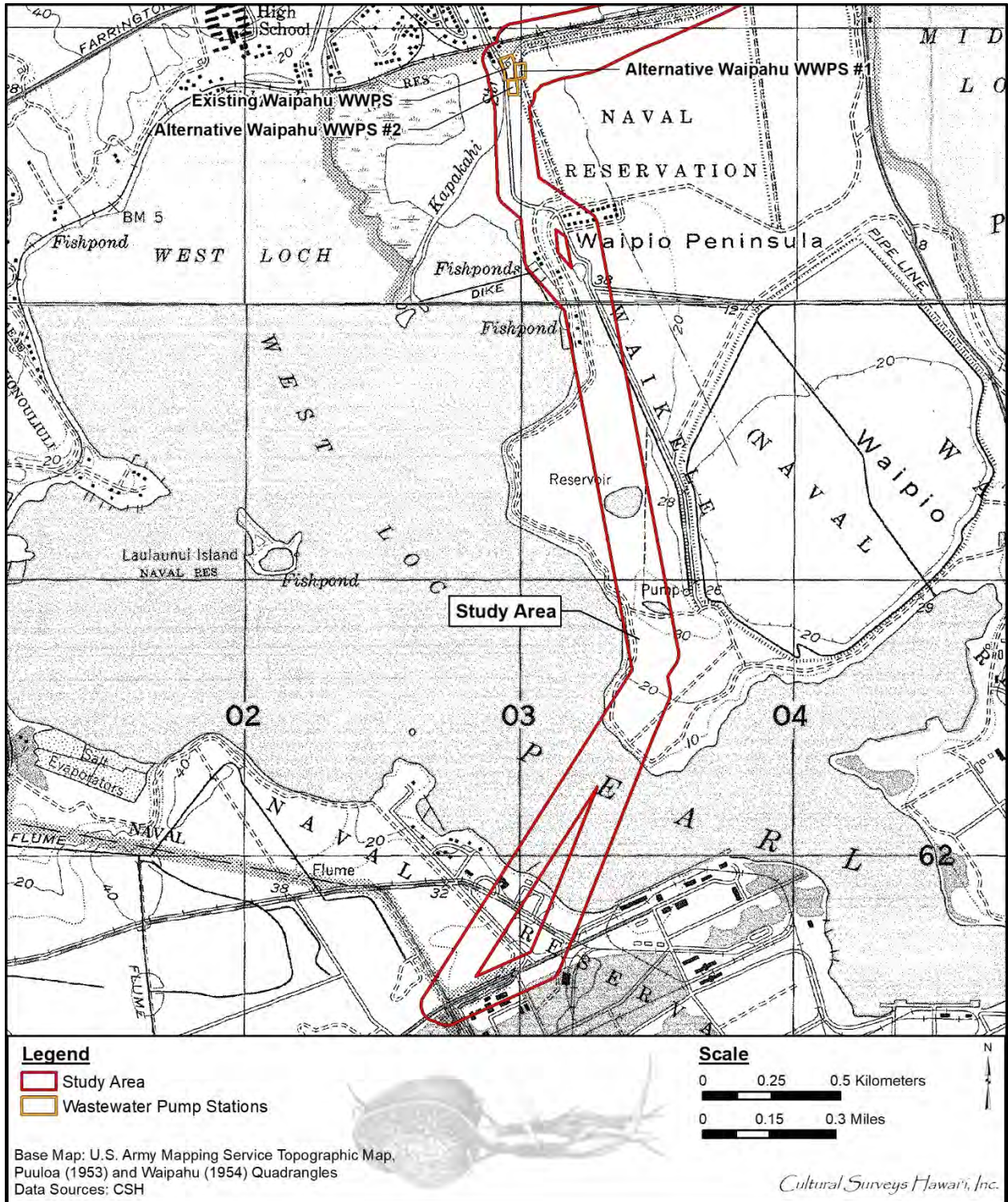


Figure 72. 1953 Puuloa and 1954 Waipahu U.S. Army Mapping Service topographic quadrangles showing the west portion of the study area

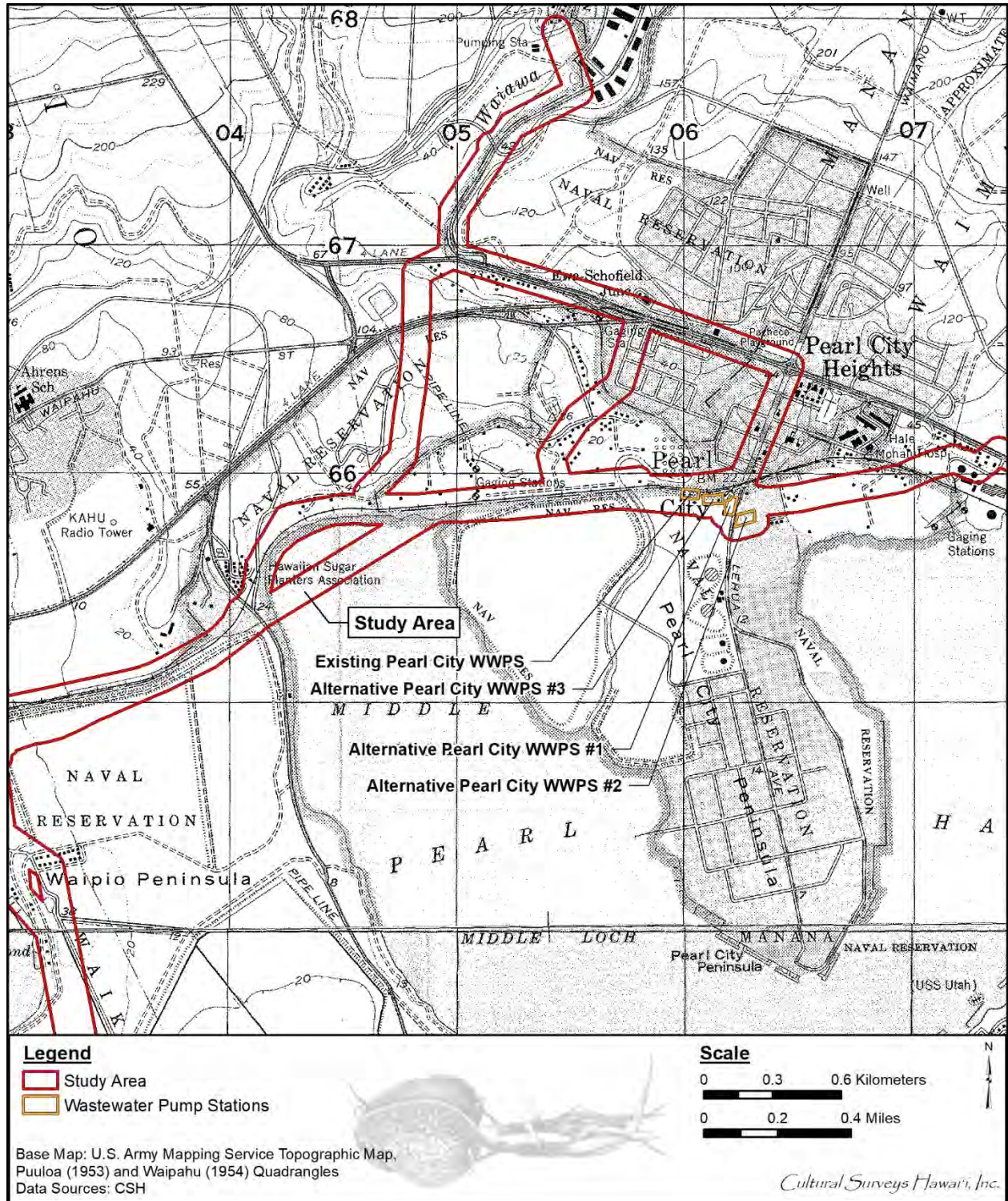


Figure 73. 1953 Puuloa and 1954 Waipahu U.S. Army Mapping Service topographic quadrangles showing the central portion of the study area

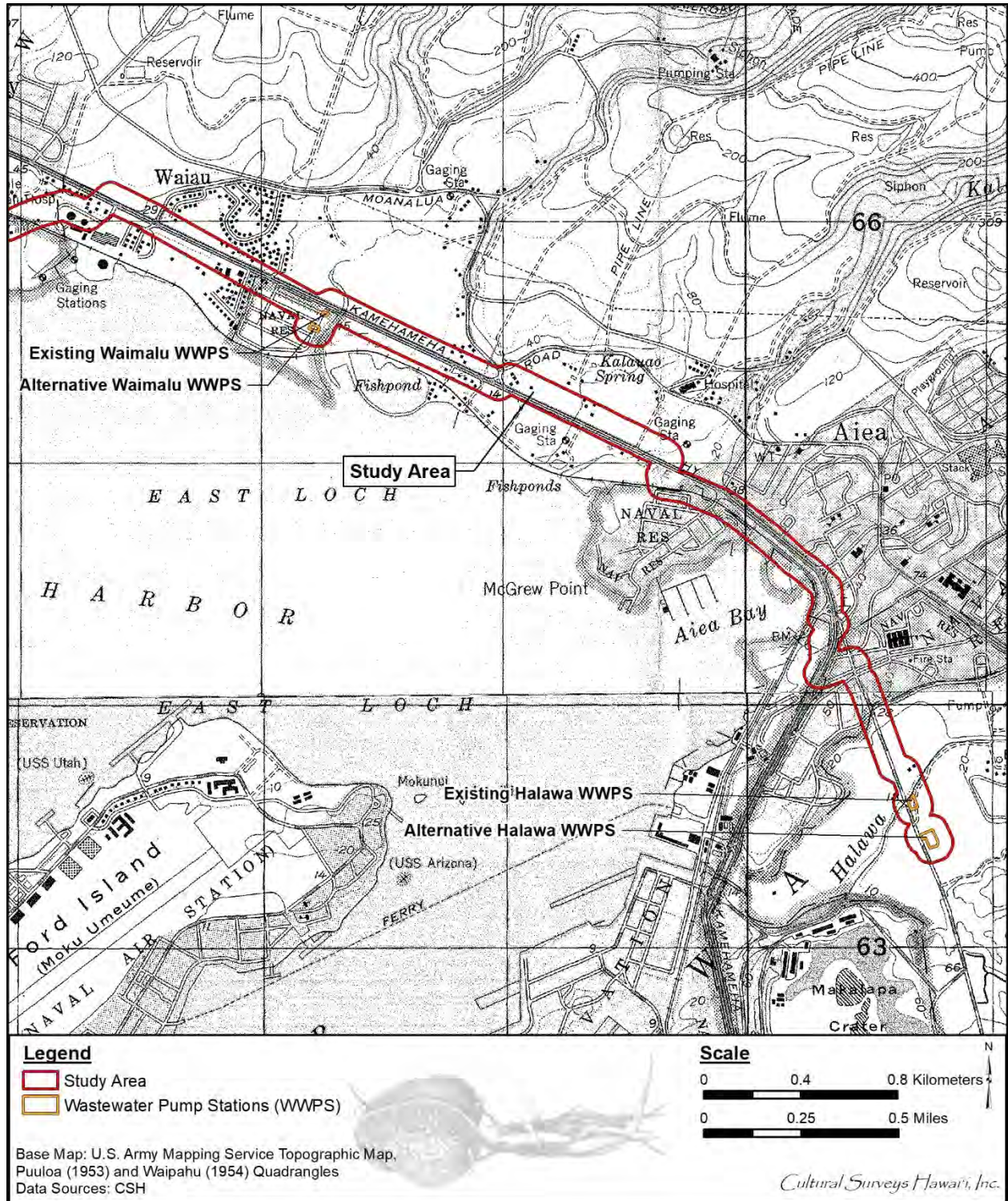


Figure 74. 1953 Puuloa and 1954 Waipahu U.S. Army Mapping Service topographic quadrangles showing the east portion of the study area



Figure 75. 1962 USDA Aerial Imagery, Pearl Harbor photo showing the western and central portions of the study area

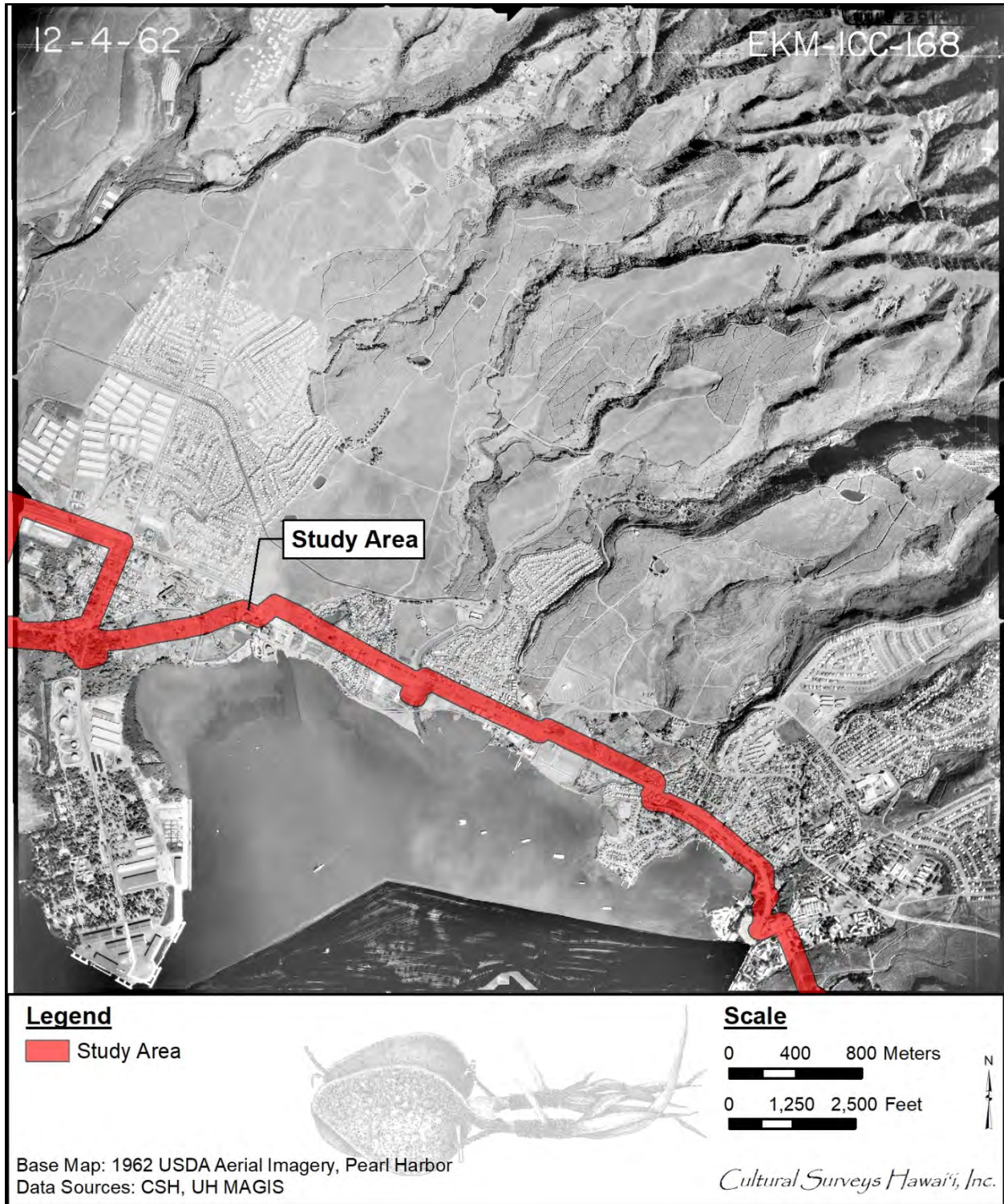


Figure 76. 1962 USDA Aerial Imagery, Pearl Harbor photo showing the central and east portions of the study area

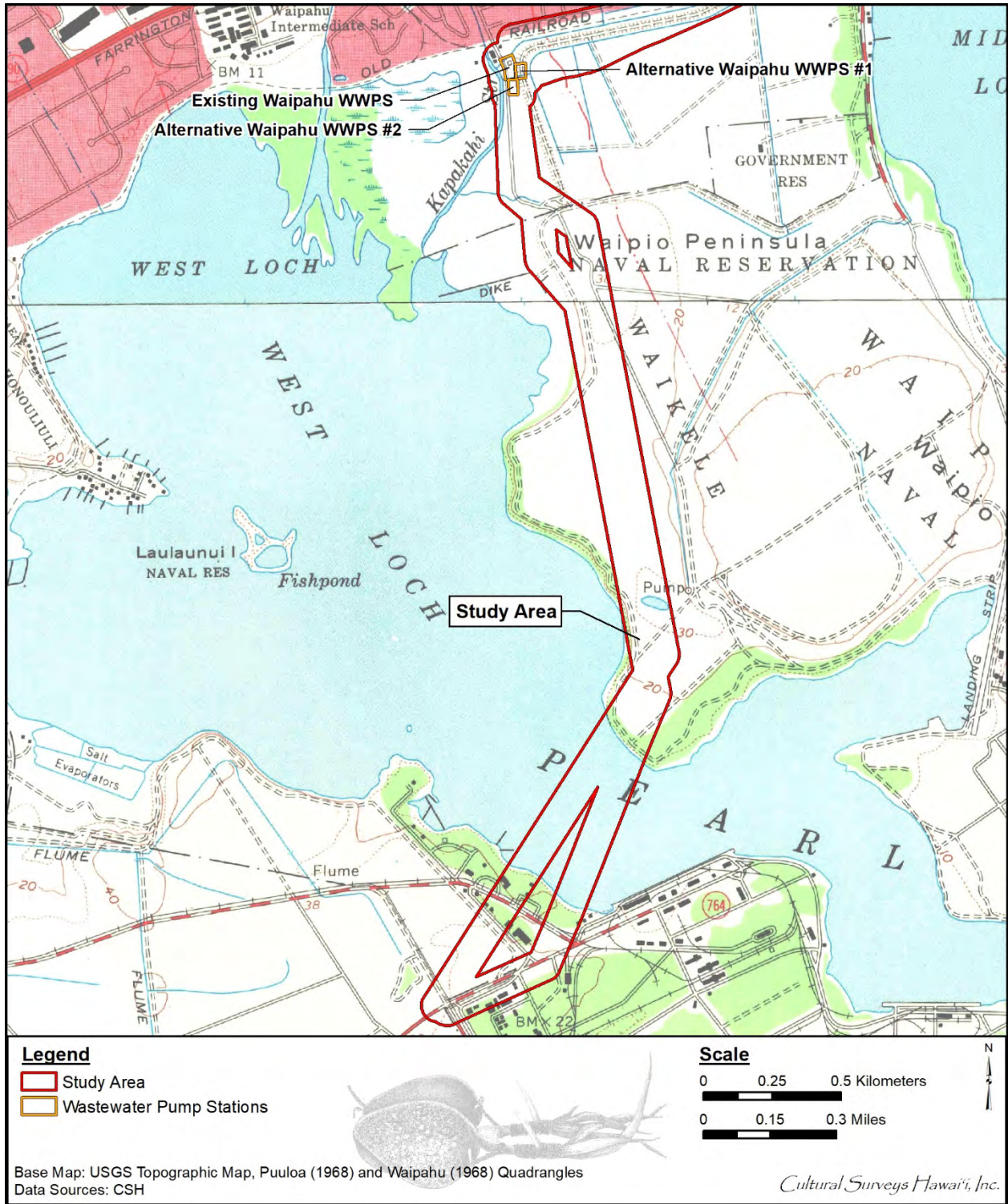


Figure 77. 1968 Puuloa and Waipahu USGS topographic quadrangles showing the west portion of the study area

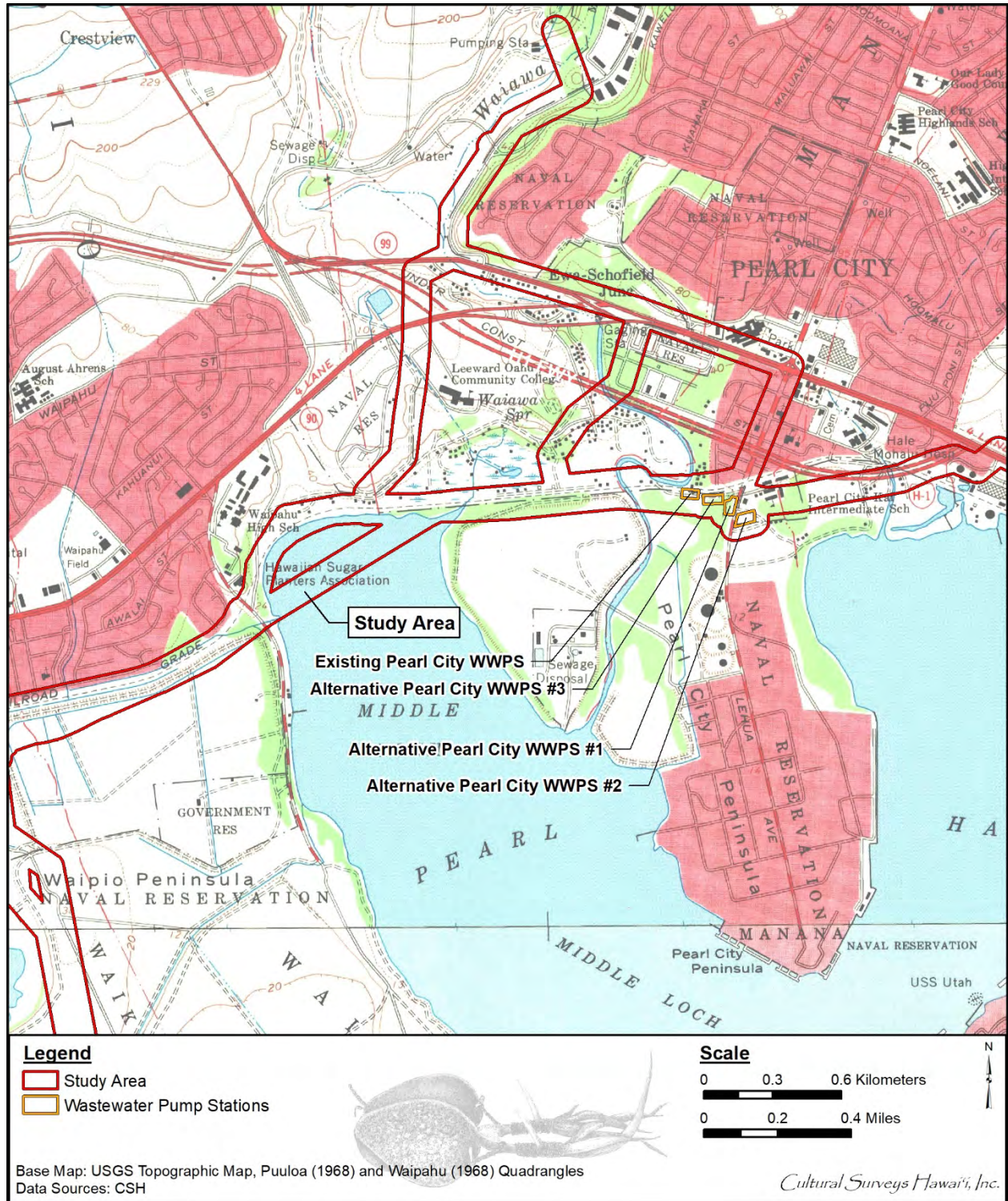


Figure 78. 1968 Puuloa and Waipahu USGS topographic quadrangles showing the central portion of the study area

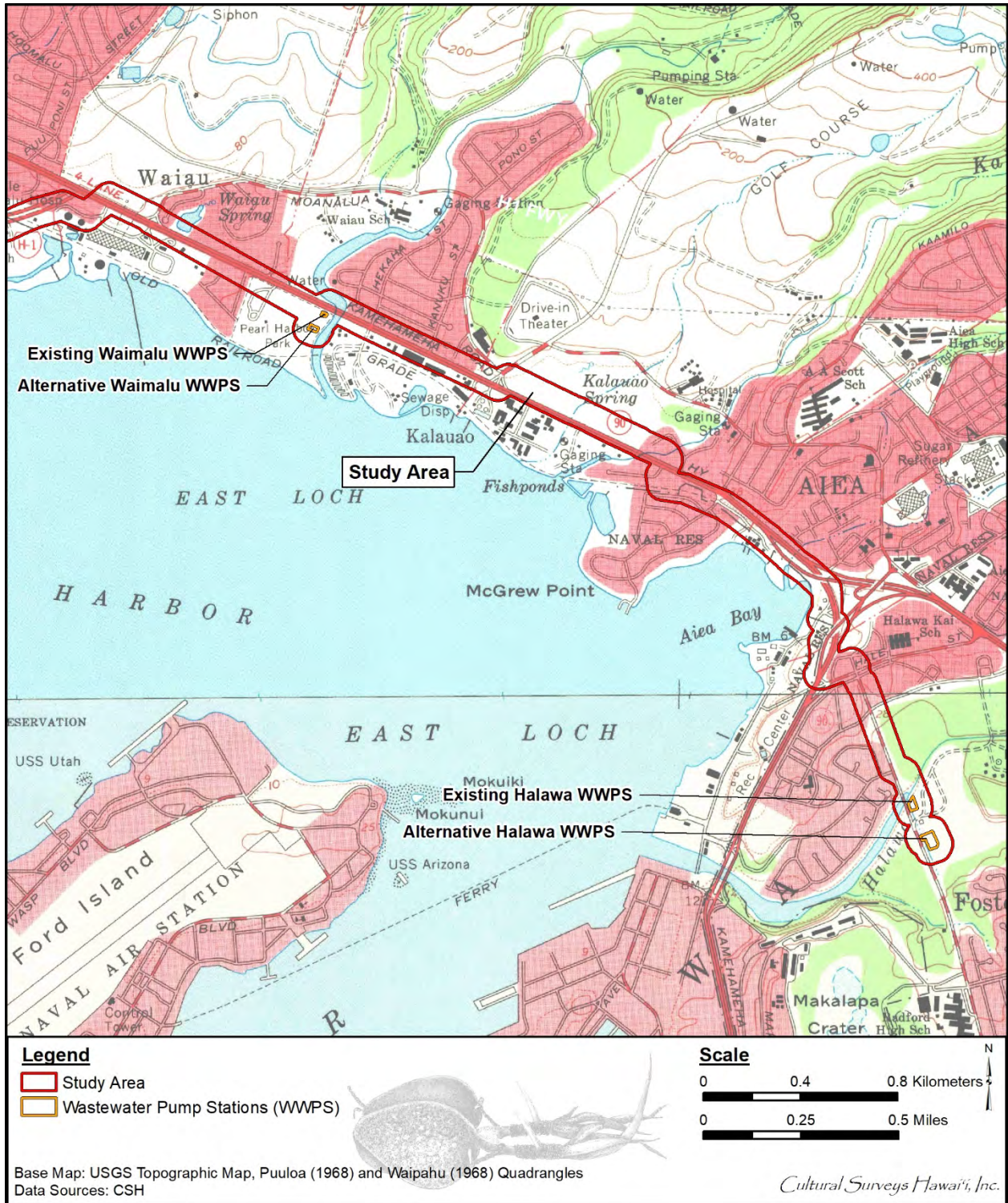


Figure 79. 1968 Puuloa and Waipahu USGS topographic quadrangles showing the east portion of the study area

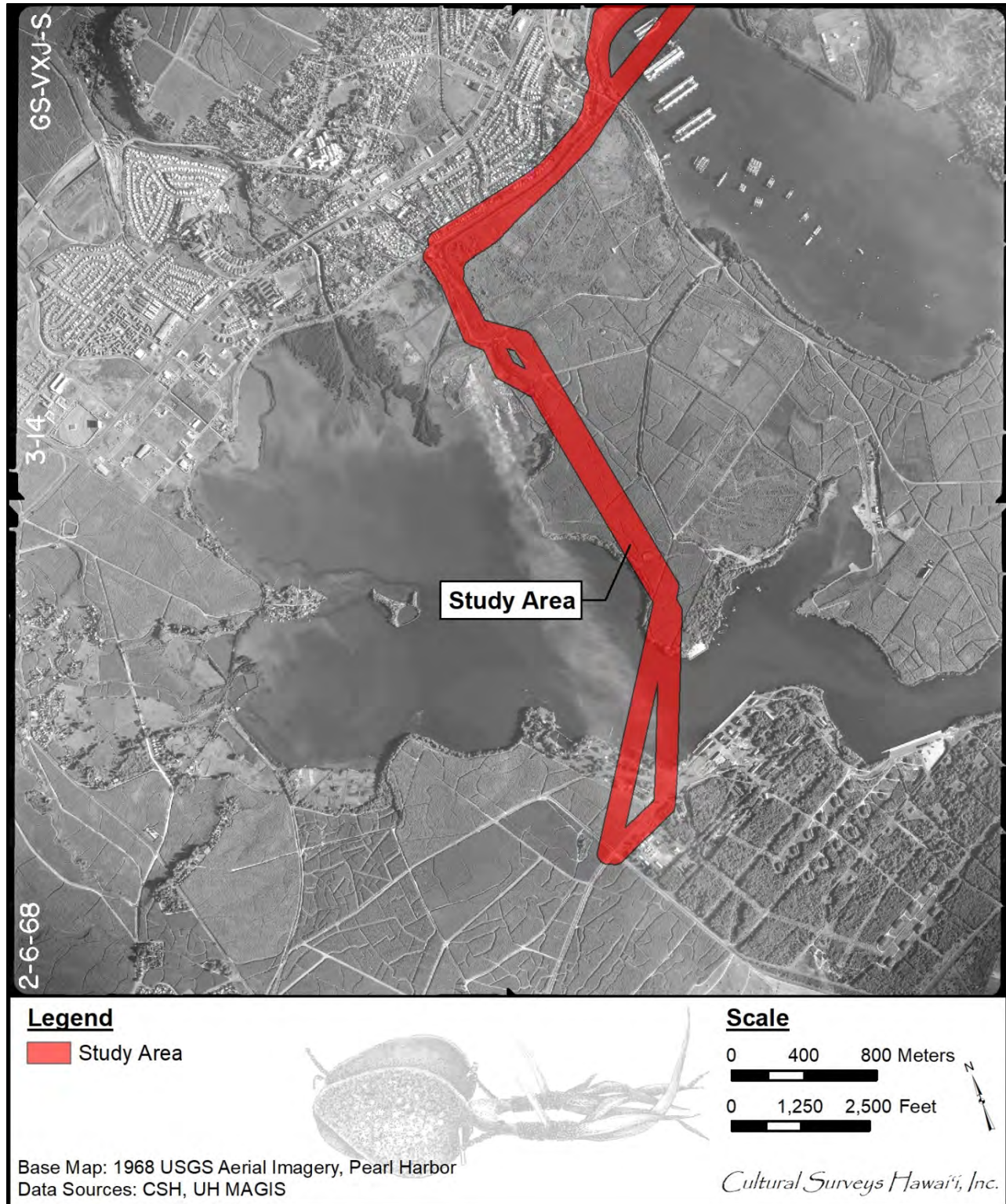


Figure 80. 1968 USGS Aerial Imagery, Pearl Harbor photo showing the west portion of the study area



Figure 81. 1968 USGS Aerial Imagery, Pearl Harbor photo showing the central portion of the study area

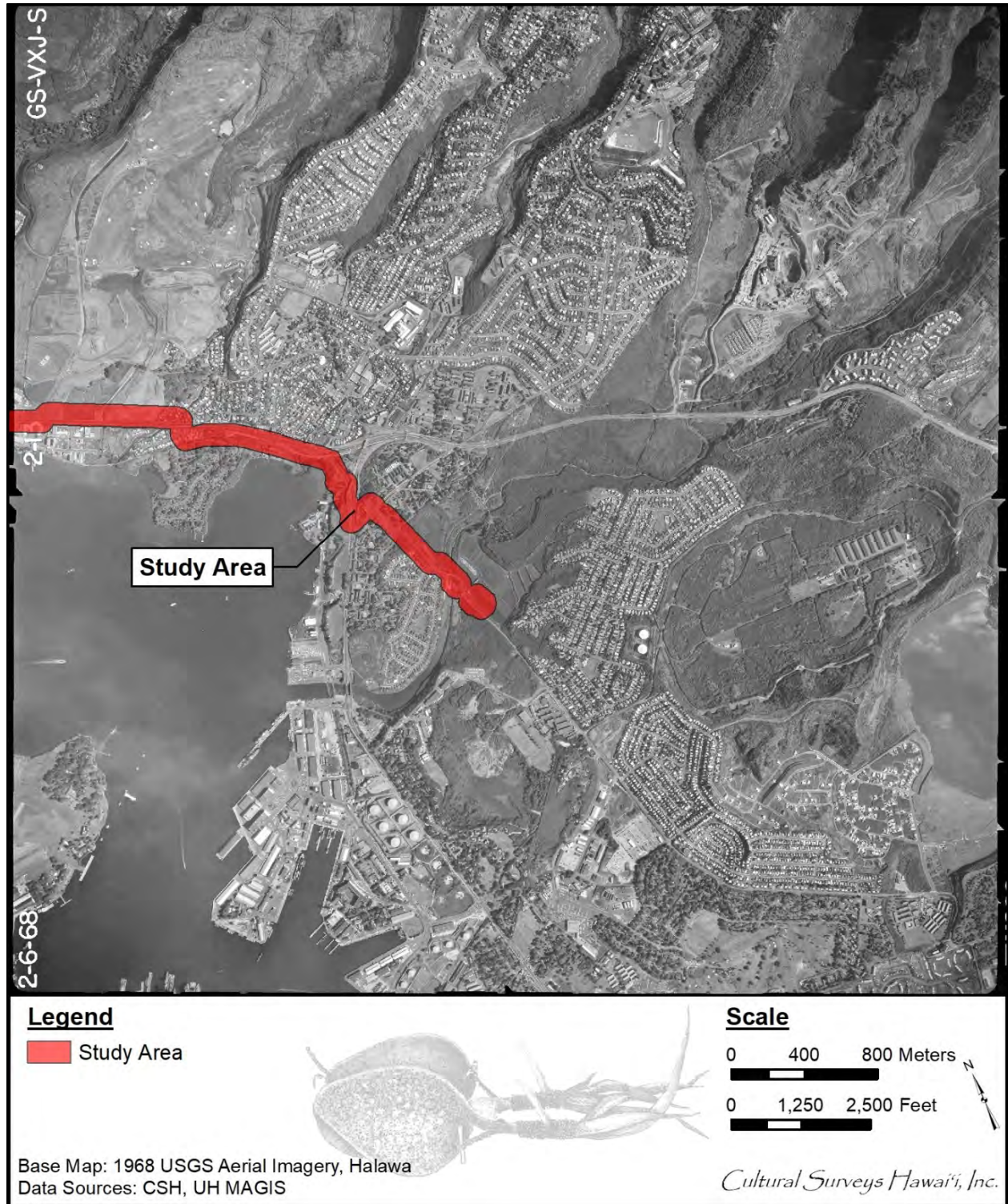


Figure 82. 1968 USGS Aerial Imagery, Pearl Harbor photo showing the east portion of the study area

Section 4 Previous Archaeological Research

4.1 Previous Archaeological Studies in the West Portion of the Study Area from Honouliuli to Waikele

Much of the land in the vicinity of the Honouliuli to Waikele section of the study area has undergone residential, public, and military development requiring cultural resource management efforts to mitigate the impact of development on archaeological resources. As a result, many archaeological studies have been conducted in the vicinity of, and within, the current study area. These archaeological studies are depicted in Figure 83 and summarized in Table 12. Previous studies include archaeological inventory surveys (AIS), paleo-environmental studies, archaeological assessments (no finds AIS), literature review and field inspections, historic property assessments, and archaeological monitoring programs, all of which are summarized in the text below in chronological order. Archaeological finds documented during these studies include pre- and post-Contact human burials, pre- and post-Contact cultural layers, Hawaiian fishpond (*loko*) deposits, *lo'i* deposits, military infrastructure, and plantation-era agricultural components. In total, 30 archaeological sites have been documented in the Honouliuli to Waikele section of the study area. Most of which have been assigned a SIHP number and some have been listed on the National Register of Historic Places (NRHP); these are indicated on Figure 84 and described in Table 13.

4.1.1 Rosendahl 1987; Dicks et al. 1987; and Wolforth et al. 1998

An archaeological reconnaissance survey (Rosendahl 1987 [phase one] and Dicks et al. 1987 [phase two]) was conducted by Paul H. Rosendahl, Ph.D., Inc., (PHRI) in association with the development of the 232-acre “West Loch Estates” Residential Increments I and II (including golf course and parks) project, in the section of Honouliuli taro lands adjacent to Pearl Harbor and west of the current study area (in the vicinity of at Kapapapūhi Point and West Loch Community Shoreline Park). The project covered portions of the old town of Honouliuli, which was the focus of population in the early historic period (and possibly earlier). This study identified a modern cemetery (SIHP # 50-80-13-03319) with a remnant pre-Contact deposit; two historic sites of minimal integrity with some possible pre-Contact deposits (SIHP #s 50-80-13-03318 and -3320) at Kapapapūhi Point; a significant pre-Contact deposit with trash pits, fire pits, and at least one human burial (SIHP # 50-80-13-03321); a buried fishpond (SIHP # 50-80-13-03322); an historic fishpond (SIHP # 50-80-13-03323) built in the 1890s during the construction of the OR&L railroad; and a buried pond field system (SIHP # 50-80-13-03324) (Rosendahl 1987:7, 9). It was noted that some artifacts “indicate the possibility of pre-1900 occupation” (Rosendahl. 1987:8). An unsuccessful effort was also made to confirm McAllister’s Site 139, Kalanamaihiki Ko‘a (fishing shrine). The archaeologists found a small boathouse and dock in the shrine’s reported location and concluded it had been destroyed since McAllister’s survey in the 1930s. Furthermore, Dicks et al. (1987) discuss two possible former cemeteries at Hō‘ae‘ae Point near the proposed West Loch Estates; it was not possible to confirm these during reconnaissance.

Nearly a decade after archaeological reconnaissance, archaeological data recovery was completed by Wolforth et al. (1998). Radiocarbon dates from this study resulted in the conclusion that the agricultural use of the Honouliuli Stream floodplain for pond-field cultivation of taro may have begun in the lower valley segment as early as AD 1000, while cultivation of the upper valley

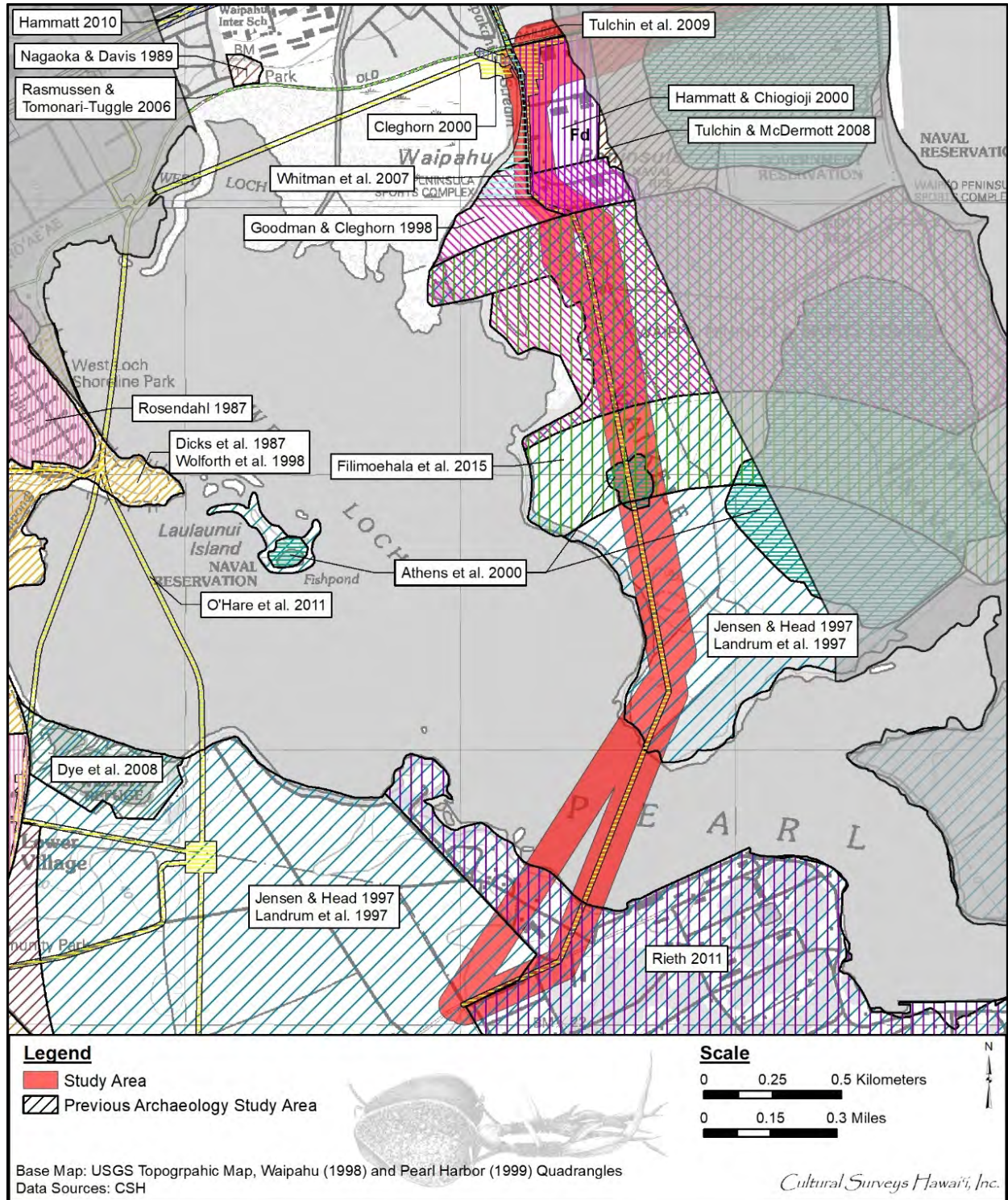


Figure 83. Previous archaeological investigations in vicinity of the western section of the study area from Honouliuli to Waikele Ahupua'a

Table 12. Previous archaeological investigation in vicinity of the western section of the study area from Honouliuli to Waikele Ahupua'a

Reference	Type of Study	Location	Results
Rosendahl 1987; Dicks et al. 1987; Wolforth et al. 1998	Archaeological reconnaissance survey and archaeological data recovery	West Loch Estates – Residential Increments I and II, Golf Course, and Parks, Honouliuli Ahupua'a (in vicinity of Kapapapūhi Point and West Loch Community Shoreline Park)	Seven historic properties identified: SIHP #s 50-80-13-3318 and -3320, pre- to post-Contact deposits at Kapapapūhi Point; SIHP # -3319, a modern cemetery with a remnant pre-Contact deposit; SIHP # -3321, a pre-Contact deposit with trash pits, fire pits, and at least one human burial; SIHP # -3322, a buried fishpond; SIHP # -3323, a historic fishpond; and SIHP # -3324, a buried pond-field system
Nagaoka and Davis 1989	Archaeological reconnaissance survey and archaeological monitoring	Pupu'ole Park area, Waipahu	No historic properties identified; radiocarbon dates from secondary cultural deposit containing charcoal, historic artifacts, and possible shell midden indicate land use in area potentially spanning 500 years
Jensen and Head 1997; Landrum, Drolet and Bouthillier 1997	Archaeological reconnaissance survey; cultural resources overview survey	Naval Magazine (NAVMAG), Lualualei Headquarters Branch (NAVMAG-LLL); West Loch Branch (NAVMAG-West Loch); and Waikele Branch (NAVMAG-Waikele); Honouliuli, Waikele, and Waipi'o Ahupua'a	Identified and evaluated 281 historic properties/features associated with both pre and post-Contact land use including military, agricultural, and traditional components
Goodman and Cleghorn 1998	Archaeological inventory survey (AIS)	Waipi'o Sports Complex, Waipi'o and Waikele Ahupua'a	Two historic properties identified: SIHP # 50-80-13-5597, a sugarcane irrigation complex consisting of two concrete pumping stations and associated irrigation ditches; and SIHP # -9714, a railroad berm remnant and an iron bridge associated with OR&L Right-of-Way (ROW)

Reference	Type of Study	Location	Results
Athens et al. 2000	Paleo-environmental study	Pearl Harbor area	Study identified eight of 21 targeted Hawaiian fishponds and provided insight into future endeavors to construct a chronological framework for fishpond construction using qualitative dating techniques and Bayesian analysis
Cleghorn 2000	Pedestrian inspection	Waipi'o Peninsula Soccer Park, Waipi'o Ahupua'a	One historic property identified: SIHP # 50-80-12-9714, OR&L Right-of-way (ROW)
Hammatt and Chiogioji 2000	Archaeological and cultural assessment	City and County of Honolulu-owned parcel on Waipi'o Peninsula, Waikele Ahupua'a	No historic properties identified; noted thick land fill up to 3 m deep
Rasmussen and Tomonari-Tuggle 2006	Archaeological monitoring	Waiau Fuel Pipeline corridor from HECO Barbers Point Tank Farm to Waiau Generating Station; Honouliuli to Waiau Ahupua'a	No historic properties identified
Whitman et al. 2007	Archaeological literature review, field inspection, and cultural impact evaluation	Waipahu Depot St, south of Farrington Hwy on Waipi'o Peninsula, Waikele Ahupua'a	One historic property identified: SIHP # 50-80-12-9714, OR&L railroad bridge and ROW
Dye et al. 2008	Historic properties assessment	Pearl Harbor National Wildlife Refuge: Waiawa, Honouliuli, and Kalaeloa units; Waiawa and Honouliuli Ahupua'a	No new historic properties identified; assessment focused on previously documented historic properties within refuge units
Tulchin and McDermott 2008	Archaeological literature review and field inspection (LRFI)	Ted Makelena Golf Course at Waipi'o Peninsula; Waipi'o Ahupua'a	No historic properties identified; noted Ted Makelena Golf Course area has been heavily modified for construction of golf course

Reference	Type of Study	Location	Results
Tulchin et al. 2009	AIS	Proposed Koa Ridge Makai Development in Waipi'o <i>mauka</i> to Waipahu Wastewater Pump Station; Waipi'o and Waikele Ahupua'a	One historic property identified: SIHP # -6959, plantation-era irrigation infrastructure including ditches and water control feature
Hammatt 2010	AIS	Western portion of Honolulu High Capacity Transportation Corridor Project (HHCTCP) (extending from Kapolei Station in the west to Pearl Highlands Station in the east); Honouliuli and Waiawa Ahupua'a	One historic property identified: SIHP # -7751, subsurface cultural deposit of <i>lo'i</i> sediments
O'Hare et al. 2011	Archaeological LRFI	Project area roughly aligned with Kamehameha Hwy and Pearl Harbor shoreline until extending into <i>makai</i> portion of Honouliuli; Honouliuli to Hālawa Ahupua'a	No historic properties identified
Rieth 2011	Archaeological relocation survey and subsurface testing	Naval Magazine West Loch; Honouliuli Ahupua'a	Identified 257 historic properties (243 previously identified and 14 newly identified) associated with both pre- and post-Contact land use including military, agricultural, and traditional components
Filimoehala et al. 2015	AIS and paleo-environmental study	Central portion of Waipi'o Peninsula	Three historic properties identified: SIHP # 50-80-13-7796, post-Contact irrigation complex covering 287-acres; SIHP # -7797, a post-Contact boat landing; and SIHP # -125, Hawaiian fishpond Loko Hanaloa

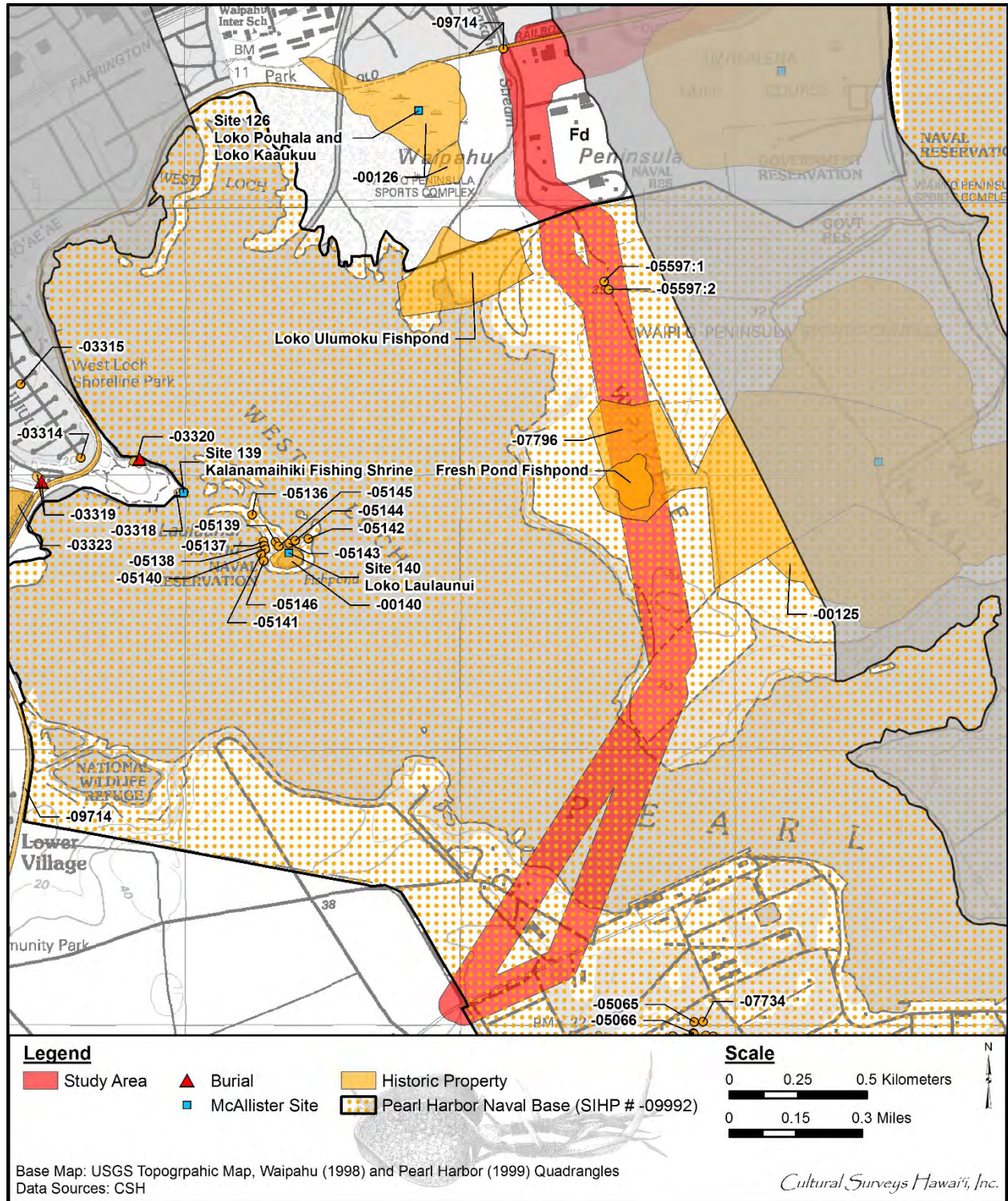


Figure 84. Previously identified historic properties in the vicinity of the western section of the study area from Honouliuli to Waikele Ahupua'a

Table 13. Previously identified historic properties in the vicinity of the western section of the study area from Honouliuli to Waikele Ahupua'a

SIHP # (50-80-)	Formal Type	Source	Comment
09-00126	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Kaaukuu and Loko Pouhala; formerly adjoined agricultural ponds
12-09714	Railroad	Goodman and Cleghorn 1998, Cleghorn 2000, Whitman et al. 2007	OR&L ROW
13-00125	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Hanaloa; large pond at center of Waipi'o Peninsula built of coral slabs
13-00140	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Lauaunui Small; fishpond with wall
13-03314	Subsurface cultural deposit	Rosendahl 1987	Midden deposit
13-03315	Surface artifact collection	Rosendahl 1987	Post-Contact
13-03318	Subsurface artifact concentration	Rosendahl 1987	Pre- to post-Contact deposits at Kapapahu Point associated with habitation
13-03319	Complex	Dicks et al 1981	Remnant pre-Contact deposit, possible historic church and cemetery site; human burial
13-03320	Subsurface cultural deposit	Dicks et al 1981	Pre- to post-Contact deposits at Kapapahu Point associated with habitation
13-03323	Historic fishpond	Dicks et al 1981	Constructed in 1890s by OR&L
13-05065	Temporary habitation structure	Jensen and Head 1997, Rieth 2011	Circular enclosure (conjoined C- shapes) possibly associated with traditional Hawaiian habitation
13-05066	Platform and mound	Jensen and Head 1997, Rieth 2011	Traditional Hawaiian limestone cobble platform and mound possibly associated with agriculture
13-05136	Military structural remnant	Jensen and Head 1997	Post-Contact concrete slab
13-05137	Military complex	Jensen and Head 1997	Post-Contact complex with concrete slab and wall
13-05138	Military structural remnant	Jensen and Head 1997	Post-Contact concrete slab

SIHP # (50-80-)	Formal Type	Source	Comment
13-05139	Military complex	Jensen and Head 1997	Post-Contact complex with concrete slab and gun emplacement
13-05140	Military structural remnant	Jensen and Head 1997	Post-Contact concrete slab
13-05141	Military structural remnant	Jensen and Head 1997	Post-Contact concrete basement
13-05142	Military structural remnant	Jensen and Head 1997	Post-Contact metal A-frame structure
13-05143	Utility	Jensen and Head 1997	Post-Contact utility associated with military facilities
13-05144	Military barge	Jensen and Head 1997	Post-Contact metal barge/landing with wooden deck
13-05145	Retaining wall	Jensen and Head 1997	Post-Contact stacked limestone retaining wall
13-05146	Military complex	Jensen and Head 1997	Post-Contact complex with concrete paving, wall, concrete slab, wall, and concrete step
13-05597:1	Agriculture	Goodman and Cleghorn 1998	Sugarcane irrigation complex consisting of two concrete pumping stations and irrigation ditches
13-05597:2	Agriculture	Goodman and Cleghorn 1998	Sugarcane irrigation complex consisting of two concrete pumping stations and irrigation ditches
13-07734	Paving	Rieth 2011	Limestone cobble paving associated with traditional Hawaiian habitation
13-07796	Agriculture	Filimoehala et al. 2015	Large post-Contact irrigation complex
13-09992	Historic District	Apple 1978	U.S. Naval Base, Pearl Harbor Historic District (NRHP #66000940)
McAllister 139 [no SIHP # assigned]	Fishing shrine	McAllister 1933	Has not been confirmed
N/A	Hawaiian fishpond	Athens et al. 2000	Pre-Contact "Fresh Pond Fishpond"
N/A	Hawaiian fishpond	Athens et al. 2000	Loko Ulumoku

pond-fields may have begun as early as the thirteenth and fourteenth centuries (Rosendahl 1987; Dicks et al. 1987; and Wolforth et al. 1998).

4.1.2 Nagaoka and Davis 1989

In 1988, International Archaeological Research Institute, Inc. (IARII), conducted a reconnaissance and subsurface survey, as well as archaeological monitoring for the proposed Pupū'ole Park area in Waipahu, 'Ewa District. Although no historic properties were identified during this study, it was determined that the area has been utilized by pre-Contact populations for as long as 500 years prior. This is based on radiocarbon dates from secondary cultural deposits which include charcoal, historic artifacts, and high quantities of shell commonly considered midden (Nagaoka and Davis 1989).

4.1.3 Jensen and Head 1997; Landrum, Drolet and Bouthillier 1997

An archaeological pedestrian survey of four parcels within the West Loch Branch of NAVMAG-Lualualei was completed by PHRI in 1995 and addressed in two companion studies (Jensen and Head 1997; Landrum, Drolet and Bouthillier 1997). The survey includes a large portion of the southwest section of the current study area. A total of 281 sites were recorded during the survey, 254 of which are within the "West Loch Unimproved" parcel that the current study area briefly crosses. Identified sites are associated with both the pre and post-Contact era and include military, agricultural, and traditional components. A subsequent cultural resources overview survey was conducted by Ogden Environmental and Energy Services Company, Inc. (Landrum et al. 1997) to further evaluate the cultural resources identified by Jensen and Head (1997). No additional historic properties were identified by Landrum et al. (1997). Multiple military resources that were evaluated by Landrum et al. (1997) are included within the current study area and are components of NAVMAG-Lualualei, which was determined to comprise a portion of Pearl Harbor Naval Base Historic District (SIHP # -9992).

4.1.4 Goodman and Cleghorn 1998

In 1998, Pacific Legacy conducted an AIS for the Waipi'o Sports Complex, which extends throughout the current 400-ft-wide project area corridor near the *mauka* (northern) extent of its western section. Two historic properties were identified: SIHP # 50-80-13-5597, a sugarcane irrigation complex consisting of two concrete pumping stations and associated irrigation ditches; and SIHP # 50-80-12-9714, a railroad berm remnant and an iron bridge associated with the OR&L right-of-way (ROW). Subsurface testing determined "the peninsula has at least 3.0 m of fill on it, effectively burying any evidence of prehistoric use" (Goodman and Cleghorn 1998:33).

4.1.5 Athens et al. 2000

In 1995, IARII conducted field research designed to target 21 former fishponds around the Pearl Harbor area. The project aimed to create a chronological framework for fishpond construction using qualitative dating methods and Bayesian calibration. A chronology was unable to be produced due to complications associated with methodology, however, Athens et al. (2000) offer insight into future endeavors with similar goals and the identification of fishpond sediment. Their results conclude that many of the former fishponds were heavily disturbed by historical land use and fishpond sediments were only distinguishable in eight of the 21 targeted fishponds (Athens et al. 2000). Study areas near the west portion of the present study area included the Lauaunui Island fishpond in West Loch and the Loko Hanaloa fishpond and "Fresh Pond" on the Waipi'o

Peninsula. Twelve layers were identified in the Loko Hanaloa sequence. None could be clearly identified as a fishpond layer and there were problems (chronological inversions and indications of disturbance) in the dating sequence. The Loko Lauaunui island fishpond was the subject of three sediment cores yielding two layers but it was concluded that a calibration of dates was inappropriate and thus the dating of fishpond creation is also uncertain. The small "Fresh Pond" fishpond (no SIHP # assigned) lies mostly within the present project corridor on Waipi'o Peninsula (see Figure 84). Three cores were taken but there was no indication of the presence of fishpond sediments and no chronology of use was developed.

4.1.6 Cleghorn 2000

In 1999, Pacific Legacy, Inc., conducted a pedestrian survey for a proposed irrigation line for the Waipi'o Soccer Park located at Waipi'o Peninsula. The pedestrian survey identified a portion of the OR&L Right-of-way (ROW) (SIHP # 50-80-12-9714) and determined no other cultural resource would be impacted by the proposed irrigation line (Cleghorn 2000).

4.1.7 Hammatt and Chiogioji 2000

In 2000, CSH prepared an archaeological assessment (no finds AIS) of City and County lands on Waipi'o Peninsula, adjacent to the south of the OR&L alignment, including the Waipahu Wastewater Pump Station. Although the rich cultural history is documented for the immediate area including an extensive complex of fishponds, agricultural fields, house lots, and pasture lands, the report also notes extensive fill activities during World War II and relates observation of fill 3 m deep. No further archaeological work was recommended (Hammatt and Chiogioji 2000).

4.1.8 Rasmussen and Tomonari-Tuggle 2006

In 2004, archaeological monitoring was conducted by IARII along the Waiiau Fuel Pipeline corridor from the HECO Barbers Point Tank Farm to the Waiiau Generating Station traversing most of coastal 'Ewa Moku (District). Ground disturbance within the portion of this corridor west of Kunia Road/Fort Weaver Road was not monitored since that portion of the corridor had been determined to not be archaeologically sensitive. East of Kunia Road/Fort Weaver Road, the Waiiau Fuel Pipeline corridor generally extends within the alignment of the OR&L ROW. The Rasmussen and Tomonari-Tuggle 2006 project area converges with the present study corridor at the intersection of Waipahu Depot Street and the Pearl Harbor Bike Path (along the former OR&L alignment). Monitoring results are reported for the area *mauka* (north) of the Makalena Golf Course just east of Kapakahi Stream with detailed results reported from the station sequence of 521+60 to 552+00 in the location of the former Loko Eo fishpond (Rasmussen and Tomonari-Tuggle 2006:34–52). Typically, thick fill layers were identified, from 155 to 250 cm thick (seemingly averaging more than 2 m thick) extending down to close to the water table and overlying what appeared to be a disturbed clay loam layer. Disturbed wetland clay loam sediments were observed close to the water table; typically, at depths of 2 m or greater. No cultural material or features appear to have been identified. It appears the natural land surface rises in the vicinity of Waipi'o Point Access Road in the central portion of the present project area.

4.1.9 Whitman et al. 2007

In 2007, CSH conducted an archaeological field inspection for proposed improvements to Waipahu Depot Street on Waipio Peninsula. The field inspection identified a railroad bridge and

the OR&L ROW which are components of SIHP # 50-80-12-9714. This study area overlaps with the current study area near its northwest extent.

4.1.10 Dye et al. 2008 (Honouliuli Refuge Unit)

In 2008, T.S. Dye & Colleagues, Archaeologists, Inc., conducted an historic properties assessment for the Pearl Harbor National Wildlife Refuge: Waiawa, Honouliuli, and Kalaeloa units. The purpose of the assessment was to compile and synthesize the information about previously identified historic properties within the refuge units. Dye et al. (2008) concluded most of the landscape within the district of 'Ewa has been greatly impacted by the last 150 to 200 years of land use which were dominated by cattle ranching and large-scale commercial cultivation of cash crops. Due to this, few extant traditional Hawaiian surface structures remain, and none are within the assessed refuge units determined to have a low likelihood of significant cultural resources present (Dye et al. 2008).

4.1.11 Tulchin and McDermott 2008

In 2008, CSH conducted an archaeological LRFI for a Ted Makalena Golf Course Improvements project, which encompasses approximately 150 acres within the northern portion of the Waipi'o Peninsula. No historic properties were identified during the field inspection and it was determined that the absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and military operations, as well as the modern golf course development observed throughout the project area. Background research for this project also suggests the entire project area likely contains 3- to 7-m-thick deposits of fill (Tulchin and McDermott 2008).

4.1.12 Tulchin et al. 2009

In 2009, CSH conducted an AIS of a trunk sewer alignment for the proposed Koa Ridge Makai Development project, which encompasses approximately 574 acres located between Kīpapa Gulch and the H-2 Freeway. A 100% pedestrian inspection of the project area was undertaken and one historic property was identified. SIHP # 50-80-09-6959 consists of an irrigation ditch and water control box located at the northern tip of the project area, approximately 6 m southwest of Kamehameha Highway, along the upslope edge of a road cut, well north of the present study area. The dimensions of this historic property are approximately 13 m long (north-south) by 5 m wide (west-east). Of note is the fact that SIHP # -6959 extends for an undetermined distance to the north, well beyond the project area boundaries.

4.1.13 Hammatt 2010

In 2010, CSH completed an AIS for Construction Phase 1 and the western portion of Phase 2 of the HHCTCP, which runs *mauka* (typically approximately 300 m north) of the current study area before intersecting it briefly in Waiawa and Mānana Ahupua'a to the east. Fieldwork involved pedestrian inspection, ground penetrating radar (GPR) survey, and subsurface testing via backhoe. Pedestrian inspection of the Phase 2 portion of the survey area confirmed the entire survey area was previously disturbed by urban development. No surface cultural resources were identified and the results of GPR within the survey area were limited. Test excavations targeted proposed transit stations with a focus on testing areas planned for subsurface disturbance (i.e., elevator shafts, subsurface utilities). Test excavations were also located at selected guideway column foundation locations along the proposed elevated rail line.

The germane portion of the Hammatt 2010 study for the west portion of the present study area was the test excavations for the Waipahu Transit Center Station and vicinity located along Farrington Highway approximately 200 m east of Waipahu Depot Road and Kapakahi Stream and approximately 300 m north of the present study area (the 19 test excavations in the “RW011 Construction Sheet):

In general the observed and documented stratigraphy consisted of varying imported fill layers overlying naturally deposited alluvial sediment inundated with water, suggesting the area was once a marsh prior to urban development. [Hammatt 2010:259]

Fill was commonly on the order of 175-230 cm thick with the water table at around 225-250 cmbs.

However, one historic property, SIHP # 50-80-09-7751 described as “subsurface agricultural sediment (likely from cultivation of wetland *kalo* (taro)-buried *lo'i* (irrigated pond-field) deposit” was designated on the *makai* side of Farrington Highway at the proposed Waipahu Transit Center Station location. Described as Stratum II in trenches 1–6 within the *makai* portion of the Waipahu Transit Center, this black (10 YR 2/1) clay contained noticeable, well-dispersed small flecks of charcoal and many reddish-orange mottles associated with in-use and remnant (abandoned and buried) *lo'i* sediments. (Hammatt 2010:418). While this is nearly 300 m north of the present study area (and hence not shown Figure 84 or discussed in Table 13. Previously identified historic properties in the vicinity of the western section of the study area from Honouliuli to Waikele Ahupua'a) it does show the potential for agricultural deposits under thick fill layers.

4.1.14 O'Hare et al. 2011

In 2010, CSH conducted an archaeological LRFI for the Honouliuli/Waipahu/Pearl City Wastewater Facilities from Honouliuli to Hālawā Ahupua'a. This study area runs roughly in alignment with the current study area as far west as Waipahu Depot Street before diverging near the west side of Waipi'o Peninsula with the O'Hare et al. 2011 study area arcing around the north and west sides of West Loch. The O'Hare et al. (2011:194–199) study examined the area along Waipahu Depot street *makai* (south) of Farrington Highway and the vicinity of the Waipahu Wastewater Pumping Station (WWPS). The study notes the vicinity has been much impacted by twentieth century activities but that much of the vicinity of the Waipahu Waste Water Pumping Station appears to lie close to the water table.

No historic properties were identified during the O'Hare et al. 2011 archaeological surface survey in the vicinity of the west portion of the present study area.

O'Hare et al (2011:231) note the extensive previous disturbance but conclude the proximity to Kapakahi Stream and the coast indicates the potential for cultural resources and merits at least initial on-site monitoring. It was noted that the high water table and high berms would make archaeological inventory survey testing difficult.

4.1.15 Rieth 2011

In 2008, IARII completed an archaeological survey and test excavations in the unimproved portion of Naval Magazine (NAVMAG) West Loch, which overlaps with the current study area corridor near its southwest extent. The purpose of their study was to ground truth previously

identified sites (Jensen and Head 1997) within this portion of the NAVMAG-West Loch facility. The archaeological survey resulted in the identification of 243 previously identified historic properties and 14 newly identified historic properties. Like its predecessor (Jensen and Head 1997), Rieth (2011) identified a mixture of traditional and historic sites with most of the traditional sites occurring within a high-density archaeological area near the northwest corner of the study area, south of the current study area. Targeted test excavations within this area produced invertebrate and vertebrate faunal assemblages, a small collection of lithic tools, and radiocarbon dates indicating that occupation occurred between approximately AD 1650-1820. Rieth (2011) recommended that preservation and management actions be implemented for the sites at NAVMAG-West Loch. No historic properties were identified within 300 m of the present study area(s).

4.1.16 Filimoehala et al. 2015

In 2014, IARII completed an AIS and paleoenvironmental study of the Navy SEALs Training Area at Waipi'o Peninsula on Joint Base Pearl Harbor-Hickam (JBPHH). This work included a pedestrian survey covering 365 of 630 acres, paleoenvironmental coring, subsurface testing, and laboratory analyses of paleoenvironmental materials. Two historic properties, SIHP #s 50-80-13-7796 and -7797, were identified during the pedestrian survey. SIHP # -7796 consists of a post-Contact irrigation complex which covers 287 acres and includes ditches, settling ponds, an above-ground pipeline, and stacked limestone features. This very extensive identified historic property extends completely across the width of the present study area (see Figure 84). SIHP # -7797 is a post-Contact boat landing associated with the transportation of sugarcane from Ford Island and is not near the present study area. Furthermore, a previously identified Hawaiian fishpond called Loko Hanaloa (SIHP # 50-80-13-00125) was identified during paleoenvironmental coring (Loko Hanaloa is 200 m east of the present study area). Filimoehala et al. (2015) recommended no further mitigation for the post-Contact sites (SIHP #s -7796 and -7797) but recommended Loko Hanaloa (SIHP # -00125) as eligible for listing on the NRHP and that archaeological monitoring should be conducted in the future to mitigate potential adverse effects to the site.

4.2 Summary of Previously Identified Historic Properties within the West Portion of the Study Corridor

Research identified four previously identified historic properties within the western portion of the study area. Summarizing these from southwest to northeast (see Figure 84) they include SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District; SIHP # 50-80-13-7796, a post-Contact commercial sugarcane irrigation complex; SIHP # 50-80-13-5597, a complex of two concrete pumping stations (designated Features 1 and 2) and irrigation ditches; and SIHP # 50-80-13-9714, the OR&L ROW. Additionally, the existence of a Hawaiian fishpond referred to as "Fresh Pond Fishpond" (no SIHP # assigned) by Athens et al. (2000) has been documented within this portion of the study but has yet to be identified in an archaeological context.

SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District, is traversed by much of the western portion of the study area corridor. The National Historic Landmark and historic property includes all waters and land areas that are associated with its historic function as an active naval base from its point of conception in 1902, until today (Apple 1978). The naval base was designated a National Historic Landmark and added to the NRHP in 1966. Many components of

the historic property were determined to fall under Treatment Category I of the Archaeological Resource Protection (HARP) Plan definitions (Greenhorne and O'Mara, Inc., 1990 - *Guidance for Preparing Historic and Archaeological Resource Protection Plans at United States Naval Installations*) which means that the historic property components are "of outstanding historical, architectural, archaeological, engineering or cultural significance. Further, these resources have been evaluated as having retained their integrity i.e. original and/or authentic period materials, design and context". (Landrum et al. 1997). Landrum et al. (1997) also state that in order for individual components of SIHP # 50-80-13-9992/ NRHP #66000940 (U.S. Naval Base, Pearl Harbor Historic District) to be considered significant, they "must have played a major role in the history of the base." It is understood that the individual features of the historic district have all been inventoried and evaluated by the Navy through their historic asset management processes. Reports that have documented this information includes a Cultural Landscape Report (CLR) and an Integrated Cultural Resource Management Plan (ICRMP) for the installation. Neither of these is publicly available, but it is understood that the Navy does maintain documentation about the individual features within the Historic District, their significance, and eligibility.

SIHP # 50-80-13-7796, post-Contact commercial sugarcane irrigation complex, covers 287 acres and includes ditches, settling ponds, an above-ground pipeline, and stacked limestone features but Filimoeala et al. (2015) recommended no further mitigation for this post-Contact site. The small "Fresh Pond" fishpond (no SIHP # assigned) lies mostly within the present project corridor on Waipi'o Peninsula (see Figure 84). Three cores were taken but there was no indication of the presence of fishpond sediments and no chronology of use was developed (Athens et al. 2000). The Athens (2000) study was a significant effort to gain data on a history of cultural use and was basically unsuccessful in obtaining such data.

SIHP # 50-80-13-5597 is a sugarcane irrigation complex consisting of two concrete pumping stations and associated irrigation ditches; (Goodman and Cleghorn 1998) include a 1937 pumping station building (Feature 1) and 1919 pumping station (and associated ditches). Goodman and Cleghorn (1998:35) determined "This site appears to meet criteria 'a' and 'd' of the criteria for listing on the National Register of Historic Places" but conclude,

The Sugar Irrigation Complex (Site 5597) is a remnant of an important industry that helped shape modern Hawai'i. Because the significance of these features is limited to their informational content, and that they have been adequately recorded, it is recommended that no further work is necessary for these sites. Construction plans call for this portion of the project area to be graded in excess of nine feet. Preservation of these sites does not appear to be warranted or feasible. [Goodman and Cleghorn 1998:36]

The status of this historic property at this time is unclear and we would not assume these buildings are of no further historic preservation concern.

SIHP # 50-80-13-9714 OR&L railroad ROW as it skirts the north side of Pearl Harbor has largely been redeveloped into a bike path. A long western portion of this bike path, west (outside) of the present project area, is listed on the NRHP. Although the long portion of the SIHP # -9714 OR&L railroad ROW within the present study area, west of approximately Waipahu Depot Street, is not on the NRHP, any modification of this site remnant is still a significant historic preservation issue.

4.3 Previous Archaeological Studies in the Central Portion of the Study Area from Waipi'o to Waimano

Many archaeological studies have been conducted in the broad vicinity of the Waipi'o to Waimano central portion of the study area (Figure 85 and Table 14). Despite this, much of the land both surrounding and within the project area, has not yet been the subject of archaeological study. Many of the archaeological studies in this area have been related to large projects with multiple concentrated studies over time, as well as long study corridors that follow modern infrastructure development such as sewer lines and roadways. These studies include archaeological inventory surveys, osteological assessments, archaeological reconnaissance surveys, archaeological assessments, paleo-environmental studies, historic property assessments, literature review and field inspections, and archaeological monitoring programs, all of which are summarized in the text below in chronological order. Archaeological finds documented during these studies include pre- and post-Contact burials, pre- and post-Contact cultural layers, Hawaiian fishpond (*loko*) deposits, *lo'i* deposits, historical military structures and remnant infrastructure, plantation-era agricultural components, a petroglyph field, and a rock shelter complex. In total, 22 archaeological sites have been documented in the vicinity of the Waipi'o to Waimano section of the project area (most have been assigned a SIHP number) and are indicated on Figure 86 and described in Table 15.

4.3.1 Rosendahl 1977

From 1976 to 1977, an archaeological reconnaissance survey project was conducted by the Bernice Pauahi Bishop Museum's Department of Anthropology which included all lands owned or controlled by the Army within the State of Hawai'i. The surveyed Army lands included the Waiawa National Guard unit which extends into the extreme north portion of the current study area along the western side of Waihona Street in Waiawa Ahupua'a. Rosendahl (1977) conducted a 2.5% pedestrian ground survey of the 197.94-acre parcel and concluded the area had undergone extensive land surface modification as a result of historical commercial agricultural practices. No historic properties were identified during this study.

4.3.2 Connolly 1980

In 1980, Archaeological Research Associates conducted an archaeological reconnaissance survey of the Mānana Kai Neighborhood Park in Pearl City. The study included a pedestrian survey of the park which Connolly (1980) notes had been completely graded and landscaped for the creation of the park. No surface historic properties were identified but it was recommended that should future ground disturbance occur an archaeological monitor should be present to mitigate potential adverse effects to encountered cultural remains (Connolly 1980).

4.3.3 Tuggle 1982

In 1982, Tuggle (1982) completed an archaeological survey of a parcel of land in Waiawa Gulch proposed to be out-leased for commercial development. The study included a pedestrian survey as well as three subsurface testing units that targeted a canal and two associated terraces. The canal was constructed of locally available semi-rounded cobbles; the two associated terraces were determined to likely be natural with minor modification possible. Tuggle (1982) concludes the features are more likely related to short-term, post-Contact agriculture rather than traditional land use. No SIHP numbers were assigned.

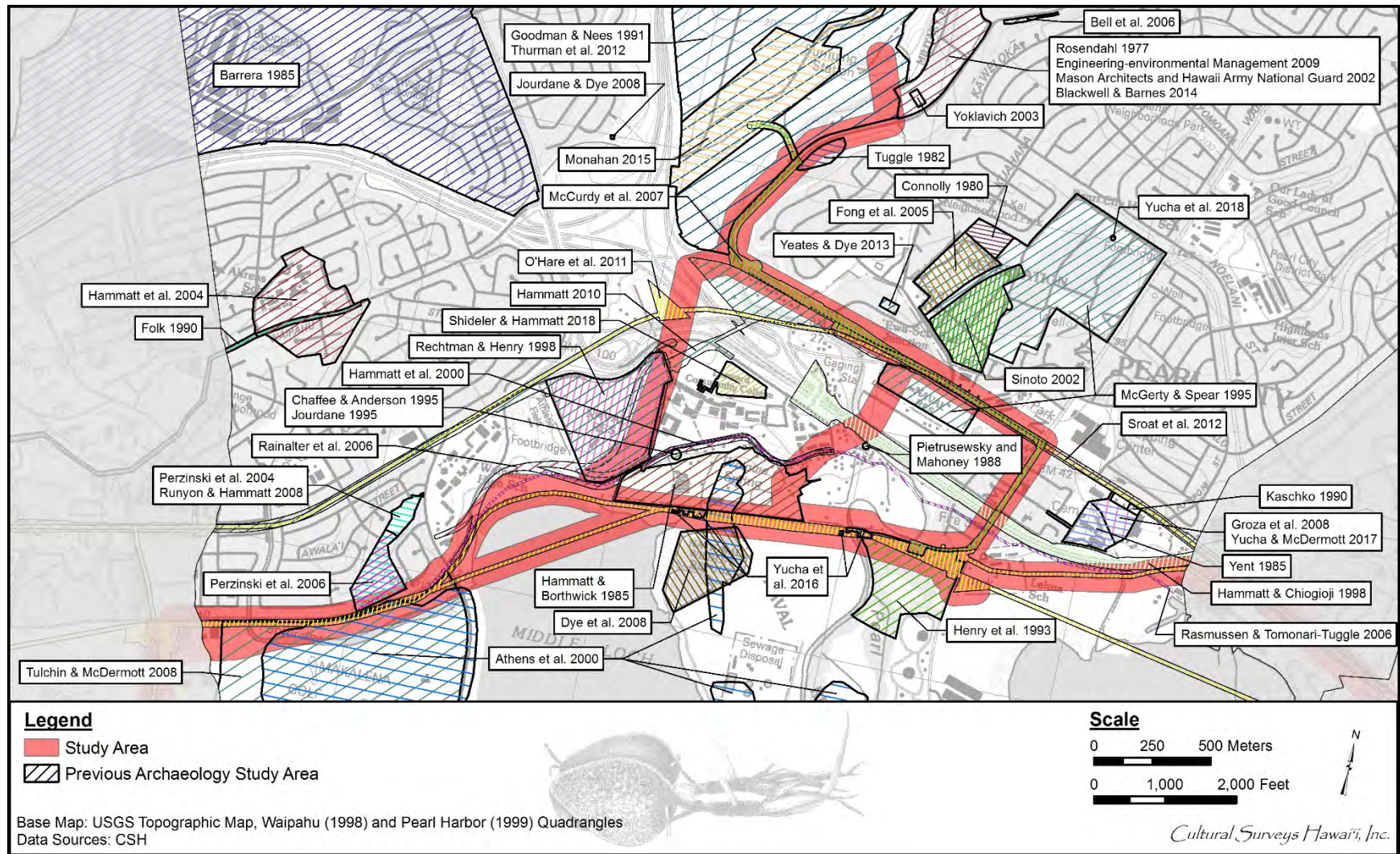


Figure 85. Previous archaeological investigations in the vicinity of the central section of the study area from Waipi'o to Waimano Ahupua'a

Table 14. Previous archaeological investigation in vicinity of the central portion of the study area from Waipi'o to Waimano Ahupua'a

Reference	Type of Study	Location	Results
Rosendahl 1977	Archaeological reconnaissance	Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	No historic properties identified
Connolly 1980	Archaeological reconnaissance survey	Mānana Kai Neighborhood Park, Waiawa Ahupua'a	No historic properties identified
Tuggle 1982	Archaeological survey	Mānana Marine Housing, Waiawa Gulch, Waiawa Ahupua'a	Identified a dry stacked basalt canal and two associated modified natural terraces, likely post-Contact; no SIHP # assigned
Barrera 1985	Archaeological reconnaissance	Parcel bounded by Waikele Gulch on the west, H-1 Freeway on the south, and Kamehameha Hwy on the northeast, Waikele and Waipi'o Ahupua'a	No historic properties identified
Hammatt and Borthwick 1985	Archaeological reconnaissance	Parcel located between Leeward Community College and northern point of Middle Loch, Waiawa Ahupua'a	No historic properties identified
Yent 1985	Archaeological reconnaissance and limited subsurface testing	Former Hale Mohalu, immediately south of Kamehameha Hwy, and east of Lehua Ave, Waimano Ahupua'a	No historic properties identified
Pietruszewsky and Mahoney 1988	Osteological assessment of inadvertent burial finds	Small parcel along southern boundary of Leeward Community College, Waiawa Ahupua'a	Identified secondarily deposited post-Contact burial remains designated as SIHP # 50-80-09-3761; six to 18 individuals ranging in age from infant to fully developed adult
Folk 1990	Archaeological reconnaissance	Waipahu St from Amokii St eastward to August Ahrens School, Waikele and Waipi'o	No historic properties identified; early 1900s curbstones and rock wall facings recommended for preservation

Reference	Type of Study	Location	Results
Greenhorn and O'Mara 1990			
Kaschko 1990	Archaeological subsurface survey	Loch View B Cemetery, Pearl City, Waimano Ahupua'a	One historic property identified: SIHP # 50-80-09-4349, minimally seven to 12 post-Contact burials within a historical cemetery
Goodman and Nees 1991	Archaeological reconnaissance and inventory survey	3,600-acre parcel bounded by H-2 Freeway to the south and Waiawa Gulch to the east, Waipi'o and Waiawa Ahupua'a	Identified 17 historic properties: SIHP # 50-80-09-1469 through -1472 and SIHP # -2261 through -2273, comprised of pre- and post-Contact sites and complexes
Henry et al. 1993	AIS	Parcel of land immediately southwest of Lehua Ave and Pearl Harbor Bike Path intersection, Mānana Ahupua'a	One historic property identified: SIHP # 50-80-09-4607, an earthen berm alignment of indeterminate function
Chaffee and Anderson 1995, Jourdane 1995	Excavation of inadvertent burial find	Magoon Estate, Waiawa Ahupua'a	One historic property identified: SIHP # 50-80-09-5302, post-Contact burial cluster of at least six individuals
McGerty and Spear 1995	Archaeological assessment	Mānana and Pearl City Junction Sites, Waiawa and Mānana Ahupua'a	No historic properties identified
Landrum 1997			
Hammatt and Chiogioji 1998	Archaeological assessment	H-1 Freeway, Waiawa to Hālawa Ahupua'a	No historic properties identified likely due to urban development along H-1 study area
Rechtman and Henry 1998	Archaeological reconnaissance assessment	'Ewa Drum Filling and Fuel Storage Area, Waipi'o and Waiawa Ahupua'a	No historic properties identified

Reference	Type of Study	Location	Results
Athens et al. 2000	Paleo-environmental study	Pearl Harbor Area	Study identified eight of 21 targeted Hawaiian fishponds and provided insight into future endeavors to construct a chronological framework for fishpond construction using qualitative dating techniques and Bayesian analysis
Hammatt et al. 2000	Archaeological assessment	Waiawa Rd adjacent to Leeward Community College southern property boundary, Waiawa Ahupua'a	No historic properties identified
Mason Architects and Hawaii Army National Guard 2002	Historical building assessment	Portion of Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	Assessed six historical buildings (Building Nos. 13, 22, 25, 27, 28, and 65) as meeting NRHP Criterion C
Sinoto 2002	Archaeological assessment	Pearl City Wal-Mart, Waiawa and Mānana Ahupua'a	No historic properties identified
Yoklavich 2003	Historical building description	Portion of Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	Written description of Building No. 22, former Navy Aviation Supply Depot Garage
Hammatt et al. 2004	Archeological and cultural assessment	Waipahu near August Ahrens Elementary School, Waipi'o Ahupua'a	No historic properties identified
Perzinski et al. 2004	AIS	Parcel adjacent to northeast corner of Ted Makalena Golf Course, Waipi'o Ahupua'a	Three historic properties identified: SIHP # 50-80-09-6671, historical remnants of the Brown estate; SIHP # -6672, a pre- and post-Contact cultural layer; and SIHP # -6673, a pre and post-Contact cultural layer with two associated traditional Hawaiian burials
Fong et al. 2005	Archaeological LRFI	Portion of Wal-Mart Pearl City lot, Waiawa Ahupua'a	No historic properties identified

Reference	Type of Study	Location	Results
Bell et al. 2006	Archaeological field check and literature review	East side of Waihona St near Waihona Place intersection, Waiawa Ahupua'a	One historic property identified: small rock-faced earthen terrace, likely historical, no SIHP # assigned
Perzinski et al. 2006	Data recovery	Parcel adjacent to northeast corner of Ted Makalena Golf Course, Waipi'o Ahupua'a	Targeted two historic properties: SIHP # 50-80-09-6672, a pre- and post-Contact cultural layer which produced a charcoal and bi-valve midden assemblage; and SIHP # --6673, a pre- and post-Contact cultural layer with two associated traditional Hawaiian burials which were disinterred and relocated
Rainalter et al. 2006	Archaeological field inspection and literature search	Three proposed corridors immediately south/southwest of Leeward Community College, Waipi'o and Waiawa Ahupua'a	Two historic properties identified: SIHP # 50-80-09-6764, the former 'Ewa Junction Navy Fuel Drum Site, and SIHP # -5302, a previously recorded post-Contact burial cluster of at least six individuals (Chaffee and Anderson 1995)
Rasmussen and Tomonari-Tuggle 2006	Archaeological monitoring	Waiau Fuel Pipeline corridor from HECO Barbers Point Tank Farm to Waiau Generating Station, Honouliuli to Waiau Ahupua'a	No historic properties identified
McCurdy et al. 2007	Archaeological LRFI	Corridor along Lehua Ave, Kamehameha Hwy, and Waihona St, Waiawa and Mānana Ahupua'a	No historic properties identified
Dye et al. 2008	Historic properties assessment	Pearl Harbor National Wildlife Refuge: Waiawa, Honouliuli, and Kalaeloa units; Waiawa and Honouliuli Ahupua'a	No new historic properties identified; assessment focuses on previously documented historic properties within refuge units

Reference	Type of Study	Location	Results
Groza et al. 2008	AIS	Former Hale Mohalu, immediately south of Kamehameha Hwy and east of Lehua Ave, Waimano Ahupua'a	One historic property identified: SIHP # 50-80-09-6918, former WWII barracks dating to 1945; <i>lo'i</i> deposit also identified, no SIHP # assigned
Jourdane and Dye 2008	Historic property assessment	99-977 Lumipolu St, Waipi'o Ahupua'a	No historic properties identified
Runyon and Hammatt 2008	Archaeological monitoring	Parcel adjacent to northeast corner of Ted Makalena Golf Course, Waipi'o Ahupua'a	No historic properties identified
Tulchin and McDermott 2008	Archaeological LRFI	Ted Makelena Golf Course at Waipi'o Peninsula, Waipi'o Ahupua'a	No historic properties identified; noted Ted Makelena Golf Course area has been heavily modified for construction of golf course
Engineering-environmental Management 2009	Historical buildings summary and evaluation	Portion of Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	Assessed three historical buildings (Building Nos. 13, 00025, and 00065) as eligible for NRHP listing
Hammatt 2010	AIS	Western portion of HHCTCP (extending from Kapolei Station in the west to Pearl Highlands Station in the east), Honouliuli and Waiawa Ahupua'a	One historic property identified: SIHP # -7751, subsurface cultural deposit of <i>lo'i</i> sediments
O'Hare 2011	Archaeological LRFI	Project area roughly aligned with Kamehameha Hwy and Pearl Harbor shoreline until extending into <i>makai</i> portion of Honouliuli, Honouliuli to Hālawa Ahupua'a	No historic properties identified
Sroat et al. 2012	AIS	Phase 2 and western portion of Phase 3 of HHCTCP, Waiawa to Hālawa Ahupua'a	One historic property identified within Waiawa Ahupua'a portion: SIHP # 50-80-09-7150, subsurface <i>lo'i</i> deposit

Reference	Type of Study	Location	Results
Thurman et al. 2012	Archeological reconnaissance survey	1,680-acre land parcel bounded by H-2 Freeway to the south and Waiawa Gulch to the east, Waipi'o and Waiawa Ahupua'a	Three historic properties identified: CSH 1, a traditional Hawaiian petroglyph site; CSH 2, a possible rock shelter; and CSH 3, a traditional Hawaiian lithic quarry; revisited ten previously identified historic properties
Yeates and Dye 2013	Archaeological assessment	Kuala St, Pearl City, Waiawa Ahupua'a	No historic properties identified
Blackwell and Barns 2014	Historical building survey and evaluation	Portion of Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	Assessed three historical buildings; none evaluated as eligible for NRHP or Hawai'i Register of Historic Places (HRHP) listing
Monahan 2015	AIS	1,395-acre land parcel north of H-1 Freeway and east of H-2 Freeway, Waipi'o and Waiawa Ahupua'a	Identified three previously documented historic properties: SIHP # -2270, a network of post-Contact roads and railroad ROWs; SIHP # -2273, post-Contact irrigation system; and SIHP # -2271, post-Contact remains of plantation worker camps
Yucha et al. 2016	Archaeological monitoring	Inland border of Pearl City Peninsula along OR&L ROW	No historic properties identified
Yucha and McDermott 2017	Archaeological monitoring	Hale Mohalu II Project, 787 Kamehameha Hwy, Waimano Ahupua'a	Three historic properties identified: SIHP # 50-80-09-4349, two human burials associated with previously identified portion of former Loch View B Cemetery; SIHP # -7214, three inadvertent post-Contact coffin burials; and SIHP # -7382, a pre- to post-Contact cultural layer with human burials
Shideler and Hammatt 2018	LRFI	Leeward Community College, Waiawa Ahupua'a	No historic properties identified
Yucha et al. 2018	Archaeological evaluation	Mānana Community Park, Mānana Ahupua'a	No historic properties identified

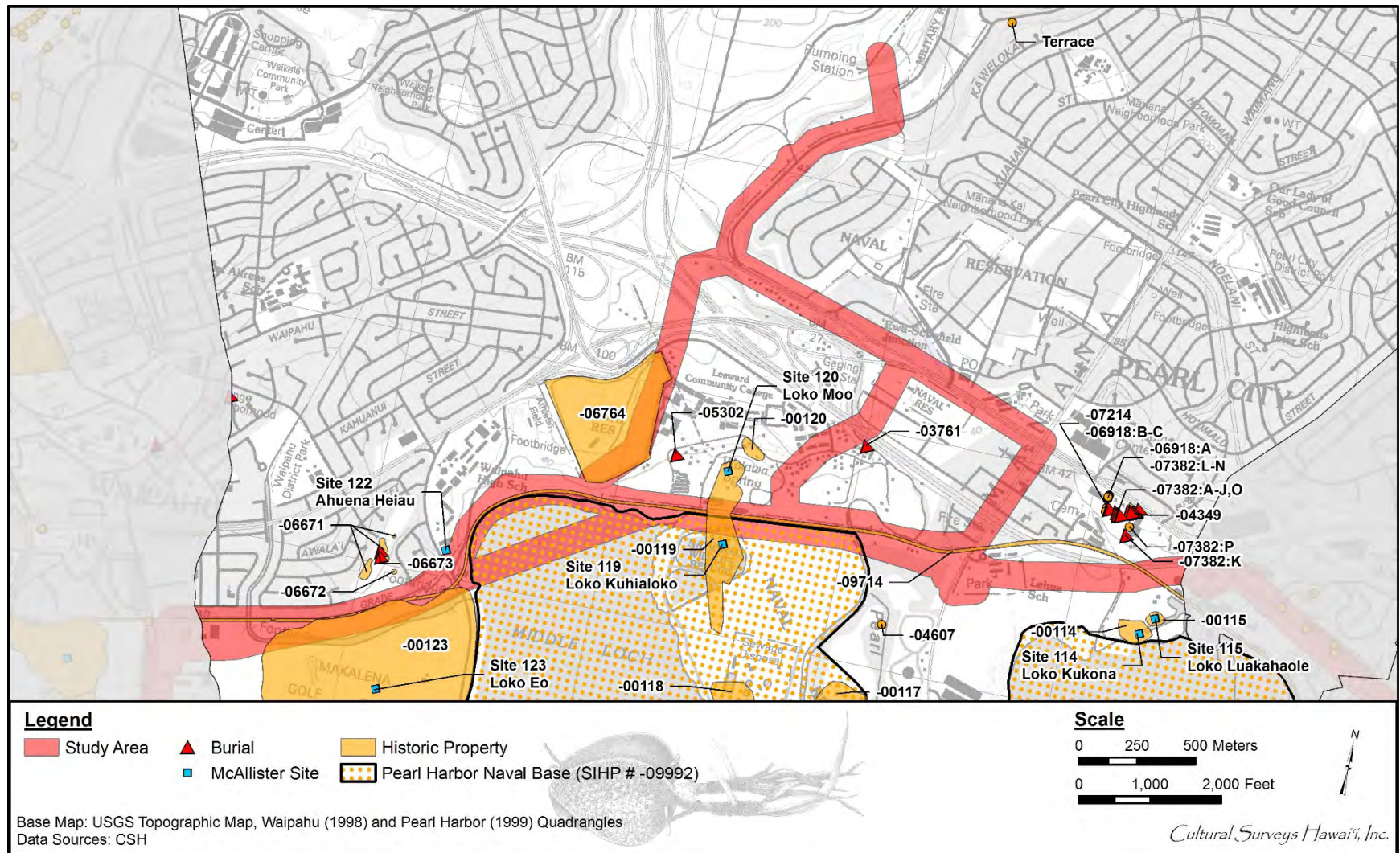


Figure 86. Previously identified historic properties in the vicinity of the central section of the study area from Waipi'o to Waimano Ahupua'a

Table 15. Previously identified historic properties in the vicinity of the central section of the study area from Waipi'o to Waimano Ahupua'a

SIHP # (50-80-)	Formal Type	Source	Comment
09-00114	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Kukona; remnants of 27-acre pond with coral and basalt wall
09-00115	Hawaiian fishpond	McAllister 1933	Loko Luakahaole; 1-acre pond filled in by 1933
09-00117	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Paauau; large pond filled in by 1933
09-00118	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Apala; small pond surrounded by wall
09-00119	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Kuhialoko; long narrow pond with wall on one of long sides
09-00123	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Eo; large pond with wall, surrounded on three sides by land
09-03761	Burial	Pietruszewsky and Mahoney 1988	Six to 18 post-Contact burials on south bank of Waiawa Stream
09-04349	Cemetery	Kaschko 1990, Yucha and McDermott 2017	Loch View B Cemetery; ca. 1900-1908, 14 coffin burials
09-04607	Alignment	Henry et al. 1993	Earthen berm alignment with unknown function
09-05302	Human burials	Chaffe and Anderson 1995, Jourdane 1995	Post-Contact burial cluster of at least six individuals
09-06671	Historic building	Perzinkski et al. 2004	Historic remnants of Brown estate
09-06672	Cultural layer	Perzinkski et al. 2004	Pre- and post-Contact layer
09-06673	Cultural layer	Perzinkski et al. 2004	Pre- and post-Contact layer with two Hawaiian burials
09-06764	Ewa Junction Navy Fuel Drum site	Rainalter et al. 2006	Post-Contact; no longer extant
09-06918:A	Concrete and basalt infrastructure	Groza et al. 2008	Remnant rock and mortar walls of WWII barracks dating to 1945
09-06918: B-C	Concrete and basalt infrastructure	Kaschko 1990	Feature B: rectangular landscaping rock; Feature C: concrete staircase

SIHP # (50-80-)	Formal Type	Source	Comment
09-07214	Human interment	Yucha and McDermott 2017	Concentration of at least three historic coffin burials
09-07382: A-P	Human interment area	Yucha and McDermott 2017	Pre- to post-Contact cultural use area containing eight human burials, three pit features, two <i>imu</i> , a charcoal lens, and a portion of Hale Mohalu driveway
12-09714	Railroad	Yucha et al. 2016	OR L ROW
13-09992	National Historic Landmark District	Apple 1978	U.S. Naval Base, Pearl Harbor Historic District (NRHP #66000940)
McAllister 122 [No SIHP # assigned]	<i>Heiau</i>	McAllister 1933, Athens et al. 2000	Ahuena Heiau; no longer in existence
"Terrace"	Terrace	Bell et al. 2006	Likely historic, possibly older, stacked cobble soil retention feature

4.3.1 Barrera 1985

Sometime prior to 1985, Chiniago, Inc. completed the pedestrian inspection of a large 586-acre parcel of land at Waikele. No historic properties were identified during the study; Barrera (1985) had predicted that any structural remains would have been destroyed by large scale commercial agriculture endeavors. The study concluded that development of the parcel may proceed without any further archaeological investigation (Barrera 1985).

4.3.2 Hammatt and Borthwick 1985

In 1985, CSH conducted an archaeological reconnaissance of a wetland parcel located between Leeward Community College and the northern point of Middle Loch, which overlays a portion of the current study area in Waiawa Ahupua'a. The purpose of the study was to locate and evaluate archaeological sites which would be impacted by proposed land-fill operations. Although a portion of their project area included the indicated location of a former Hawaiian fishpond called Loko Mo'ō, no historic properties were identified and Hammatt and Borthwick (1985) note the project area shows a severe degree of modern land modification.

4.3.3 Yent 1985

In 1985, the Department of Land and Natural Resources (DLNR), Division of State Parks, Outdoor Recreation, and Historic Sites (Yent 1985) conducted an archaeological reconnaissance and limited subsurface testing at the former Hale Mohalu Hospital in Pearl City. The purpose of the archaeological work was to define and evaluate archaeological resources on the property as part of an Environmental Assessment prior to the leasing of the property by DLNR. No historic properties were identified during the archaeological investigation. However, archival research indicated Land Commission Awards within the subject property, suggesting traditional Hawaiian agricultural use. It was recommended that if a construction project involving ground disturbance

were proposed for the subject property, a more intensive archaeological subsurface testing program should be conducted prior to construction.

4.3.4 Bath 1988 (Pietrusewsky and Mahoney 1988)

In 1987, skeletal remains were encountered at a construction site adjacent to Leeward Community College. The remains were recovered by Joyce Bath (state O'ahu archaeologist) and transported to the University of Hawai'i Anthropology Laboratory for analysis. Pietrusewsky and Mahoney (1988) conclude the remains comprise an unusual assortment of secondarily deposited human bones which comprise between six and 18 individuals of infant to adult age. Red cloth and a clear glass disk were recovered in association with the burial remains, indicating the burials are likely post-Contact. The burials were designated as SIHP # 50-80-09-3761. This burial site was on the east side of the central of three *mauka* (northern extending) corridors of the present study area (see Figure 86 and Table 15).

4.3.5 Folk 1990

In 1990, CSH conducted an archaeological reconnaissance of Waipahu Street from Amokii Street eastward to August Ahrens School, for the proposed widening of Waipahu Street. The study included a pedestrian survey intended to identify any archaeological surface sites and to determine the likelihood of encountering subsurface cultural remnants during the proposed project. The entire length of the project area was deemed to be culturally sensitive and archaeological monitoring was recommended for future groundwork in order to identify and locate any subsurface cultural remnants. Additionally, it was recommended that specific portions of curbstone and rock wall facing be preserved since they had been quarried by hand from the Lana'i Rock Quarry Company in the early 1900s (Folk 1990). No SIHP # was assigned during this project.

4.3.6 Kaschko 1990

In 1990, IARII conducted an archaeological subsurface survey on a parcel in Pearl City, immediately *makai* of Kamehameha Highway. Surface survey identified five intact graves with whole or partial headstones at the 'Ewa end of the property. Additionally, a number of broken headstones were observed piled in the *makai* and 'Ewa corner of the property. The majority of the headstones had Portuguese names with dates ranging from 1900 to 1908. Backhoe excavations and subsequent hand probing identified minimally seven to 12 burial pits containing wooden coffins within the property. All burials were left in place and the trenches were backfilled. Background research identified the parcel as the Loch View B Cemetery. It was noted that "headstones and grave outlines, etc. could have been disturbed during past construction work on Kamehameha Highway," and "one disturbed/disarticulated burial was encountered, the condition of which suggested the removal and reburial of the remains" (Kaschko (1990:3). This may indicate burials from the cemetery extend into the Kamehameha Highway ROW. The historic property is designated as SIHP # 50-80-09-4349.

4.3.7 Goodman and Nees 1991

The Applied Research Group (Bishop Museum) conducted an archaeological reconnaissance and inventory survey in 1990 for the Gentry Development Company which focused on a huge 3,600-acre parcel of land within Waiawa Ahupua'a. The parcel is bounded to the south by the H-2 Freeway and by Waihona Street to the east and is overlain by the current study area along Waihona Street. Archaeological reconnaissance included pedestrian survey where viable and

subsurface testing targeted areas with potential for pre-Contact components. Numerous features and historic properties were identified in association with both pre- and post-Contact land use. Historic properties associated with post-Contact land use include irrigation complex components, agricultural infrastructure, cemeteries and burial sites, and military infrastructure. Pre-Contact historic properties include a complex of rock shelters, a petroglyph complex, mounds, terraces, and a portion of a trail pre-Contact trail. The identified historic properties are assigned as SIHP # 50-80-09-1469 through -1472 and SIHP # 50-80-09-2261 through -2273. Of note, Goodman and Nees (1991) postulate that based on the presence of the identified rock shelter and petroglyph complexes along the pre-Contact trail, it is possible a portion of the project area “may have been used as a corridor for traversing the central plain from the southern, coastal shores to the mauka population centers (Wahiawa and Waialua)” (Goodman and Nees 1991). A combination of preservation and data recovery was recommended for the identified historic properties. The *mauka* (northernmost) portion of the present study area extends along the southeast side of this study area but none of the historic properties identified in this study are close to the present study area.

4.3.8 Henry et al. 1993

In December 1992, PHRI conducted an AIS for the Waiawa Floodplain Feasibility Study located in Mānana Ahupua‘a, between the East and Middle Lochs of Pearl Harbor. This study area includes the portion of the current study area where the existing Pearl City WWPS, and alternative Pearl City WWPS numbers one and three are located. Fieldwork for the study included a surface survey and subsurface testing involving backhoe trenches, auger tests, and Livingston Core samples. The surface survey identified SIHP # 50-80-09-4607, which was interpreted as an earthen berm alignment of indeterminate function. SIHP # 50-80-09-4607 is approximately 250 m south of the present study area. The subsurface testing was primarily within wetland and swampy portions of their study area and modern disturbances were identified in five of the 16 backhoe trenches.

4.3.9 Chaffee and Anderson 1995, Jourdane 1995

In 1995, Scientific Consultant Services, Inc., was contracted to investigate and disinter human remains from the site of a pipeline project excavation on the Magoon Estate located approximately 150 m outside the current study area. The initial find was documented by Jourdane (1995) and included one concentration of skeletal remains in a highly disturbed context. A discreet coffin burial was identified nearby upon further investigation. The concentration of skeletal remains was determined to represent a minimum of five individuals, resulting in a total of at least six individuals. The burials included associated grave goods which placed the date of the burials at no earlier than 1917. The burials are designated as SIHP # 50-80-09-5302.

4.3.10 McGerty and Spear 1995

In 1995, Scientific Consultant Services completed an AIS (recorded as an archaeological assessment) for a Department of Housing and Community project. The project area consisted of 138.5 acres on two parcels bisected by Kamehameha Highway in the Mānana Pearl City Junction (TMKs: [1] 9-7-023 and 024). The upper parcel is bounded on the ‘Ewa side by Hale Ola and Holiday City sub-divisions, and Mānana-Kai Park; on the *makai* side by Cane Haul Road; on the Koko Head side by Waimano Home Road and Kauhale Mānana sub-division; and on the *mauka* side by Kamehameha Highway. The southwestern parcel, which particularly concerns us here as it includes portions of the study area, is bounded on the *mauka* side by Kamehameha Highway; on

the 'Ewa and Koko Head side by cleared lots; and on the *makai* side by land belonging to the University of Hawai'i. The background research indicated intensive post-Contact agricultural and military use of the project area. Thus, the potential for locating intact archaeological resources has been significantly decreased. No archaeological resources were encountered during this investigation.

4.3.11 Hammatt and Chiogioji 1998

In 1998, CSH conducted an archaeological reconnaissance survey and assessment of a portion of the H-1 Freeway from Hālawā to the H1-H2 interchange at Waiawa for proposed traffic improvements (Hammatt and Chiogioji 1998). Their survey area slightly overlaps the current study area in southeast Pearl City near where Kamehameha Highway and the H-1 (Queen Lili'uokalani Freeway) cross. No archaeological sites had previously been recorded within any portion of the study area or its immediate vicinity, and no surface archaeological sites were observed during the reconnaissance survey of the lands adjacent to the highway study area corridor. It was noted that there are several buildings older than 50 years adjacent to the highway corridor at First and Second streets in Pearl City. Recommendations included consultation with the SHPD to ascertain if the buildings are of historical concern if future highway improvement activities will impact these structures. No further archaeological investigations were recommended for the area as it was determined that any prehistoric surface or subsurface archaeological remains are unlikely to be present due to urban development along the H-1 Freeway study area (Hammatt and Chiogioji 1998:20).

4.3.12 Rechtman and Henry 1998

In 1998, PHRI completed an archaeological reconnaissance survey at two discrete locations including the Red Hill Fuel Storage Area, *mauka* of Moanalua Freeway (far from the present study area), and the 'Ewa Junction Drum Filling and Fuel Storage Area, which is partially included within the western *mauka* (north-trending) corridor of the current study area. The 'Ewa Junction Drum Filling Area was located *makai* of Farrington Highway, *mauka* of Middle Loch, and immediately west of Leeward Community College, and was the proposed location for the 43.3-acre HHCTCP maintenance and storage facility. The project was undertaken in compliance with Section 110 of the National Historic Preservation Act (NHPA); "The 'Ewa Drum Filling and Fuel Storage Area received a 100% surface survey" (Rechtman and Henry 1998:6). No archaeological historic properties were identified within the project areas during the course of the fieldwork and it was concluded that "Due to the amount of prior disturbance and development at both of these facilities it is highly unlikely that any such resources, if they once existed, would have been preserved" (Rechtman and Henry 1998:ii). The study concluded, "NHPA Section 110 responsibilities with respect to the identification and evaluation of archaeological resources located within these facilities" had been fulfilled (Rechtman and Henry 1998). The 'Ewa Junction Drum Filling and Fuel Storage Area location was part of the Sroat et al. 2012 AIS study and is currently the location of the development of a HART Rail Operations Center. (This area was restricted and inaccessible during the current archaeological field inspection.)

4.3.13 Athens et al. 2000

As previously introduced in Section 4.1.5, IARII conducted field research designed to target 21 former fishponds around the Pearl Harbor area. The project aimed to create a chronological framework for fishpond construction using qualitative dating methods and Bayesian calibration. It

was not possible to produce a chronology due to complications associated with methodology, however, Athens et al. (2000) offer insight into future endeavors with similar goals and the identification of fishpond sediment. They conclude from their results that many of the former fishponds were heavily disturbed by historical land use and fishpond sediments were only distinguishable in eight of the 21 targeted fishponds (Athens et al. 2000).

The Athens et al. (2000) study addresses four fishponds near the central portion of the present study area. These are summarized below numerically by SIHP number with a brief account of the work accomplished:

- SIHP # -114 Loko Kukona: No work undertaken
- SIHP # -115 Loko Luakahaole: No work undertaken
- SIHP # -117 Loko Pā'au'au: Two cores were recovered and six radiocarbon determinations were made. Major dating inversions were noted and "Therefore, the only possible conclusion is that the stratigraphic column of Loko Pā'au'au has been massively disturbed and likely consists of fill rather than naturally deposited sediments" (Athens et al. 2000:47).
- SIHP # -118 Loko Apala: No work undertaken
- SIHP # -119, Loko Kuhia (Kuhialoko): Two cores were recovered and nine radiocarbon determinations were made. There is an inconsistency in the dating results. Historic types of pollen (*Ambrosia*, *Prosopis*, and *Batis*) were present from 318 cm to the surface of the core, leading to the conclusion that "major historic disturbances have occurred in the core at least to this depth [318 cm]" (Athens et al. 2000:52).
- SIHP # -120, Loko Moko: No work undertaken
- SIHP # -123 Loko Eo: Four cores were recovered and 16 radiocarbon determinations were made. Unfortunately, "Between Layer IIa and VII [to an indicated depth of 669 cm] the dates show no stratigraphic consistency, suggesting that this part of the core has been disturbed and is likely fill." (Athens et al. 2000:59). While there was consistency in dating from deeper layers of paleoenvironmental interest, these were all prior to human arrival.

4.3.14 Hammatt et al. 2000

In 2000, CSH conducted an AIS (recorded as an archaeological assessment) for a proposed bike path along Waiawa Road, adjacent to the southern property boundary of Leeward Community College in Waiawa. The AIS included background research and a pedestrian survey of the study area to identify potential surface sites. Background research indicated the former use of the area for traditional Hawaiian land cultivation followed by post-Contact rice farming, however, Hammatt et al. (2000) note that disturbances related to modern land use have probably eliminated any remnant sites. No surface historic properties were identified during the AIS. Archaeological monitoring was recommended for subsurface work related to bike path construction (Hammatt et al. 2000).

4.3.15 Mason Architects and Hawaii Army National Guard 2002

In 2001, Mason Architects and the cultural resources management staff of the Hawaii Army National Guard conducted an assessment of historic buildings at the Waiawa Unit Training Equipment Site located adjacent to the *mauka* (northernmost) extent of the current study area at its northern extent in Waiawa Gulch. Six buildings were evaluated including building numbers 13, 22, 25, 27, 28, and 65, all of which were constructed during World War II. All of the structures were assessed as meeting the NRHP Criterion C since they “embody the distinctive characteristics of a type, period, or method of construction” (Mason Architects and Hawaii Army National Guard 2002).

4.3.16 Sinoto 2002

Aki Sinoto Consulting conducted an AIS (recorded as an archaeological assessment) in 2002 for the proposed Wal-Mart store location in Pearl City near the Kamehameha Highway intersection with Acacia Road. The AIS included historical background research and a pedestrian survey of the 18.37-acre land parcel. Background research indicated the area has been highly affected by post-Contact sugarcane cultivation and military use, and no historic properties were identified during the pedestrian survey. Sinoto (2002) recommended that ground disturbance exceeding 1 m (3 ft) should be conducted under the supervision of an archaeological monitor.

4.3.17 Yoklavich 2003

In 2003, Mason Architects prepared a written historical and descriptive data document for the Former Navy Aviation Supply Depot Garage (Building No. 22) at Waiawa Gulch, which lies directly outside the current study area near its *mauka* (northernmost) extent in Waiawa Gulch. The document greatly details the structural components and architectural history of the building as well as the history of the complex it belongs to. Mason Architects and Hawaii Army National Guard (2002) previously assessed the World War II-era building as meeting the NRHP eligibility Criterion C.

4.3.18 Hammatt et al. 2004

In 2004, CSH conducted an archaeological assessment and cultural impact evaluation in support of the Waipahu Street Drainage Improvements project, near August Ahrens Elementary School in Waipahu. The study concluded the entire project area had been heavily modified by residential and agricultural development of the area and that any subsurface historic properties would have likely been destroyed. No historic properties were identified during the study and Hammatt et al. (2004) recommended no further work.

4.3.19 Perzinski et al. 2004

In 2004, CSH conducted an AIS of a 13-acre Queen Emma Foundation parcel located immediately north and slightly overlapping the current study area on the northeast side of Waipi'o Peninsula. Three historic properties were identified: SIHP #s 50-80-09-6671, the historical remnants of the Brown estate consisting of concrete and cinder block foundations; -6672, a subsurface cultural layer containing evidence of both pre- and post-Contact land use; and -6673, a pre- and post-Contact cultural layer containing two pre-Contact flexed human burials. Perzinski et al. (2004) recommended data recovery for SIHP # -6672, a burial treatment plan for SIHP # -6673,

and no further work for SIHP # -6671 (Perzinski et al. 2004). None of these three historic properties were within the present study corridor per se.

4.3.20 Fong et al. 2005

CSH conducted an archaeological LRFI in 2005 for a 13.54-acre land parcel proposed for commercial development near the intersection of Kamehameha Highway and Acacia Street. At the time of this study, the parcel still contained structures affiliated with former U.S. Navy occupation of the property. Fong et al. (2005) note the project area had been intensively modified by grubbing and grading to create large, terraced foundation pads for individual warehouses. No historic properties were identified, and no further archaeological work was recommended.

4.3.21 Bell et al. 2006

In 2006, CSH conducted an archaeological field check and literature review for a rockfall remediation project along Waihona Street in Waiawa Ahupua'a. One historic property comprised of a small terrace was identified during the study. The terrace is constructed of unmodified cobbles stacked up against two large natural boulders to create a semi-circle, its function interpreted as a soil retaining wall. Bell et al. (2006) concluded the terrace was likely of the post-Contact era but possibly older. While quite modest in nature and import, this is the only previously identified historic property documented on the low elevation flat land significantly inland from the coast in the central portion of the present study area.

4.3.22 Perzinski et al. 2006

CSH completed data recovery in 2005 for a 9.95-acre portion of a Castle & Cooke Homes land parcel which was previously subject of an AIS (Perzinski et al. 2004). The parcel is located immediately north of the current study area inland of the east side of Waipi'o Peninsula. The parcel contains SIHP # 50-80-09-6671, the historical remnants of the Brown estate consisting of concrete and cinder block foundations; SIHP # -6672, a subsurface cultural layer containing evidence of both pre- and post-Contact land use; and SIHP # -6673, a pre- and post-Contact cultural layer containing two pre-Contact flexed human burials. The data recovery specifically addressed SIHP # -6672 and the disinterment of SIHP # -6673. SIHP # -6672 was further investigated through subsurface testing which produced charcoal and bivalve midden; the burials associated with SIHP # -6673 were disinterred and relocated to a parcel of land in South Hālawā. Perzinski et al. recommended archaeological monitoring for all future ground disturbance within the project area land parcel (Perzinski et al. 2006).

4.3.23 Rainalter et al. 2006

In 2006, CSH conducted an archaeological LRFI for the construction of a proposed Leeward Community College Second Access Road. The study area was bounded on the *mauka* side by the Middle Loch of Pearl Harbor, on the *makai* side by Farrington Highway, on the 'Ewa side by Waipi'o Point Access Road, and on the east side by Waiawa Stream (Rainalter et al. 2006). The Rainalter et al. 2006 study area overlaps the present study corridor. Two historic properties were identified within their study area: SIHP # 50-80-09-5302, a previously recorded burial site containing both coffin and pit burials (Chaffee and Anderson 1995, Jourdan 1995), located approximately 100 m north and east of the current study area; and SIHP # -6764, the 'Ewa Junction Navy Fuel Drum Site, a fuel storage facility designed to store automobile gasoline and aviation kerosene in underground storage tanks. The Rainalter et al. (2006) study included three proposed

corridors that crossed through the former 'Ewa Junction Navy Fuel Drum Site. The study develops fairly detailed data on the 'Ewa Junction Navy Fuel Drum Site and, following consultation with the Navy, concludes, "based on this initial evaluation by the Navy, it is likely that the site would be considered eligible by the Navy for listing on the National Register . . ." The burial site, SIHP # -5302, is approximately 150 m north (outside) of the present study corridor. The east side of the westernmost *mauka* (northern) corridor of the present study area is partially within the former 'Ewa Junction Navy Fuel Drum Site, SIHP # -6764, but the import of this was resolved prior to the (presently ongoing) development as a HART Rail Operations Center.

4.3.24 Rasmussen and Tomonari-Tuggle 2006

In 2004, archaeological monitoring was conducted along the Waiau Fuel Pipeline corridor from the HECO Barbers Point Tank Farm to the Waiau Generating Station in the 'Ewa Moku (District) (previously introduced in Section 4.1.8).

Stratigraphy is reported from the northeast corner of the Makalena Golf Course and east to *makai* of Leeward Community College (Station 545+70 to Station 594+80).

The Waiau Fuel Pipeline corridor monitoring south and southeast of Leeward Community College occurred in the direct vicinity of previously identified human burials (SIHP #s 50- 80-09-3761 and -5302) and the *mauka* (north) portions of the fishponds Loko Kuhialoko (SIHP # -0119) and Loko Mo'o (SIHP # -0120). Despite being within close proximity to previously identified historic properties, it was determined that no significant archaeological finds had been identified during archaeological monitoring and that the observed stratigraphy within the project area consists of imported fills or naturally deposited sediments (Rasmussen and Tomonari-Tuggle 2006:75). Of note was the identification of

A bed of oyster shells is exposed in a natural escarpment, about 7 m high, on the north side of the trench [at Waipahu High School Station 552+00]. Macdonald and Abbott (1979:357) explain that the oyster shells were deposited during the Waimanalo sea stand and later exposed as the sea level changed. [Rasmussen and Tomonari-Tuggle 2006:55]

A similar exposure of a bed of naturally deposited oyster shells at Waipi'o Point Access Road at a depth of 150-200 cmbs was also noted (Rasmussen and Tomonari-Tuggle 2006:53).

4.3.25 McCurdy et al. 2007

In 2007, CSH conducted an archaeological LRFI for a proposed sewer line installation in the *makai* portion of Pearl City from the Pearl City WWPS east to Lehua Avenue and north to Kamehameha Highway, west along Kamehameha Highway to Waihona Street, and north along Waihona Street to the Waiawa WWPS and end of the proposed sewer line. The study consisted of historical background research and a pedestrian survey of the project area during which no historic properties were identified. McCurdy et al. (2007) state that an archaeological monitoring program may be required to address the potential of project-related excavations impacting subsurface cultural deposits.

4.3.26 Dye et al. 2008 (Waiawa Refuge Unit)

In 2008, T.S. Dye & Colleagues, Archaeologists, Inc., conducted an historic properties assessment for the Pearl Harbor National Wildlife Refuge: Waiawa, Honouliuli, and Kalaeloa

units. The purpose of the assessment was to compile and synthesize the information about previously identified historic properties within the refuge units. Dye et al. (2008) concluded most of the landscape within the district of 'Ewa has been greatly impacted by the last 150 to 200 years of land use which was dominated by cattle ranching and large-scale commercial cultivation of cash crops. Due to this, few extant traditional Hawaiian surface structures remain, and none are within the assessed refuge units which are determined to have a low likelihood of significant cultural resources present (Dye et al. 2008).

4.3.27 Groza et al. 2008

In 2007, CSH (Groza et al. 2008) completed an AIS of the Hale Mohalu II project, located on a portion of the site of the former Hale Mohalu Hospital in Pearl City. Fieldwork consisted of a surface survey and the excavation of 24 backhoe trenches. One surface historic property, SIHP # 50-80-09-6918, was identified within the project area—the remains of a former World War II barracks built by the U.S. Navy in 1945. This barracks was used as a tuberculosis treatment annex at the end of World War II and leased a few years later by the Hawaiian Board of Health to treat Hansen's disease patients. The features associated with SIHP # -6918 include two freestanding walls at the property entrance, a rock and mortar wall around the base of a banyan tree, and concrete stairs.

The stratigraphy observed in the subject property generally consisted of thick fill deposits exhibiting extensive disturbance from prior development of the area. Of note were cultural deposits identified within former LCA boundaries. These deposits consisted of culturally enriched (via charcoal flecking) clay loam, indicative of wetland taro cultivation. Charcoal samples collected from the deposits yielded a radiocarbon date range of AD 1610-1690. No SIHP numbers were assigned to the agricultural sediments.

4.3.28 Jourdane and Dye 2008

In 2008, T.S. Dye & Colleagues, Archaeologists, Inc., produced an historic properties assessment for the proposed T-Mobile H-2 Interchange Cellular Site at 94-977 Lumipolu Street in Waipahu. The assessment was based on a field inspection conducted by Hawaii Environmental Consultants, LLC. Jourdane and Dye (2008) concluded no historic properties were present within the study area and that the undertaking would have no effect on historic properties.

4.3.29 Runyon and Hammatt 2008

In 2006, CSH conducted archaeological monitoring for the installation of residential utilities at a land parcel owned by Castle & Cooke Homes Hawaii, Inc. The land parcel overlaps the current study area corridor and is located adjacent to the Pearl Harbor Bike Path and the northwest boundary of the Ted Makalena Golf Course. Monitored excavations for the project reached depths up to 1 m (approximately 3 ft). Despite the identification of SIHP # 50-80-09-6671, the historical remnants of the Brown estate consisting of concrete and cinder block foundations; SIHP # 50-80-09-6672, a subsurface cultural layer containing evidence of both pre- and post-Contact land use; and SIHP # 50-80-09-6673, a pre- and post-Contact cultural layer containing two pre-Contact flexed human burials during the AIS for the project (Perzinski et al. 2004), no historic properties were identified during archaeological monitoring (Runyon and Hammatt 2008).

4.3.30 Tulchin and McDermott 2008

In 2008, CSH conducted an archaeological LRFI for the Ted Makalena Golf Course Improvements project, which encompasses approximately 150 acres within the northern portion of the Waipi'o Peninsula. No historic properties were identified during the field inspection and it was determined that the absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and military operations, as well as the modern golf course development observed throughout the project area. Background research for this project also suggests the entire project area likely contains 3- to 7-m thick deposits of fill (Tulchin and McDermott 2008).

4.3.31 Engineering-environmental Management 2009

Engineering-environmental Management, Inc., conducted a historic building survey and evaluation in 2009, which included ten Army National guard facilities on O'ahu. The survey was intended to aid the Hawaii Army National Guard in complying with Sections 106 and 110 of the National Historic Preservation Act of 1966, as amended, and the requirements of Army Regulation 200-1. The survey included the three structures at the Waiawa National Guard Facility, which is adjacent to the northernmost extent of the current study area on the west side of Waiawa Gulch. Engineering-environmental Management, Inc., assessed the RC Organizational Storage (Building 13) and two Unit Training Equipment Site Military Vehicle Storage Buildings (Building 00025 and Building 00065), which were constructed between 1943 and 1945, as eligible for NRHP listing under Criterion A for their association "with the broad pattern of military storage expansion during World War II" and under Criterion C for "embodying distinctive characteristics of type and period of construction and as a significant grouping whose components lack individual distinction, but an overall distinguishable entity." It is also stated that the remaining World War II-era warehouses at Waiawa Gulch are also evaluated as eligible for NRHP listing under the same criteria (Engineering-environmental Management 2009).

4.3.32 Hammatt 2010

As previously introduced (in Section 4.1.13), in 2010, CSH completed an AIS for Construction Phase 1 and the western portion of Phase 2 of the HHCTCP, which runs *mauka* (north) of the current study area before intersecting it briefly in Waiawa and Mānana Ahupua'a. Pedestrian inspection of the Phase 2 portion of the survey area confirmed the entire survey area was previously disturbed by urban development. No surface cultural resources were identified. Test excavations targeted proposed transit stations with a focus on testing areas that are planned for subsurface disturbance (i.e., elevator shafts, subsurface utilities). Test excavations were also located at selected guideway column foundation locations along the proposed elevated rail line.

The stratigraphy described along Kamehameha Highway consisted of varying layers of fill overlying naturally deposited alluvial sediment, which was encountered at approximately 1.1 to 1.4 m below surface.

A focus of subsurface testing was the then-proposed Transit Maintenance and Storage Facility (the westernmost of the three present study corridors extending *mauka* traverses this parcel) and the Leeward Community College Station adjacent to the east. Nine test trenches were excavated at the Maintenance and Storage Facility and three test trenches were excavated at the Leeward Community College Station. The observed and documented stratigraphy within the Maintenance

and Storage Facility consisted of varying layers of naturally deposited silt. In some instances limestone and basalt bedrock were encountered. The observed and documented stratigraphy within the LCC Station consisted of varying layers of imported fill associated with parking lot construction, overlying naturally deposited silt. No subsurface cultural resources were observed.

Another focus of subsurface testing was the Pearl Highlands Station and park-and-ride facility (located where the westernmost *mauka* corridor of the present study area meets the Kamehameha Highway portion of the present study area) where 15 test excavations were undertaken. In general, the stratigraphy at the Pearl Highlands Station consisted of varying layers of fill to depths in excess of 3.5 m. Fill events were determined to be associated with residential and agricultural development. Natural alluvial sediments, which were expected along the margins of Waiawa Stream, were encountered beneath the extensive fill deposits in only three of the test excavations.

One historic property other than the previously discussed SIHP # 50-80-09-7751, comprised of a subsurface *lo'i* deposits (at the proposed Waipahu Transit Center location) was identified in the Hammatt 2010 study.

4.3.33 O'Hare et al. 2011

As previously introduced (Section 4.1.14), in 2010, CSH conducted an archaeological LRFI for the Honouliuli/Waipahu/Pearl City Wastewater Facilities from Honouliuli to Hālawā Ahupua'a. This study area runs roughly in alignment with the *makai* bike path portion of the central portion of the current study area. No historic properties were identified during the archaeological surface survey of the project area. Based on the intersection of the project area with locations likely to have been utilized for Hawaiian settlement due to proximity to a water source, O'Hare et al. 2011 recommended a combination of on-call monitoring, on-site monitoring, and AIS for different nodes throughout the project area (O'Hare et al. 2011).

4.3.34 Sroat et al. 2012

In 2011, CSH conducted an AIS of a 6.5-km (4.1-mile) section of the proposed Honolulu High-Capacity Transit Corridor Project (HTTCTCP) in Waiawa, Mānana, Waimano, Waiāu, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a. Field methods included pedestrian survey, ground penetrating radar, and backhoe-assisted subsurface testing. This AIS study overlapped with approximately the eastern half of the Kamehameha Highway section of the central portion of the present project area. Stratigraphy from a couple of test excavations (E1 and E2) are germane to the east end of the central portion of the present study area.

Trench E1 was located along Kamehameha Highway on the east side of the Pu'u Momi Street intersection. The stratigraphy encountered in Trench E1 consisted of the asphalt road surface (Stratum Ia at 0–15 cmbs), basalt gravel base course (Stratum Ib to 40 cmbs), and gravelly clay loam fill (Stratum II to BOE at 149 cmbs.). Trench E2 located along Kamehameha Highway immediately north of Loch View B Cemetery was virtually identical (Sroat et al. 2012:92–99).

Only one historic property, SIHP # 50-80-09-7150, a subsurface cultural deposit (*lo'i* sediments) was identified in the Sroat et al. 2012 AIS and that was well to the east of the central portion of the present study area within Waiāu Ahupua'a; this will be discussed further in the overview of that eastern portion of the present study area.

4.3.35 Thurman et al. 2012

In 2011, CSH conducted an archaeological reconnaissance survey of a 1,680-acre parcel of Kamehameha School Lands in the uplands of Waiawa Ahupua'a, which stretches from the H-2 Freeway in the west to Waiawa Gulch in the east. The purpose of the study was to explore the gulches, rock outcrops, and karst topographic areas, and to revisit previously recorded historic properties. Newly identified historic properties within the study area included CSH 1, a traditional Hawaiian petroglyph site consisting of three images; CSH 2, a possible rock shelter that requires additional investigation; and CSH 3, a traditional Hawaiian lithic quarry. Revisited historic properties include SIHP #s 50-80-09-1470, -1471, -1472, -2262, -2263, -2264, -2270, -2271, -2272, and -2273 which were initially identified during an archaeological reconnaissance and inventory survey (Goodman and Nees 1991). Recommendations for the newly and previously identified historic properties range from preservation to further documentation (Thurman et al. 2012). None of the identified sites was near the present study area.

4.3.36 Yeates and Dye 2013

In 2011, T.S. Dye & Colleagues, Archaeologists, Inc., conducted an AIS (recorded as an archaeological assessment) for a proposed plaza at Pearl City Assisted Living Center in Waiawa Ahupua'a. The AIS consisted of a 100% pedestrian survey of the project area and the excavation of five test excavations. No historic properties were identified and Yeates and Dye (2013) concluded the entire project area had been greatly modified to include only fill material.

4.3.37 Blackwell and Barnes 2014

In 2014, HDR, Inc., conducted an historic building survey and evaluation of Army National Guard facilities adjacent to the northernmost portion of the present study area for the sake of compliance with Section 106 of the National Historic Preservation Act of 1966, as amended; the requirements of Army Regulation 200-1; Hawai'i Revised Statutes (HRS) §6E; and HAR §275–284. The survey included the Waiawa Gulch Unit Regional Training Site Maintenance and the former Training Equipment Site structures which are/were located adjacent to the current study area at its northern extent in Waiawa Gulch. The structures assessed were constructed in the 1960s, however, neither was assessed as eligible for listing on the NRHP or the HRHP (Blackwell and Barnes 2014).

4.3.38 Monahan 2015

In 2014, TCP Hawai'i, LLC conducted an AIS of a 1,395-acre Kamehameha Schools land parcel for a proposed solar farm development project. The study area is located north of the H-1 Freeway, east of the H-2 Freeway, and immediately west of the northernmost portion of the current study area along Waihona Street in Waiawa Ahupua'a. The study included a combination of targeted pedestrian inspection, systematic pedestrian survey, and targeted subsurface testing. Three historic properties, previously documented by Goodman and Nees (1991), were identified during the study as well as previously identified features associated with the historic properties. These historic properties include 1) SIHP # 50-80-09-2270, a network of post-Contact roads and railroad ROWs comprised of 28 features; 2) SIHP # -2273, a post-Contact irrigation system consisting of 25 features; and 3) SIHP # -2271, remnant plantation worker camps including two features. Recommendations pertaining to the historic properties included no further work for SIHP #s -2270

and -2271, and preservation for SIHP # -2273 (Monahan 2015). The historic properties discussed are well inland of the present study area.

4.3.39 Yucha et al. 2016

In 2014, CSH completed archaeological monitoring for the Pearl City Force Main project at four discrete locations near the inland border of Pearl City Peninsula along the OL&R ROW. All four locations fall within the current study area corridor and include study areas near Waiawa Stream and Waiawa Spring. Despite the study area being directly adjacent to two known historic properties, SIHP # 50-80-09-0019 (Loko Kuhialoko) and SIHP # 50-80-12-9714 (OR&L ROW), no historic properties were identified during the implemented monitoring program (Yucha et al. 2016).

4.3.40 Yucha and McDermott 2017

In 2013, CSH completed an archaeological monitoring program for the Hale Mohalu II project along Kamehameha Highway in Pearl City, Waimano Ahupua'a. The monitoring program resulted in the identification of three historic properties including SIHP #s 50-80-09-4349, -7214, and -7382. SIHP # -4349 consists of four inadvertently encountered post-Contact coffin burials that are components of what has previously been identified as the former Loch View B Cemetery. One burial yielded a half silver dollar dating to "1905," indicating the burial area was used at least until then. SIHP # -7214 is comprised of at least three inadvertently encountered post-Contact human burials and SIHP # -7382 consists of a pre- to post-Contact cultural layer with multiple traditional Hawaiian features and human burial components (Yucha and McDermott 2017).

4.3.41 Shideler and Hammatt 2018

In 2018, CSH conducted an LRFI at Leeward Community College in Waiawa Ahupua'a, for a proposed photovoltaic and energy storage project. The study included a pedestrian survey of the project area during which no historic properties or evidence of previous land use was visible at ground surface. No further archaeological work was recommended within the project area (Shideler and Hammatt 2018).

4.3.42 Yucha et al. 2018

CSH conducted an archaeological evaluation in 2018 for the Defense Emergency Siren Modernization Program at 14 discreet locations including Mānana Community Park, which is in the vicinity of the current study area within Mānana Ahupua'a. Based on the geographic location, known cultural history at this specific geographic location, absence of any indication of prior finds at this specific location, and indication of land alteration, no further archaeological work was recommended by Yucha et al. (2018) for the Mānana Community Park Siren location.

4.4 Summary of Previously Identified Historic Properties within the Central Portion of the Study Corridors

As defined for the purposes of this study, the central portion of the study corridor traverses (from west to east) SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District; SIHP # 50-80-09-123, Loko Eo fishpond; SIHP # 50-80-09-6764, the former Ewa Junction Navy Fuel Drum site; SIHP # 50-80-09-119, the Loko Kuhia (Kuhialoko); and SIHP # 50-80-12-9714, the former OR&L alignment.

SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District, is traversed in the central portion of the study area along Middle Loch and Pearl City Peninsula. A brief discussion on the National Historic Landmark and historic property can be found in Section 4.2.

SIHP # 50-80-09-6764 (Loko Eo) and SIHP # 50-80-12-9714 (Kuhialoko), have been previously documented but have yet to be identified in an archaeological context. Athens et al. (2000) made a significant effort to test Loko Eo and Loko Kuhia with problematic results. While this certainly does not rule out future testing efforts, it suggests they may not be fruitful. On the other hand, monitoring might produce data on the presence and nature of fishpond walls or phases of maintenance that may not have been readily available with the employed coring methodology previously used.

SIHP # 50-80-09-6764, the former Ewa Junction Navy Fuel Drum site, was at the time of the fieldwork for the present study, actively being redeveloped for a HART Rail Operations Center and is suggested to be a non-issue for the present project.

As previously noted, even though the portion of the SIHP # 50-80-12-9714 OR&L railroad ROW that skirts the north side of Pearl Harbor has largely been redeveloped into a bike path, and lies outside the portion on the NRHP, any modification of this site remnant is still a significant historic preservation issue.

4.5 Previous Archaeological Studies in the East Portion of the Study Area from Waiau to Hālawā

Much of the lands in the vicinity of the Waiau to Hālawā section of the current study area were developed prior to the establishment of legislation requiring cultural resource management efforts to mitigate the impact of development on archaeological resources. As a result, there have been relatively few archaeological studies conducted in the vicinity of the current study area (Figure 87 and Table 16). These studies include archaeological inventory surveys, archaeological reconnaissance, osteological assessments, literature review and field inspections, and archaeological monitoring programs which are summarized in the text below in chronological order. Archaeological finds documented during these studies include post-Contact burials, pre- and post-Contact cultural layers, Hawaiian *loko* deposits, *lo'i* deposits, and historical infrastructure. In total, 21 archaeological sites have been documented in the vicinity of the Waiau to Hālawā section of the study area (most have been assigned a SIHP number); these are indicated on Figure 88 and described in Table 17.

4.5.1 Cluff 1970

An archaeological surface survey and investigation was undertaken by the Division of State Parks, Outdoor Recreation and Historic Sites, DLNR in 1969. The survey included a portion of the Hālawā interchange, less than 500 m northeast of the current study area, that had reportedly been the location of numerous graves and the remains of a *heiau* which had not been previously recorded or examined archaeologically. The surface survey revealed a possible site of a *heiau*, a stone house platform, several grave structures, and family burial plots. No SIHP numbers were assigned (Cluff 1970).

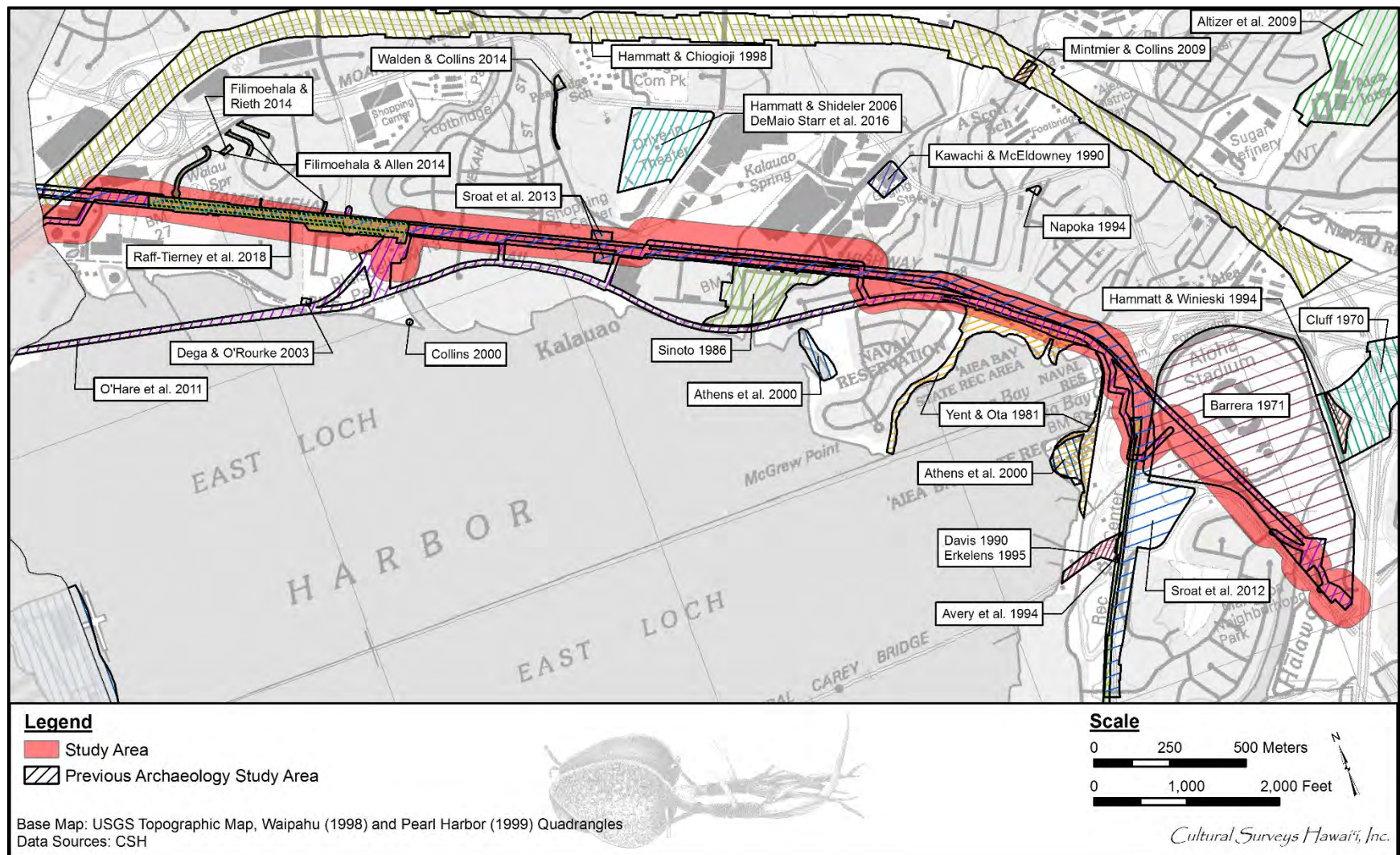


Figure 87. Previous archaeological investigations in the immediate vicinity of the study area from Waiau to Hālawā

Table 16. Previous archaeological investigations in the immediate vicinity of the study area from Waiau to Hālawā (listed chronologically)

Reference	Type of Study	Location	Results
Cluff 1970	AIS	Adjacent to H-1 freeway eastbound off-ramp exit for Aloha Stadium, Hālawā Ahupua'a	Identified possible <i>heiau</i> remnants, historical structural remnants, a coral and basalt stone wall, three irregular basalt stone mounds (possibly associated with burial/s), concrete enclosure in basalt paving stones (possibly associated with a burial), and three burial plots containing no less than 23 individuals; no SIHP #s assigned
Barrera 1971	Archaeological surface survey	Aloha Stadium, Hālawā Ahupua'a	No historic properties identified; noted graves in adjacent 'Aiea Cemetery
Yent and Ota 1981	Archaeological reconnaissance	Rainbow Bay State Park, Kalauao and 'Aiea Ahupua'a	No historic properties identified
Sinoto 1986	Archaeological surface survey	Pearl Promenade in Aiea, Kalauao Ahupua'a	One historic property identified: SIHP # 50-80-12-9714, OR&L Railroad ROW
Davis 1990	Archaeological field inspection	Terminal points of Admiral Carey Bridge, Hālawā Ahupua'a and Ford Island	No historic properties identified
Kawachi and McEldowney 1990	Osteological assessment	Kaonohi gauging station at intersection of Pali Momi and Moanalua Rd, Kalauao Ahupua'a	One historic property identified: SIHP # 50-80-09-3713, two historic coffin burials and a subsurface cultural layer containing charcoal lenses, and midden, and both traditional and historic artifacts; coffins disinterred and relocated to unknown location
Avery et al. 1994	Archaeological monitoring	Kamehameha Hwy from western boundary of Hālawā to Radford Dr, Hālawā Ahupua'a	No historic properties identified

Reference	Type of Study	Location	Results
Hammatt and Winieski 1994	Archaeological reconnaissance	Adjacent to H-1 freeway eastbound off-ramp exit for Aloha Stadium, Hālawā Ahupua'a	No historic properties identified
Napoka 1994	Field inspection	Intersection of Moanalua Rd and Nalopaka Place, 'Aiea Ahupua'a	One historic property identified: SIHP # 50-80-09-4892, Pōhaku o Ki'i
Erkelens 1995	Archaeological inventory surface	Ford Island Golf Park and Rainbow Marina, East Loch, Pearl Harbor, Hālawā Ahupua'a	No historic properties identified
Hammatt and Chiogioji 1998	Archaeological reconnaissance and assessment	H-1 Freeway, Waiawa to Hālawā Ahupua'a	No historic properties identified
Athens et al. 2000	Paleo-environmental study	Pearl Harbor Area	Study identified eight of 21 targeted Hawaiian fishponds and provided insight into future endeavors to construct a chronological framework for fishpond construction using qualitative dating techniques and Bayesian analysis
Collins 2000	Personal communication	Neal S. Blaisdell Park, Waimalu Ahupua'a	One historic property identified: SIHP # 50-80-12-6383, two previously disturbed human burials
Dega and O'Rourke 2003	Archaeological monitoring	Neal S. Blaisdell Park, Waimalu Ahupua'a	No historic properties identified
Hammatt and Shideler 2006	Archaeological LRFI	Northeast portion of city block bounded by Moanalua Rd to the northeast and Kaonohi St to the southeast, Kalauao Ahupua'a	No historic properties identified
CSH 2008	Archaeological technical report	HHCTCP	One historic property identified within current study area: 'Aiea Cemetery (not included on Fig. 50)
Altizer et al. 2009	Archaeological LRFI	'Aiea Intermediate School, 'Aiea Ahupua'a	No historic properties identified

Reference	Type of Study	Location	Results
Mintmier and Collins 2009	Archaeological assessment	H-1 freeway intersection with Ka'amilo St, Kalauao Ahupua'a	No historic properties identified
O'Hare et al. 2011	Archaeological LRFI	Project area roughly aligned with Kamehameha Hwy and Pearl Harbor shoreline until extending into <i>makai</i> portion of Honouliuli, Honouliuli to Hālawa Ahupua'a	No historic properties identified
Sroat et al. 2012	AIS	Phase 2 and western portion of Phase 3 of HHCTCP, Waiawa to Hālawa Ahupua'a	One historic property identified within Waiawa Ahupua'a portion: SIHP # 50-80-09-7150, subsurface <i>lo'i</i> deposit yielding radiocarbon date range of AD 1414-1480
Sroat et al. 2013	Supplementary AIS	Pearlridge Station of HHCTCP, Waimalu Ahupua'a	No additional historic properties identified (supplement of Sroat et al. 2012)
Filimoehala and Allen 2014	Archaeological monitoring	Kuleana Place, Kaulike Dr, and Kauhiau Place, Waiawa Ahupua'a	Three historic properties identified: SIHP # 50-80-09-7569, a pre-Contact charcoal deposit; SIHP # -7570, a fire feature; and SIHP # -7571, a post-Contact subsurface deposit with two fire or refuse features; one modern rock wall alignment identified in addition (no SIHP # assigned)
Filimoehala and Reith 2014	Archaeological assessment	North of Kamehameha Hwy near Waiawa Spring area, Waiawa Ahupua'a	No historic properties identified
Walden and Collins 2014	AIS	Northeast extent of Moanalua Loop, Waimalu Ahupua'a	One historic property identified: SIHP # 50-80-09-7567, comprised of two culverts (Features 1 and 2) constructed in the mid-1950s

Reference	Type of Study	Location	Results
Demaio Starr et al. 2016	AIS	Northeast portion of city block bounded by Moanalua Rd to the northeast and Kaonohi St to the southeast, Kalauao Ahupua'a	One historic property identified: SIHP # 50-80-09-7811, Kam Hi-Way Drive-In which includes original projection booth and concession stand
Raff-Tierney et al. 2018	Archaeological monitoring	Kamehameha Hwy alignment, at abutment of Waiiau and Waimalu Ahupua'a	Two historic properties identified: SIHP # 50-80-09-8144, a historical subsurface trash deposit, and SIHP # -7150, a previously identified subsurface <i>lo'i</i> deposit (see Sroat et al. 2012)

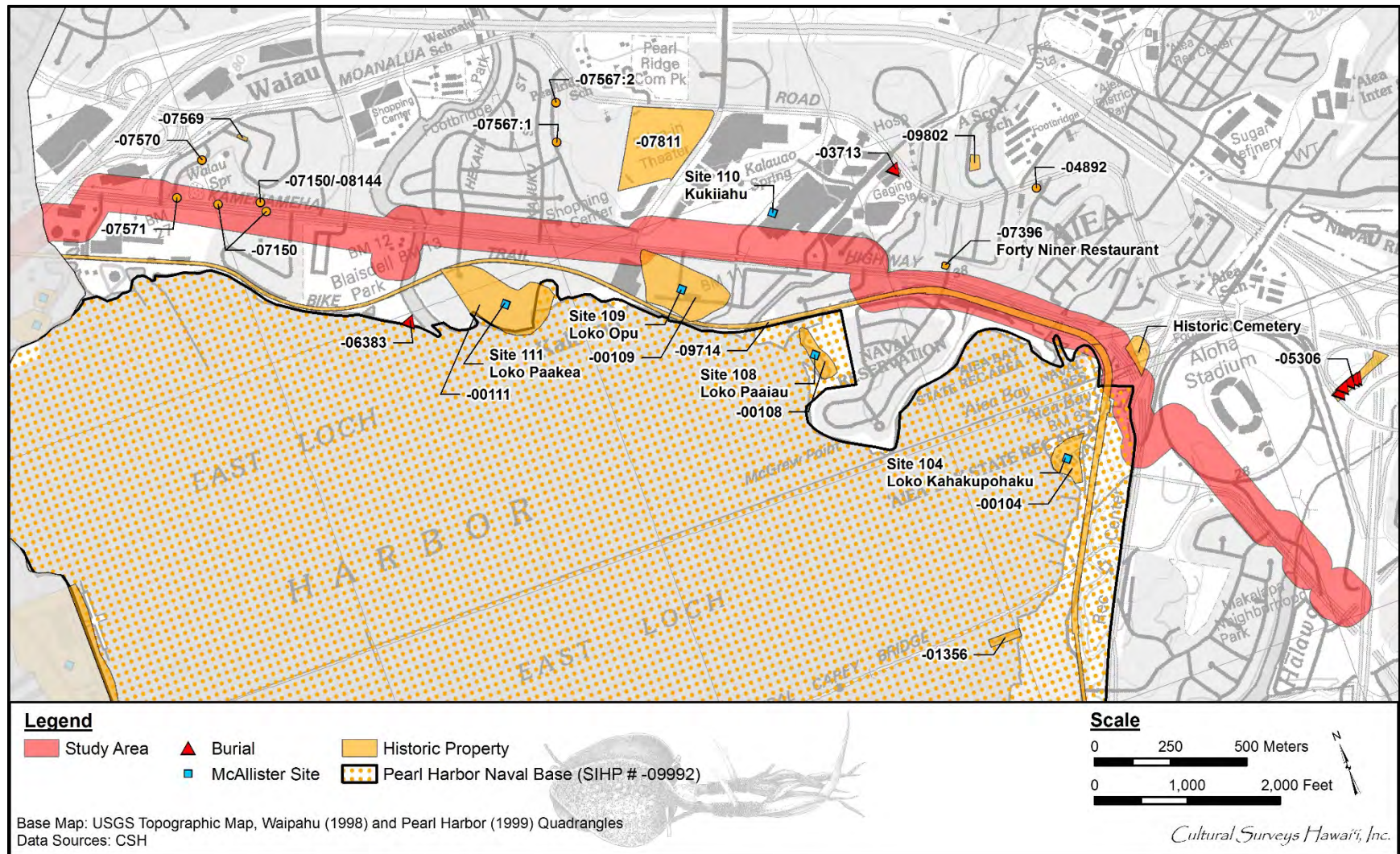


Figure 88. Previously identified historic properties in the immediate vicinity of the eastern section of the study area from Waiau to Hālawā

Table 17. Previously identified historic properties in the immediate vicinity of the eastern section of the study area from Waiiau to Hālawā

SIHP # (50-80-)	Formal Type	Source	Comment
09-00108	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Paaiāu; rectangular pond surrounded by land and wall on harbor side
09-00109	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Opu; 10.5-acre pond, partially filled in and surrounded by wall
09-00111	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Paakea; 12-acre pond with 1,850 ft wall and adjoining smaller pond
09-03713	Burial	Kawachi and McEldowney 1990	Pre- to post-Contact cultural deposits and two historical coffin burials
09-04892	Storied stone (Pōhaku o Ki'i)	Napoka 1994	Rock associated with significant Hawaiian legend
09-05306	Human interment area	Cluff 1970	Three burial plots potentially containing 23 individuals and possible <i>heiau</i> remnants
09-07150	Subsurface cultural deposits	Sroat et al 2012, Raff-Tierney et al. 2018	<i>Lo'i</i> sediments yielding a radio-carbon date range in the 1400s
09-7396	Building	Cordes and Cordes 2012	Forty Niner Restaurant, constructed in 1947
09-07567: 1 & 2	Water control feature	Walden and Collins 2014	Two culverts constructed in the mid-1950s
09-07569	Cultural deposit	Filimoehala and Allen 2014	Pre-Contact charcoal deposit associated with traditional Hawaiian irrigation
09-07570	Fire feature	Filimoehala and Allen 2014	Presumed post-Contact
09-07571	Subsurface cultural deposit	Filimoehala and Allen 2014	Post-Contact deposit consisting of two fire or refuse features
09-07811	Kam Hi-Way Drive-In	Demaio-Starr et al. 2016	Mid-1900s drive-in cinema
09-08144	Subsurface trash deposit	Raff-Tierney et al. 2018	Trash deposit dating to the early to mid- twentieth century
09-09802	Historic residence	HRHP	Honolulu Plantation manager's residence constructed in 1926
12-06383	Burial	Collins 2000	Two previously disturbed human burials in secondary context

SIHP # (50-80-)	Formal Type	Source	Comment
12-09714	Railroad	Sinoto 1986	OR&L ROW
13-00104	Hawaiian fishpond	McAllister 1933 and Athens et al. 2000	Loko Kahakupōhaku; small pond of 3 acres with a semi-circular wall
13-01356	USS <i>Bowfin</i>	National Register of Historic Places	WWII-era U.S. submarine
13-09992	Natuional Historic Landmark District	Apple 1978	U.S. Naval Base, Pearl Harbor Historic District (NRHP #66000940)
McAllister 110 (no SIHP # assigned)	Traditional habitation	McAllister 1933	Kukiiahu; habitation place of chiefess Kalaimanua and setting for battle of Kukiiahu
Historic Cemetery	‘Aiea Cemetery	CSH 2008	Early to mid-1900s cemetery established by Honolulu Plantation Co.

4.5.1 Barrera 1971

In 1971, the Bishop Museum (Barrera 1971) conducted an archaeological surface survey of the Aloha Stadium property in Hālawā. Numerous marked and unmarked graves were observed near the housing area adjacent to the proposed stadium site. It appears the author was likely referring to graves within the historic ‘Aiea Cemetery, located immediately northwest of the Aloha Stadium property. No SIHP number was assigned to the historic cemetery. No additional archaeological resources were encountered during the investigation.

4.5.2 Yent and Ota 1981

In 1981, the DLNR Division of State Parks conducted an archaeological reconnaissance survey at Rainbow Bay State Park, along the ‘Aiea Bay shoreline. No historic properties were identified, and extensive land disturbance was noted. The study did indicate the likely presence of subsurface cultural deposits associated with pre-Contact land use, specifically associated with aquaculture (i.e., fishponds) (Yent and Ota 1981). Sinoto 1986

In 1986, the Bishop Museum (Sinoto 1986) conducted an archaeological surface survey for the Pearl Promenade project, near the Pearlridge Shopping Center. One historic property was identified: SIHP # 50-80-12-9714, the OR&L Railroad ROW. Background research indicated the area was traditionally utilized by Hawaiians for aquaculture (i.e., fishponds). However, surface survey revealed the entire area was filled in and graded, associated with historic and modern development. As the entire study area showed signs of extensive land alteration, no further cultural resource management work was recommended.

4.5.3 Davis 1990

IARII conducted an archaeological field inspection at the terminal points of the Admiral Carey Bridge that extends from the shore of Hālawā to Ford Island. No historic properties were identified at surface level within the project area; the area had been heavily developed. Background research

for the project did, however, determine the former existence of multiple fishponds along the now buried shoreline near to the current study area (Davis 1990).

4.5.4 Kawachi and McEldowney 1990

In 1990, active construction in the Pearlridge-Pali Momi area at the Kaonohi gauging station, adjacent to Pali Momi Road and Moanalua Road, unearthed two previously undocumented coffin burials. Kawachi and McEldowney from the State of Hawai'i's Historic Preservation program inspected the area prior to disinterment of the burials and identified historical cultural deposits as well as indications of traditional land use such as shell midden and a stone adze. The Kaonohi (Pali Momi) prehistoric habitation site and historic burials are designated as SIHP # 50-80-09-3713 (Kawachi and McEldowney 1990).

4.5.5 Avery et al. 1994

From 1992 to 1993, Archaeological Consultants of Hawaii, Inc. (ACH) (Avery et al. 1994) monitored subsurface drilling associated with the installation of power line poles along Kamehameha Highway from Aloha Stadium to the Makalapa Gate of the Pearl Harbor Naval Base. No historic properties were identified during the archaeological monitoring. A paleoenvironmental analysis of alluvial sediments was also undertaken, indicating the possible existence of a lowland *Pritchardia* palm forest prior to Polynesian settlement.

4.5.6 Hammatt and Winieski 1994

In 1994, CSH conducted an archaeological reconnaissance survey at the proposed Hālawā Caprock non-potable well located adjacent to the H-1 Freeway on-ramp which serves as the *makai* exit for Aloha Stadium. The study concluded all evidence of early historic or pre-historic Hawaiian activity would have been eradicated by development of the project area in the late nineteenth century for commercial sugar cultivation. No historic properties were identified (Hammatt and Winieski 1994).

4.5.7 Napoka 1994

In 1994, the State of Hawai'i DLNR, State Historic Preservation Division, determined the cultural significance of a large boulder called Pōhaku o Ki'i at the intersection of Moanalua Road and Nalopaka Place in 'Aiea. The *pōhaku* (rock) is associated with traditional legendary accounts of the area and SHPD determined that they be consulted prior to any undertakings in the area which might affect the historic property. Pōhaku o Ki'i is designated as SIHP # 50-80-09-0492.

4.5.8 Erkelens 1995

IARII conducted an archaeological study for the proposed Ford Island Golf Park and Saratoga Boulevard relocation. The study area is located at the Ford Island Golf Park and the Rainbow Marina in the East Loch of Pearl Harbor. No historic properties were identified during the archaeological investigation and it was determined that the project area has likely been affected by previous historical ground disturbance. Therefore, no further archaeological mitigation measures were recommended (Erkelens 1995).

4.5.9 Hammatt and Chiogioji 1998

In 1998, CSH conducted an archaeological reconnaissance survey and assessment of a portion of the H-1 Freeway from Hālawā to the H1-H2 interchange at Waiawa for proposed traffic

improvements (Hammatt and Chiogioji 1998). The survey area traverses approximately 60 m south of the current study area. No archaeological sites had previously been recorded within any portion of the study area or its immediate vicinity, and no surface archaeological sites were observed during the reconnaissance survey of the lands adjacent to the highway study area corridor. There are several buildings older than 50 years adjacent to the highway corridor at First and Second streets in Pearl City. Recommendations included consultation with the SHPD to ascertain if the buildings are of historical concern if future highway improvement activities will impact these structures. No further archaeological investigations were recommended for the area; it was determined that any prehistoric surface or subsurface archaeological remains are unlikely to be present due to urban development along the H-1 Freeway study area (Hammatt and Chiogioji 1998:20).

4.5.10 Athens et al. 2000

In 2005, IARII conducted field research designed to target 21 former fishponds around the Pearl Harbor area (as previously introduced in Sections 4.1.5 and 4.3.16). The project aimed to create a chronological framework for fishpond construction using qualitative dating methods and Bayesian calibration. It was not possible to produce a chronology due to complications associated with methodology, however, Athens et al. (2000) offer insight into future endeavors with similar goals and the identification of fishpond sediment. Their results conclude that many of the former fishponds were heavily disturbed by historical land use and fishpond sediments were only distinguishable in eight of the 21 targeted fishponds (Athens et al. 2000).

- SIHP # -104 Loko Kahakupōhaku: “This is a small filled fishpond located along the east shoreline of East Loch. No field investigations were undertaken at this pond due to possible hazardous waste contamination of the overlying fill” (Athens et al. 2000:31). A photo is supplied.
- SIHP # -108 Loko Paaiau: “Loko Paaiau is a small fishpond located on the west side of McGrew Point at the northeast end of East Loch. This pond is one of the few in the Pearl Harbor area that is not covered by fill. There is about 1 m of standing water in the pond. The outer pond wall, except for its northeast section, appears mostly intact although overgrown with mangroves” (Athens et al. 2000:31). Two partial cores and one full core were taken, and 21 carbon dates were obtained. It was concluded that “fishpond sediments for one reason or another were not preserved at the coring location. Other locations, therefore, should be tested at Loko Paaiau for the presence of fishpond sediments” (Athens et al. 2000:33).
- SIHP # -109 Loko Opu, no work undertaken
- SIHP # -111, Loko Pa‘akea, no work undertaken

4.5.11 Collins 2000

In 2000, the partial remains of two individuals were inadvertently identified in the southeastern portion of Blaisdell Park. The remains were encountered within a disturbed context and may have been reburied after initial disturbance. A possible cultural layer was also identified in association with the human burials. “Collins 2000” refers to personal communications between Dega and/or O’Rourke and Sara Collins of the SHPD (Dega and O’Rourke 2000:19). The burials are designated

as SIHP # 50-08-12-6383. We note in passing that additional human remains were found near Blaisdell Park on March 15, 2011 (Shikina 2011).

4.5.12 Dega and O'Rourke 2003

In 2003, Dega and O'Rourke conducted an archaeological investigation of environmental sampling at the Neal S. Blaisdell Park located approximately 100 m south of the current study area. Environmental testing occurred in the southwestern corner of Blaisdell Park at the location of the former Waiiau Drum Storage Facility and included shallow surface soil collection as well as the drilling of four wells to test groundwater. Though Dega and O'Rourke (2003) had hypothesized the area to have moderate to high probability for documenting historic properties, no cultural materials were identified during the study. It was also noted by the authors that areas of deep subsurface investigation revealed stratigraphy consisting of natural sediments overlain by historic and modern fill deposits.

4.5.13 Hammatt and Shideler 2006

In 2006, Hammatt and Shideler from CSH conducted a LRFI for the Live Work Play 'Aiea project located within the Pearl Ridge area and bounded by Moanalua Road to the north and Ka'onohi Street to the southeast. They determined the project area was unlikely to have any significant subsurface cultural deposits. If there had been cultural materials in the past, they most likely were destroyed by decades of commercial sugarcane cultivation or the grading associated with the establishment of the Kamehameha Drive-In (Hammatt and Shideler 2006).

4.5.14 CSH 2008 (not depicted on Figure 87)

In 2008, CSH completed an archaeological technical report for the HHCTCP (CSH 2008). The report identified likely impacts to archaeological resources within the HHCTCP corridor. Within the Kamehameha Highway portion of the project corridor, the study identified and provided brief documentation of 'Aiea Cemetery, located on the *mauka* side of Kamehameha Highway, adjacent to the Aloha Stadium property.

Background research associated with an additional archaeological study (Sroat et al. 2012) indicated the cemetery was established by the Honolulu Plantation Company. The cemetery previously extended *makai* of Kamehameha Highway, but was bisected during highway construction. The burials in the *makai* portion of the cemetery were indicated to have been relocated to the *mauka* portion of the cemetery prior to highway construction.

4.5.15 Altizer et al. 2009

CSH completed an LRFI in 2009 for the 'Aiea Intermediate School Erosion Control project. The project area is located approximately 750 m northeast of current study area, bounded by 'Aiea Stream to the northeast and Ali'ipoe Street to the southeast. No historic properties were identified during the field inspection and the study determined there is little potential for intact cultural deposits within the project area (Altizer et al. 2009).

4.5.16 Mintmier and Collins 2009

Pacific Consulting Services, Inc. conducted an AIS (recorded as an archaeological assessment) in 2009 for the Freeway Management System replacement of a dynamic message sign at the intersection of the H-1 Freeway with Ka'milo Street. No historic properties were identified during

the surface assessment but Mintmier and Collins (2009) conclude subsurface cultural deposits may be present since this area was traditionally and historically used for agriculture and settlement and was also a seat of power for many of O'ahu's royal leaders.

4.5.17 O'Hare et al. 2011

In 2010, CSH conducted an archaeological LRFI for the Honouliuli/Waipahu/Pearl City Wastewater Facilities from Honouliuli to Hālawā Ahupua'a. This project area runs roughly parallel on the *makai* side of the current study area, ranging from 0 to 500 m *makai* (south) of the current study area, before diverging near Aloha Stadium. No historic properties were identified during the archaeological surface survey of the project area. Based on the intersection of the project area with locations likely to have been utilized for Hawaiian settlement due to proximity to a water source, O'Hare et al. 2011 recommended a combination of on-call monitoring, on-site monitoring, and archaeological inventory survey for different nodes throughout the project area (O'Hare et al. 2011).

4.5.18 Sroat et al. 2012

In 2011, CSH conducted an AIS of a 6.5-km (4.1-mile) section of the proposed HTTCTCP in Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a. Field methods included pedestrian survey, ground penetrating radar, and backhoe-assisted subsurface testing. Twenty-two test excavations (E4 through E25) were conducted along Kamehameha Highway within the present project area corridor between Pu'u Poni Street on the west and Aloha Stadium on the east.

It is noted that the project area "is largely confined to the footprint of Kamehameha Highway" and that

Kamehameha Highway has long been a major utility corridor, including: fuel, gas, cable TV, electric, fiber optic, water, storm drains, and sewer lines. The installation of these numerous linear utility lines, extending parallel to the highway's long axis, has undoubtedly affected portions of the study area by increasing the disturbance of underlying natural sediments beneath the highway surface. [Sroat et al. 2012:90]

Hence, outside the highway corridor the stratigraphy could be significantly different.

Only one historic property was identified during this study, during a test excavation within Waiau Ahupua'a just west of Blaisdell Park: SIHP # 50-80-09-7150, a subsurface cultural deposit (*lo'i* sediments) yielding a radiocarbon date range of AD 1414-1480. Sroat et al. (2012) evaluated the historic property as eligible for inclusion in the NRHP as well as HRHP under Criterion D. Four segments within the Section 2 construction were recommended for full-time on-site monitoring, including the area around SIHP # -7150. The remaining segments of the Section 2 project area were recommended for on-call monitoring with weekly spot checks (Sroat et al. 2012).

4.5.19 Sroat et al. 2013

In 2013, an additional inventory survey was conducted by CSH in association with Sroat et al. (2012), around the area of the Pearlridge Station, within Section 2 of the HTTCTCP. No additional historic properties were identified, and monitoring recommendations stated in the previous report were reiterated (Sroat et al. 2013).

4.5.20 Filimoehala and Allen 2014

In 2013, IARII conducted archaeological monitoring in support of the Waiiau Area Sewer Rehabilitation/Reconstruction project located adjacent and north of the current study area. Three historic properties were identified (SIHP #s 50-80-09-7569 through -7571), and one modern wall rock alignment was observed (no SIHP number assigned). SIHP # -7569 is a pre-Contact charcoal deposit associated with traditional Hawaiian irrigated cultivation. A native plant charcoal sample obtained from an associated deposit yielded a radiocarbon date with a bimodal distribution of AD 1518-1593 and 1618-1664. SIHP # -7570 is a fire feature (undated, presumed post-Contact), and SIHP # -7571 (located adjacent to the western end of the current study area) is a post-Contact subsurface deposit consisting of two fire or refuse features (Filimoehala and Allen 2014).

4.5.21 Filimoehala and Reith 2014

In 2014, IARII conducted an AIS (recorded as an archaeological assessment) of a 0.03-acre house lot located approximately 150 m northeast of the current study area. No historic properties were identified. However, one isolated mid-twentieth century bottle was observed within fill (Filimoehala and Reith 2014).

4.5.22 Walden and Collins 2014

In 2013, Pacific Consulting Services, Inc. conducted an AIS, approximately 500 m north of the current study area, along a steep embankment at the northeast extent of Moanalua Loop to facilitate proposed rockfall mitigation. One post-Contact historic property was identified; SIHP # 50-80-09-7567, which consists of two culverts (Features 1 and 2) constructed in the mid-1950s. The presence of a concrete chute drain constructed in 1966 was also noted. Since at the time of the report the structure was less than 50 years old, it did not qualify as a historic property and no SIHP number was assigned (Walden and Collins 2014).

4.5.23 Demaio Starr et al. 2016

CSH completed an AIS for the Live Work Play 'Aiea project located within the Pearl Ridge area and bounded by Moanalua Road to the north and Ka'onohi Street to the southeast (same as the Hammatt and Shideler 2006 project area). One historic property was identified and consisted of the Kam Hi-Way Drive-In property, which is designated as SIHP # 50-80-09-7811. The AIS lead to the SHPD determination that no further archaeological work was required for the project (Demaio Starr et al. 2016).

4.5.24 Raff-Tierney et al. 2018

Between 2014 and 2016, CSH conducted archaeological monitoring fieldwork for the Waimalu WWPS Force Main and Waiiau Area Sewer Rehabilitation/Reconstruction project. This project area is located within the current study area, where Waiiau and Waimalu Ahupua'a abut. Two historic properties were identified during monitoring including SIHP # 50-80-09-8144, a subsurface trash deposit identified in a fill deposit dating to the early to mid-twentieth century, and SIHP # -7150, a subsurface *lo'i* deposit which was previously identified by Sroat et al. (2012) (Raff-Tierney et al. 2018).

4.5.25 Honolulu Rapid Transit Project (H RTP) Archaeological Monitoring To Date

The Honolulu Rapid Transit Project (H RTP) to date has encountered human skeletal remains in two locations within 'Ewa District; both within the present study area (general location of the finds depicted on Figure 89). Human tibia shaft and fibula shaft (leg bone) fragments were identified (designated Burial Find 1) in previously disturbed fill sediments near the corner of 'Aiea Kai Place and Kamehameha Highway on December 4, 2014. Human skeletal remains (designated Burial Find 2 through 10) were identified in the Pearl Ridge Makai Station in August 2017. Treatment has moved forward in consultation with the SHPD and O'ahu Island Burial Council. The finalization of reporting is pending.

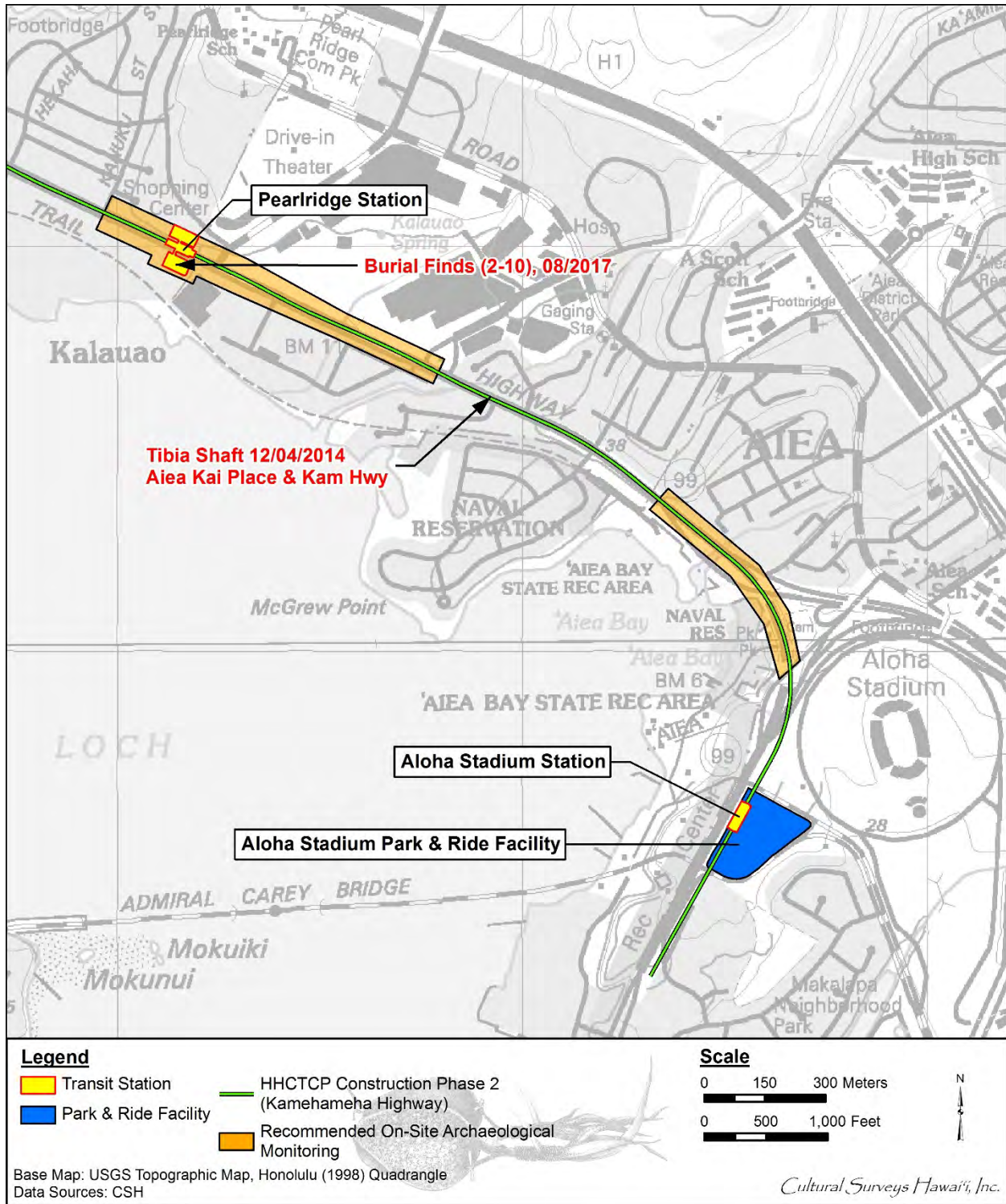


Figure 89. Portion of a 1998 Honolulu USGS topographic quadrangle showing locations of human skeletal remains identified in 'Ewa District during the HRTCP monitoring

4.6 Summary of Previously Identified Historic Properties within the East Portion of the Study Corridor

The eastern portion of the study area is relatively free of previously identified historic properties. In the area just west of Blaisdell Park are features of two sites (SIHP #s 50-80-09-7150 and -7571). SIHP # -7150 identifies subsurface cultural deposits relating to *lo'i* sediments previously identified by Sroat et al. (2012) and Raff-Tierney et al. (2018). These sediments yielded a radio-carbon date range for ponded field taro cultivation in the 1400s. SIHP # -7571 identifies a subsurface post-Contact cultural deposit consisting of two fire or refuse features identified in the Filimoehala and Allen (2014) study.

Near Kalauao Spring stream, the south side of the study area is adjacent to the Loko Opu fishpond (SIHP # 50-80-09-109). We are not aware of any archaeological study at this fishpond since it was identified by McAllister in 1933.

SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District, is traversed in the eastern portion of the study area, west of the Aloha Stadium. A brief discussion on the National Historic Landmark and historic property can be found in Section 4.2.

The 'Aiea cemetery (no SIHP #) is adjacent to the north side of the project corridor just west of Aloha Stadium but because of the situating of this cemetery effectively up on a bluff it is thought not to be of concern for the present project.

4.7 Background Summary and Predictive Models

The margins of Pearl Harbor were highly productive lands, owing to the availability of marine resources, riparian resources, well-watered bottom lands for *kalo* cultivation and other forms of agriculture, and the generally sheltered conditions. These lands responded rapidly to human endeavor, and the many fishponds, irrigation ditches, and pond-fields of the region supported a substantial pre-Contact and early post-Contact population. The richness of the margins of Pearl Harbor also attracted later settlement by ethnic groups throughout the early post-Contact period.

During the second half of the nineteenth century, traditional agricultural pursuits in the Pearl Harbor area were being displaced by other agricultural interests, including commercial cultivation of rice and sugarcane. The expansion of commercial agricultural interests resulted in an extensive modification of the pre-Contact landscape. The establishment of the OR&L railway line along the Pearl Harbor coast in the late 1800s and U.S. military development in the Pearl Harbor region in the early 1900s contributed to increased post-Contact settlement and urban development in the region. By the mid-1900s the Pearl City and 'Aiea areas had developed into modern towns, and by the 1970s, much of the Pearl Harbor area was urbanized.

A relatively low number of archaeological studies have been conducted in the vicinity of the current study area, as the Pearl Harbor area was developed prior to the establishment of legislation requiring cultural resource management efforts. The archaeological studies that have been conducted in the vicinity generally lack significant findings, which have been attributed to extensive disturbance from prior development activities. However, these previous archaeological studies were largely conducted on historically or modernly developed parcels adjacent to Kamehameha Highway, with little or no subsurface testing performed.

Intact subsurface cultural deposits, features, and/or human skeletal remains, relating to both pre-Contact and early post-Contact traditional Hawaiian habitation and agriculture, may be encountered beneath fill sediments associated with the construction of Kamehameha Highway and development of the surrounding area. Human skeletal finds in two locations during recent archaeological monitoring for the H RTP (see Section 4.5.26 and Figure 89) underscores the potential for similar finds in the future.

Traditional Hawaiian cultural deposits or features could include pond and *lo'i* (irrigated terrace) sediments; *kuāuna* (embankments) that served as boundaries of ponds or *lo'i*; and buried land surfaces containing midden, artifacts, or hearth features. The likelihood of such finds is suggested to be higher in the vicinity of known Land Commission Awards, and in close proximity to streams, springs, and the coast. Historic cultural resources, associated with post-Contact habitation, commercial agricultural interests, or military development, may also be encountered throughout the study area. Post-Contact cultural deposits or features could include isolated artifacts, trash pits, privies, and building foundations or other subsurface structural features.

Surface archaeological sites and features are expected to be largely limited to post-Contact land use associated with historic commercial agriculture, military occupation, and infrastructure related to transportation. Based on previous archaeological studies, it is anticipated that remnants and structures associated with the development of Naval Magazine Pearl Harbor (West Loch)(SIHP # -9992, U.S. Naval Base, Pearl Harbor Historic District) will be encountered along the western shores of West Loch. Remnants of the Oahu Sugar Company's large irrigation complex (SIHP #s 50-80-13-5597 and/or -7796) are likely to be identified throughout much of Waipi'o Peninsula. Historical infrastructure related to transportation may include portions of SIHP # 50-80-12-9714 (OR&L Railroad) along the *makai* portions of the project area, and features such as bridges and culverts associated with plantation roads and Kamehameha Highway, which was constructed in the mid-1900s. Although the portion of the OR&L alignment that is on the NRHP is well to the west of the present project area, impacts to this alignment in the vicinity of the present project area have been problematic and early consultation with the SHPD regarding impacts to SIHP # -9714 are recommended.

Section 5 Results of Fieldwork

CSH archaeologists undertook an archaeological field inspection to determine the likelihood of potential archaeological historic properties. Results of the field inspection relating to components of the proposed Honouliuli Waipahu Pearl City Wastewater Collection System Improvement Project are summarized in Table 18. The findings of the field inspection for the western (from Honouliuli to Waikele Ahupua'a), central (Waipi'o to Waimano Ahupua'a), and eastern (Waiau to Hālawā Ahupua'a) sections of the study area are reported in detail below. Potential historic properties that have not been designated with SIHP numbers are also discussed in this section. The previously identified historic properties are discussed in detail in Section 8.

5.1 From Honouliuli to Waikele

The eastern section of the study area stretches from Honouliuli Ahupua'a near the western banks of West Loch, across West Loch to the northeast, and extends north on Waipi'o Peninsula, terminating at the eastern boundary of Waikele Ahupua'a near the Pearl Harbor Bike Path. This section of the study area includes a main corridor that briefly forks near the inland portion of Waipi'o Peninsula, and near the middle of West Loch. The study area crosses a portion of the Naval Magazine Pearl Harbor (West Loch) (Figure 90 and Figure 91). On Waipi'o Peninsula, the study area is vastly undeveloped and overgrown with vegetation that reflects the landscape's historical use for commercial agriculture (Figure 92 and Figure 93). The Waipi'o Soccer Complex is just east of the study area, however, the study area crosses the reservoir for the complex (Figure 94 and Figure 95). The *mauka* portion includes a residential community, commercial businesses, the Honolulu Police Training Academy (Figure 96), and the existing Waipahu WWPS (Figure 97). The *mauka* portion also includes a portion of the Pouhala Marsh Wildlife Sanctuary.

Four previously identified historic properties and one previously documented Hawaiian fishpond were identified within this section of the study area. This includes SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District; SIHP # 50-80-12-9714, the OR&L Railroad ROW and a steel spur railroad bridge (Whitman et al. 2007); SIHP # 50-80-13-5597, a sugar irrigation complex including two extant pumping stations (Goodman and Cleghorn 1998); SIHP # 50-80-13-7796, an irrigation complex consisting of ditches, settling ponds, a pipeline, and limestone features (Filimoehala et al. 2015).

Forty-seven potential historic properties were identified during the current study within Honouliuli and Waikele Ahupua'a. Twenty-four of the potential historic properties (CSH 21–40, 45, and 46) are likely related to SIHP # -5597 and/or SIHP # -7796, including berms, ditches, sluice gates, and water control features. The 23 additional potential historic properties (CSH 1–19) include various military related structures and infrastructure remnants associated with Naval Magazine Pearl Harbor (West Loch) (which is a component of SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District), a mechanical refuse dump (CSH 20), a mortared basalt culvert (CSH 44), mortared basalt retaining wall (CSH 43), and an overgrown concrete walkway (CSH 47). Additional areas of potential archaeological concern include three limestone caves (CSH 41) documented in the *mauka* (northern) half of Waipi'o Peninsula. These findings are listed in Table 19, depicted on Figure 98 through Figure 100, and discussed in further detail below. The archaeologists' track logs are shown in Figure 101 through Figure 103.

Table 18. Results of fieldwork pertaining to individual project components

Project Component	Study Area Section	Potential/Previously Identified Historic Properties (in vicinity)
Waipahu Force Main	Honouliuli to Waikele	CSH 1–19, various military related structures and infrastructural remnants associated with Naval Magazine Pearl Harbor (West Loch) (within SIHP # -9992); CSH 20, a mechanical refuse dump; CSH 44, a mortared basalt culvert; CSH 43, mortared basalt retaining wall; CSH 47, overgrown concrete walkway; SIHP # -5597 and -7796, historical irrigation complex and associated potential historic properties (CSH 21–40, 45 and 46); and SIHP # -9714, OR&L ROW and spur steel railroad bridge
Waipahu WWPS Locations	Honouliuli to Waikele	CSH 47, overgrown concrete walkway, in vicinity of alternative WWPS #2
Pearl City Dual Force Main	Honouliuli to Waikele/ Waipi'o to Waimano	SIHP # -9714, OR&L ROW and SIHP # -9992, U.S. Naval Base, Pearl Harbor Historic District
Pearl City WWPS	Waipi'o to Waimano	SIHP # -9714, OR&L ROW in vicinity of existing WWPS and alternative WWPS #3
Corridor G	Waipi'o to Waimano	SIHP # -9714, OR&L ROW; CSH 48, Waiawa Stream Bridge-Kamehameha Highway; and CSH 49, culvert
Corridor D	Waipi'o to Waimano	SIHP # -9714, OR&L ROW; and CSH 49, culvert
Corridor A	Waipi'o to Waimano	SIHP # -9714, OR&L ROW; CSH 49, culvert; and CSH 50, fire station
Pearl City Influent Trunk Sewer	Waipi'o to Waimano/ Waiau to Hālawā	SIHP # -9714, OR&L ROW and CSH 51, active <i>lo'i kalo</i>
Waimalu Force Main	Waiau to Hālawā	CSH 52, weir; and CSH 53, Waimalu Stream Bridge
Waimalu WWPS	Waiau to Hālawā	No historic properties identified
Waimalu Influent Trunk Sewer	Waiau to Hālawā	SIHP # -9714, OR&L ROW; SIHP # -9992, U.S. Naval Base, Pearl Harbor Historic District; CSH 54, Sumida Watercress Farm; CSH 55, Kalauao Spring Bridge; CSH 56, Kalauao Stream Bridge; CSH 57, 'Aiea Stream Bridge; CSH 58, 'Aiea Cemetery; and CSH 59, culvert
Hālawā Force Main	Waiau to Hālawā	CSH 60, Salt Lake Blvd Bridge-Hālawā Stream
Hālawā WWPS	Waiau to Hālawā	No historic properties identified

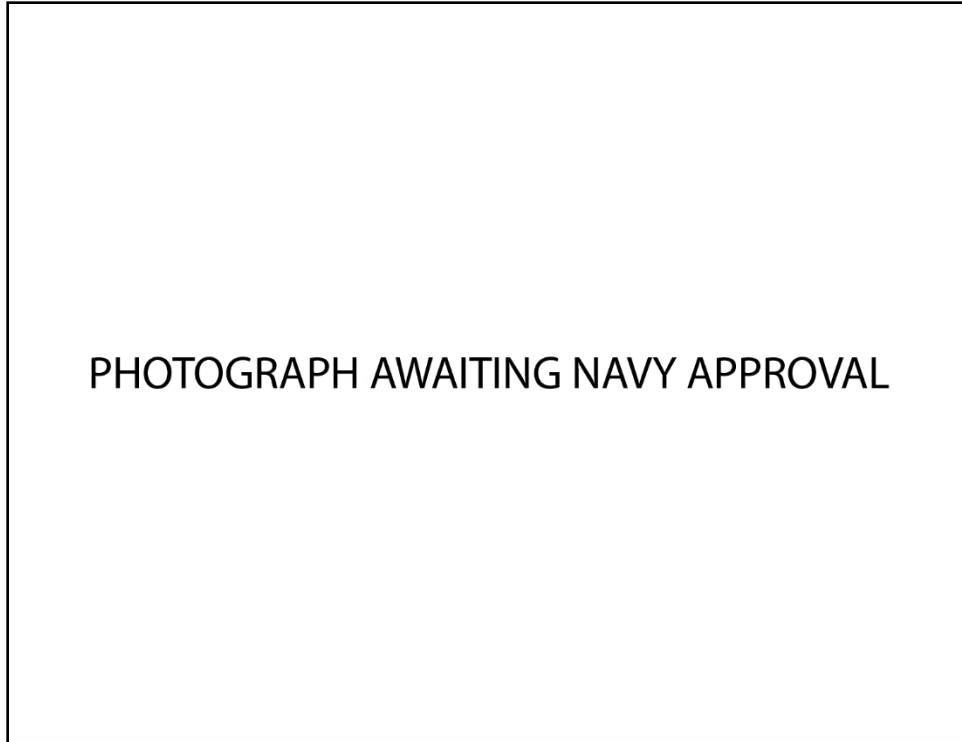


Figure 90. General view of West Loch portion of study area

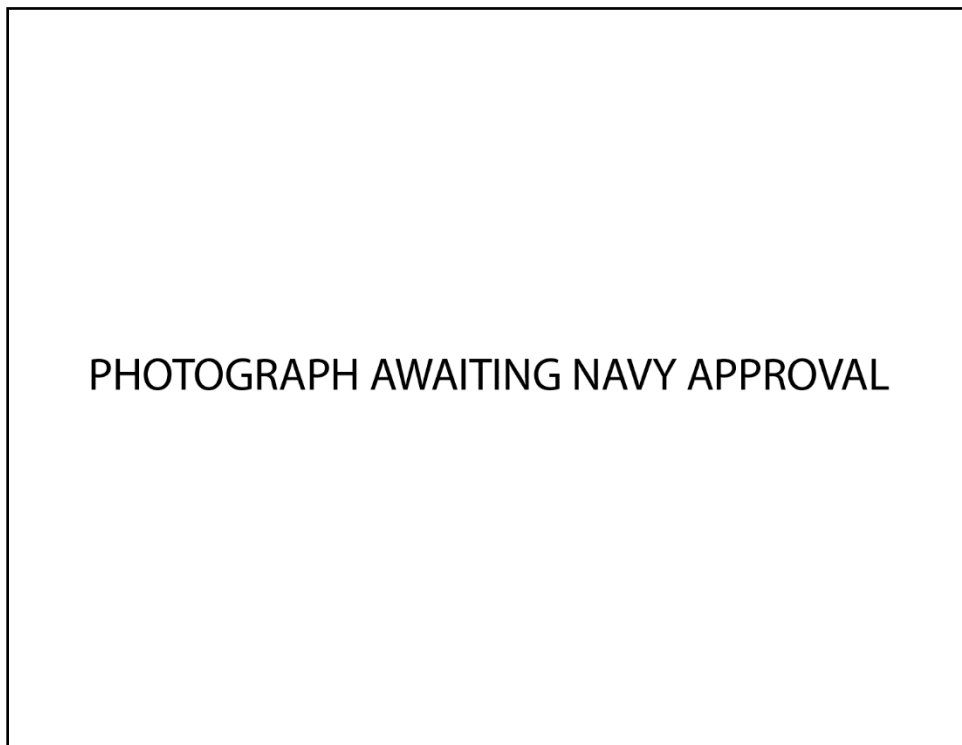


Figure 91. General view of West Loch portion of study area

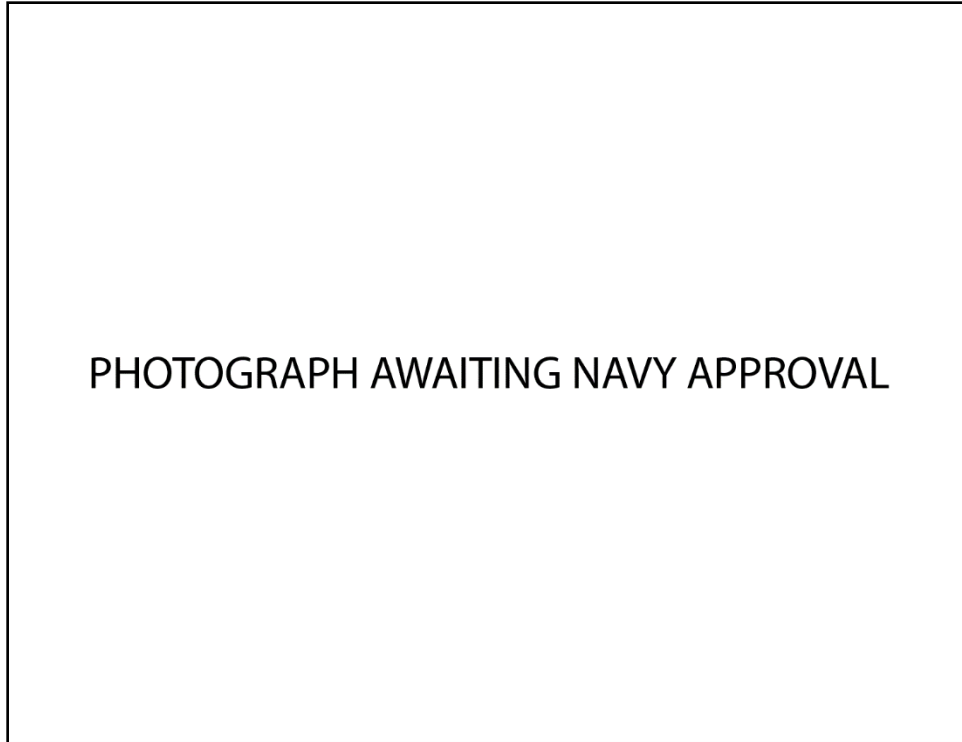


Figure 92. General view of Waipi'o Peninsula portion of study area

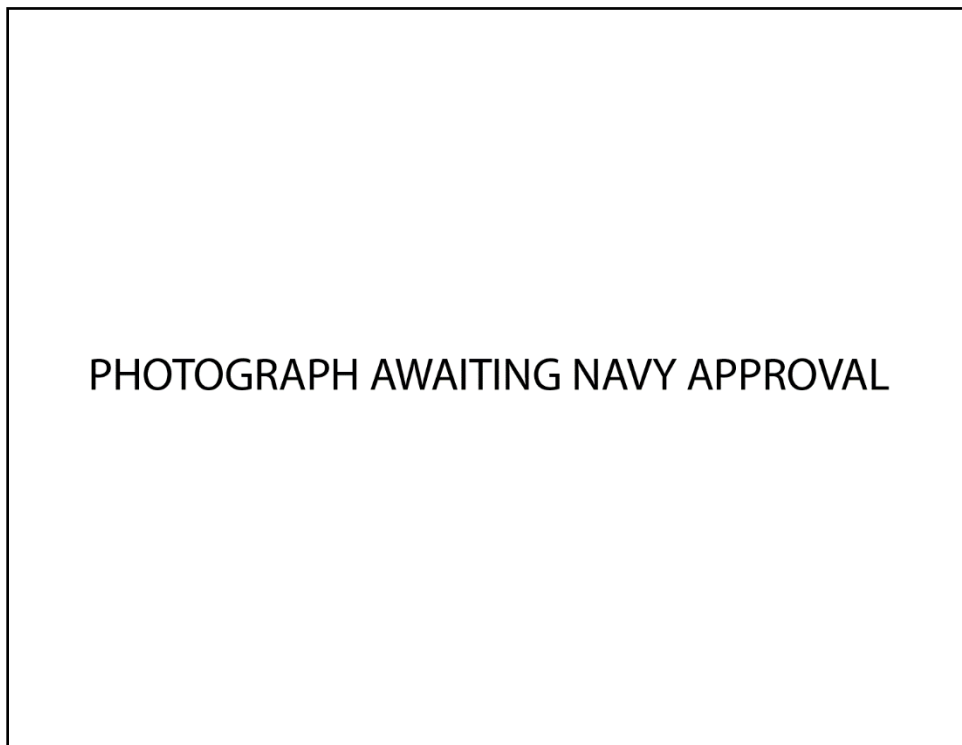


Figure 93. General view of Waipi'o Peninsula portion of study area

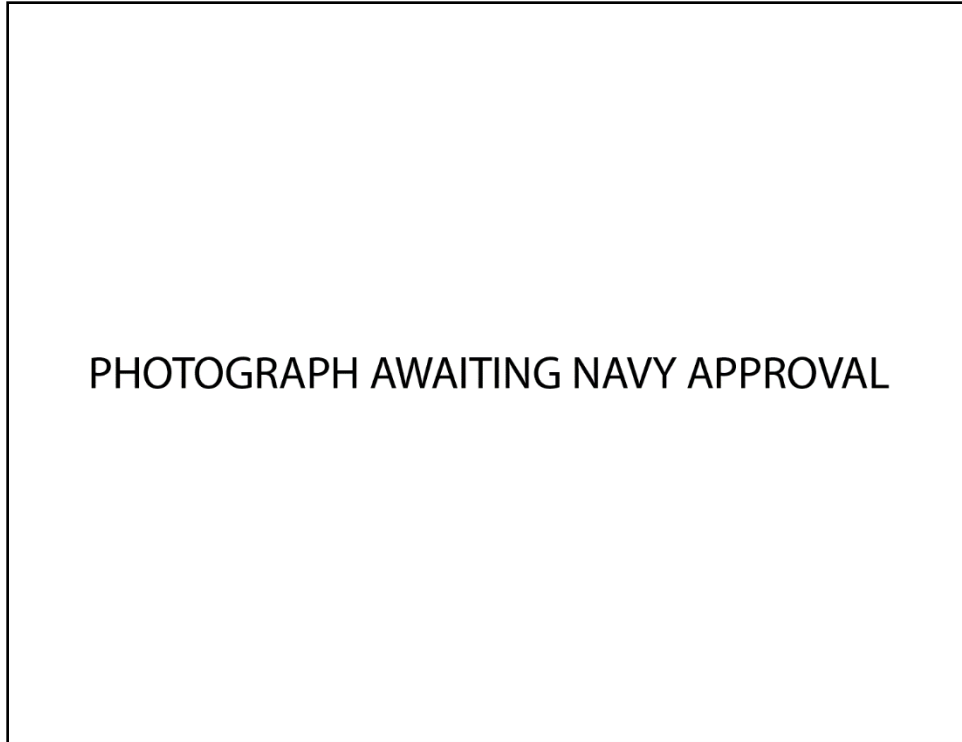


Figure 94. General view of portion of study area near the Waipi'o Soccer Complex

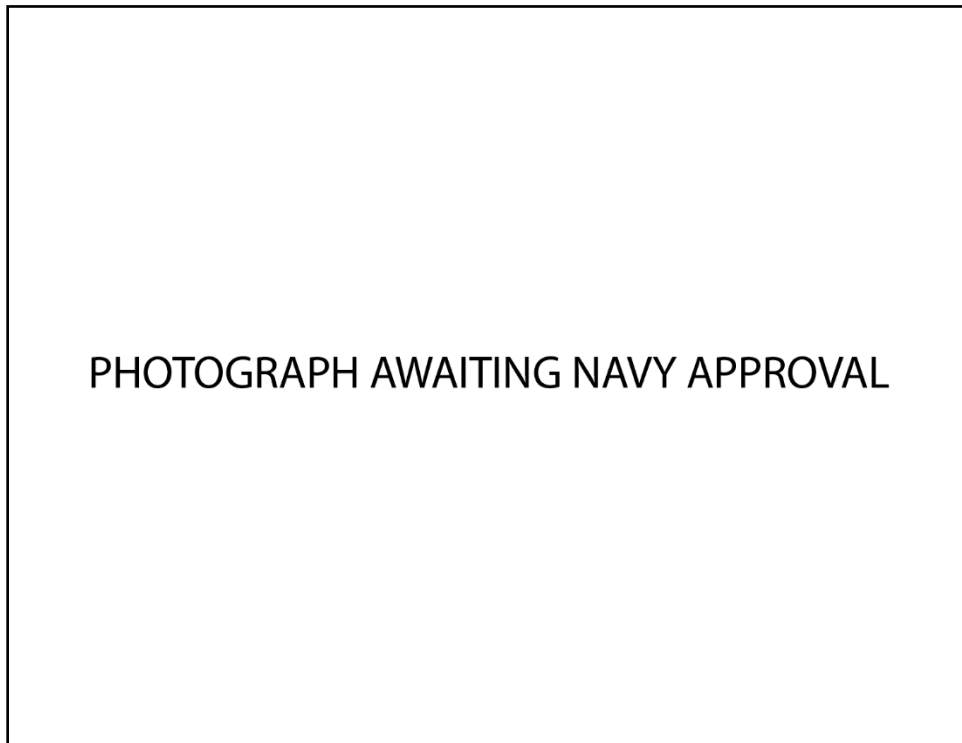


Figure 95. General view of the Waipi'o Soccer Complex reservoir



Figure 96. The Honolulu Police Training Academy within the study area, view to east



Figure 97. General view of the Waipahu WWPS and alternate areas, view to east

Table 19. Identified historic properties/potential historic properties from Honouliuli to Waikele

Feature Designation	Type	Function	Feature Designation	Type	Function
CSH 1	Railroad	Military	CSH 26	Irrigation	Agriculture
CSH 2	Structural foundation	Military	CSH 27	Irrigation	Agriculture
CSH 3	Railroad	Military	CSH 28	Irrigation	Agriculture
CSH 4	Structure	Military	CSH 29	Irrigation	Agriculture
CSH 5	In-filled pool	Military	CSH 30	Irrigation	Agriculture
CSH 6	Structure	Military	CSH 31	Irrigation	Agriculture
CSH 7	Concrete slab	Military	CSH 32	Irrigation	Agriculture
CSH 8	Tennis court	Military	CSH 33	Irrigation	Agriculture
CSH 9	Structure	Military	CSH 34	Irrigation	Agriculture
CSH 10	Structural foundation	Military	CSH 35	Irrigation	Agriculture
CSH 11	Flagpole foundation	Military	CSH 36	Pipeline	Unknown
CSH 12	Structural foundation	Military	CSH 37	Irrigation	Agriculture
CSH 13	Utility	Military	CSH 38	Irrigation	Agriculture
CSH 14	Concrete surface	Military	CSH 39	Irrigation	Agriculture
CSH 15	Concrete slab	Military	CSH 40	Irrigation	Agriculture
CSH 16	Retaining wall	Military	CSH 41	Caves	Unknown
CSH 17	Concrete pillar	Military	CSH 42	Irrigation	Agriculture
CSH 18	Concrete pillar	Military	CSH 43	Retaining Wall	Infrastructure
CSH 19	Concrete pillar	Military	CSH 44	Culvert	Infrastructure
CSH 20	Trash dump	Unknown	SIHP # -5597 Fea. 1 & 2	Sugar cane irrigation complex	Agriculture
CSH 21	Irrigation complex	Agriculture	SIHP # -7796	Sugar cane irrigation complex	Agriculture
CSH 22	Irrigation	Agriculture	CSH 45	Irrigation	Agriculture
CSH 23	Irrigation	Agriculture	CSH 46	Irrigation	Agriculture
CSH 24	Irrigation	Agriculture	CSH 47	Walkway	Unknown
CSH 25	Irrigation	Agriculture	SIHP # -9714	OR&L ROW	Transportation

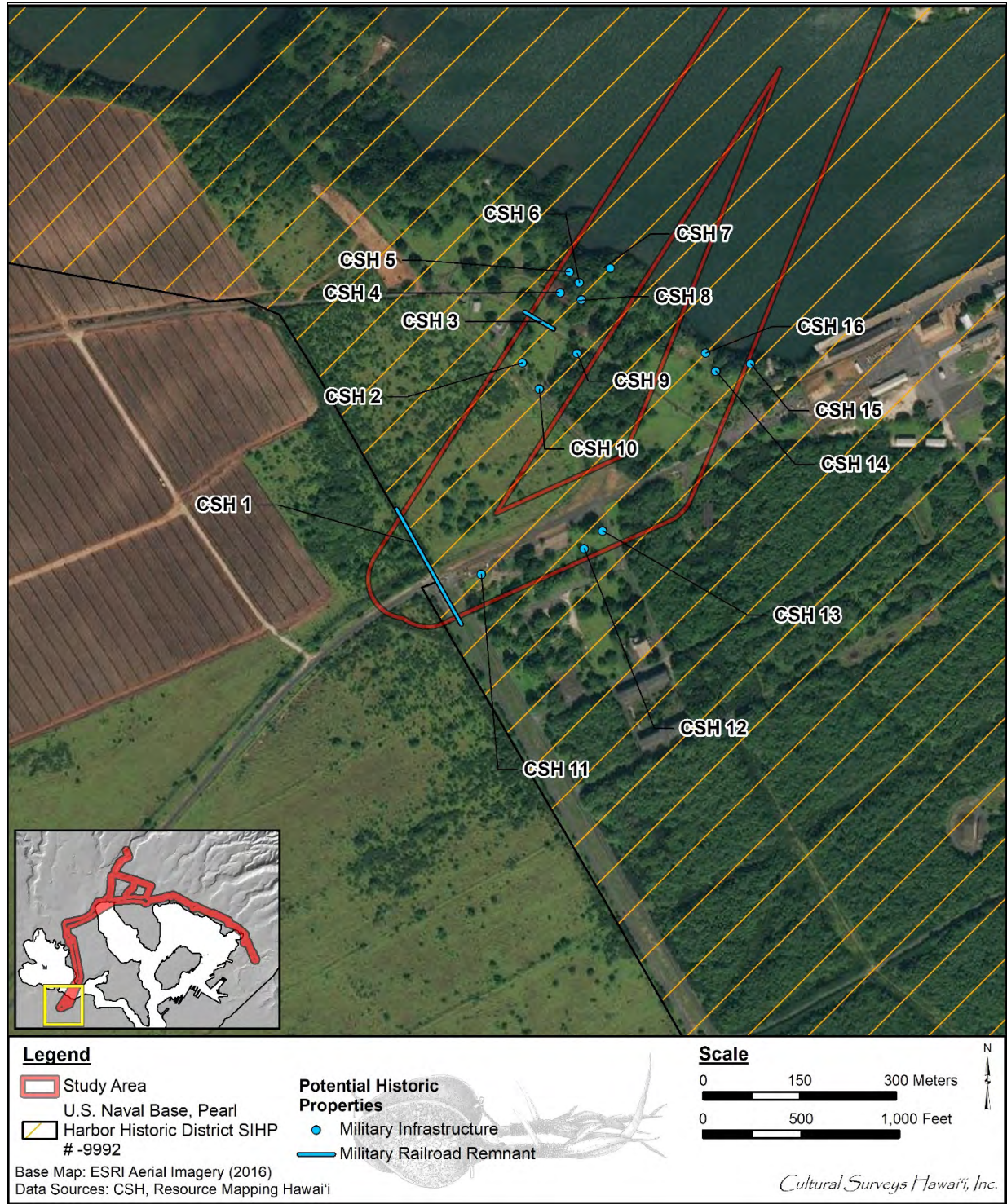


Figure 98. 2016 ESRI aerial photograph showing potential historic properties identified during the field inspection from Honouliuli to Waikale

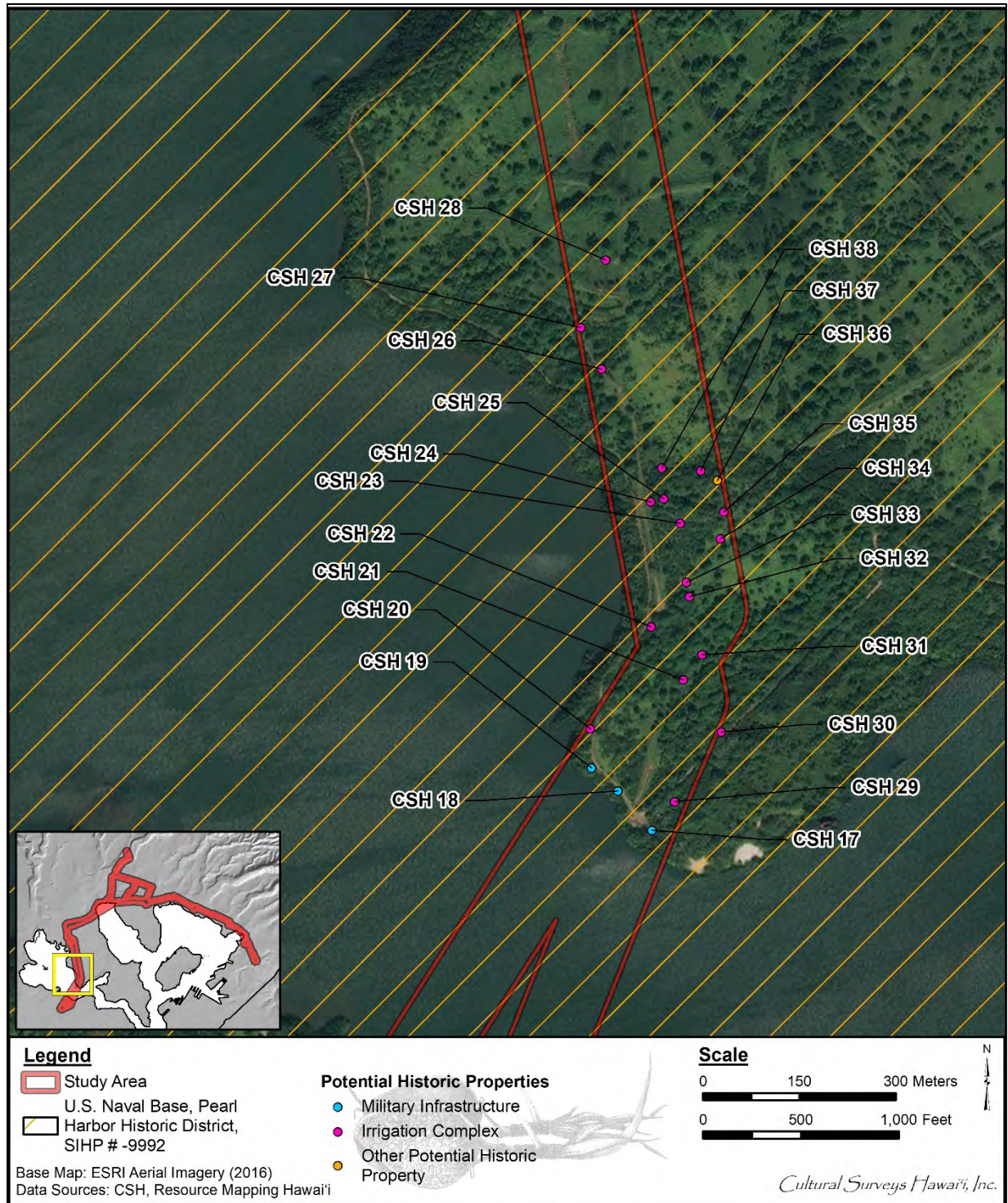


Figure 99. 2016 ESRI aerial photograph showing potential historic properties identified during the field inspection from Honouliuli to Waikale

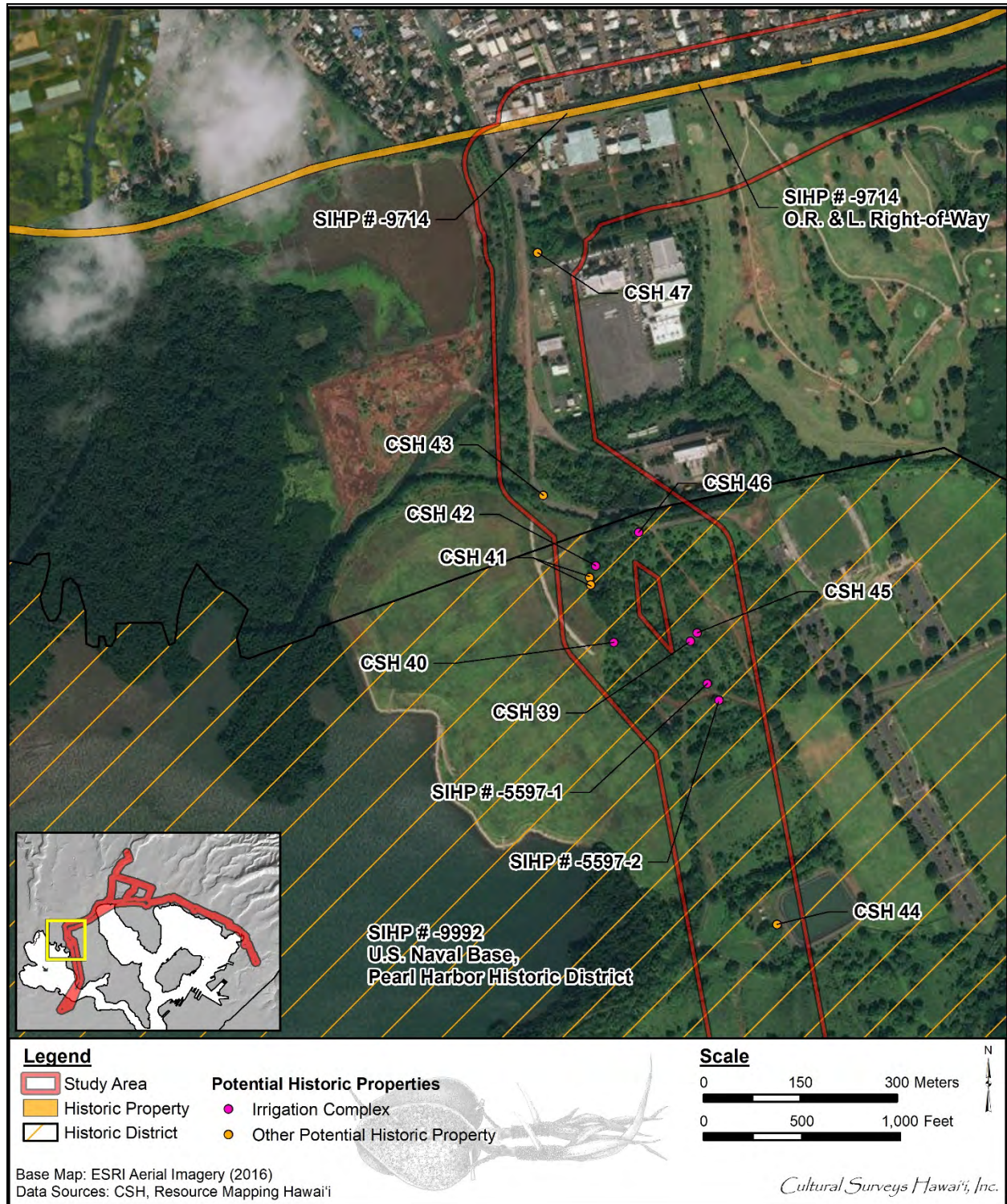


Figure 100. 2016 ESRI aerial photograph showing previously identified and potential historic properties identified during the field inspection from Honouliuli to Waikēle

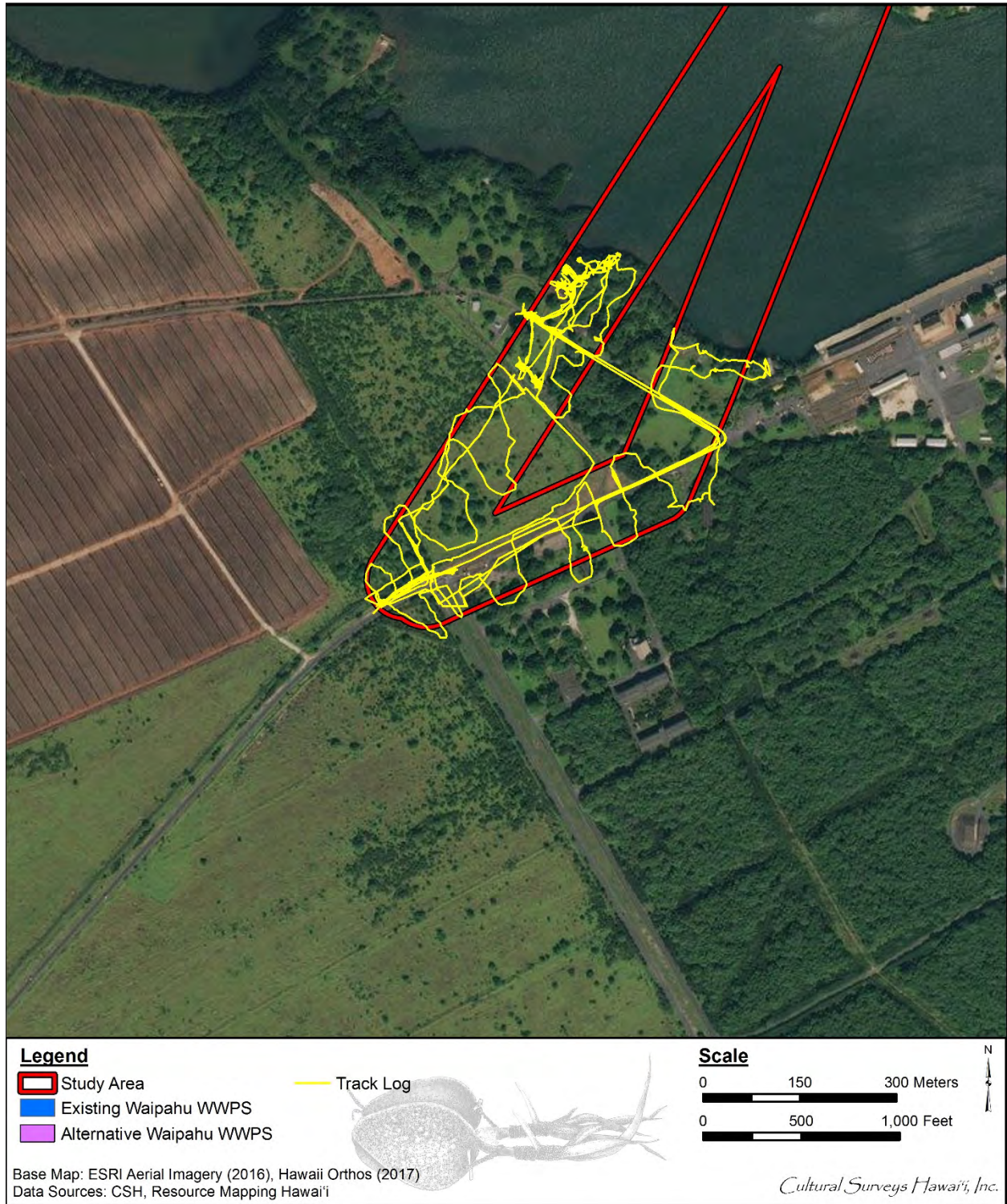


Figure 101. 2016 ESRI aerial photograph showing archaeologists track logs during the field inspection of the study area in Honouliuli

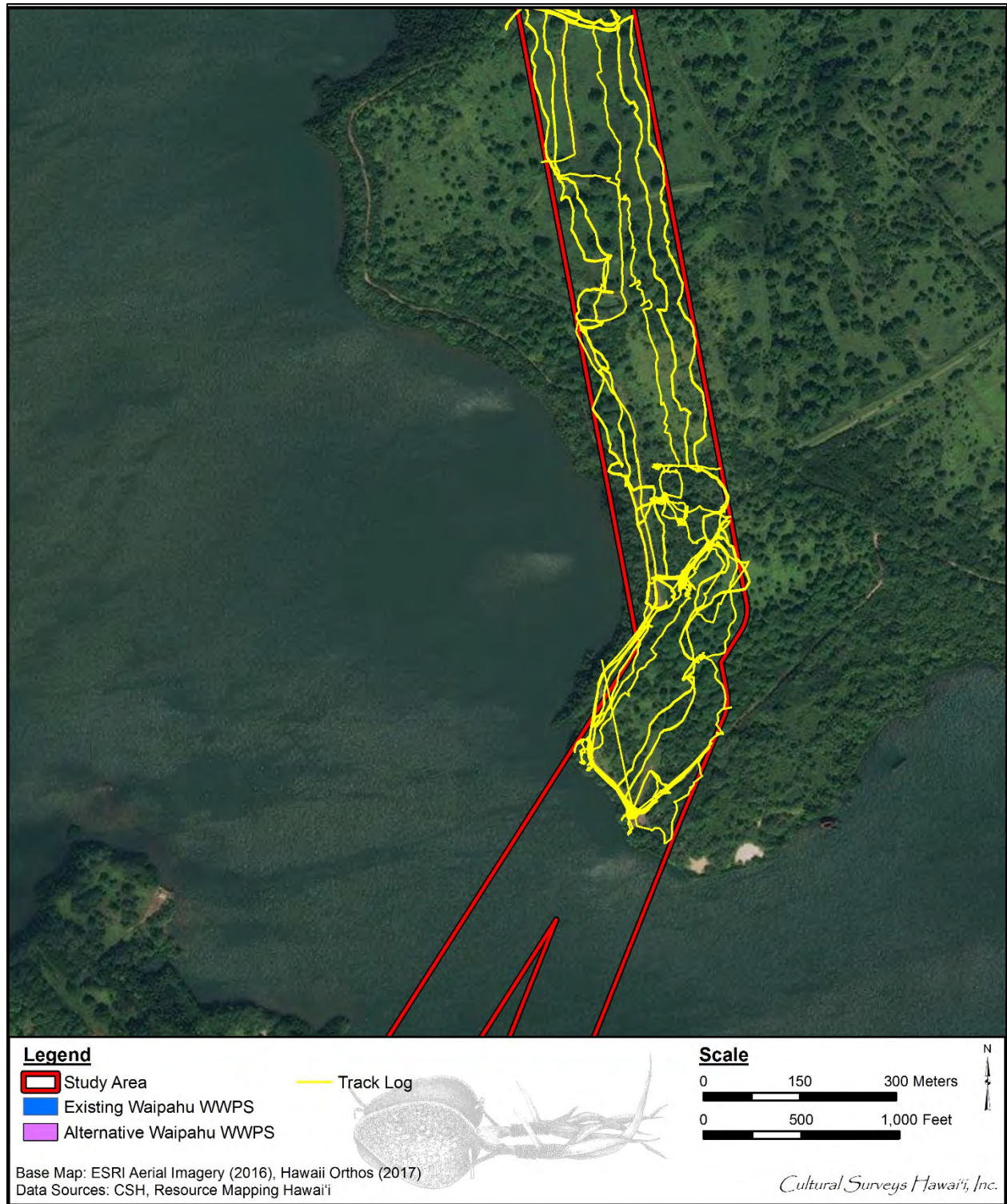


Figure 102. 2016 ESRI aerial photograph showing archaeologists track logs during the field inspection of the study area in Waikele (Lower Waipi'o Peninsula portion)

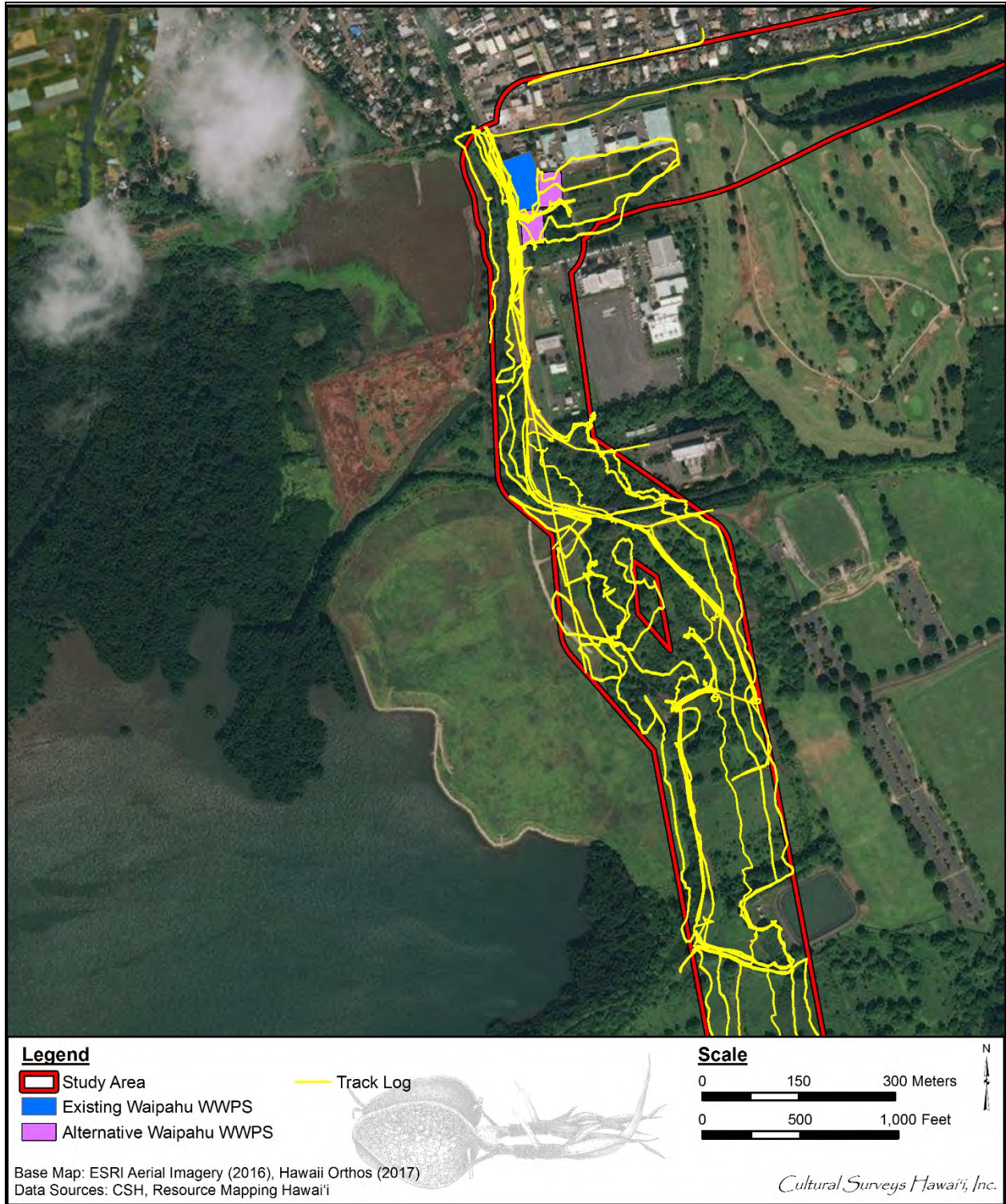


Figure 103. 2016 ESRI aerial photograph showing archaeologists' track logs during the field inspection of the study area in Waikele (Upper Waipi'o Peninsula portion)

5.1.1 SIHP # 50-80-12-9714, OR&L ROW

The OR&L ROW (SIHP # 50-80-12-9714) and associated features were identified within Waikele Ahupua'a at the inland boundary of Waipi'o Peninsula (see Figure 100). Within this section of the study area, SIHP # -9714 consists of the railroad ROW and a steel spur railroad bridge (Figure 104 and Figure 105). The ROW extends through much of the entire study area and is in modern times overlain by the Pearl Harbor Bike Path in this section of the study area. The steel spur bridge is along the ROW alignment, immediately west of Waipahu Depot Street. The OR&L Railroad appears on maps as early as the 1890s (see an 1890 promotion map, Figure 43, and an 1897 Nichols map, Figure 45). The bridge appears to remain in structurally stable condition and was occupied by homeless individuals at the time of the field inspection. The portion within the study area is not the portion of SIHP # -9714 listed on the NRHP.

5.1.2 Naval Magazine Pearl Harbor (West Loch) (SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District)

CSH 1 and 3, Railroad Tracks

CSH 1 and 3 were identified within Honouliuli Ahupua'a in the portion of the study area west of West Loch. CSH 1 consists of a decommissioned railroad track that extends across the southern tip of the study area in alignment with West Loch Drive (Figure 106). The northern portion of the track, which is overgrown and in remnant condition, is within an out-of-use agricultural field and lies atop an earthen berm. The southern portion is adjacent to West Loch Drive at ground level and remains intact. CSH 3 consists of a portion of decommissioned railroad track that extends across the intersection of Arizona Road and Arizona Loop within the Naval Magazine Pearl Harbor (West Loch) (Figure 107). The discontinuous track is in remnant condition and appears to have been affected by the construction of Arizona Loop. Both railroad tracks (CSH 1 and 3) first appear on a 1951 map (see Figure 67) as a component of the United States Navy Railroad.

CSH 2, 10, and 12, Structural Foundations

Three remnant structural foundations were identified within the Naval Magazine Pearl Harbor (West Loch). CSH 2 and CSH 10 are along "B" Avenue and CSH 12 is on the block bounded by 1st Street, "C" Avenue, and 2nd Street. CSH 2 and 10 are large rectangular concrete foundations with seamed concrete floors and raised concrete frames with metal pins and washers around the perimeter (Figure 108 and Figure 109). A 1951 map of U.S. Naval Ammunition Depot West Loch Branch indicates the former super structures were designated as buildings "A," which functioned as "Dependent Public Quarters, Senior Officers" (see Figure 67). CSH 12 is a small rectangular concrete foundation with a raised concrete frame and a graded metal drain in the center (Figure 110).

CSH 4, Barracks 9 (Special Service Center/Gymnasium)

CSH 4 was identified near the western bank of West Loch, off Arizona Road and Arizona Loop. The large structure labelled with a "9" is currently decommissioned and appears to have been in use at least until 1997 when it was assessed by Landrum et al. (1997) (Figure 111). The structure was constructed in 1932 and is associated with initial Naval Magazine Pearl Harbor (West Loch) construction (Landrum et al. 1997).



Figure 104. Pearl Harbor Bike Path within the SIHP # 50-80-12-9714, OR&L ROW in Waikele Ahupua'a, view to west



Figure 105. SIHP # 50-80-12-9714, OR&L spur steel bridge in Waikele Ahupua'a, view to east

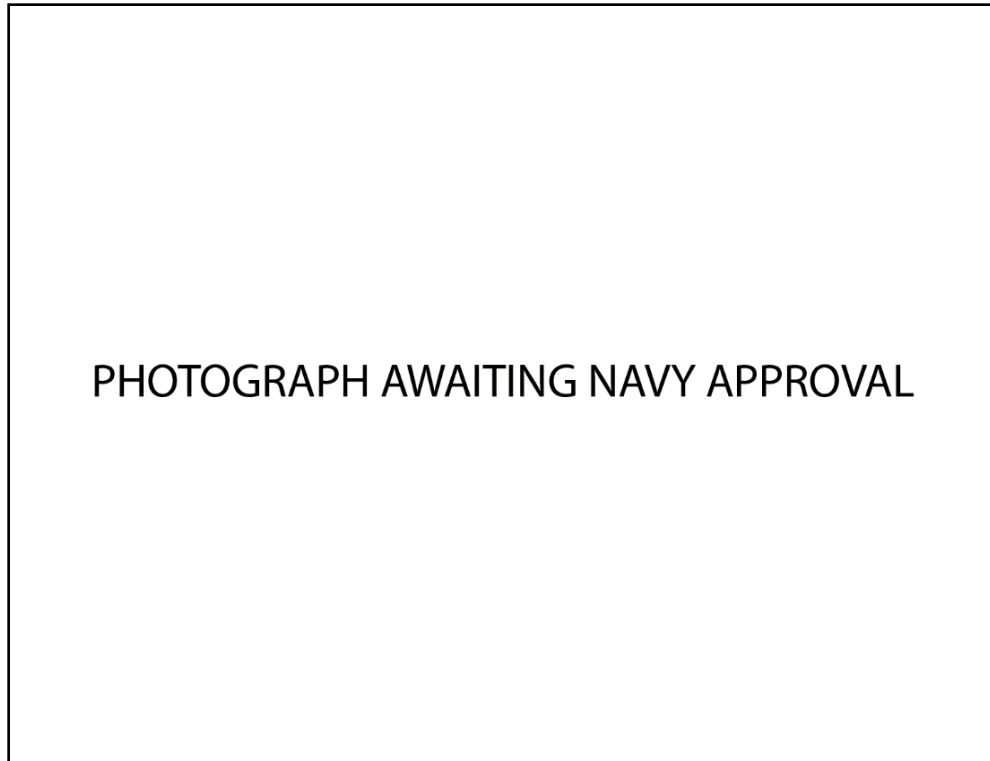


Figure 106. CSH 1, railroad track remnants at Naval Magazine Pearl Harbor (West Loch)

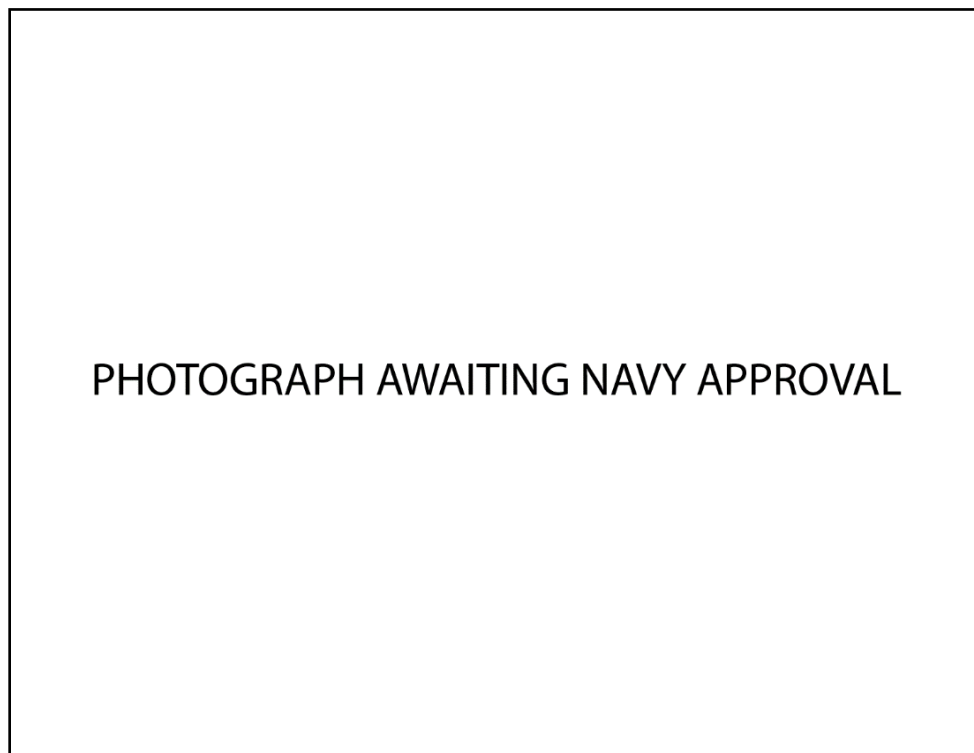


Figure 107. CSH 3, railroad track remnants at Naval Magazine Pearl Harbor (West Loch)



Figure 108. CSH 2, structural foundation within Naval Magazine Pearl Harbor (West Loch)

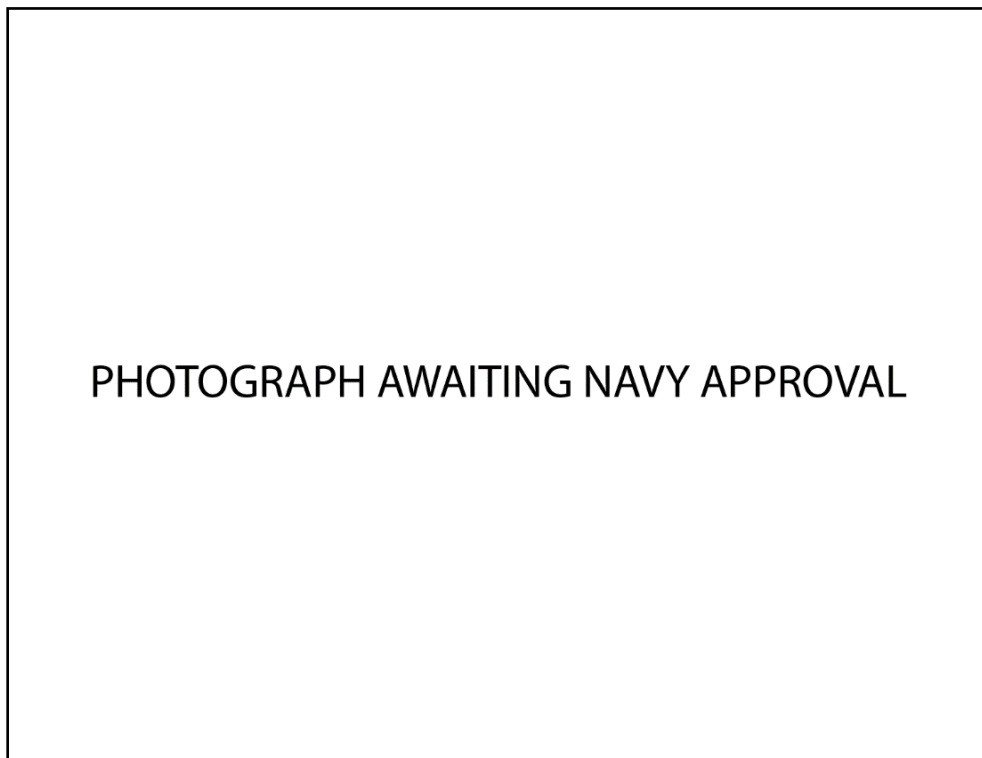


Figure 109. CSH 10, structural foundation within Naval Magazine Pearl Harbor (West Loch)

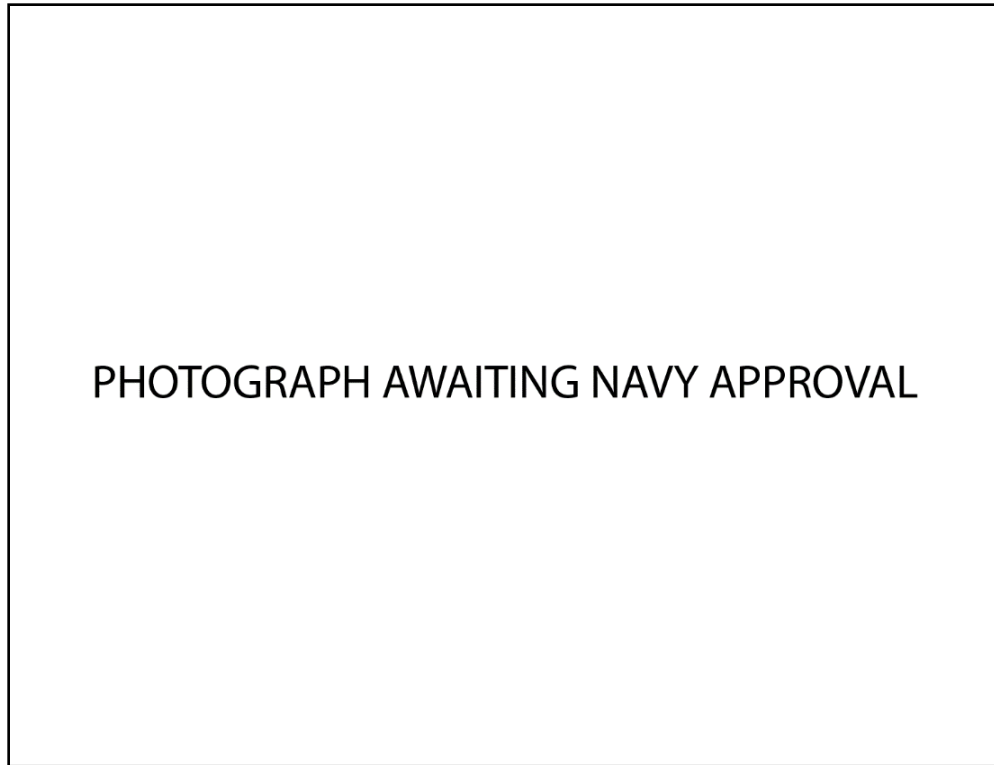


Figure 110. CSH 12, structural foundation within Naval Magazine Pearl Harbor (West Loch)

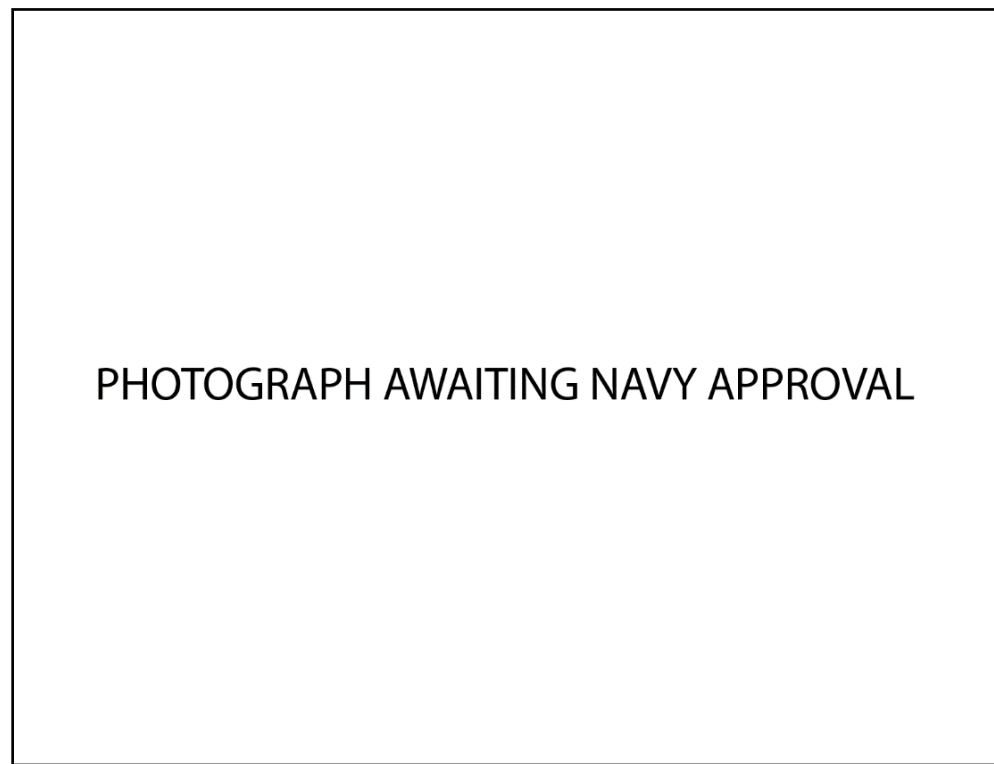


Figure 111. CSH 4, Barracks 9 remnant within Naval Magazine Pearl Harbor (West Loch)

CSH 5, In-filled Swimming Pool

CSH 5 is west of CSH 4 and consists of a decommissioned in-ground tiled swimming pool that has been filled with boulders and earth (Figure 112). The pool is rectangular and surrounded by a poured concrete deck with concrete walkways leading to CSH 4. The swimming pool was constructed in 1945 as a recreational facility for enlisted military men (Landrum et al. 1997) and appeared to have been in use at least until 1997 when it was assessed by Landrum et al. (1997).

CSH 6, Building No. 452

CSH 6 is adjacent to CSH 5 and is a small structure associated with the in-filled swimming pool (Figure 113). The structure labeled "452" contains remnant utility pipes and tanks, and likely functioned as a utility and maintenance house for the pool. A construction date for the structure is unknown although it was likely constructed along with or sometime after the construction of the pool in 1945 and remained in use at least until 1997 when the area was assessed by Landrum et al. (1997).

CSH 7, 14, and 15, Concrete Slabs

CSH 7 was identified near the recreation facilities designated as CSH 4–6, and CSH 8, near the western shore of West Loch. CSH 7 is a raised concrete slab coated in an oily sheen and covered with shingle fragments (Figure 114). This concrete slab is likely associated with a nearby decommissioned concrete boat dock, as the paved road for the boat dock abuts the concrete slab. CSH 14 and 15 were identified to the southeast of CSH 7, also along the western shore of West Loch. CSH 14 is a large, flat, seamed concrete surface (Figure 115) and CSH 15 is a raised concrete slab (Figure 116). CSH 14 and 15 are near a second decommissioned boat ramp that falls outside the bounds of the study area to the east. The former functions and construction dates for all identified concrete slabs are unknown.

CSH 8, Tennis Court

CSH 8 was identified in the area immediately south of CSH 4 through 6 and consists of a decommissioned tennis court (Figure 117). The tennis court is fenced in with 2-3 m tall chain-link fencing and has a hard surface. The overgrown court is in disrepair, and its decommissioning was likely associated with the decommissioning of the recreational facilities in the area (CSH 4 through 6) sometime after 1997. It is unknown when the court was constructed but it was likely part of the effort to provide recreational facilities for enlisted military men.

CSH 9, Building 49

Building 49 is a stand-by generator building identified along the southwest side of Arizona Road (Figure 118). The small, bomb-proof single-story structure was constructed in 1943 (Landrum et al. 1997) and appears to remain completely intact. It is unclear whether the structure is still in use.

CSH 11, Flagpole Base

CSH 11 was identified near the southern extent of the study area, near a Naval Magazine Pearl Harbor (West Loch) entrance gate. It consists of a circular concrete foundational block with an inlaid cut metal pipe near the center of the block (Figure 119). The feature is interpreted as a decommissioned flagpole base with an unknown date of construction.

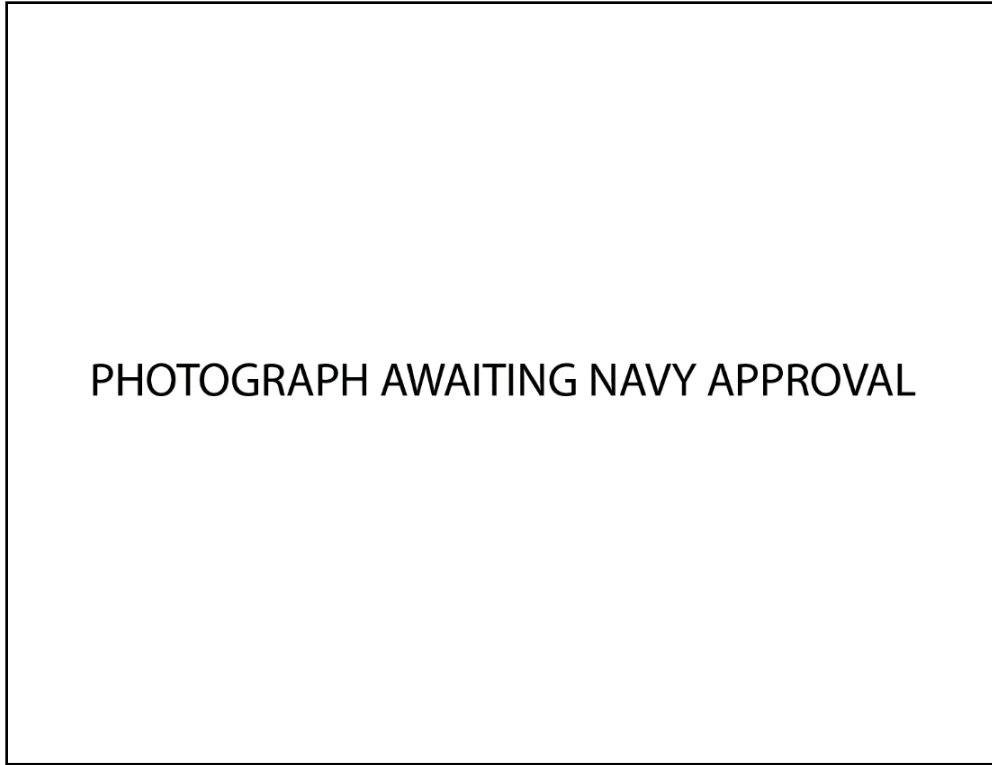


Figure 112. CSH 5, in-filled swimming pool within Naval Magazine Pearl Harbor (West Loch)

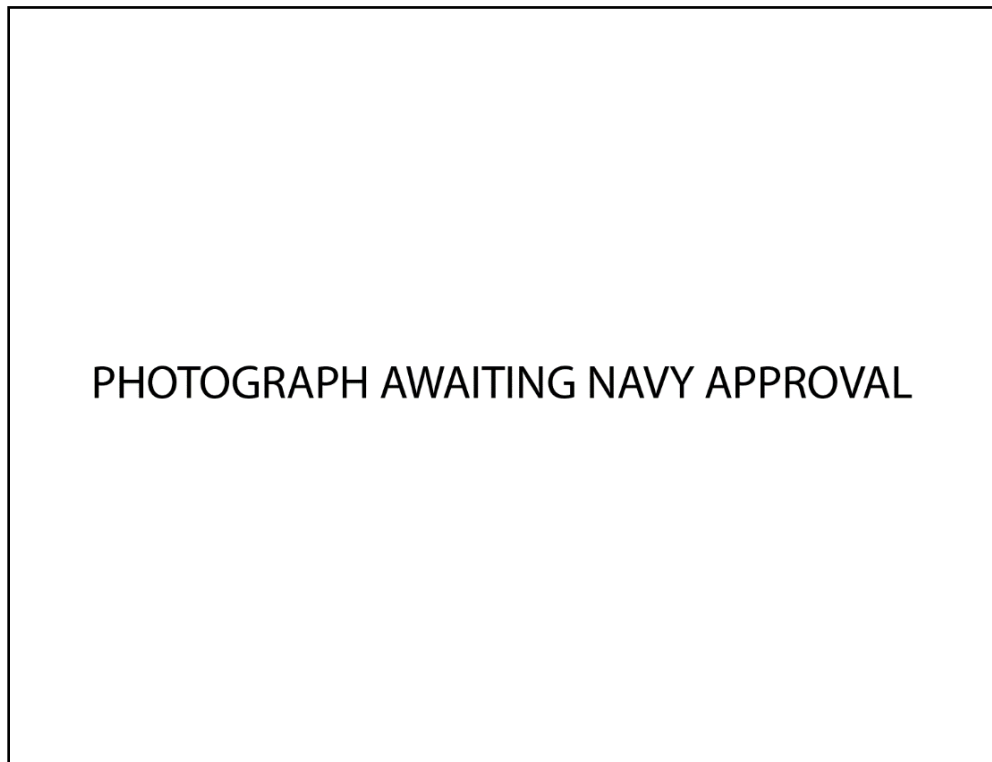


Figure 113. CSH 6, Building No. 452 within Naval Magazine Pearl Harbor (West Loch)

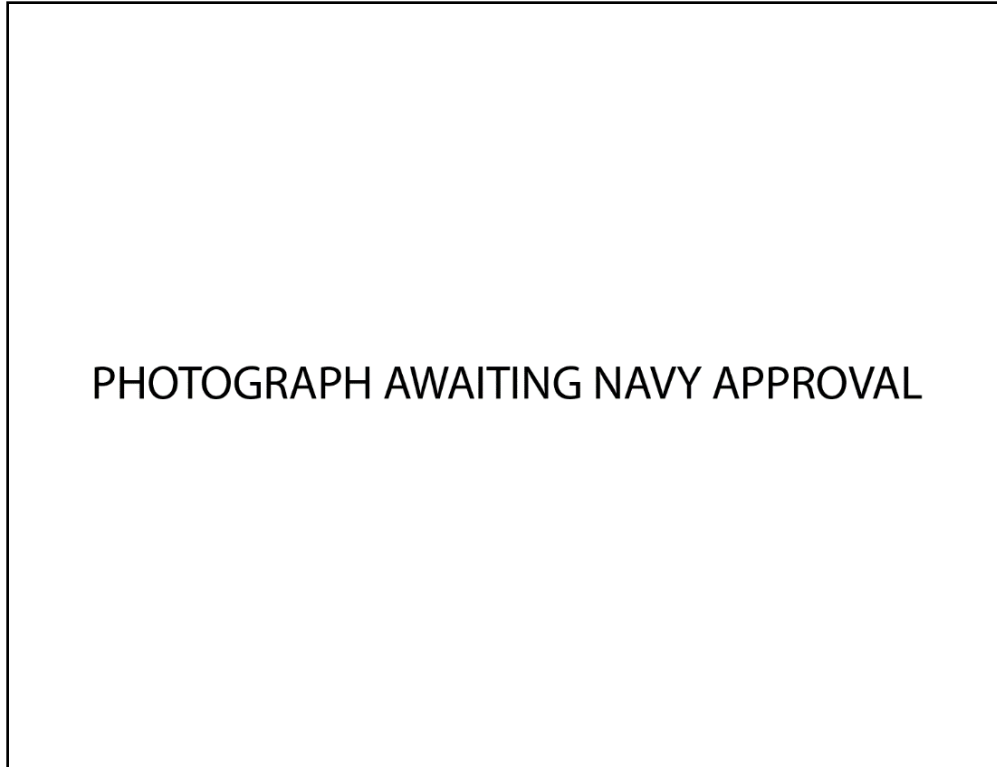


Figure 114. CSH 7, concrete slabs within Naval Magazine Pearl Harbor (West Loch)

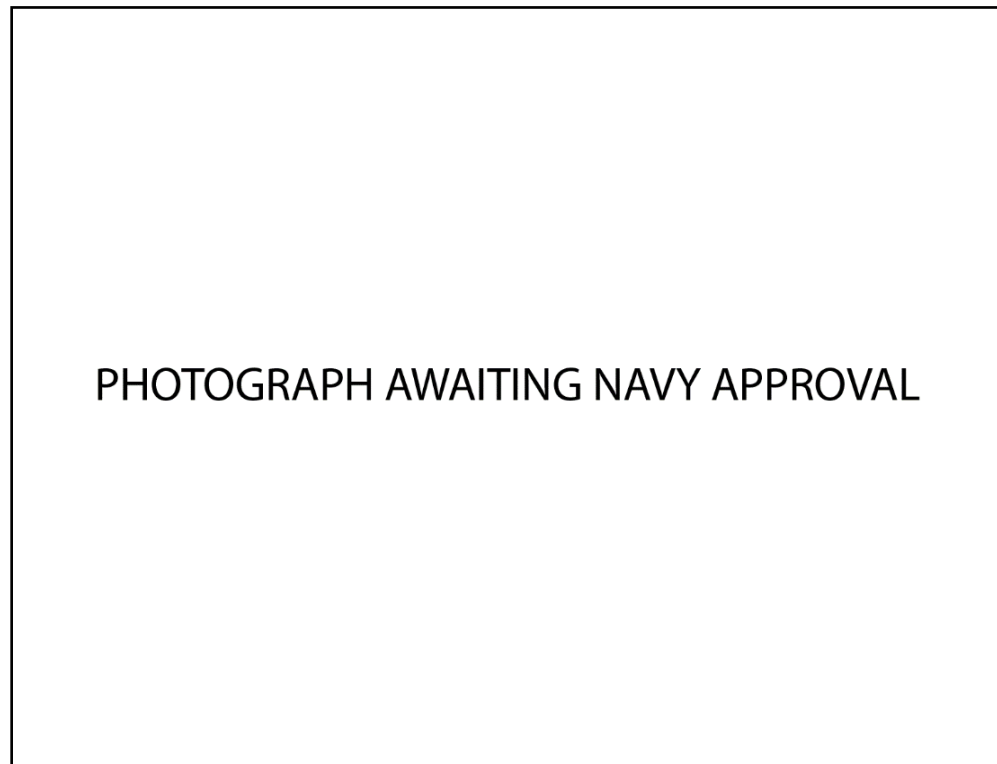


Figure 115. CSH 14, concrete slabs within Naval Magazine Pearl Harbor (West Loch)

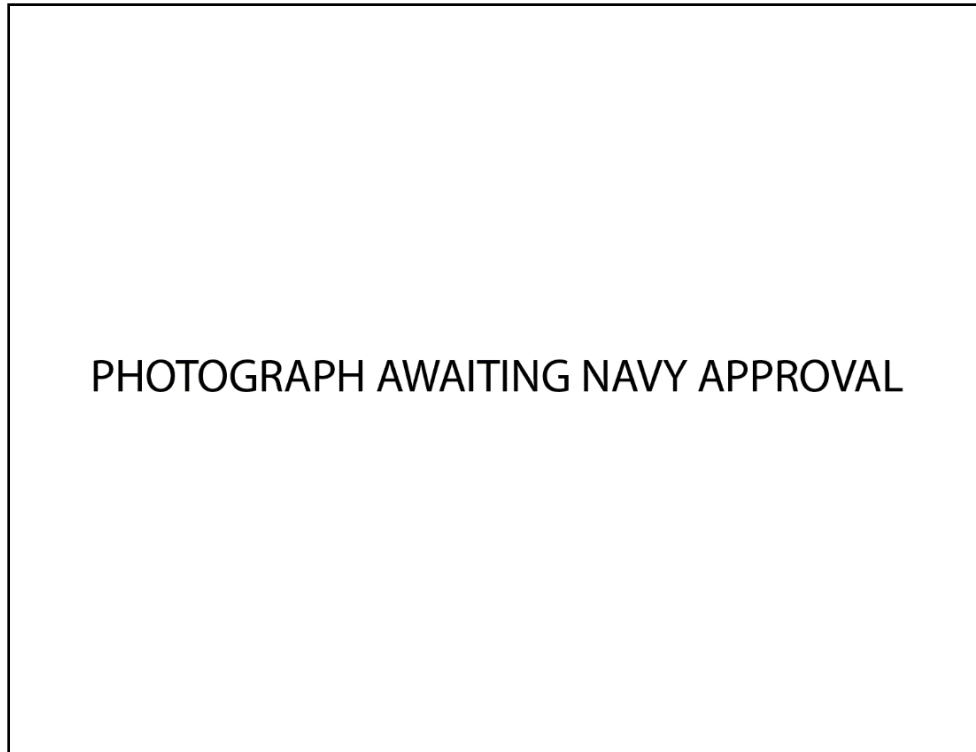


Figure 116. CSH 15, concrete slabs within Naval Magazine Pearl Harbor (West Loch)

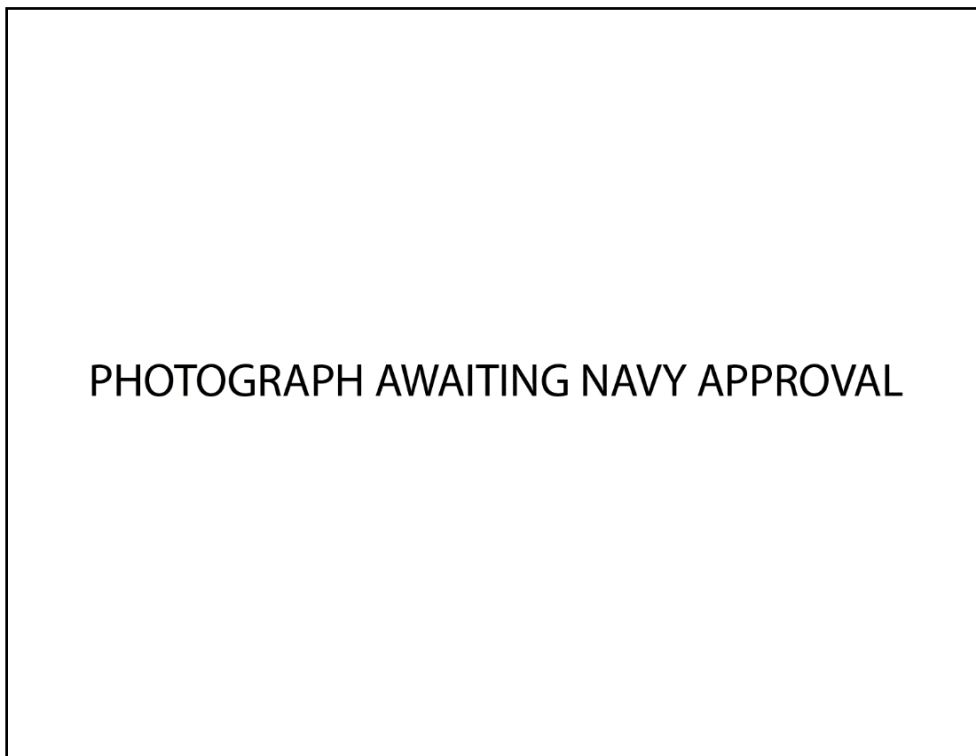


Figure 117. CSH 8, tennis court within Naval Magazine Pearl Harbor (West Loch)

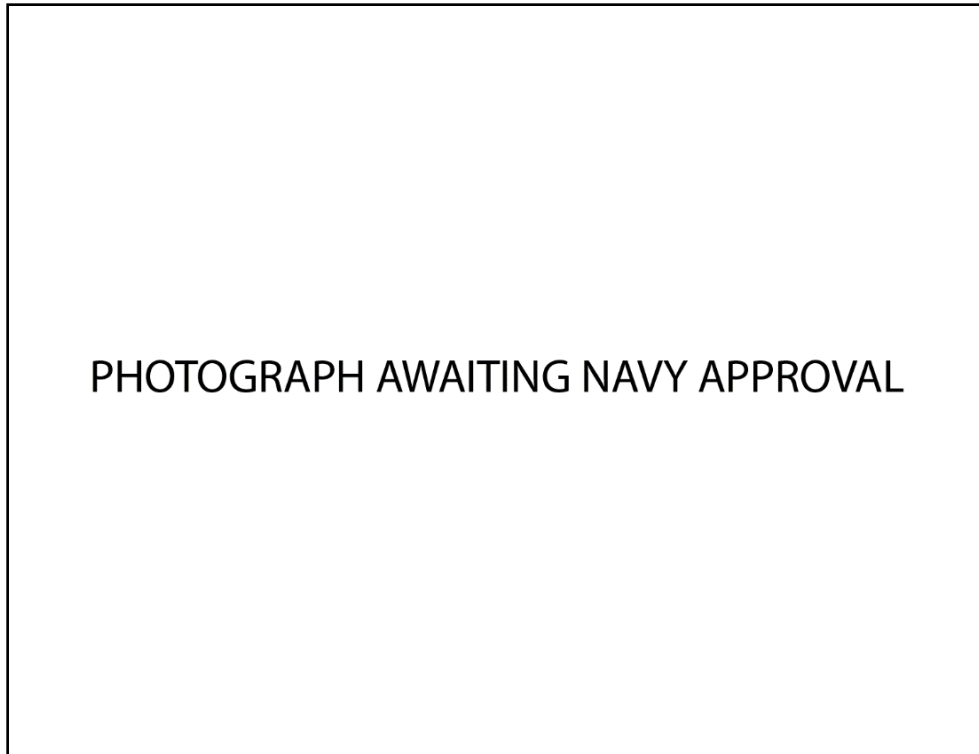


Figure 118. CSH 9, Building 49 within Naval Magazine Pearl Harbor (West Loch)

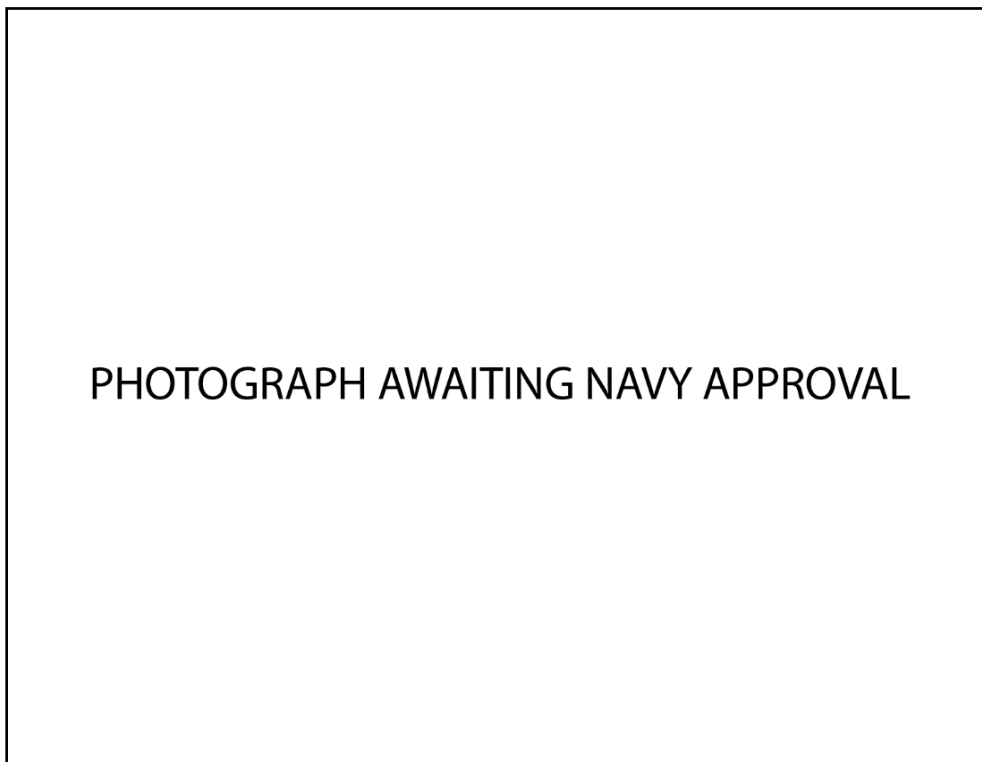


Figure 119. CSH 11, flagpole base within Naval Magazine Pearl Harbor (West Loch)

CSH 13, Manhole SMH 13

CSH 13 is a utility manhole identified on the block bounded by 1st Street, “C” Avenue, and 2nd Street west. It is constructed of a raised concrete frame and lined with bricks along the outer perimeter (Figure 120). The interior is comprised of a steel diamond plate with the letters “SMH” spray-painted in the middle. It is unknown whether the manhole is still in use, but the style of construction may suggest the utility is associated with early construction phases of Naval Magazine Pearl Harbor (West Loch).

CSH 16, Retaining Wall

CSH 16 is a retaining wall identified along the limestone cliffs that comprise the western shore of West Loch. The retaining wall is curved, 2 to 3 m tall, approximately 5 m long, and constructed of mortared basalt (Figure 121). It is likely the retaining wall was constructed to stabilize a portion of the limestone cliff although no additional features were identified in the immediate vicinity of the retaining wall, and no others were observed along similar cliff-laden portions of shoreline. A date of construction for the retaining wall is unknown.

CSH 17, 18 and 19, Concrete Pillars

CSH 17 through 19 were identified along the eastern shoreline of West Loch, on Waipi'o Peninsula. The three pillars are identical and dispersed along the shoreline non-systematically (Figure 122 through Figure 124). Each pillar stands 1.4 m tall at a slight up-right angle. The pillars are rectangular with beveled edges and stabilized into the ground and limestone cliffside with twisted wire ropes. Each pillar is hand inscribed with “2-10” written upside down.

5.1.3 Irrigation Complex

Waipi'o Peninsula was leased by the Oahu Sugar Company during the late 1800s and early 1900s. Much of the peninsula was converted to sugarcane fields by means of filling in previously existing fishponds and moving massive amounts of earth to create a commercial-scale irrigation complex. Many features associated with this irrigation complex remain intact, or in remnant condition throughout the current study area. Previous archaeological studies have identified features of the irrigation complex and two discrete SIHP designations have been assigned to said features: SIHP # 50-80-13-5597 (Goodman and Cleghorn 1998), two early 1900s pumping stations, and SIHP # 50-80-13-7796, an irrigation complex consisting of ditches, settling ponds, a pipeline, and limestone features (Filimoehala et al. 2015). Despite this differentiation, it is likely both historic properties and all identified features are a part of the same irrigation complex.

The current study has identified 14 distinct areas of sluice gate structures with associated ditches (CSH 21 through 27, 31 through 34, and 37 through 39), two sections of channelized ditch (CSH 30 and 40), a water control valve associated with a large earthen water retainment feature (CSH 35), a portion of a historical pipeline (CSH 42), two large metal siphon pipes and a remnant portion of pipe (CSH 28, 45, and 46), and a small retention basin (CSH 29). The sluice gate structures and channelized ditches are constructed with a combination of mortared basalt, limestone blocks, and various forms of concrete and fitted with wooden board gates in remnant condition. Additionally, the landscape includes decommissioned roads, numerous ditches, and earthen berms ranging from 1-4 m in height. The earthen berms are associated with ditches and large above-ground settling ponds (Figure 125).

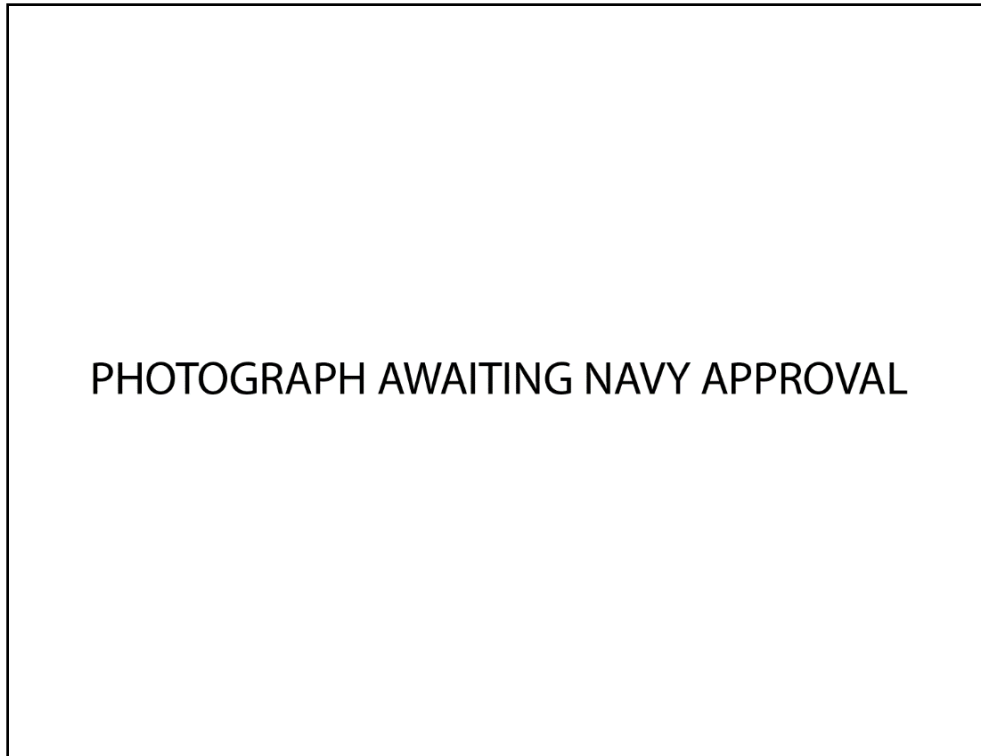


Figure 120. CSH 13, manhole within Naval Magazine Pearl Harbor (West Loch)

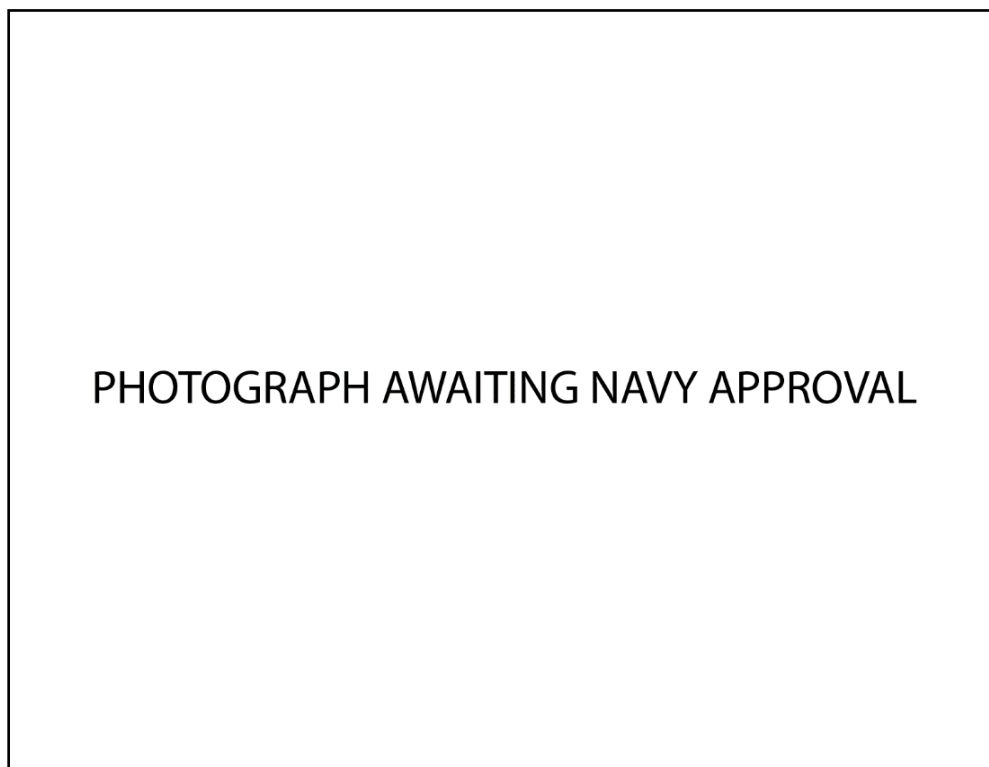


Figure 121. CSH 16, retaining wall within Naval Magazine Pearl Harbor (West Loch)

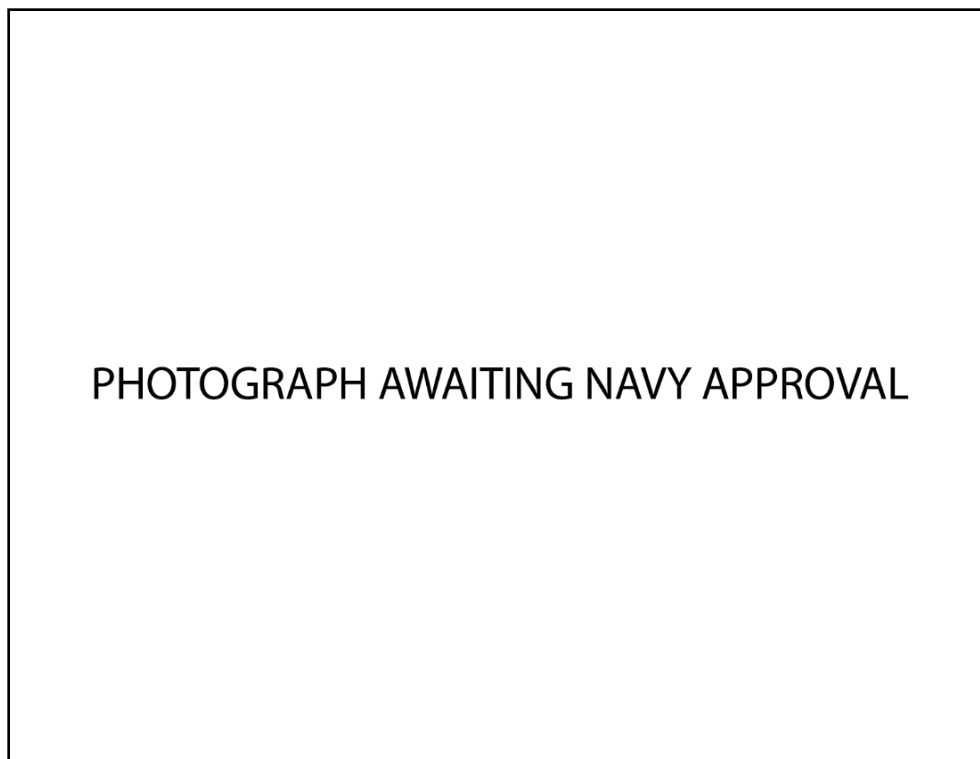


Figure 122. CSH 17, concrete pillar on east shore of West Loch on Waipi'o Peninsula

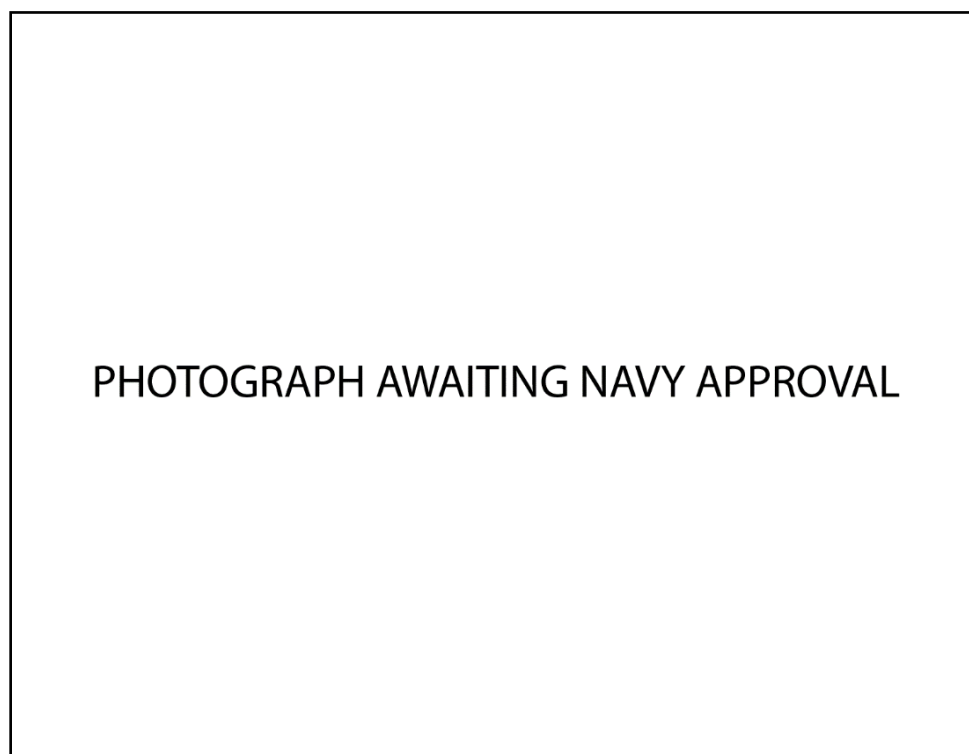


Figure 123. CSH 18, concrete pillar on east shore of West Loch on Waipi'o Peninsula

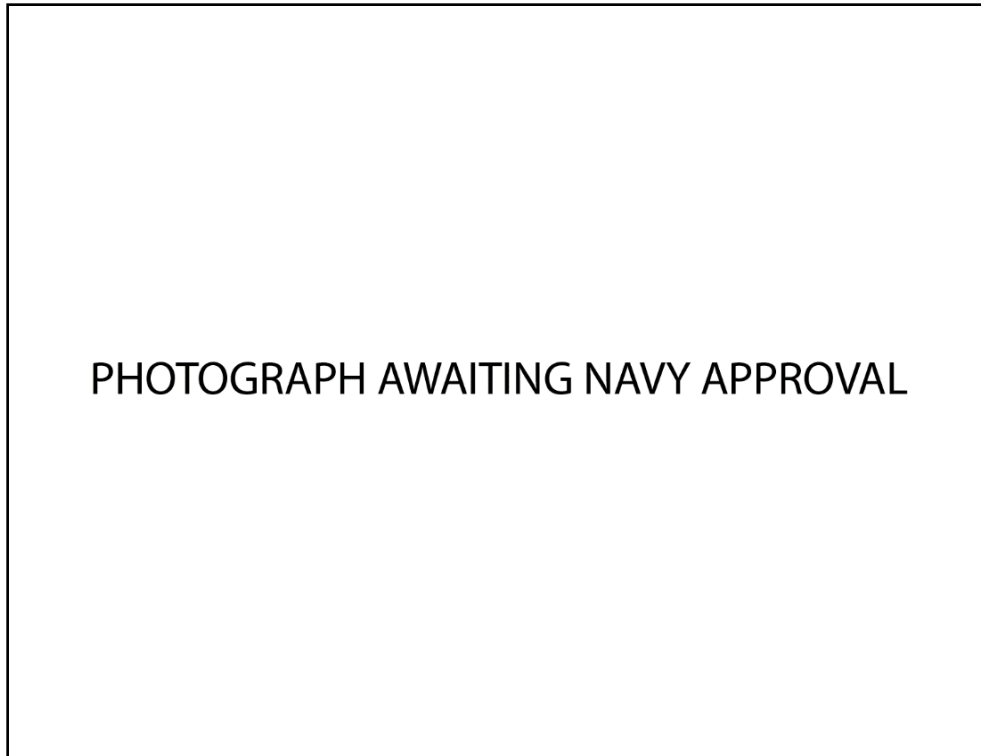


Figure 124. CSH 19, concrete pillar on east shore of West Loch on Waipi'o Peninsula

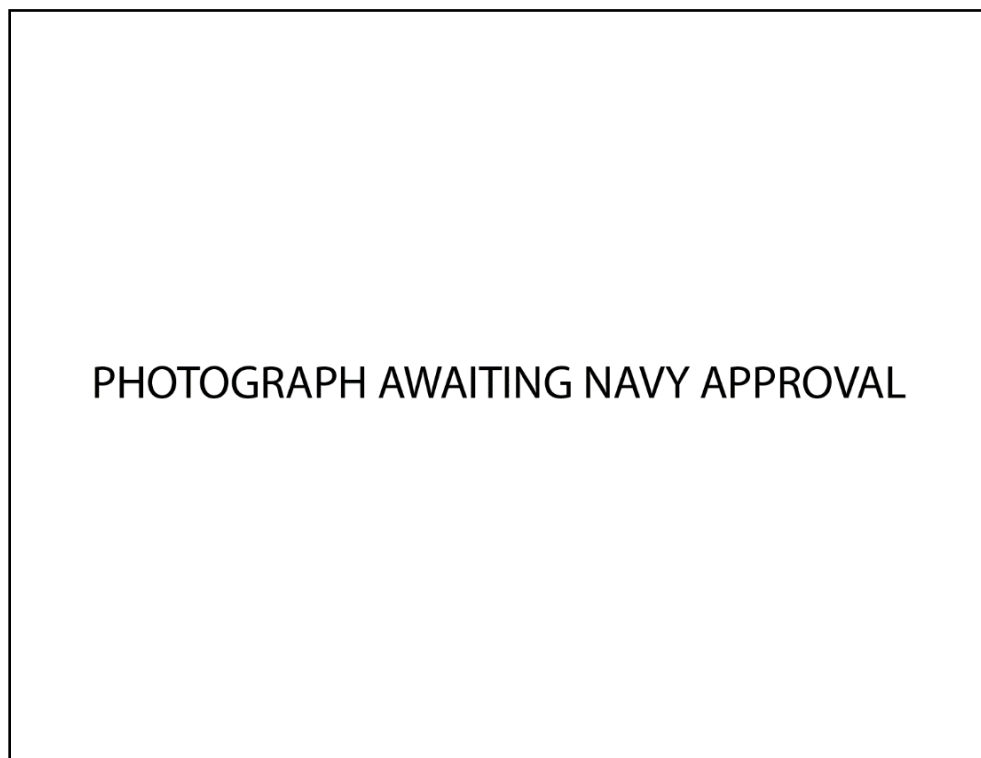


Figure 125. Earthen berms likely associated with irrigation complex on Waipi'o Peninsula

5.1.4 Other Potential Historic Properties

CSH 20, Mechanical Trash Dump

CSH 20 was identified along the eastern shoreline of West Loch, on Waipi'o Peninsula. It consists of an area with a concentration of oil drums and mechanical trash that are likely related to either military activity on the peninsula, or agricultural practices that spanned from the late 1800s to the late 1900s (Figure 126).

CSH 36, PVC Pipeline

CSH 36 is a PVC pipeline identified in the southern portion of the study area on Waipi'o Peninsula (Figure 127). The pipe is approximately 13 cm in diameter and elevated atop rusted metal supports. The pipe descends a large earthen berm that runs roughly north to south; it is unclear whether the pipe is decommissioned or still in use. The metal support structures appear to outdate the modern PVC pipeline, and it is possible the pipe replaced a previously existing historical metal pipe during the late phases of agricultural land use on the peninsula (late 1900s).

CSH 41, Limestone Caves

CSH 41 consists of three limestone caves identified near the western boundary of the study area in the inland portion of Waipi'o Peninsula. The limestone caves are situated in the side of a limestone plateau and appear to be a natural feature of the landscape (Figure 128). The entrances to the caves range from 0.6 to 1 m tall and 0.5 to 1.2 m wide, and the caves extend to an unmeasured depth. No indications of cultural use were initially observed during the current study, but limitations prevented the exploration of the cave interiors. The possibility exists that the caves could have been previously utilized as temporary shelters or caches.

CSH 43, Retaining Wall

CSH 43 is a mortared basalt retaining wall located on the east side of Waipahu Depot Street, immediately adjacent to the road. The wall comprises one side of a water-filled basin and the remaining three walls are constructed of earthen berms (Figure 129). The basin is approximately 1.3 m long, 2 m wide, and extends 1 m subsurface. It appears the basin was constructed to control flooding of the road. A date of construction is unknown.

CSH 44, Culvert

CSH 44 is a mortared basalt culvert identified near the reservoir for the Waipi'o Soccer Complex with a barbed wire enclosure. Based on the space between the culvert and the pond, it is possible the two are associated (Figure 130). If this is the case, the culvert dates to around 2000 when the soccer complex was opened.

CSH 47, Concrete Walkway

CSH 47 is a concrete walkway identified in a densely overgrown portion of the study area between the existing Waipahu WWPS and the Honolulu Police Academy (Figure 131). The extent of the walkway is unknown, as is the association and date of construction for the walkway.

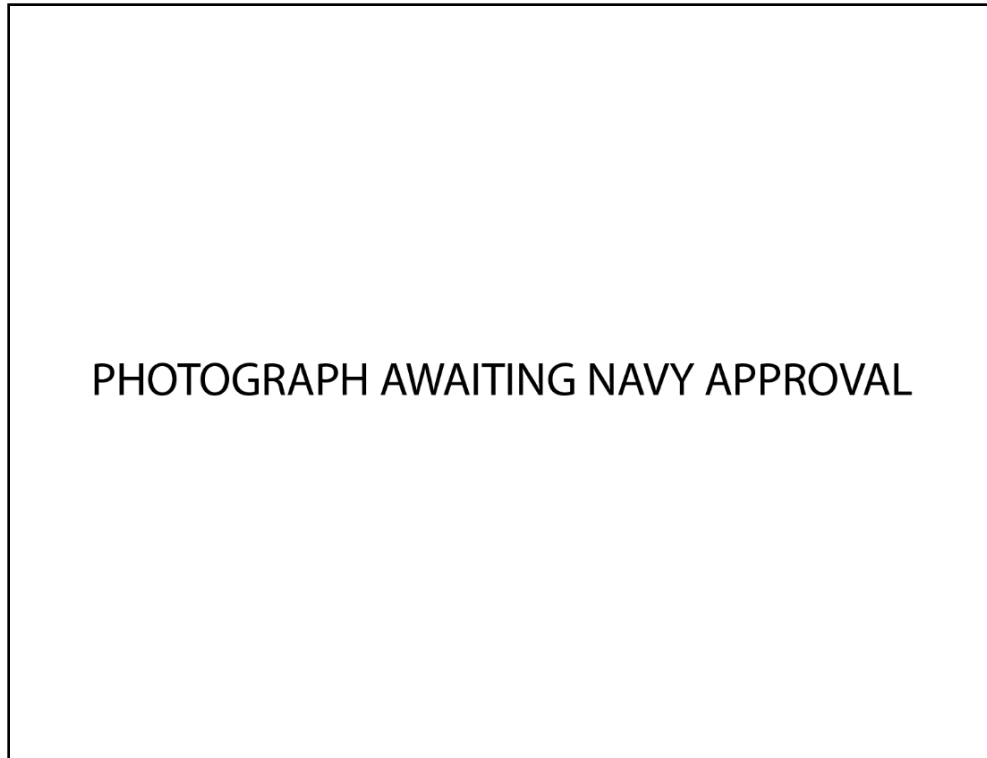


Figure 126. CSH 20, mechanical trash dump on Waipi'o Peninsula

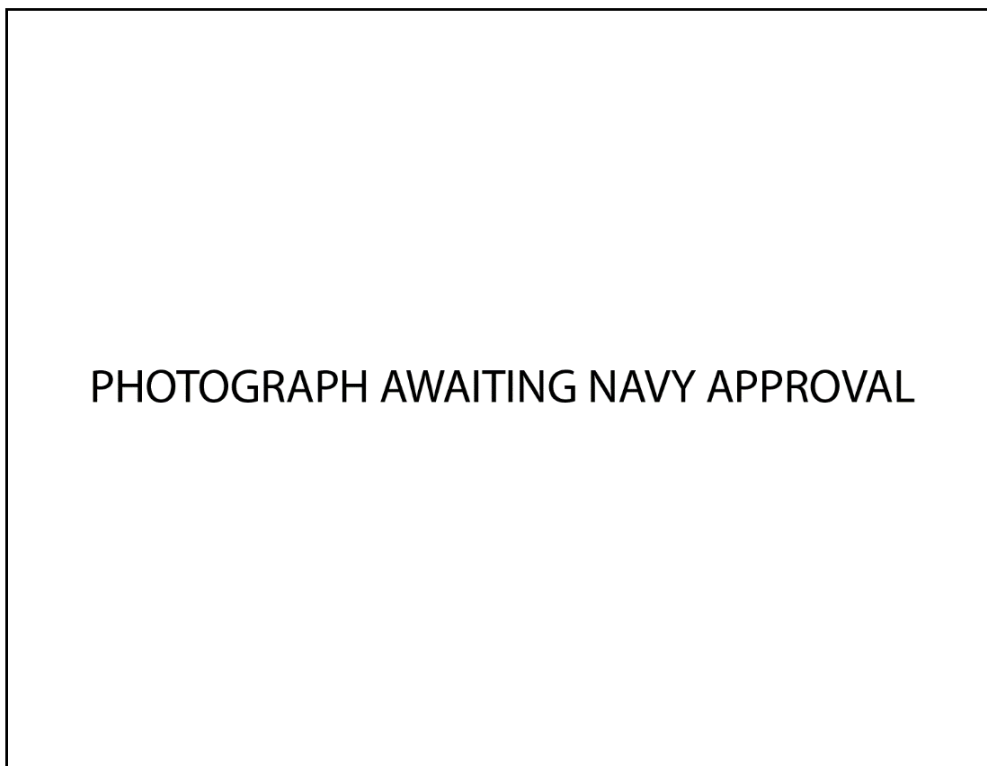


Figure 127. CSH 36, PVC pipeline on Waipi'o Peninsula

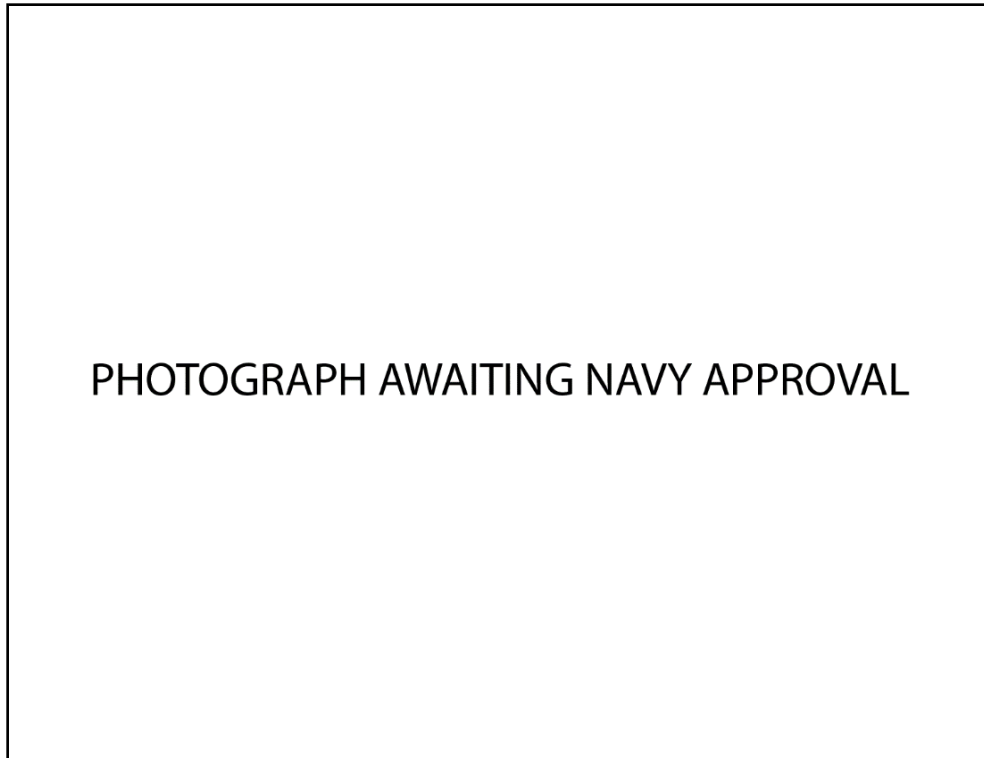


Figure 128. CSH 41, limestone caves on Waipi'o Peninsula

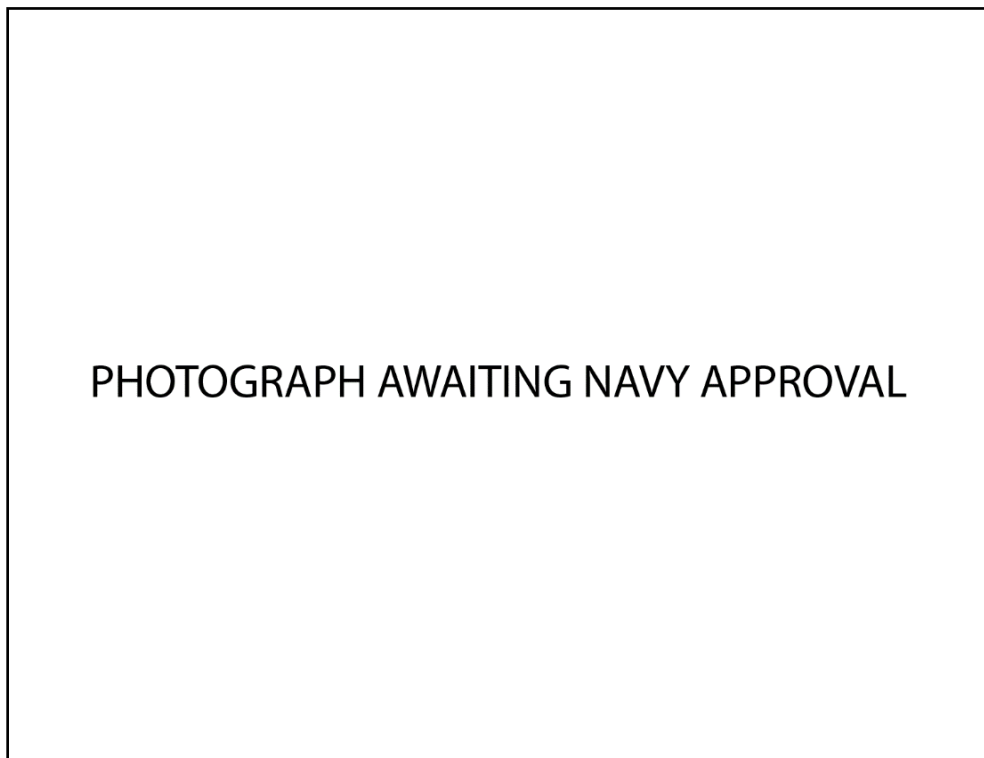


Figure 129. CSH 43, retaining wall on Waipi'o Peninsula

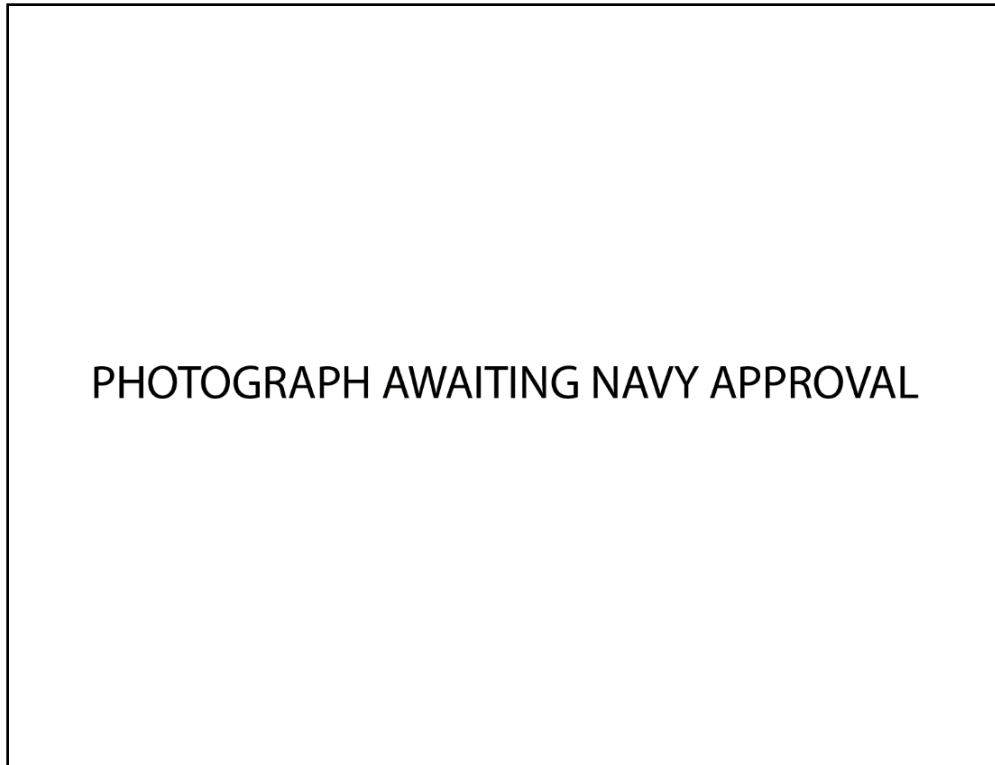


Figure 130. CSH 44, culvert on Waipi'o Peninsula



Figure 131. CSH 47, concrete walkway on Waipi'o Peninsula, view to north

5.2 From Waipi'o to Waimano

The central section of the study area stretches from the western boundary of Waipi'o to the eastern boundary of Waimano Ahupua'a. This section of the study area includes a main *makai* (southern) corridor that generally aligns with the Pearl Harbor Bike Path from Waimano to Waipi'o, a small offshoot of the main corridor that extends *makai* from shore to shore through Middle Loch, a secondary *mauka* (northern) corridor following the Kamehameha Highway alignment from the H-2 Freeway on-ramp to Waimano Home Road, three intermediary corridors aligned northeast to southwest between the main and secondary corridor, and an additional offshoot from the Kamehameha Highway corridor that follows Waihona Street up Waiawa Gulch for approximately 1,000 m before branching to the northwest into private land for approximately 300 m. Although most of this section of the study area has been affected by some sort of modern development, much of it remains less developed than the surrounding Pearl City area.

The *mauka* corridor includes commercial and industrial complexes set against wooded cliffsides along Waihona Street and urban developments along Kamehameha Highway and the HHCTC (Figure 132 and Figure 133). Conversely, the *makai* corridor comprises somewhat rural development with a small housing community that lines the *makai* side of the Pearl Harbor Bike Path, stream-fed agricultural plots, Makalena Golf Course, Lehua Elementary School, Lehua Community Park, and the Waiawa Power Plant. Most undeveloped areas throughout this *makai* portion are being utilized as homeless encampments. The tertiary corridors that extend between the *mauka* and *makai* corridors vary as the westernmost includes Leeward Community College, the H-1 Freeway/H-2 Freeway/Farrington Highway interchange and the HART Rail Operations Center; the center corridor includes an apartment complex, the H-1 Freeway, and a University of Hawai'i agricultural facility; and the easternmost corridor consists of a residential neighborhood and the H-1 Freeway overpass.

Five historic properties have been previously identified within this section of the study area. This includes SIHP # 50-80-09-123, a pre-Contact fishpond named Loko Eo (McAllister 1933); SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor; SIHP # 50-80-09-6764, post-Contact 'Ewa Junction Navy Fuel Drum Site (Rainalter et al. 2006); SIHP # 50-80-09-119, a pre-Contact fishpond named Loko Kuhialoko (Athens et al. 2000 and McAllister 1933); and SIHP # 50-80-12-9714, the OR&L ROW (Hammatt and Chiogioji 1997). Of the five previously identified historic properties, only indications of SIHP # -9714 (OR&L ROW) and SIHP # 50-80-13-9992 (U.S. Naval Base, Pearl Harbor) were identified during the current field investigation. SIHP # -9714 is identified as the alignment for the Pearl Harbor Bike Path, which is traversed by the *makai* portion of this section of the study area from Waipi'o to Waimano Ahupua'a. SIHP # -9992 is recognized as the lands and waters *makai* of the Pearl Harbor Bike Path along the shorelines of Middle Loch and across Pearl City Peninsula. The remaining historic properties were not identified during the archaeological field inspection as their locations have been greatly modified by historical and modern land use.

Potential historic properties include a highway bridge (CSH 48), a culvert (CSH 49), a fire station (CSH 50), and an active *lo'i kalo* complex (CSH 51). The archaeologists' track logs are shown in Figure 138. These findings are depicted on Figure 139, listed in Table 20, and discussed in further detail below.



Figure 132. General view of the study area along Waihona Street in Waiawa Ahupua'a, showing commercial facilities amongst an otherwise rural setting, view to southwest



Figure 133. General view of the study area near the intersection of Kamehameha Highway and Acacia Road within Waiawa Ahupua'a, view to east



Figure 134. General view of the study area overlooking developed roadways associated with Leeward Community College and HART Rail Operations Center in the photograph background, view to southwest



Figure 135. General view of the study area showing the Pearl Harbor Bike Path (OR&L ROW; SIHP # 50-80-12-9714) and peripheral areas within the study area in Waiawa Ahupua'a, view to west



Figure 136. General view of the study area within Mānana Ahupua‘a, west of the existing Pearl City WWPS and adjacent to the Pearl Harbor Bike Path, showing dump sites along an unimproved road and surrounding undeveloped areas, view to west



Figure 137. General view of the study area *mauka* of the Pearl Harbor Bike Path within Waimano Ahupua‘a, showing an undeveloped area surrounding the Waiiau Stream, view to north



Figure 138. 2016 ESRI aerial photograph showing archaeologists' track logs during the field inspection of the study area from Waipi'o to Waimano Ahupua'a

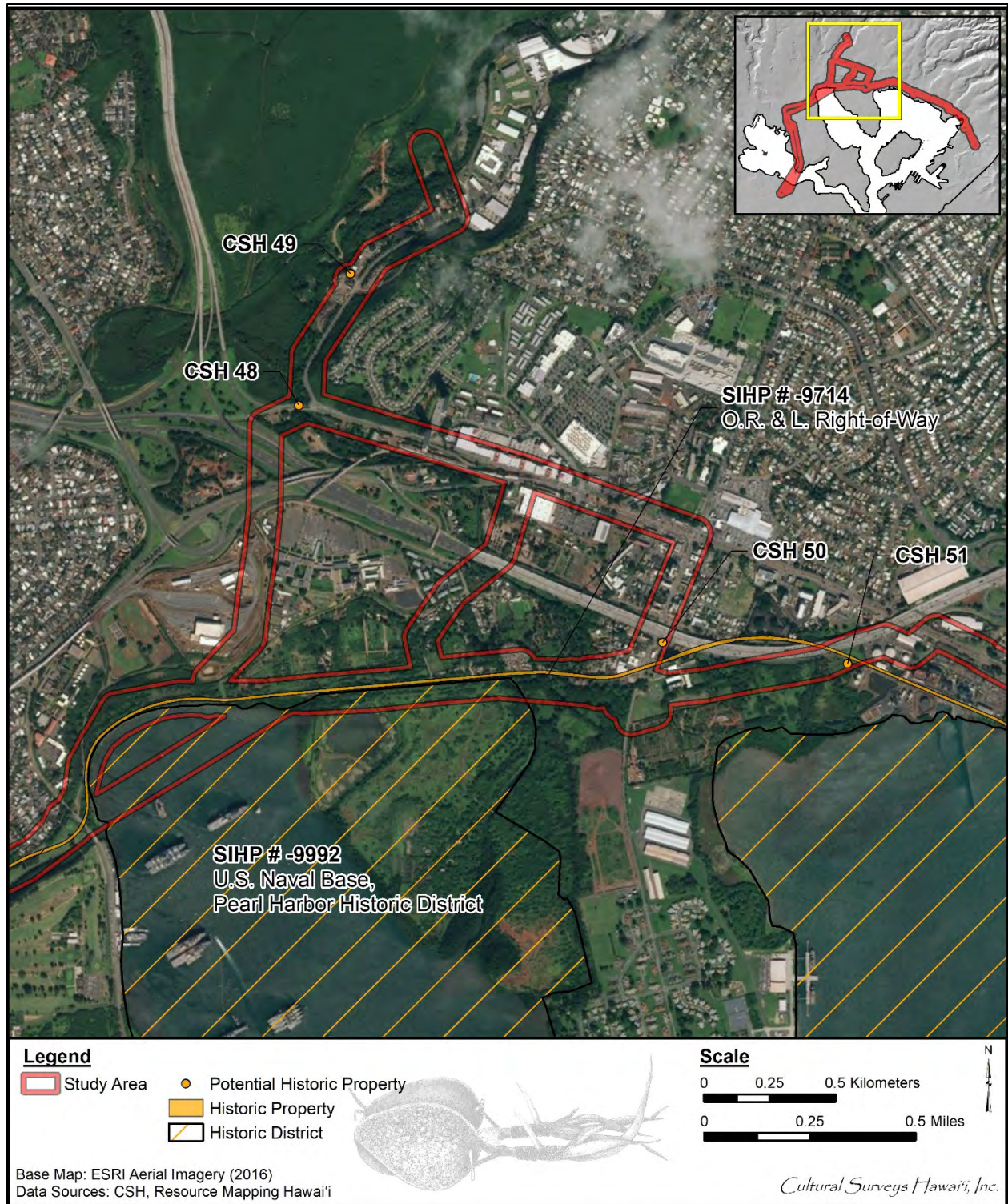


Figure 139. 2016 ESRI aerial photograph showing previously identified and potential historic properties identified during the field inspection from Waipi'o to Waimano Ahupua'a

Table 20. Identified historic properties/potential historic properties from Waipi'o to Waimano

Feature Designation	Type	Function
SIHP # 50-80-12 -9714	OR&L ROW	Transportation
SIHP # 50-80-13-09992	U.S. Naval Base, Pearl Harbor Historic District	Military Base
CSH 48	Waiawa Stream Bridge-Kamehameha Hwy	Transportation
CSH 49	Culvert	Transportation
CSH 50	Honolulu Fire Dept. Station 20, Pearl City	Fire station
CSH 51	<i>Lo'i kalo</i>	Active agriculture

5.2.1 SIHP # 50-80-12-9714

SIHP # 50-80-12-9714 was identified spanning through this section of the study area, at the inland boundary of Waipi'o Peninsula. It is a previously identified historic property comprised of the OR&L Railroad and associated features. Within this section of the study area, the ROW extends through much of the entire study area and in modern times is overlain by the Pearl Harbor Bike Path (see Figure 137). The OR&L Railroad appears on maps of the study area as early as the 1890s (see an 1890 promotion map, Figure 43, and an 1897 Nichols map, Figure 45).

5.2.2 SIHP # 50-80-13-9992

SIHP # 50-80-13-9992 was identified *makai* of the Pearl Harbor Bike Path along Middle Loch and across Pearl City Peninsula. SIHP # -9992 comprises the U.S. Naval Base, Pearl Harbor Historic District. This includes naval lands associated with Pearl Harbor, as well as the lochs of Pearl Harbor. The central segment of the study area traverses a small and relatively undeveloped area within the boundary of the historic district. Significant features were not identified in this area in the course of this study.

5.2.3 CSH 48, Waiawa Stream Bridge-Kamehameha Highway

The Waiawa Stream Bridge is in Waiawa Ahupua'a, where Kamehameha Highway crosses Waiawa Stream, running approximately east to west (Figure 140). It is classified as a concrete tee beam type bridge with concrete open horizontal railings; the eastbound portion of the bridge was constructed in 1949, and the westbound portion in 1953 (MKE associates LLC and Fung Associates, Inc. 2013). The bridge is not listed on the NRHP or HRHP and the Hawai'i State Historic Bridge Inventory and Evaluation (MKE associates LLC and Fung Associates, Inc. 2013) determined "This is a typical post-war bridge" which falls under Program Comments. The east- and westbound portions of the bridge are designated as bridge number 003000990401745 and 003000990401746 respectively (MKE associates LLC and Fung Associates, Inc. 2013).

5.2.4 CSH 49, Waiawa Stream Culvert

A dry stacked basalt and concrete culvert was identified underlying an unnamed road that runs northwest to southeast from Waihona Street, across Waiawa Stream in Waiawa Ahupua'a (Figure 141). The culvert system contains two pipes which were likely intended to permit the flow of the Waiawa Stream and prevent the overlying road from flooding. Currently, the culverts appear blocked or plugged and the stream flows atop the lightly trafficked road. Although the construction



Figure 140. CSH 48, Waiawa Stream Bridge, view to west



Figure 141. CSH 49, Waiawa Stream Culvert, view to northwest

date of the culvert is unknown, the overlying road appears in historic photographs by 1952 (see Figure 68). The unimproved nature of the culvert suggests it may be historic.

5.2.5 CSH 50, Honolulu Fire Department Station 20, Pearl City

The Honolulu Fire Department Station 20–Pearl City was identified at the corner of Lehua Avenue and First Street, on the *makai* (south) side of the H-1 Freeway corridor (Figure 142). A dedication plaque for the fire station tells that the structure was erected by the Pearl City Community Association and dedicated in 1953. Furthermore, Smith (1978) describes that an auxiliary engine company was put in service at Pearl City on 2 February 1942, and the company was placed under the control of the City and County of Honolulu on 30 September 1944. The fire station building may have been erected during that period, prior to dedication.

5.2.6 CSH 51, Lower Waimano *Lo'i Kalo*

A parcel of land operating as *lo'i kalo* was identified within the study area boundaries in the lower, easternmost portion of Waimano Ahupua'a (Figure 143). The operation appears to be family owned and operated and no commercial information has been found regarding the operation. *Lo'i* patches are on both the *mauka* and *makai* side of the Pearl Harbor Bike Path and it is unclear whether the discrete parcels are owned by the same proprietor. This area of Waimano Ahupua'a is traditionally known for pre-Contact fishponds, stream-fed irrigated agriculture, and Hawaiian settlement. This specific set of *lo'i kalo* are likely fed by the Waiiau Stream and it is possible it is a continuation of traditional *lo'i kalo* production. Two LCA parcels have been documented in the vicinity including LCA 11029, which did not report land use, and LCA 9391, which was reported to include six *lo'i* patches, a fishpond, and a house lot (See Figure 23).

5.3 From Waiiau to Hālawā

The eastern section of the study area stretches from Waiiau to Hālawā and is generally aligned with Kamehameha Highway from the H-1 eastbound Pearl City exit, until diverging southeast into the Aloha Stadium property and onward along Salt Lake Boulevard to the intersection with Kahupuaani Street at the study area's eastern extent. Most of this section of the study area is highly developed and includes numerous retail centers and strip malls, major roadways, the HHCTC, residential neighborhoods, and the Aloha Stadium (Figure 144 through Figure 146). Small, discreet areas within this section are substantially less developed or undeveloped, including the area of Waiiau Spring, Neal S. Blasdell Park, 'Aiea Bay State Recreation Area, the Pearl Harbor Bike Path, and the area *makai* (southwest) of the Kamehameha Highway/'Aiea Access Road/Moanalua Freeway Interchange (Figure 147 through Figure 149).

Six historic properties and one historic cemetery have previously been identified within this section of the study area. This includes SIHP # 50-80-09-7571, a post-Contact subsurface deposit (Filimoehala and Allen 2014) ; SIHP # 50-80-09-7150, a subsurface *lo'i* deposit (Raff-Tierney et al. 2018 and Sroat et al. 2012); SIHP # 50-80-09-8144, a historical subsurface trash deposit (Raff-Tierney et al. 2018); SIHP # 50-80-13-0109, a pre-Contact fishpond named Loko Paakea (Athens et al. 2000 and McAllister 1933); SIHP # 50-80-12-9714, the OR&L Railroad ROW (Hammatt and Chiogioji 1997); SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District; and the 'Aiea Cemetery (CSH 2008). Of the six historic properties, only indications of SIHP # -9714, OR&L ROW, and SIHP # -9992, U.S. Naval Base, Pearl Harbor Historic District were identified



Figure 142. Photograph showing Honolulu Fire Department Station 20–Pearl City, located within Mānana Ahupua‘a, view to northeast



Figure 143. Photograph showing the *mauka* portion of lower Waimano Ahupua‘a *lo‘i kalo* production along the *makai* side of the Pearl Harbor Bike Path, view to southwest



Figure 144. General view of the study area within Kalauao Ahupua'a, showing Kamehameha Highway eastbound lane near Pearlridge Center, the HHCTC on the *mauka* (north) side of the highway, and a shopping center on the *makai* (south) side, view to east



Figure 145. General view of the study area within 'Aiea Ahupua'a, showing Kamehameha Highway and the 'Aiea Access Road/Moanalua Freeway Interchange in the background, view to southeast



Figure 146. General view of the study area within Hālawā Ahupua‘a, showing the Aloha Stadium and associated parking lot where the 50th State Fair is held annually, view to north



Figure 147. General view of the study area within Waimalu Ahupua‘a, showing the Pearl Harbor Bike Path (SIHP # 50-80-12-9714, OL&R ROW) between a residential neighborhood on the *mauka* (north) side of the bike path, and a fenced military residential community on the *makai* (south) side of the path, view to east



Figure 148. General view of the study area within 'Aiea Ahupua'a, showing an undeveloped parcel of government owned land *makai* of the Moanalua Freeway/Kamehameha Highway/'Aiea Access Road interchange, view to southwest



Figure 149. General view of the study area within Hālawā Ahupua'a, showing an undeveloped parcel of land south of the Aloha Stadium, near the existing and proposed location for the Hālawā WWPS, view to north

during the current field inspection. SIHP # -9714 was identified as the alignment for the Pearl Harbor Bike Path, which is included within a section of the study area that runs through Kalauao and 'Aiea Ahupua'a. SIHP # -9992, U.S. Naval Base, Pearl Harbor Historic District, was identified as a largely inaccessible swath of land west of Aloha Stadium. Additionally, 'Aiea Cemetery (CSH 58) was identified along the *mauka* (northeast) extent of the study area within the Moanalua Freeway/Kamehameha Highway/'Aiea Access Road interchange. The cemetery contains grave markers with observed burial dates ranging from the 1920s to the 1940s. The remaining historic properties were not identified during the archaeological field inspection as their locations have been greatly modified by historical and modern land use.

Potential historic properties identified within this section of the study area include two water control features (CSH 52 and 59), five highway bridges still in use (CSH 53, 55 through 57, and 60), and a still operating watercress farm (CSH 54). These findings are listed in Table 21, are depicted on Figure 150 and Figure 151, and discussed in further detail below. The archaeologists' track logs are shown in Figure 152 and Figure 153.

Table 21. Identified historic properties/potential historic properties from Waiiau to Hālawā

Feature Designation	Type	Function
SIHP # 50-80-12-9714	OR&L Railroad	Transportation
SIHP # 50-80-13-9992	U.S. Naval Base, Pearl Harbor Historic District	Military Base
CSH 52	Waiiau Spring weir	Transportation
CSH 53	Waimalu Stream Bridge	Transportation
CSH 54	Sumida Watercress Farm	Active Agriculture
CSH 55	Kalauao Spring Bridge	Transportation
CSH 56	Kalauao Stream Bridge	Transportation
CSH 57	'Aiea Stream Bridge	Transportation
CSH 58	'Aiea Cemetery	Cemetery
CSH 59	Culvert	Infrastructure
CSH 60	Salt Lake Boulevard Bridge-Halawa Stream	Transportation

5.3.1 SIHP # 50-80-12-9714

SIHP # 50-80-12-9714 was identified spanning through a small section of this portion of the study area, along the shores of East Loch through Kalauao and 'Aiea Ahupua'a. It is a previously identified historic property composed of the OR&L Railroad and associated features. Within this section of the study area, the ROW is overlain by the Pearl Harbor Bike Path. The OR&L Railroad appears on maps of the study area as early as the 1890s (see an 1890 promotion map, Figure 43, and an 1897 Nichols map, Figure 45).

5.3.2 SIHP # 50-80-13-9992

SIHP # 50-80-13-9992 was identified within the eastern portion of the study area both *mauka* and *makai* of a small section of the Pearl Harbor Bike Path within Hālawā Ahupua'a. SIHP # -

9992 comprises the U.S. Naval Base, Pearl Harbor Historic District which includes naval lands associated with Pearl Harbor, as well as the lochs of Pearl Harbor. The portion of the historic district that is traversed by the study area in Hālawā Ahupua‘a is mostly inaccessible but appeared free of features or structures that may be deemed significant.

5.3.3 CSH 52, Waiāu Spring Culvert and Weir

A mortared basalt weir and a concrete culvert were identified on the *makai* (southwest) side of Kamehameha Highway, adjacent to Waiāu Spring within Waiāu Ahupua‘a (Figure 154). The culvert has three pipes (two circular and one rectangular) that extend beneath Kamehameha Highway from Waiāu Spring and regulate the flow of water from the spring toward the East Loch of Pearl Harbor. The culvert and weir were likely constructed in association with the construction of the Kamehameha Highway to allow Waiāu Spring to continue flowing under the highway toward the East Loch of Pearl Harbor.

5.3.4 CSH 53, Waimalu Stream Bridge

Located in Waimalu Ahupua‘a, the Waimalu Stream Bridge carries Kamehameha Highway east-west across Waimalu Stream (Figure 155). It is classified as a concrete girder type bridge with concrete open Greek cross railings. The eastbound portion of the bridge was constructed in 1936, and the westbound portion in 1945 (MKE associates LLC and Fung Associates, Inc. 2013). While the interior railings of the bridge are original, the exterior railings of the bridge were replaced with the modern observed concrete and metal railings when the bridge underwent widening in 1966. It is possible that at this time the stream walls and basin were channelized with concrete as it stands today. Although the bridge is not listed on the NRHP or HRHP, the Hawaii State Historic Bridge Inventory and Evaluation (MKE associates LLC and Fung Associates, Inc. 2013) evaluated the bridge as eligible based on its association with “post-war developments of the community.” The east- and westbound portions of the bridge are designated as bridge numbers 003000990401986 and 003000990401987 respectively (MKE associates LLC and Fung Associates, Inc. 2013).

5.3.5 CSH 54, Sumida Watercress Farm Inc.

Sumida Watercress Farm is located within Kalauao Ahupua‘a, at 98-160 Kamehameha Highway, adjacent to the westbound lane of the highway and immediately south of the Pearlridge Center. It is reported that the property has been in operation since 1928, and it remains the largest producer of watercress in the state of Hawai‘i (Mason Architects 2008). Only the *makai* (southern) portion of the farm falls within the bounds of the study area and includes a small grass field hut and many patches for growing watercress, which are partitioned by low, concrete masonry walls (Figure 156). The farm is fed by the Kalauao Spring and a culvert at the southeast corner of the property diverts runoff into a channelized segment of the spring that flows toward Pearl Harbor. This property has previously been evaluated as eligible for the NRHP

as a rural historic landscape site under Criterion A—for its association with the history of diversified agriculture in the Pearl City area, and under Criterion C—for its distinctive method of construction of a watercress farm, innovatively applying a naturally flowing artesian system to watercress farming. This site is significant as a rural historic landscape reflecting the occupational activities of wetland agriculture, which was an important historical activity. [Mason Architects 2008]

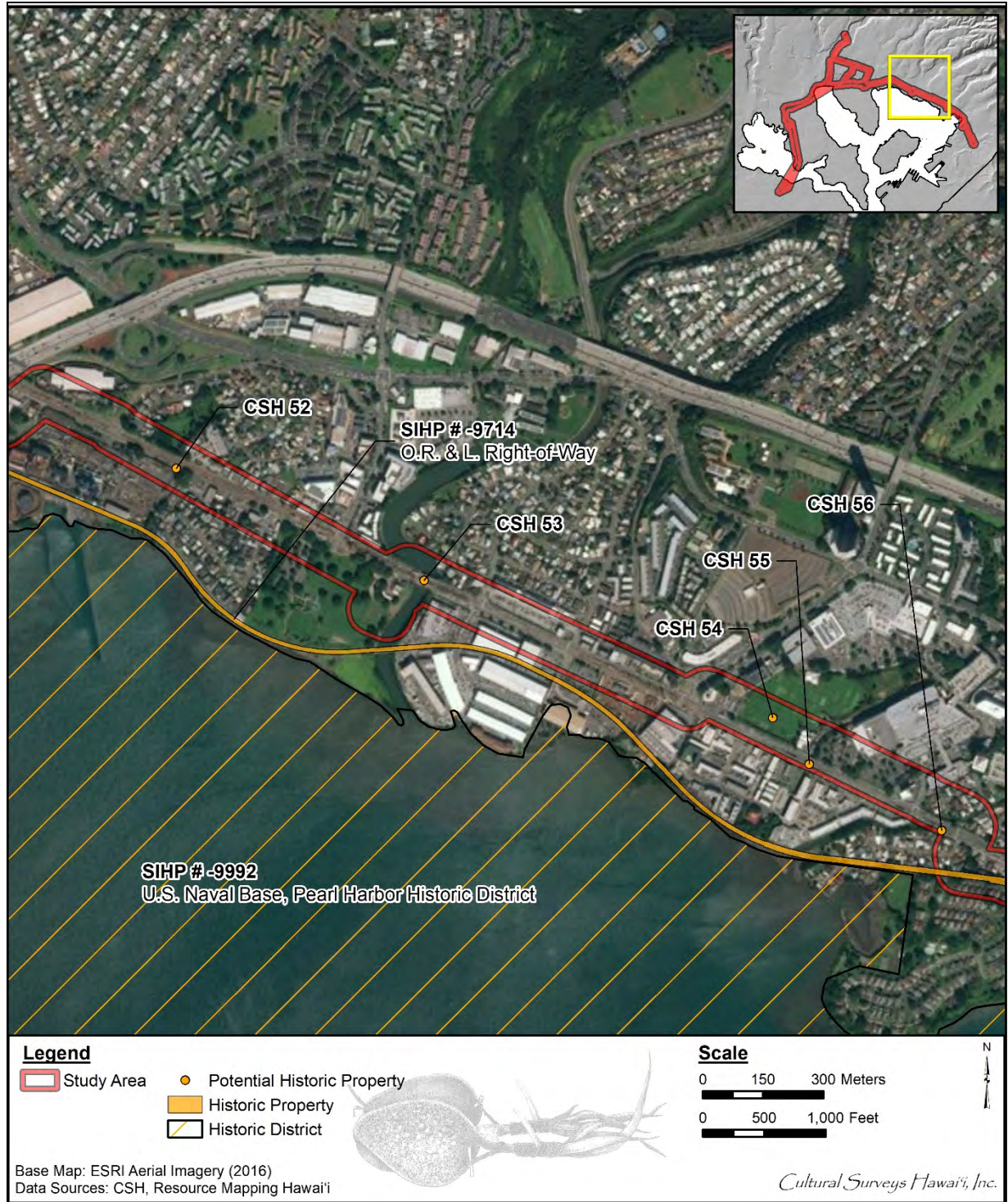


Figure 150. 2016 ESRI aerial photograph showing previously identified and potential historic properties identified during the field inspection from Waiiau to Hālawā Ahupua‘a

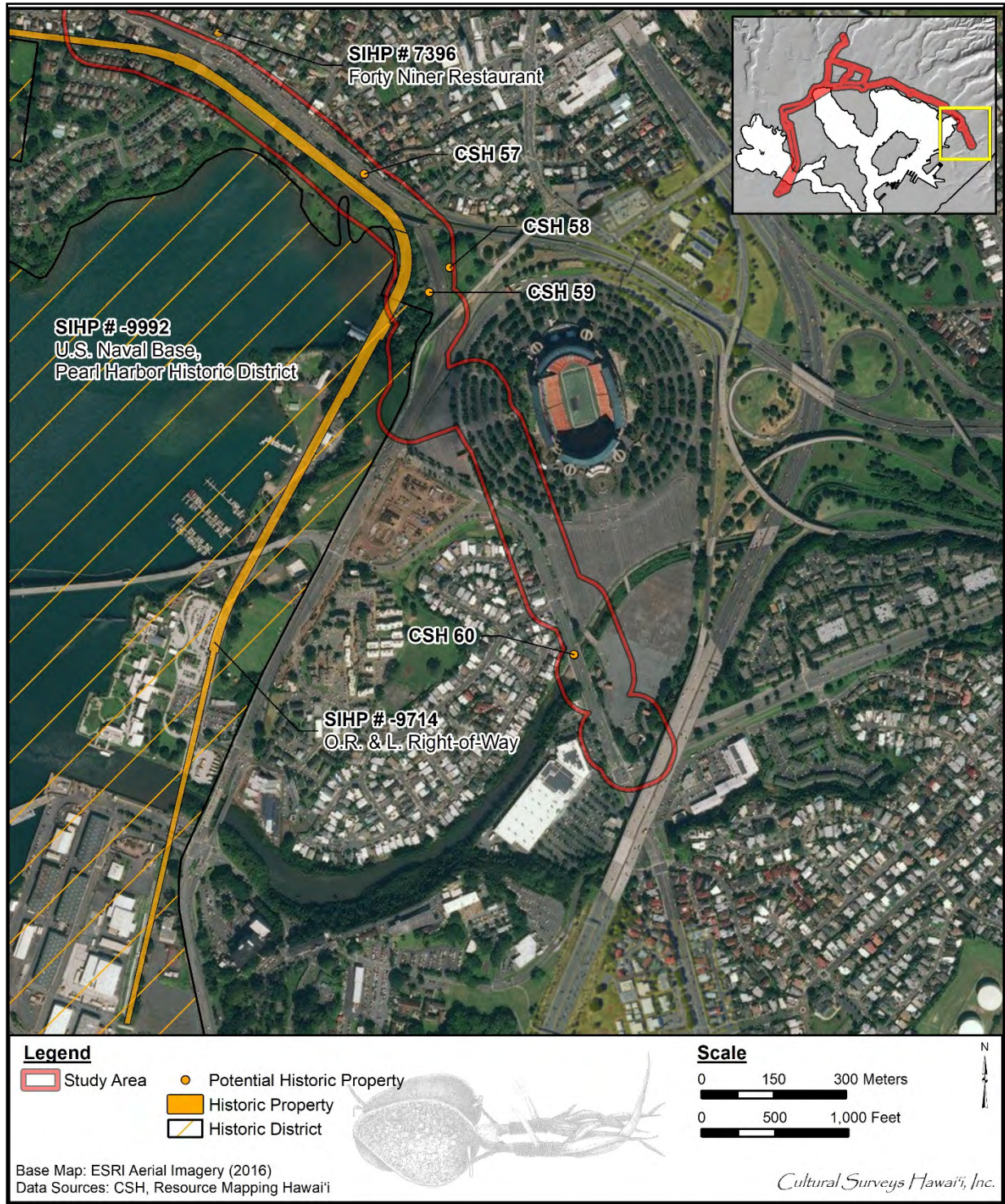


Figure 151. 2016 ESRI aerial photograph showing previously identified and potential historic properties identified during the field inspection from Waiau to Hālawā Ahupua‘a



Figure 152. 2016 ESRI aerial photograph showing archaeologists' track logs during the field inspection of the study area from Waiau to Kalauao Ahupua'a

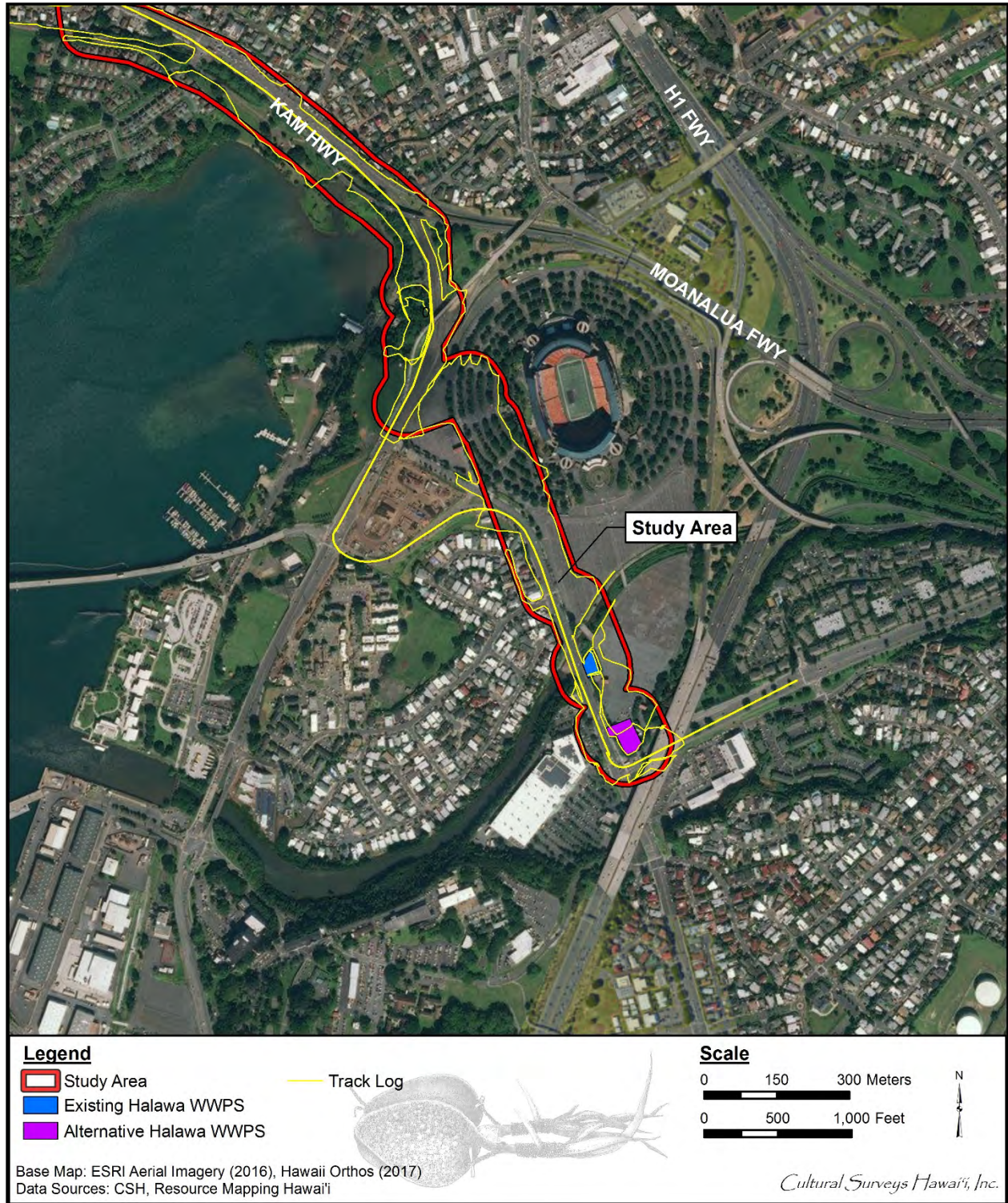


Figure 153. 2016 ESRI aerial photograph showing archaeologists' track logs during the field inspection of the study area from 'Aiea to Hālawā Ahupua'a



Figure 154. CSH 52, Waiiau Spring weir and culvert on the *makai* (south) side of Kamehameha Highway, view to northeast



Figure 155. CSH 53, Waimalu Stream Bridge, view to north



Figure 156. Photograph showing Sumida Watercress Farm, specifically the *makai* portion that falls within the study area, view to east



Figure 157. Photograph showing the interior railing of the Kalauao Spring Bridge westbound lane of Kamehameha Highway constructed in 1945, view to southwest

5.3.6 CSH 55, Kalauao Spring Bridge

Located in Kalauao Ahupua'a, the Kalauao Spring Bridge carries Kamehameha Highway across Kalauao Spring (see Figure 157). It is classified as a concrete girder type bridge with concrete open Greek cross railings. The eastbound portion of the bridge was constructed in 1936, and the westbound portion in 1945. While the interior railings of the bridge are original, the exterior railings of the bridge were replaced with more modern concrete and metal railings when the bridge underwent widening in 1966. Additionally, the channelized spring appears to have undergone two phases of development as the portions of the channel adjacent to the bridge are constructed with mortared basalt while the portions extending *mauka* and *makai* are constructed of concrete (Figure 158). Although the bridge is not listed on the NRHP or HRHP, the Hawaii State Historic Bridge Inventory and Evaluation evaluated the bridge as eligible based on its association with "post-war developments of the community." The east- and westbound portions of the bridge are designated as bridge numbers 003000990402053 and 003000990402054 respectively (MKE associates LLC and Fung Associates, Inc. 2013).

5.3.7 CSH 56, Kalauao Stream Bridge

Located in Kalauao Ahupua'a, the Kalauao Stream Bridge carries Kamehameha Highway across Kalauao Stream (Figure 159). It is classified as a concrete girder type bridge with concrete open Greek cross railings. The eastbound portion of the bridge was constructed in 1936, and the westbound portion in 1945. While the interior railings of the bridge are original, the exterior railings of the bridge were replaced with more modern concrete and metal railings when the bridge underwent widening in 1966. The overgrown stream below is channelized with mortared basalt walls and a concrete terraced stream bed that alludes to prior land use as taro, banana, coconut, and squash were observed growing within. Although the bridge is not listed on the NRHP or HRHP, the Hawaii State Historic Bridge Inventory and Evaluation evaluated the bridge as eligible based on its association with "post-war developments of the community." The east- and westbound portions of the bridge are designated as bridge numbers 003000990402074 and 003000990402075 respectively (MKE associates LLC and Fung Associates, Inc. 2013).

5.3.8 CSH 57, 'Aiea Stream Bridge

Located in 'Aiea Ahupua'a, the 'Aiea Stream Bridge carries Kamehameha Highway east to west across 'Aiea Stream (Figure 160). It is classified as a concrete tee beam type bridge with concrete and metal railings. The bridge was constructed in 1938 and was significantly altered in 1965 when the structure of the bridge was completely modified (MKE associates LLC and Fung Associates, Inc. 2013). It is possible the stream below was channelized with tall, vertical concrete walls contemporaneously to this modification. The Hawaii State Historic Bridge Inventory and Evaluation (MKE associates LLC and Fung Associates, Inc. 2013) determined the bridge "does not reflect the typical characteristics of a 1930s bridge" and it falls under Program Comments. The bridge is designated as bridge number 003000990402120 (MKE associates LLC and Fung Associates, Inc. 2013).



Figure 158. Photograph of Kalauao Spring Bridge and channelized stream below (note two possible channelizing events—mortared basalt, later followed by concrete), view to east



Figure 159. CSH 56, Kalauao Stream Bridge, view to south



Figure 160. CSH 57, 'Aiea Stream Bridge, view to north



Figure 161. 'Aiea Cemetery, specifically the *makai* portion that falls within the study area, view to north

5.3.9 CSH 58, 'Aiea Cemetery

The 'Aiea Cemetery was identified within 'Aiea Ahupua'a, at the Moanalua Freeway/Kamehameha Highway/'Aiea Access Road interchange and the cemetery's *makai* portion falls within the current study area (see Figure 161). In 2008, CSH completed an archaeological technical report for the HHCTCP (CSH 2008) which identified likely impacts to archaeological resources within the HHCTCP corridor. The 2008 CSH study provided a brief description of the 'Aiea Cemetery:

The approximately 1.5-acre, roughly diamond-shaped cemetery parcel is surrounded by roadways, including Kamehameha Highway and the access roads that feed traffic into Aloha Stadium and the H-1 Freeway . . . The cemetery is owned by the State of Hawai'i and is actively maintained, based on the recently trimmed lawn and graves with fresh flowers. A rusted, partially collapsed chain link fence marks the cemetery boundary . . . The graves appear to be grouped in clusters and cover nearly all of the available area within the cemetery. Grave markers are concrete, native basalts, and various non-native stones, such as granite. Most grave markers have some sort of inscription, either in the Roman alphabet or in Japanese characters. The largest, centrally-located grave marker or monument may be inscribed with Chinese characters. The Roman inscriptions are predominantly Portuguese names with associated text in English; although in some cases the text is written in Portuguese as well. What appeared to be Anglo- American and Filipino names were also noted. The observed Roman alphabet inscriptions all marked interments between 1911 and 1948. The date on a single Japanese character inscription was tentatively translated as 1917. Based on available evidence, the cemetery's period of use was the first half of the 20th century, although the many Japanese inscriptions were not dated. No SIHP number has been designated for the cemetery and it does not appear to have been evaluated for eligibility for either the Hawaii or National Register of Historic Places. [CSH 2008:4–28, 29]

Background research associated with an additional archaeological study (Sroat et al. 2012) indicated the cemetery was established by the Honolulu Plantation Company. The cemetery previously extended *makai* of Kamehameha Highway, but was bisected during highway construction. The burials in the *makai* portion of the cemetery were indicated to have been relocated to the *mauka* portion of the cemetery prior to highway construction.

5.3.10 CSH 59, Culvert and Drainage Channel

A mortared basalt drainage channel with a concrete culvert was identified between the Kamehameha Highway and 'Aiea Access Road split, near the Moanalua Freeway/Kamehameha Highway/'Aiea Access Road interchange within 'Aiea Ahupua'a (Figure 162). The channel runs approximately north to south, with the culvert at the southern end of the channel extending beneath Kamehameha Highway. The channel is approximately 0.6 m in depth and 0.8 m wide. It is likely associated with Kamehameha Highway based on its location relative to the surrounding roadways.



Figure 162. CSH 59, culvert and drainage channel, view to south



Figure 163. CSH 60, Salt Lake Boulevard Bridge–Hālawa Stream, view to southeast

5.3.11 CSH 60, Salt Lake Boulevard Bridge-Hālawā Stream

Located in Hālawā Ahupua‘a, the Salt Lake Boulevard Bridge-Hālawā Stream carries Salt Lake Boulevard north to south across the Hālawā Stream (Figure 163). It is classified as a concrete girder type bridge with concrete and metal railings and was constructed in 1968 (MKE associates LLC and Fung Associates, Inc. 2013). The portion of Hālawā Stream that runs below the bridge is completely channelized with concrete walls and basin. The bridge is not listed on the NRHP or HRHP and the Hawaii State Historic Bridge Inventory and Evaluation (MKE associates LLC and Fung Associates, Inc. 2013) determined it is a “typical post-war bridge” and falls under Program Comments. The bridge is designated as bridge number 003067001400301 (MKE associates LLC and Fung Associates, Inc. 2013).

Section 6 Site Descriptions for Previously Identified Historic Properties

Ten previously identified archaeological sites given SIHP numbers were identified within or immediately adjacent to the current study area in the archaeological literature; an additional three historic properties have been discussed but not assigned SIHP #s. They are summarized in Table 22 and their locations are provided on Figure 84, Figure 86, and Figure 88.

Historic properties identified during the present fieldwork are depicted on Figure 98, Figure 99, Figure 100, Figure 139, Figure 150, and Figure 151.

Table 22. Sites identified within the current study area

SIHP #	Formal Type	Function
50-80-09-109	Hawaiian fishpond (Loko Opu)	Aquaculture
50-80-09-119	Hawaiian fishpond (Loko Kuhia also Kuhialoko)	Aquaculture
50-80-09-123	Hawaiian fishpond (Loko Eo)	Aquaculture
50-80-09-6764	Military installation	Fuel storage (former Ewa Junction Navy Fuel Drum site)
50-80-09-7150	Subsurface cultural deposit	Taro cultivation (<i>lo'i</i> sediments)
50-80-09-7571	Subsurface cultural deposit	Fire features
50-80-12-9714	OR&L Railroad ROW	Transportation
50-80-13-5597	Sugar Irrigation Complex	Agriculture
50-80-13-7796	Irrigation Complex	Agriculture
50-80-13-9992	U.S. Naval Base, Pearl Harbor Historic District	Military Base
No SIHP # assigned; McAllister site 122	<i>Heiau</i> (pre-Christian place of worship)	Place of worship
No SIHP # assigned; Freshpond Fishpond	Hawaiian fishpond (Freshpond Fishpond)	Aquaculture
No SIHP # assigned; 'Aiea Cemetery	Cemetery	Burial

6.1 SIHP # 50-80-09-109

FORMAL TYPE:	Hawaiian fishpond
FUNCTION:	Aquaculture
NUMBER OF FEATURES:	1
AGE:	Pre-Contact and post-Contact
TAX MAP KEY:	TMK: [1] 9-8-014
LAND JURISDICTION:	Several owners ?
PREVIOUS DOCUMENTATION:	McAllister 1933: 103

SIHP # 50-80-09-109 identifies Loko Opu, a traditional Hawaiian fishpond, first described by J. Gilbert McAllister as follows:

Loko Opu, fishpond at Kalauao.

Has not been completely filled in. It was 10.5 acres in size and apparently completely surrounded by a wall 2700 feet in extent. It was built by Kalaimanua [McAllister 1933:103]

McAllister cites Abraham Fornander (Fornander 1880:269) for his reference to the construction of Loko Opu during the reign of the O'ahu ruling chief Kalaimanua. We are not aware of any subsequent study at Loko Opu.

6.2 SIHP # 50-80-09-119

FORMAL TYPE:	Hawaiian fishpond
FUNCTION:	Aquaculture
NUMBER OF FEATURES:	1
AGE:	Pre-Contact and post-Contact
TAX MAP KEY:	TMK: [1] 9-8-020?
LAND JURISDICTION:	Navy
PREVIOUS DOCUMENTATION:	McAllister 1933 and Athens et al. 2000:51–55 (see also Rasmussen and Tomonari-Tuggle 2006:75).

SIHP # 50-80-09-119 identifies Loko Kuhia (also called Kuhialoko), a traditional Hawaiian fishpond, first described by J. Gilbert McAllister as follows:

Loko Kuhialoko, fishpond at Waiawa, southwest side of the Pearl City Peninsula, on the sea side of the Oahu railroad.

A long, narrow pond, now only a few acres in size, with the wall running the length of one of the long sides. It formerly covered 133 acres. The wall is about 3000 feet in length and there are three *makaha* [*mākāhā*]. [McAllister 1933:105]

Athens et al. (2000:52) document two cores recovered and nine radiocarbon determinations made. There is an inconsistency in the dating results. Historic types of pollen (*Ambrosia*, *Prosopis*, and *Batis*) were present from 318 cm to the surface of the core, leading to the conclusion that “major historic disturbances have occurred in the core at least to this depth [318 cm].”

6.3 SIHP # 50-80-09-123

FORMAL TYPE:	Hawaiian fishpond
FUNCTION:	Aquaculture
NUMBER OF FEATURES:	1
AGE:	Pre-Contact and post-Contact
TAX MAP KEY:	TMK: [1] 9-8-002?
LAND JURISDICTION:	City and County of Honolulu and Navy
PREVIOUS DOCUMENTATION:	McAllister 1933 and Athens et al. 2000

SIHP # 50-80-09-123 identifies Loko Eo, a traditional Hawaiian fishpond, first described by J. Gilbert McAllister as follows:

Loko Eo, fishpond at the north end of Waipio Peninsula.

The pond covers 137 ac res. It is surrounded on three sides by land with a wall approximately 2040 feet in extent on the fourth side. The wall was about 6 feet wide of coral stone and about 4 feet high, with six *makaha* [*mākāhā*]. The wall has been greatly widened now, forming a railroad track bed for the plantation train. [McAllister 1933:106]

Athens et al. introduce the fishpond site as follows:

This very large fishpond is located on the east side of the upper part of Waipio Peninsula, which separates West Loch from Middle Loch. The Ted Makalena Golf Course has been built on top of this filled pond, though Naval facilities presently occupy the coastal margin to the east. [Athens et al. 2000:55]

Athens et al. (2000:55–60) document four cores recovered and 16 radiocarbon determinations made. Unfortunately, “Between Layer IIa and VII [to an indicated depth of 669 cm] the dates show no stratigraphic consistency, suggesting that this part of the core has been disturbed and is likely fill” (Athens et al. 2000:59). While there was consistency in dating from deeper layers of paleoenvironmental interest, these were all from prior to human arrival.

6.4 SIHP # 50-80-09-6764

FORMAL TYPE:	Military installation
FUNCTION:	Fuel storage (the former Ewa Junction Navy Fuel Drum site)
NUMBER OF FEATURES:	1
AGE:	Construction began in 1943 (Rainalter et al. 2006:78)
TAX MAP KEY:	TMK: [1] 9-3-002
LAND JURISDICTION:	City and County of Honolulu (HART)
PREVIOUS DOCUMENTATION:	Rechtman and Henry 1998, Rainalter et al. 2006, Sroat et al. 2012

“The ‘Ewa Drum Filling and Fuel Storage Area received a 100% surface survey” (Rechtman and Henry 1998:6). No archaeological historic properties were identified within that project area during the course of the fieldwork and it was concluded that “Due to the amount of prior

disturbance and development at both of these facilities it is highly unlikely that any such resources, if they once existed, would have been preserved” (Rechtman and Henry 1998:ii). The study concluded, “NHPA Section 110 responsibilities with respect to the identification and evaluation of archaeological resources located within these facilities” had been fulfilled (Rechtman and Henry 1998).

In 2006, CSH conducted an archaeological field inspection and literature search for the construction of a proposed Leeward Community College Second Access Road. The study recorded the ‘Ewa Junction Navy Fuel Drum Site, a fuel storage facility designed to store automobile gasoline and aviation kerosene in underground storage tanks as SIHP # 50-80-09-6764. The study develops fairly detailed data on the ‘Ewa Junction Navy Fuel Drum Site and, following consultation with the Navy, concludes, “based on this initial evaluation by the Navy, it is likely that the site would be considered eligible by the Navy for listing on the National Register . . .”

The ‘Ewa Junction Drum Filling and Fuel Storage Area location was part of the Sroat et al. 2012 AIS study and the import of this site was resolved prior to the (presently ongoing) development as a HART Rail Operations Center (this area was restricted and inaccessible during the current archaeological field inspection).

6.5 SIHP # 50-80-09-7150

FORMAL TYPE:	Subsurface cultural deposit
FUNCTION:	Taro cultivation (<i>lo‘i</i> sediments)
NUMBER OF FEATURES:	1
AGE:	Pre-Contact and post-Contact
TAX MAP KEY:	TMK: [1] 9-8
LAND JURISDICTION:	State of Hawai‘i (HDOT)
PREVIOUS DOCUMENTATION:	Sroat et al. (2012:209–217)

The subsurface cultural deposit identified as SIHP # 50-80-09-7150 by Sroat et al. (2012:209–217) consists of two layers of silty clay (Strata IIIa and IIIb), overlying natural waterworn basalt gravels and cobbles (Stratum IV). Both strata of silty clay contained organic and cultural material consisting of very fine rootlets and small fragments of charcoal (~2-4 mm) interpreted as ponded taro field (*lo‘i*) sediments. Radiocarbon dates obtained from the underlying Stratum IIIb yielded a single date range of AD 1414-1480, while Stratum IIIa yielded two equally possible date ranges of AD 1450-1530 and AD 1540-1635.

6.6 SIHP # 50-80-09-7571

FORMAL TYPE:	Subsurface cultural deposit
FUNCTION:	Fire features
NUMBER OF FEATURES:	2
AGE:	Post-Contact
TAX MAP KEY:	TMK: [1] 9-8-005
LAND JURISDICTION:	City and County of Honolulu (Kuleana Place)
PREVIOUS DOCUMENTATION:	Filimoehala and Allen 2014

SIHP # 50-80-09-7571 included a pair of features: Feature 1, a fire or refuse feature; and Feature 2, a fire feature. SIHP # -7571 Feature 1 contains post-Contact materials. Based on this material and the close proximity of the two features they are both presumed to post-date Western Contact (Filimoehala and Allen 2014:iii).

6.7 SIHP # 50-80-12-9714

FORMAL TYPE:	OR&L Railroad ROW
FUNCTION:	Transportation
NUMBER OF FEATURES:	Two
AGE:	Post-Contact
TAX MAP KEY:	TMK: [1] 9-1, 3, 4, and 6–9, multiple plats
LAND JURISDICTION:	N/A
PREVIOUS DOCUMENTATION:	Sinoto 1986, Hammatt and Chiogioji 1997, Goodman and Cleghorn 1998, Cleghorn 2000, and Whitman et al. 2007

SIHP # 50-80-12-9714 comprises the previously identified remains of the OR&L Railroad ROW and its associated features. The OR&L Railroad was established by Benjamin F. Dillingham in 1889 to provide transportation from Honolulu and around south, west, and north shores of O'ahu. The OR&L Railroad proved to be a vital part of sugarcane cultivation and plantation era agriculture on O'ahu but it also played a very important role during World War II when the railroad was utilized for troops and munitions. The OR&L Railroad was decommissioned in 1947 (Hungerford 1963) and a western portion (outside the study area) has since been placed on the NRHP (Site 50-80-12-9714).

Remnants of the OR&L Railroad (SIHP # -9714) were identified within the western, central, and eastern sections of the current study area. In the western section, SIHP # -9714 extends across the *mauka* extent of the study area. It includes a steel-spur bridge immediately west of Waipahu Depot Street, and the extant railroad ROW alignment which is now occupied by the Pearl Harbor Bike Path. In the central section of the study area, the SIHP # -9714 alignment continues through much of the *makai* study area corridor, but deviates outside the study area near Lehua Avenue in Manana Ahupua'a. The historic property re-enters the study area near Kalauao Stream in Kalauao Ahupua'a and remains within most of 'Aiea Ahupua'a. With the exception of remnant railroad tracks observed atop the steel-spur bridge in the western section of the study area, the observed portions of SIHP # -9714 were only identified as the alignment modernly occupied by the Pearl Harbor Bike Path.

6.8 SIHP # 50-80-13-5597

FORMAL TYPE:	Sugar Irrigation Complex
FUNCTION:	Agriculture
NUMBER OF FEATURES:	Two
AGE:	Post-Contact
TAX MAP KEY:	TMK: [1] 9-1, 3, 4, 6, and 9, multiple plats
LAND JURISDICTION:	U.S. Federal Government
PREVIOUS DOCUMENTATION:	Goodman and Cleghorn 1998

SIHP # 50-80-12-5597 is described as a sugarcane irrigation complex consisting of two concrete pumping stations and associated irrigation ditches (Goodman and Cleghorn 1998) that include a 1937 pumping station building (Feature 1) and 1919 pumping station (and associated ditches) (Feature 2). Goodman and Cleghorn (1998:35) determined “This site appears to meet criteria ‘a’ and ‘d’ of the criteria for listing on the National Register of Historic Places” but conclude,

The Sugar Irrigation Complex (Site 5597) is a remnant of an important industry that helped shape modern Hawai'i. Because the significance of these features is limited to their informational content, and that they have been adequately recorded, it is recommended that no further work is necessary for these sites. Construction plans call for this portion of the project area to be graded in excess of nine feet. Preservation of these sites does not appear to be warranted or feasible. [Goodman and Cleghorn 1998:36]

The status of this historic property at this time is unclear and we would not assume that these buildings are of no further historic preservation concern.

6.9 SIHP # 50-80-13-7796

FORMAL TYPE:	Irrigation Complex
FUNCTION:	Agriculture
NUMBER OF FEATURES:	Unknown
AGE:	Post-Contact (1927 to possibly as late as the early 1990s)
TAX MAP KEY:	TMK: [1] 9-3, multiple plats
LAND JURISDICTION:	U.S. Federal Government
PREVIOUS DOCUMENTATION:	Filimoehala et al. 2015

SIHP # 50-80-13-7796 is a network of plantation irrigation features consisting of large ditches, settling ponds, and a metal pipeline recorded across approximately 287 acres of the survey area (Filimoehala et al. 2015:77). The ditches are linear depressions with earthen berms on each side. The ditches are 1-16 m wide and 0.7-6.75 m deep. A series of 11 settling ponds which total 79.11 acres were also documented as part of this extensive irrigation complex

6.10 SIHP # 50-80-13-9992

FORMAL TYPE:	U.S. Naval Base, Pearl Harbor Historic District
FUNCTION:	Military Base
NUMBER OF FEATURES:	Unknown
AGE:	Post-Contact (1902 to present)
TAX MAP KEY:	TMK: [1] 9-1, 3, 6, 7, 8, 9, multiple plats
LAND JURISDICTION:	U.S. Federal Government
PREVIOUS DOCUMENTATION:	Landrum et al. 1997 and Apple 1978

SIHP # 50-80-13-9992 is a historic district which consists of all lands and waters that are associated with U.S. Naval Base, Pearl Harbor. The naval base was listed as a National Historic Landmark and added to the National Register of Historic Places in 1966 (NRHP #66000940) based on the significant role that the base played during WWII and in the history of the United States. The military base was then added to the State Inventory of Historic Places in 1971. Features of the historic district include memorials, ship yards, ammunition depots, barracks, fleet training centers, a submarine base, and numerous various structures and facilities. Although the historic district is significant as a whole, it is worth noting that features within the district have previously been individually assessed for significance and while some have been assigned individual SIHP numbers (none within the current study area), others have been assessed as lacking significance (Landrum et al. 1997).

6.11 No SIHP # assigned; McAllister Site 122

FORMAL TYPE:	Heiau
FUNCTION:	Place of worship
NUMBER OF FEATURES:	1
AGE:	Pre-Contact and early post-Contact
TAX MAP KEY:	Uncertain
LAND JURISDICTION:	Uncertain
PREVIOUS DOCUMENTATION:	McAllister 1933

According to CSH records, McAllister Site 122 has never been formally assigned an SIHP #. McAllister (1933:106) provides the following description:

Ahuena heiau, Halaulani, Waipio, just seaward of the Experiment Station of the Hawaiian Sugar Planters' Association.

Only a small portion of paving of very small waterworn stones at the edge of the 25-foot elevation remains of what must have been an important heiau, for the site is known and remembered by all the old Hawaiians (*kamaaina*) [*kama 'āina*] in the district. There is a vague memory that this heiau was formerly located in the mountains in Honouliuli at Punahawele. Thrum [citing Thrum's "Heiaus and heiau sites throughout the Hawaiian islands," 1907 and 1909] states: 'Hon. John Ii used to be the custodian of its idols.' [McAllister 1933:106]

It seems likely this site was never given an SIHP # as it was never recorded after McAllister's [1931] fieldwork and the site is referred to as being "destroyed" in a 2006 field inspection by Rainalter et al.

6.12 No SIHP # assigned; Freshpond Fishpond

FORMAL TYPE:	Hawaiian fishpond
FUNCTION:	Aquaculture
NUMBER OF FEATURES:	1
AGE:	Pre-Contact and post-Contact
TAX MAP KEY:	TMK: [1] 9-3-002
LAND JURISDICTION:	Navy
PREVIOUS DOCUMENTATION:	Athens 2000

Athens et al. (2000:69) describe "Freshpond" as follows: "Fresh Pond, a small fishpond, is located on the west side of the upper Waipi'o Peninsula, but somewhat inland of the shoreline. It is directly west of the center part of Loko Hanaloa, separated from it by about 250m." The small "Fresh Pond" fishpond (no SIHP # assigned) lies mostly within the present study corridor on Waipi'o Peninsula (see Figure 84). Three cores were taken during the Athens et al. (2000) study but there was no indication of the presence of fishpond sediments.

6.13 No SIHP # assigned; 'Aiea Cemetery

FORMAL TYPE:	Cemetery
FUNCTION:	Burial
NUMBER OF FEATURES:	1 cemetery (many burials)
AGE:	Post-1911
TAX MAP KEY:	TMK: [1] 9-9-043:029
LAND JURISDICTION:	Roman Catholic Church in the State of Hawai'i
PREVIOUS DOCUMENTATION:	CSH 2008

In 2008, CSH completed an archaeological technical report for the HHCTCP (CSH 2008). The report identified likely impacts to archaeological resources within the HHCTCP corridor. Within the Kamehameha Highway portion of the project corridor, the study identified and provided brief documentation of 'Aiea Cemetery, located on the *mauka* side of Kamehameha Highway, adjacent to the Aloha Stadium property. The description of 'Aiea Cemetery was provided as follows:

The approximately 1.5-acre, roughly diamond-shaped cemetery parcel is surrounded by roadways, including Kamehameha Highway and the access roads that feed traffic into Aloha Stadium and the H-1 Freeway . . . The cemetery is owned by the State of Hawai'i and is actively maintained, based on the recently trimmed lawn and graves with fresh flowers. A rusted, partially collapsed chain link fence marks the cemetery boundary . . . The graves appear to be grouped in clusters and cover nearly all of the available area within the cemetery. Grave markers are concrete, native basalts, and various non-native stones, such as granite. Most grave markers have some sort of inscription, either in the Roman alphabet or in Japanese characters. The largest, centrally-located grave marker or monument may be

inscribed with Chinese characters. The Roman inscriptions are predominantly Portuguese names with associated text in English; although in some cases the text is written in Portuguese as well. What appeared to be Anglo- American and Filipino names were also noted. The observed Roman alphabet inscriptions all marked interments between 1911 and 1948. The date on a single Japanese character inscription was tentatively translated as 1917. Based on available evidence, the cemetery's period of use was the first half of the 20th century, although the many Japanese inscriptions were not dated. No SIHP number has been designated for the cemetery and it does not appear to have been evaluated for eligibility for either the Hawaii or National Register of Historic Places. [CSH 2008:4–28, 29]

Background research associated with an additional archaeological study (Sroat et al. 2012) indicated the cemetery was established by the Honolulu Plantation Company. The cemetery previously extended *makai* of Kamehameha Highway, but was bisected during highway construction. The burials in the *makai* portion of the cemetery were indicated to have been relocated to the *mauka* portion of the cemetery prior to highway construction.

Section 7 Summary and Recommendations

7.1 Overview

It is important to be clear that under Hawai‘i Administrative Rules, “ ‘Historic Property’ means any building, structure, object, district, area, or site, including heiau and underwater site, which is over fifty years old” (HAR §13-275-2).

This study area is quite large (approximately 12 miles in length for 714.59 acres or 289.18 hectares) and could include hundreds of older buildings and roads that could technically be historic properties by virtue of having been built prior to 1970. Most of the project area lies along older transportation alignments (particularly portions of Kamehameha Highway, Lehua Avenue and the OR&L alignment that is now largely developed as a bike path). Thus, it could truly be said that the majority of the study area is upon previously identified or potential historic properties.

Particular consideration should be given to the OR&L alignment (SIHP # 50-80-12-9714) that comprises the previously identified remains of the OR&L Railroad ROW and its associated features. The OR&L Railroad was established by Benjamin F. Dillingham in 1889 to provide transportation from Honolulu and around south, west, and north shores of O‘ahu. The OR&L Railroad proved to be a vital part of sugarcane cultivation and plantation-era agriculture on O‘ahu but it also played a very important role during World War II when the railroad was utilized for troops and munitions. Most (or all) of the OR&L alignment within the project corridor is understood to have been built in 1890. The OR&L Railroad was decommissioned in 1947 (Hungerford 1963) and a western portion (outside the study area) has since been placed on the NRHP (Site 50-80-12-9714). The State of Hawai‘i Department of Transportation is understood as the landowner of the OR&L alignment in the project area. It is understood that the Federal Highways Administration (FHWA) and certainly the SHPD have particular interests in this historic property. Addressing crossings or any impacts within the OR&L alignment can take an extended period of time for agencies seeking to gain easements and resolve mitigation of impacts.

Additional attention should be given to U.S. Naval Base, Pearl Harbor Historic District (SIHP # 50-80-13-9992) which includes all lands and waters associated with the naval base. The historic district is a National Historic Landmark and is listed on the National Register of Historic Places (NRHP #66000940). Some military structures that were identified during the current study within Naval Magazine Pearl Harbor (West Loch), have previously been assessed as components of SIHP # -9992. Portions of the U.S. Naval Base, Pearl Harbor Historic District (SIHP # -9992) are traversed by many sections of the current study corridor but only the portion within Naval Magazine Pearl Harbor (West Loch) have been identified in this study to include components of potential significance.

For the lay person, archaeological sites in Hawai‘i are typically associated with traditional Hawaiian occupation or early post-Contact occupation. Much of the study area was subject to early twentieth century agriculture (sugar and rice cultivation) and remnants of this cultivation may be widespread, and by virtue of being more than 50 years old, constitute historic properties. For example, on Waipi‘o Peninsula and covering an extensive portion of the study corridor is SIHP # 50-80-13-7796, a network of plantation irrigation features consisting of large ditches, settling ponds, and a metal pipeline recorded across approximately 287 acres of the survey area

(Filimoehala et al. 2015:77). This is a very large site area, but as Filimoehala et al. (2015) recommended no further mitigation for this post-Contact site, and the Navy appears to have agreed, this historic property is likely to be of relatively little concern for the present project.

Another point to be considered is that even where traditional Hawaiian historic properties are known and have been identified, evidence is often lacking due to subsequent ground disturbance. We can say with some certainty that the study area includes “Fresh Pond” Fishpond (no SIHP #), Loko Eo Fishpond (SIHP # 50-80-09-123), Loko Kuhia (Kuhialoko, SIHP # 50-80-09-119), and probably a northwest corner of Loko Opu Fishpond (SIHP # 50-80-09-109) but whether in fact any evidence of these fishponds such as walls or even fishpond sediments exist is unclear.

It needs to be said that any assessment of archaeological potential is only as good as the data set it is based on. While this study reviews approximately 85 prior archaeological studies within the study area, this is a relatively low level of coverage for the south shore of O‘ahu. Hence there probably are significant archaeological sites within the study area that are presently unknown.

It is illustrative to look at two recent examples (some documentation still in draft form) coming out of the Transit project. In general terms, the Transit project has similarities to the present study and future wastewater collection system improvement projects in that it arcs around coastal Pearl Harbor and involves relatively intensive ground disturbance. There is extensive overlap of the Transit project with the present study area both along Kamehameha Highway north of the Pearl City peninsula and also as Kamehameha Highway skirts the coast of East Loch. During the Transit archaeological inventory survey projects (Hammatt 2010, Sroat et al. 2012), two historic properties were designated in the vicinity of the present study area. The Hammatt 2010 study documented SIHP # 50-80-09-7751, subsurface agricultural sediments, near Farrington Highway north of Waipi‘o Peninsula (outside the present study area) and the Sroat et al. 2012 study documented SIHP #50-80-09-7150, subsurface cultural deposit (*lo‘i* sediments) along Kamehameha Highway northwest of Blaisdell Park. The point is that this very extensive subsurface testing only identified two historic properties and both were of a relatively modest nature (agricultural sediments). The actual construction-related excavation has brought to light a couple of additional historic properties. In December 2014, a human tibia shaft and fragment of a human fibula were found near Aiea Kai Place and Kamehameha Highway. Similar finds could occur virtually anywhere in coastal O‘ahu. Of greater note, some ten finds of human skeletal remains (possibly as few as three individuals are represented) were encountered at the proposed Transit Pearl Ridge Station along the *makai* side of Kamehameha Highway west of Kaonohi Street near the boundary of Waimalu and Kalauao Ahupua‘a within the present project area. So on the one hand, the Transit project was a massive study significantly overlapping the present project with very few finds and on the other hand there were finds that could be virtually anywhere within the present project area.

7.2 Summary of Findings

As a sweeping generalization the study area has a remarkable absence of previously identified traditional Hawaiian or early post-Contact historic properties. This is at odds with the historic evidence, such as the LCA data that suggests very intensive and extensive Native Hawaiian land use within the project area. There is certainly some truth to the “nobody has looked!” explanation but this lack of previously identified early historic properties probably reflects more the very extensive nature of prior ground disturbance.

In the archaeological studies reviewed not a single human bone was identified within the study area per se prior to the recent finds noted above at the Pearl Ridge Station and near 'Aiea Kai Place.

7.2.1 West Portion of the Study Area (Honouliuli and Waikele Ahupua'a)

In the western portion of the project area (see Figure 84 and Table 13), research identified five historic properties. Summarizing these from southwest to northeast they include SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District; SIHP # 50-80-13-7796, a post-Contact commercial sugarcane irrigation complex; "Fresh Pond Fishpond" (no SIHP # assigned); SIHP # 50-80-13-5597, a complex of two concrete pumping stations (designated Features 1 and 2) and irrigation ditches; and SIHP # 50-80-13-9714, the OR&L ROW.

Forty-seven potential historic properties were identified during the current study within Honouliuli and Waikele Ahupua'a. Twenty-four of the potential historic properties (CSH 21–40, 45, and 46) are likely related to SIHP # -5597 and/or SIHP # -7796, including berms, ditches, sluice gates, and water control features. The 23 additional potential historic properties include various military related structures and infrastructural remnants associated with SIHP # -9992, Naval Magazine Pearl Harbor (West Loch) (CSH 1–19), a mechanical refuse dump (CSH 20), a mortared basalt culvert (CSH 44), a mortared basalt retaining wall (CSH 43), and an overgrown concrete walkway (CSH 47). Additional areas of potential archaeological concern include three limestone caves (CSH 41) which were documented in the *mauka* (northern) half of Waipi'o Peninsula. These findings are listed in Table 19, depicted on Figure 98 through Figure 100, and are discussed in further detail in Section 5.1 above.

7.2.1 Central Portion of the Study Area (Waipi'o to Waimano Ahupua'a)

In the central portion of the project area (see Figure 86 and Table 14) previously identified historic properties include SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District; SIHP # 50-80-09-123, Loko Eo Fishpond; SIHP # 50-80-09-6764, the former Ewa Junction Navy Fuel Drum site; SIHP # 50-80-09-119, the Loko Kuhia (Kuhialoko); and again, SIHP # 50-80-12-9714, the former OR&L alignment.

Potential historic properties identified during the present fieldwork include a highway bridge (CSH 48), a culvert (CSH 49), a fire station (CSH 50), and an active *lo'i kalo* complex (CSH 51). These findings are depicted on Figure 139, are listed in Table 20, and are discussed in further detail in Section 5.2 above.

7.2.1 East Portion of the Study Area (Waiau to Hālawa Ahupua'a)

In the eastern portion of the project area (see Figure 88 and Table 15) west of Blaisdell Park SIHP # 50-80-09-7150 identifies subsurface cultural deposits relating to *lo'i* sediments previously identified by Sroat et al. (2012) and Raff-Tierney et al. (2018) and SIHP # 50-80-09-7571 identifies a subsurface post-Contact cultural deposit consisting of two fire or refuse features identified in the Filimoehala and Allen (2014) study. Near Kalauao Spring stream the south side of the study area is adjacent to the Loko Opu Fishpond (SIHP # 50-80-09-109). A small, inaccessible portion of SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District is located *makai* of Aloha Stadium and is apparently lacking in features. The 'Aiea Cemetery (no SIHP #; CSH 58) is adjacent to the north side of the project corridor just west of Aloha Stadium but because of the siting of this cemetery effectively up on a bluff, it is not a concern for the present project.

Potential historic properties identified within this eastern section of the study area during the current field inspection include two water control features (CSH 52 and 59), five highway bridges still in use (CSH 53, 55 through 57, and 60), and a watercress farm still in operation (CSH 54). These findings are listed in Table 21, are depicted on Figure 150 and Figure 151, and are discussed in further detail in Section 5.3 above.

SIHP # -9714 was identified as the alignment for the Pearl Harbor Bike Path, which is included within a section of the study area that runs through Kalauao and 'Aiea Ahupua'a. SIHP # -9992, U.S. Naval Base, Pearl Harbor Historic District, was identified as a largely inaccessible swath of land west of Aloha Stadium. Additionally, 'Aiea Cemetery (CSH 58) was identified along the *mauka* (northeast) extent of the study area within the Moanalua Freeway/Kamehameha Highway/'Aiea Access Road interchange. The cemetery contains grave markers with observed burial dates ranging from the 1920s to the 1940s. The remaining historic properties were not identified during the archaeological field inspection as their locations have been greatly modified by historical and modern land use.

7.3 Archaeological Sensitivity

A summary map of "Archaeological Sensitivity" has been prepared (Figure 164) attempting to reflect the relative sensitivity for "significant" historic properties (red = higher sensitivity, yellow = moderate sensitivity, green = low sensitivity) based on available studies to date and in consideration of known patterns of traditional Hawaiian and later land use. Moving from west to east, the Honouliuli portion and Waipi'o Peninsula of the study area appear to have a generally low sensitivity. Closer to the margins of West Loch the sensitivity is suggested to be moderate due both to traditional patterns of Hawaiian harvesting of marine resources and the development of military infrastructure. Where the study corridor turns east near the Waipahu WWPS it enters a band of traditional Hawaiian habitation and agriculture skirting the edge of Pearl Harbor all the way to 'Aiea Bay. At least where archaeologists have looked, the archaeological evidence of this habitation and agriculture has been remarkably absent, which is attributed to the history of massive modern land alteration. Most of the *mauka* portions of the study area have a lower level of archaeological sensitivity with exceptions being the western portion of Kamehameha Highway near Waihona Street and the Lehua Avenue area due to the LCA pattern and early post-Contact development. The east end of the study area in Hālawa appears to have low sensitivity, possibly a little higher on the immediate banks of the traditional Hālawa Stream alignment.

7.4 Recommendations

The present study area is of corridors 400-feet wide and hence is much larger (wider) than the area of ground disturbance/impact that is likely expected in the actual buildout of the project. As there are numerous potential archaeological historic properties within the larger study area, a more defined project area would better inform regarding the potential impacts to historic properties. It is expected that these may include architectural historic properties (bridges, buildings, structures, etc.) as well as archaeological (sites), and possibly human burials. Therefore, as the project area is narrowed, and the potential impacts are clarified, it is recommended that consultation with the SHPD Architecture, Archaeology, and History and Culture Branches be conducted for the proposed project to determine appropriate historic preservation requirements.

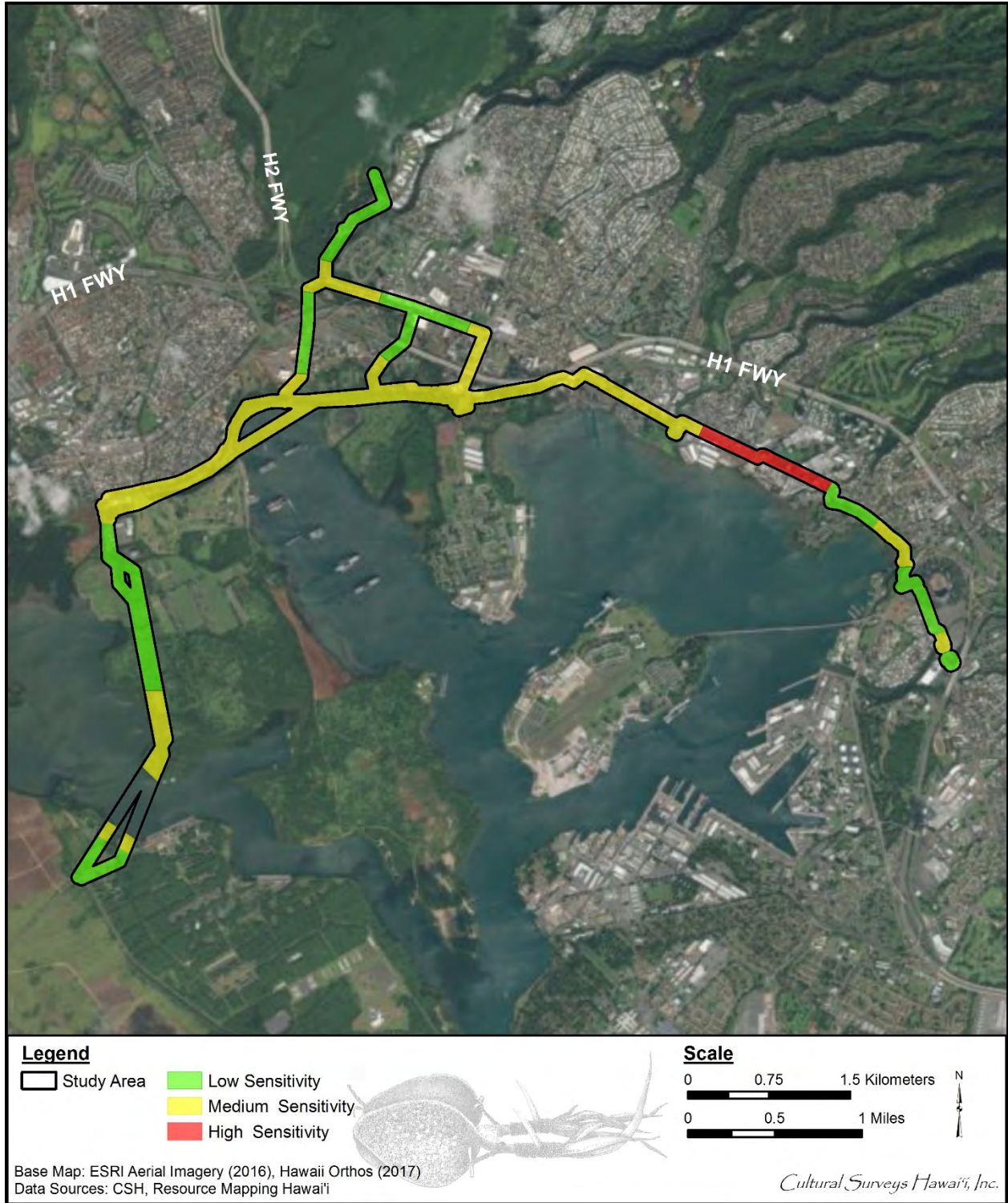


Figure 164. Archaeological sensitivity map attempting to reflect the relative sensitivity for “significant” historic properties (red = higher sensitivity, yellow = moderate sensitivity, green = low sensitivity)

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Appendix C: Cultural Impact Assessment

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DRAFT
Cultural Impact Assessment for the
Honouliuli Waipahu Pearl City Wastewater
Collection System Improvement Project,
Honouliuli, Waikele, Waiawa, Mānana, Waimano, Waiiau,
Waimalu, Kalauao, ‘Aiea and Hālawā Ahupua‘a,
‘Ewa District, O‘ahu
TMKs: [1] 9-1, 3, 4, and 6–9; multiple plats

Prepared for
AECOM Technical Services, Inc.

Prepared by
Kellen Tanaka,
and
Hallett H. Hammatt, Ph.D.

Cultural Surveys Hawai‘i, Inc.
Kailua, Hawai‘i
(Job Code: HONOULIULI 176)

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Management Summary

Reference	Cultural Impact Assessment for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement Project, Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiiau, Waimalu, Kalauao, 'Aiea, and Hālawa Ahupua'a, 'Ewa District, O'ahu, TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats
Date	July 2019
Project Number(s)	Cultural Surveys Hawai'i, Inc. (CSH) Job Code: HONOULIULI 176
Agencies	State of Hawai'i, Department of Health, Office of Environmental Quality Control (DOH/OEQC)
Land Jurisdiction	City and County of Honolulu, State of Hawai'i, Federal Government, Private
Project Proponent	City and County of Honolulu (CCH) Department of Environmental Services (ENV)
Project Location	The study area is located within Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiiau, Waimalu, Kalauao, and Hālawa Ahupua'a, 'Ewa District, O'ahu, TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats. The western portion of the study area originates in 'Ewa near the intersection of Iroquois Road and West Loch Drive at the Naval Magazine Pearl Harbor (West Loch). The study area extends north across West Loch until converging with the Pearl Harbor Bike Path near Waipi'o Point Access Road where it continues to follow the bike path until it nears the intersection with Kamehameha Highway in Waiiau Ahupua'a. The study area then follows the alignment of Kamehameha Highway until diverging along Salt Lake Boulevard near the Aloha Stadium and terminating at the intersection of Salt Lake Boulevard and Kahuapa'ani Street in Hālawa Ahupua'a. A secondary portion of corridor also runs in alignment with Kamehameha Highway, <i>mauka</i> (toward the uplands, north) of Pearl City Peninsula within Waiawa and Mānana Ahupua'a and intermediary corridors run northeast to southwest between the <i>mauka</i> corridor and the main corridor. A portion of the study area also extends from the <i>mauka</i> corridor up Waihona Street in Waiawa Gulch. The study area includes the Waipahu Wastewater Pumping Station (WWPS) and two adjacent alternative locations, the Pearl City WWPS and an adjacent alternative location, the Waimalu WWPS and an adjacent alternative location, and the Hālawa WWPS and an adjacent alternative location. The study area is depicted on a portion of the 1998 Waipahu and 1999 Pearl Harbor U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles.
Project Description	The project's proposed action aims to rehabilitate, upgrade, and/or expand the existing Honouliuli major sewer conveyance system (East Inceptor System) to accommodate flows through 2050. The affected

	area includes areas with current wastewater flows to the Honouliuli Wastewater Treatment Plant (WWTP) as well as potential future flows from areas including but not limited to Hālawā, ‘Aiea, Pearl City, Waipi‘o, Waikele, Waipahu, ‘Ewa, Kapolei, and Mililani.
Project Acreage	714.59-acres (289.18 hectares); approximately 12 miles in length
Document Purpose	The purpose of this cultural impact assessment (CIA) is to comply with the State of Hawai‘i’s environmental review process under Hawai‘i Revised Statutes (HRS) §343, which requires consideration of the project’s potential effect on cultural beliefs, practices, and resources. Through document research and cultural consultation efforts, this report provides information compiled to date pertinent to the assessment of the proposed project’s potential impacts on cultural beliefs, practices, and resources (pursuant to the Office of Environmental Quality Control’s <i>Guidelines for Assessing Cultural Impacts</i>), which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawai‘i significance Criterion e, pursuant to Hawai‘i Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that “have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group’s history and cultural identity” (HAR §13-275-6 and §13-284-6). The document will likely also support the project’s historic preservation review under HRS §6E and HAR §13-275 and §13-284. The document is intended to support the project’s environmental review and may also serve to support the project’s historic preservation review under HRS §6E-8 and HAR §13-284.
Results of Background Research	Background research for this study yielded the following results, presented in approximate chronological order: <ol style="list-style-type: none"> 1. The study area traverses 11 of the 13 <i>ahupua‘a</i> (traditional land division) located in the <i>moku</i> (district) of ‘Ewa. They are (from west to east) Honouliuli, Waikele, Waipi‘o, Waiawa, Mānana, Waimano, Waiāu, Waimālu, Kalāuao, ‘Aiea, and Hālawā Ahupua‘a. 2. The ‘Ewa District had more fishponds than any other district on O‘ahu, indicating that agricultural and aquacultural intensification was a direct link to the chiefs who resided there and to the increasing needs of the population. 3. In traditional Hawaiian times, the areas of exposed coral (Pleistocene limestone) outcrop were undoubtedly more extensive. This Pleistocene limestone outcrop, where not covered by alluvium or stockpiled material, has characteristic dissolution “pit caves” (Myroie and Carew 1995), which are

	<p>nearly universally, but erroneously, referred to as “sink holes” (Halliday 2005). According to McAllister (1933), holes and pits in the coral were generally accessed for water, while larger pits, often containing soil, were used for cultivation.</p> <p>4. The <i>mo'olelo</i> (stories) of 'Ewa invoke the deep Hawaiian past. Some <i>mo'olelo</i> make connections with Kahiki, the traditional homeland of Hawaiians in central Polynesia. Most notably, the chief Kaha'i left from Kalaeloa (coastal area in Honouliuli Ahupua'a) for a trip to Kahiki, and on his return to the Hawaiian Islands, brought back the first breadfruit (Kamakau 1991b:110) and planted it near the waters of Pu'uloa (long hill), now known as Pearl Harbor (Beckwith 1940:97). In addition, several <i>mo'olelo</i> associate places in 'Ewa with the gods Kāne and Kanaloa, the pig god Kamapua'a, the Hina family, and with the sisters of the Hawaiian volcano goddess Pele, all of whom have strong connections with Kahiki (Kamakau 1991b:111; Pukui et al. 1974:200).</p> <p>5. There were numerous <i>heiau</i> (pre-Christian place of worship) within the <i>moku</i> of 'Ewa. Archaeologist Gilbert McAllister reports on two known <i>heiau</i> in the <i>ahupua'a</i> of Honouliuli, as well as two other sites that could have possibly been <i>heiau</i>. These <i>heiau</i> were located on Pu'u Ku'ua, on Pu'u o Kapolei, at the foot of Pu'u Kanehoa, and at the foot of Mauna Kapu (McAllister 1933). There were two <i>heiau</i> in Waikele, Mokoula and Hapupu, both just north of the present Interstate H-1 Freeway. In Waipi'o, a <i>heiau</i> called Keakua'ōlelo was located in Pānakauahi Gulch. There was once a <i>heiau</i> in the area between Farrington Highway and the coast, called Ahu'ena (“red hot heap”). McAllister noted two <i>heiau</i>, Moa'ula and Heiau o 'Umi, along the main coastal trail in Waipi'o. McAllister (1933:105) also recorded a <i>heiau</i> called Puoiki located on the point of the ridge called Lae Pōhaku, the boundary point between Waiawa and Mānana Ahupua'a. McAllister (1933:105) also noted a <i>heiau</i> on the ridge between Waiawa and Waimalu gulches named Kolokukahau Heiau. Naulu-a-Maihea Heiau is located within Waimalu Ahupua'a (Sterling and Summers 1978:14). Keaiwa Heiau is located at the top of 'Aiea Heights Drive (Sterling and Summers 1978:11). There were four <i>heiau</i> located in Hālawa Ahupua'a including Waipao Heiau, Waikahi Heiau, Hale of Papa Heiau, and Luakini Heiau (McAllister 1933).</p> <p>6. There were several pre-Contact/early historic trails across 'Ewa: a cross-<i>ahupua'a</i> trail that crossed 'Ewa and connected Honolulu to Wai'anae; a <i>mauka-makai</i> (mountain to the sea) trail that branched off from the first trail and followed the boundary between Honouliuli and Hō'ae'ae to the Pōhākea Pass</p>
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	<p>and to Wai‘anae; and a second branching <i>mauka-makai</i> trail that generally followed the path of Waikele Stream in Waikele Ahupua‘a. This trail eventually led through the Kolekole Pass to Wahiawā and to Waialua District on the windward side of the island. A <i>mauka-makai</i> (north-south) trail branched off the cross-<i>ahupua‘a</i> trail into two offshoots which led to the coastal settlements of Kūalaka‘i and One‘ula.</p> <ol style="list-style-type: none"> 7. Along the trails within the <i>moku</i> of ‘Ewa were a number of places where travelers could stop and rest. Along the coastal trail connecting Honolulu to Wai‘anae was a small waterfall called Kahuawai (or Kahuewai) (water gourd container; Soehren 2009) along Kalauao Stream, which ‘Ī‘ī (1959:95) stated was once a favorite resting place for travelers, exclusively for <i>ali‘i</i> (royalty). Along the coastal trail connecting Honolulu to Wai‘anae, ‘Ī‘ī (1959:95) mentioned two resting places in Hālawa for travelers, Napehā and Kauwamoa. Napehā was a pool and resting place where people went diving. The pool was said to have been named for the chief, Kūali‘i, who stopped and bent over the pool to take a drink (‘Ī‘ī 1959:95). Kauwamoa was also a diving place where people liked to gather, said to be a favorite diving spot of Pe‘ape‘a, son of Kamehamehanui of Maui (‘Ī‘ī 1959:95). 8. The rich resources of Pu‘uloa—the fisheries in the lochs, the shoreline fishponds, the numerous springs, and the irrigated lands along the streams—made ‘Ewa a prize for competing chiefs. ‘Ewa Moku was also a political center and home to many chiefs in its day. Oral accounts of <i>ali‘i</i> recorded by Hawaiian historian Samuel Kamakau date back to at least the twelfth century. <i>Ali‘i</i> associated with Honouliuli and greater ‘Ewa Moku included Kākuhihewa, Keaunui, Lakona, Mā‘ilikūkahi, and Kahahana. 9. Beginning with the time of Western Contact, however, Hawaiian populations were introduced to many virulent western diseases which began to decimate the native populations. Thus, four years following the 1832 census, the ‘Ewa population had dropped to 3,423 (Schmitt 1973:9, 36), “a decrease of 592 in 4 years” (Ewa Station Reports 1836). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages. 10. As the demand for <i>kalo</i> (taro) declined and importation of Chinese laborers to the west coast of California and Hawai‘i increased, a market for rice developed. <i>Lo‘i</i> (irrigated taro patches) lands were ideal for growing rice, and as these lands lay in disuse and became more available, the Chinese farmers quickly purchased these lots. By the mid-1860s, much of the <i>lo‘i</i> on O‘ahu had been transformed into rice fields.
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	<ol style="list-style-type: none"> 11. With the increasing foreign interests on O‘ahu Island during the last half of the nineteenth century, an array of agricultural enterprises were attempted. In 1871, John Coney rented the lands of Honouliuli to James Dowsett and John Meek, who used the land for cattle grazing. In 1877, James Campbell purchased most of Honouliuli Ahupua‘a for a total of \$95,000. 12. By 1889, the Ewa Plantation Company was established and lands throughout Honouliuli were designated for sugarcane cultivation. Sugar production exploded with the successful drilling of an artesian well by James Campbell on the ‘Ewa Plain. Campbell’s first well was named Waianiani (“crystal waters”) by the <i>kama‘āina</i> (native born) of Honouliuli (Nellist 1925). By 1930, Ewa Plantation had drilled 70 artesian wells to irrigate cane lands; artesian wells provided fresh water to Honouliuli for nearly 60 years (Ho‘okuleana 2014). 13. In 1897, B.F. Dillingham established the Oahu Sugar Company on 12,000 acres leased from the estates of John Papa ‘Ī‘Ī, Bishop, and Robinson. The Oahu Sugar Company had over 900 field workers, composed of 44 Hawaiians, 473 Japanese, 399 Chinese, and 57 Portuguese. The first sugar crop was harvested in 1899, ushering in the sugar plantation era in Waipahu (Ohira 1997). 14. The eastern section of ‘Ewa was largely developed by the Honolulu Plantation Company. Commercial sugarcane cultivation began in Waimalu and Hālawā in the 1850s, on the estate of Mr. J.R. Williams (Condé and Best 1973:327). The plantation was first known as the Honolulu Sugar Company. 15. The early twentieth century saw the lands of Honouliuli heavily utilized by both civilians and the U.S. military for transportation. The U.S. Government began acquiring the coastal lands of ‘Ewa for development of a naval base at Pearl Harbor. In 1901, the U.S. Congress formally ratified annexation of the Territory of Hawaii, and the first 1,356.01 acres of Pearl Harbor land were transferred to U.S. ownership. 16. In 1909, the government appropriated the entire Waipi‘o peninsula from the ‘Ī‘Ī Estate for the Pearl Harbor Naval Station and Shipyard. Additional dredging to deepen and widen the channel was conducted in the 1920s.
<p>Results of Community Consultation</p>	<p>CSH attempted to contact 109 Hawaiian organizations, agencies, and community members. Consultation for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement Project is ongoing.</p>
<p>Impacts and Recommendations</p>	<p>Impacts and recommendations for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement Project are pending the results of the community consultation process.</p>

	<ol style="list-style-type: none">1. Project construction workers and all other personnel involved in the construction and related activities of the project should be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities will cease and the State Historic Preservation Division (SHPD) will be notified pursuant to HAR §13-280-3. In the event that <i>iwi kūpuna</i> (Native Hawaiian skeletal remains) are identified, all earth moving activities in the area will stop, the area will be cordoned off, and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended.2. In the event that <i>iwi kūpuna</i> and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance.
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Section 1 Introduction

1.1 Project Background

At the request of AECOM, and on behalf of the City and County of Honolulu (CCH) Department of Environmental Services (ENV), Cultural Surveys Hawai‘i, Inc. (CSH) has prepared this cultural impact assessment (CIA) for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement Project, Honouliuli, Waikele, Waipi‘o, Waiawa, Mānana, Waimano, Waiiau, Waimalu, Kalauao, ‘Aiea, and Hālawā Ahupua‘a, ‘Ewa District, O‘ahu, TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats. This CIA study is being conducted to inform the Environmental Impact Statement (EIS) being prepared by the ENV to evaluate the potential impacts from the proposed improvements and upgrades to cultural beliefs, practices, and resources.

The main corridor of the study area stretches roughly 19.3 km (12 miles) from ‘Ewa, extending from the southwest shore of the West Loch of Pearl Harbor northeast across West Loch to the west side of Waipi‘o Peninsula, north up the west side of Waipi‘o Peninsula, to where it follows the Pearl Harbor Bike Path east along the inland extent of the Waipi‘o Peninsula and the Pearl City Peninsula until intersecting with Kamehameha Highway in Waiiau Ahupua‘a. From there the study area corridor follows the highway alignment to the Aloha Stadium where the study area diverges along Salt Lake Boulevard until its eastern termination point at Kahuapaani Street in Hālawā Ahupua‘a.

The study area also has a secondary *mauka* (toward the mountains) northwest/southeast trending corridor following the Kamehameha Highway alignment from the H-2 Freeway on-ramp in Waiawa Ahupua‘a to Waimano Home Road in Mānana Ahupua‘a, and three intermediary corridors aligned northeast to southwest between the main and secondary corridor (only the easternmost follows a road alignment [Lehua Avenue]). An additional offshoot from the western extent of the secondary *mauka* Kamehameha Highway corridor follows Waihona Street up Waiawa Gulch in Waiawa Ahupua‘a for approximately 1,000 m.

The study area also includes the Waipahu Wastewater Pumping Station (WWPS) and two adjacent alternative locations, the Pearl City WWPS and an adjacent alternative location, the Waimalu WWPS and an adjacent alternative location, and the Halawa WWPS and an adjacent alternative location.

A general corridor width of 400 feet (ft) was used to define the CIA study area. The study area is depicted on a portion of the 1998 Waipahu and 1999 Pearl Harbor U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1 through Figure 4), tax map key section maps (Figure 5 through Figure 11), and 2016 ESRI Aerial Imagery/2017 Hawaii Orthos aerial photographs (Figure 12 through Figure 15).

The project’s proposed action aims to rehabilitate, upgrade, and/or expand the existing Honouliuli major sewer conveyance system (East Inceptor System) to accommodate flows through 2050 (Figure 16). The affected area includes areas with current wastewater flows to the Honouliuli Wastewater Treatment Plant (WWTP) as well as potential future flows from areas including but not limited to Hālawā, ‘Aiea, Pearl City, Waipi‘o, Waikele, Waipahu, ‘Ewa, Kapolei, and Mililani. The proposed action includes portions of coastal Honouliuli, Waikele, Waipi‘o, Waiawa, Mānana, Waimano, Waiiau, Waimalu, Kalauao, ‘Aiea, and Hālawā Ahupua‘a.

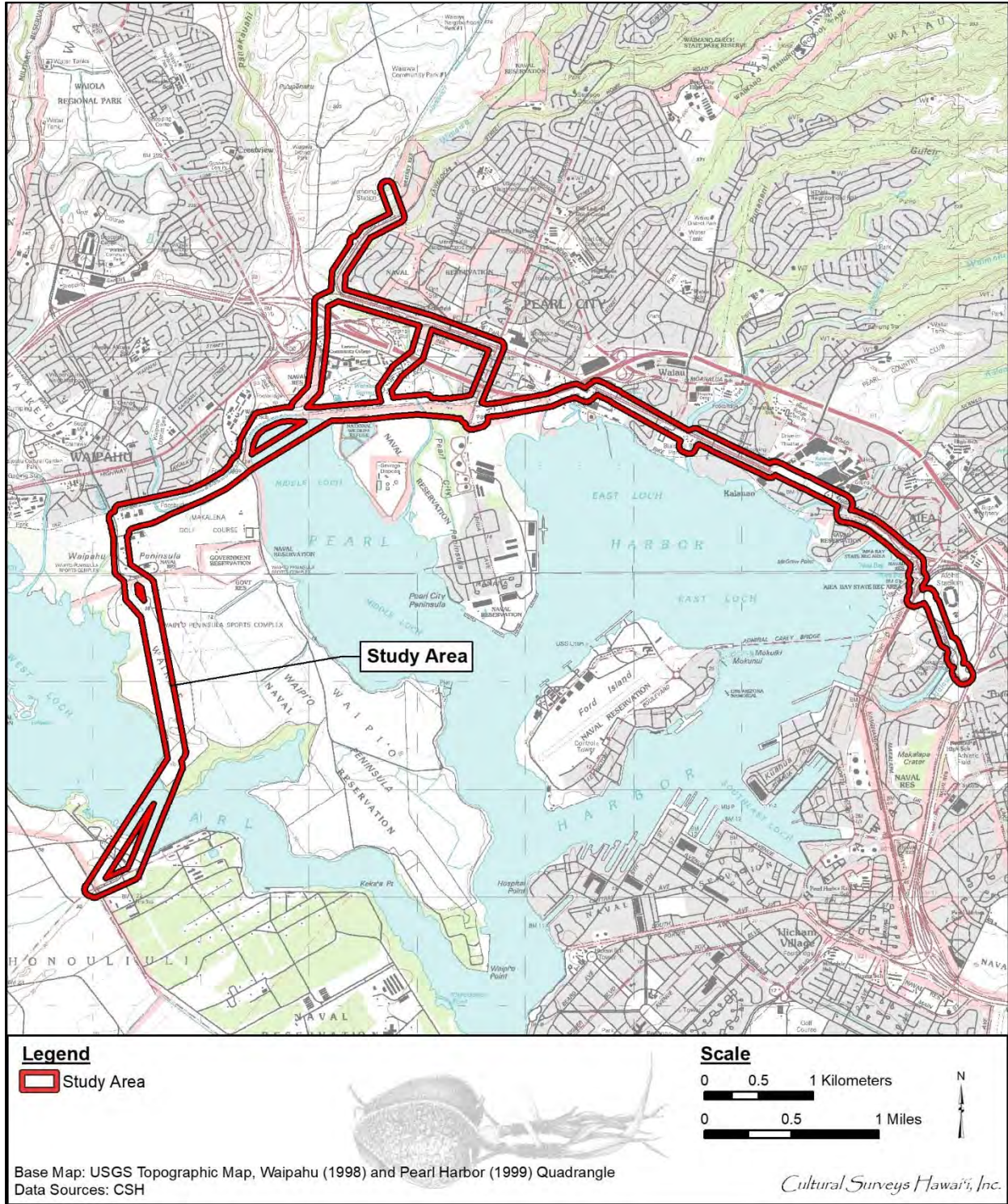


Figure 1. Portion of the 1998 Waipahu and 1999 Pearl Harbor USGS topographic quadrangles showing location of the study area

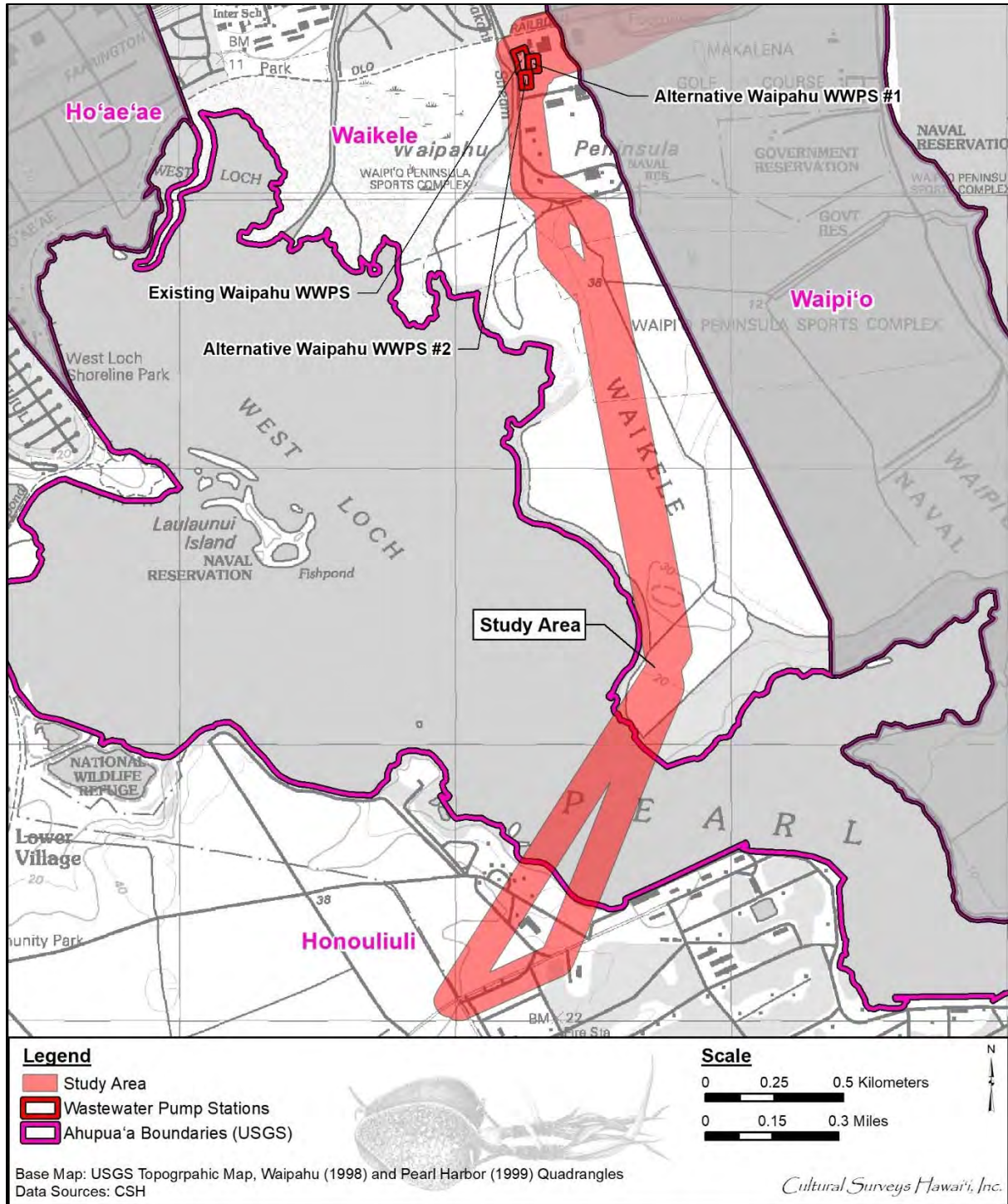


Figure 2. Portion of the 1998 Waipahu and 1999 Pearl Harbor USGS topographic quadrangles showing the location of the western portion of study area from Honouliuli to Waikele Ahupua'a

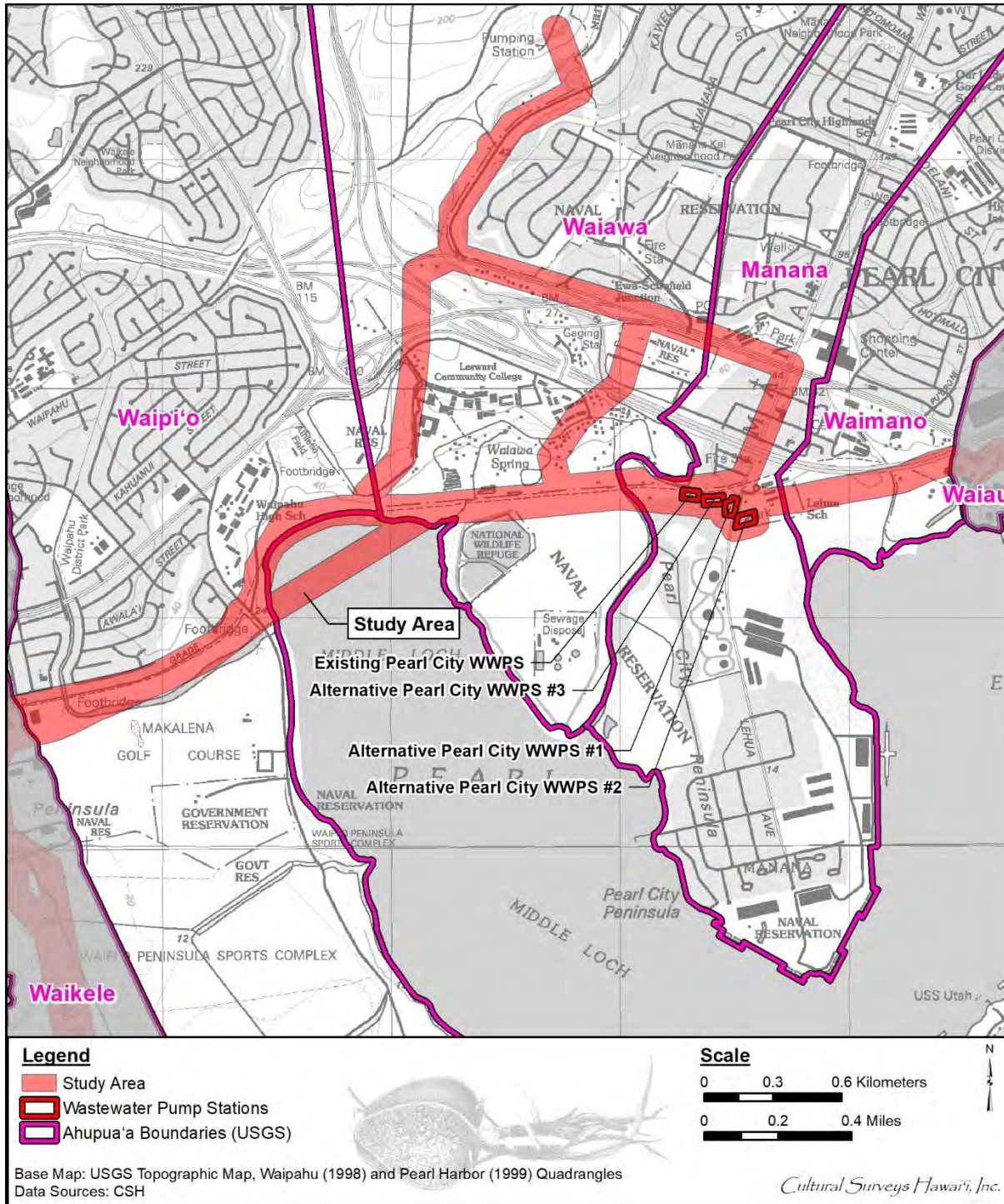


Figure 3. Portion of the 1998 Waipahu and 1999 Pearl Harbor USGS topographic quadrangles showing the location of the center portion of study area from Waipi'o to Waimano Ahupua'a

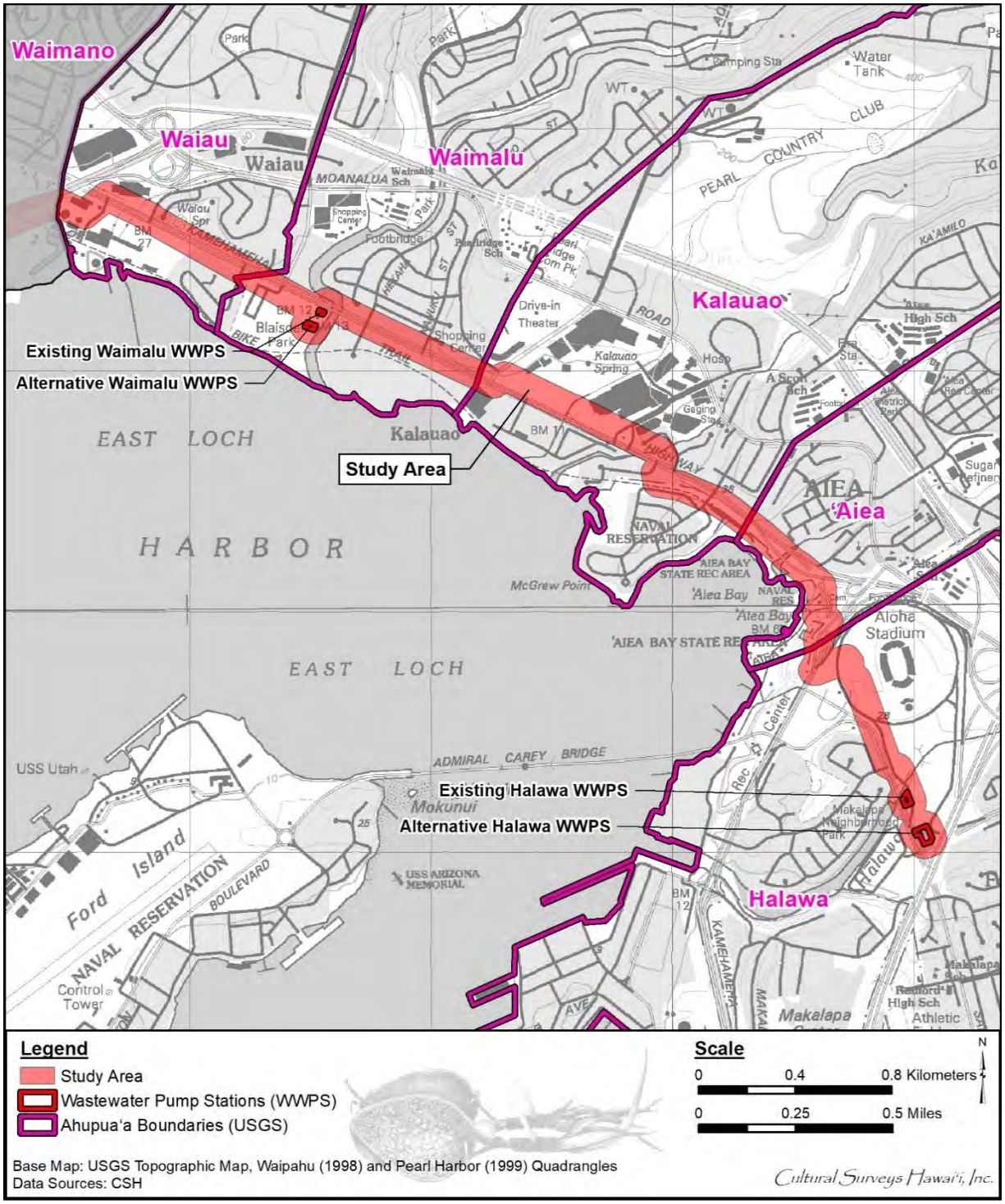


Figure 4. Portion of the 1998 Waipahu and 1999 Pearl Harbor USGS topographic quadrangles showing the location of the eastern portion of study area from Waiau to Hālawā Ahupua'a

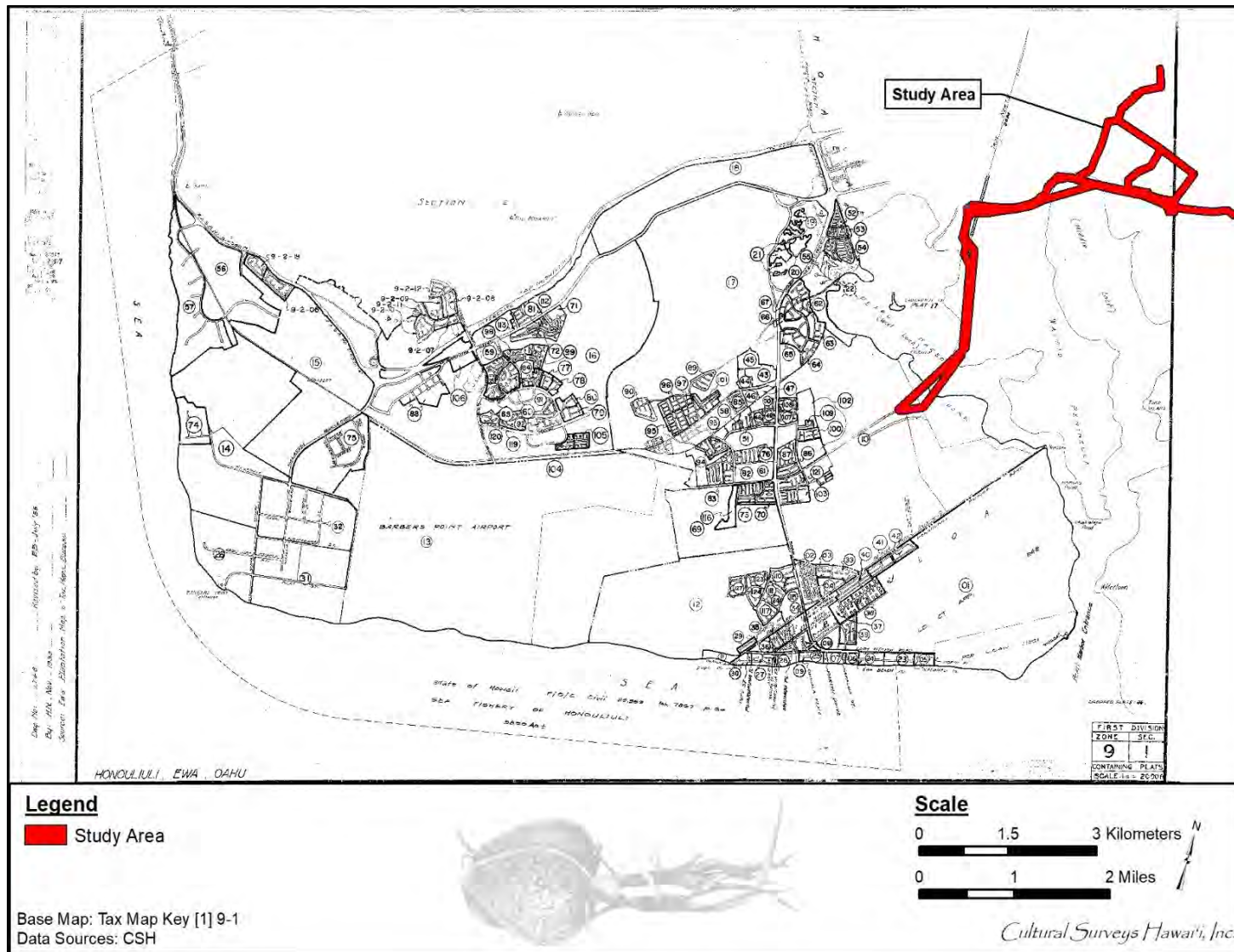


Figure 5. Tax Map Key (TMK) [1] 9-1 section map showing the western portion of the study area (Hawai'i TMK Service 2014)

CIA for the Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, 'Ewa, O'ahu

TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats

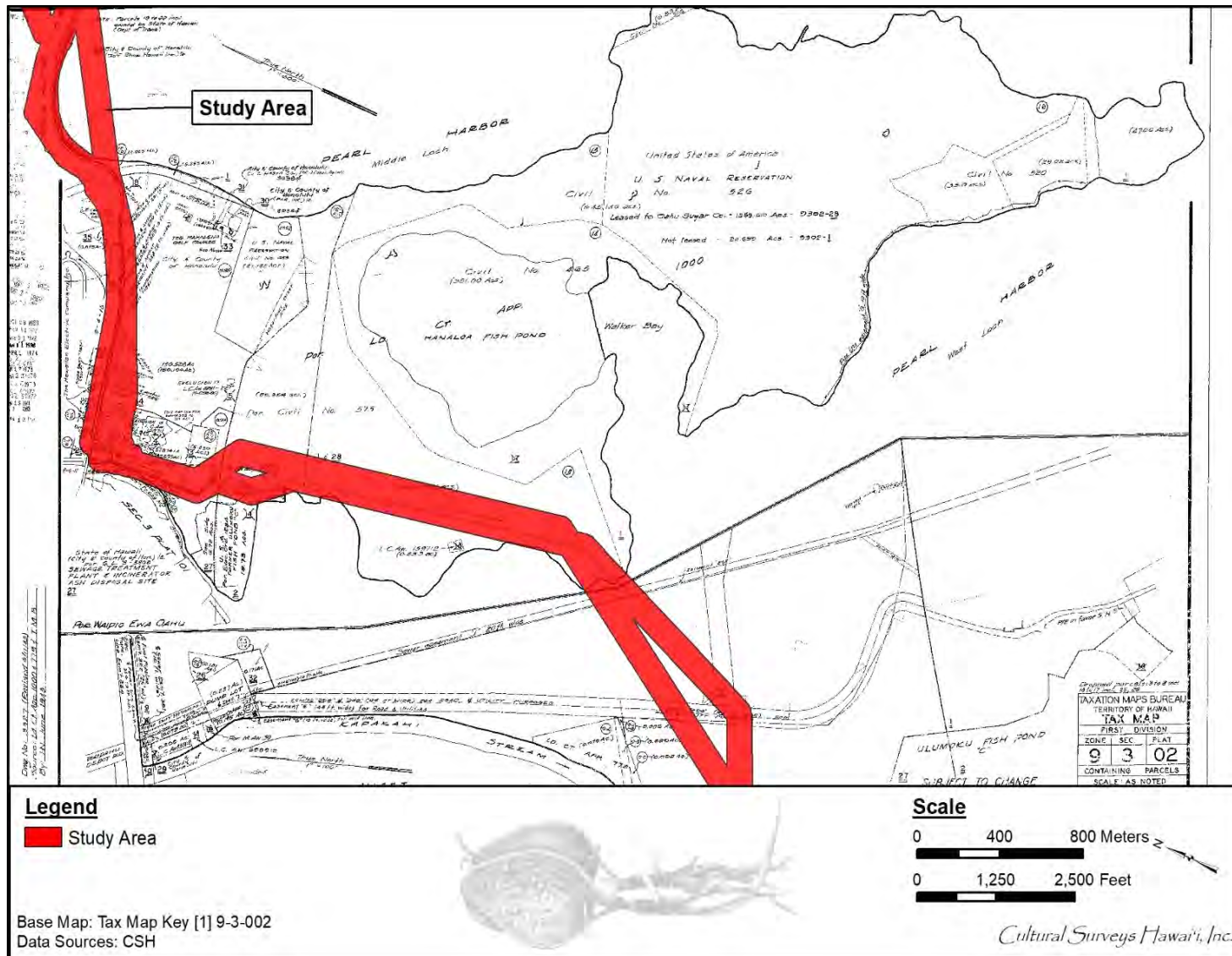


Figure 6. TMK: [1] 9-3-002 map showing the western portion of the study area (Hawai'i TMK Service 2014)

CIA for the Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawala, 'Ewa, O'ahu

TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats

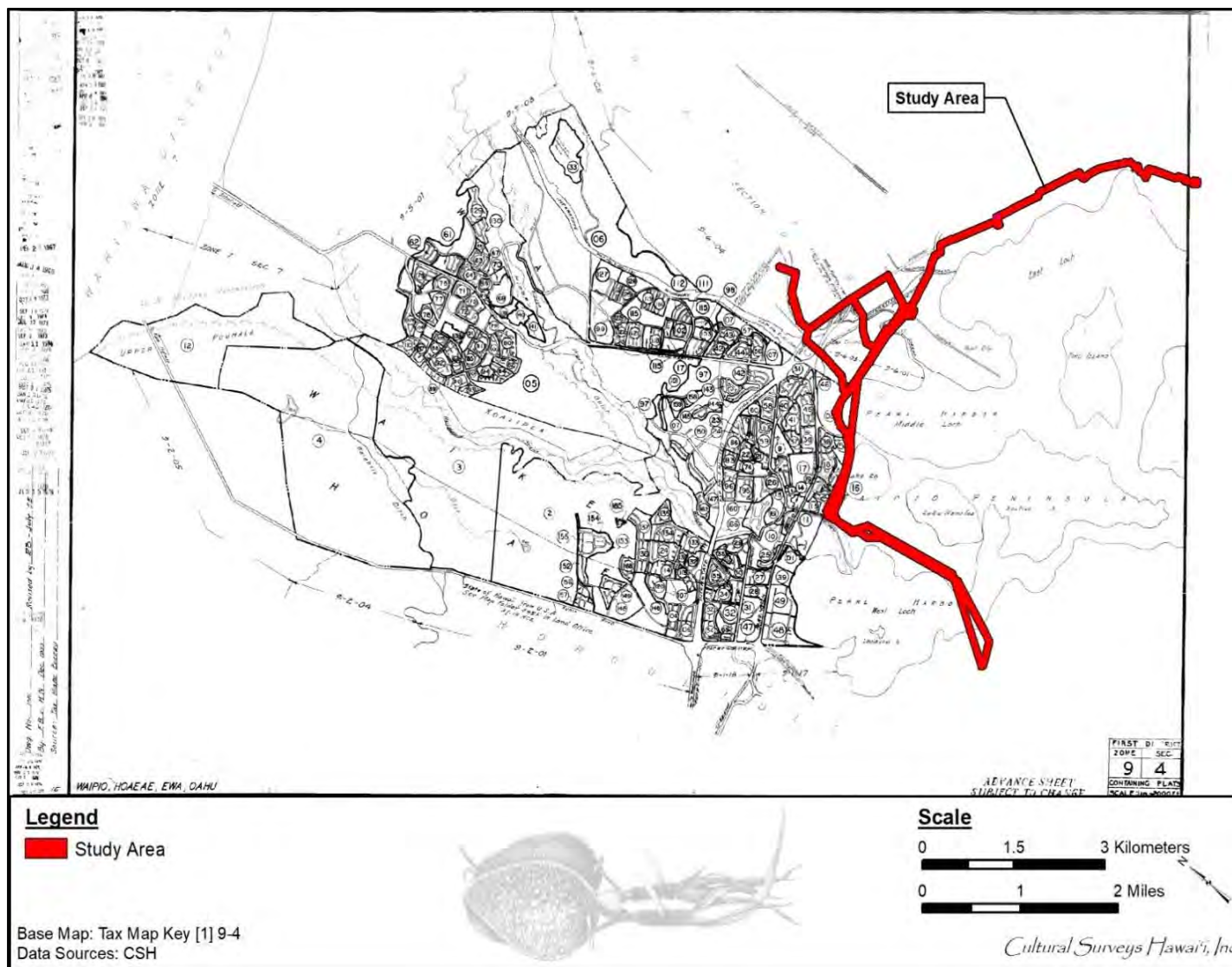


Figure 7. TMK: [1] 9-4 section map showing the western and center portion of the study area (Hawai'i TMK Service 2014)

CIA for the Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, 'Ewa, O'ahu

TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats

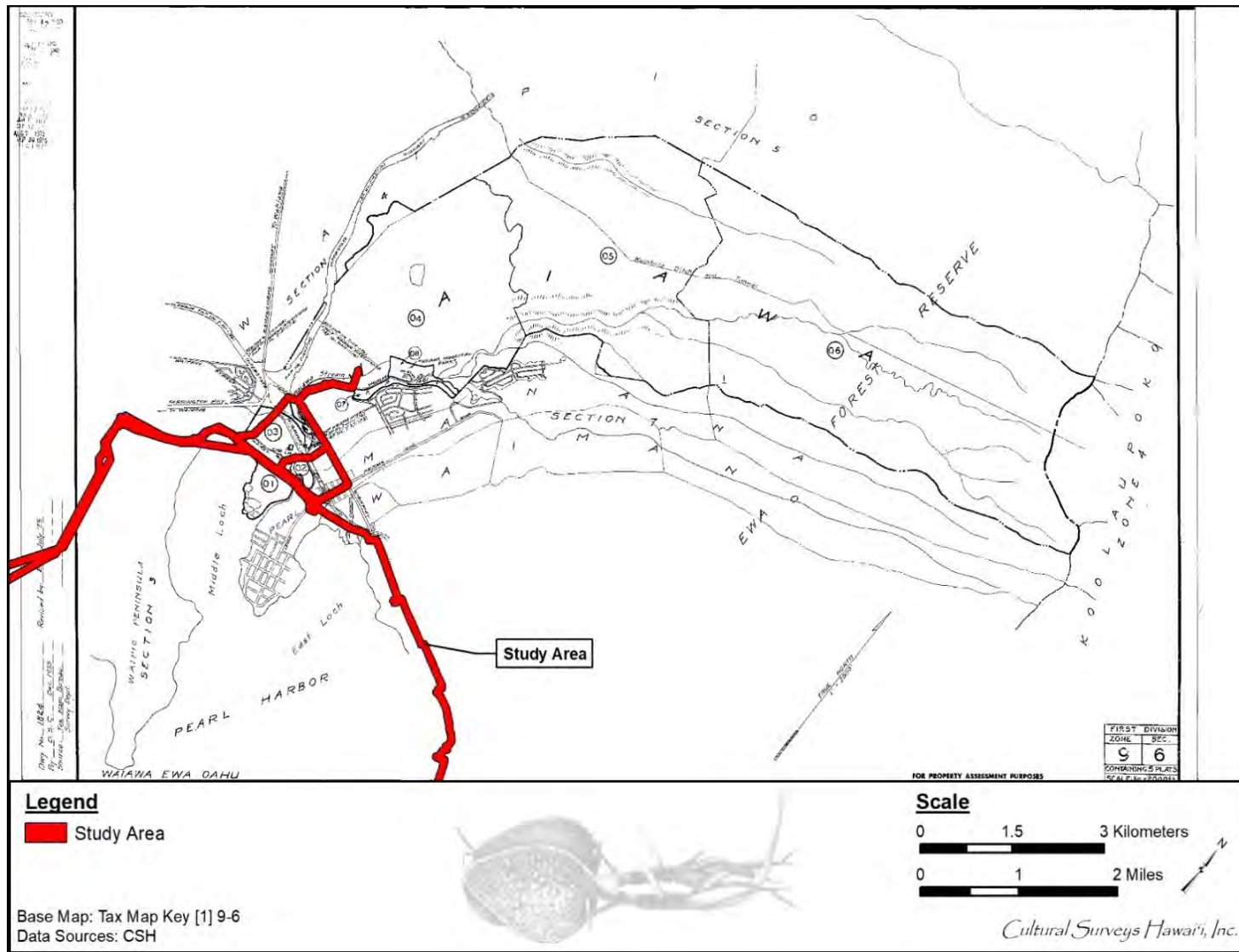


Figure 8. TMK: [1] 9-6 section map showing the central portion of the study area (Hawai'i TMK Service 2014)

CIA for the Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, 'Ewa, O'ahu

TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats

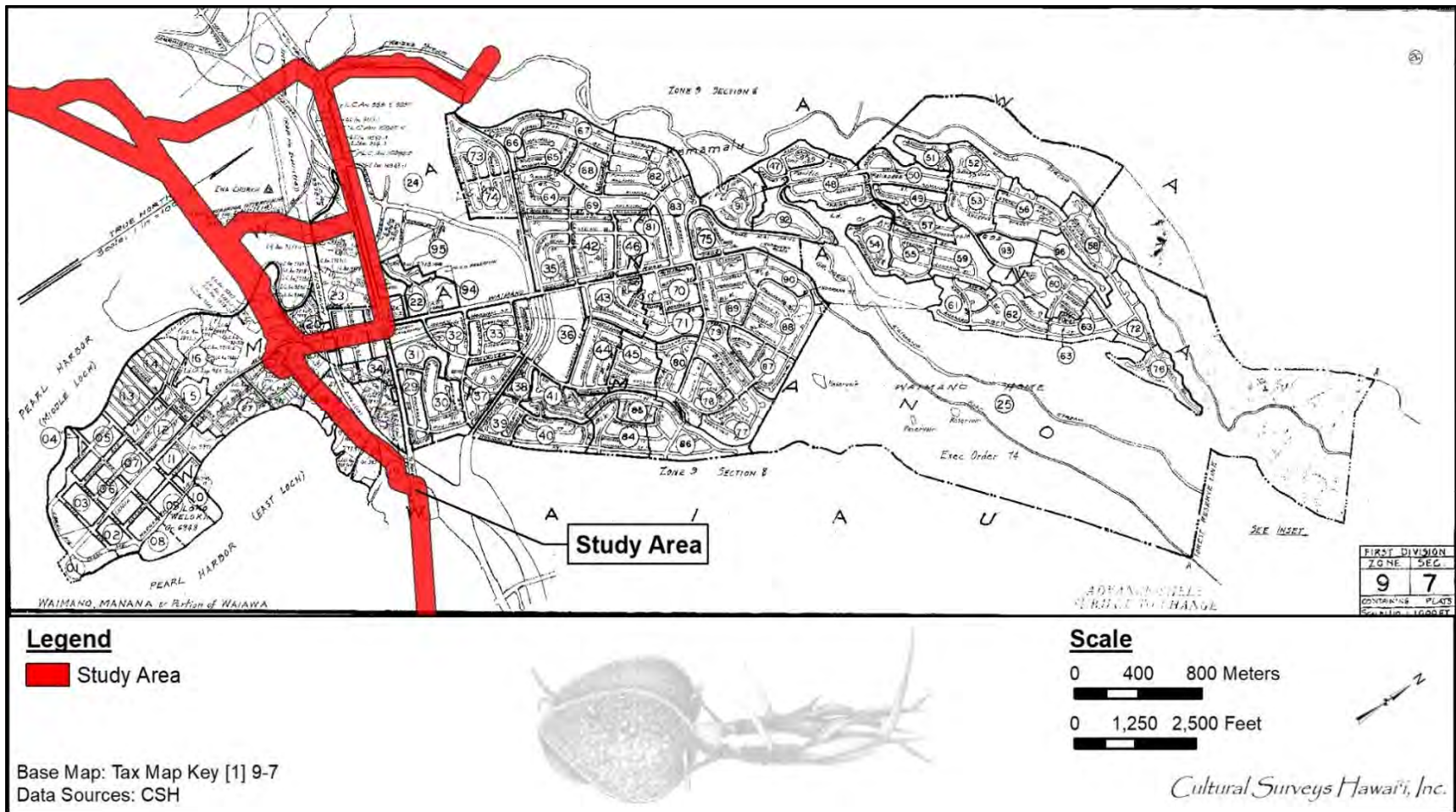


Figure 9. TMK: [1] 9-7 section map showing the central portion of the study area (Hawai'i TMK Service 2014)

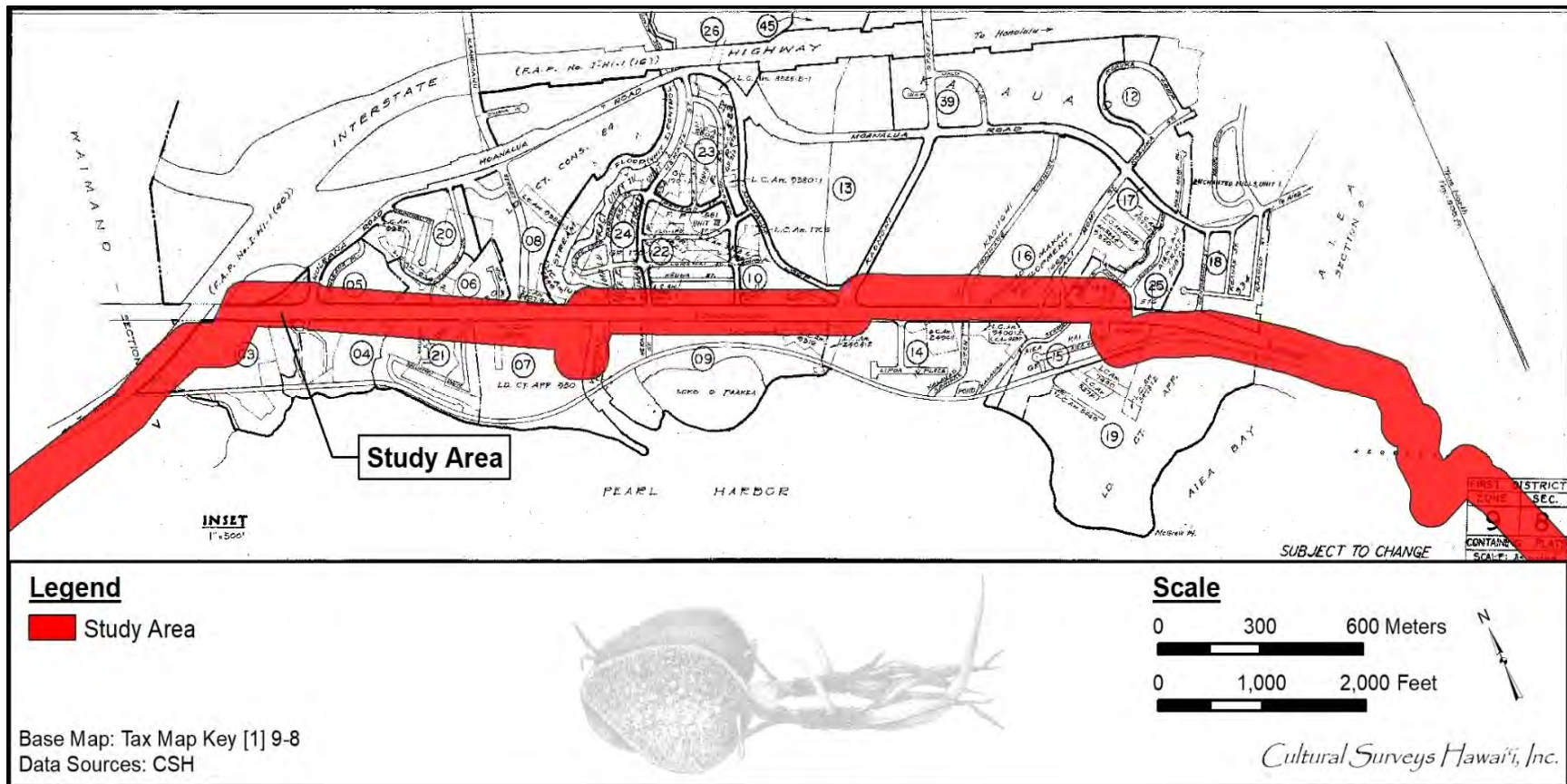


Figure 10. TMK: [1] 9-8 section map showing the eastern portion of the study area (Hawai'i TMK Service 2014)

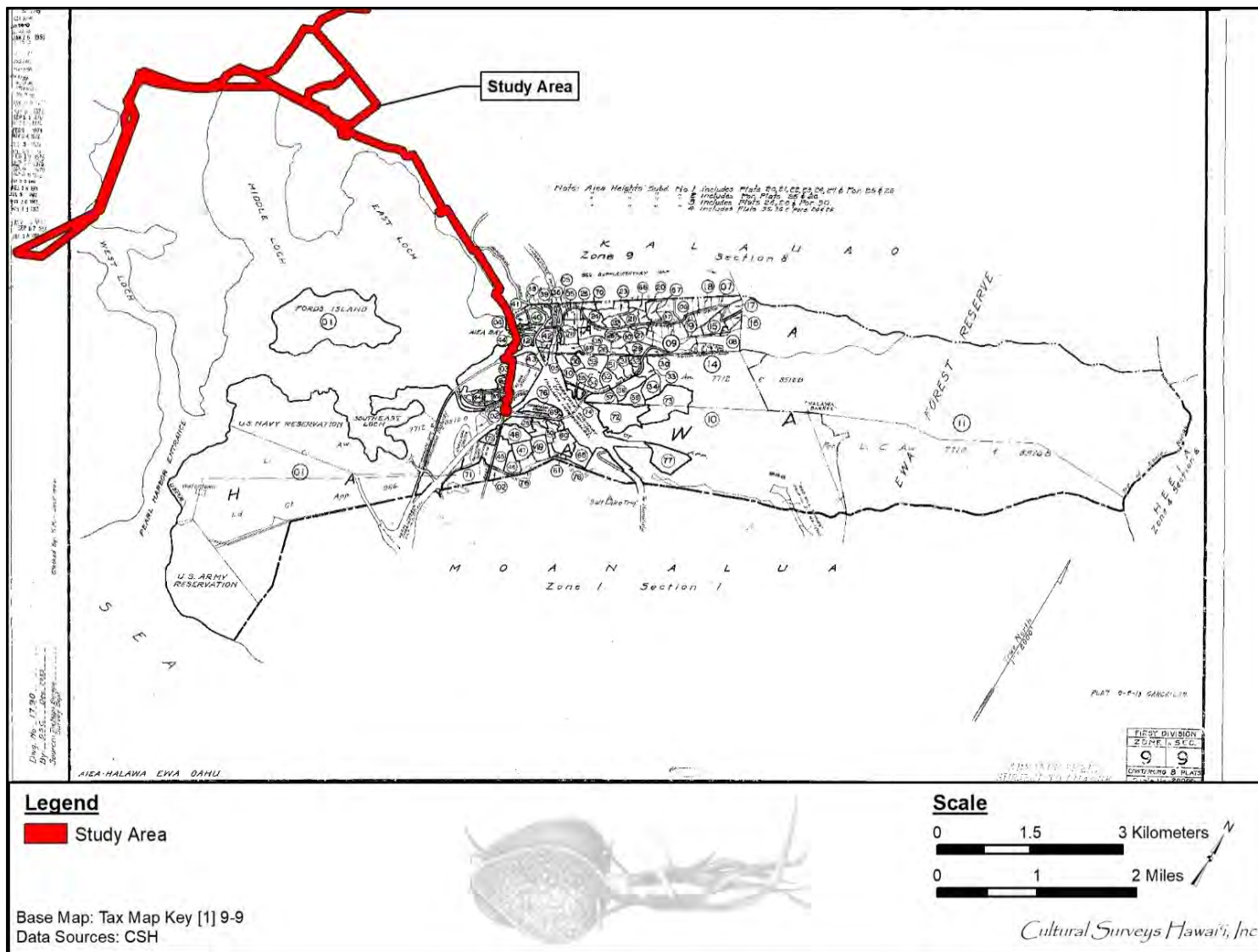


Figure 11. TMK: [1] 9-9 section map showing the eastern portion of the study area (Hawai'i TMK Service 2014)

CIA for the Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, 'Ewa, O'ahu

TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats

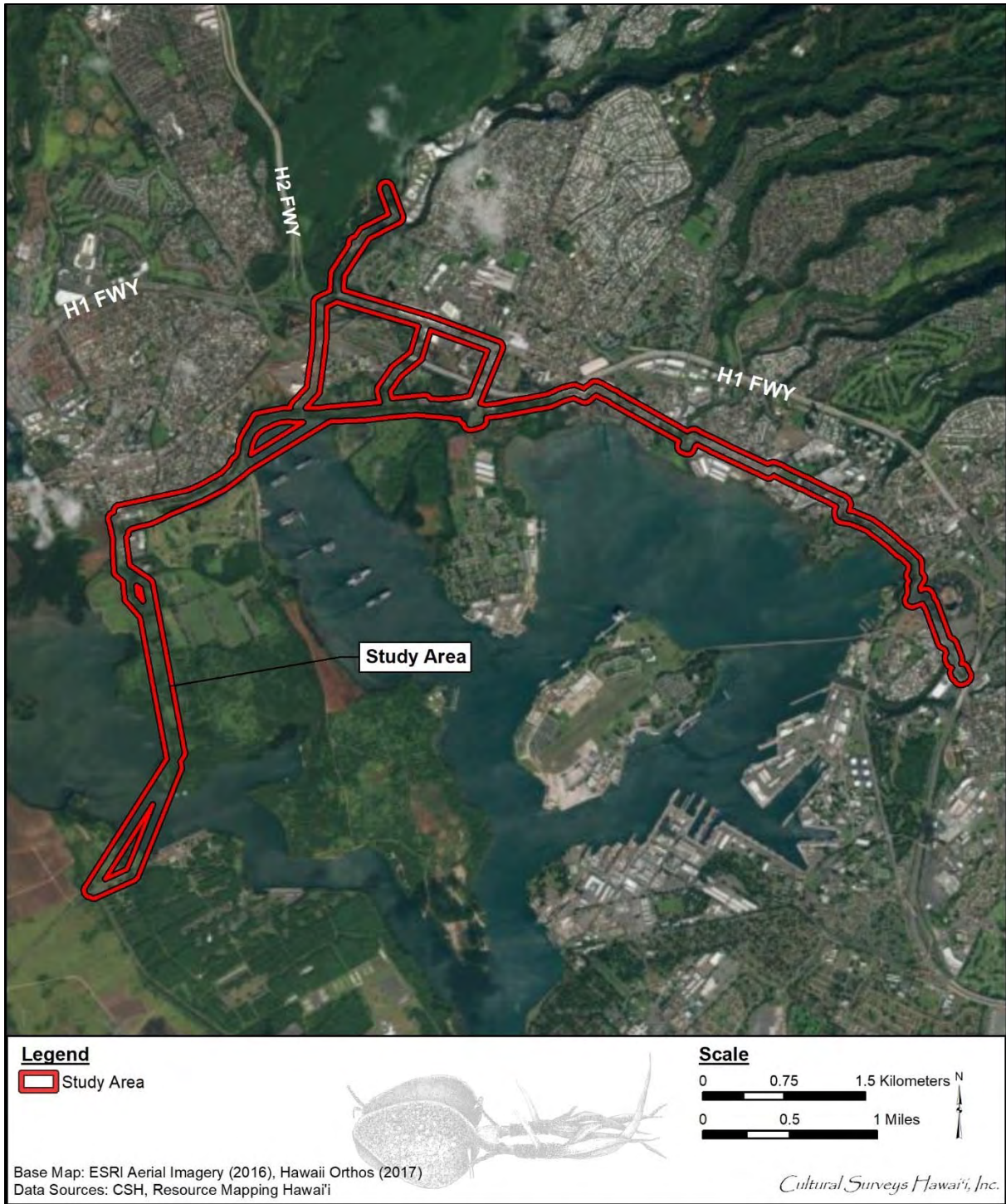


Figure 12. 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photograph showing location of the study area

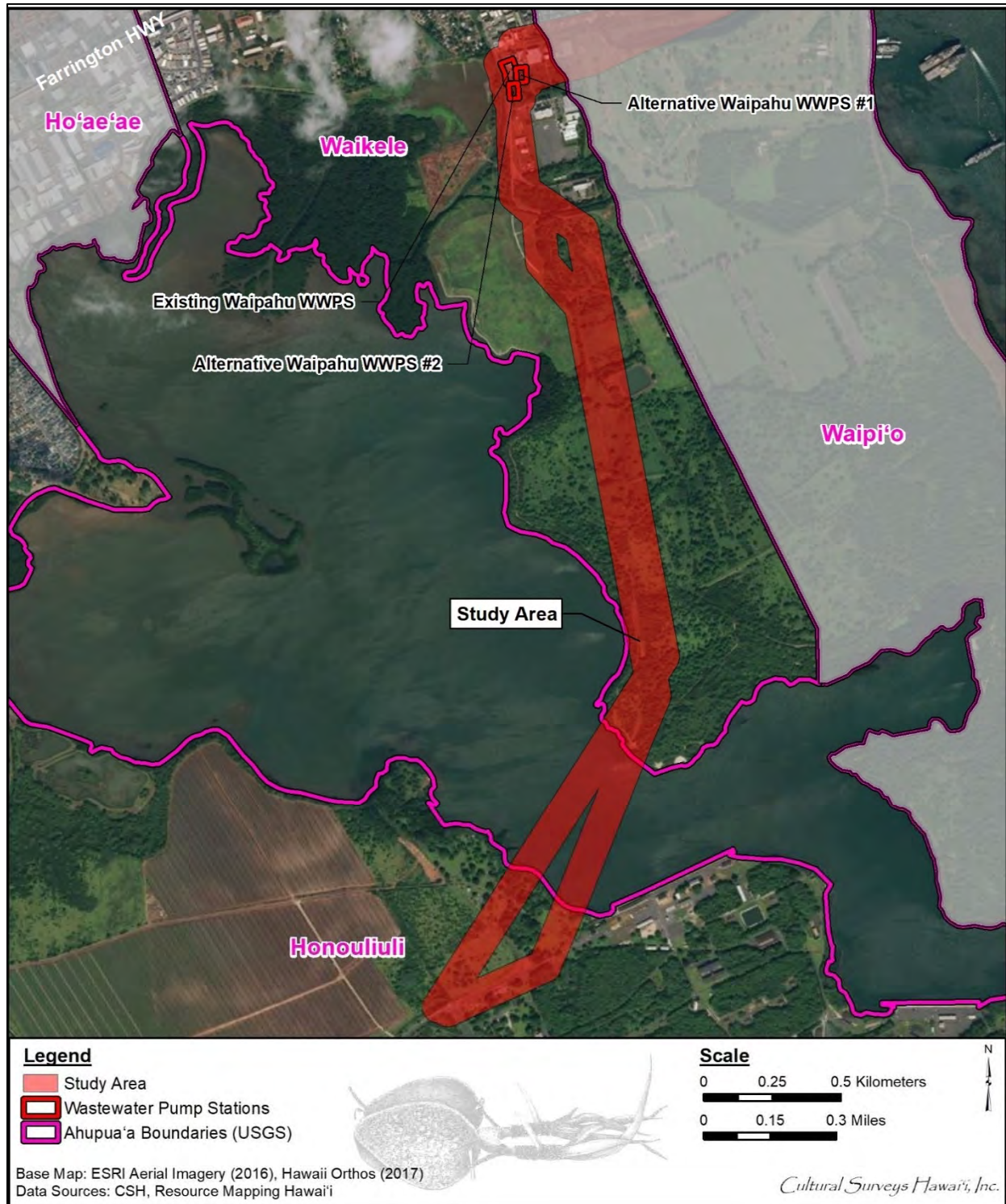


Figure 13. 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photograph showing the location of the western portion of the study area



Figure 14. 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photograph showing the location of the central portion of the study area

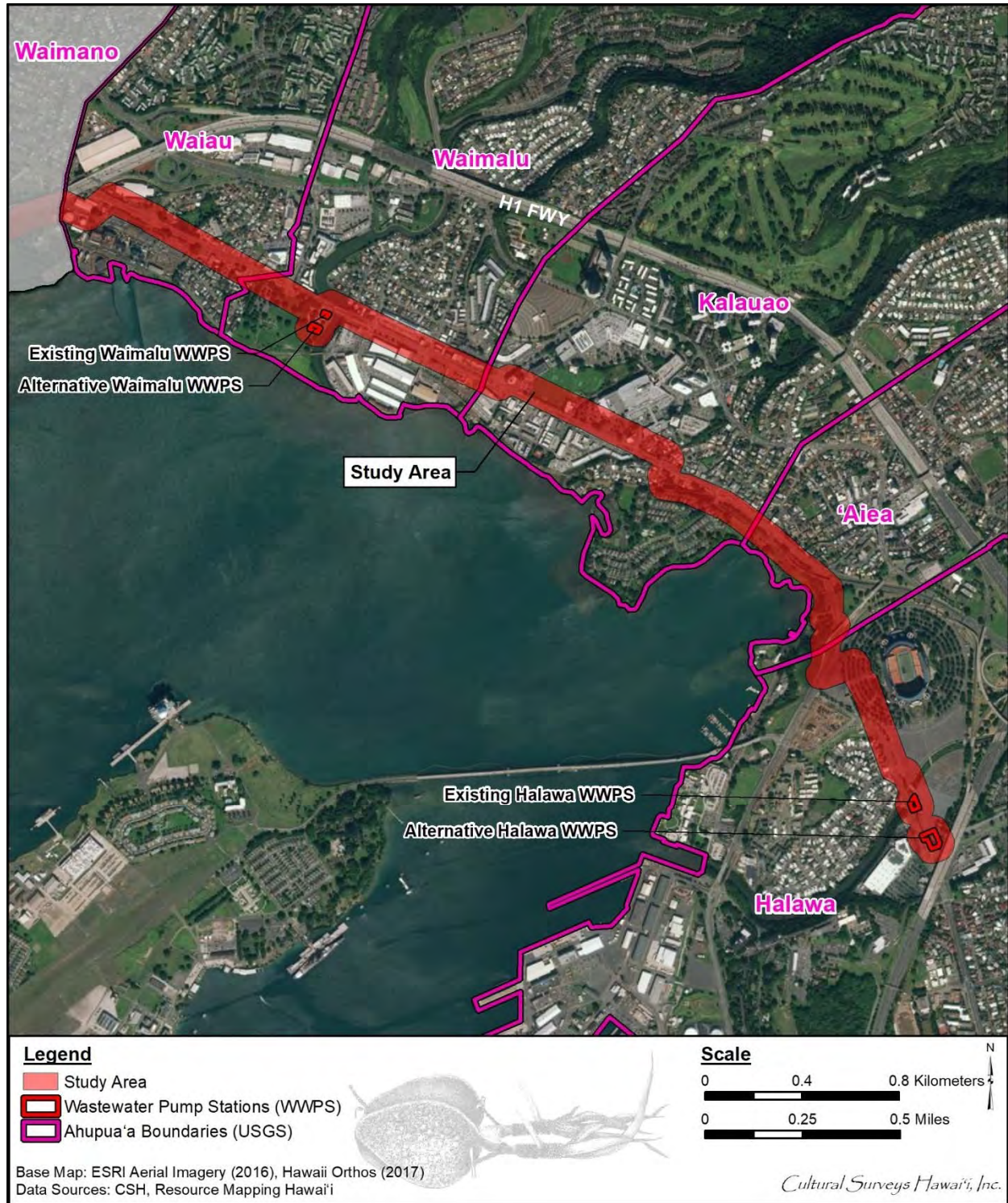


Figure 15. 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photograph showing the location of the eastern portion of the study area

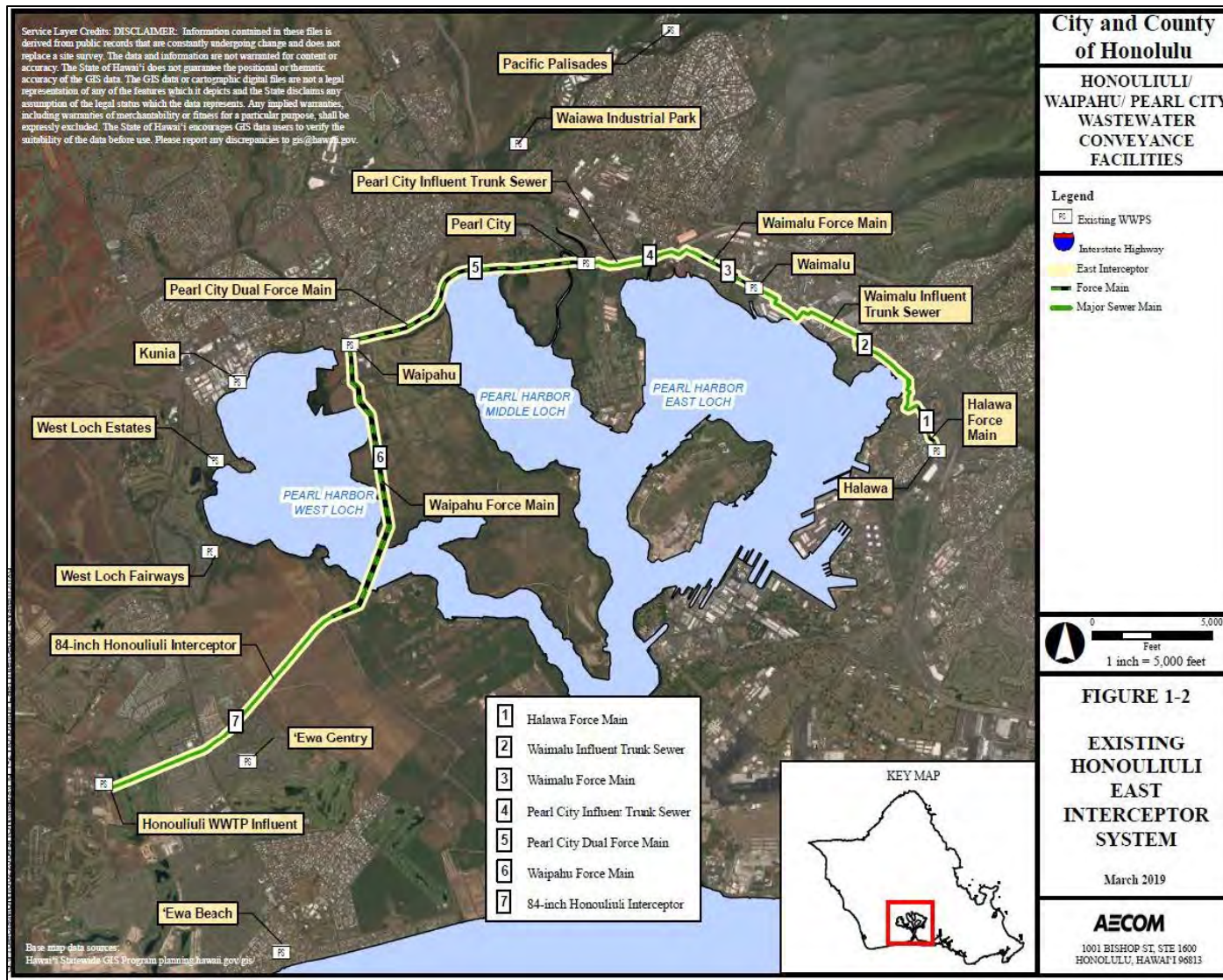


Figure 16. Figure showing the existing Honouliuli East Inceptor System (courtesy of client)

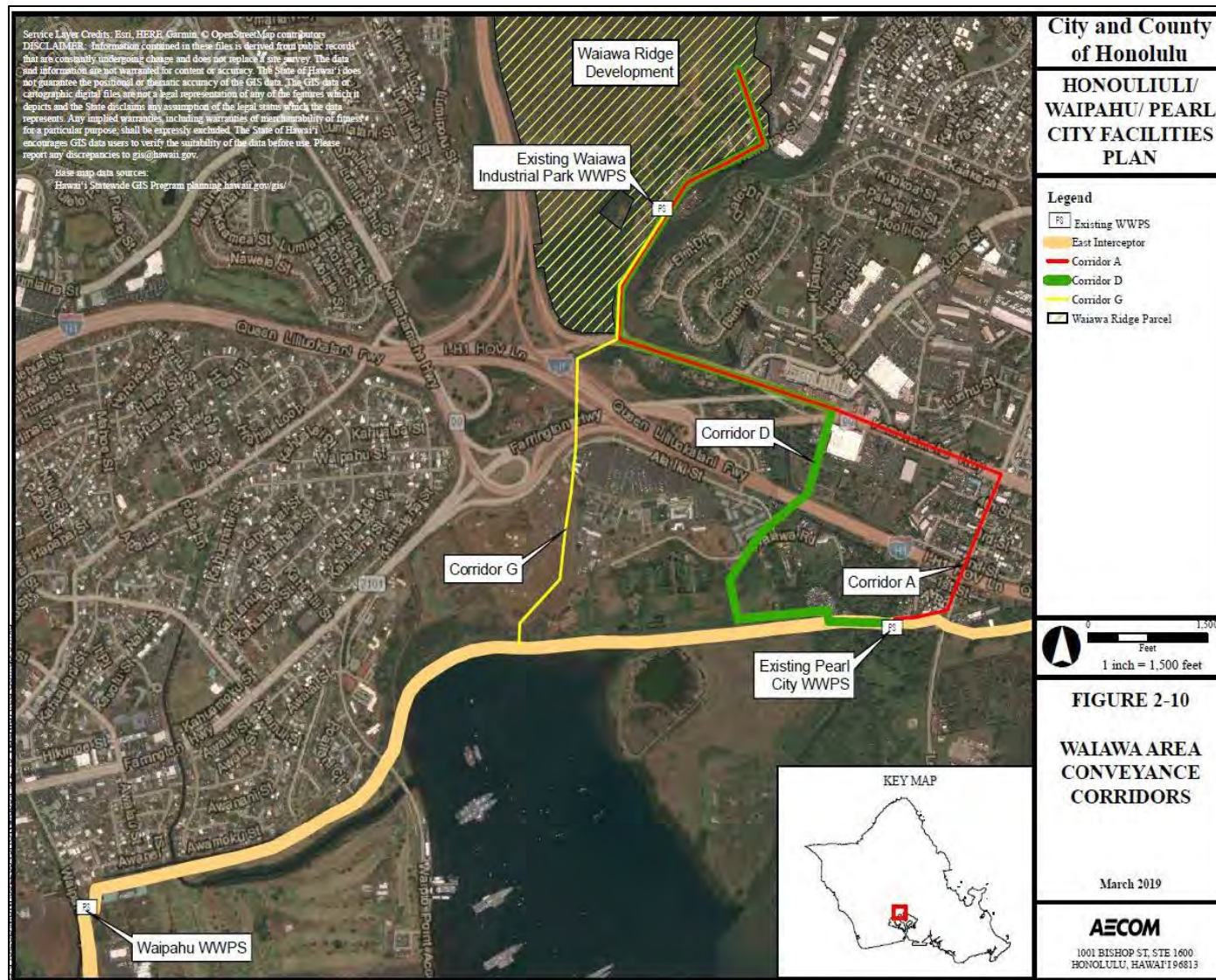


Figure 17. Figure showing the Waiawa Area Conveyance Corridors (courtesy of client)

CIA for the Honouliuli Waipahu Pearl City Wastewater Collection Project, Honouliuli to Hālawā, 'Ewa, O'ahu

TMKs: [1] 9-1, 3, 4, and 6-9; multiple plats

1.2 Document Purpose

The purpose of this CIA is to comply with the State of Hawai'i's environmental review process under Hawai'i Revised Statutes (HRS) §343, which requires consideration of the project's potential effect on cultural beliefs, practices, and resources. Through document research and cultural consultation efforts, this report provides information compiled to date pertinent to the assessment of the proposed project's potential impacts on cultural beliefs, practices, and resources (pursuant to the Office of Environmental Quality Control's *Guidelines for Assessing Cultural Impacts*), which may include traditional cultural properties (TCPs). These TCPs may be significant historic properties under State of Hawai'i significance Criterion e, pursuant to Hawai'i Administrative Rules (HAR) §13-275-6 and §13-284-6. Significance Criterion e refers to historic properties that "have an important value to the native Hawaiian people or to another ethnic group of the state due to associations with cultural practices once carried out, or still carried out, at the property or due to associations with traditional beliefs, events or oral accounts—these associations being important to the group's history and cultural identity" (HAR §13-275-6 and §13-284-6). The document will likely also support the project's historic preservation review under HRS §6E and HAR §13-275 and §13-284.

1.3 Scope of Work

The scope of work for this cultural impact assessment includes the following:

1. Examination of cultural and historical resources, including Land Commission documents, historic maps, and previous research reports, with the specific purpose of identifying traditional Hawaiian activities including gathering of plant, animal, and other resources or agricultural pursuits as may be indicated in the historic record.
2. Review of previous archaeological work at and near the subject parcel that may be relevant to reconstructions of traditional land use activities; and to the identification and description of cultural resources, practices, and beliefs associated with the parcel.
3. Consultation and interviews with knowledgeable parties regarding cultural and natural resources and practices at or near the parcel; present and past uses of the parcel; and/or other practices, uses, or traditions associated with the parcel and environs.
4. Preparation of a report that summarizes the results of these research activities and provides recommendations based on findings.

1.4 Environmental Setting

The environmental setting draws from previous environmental and historical surveys conducted throughout the Hawaiian archipelago (Foote et al. 1972; Giambelluca 1986; Nakuina 1992) as well as cultural sources and may be thought of as being divided into two sections. The natural environment begins with a discussion of geologic history and the 1972 soil surveys conducted by the Foote et al. research team, and then shifts to a description of prevailing winds, precipitation, streams, and coastal/marine environment found within and in proximity to the study area. Throughout these subsections, an effort is made to ground scientific knowledge within traditional cultural frameworks or knowledge systems. That is, understandings of the 'Ewa environment have also been informed by various traditional sources, including *mo'olelo* (stories), *mele* (songs), or

oli (chant). As pointed out by anthropologist Laura Nader and reiterated by Dr. Kathleen Kawelu, “science is not free of culture; rather, it is full of it” (Kawelu 2015:6; Nader 1996: xiii). The second setting section concludes with a description of the built environment, emphasizing a transitional change into modernity.

1.4.1 *Ka Lepo* (Soils)

According to the U.S. Department of Agriculture (USDA) Soil Survey Geographic (SSURGO) database (2001) and soil survey data gathered by Foote et al. (1972), soils within the study area, shown on Figure 18 through Figure 20 and listed in Table 1, consist of Ewa silty clay loam, moderately shallow (EmA), Hanalei silty clay, 2 to 6% slopes (HnB), Honouliuli clay, 0 to 2% slopes (HxA), Kawaihapai clay loam, 0 to 2% slopes (K1A), Kawaihapai clay loam, 6 to 15% slopes (K1C), Keaau clay, saline, 0 to 12% slopes (KmbA), Makalapa clay, 2 to 6% slopes (MdB), Malama stony silty clay loam, 0 to 12% slopes (MnC), Molokai silty clay loam, 7 to 15% slopes (MuC), Pearl Harbor clay (Ph), Tropaquepts (TR), Waialua stony silty clay, 3 to 8% slopes (WiB), and Waipahu silty clay, 6 to 12% slopes (WzA). Additional symbols on the soils map are Coral outcrop (CR), Fill land (Fd), Fill land, mixed (FL), Rock land (rRK), and Water (W).

Ewa series (EmA) are described as follows:

This series consists of well-drained soils in basins and on alluvial fans on the islands of Maui and Oahu. These soils developed in alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevations range from near sea level to 150 feet. The annual rainfall amounts to 10 to 30 inches. . . . Ewa soils are geographically associated with Honouliuli, Mamala, Molokai, Pulehu, and Waiakoa soils. . . . These soils are used for sugarcane, truck crops, and pasture. The natural vegetation consists of fingergrass, kiawe, koa haole, klu, and uhaloa. [Foote et al. 1972:29]

Hanalei series (HnB) are described as follows:

This series consists of somewhat poorly drained to poorly drained soils on bottom lands on the islands of Kauai and Oahu. These soils developed in alluvium derived from basic igneous rock. They are level to gently sloping. Elevations range from nearly sea level to 300 feet. The annual rainfall amounts to 200 to 120 inches. . . . Hanalei soils are geographically associated with Haleiwa, Hihimanu, Mokuleia, and Pearl Harbor soils. . . . These soils are used for taro, pasture, sugarcane, and vegetables. The natural vegetation consists of paragrass, sensitive plant, homohono, Java plum and guava. [Foote et al. 1972:38]

Honouliuli series (HxA) 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. . . . 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]

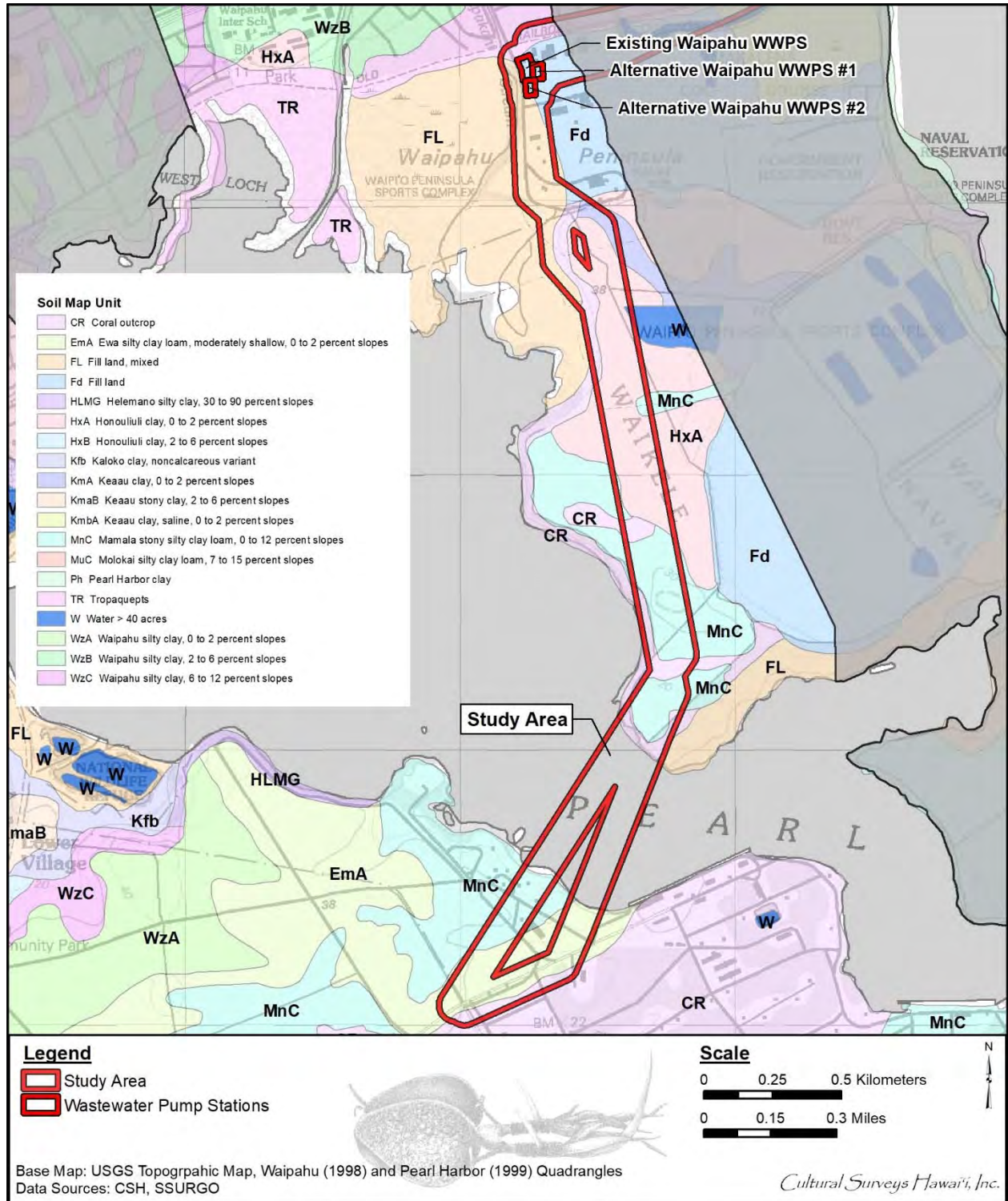


Figure 18. Soils map of western portion of study area, overlain on 1998 Waipahu and 1999 Pearl Harbor USGS 7.5-minute topographic quadrangles

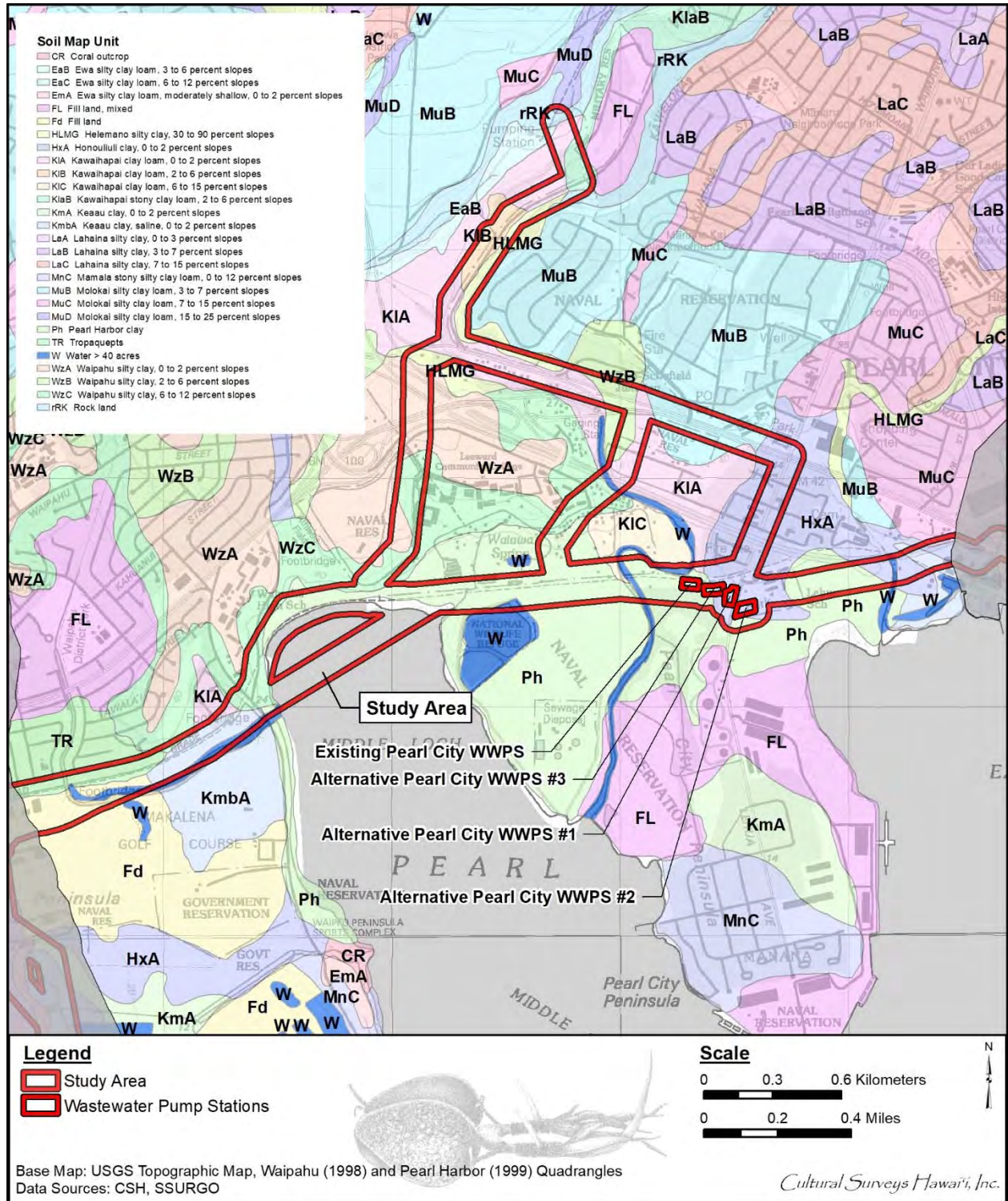


Figure 19. Soils map of central portion of study area, overlain on 1998 Waipahu and 1999 Pearl Harbor USGS 7.5-minute topographic quadrangles

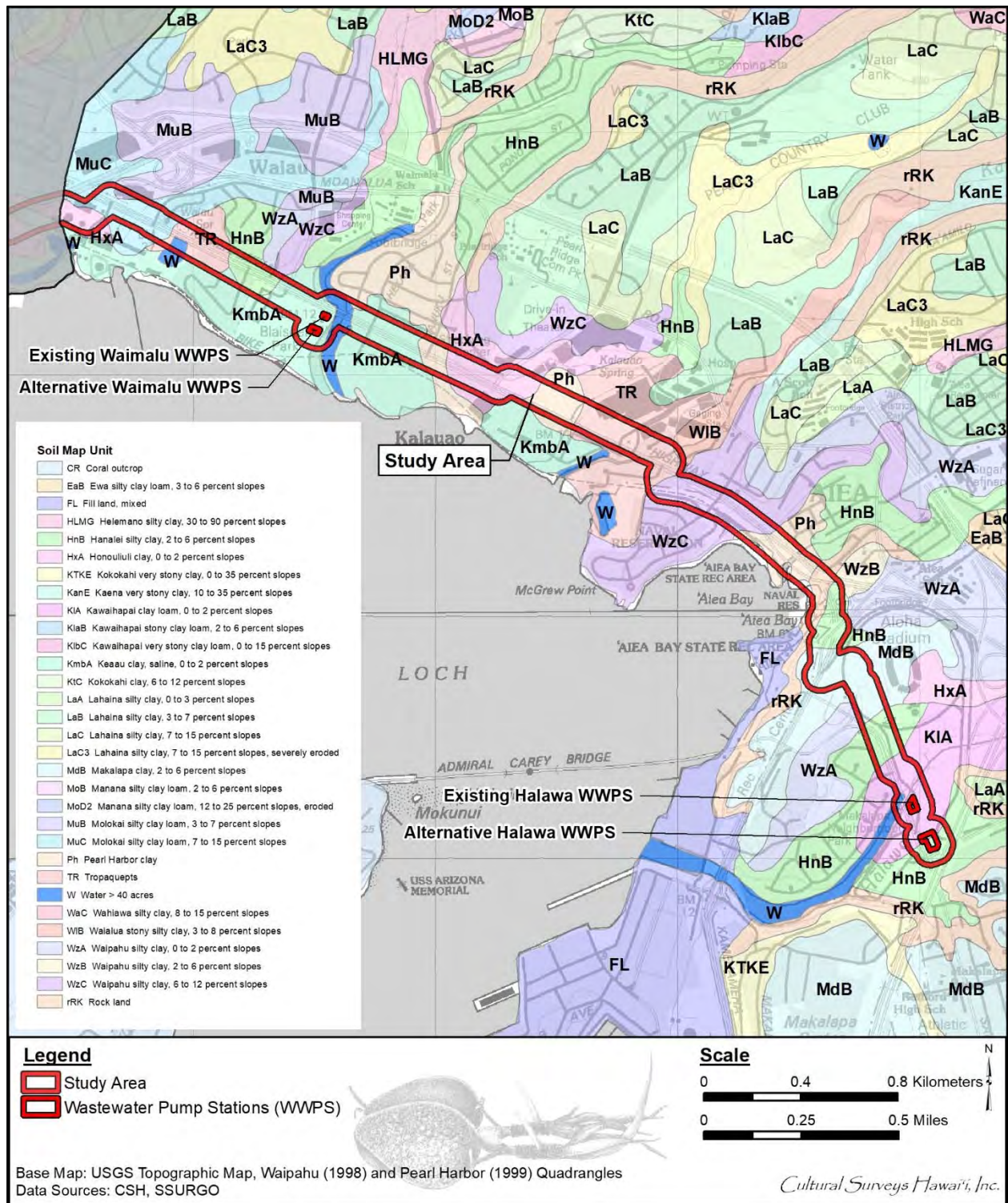


Figure 20. Soils map of eastern portion of study area, overlain on 1998 Waipahu and 1999 Pearl Harbor USGS 7.5-minute topographic quadrangles

Table 1. Soil types

Code	Soil Name
CR	Coral outcrop
EmA	Ewa silty clay loam, moderately shallow
Fd	Fill land
FL	Fill land, mixed
HnB	Hanalei silty clay, 2 to 6% slopes
HxA	Honouliuli clay, 0 to 2% slopes
KIA	Kawaihapai clay loam, 0 to 2% slopes
KIC	Kawaihapai clay loam, 6 to 15% slopes
KmbA	Keaau clay, saline, 0 to 12% slopes
MdB	Makalapa clay, 2 to 6% slopes
MnC	Malama stony silty clay loam, 0 to 12% slopes
MuC	Molokai silty clay loam, 7 to 15% slopes
Ph	Pearl Harbor clay
rRK	Rock land
TR	Tropaquepts
W	Water
WiB	Waialua stony silty clay, 3 to 8% slopes
WzC	Waipahu silty clay, 6 to 12% slopes

Kawaihapai series (KIA and KIC) are described as follows:

This series consists of well-drained soils in drainageways and on alluvial fans on the coastal plains on the islands of Oahu and Molokai. These soils formed in alluvium derived from basic igneous rock in humid uplands. They are nearly level to moderately sloping. Elevations range from nearly sea level to 300 feet. The annual rainfall amounts to 30 to 50 inches. . . . These soils are used for sugarcane, truck crops, and pasture. The natural vegetation consists of kiawe, koa haole, lantana, and bermudagrass. [Foote et al. 1972:63–64]

Keaau series (KmbA) are described as follows:

This series consists of poorly drained soils on coastal plains on the island of Oahu. These soils developed in alluvium deposited over reef limestone or consolidated coral sand. They are nearly level and gently sloping. Elevations range from 5 to 40 feet. The annual rainfall amounts to 20 to 35 inches. . . . Keaau soils are geographically associated with Kaloko, Mokuleia, and Pearl Harbor soils. . . . These soils are used for sugarcane and pasture. The natural vegetation consists of kiawe, bermudagrass, bristly foxtail, and fingergrass. [Foote et al. 1972:64–65]

Makalapa series (MdB) are described as follows:

This series consists of well-drained soils on uplands on the island of Oahu, near Salt Lake Crater, Diamond Head and the Mokapu Peninsula. These soils formed in volcanic tuff. They are gently sloping to moderately steep. Elevations range from 20 to 200 feet. The annual rainfall amounts to 20 to 35 inches. . . . Makalapa soils are geographically associated with Kokokahi and Mamala soils. . . . These soils are used for urban development and pasture. The natural vegetation consists of kiawe, koa haole, lantana, bermudagrass, and fingergrass. [Foote et al. 1972:87]

Malama series (MnC) are described as follows:

This series consists of excessively drained, extremely stony, very shallow, organic soils on uplands on the island of Maui. These soils developed in organic material. They are gently sloping to moderately steep. Elevations range from nearly sea level to 1,000 feet. The annual rainfall amounts to 60 to 90 inches. . . . Malama soils are geographically associated with Hana and Opihikao soils. . . . These soils are used mostly for water supply. Small acreages are used for orchard crops and pasture. The natural vegetation consists of californiagrass, guava, hala, kukui, ohia, and treefern. [Foote et al. 1972:93]

Molokai series (MuC) are described as follows:

This series consists of well-drained soils on uplands on the islands of Maui, Lanai, Molokai, and Oahu. These soils formed in material weathered from basic igneous rock. They are nearly level to moderately steep. Elevations range mainly from nearly sea level to 1,000 feet but are as much as 1,500 feet on Lanai. The annual rainfall amounts to 20 to 25 inches . . . These soils are used for sugarcane, pineapple, pasture, wildlife habitat, and homesites. The natural vegetation consists of kiawe, ilima, uhaloa, feather fingergrass, and buffelgrass. [Foote et al. 1972:96]

Pearl Harbor series (Ph) are described as follows:

This series consists of very poorly drained soils on nearly level coastal plains on the island of Oahu. These soils developed in alluvium overlying organic material. Elevations range from nearly sea level to 5 feet. The annual rainfall amounts to 18 to 40 inches. . . . Pearl Harbor soils are geographically associated with Hanalei, Kaloko, and Keaau soils. . . . These soils are used for taro, sugarcane, and pasture. The natural vegetation consists of cattails, mangrove trees, californiagrass, and sedges. [Foote et al. 1972:112]

Tropaquepts series (TR) are described as follows:

Tropaquepts (TR) are poorly drained soils that are periodically flooded by irrigation in order to grow crops that thrive in water. They occur as nearly level flood plains on the islands of Oahu and Maui. Elevations range from sea level to 200 feet. The annual rainfall amounts to 20 to 150 inches. . . . Tropaquepts are used for production of taro, rice, and watercress on flooded paddies. [Foote et al. 1972:121]

Waiialua series (WiB) are described as follows:

This series consists of moderately well drained soils on alluvial fans on the island of Oahu. These soils developed in alluvium weathered from basic igneous rock. They are nearly level to steep. Elevations range from 10 to 100 feet. The annual rainfall amounts to 25 to 50 inches; . . . Waiialua soils are geographically associated with Honouliuli, Kaena, and Kawaihapai soils. . . . These soils are used for sugarcane, truck crops, orchards, and pasture. The natural vegetation is swollen fingergrass, koa haole, and uhaloa. [Foote et al. 1972:128]

Waipahu series (WzA) are described as follows:

This series consists of well-drained soils on marine terraces on the island of Oahu. These soils developed in old alluvium derived from basic igneous rock. They are nearly level to moderately sloping. Elevations range from nearly sea level to 125 feet. Rainfall amounts to 25 to 35 inches annually; . . . Waipahu soils are geographically associated with Hanalei, Honouliuli, and Waiialua soils. . . . These soils are used for sugarcane and homesites. The natural vegetation is fingergrass, bermudagrass, bristly foxtail, and kiawe. [Foote et al. 1972:134]

Coral outcrop (CR) are described as follows:

Coral outcrop (CR) consists of coral or cemented calcareous sand on the island of Oahu. The coral reefs formed in shallow ocean water during the time the ocean stand was at a higher level. Small areas of coral outcrop are exposed on the ocean shore, on the coastal plains, and at the foot of the uplands. Elevations range from sea level to approximately 100 feet. The annual rainfall amounts to 18 to 40 inches. Coral outcrop is geographically associated with Jaucas, Keaau, and Mokuleia soils. . . . This land type is used for military installations quarries, and urban development. Vegetation is sparse. It consists of kiawe, koa haole, and fingergrass. [Foote et al. 1972:29]

Fill land (Fd and FL) are described as follows:

This land type consists of areas filled with material from dredging, excavation from adjacent uplands, garbage, and bagasse and slurry from sugar mills. The areas are on the islands of Kauai, Maui, and Oahu. [Foote et al. 1972:31]

Rock land (rRK) are described as follows:

Rock land (rRK) is made up of areas where exposed rock covers 25 to 90 percent of the surface. It occurs on all five islands. The rock outcrops and very shallow soils are the main characteristics. The rock outcrops are mainly basalt and andesite. This land type is nearly level to very steep. Elevations range from nearly sea level to more than 6,000 feet. The annual rainfall amounts to 15 to 60 inches. . . . Rock land is used for pasture, wildlife habitat, and water supply. The natural vegetation at the lower elevations consists mainly of kiawe, klu, piligrass, Japanese tea, and koa haole. Lantana, guava, Natal redtop, and molassesgrass are dominant at the higher elevations. This land type is also used for urban development. In many areas,

especially on the island of Oahu, the soil material associated with the rock outcrops is very sticky and very plastic. [Foote et al. 1972:119]

1.4.2 *Ka Makani* (Winds)

Makani is the Hawaiian word for wind. *The Wind Gourd of La'amaomao* tells the story of Pāka'a and his son Kuāpāka'a, descendants of the wind goddess La'amaomao. They are able to control the winds of Hawai'i which are contained in a gourd and may be called forth by chanting their names. Pāka'a's chant traces the winds of O'ahu in the *moku* (district) of 'Ewa. Five winds are identified throughout this *moku* and are presented in Pāka'a's chant as follows:

<i>He Moae-ku ko Ewaloa,</i>	Moa'e-ku is of Ewaloa,
<i>He Kehau ko Waiopua,</i>	Kēhau is of Waiopua,
<i>He Waikoloa ko Lihue,</i>	Waikōloa is of Līhu'e,
<i>He Kona ko Puukapolei,</i>	Kona is of Pu'ukapolei,
<i>He Maunuunu ko Puuloa. . .</i>	Māunuunu is of Pu'uloa. . .
[Nakuina 1902:57]	[Nakuina 1992:51]

1.4.3 *Ka Ua* (Rains)

Precipitation is a major component of the water cycle, and is responsible for depositing *wai* (fresh water) on local flora. Pre-Contact *kānaka* (Native Hawaiians) recognized two distinct annual seasons. The first, known as *kau* (period of time, especially summer) lasts typically from May to October and is a season marked by a high-sun period corresponding to warmer temperatures and steady trade winds. The second season, *ho'oilō* (winter, rainy season) continues through the end of the year from November to April and is a much cooler period when trade winds are less frequent, and widespread storms and rainfall become more common (Giambelluca et al. 1986:17). Typically, the maximum rainfall occurs in January and the minimum in June (Giambelluca et al. 1986:17).

It was a customary tradition to grant a name for each type of rain. Rains were named to show their action toward plants or the supposed effects on people or their possessions (Pukui and Elbert 1986:361). There are different rains associated with the *moku* of 'Ewa including the Kuahine, Nāulu, and Wa'ahila rain (Akana and Gonzalez 2015:114, 195, 272).

1.4.3.1 *Ka Ua Kuahine*

The Kuahine rain is mentioned in association with Kanoenoe by Hi'iakaikapoliopole as she reflects on her travels and her consequent nickname, Wahinepo'aimoku (Island-encircling woman) (Akana and Gonzales 2015:114).

<i>Noho nō i Kanoenoe ke Kuahine</i>	The Kuahine rain dwells in Kanoenoe
<i>Hele a haiamū ka ua i ke kula</i>	The rains gather in the plains
[Ho'oulumāhiehie 2008a:173; Ho'oulumāhiehie 2008b:162]	

1.4.3.2 *Ka Ua Nāulu*

Despite the relative lack of rainfall in this area, the Nāulu rain is known to be associated with the *ahupua'a* (traditional land division) of Honouliuli. This rain is generally understood as a

sudden shower, and more commonly associated with Kawaihae, Hawai'i and Ni'ihau (notoriously dry locations as well) (Akana and Gonzalez 2015:187). The Nāulu rain is mentioned in an *oli* offered by Hi'iakaikapoliopole. During Hi'iaka's travel through 'Ewa she recites this affectionate *oli* as she recalls the Kai'okia edict placed on her and Lohi'au by Pele:

<i>'A'ole au e hele i ke kaha o Kaupe'a</i>	I shall not tread Kaupe'a's expanse
<i>Kēlā kaha kūpā koili a ka lā i ke kula</i>	That stretch where the sun beats down on the plain
<i>Ua kūpono a'ela ka lā i ka piko o Wākea</i>	The sun is right overhead, at the navel of Wākea
<i>Ola i ke ahe aka makani Māunuunu</i>	I am spared by the Māunuunu wind
<i>I ka hapahapai mai aka makani 'Ao'aoa</i>	By the uplifting 'Ao'aoa breeze
<i>Ke koi lā i ke ao o ka Nāulu</i> <i>e hanini i ka wai</i>	Urging the Nāulu storm clouds to pour down their waters
<i>Ola ihola nā kupa kama'āina i ka wai</i> <i>a ka 'ōpua</i>	The natives here survive on water from the clouds
<i>Ke halihali a'ela nā 'ōpua i ke awa lau</i>	Which billowing clouds carry along to the branching lochs
<i>E koi mai ana iā Hi'iaka e kūo'e hele</i> <i>i ke kula</i>	Compelling Hi'iaka to trudge that open stretch
<i>I kuleana i lāhui ai ka moe i Laila</i>	Duty making rest forbidden there
<i>I laila au lohe i ke kani leo le'a a ka</i> <i>'ō'ō i ke kula</i>	There I heard the happy trill of the 'ō'ō bird on the plain
<i>Ho'āikāne ana lāua me ke kai o</i> <i>Wāwaemoku</i>	Befriending the sea of Wāwaemoku
<i>Mokumokuāhua loko, kupākupā koili</i> <i>i ka 'ino</i>	My heart grieves, thrashed by harm
<i>I 'ino ho'i au i kēia kanaka i ka hiki</i> <i>'ana mai</i>	I may be harmed by this person upon arrival
<i>I kahela a'ela ka 'ai a ka manu</i>	Leaving the birds to feed expansively
<i>I ka pua o ka wiliwili</i>	On the blossoms of the <i>wiliwili</i> trees
<i>Wili a'ela nā 'ōpua i luna</i>	The clouds spin above
<i>No luna wau</i>	I am from above
<i>Wili a'ela nā 'ōpua i lalo</i>	The clouds spin below
<i>Lalo ē!</i>	Below indeed!
<i>Lilo i lalo ka hele 'ana a ke kanaka</i>	The movement of mankind is cast down

<i>Kalakala ke ao no Hawai'i</i>	Craggy are the clouds from Hawai'i
<i>I ka pā 'ia mai e kēia makani</i>	Blown here by this wind
<i>'A'ole a'u makana i ka lā o ka hilahila</i>	I have no gift to offer on this day of shame
<i>E hili hewa paha auane 'i au</i>	I shall perhaps end up astray
<i>Wilia i na'e, wilia i lalo</i>	Spiraling windward, or to the lee
<i>Wilia i kai, wilia i uka</i>	Spinning toward the sea, toward the highlands
<i>'O kauhale a ka 'ōlelo</i>	O house made of words
<i>Ho'ohiki ihola i kānāwai</i>	Utter as an edict
<i>Kau ihola i kānāwai</i>	Place as a law
<i>He kānāwai 'okia</i>	An order of separation
<i>'Ālina ihola ka 'o Pu'uloa</i>	Thus Pu'uloa is branded by epithet
<i>He 'āina kauā.</i>	A land of outcasts and slaves.

[Ho'oulumāhiehie 2008a:294–295; Ho'oulumāhiehie 2008b:275–276]

1.4.3.3 Ka Ua Wa'ahila

The following passage is a message of condolence from members of the Christian Endeavor Society and speaks of the Wa'ahila rain of Hālawā:

No laila, 'o mākou o ka Ahahui Hooikaika Kristiano holo 'oko 'a o ka ua Wa'ahila o Hālawā, 'Ewa, ma o ko mākou mālie kōmike lā, ke komo pū aku nei e ka'ana pū i nā 'īnea o kēia mau lā 'eha 'eha me nā mākou i ho'onele 'ia i ka lei 'ole, ka 'ohana a me nā pilikana me ke kau nui aku i maluhia mai ko kākou pu'uhonua a me ka ikaika mai.

Translation:

There, we, on behalf of the entire Ahahui Hooikaika Kristiano of the Wa'ahila rain of Hālawā, 'Ewa, through out committee, join in sharing the hardships of these tragic days with the parents, family, and relatives who have been deprived of their children, with hopes for peace and strength from refuge. [Akana and Gonzalez 2015:272]

Another reference was taken from the Hawaiian language newspaper, *Kuokoa Home Rula* and includes a passage submitted by a Mr. George M.K. Aekai o Kuloloia in response to a *nane* (riddle) printed in the paper:

*Nani Hālawā i ka ua Wa'ahila
Ke Kīpū maila i luna o 'Aiea*

Translation:

Hālawa is beautiful in the Wa‘ahila rain

Remaining above ‘Aiea

[Akana and Gonzalez 2015:272]

1.4.4 *Nā Kahawai* (Streams)

There are numerous streams within the *moku* of ‘Ewa. The western section of the study area extends from the ‘Ewa Plain across West Loch and *mauka* through Waipi‘o Peninsula from the eastern shores of Honouliuli Ahupua‘a to the eastern boundary of Waikele Ahupua‘a. The only major stream running through this western section is Honouliuli Stream. The “perennial/intermittent” Honouliuli Stream and its tributaries “have a total stream length of 32.5 miles” (O‘ahu Resource Conservation and Development Council 2013:16).

The central and eastern sections of the study area extend across the inland boundary of Waipi‘o Peninsula, then eastward inland of the West and Middle lochs of Pearl Harbor. There are six perennial streams in these sections including Waiawa, Waimalu, Kalauao, ‘Aiea, and Hālawa. Three smaller, non-perennial streams and three fresh water springs also intersect these study area sections: Kapakahi and Makalena streams between West and Middle lochs, Waiawa Spring near the northeast bank of Middle Loch, Waiiau Stream and Waiiau Spring in Waiiau Ahupua‘a, and Kalauao Spring in Kalauao Ahupua‘a.

1.4.5 *Lihikai ame ka Moana* (Seashore and Ocean)

The Hawaiians called Pearl Harbor Pu‘uloa (“long hill”). According to *mo‘olelo*, this location was a storied place, due to the presence of Ka‘ahupāhau. Ka‘ahupāhau, queen of all the sharks of O‘ahu, dwelled in a large cavern on the Honouliuli side of Pearl Harbor (Clark 1977:69).

The Hawaiians knew Pearl Harbor as Pu‘uloa, and they believed that there, dwelling in a large cavern on the Honouliuli side of the harbor, Ka‘ahupāhau, the queen of all sharks on O‘ahu, made her home. Her chief guard was a brother shark, who lived in a pit at the entrance to the lochs. The Hawaiian people said the drydock was built over the cavern of Ka‘ahupāhau’s son, who also lived in Pu‘uloa. Angered by the violation of his home, the shark prince destroyed the imposing structure. The engineers in charge of the project attributed the collapse of the foundation to hydrostatic pressure. Whatever the cause, several years’ work was wrecked within minutes . . . this time, before starting to rebuild, they asked the Hawaiians to bless the site. After that the work continued without further trouble. [Clark 1977:69–70]

Both seashore and ocean provided physical and spiritual sustenance (NOAA 2017) for the people of ‘Ewa. According to Malo, the ocean was divided into smaller divisions, stretching from ‘*ae kai* (water’s edge) to *moana* (pelagic zone) (Malo 1951:25–26). Outside the coastal areas was the belt known as *kua au*, where the shoal water ended (Malo 1951:26). Further out was the *kai au*, deeper waters designated for surfing, swimming, or spearing squid (Malo 1951:26).

Traditionally, the seashore and ocean areas were vitally important for resource extraction in the early days of settlement. Fishermen along the coast maintained a respected status within traditional

Hawaiian society; Kanahale asserts that “early Hawaiians regarded fishing as the oldest, and hence the most prestigious of professions” (Kanahale 1995:17).

According to Charles Howard Edmondson (1946:5), the coastal waters of Pearl Harbor were “a natural aquarium for many varieties of marine animals.” Titcomb (1952:7) identifies the Pearl Harbor area as the only large natural inland lagoon, famous for its fish and fishponds. The *nehu* (anchovy; *Anchoviella purpurea*) was said to fill the lochs of Pearl Harbor. Citing Kamakau, Margaret Titcomb writes that the *nehu*, “filled the lochs from the channel of Pu‘uloa (Pearl Harbor) inland to the Ewas” (Titcomb 1952:97). Due to the presence of the *nehu*, the *kama‘āina* (native born) of Honouliuli and ‘Ewa developed this saying,

He kai puhi nehu, puhi lala ke kai o ‘Ewa e, e noho i ka la‘i o ‘Ewa nui a La‘akona
 (“A sea that blows up nehu, blows them up in rows, is ‘Ewa, until they rest in the calm of great ‘Ewa-a-La‘akona”). [Kamakau 1991a:84]

1.4.6 Built Environment

The study area corridor that encompasses the Honouliuli East Inceptor System, existing and proposed wastewater pump station locations, proposed improvements, and proposed Waiawa Area Conveyance Corridors varies throughout, generally becoming more densely developed from west to east. The western section of the study area, which contains the Waipahu Force Main, Waipahu WWPS locations, and a portion of the Pearl City Dual Force Main, is largely undeveloped in the modern sense. The portion on the west shores of West Loch consists of decommissioned and remnant military facilities related to Naval Magazine Pearl Harbor (West Loch); the Waipi‘o Peninsula portion is mostly comprised of an overgrown, out-of-use agricultural complex. Moving inland along Waipi‘o Peninsula toward the eastward bend of the study area corridor, public, commercial, and residential development increases to include the Honolulu Police Training Academy, the existing Waipahu WWPS, various small businesses, and a residential community.

The central section of the study area is more diverse as it includes areas of both urban and rural development within the greater urban developed area of Pearl City. The *makai* corridor of this section follows the modern undeveloped alignment of the Pearl Harbor Bike Path, which was occupied by numerous homeless encampments at the time of the field inspection. The *makai* corridor also runs adjacent to rural residential communities with active agricultural plots. The *mauka* corridor of the center section follows Kamehameha Highway and the built environment is typical of Pearl City, including many commercial developments surrounded by industrial development and residential neighborhoods.

The eastern section of the study area follows the parallel alignment of the Pearl Harbor Bike Path and Kamehameha Highway until diverging south along Salt Lake Boulevard. As these are major thoroughways, the areas adjacent to the roads are densely developed, with residential neighborhoods, large shopping complexes, hospitals and schools, office buildings, military installations, and other structures/areas.

Section 2 Methods

2.1 Archival Research

Research centers on Hawaiian activities including *ka‘ao* (legends), *wahi pana* (storied places), *‘ōlelo no‘eau* (proverbs), *oli*, *mele*, traditional *mo‘olelo*, traditional subsistence and gathering methods, ritual and ceremonial practices, and more. Background research focuses on land transformation, development, and population changes beginning with the early post-Contact era to the present day.

Cultural documents, primary and secondary cultural and historical sources, historic maps, and photographs were reviewed for information pertaining to the study area. Research was primarily conducted at the CSH library. Other archives and libraries including the Hawai‘i State Archives, the Bishop Museum Archives, the University of Hawai‘i at Mānoa’s Hamilton Library, Ulukau, The Hawaiian Electronic Library (Ulukau 2014), the State Historic Preservation Division (SHPD) Library, the State of Hawai‘i Land Survey Division, the Hawaiian Historical Society, and the Hawaiian Mission Houses Historic Site and Archives are also repositories where CSH cultural researchers gather information. Information on Land Commission Awards (LCAs) were accessed via Waihona ‘Aina Corporation’s Māhele database (Waihona ‘Aina 2000), the Office of Hawaiian Affairs (OHA) Papakilo Database (Office of Hawaiian Affairs 2015), and the Ava Konohiki Ancestral Visions of ‘Āina website (Ava Konohiki 2015).

2.2 Community Consultation

2.2.1 Scoping for Participants

We begin our consultation efforts with utilizing our previous contact list to facilitate the interview process. We then review an in-house database of *kūpuna* (elders), *kama‘āina*, cultural practitioners, lineal and cultural descendants, Native Hawaiian Organizations (NHOs; includes Hawaiian Civic Clubs and those listed on the Department of Interior’s NHO list), and community groups. We also contact agencies such as SHPD, OHA, and the appropriate Island Burial Council where the proposed project is located for their response on the project and to identify lineal and cultural descendants, individuals and/or NHO with cultural expertise and/or knowledge of the study area. CSH is also open to referrals and new contacts.

2.2.2 “Talk Story” Sessions

Prior to the interview, CSH cultural researchers explain the role of a CIA, how the consent process works, the project purpose, the intent of the study, and how their *‘ike* (knowledge) and *mana‘o* (thought, opinion) will be used in the report. The interviewee is given an Authorization and Release Form to read and sign.

“Talk Story” sessions range from the formal (e.g., sit down and *kūkākūkā* [consultation, discussion] in participants choice of place over set interview questions) to the informal (e.g., hiking to cultural sites near the study area and asking questions based on findings during the field outing). In some cases, interviews are recorded and transcribed later.

CSH also conducts group interviews, which range in size. Group interviews usually begin with set, formal questions. As the group interview progresses, questions are based on interviewees’

answers. Group interviews are always transcribed and notes are taken. Recorded interviews assist the cultural researcher in 1) conveying accurate information for interview summaries, 2) reducing misinterpretation, and 3) missing details to *mo'olelo*.

CSH seeks *kōkua* (assistance) and guidance on identifying past and current traditional cultural practices of the study area. Those aspects include general history of the *ahupua'a*; past and present land use of the study area; knowledge of cultural sites (for example, *wahi pana*, archaeological sites, and burials); knowledge of traditional gathering practices (past and present) within the study area; cultural associations (*ka'ao* and *mo'olelo*); referrals; and any other cultural concerns the community might have related to Hawaiian cultural practices within or in the vicinity of the study area.

2.2.3 Completion of Interview

After an interview, CSH cultural researchers transcribe and create an interview summary based on information provided by the interviewee. Cultural researchers give a copy of the transcription and interview summary to the interviewee for review and ask them to make any necessary edits. Once the interviewee has made those edits, we incorporate their *'ike* and *mana'o* into the report. When the draft report is submitted to the client, cultural researchers prepare a finalized packet of the participant's transcription, interview summary, and any photos that were taken during the interview. We also include a thank you card and honoraria. This is for the interviewee's records.

It is important to CSH cultural researchers to cultivate and maintain community relationships. The CIA report may be completed, but CSH researchers continuously keep in touch with the community and interviewees throughout the year—such as checking in to say hello via email or by phone, volunteering with past interviewees on community service projects, and sending holiday cards to them and their *'ohana* (family). CSH researchers feel this is an important component of building relationships and being part of an *'ohana* and community.

"I ulu no ka lālā i ke kumu—the branches grow because of the trunk," an *'ōlelo no'eau* (#1261) shared by Mary Kawena Pukui with the simple explanation: "Without our ancestors we would not be here" (Pukui 1983:137). As cultural researchers, we often lose our *kūpuna* but we did not lose their wisdom and words. We routinely check obituaries and gather information from other informants if we have lost our *kūpuna*. CSH makes it a point to reach out to the *'ohana* of our fallen *kūpuna* and pay our respects including sending all past transcriptions, interview summaries, and photos for families to have on file for genealogical and historical reference.

Section 3 *Ka'ao and Mo'olelo*

Hawaiian storytellers of old were greatly honored; they were a major source of entertainment and their stories contained lessons while interweaving elements of Hawaiian lifestyles, genealogy, history, relationships, arts, and the natural environment (Pukui and Green 1995:IX). According to Pukui and Green (1995), storytelling is better heard than read for much becomes lost in the transfer from the spoken to the written word and *ka'ao* are often full of *kaona* or double meanings.

Ka'ao are defined by Pukui and Elbert (1986:108) as a “legend, tale [...], romance, [and/or], fiction.” *Ka'ao* may be thought of as oral literature or legends, often fictional or mythic in origin, and have been “consciously composed to tickle the fancy rather than to inform the mind as to supposed events” (Beckwith 1970:1). Conversely, Pukui and Elbert (1986:254) define *mo'olelo* as a “story, tale, myth, history, [and/or] tradition.” The *mo'olelo* are generally traditional stories about the gods, historic figures or stories which cover historic events and locate the events with known places. *Mo'olelo* are often intimately connected to a tangible place or space (*wahi pana*).

In differentiating *ka'ao* and *mo'olelo* it may be useful to think of *ka'ao* as expressly delving into the *wao akua* (realm of the gods), discussing the exploits of *akua* (gods) in a primordial time. *Mo'olelo* on the other hand, reference a host of characters from *ali'i* (royalty) to *akua*; *kupua* (supernatural beings) to *maka'ainana* (commoners); and discuss their varied and complex interactions within the *wao kānaka* (realm of man). Beckwith elaborates, “In reality, the distinction between *ka'ao* as fiction and *mo'olelo* as fact cannot be pressed too closely. It is rather in the intention than in the fact” (Beckwith 1970:1). Thus a so-called *mo'olelo*, which may be enlivened by fantastic adventures of *kupua*, “nevertheless corresponds with the Hawaiian view of the relation between nature and man” (Beckwith 1970:1).

Both *ka'ao* and *mo'olelo* provide important insight into a specific geographical area, adding to a rich fabric of traditional knowledge. The preservation and passing on of these stories through oration remains a highly valued tradition. Additionally, oral traditions associated with the study area communicate the intrinsic value and meaning of a place, specifically its meaning to both *kama'aina* as well as others who also value that place.

The following section presents traditional accounts of ancient Hawaiians living in the vicinity of the study area. Many relate an age of mythical characters whose epic adventures inadvertently lead to the Hawaiian race of *ali'i* and *maka'ainana*. The *ka'ao* in and around the study area shared below are some of the oldest Hawaiian stories that have survived; they still speak to the characteristics and environment of the area and its people.

3.1 *Mo'olelo (Stories)*

The *mo'olelo* of 'Ewa invoke the deep Hawaiian past. Some *mo'olelo* make connections with Kahiki, the traditional homeland of Hawaiians in central Polynesia. Most notably, the chief Kaha'i left from Kalaeloa (coastal area in Honouliuli Ahupua'a) for a trip to Kahiki, and on his return to the Hawaiian Islands, brought back the first breadfruit (Kamakau 1991b:110) and planted it near the waters of Pu'uloa (long hill), now known as Pearl Harbor (Beckwith 1940:97). In addition, several *mo'olelo* associate places in 'Ewa with the gods Kāne and Kanaloa, the pig god Kamapua'a, the Hina family, and with the sisters of the Hawaiian volcano goddess Pele, all of whom have strong connections with Kahiki (Kamakau 1991b:111; Pukui et al. 1974:200).

3.1.1 Mo'olelo of Pu'uloa (Pearl Harbor)

3.1.1.1 Pipi of Pu'uloa

Pearl Harbor was called Pu'uloa or *Keawalau-o-Pu'uloa*, “the many harbored-sea of Pu'uloa” (Pukui 1983:182) by the Hawaiians. An alternate name was Awawalei, or “garland (*lei*) of harbors” (Handy and Handy 1972:469). Pukui (1983:120) uses the name Awalau for Pearl Harbor, as in the saying “*Huhui na 'ōpua i Awalau*, The clouds met at Pearl Harbor. Said of the mating of two people.” Emerson (1993:167) interpreted Awalau as “leaf-shaped lagoon.”

Clark (1977:70) says that its English name came from the name Waimomi, or “water of the pearl,” an alternate name for the Pearl River (Pearl Harbor). The harbor was named Pearl Harbor after the pearl oysters of the family Pteriidae (mainly *Pinctada radiata*), which were once abundant on the harbor reefs, but were later decimated by over-harvesting. Kamakau notes the abundance of *pipi* around Pu'uloa was sufficient enough to feed the entire *moku* of 'Ewa:

The *pipi* (pearl oyster)—strung along from Namakaohalawa [Hālawa] to the cliffs of Honouliuli, from the *kuapa* fishponds of inland 'Ewa clear out to Kapakule [Honouliuli]. That was the oyster that came in from deep water to the mussel beds near shore, from the channel entrance of Pu'uloa to the rocks along the edges of the fishponds. They grew right on the *nahawe* mussels, and thus was this *i'a* [food] obtained. Not six months after the *hau* branches . . . that placed a *kapu* on these waters until the *pipi* should come in . . . were set up, the *pipi* were found in abundance— enough for all of 'Ewa—and fat with flesh. [Kamakau 1991a:83]

Kamakau also noted that Pu'uloa was also famous for other kinds of marine resources including '*opae* (shrimp), *nehu* (anchovy), *mahamoe* (bivalve) and '*okupe* (bivalve).

The transparent shrimp, '*opae huna*, and the spiked shrimp, '*opae kakala*, such as came from the sea into the *kuapa* and *pu'uone* fishponds. *Nehu pala* and *nehu maoli* fishes filled the lochs (*nuku awalau*) from the entrance of Pu'uloa to the inland 'Ewas.

Other famous *i'a* [food] of 'Ewa, celebrated land of the ancestors, were the *mahamoe* and '*okupe* bivalves and many others that have now disappeared. [Kamakau 1991a:84]

This oyster was supposedly brought from Kahiki, the Hawaiian ancestral lands, by a *mo'o* (lizard or water spirit) named Kānekua'ana (Handy and Handy 1972:470). Kānekua'ana was the *kia'i* (food guardian) for 'Ewa. When food was scarce, the descendants of Kua'ana built *waihau heiau* (a *heiau* [pre-Christian place of worship] for *mo'o*) for her and lit fires to plead for her blessings.

Kanekua'ana guarded all the district of Ewa and the natives from Halawa to Honouliuli had faith in her. She cared specially for those related to her but the blessings that came to them were shared by all. The people of Ewa depended upon her as their guardian to bless them. When their children were suffering from a scarcity of fish, the relatives of Kanekua'ana from Halawa to Honouliuli erected *waihau* [a *heiau* with food offerings] for Kanekua'ana and lighted fires to bring

blessings upon the whole people. [translation of story by S.M. Kamakau, in Sterling and Summers 1978:51]

For 'Ewa, the chief *i'a* (marine food) blessing was the famous *pipi*, or pearl oyster. Samuel Kamakau describes the *pipi* of Honouliuli.

That was the oyster that came in from deep water to the mussel beds near shore, from the channel entrance of Pu'uloa to the rocks along the edges of the fishponds. They grew right on the *nahawele* mussels and thus was this *i'a* obtained. Not six months after the *hau* branches [that placed a *kapu* on these waters until the *pipi* should come up] were set up, the *pipi* were found in abundance-enough for all 'Ewa-and fat with flesh. Within the oyster was a jewel (daimana) called a pearl (*momi*), beautiful as the eyeball of a fish, white and shining; white as the cuttle fish, and shining with the colors of the rainbow-reds and yellow and blues, and some pinkish white, ranging in size from small to large. They were of great bargaining value (*he waiwai kumuku'ai nui*) in the ancient days, but were just 'rubbish' (*'opala*) in 'Ewa. [Kamakau 1991a:83]

This oyster, the *pipi*, was sometimes called "the silent fish," or, *i'a hamau leo o 'Ewa*, 'Ewa's silent sea creature (Handy and Handy 1972:471), since the collectors were supposed to stay quiet while harvesting the shells, as in the sayings:

Ka i'a hāmau leo o 'Ewa. The fish of 'Ewa that silences the voice.

The pearl oyster, which has to be gathered in silence. [Pukui 1983:144]

Haunāele 'Ewa i ka Moa'e. 'Ewa is disturbed by the Moa'e wind.

Used about something disturbing, like a violet argument. When the people of 'Ewa went to gather the *pipi* (pearl oyster), they did so in silence, for if they spoke, a Moa'e breeze would suddenly blow across the water, rippling it, and the oysters would disappear. [Pukui 1983:59]

E hāmau o makani mai auane'i. Hush, lest the wind rise.

Hold your silence or trouble will come to us. When the people went to gather pearl oysters at Pu'uloa, they did so in silence, for they believed that if they spoke, a gust of wind would ripple the water and the oysters would vanish. [Pukui 1983:34]

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

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

Sereno Bishop, an early resident of O'ahu, wrote of his time in the area around 1836, of the pearl oyster, the *pipi*, and another edible clam, identified by Margaret Titcomb (1979:351) as probably *Lioconcha heiroglyphica*.

The lochs or lagoons of Pearl River were not then as shoal as now. The subsequent occupation of the uplands by cattle denuded the country of herbage, and caused vast quantities of earth to be washed down by storms into the lagoons, shoaling the water for a long distance seaward. No doubt the area of deepwater and anchorage has been greatly diminished. In the thirties, the small oyster was quite abundant,

and common on our table. Small pearls were frequently found in them. No doubt the copious inflow of fresh water favored their presence. I think they have become almost entire extinct, drowned out by the mud. There was also at Pearl River a handsome speckled clam, of a delicate flavor which contained milk white pearls of exquisite luster and perfectly spherical. I think the clam is still found in the Ewa Lochs. [Bishop 1901:87]

Older Hawaiians believed that the *pipi* disappeared around the time of the smallpox epidemic of 1850-1853, because Kānekua'ana became displeased at the greed of some *konohiki* (overseer).

The people of the place believe that the lizard was angry because the *konohikis* imposed *kapus* [bans], were cross with the women and seized their catch of oysters. So this "fish" was removed to Tahiti and other lands. When it vanished a white, toothed thing grew everywhere in the sea, of 'Ewa, which the natives of 'Ewa had named the *pahikaua* (sword). It is sharp edged and had come from Kauai-helanai, according to this legend. [Manu 1885 in Sterling and Summer 1978:50]

Pahikaua is the Hawaiian name for the mussel, *Brachidontes crebristriatus* (Mytilidae), which was also a popular clam eaten by the residents of Pearl Harbor.

A clarification of the story of Kānekua'ana and the pearl oysters of Pearl Harbor is given, in which it seems an overseer had set a ban on the *pipi* for several months a year so that they could increase. A poor widow, a relation of the *mo'ō*, took some of the *pipi* and hid them in a basket. The *konohiki* found the hidden shells, and took them from her, emptying them back into the sea, which was proper. However, after this he followed the woman home and also demanded that she pay a stiff fine in cash, which she did not have. The *mo'ō* thought this was unjust and the next night she took possession of a neighbor who was a medium.

. . . After the overseer had gone back to Palea the lizard goddess possessed her aged keeper [a woman of Ewa] and said to those in the house, 'I am taking the *pipi* back to Kahiki and they will not return until all the descendants of this man are dead. I go to sleep. Do not awaken my medium until she wakes of her own accord.' The command was obeyed and she slept four days and four nights before she awoke. During the time that she slept the pearl oysters vanished from the places where they were found in great numbers, as far as the shore. The few found today are merely nothing . . . [Ka Loea Kālai'āina, 3 June 1899, translation in Sterling and Summers 1978:49-50]

3.1.1.2 Ka'ahupāhau and Other Shark 'Aumākua of 'Ewa

Pu'uloa is closely associated with shark 'aumākua, guardian spirits for specific Hawaiian families or clans. Pukui (1943:56) and others (Sheldon 1883) claim the sharks of Pearl Harbor were so tame that people used to ride on their backs, and that their human relatives would feed them with 'awa (*Piper methysticum*). The most famous guardian shark was Ka'ahupāhau, the queen shark of O'ahu, who lived in Pu'uloa, now called Pearl Harbor. Her name means "cloak well cared for" (Pukui 1943:56), or "well cared-for feather cloak"; the feather cloak was a symbol of royalty.

Ka'ahupāhau and her brother, Kahi'uka, had been born as humans and were turned into sharks (Mary Kawena Pukui, 29 March 1954 in Sterling and Summers 1978:56).

The mother, who was a chiefess, of Ka'ahupahau was gathering limu [seaweed] in the waters of Pearl Harbor when she had a miscarriage. Thinking the baby dead she left it in the water to be washed away. Later she went again to gather limu and was bitten by a shark. She went to a kahuna [priest] who told her that the shark was Ka'ahupahau who was her own daughter, the baby she thought was dead. The kahuna [priest] advised her to go to the place and build an ahu (heap) of hau a sort of landing from which she could feed the shark and care for it. It was from that time by command of the mother that all people of Ewa were to be always be protected from sharks whether in Pearl Harbor or outside. [Elisabeth Sterling, as told by Simeon Nawaa, 22 March 1954 in Sterling and Summers 1978:56]

This explains the meaning of the shark's name Ka'ahupāhau, “the mound (*ahu*) of *hau* (*Hibiscus tiliaceus*).”

A different version of the origin of Ka'ahupāhau is provided by Pukui and Curtis:

Ka'ahu was once a lovely girl. She and her family lived beside a little stream which flowed into Pu'uloa. Often Ka'ahu and her brother went down to the harbor to swim. For hours they swam and played about, happy as fish. A shark god liked to watch those children jump and swim. They should be sharks, he thought, and live in Pu'uloa. So he changed their form. . . Years went by. Ka'ahu became the chiefess and her brother, Striking Tail, was also honored by the older sharks. The parents of those children did but brothers, and sisters and other relatives still loved and fed the sharks. [Pukui and Curtis 1949:149–150]

Koihala, the grandmother of Ka'ahupāhau and her brother, lived in Honouliuli; one day she was making *lei* (garland) for her shark grandchildren. A young girl named Pāpio rudely begged for one of the *lei*, but Koihala refused. On her way to her favorite surfing spot at Keahi Point in Honouliuli, Pāpio snatched up one of the *lei*, and laughingly went surfing. She swam across the narrow Pearl River channel to the east side in Hālawa and basked on a rock near the water. Koihala angrily told Ka'ahupāhau about the stolen *lei*, and the shark killed the girl, grabbing her from a rock in the sea where she was resting. The blood spewed everywhere, staining the soil of Hālawa red, the same color as it is today.

Ka'ahupahau soon recovered from her anger and became very sorry. She declared that from hence forth all sharks in her domain should not destroy, but protect the people round about. As flowers were the cause of the trouble she forbade their being carried or worn on the water of Pu'uloa. From that time all the people of that locality and the sharks in the lochs were the best of friends. [Pukui 1943:56]

In a second version of this story, the shark gods Kānehunamoku and Kamohoali'i were the ones that had placed a *kanawai* (decree) against the attack of men by all sharks around O'ahu. As the result of the attack of the chiefess Pāpio, Ka'ahupāhau was put on trial and tried at Uluka'a (the realm of the gods). She escaped the punishment of death, but was placed in confinement.

After her confinement ended several years later Ka'ahupahau was very weak. She went on a sightseeing trip, got into trouble, and was almost killed. But she received great help from Kupiapia and Laukahi'u, sons of Kuhaimoana, when their enemies were all slain the *kanawai* was firmly established. This law-that no shark must bite

or attempt to eat a person in Oahu waters-is well known from Pu'uloa to the Ewa. Anyone who doubts my work must be a *malihini* [recent resident] there. Only in recent times have sharks been known to bite people in Oahu waters or to have devoured them; it was not so in old times. [Kamakau 1991a:73]

In one version of the Story of Pāpio, it is said that Ka'ahupāhau later turned into a stone, although the people of Pu'uloa continued to feed her (Sterling and Summers 1978:56).

This information on the protective nature of Ka'ahupāhau is somewhat contradicted by the writings of the Russian explorer Otto Von Kotzebue, who walked to Pearl Harbor in 1821, but was unable to actually sail on the waters. He was told that people were thrown into the water as sacrifices to the sharks; however, it is uncertain if the person who told him this was an actual resident of 'Ewa, who would know the real truth. Kotzebue's account is as follows:

In the Pearl River there are sharks of remarkable size, and there have made on the banks an artificial pond of coral stones, in which a large shark is kept, to which, I was told, they often threw grown-up people, but more frequently children, as victims. [Kotzebue 1821:338–348]

The protection of Ka'ahupāhau is emphasized in many other Hawaiian traditions. One time, a man-eating shark called Mikololou from the Ka'ū district of the island of Hawai'i came visiting at Pearl Harbor with other sharks, some man-eating, some not. Mikololou remarked "What fine, fat crabs you have here," from which Ka'ahupāhau knew that some of the sharks were man-eaters, since sharks referred to fishermen as "fat crabs." She directed the fishermen to place a barrier of nets across the entrance to the harbor, and when the sharks left her home, they could not get back out to the ocean.

The sharks of the lochs attacked the man-eaters from outside and beat them unmercifully. A shark from Ka'u, Hawaii, who was not a man-eater, threw his weight over the nets and pressed them down. His sons changed themselves into pao'o [blennies] fishes and leaped where the net was forced down, thus escaping from the place where the battle of sharks was raging. Mikololou was caught fast in the nets and dragged ashore where his head was cut off and his body burned. [Pukui 1943:56]

In another version of this story, Mikololou is accompanied to Pearl Harbor with his shark friends Kua, Keali'ikauaoka'ū, Pākaiea, and Kalani; Mikololou was the only man-eater. To escape the nets:

Keali'ikauaoka'ū changed himself into a pao'o fish, which lives among the rocks, and leapt out of the net. Kua changed into a lupe, as the spotted stingray is called, and weighted down the net on one side, helping his son Kalani and nephew Pākaiea, who were half human, to escape. [Pukui and Green 1995:40]

Only Mikololou was caught in the nets, and his body was tossed on shore to rot, until only the tongue was left. In some versions of this story, the tongue immediately jumps into the water and then becomes a shark again (Pukui and Green 1995:41). In other versions (Pukui 1943:56), the tongue is eaten by a dog, which then jumps into the water, turns into a shark, and escapes. In both versions, Mikololou returns to Ka'ū, never to bother Ka'ahupāhau again.

In a third version (Webb 1923:307-308), Mikololou went back to his home island of Hawai'i and organized an army of sharks to return to Pearl Harbor, but he was again defeated by the fishermen of 'Ewa under the command of Ka'ahupāhau, who slaughtered so many of the sharks that from then on “the sea of Pu'uloa is safe and peaceful through her law that sharks shall not attack man. That is why these waters are safe for people to swim from shore to shore without fear” (Webb 1923:308). The watchful eye of Ka'ahupāhau led to these Hawaiian sayings:

<i>Alahula Pu'uloa, he alahele</i>	Everywhere in Pu'uloa is the trail
<i>na Ka'ahupāhau</i>	of Ka'ahupāhau

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

Ho'ahewa na niuhi ia Ka'ahupāhau The man-eating sharks blamed Ka'ahupāhau.

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

<i>Mehameha wale no o Pu'uloa,</i>	Pu'uloa became lonely when
<i>i ka hele a Ka'ahupāhau.</i>	Ka'ahupāhau went away.

The home is lonely when a loved one has gone. Ka'ahupāhau, guardian shark of Pu'uloa (Pearl Harbor), was dearly loved by the people. [Pukui 1983:234]

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

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

In a fourth version of the *mo'olelo* of Mikololou, J.S. Emerson states that Mikolou was from the island of Maui. When Mikololou came to visit with the sharks of Pu'uloa, he became upset that he was not allowed to eat humans. Ka'ahupāhau invited Mikolou to a feast where they stupefied him a large amount of 'awa. Ka'ahupāhau's friends closed up the Waipahu River with their fishing nets and attacked Mikololou. Mikololou was dragged onto the shore and burned to ashes, however, a portion of Mikololou's tongue was eaten by a dog who dropped the remaining portion into the river where the spirit of Mikololou was restored.

After a time the man-eating shark, Mikololou, from the coast of the island of Maui, paid them a visit and enjoyed their hospitality until he reproached them for not providing him with his favorite human flesh. This they indignantly refused to give, whereupon, in spite of their protest, he made a raid on his own account upon the natives, and secured one or more of their number to satisfy his appetite. Kaahupāhau and her brother promptly gave warning to their friends on shore of the character of this monster that had invaded their waters. To ensure his destruction they invited their unsuspecting guest to a feast made in his honor at their favorite resort up the Waipahu river. Here they fed him sumptuously, and at length stupefied him with the unusual amount of awa with which they supplied him. While he was in this condition, their friends, who had come in great numbers from the

surrounding country, were directed to close up the Waipahu river, which empties into the Ewa Lagoon, with their fish nets, brought for the purpose, while they attacked him in the rear. In his attempt to escape to the open sea he broke through one net after another, but was finally entangled and secured. His body was then dragged by the victorious people on shore and burned to ashes, but a certain dog got hold of his tongue, and, after eating a portion, dropped the remainder into the river. The spirit of the man-eater revived again, and, as a tongue, now restored and alive, made its way to the coast of Maui and Hawaii, pleading with the sharks of those waters for vengeance upon the sharks of the Ewa Lagoon. [Emerson 1892:11]

Mikololou successfully gained support for his vendetta and returned to Pu'uloa to battle Ka'apāhau and her allies:

They meantime secured the aid of Kuhaimoana and other notable sharks from the islands of Kaula, Niihau, Kauai, and Oahu. A grand sight it was to the numerous spectators on shore when these mighty hosts joined combat and began the great shark war. It was a contest of gods and heroes whose exploits and deeds of valor have long been the theme of the bards of the Hawaiian Islands. We cannot enter into the details of this story, which, wrought out, would be worthy of being called an epic. We will only say that in the first great battle the friends and allies of the cruel man-eater were routed by the superior force of their opponents, while the good Kaahupahau and her brother long continued to enjoy the affectionate worship of their grateful people. [Emerson 1892:11]

The death of Ka'ahāpau is discussed in the story of Keli'ikauoka'ū. According to the *mo'olelo*, which is found in the Hawaiian newspaper *Home Rula Repubalika*, Ka'ahupāhau was killed by Keli'ikau-o-Ka'ū, a shark with the ability to assume various body forms and "attacked Ka'ahupāhau from within, and outside her body" (Maly and Maly 2003:117). Keli'ikau-o-Ka'ū came to Pu'uloa with Mikololou to assist him in his battle with Ka'ahupāhau. The following passage which was taken from "He Mo'olelo Ka'ao Hawai'i no Keli'ikauoka'ū" was translated by Maly (2003:117):

Keli'ikau-o-Ka'ū fought with and killed Ka'ahupāhau, and it is because of this event, that the famous saying, 'Mehameha Pu'uloa, ua make o Ka'ahupāhau (Pu'uloa is alone, for Ka'ahupāhau is dead),' came about. Keli'ikau-o-Ka'ū assumed various body forms he possessed and attacked Ka'ahupāhau from within, and outside her body. Ka'ahupāhau went in spirit form to her attendant, Koihala, calling to her, saying that she was dying. Upon her death, Keli'ikau-o-Ka'ū called out to Kamoana and Kahi'ukā, taunting them. He then proceeded to swim through Pu'uloa, biting and tearing at the native sharks of the region, throwing their bodies up onto the dry land from Kalaekao, Kapua'ikāula, Keanapua'a, Kamoku'ume'ume, 'Aiea, Kalauao, Waimalu, Waiau, Waimano, the two lands of Mānana, Waiawa, Hanapōuli, Waipi'o, Waikele, Hō'ae'ae, Honouliuli, Kalaeokahuka, Kanahunaopapio, Kepo'okala and Pu'uloa.

Keli'ikau-o-Ka'ū destroyed all the sharks of 'Ewa and the stench rose upon the land. . . Following the death of Ka'ahupāhau in this war between sharks, the shark

chiefs of both sides met in council and agreed to no further wars should be fought between them. . . [Maly and Maly 2003:117]

Maly also notes that “the elder kama‘āina of the ‘Ewa District still claim that Ka‘ahupāhau was seen and cared for during their lifetime” (Maly and Maly 2003:117).

There were other guardian sharks in Pearl Harbor, including a brother of Ka‘ahupāhau’s named Kahi‘ukā (the smiting tail), and a son named Kūpīpī (Pukui 1943:57), or, in some versions, twin sons, named Kūpīpī and Kūmaninini (Pukui and Green 1995:41).

Kahi‘ukā was the brother of Ka‘ahupāhau. The name means “smiting tail.” This shark was called by this name because it was his duty to warn the people of Ewa of the presence of strange and unfriendly sharks in these waters and he did so by nudging them or striking at them with his tail. Whenever anyone was fishing and felt a nudge they would know it was Kahi‘uka, warning them and they would leave the water immediately. [Elisabeth Sterling, as told by Simeon Nawaa, 22 March 1954 in Sterling and Summers 1978:56]

There are two different accounts of the home of this shark brother. The above reference says that Kahi‘ukā lived at the site of the old dry dock. Mary Pukui disagrees, and says the site of the old dry dock was the home of the son, not the brother of Ka‘ahupāhau. Mary Pukui says Kahi‘ukā lived in a cavern underwater off Moku‘ume‘ume (Ford Island) near Keanapua‘a Point; he had a stone form in deep water some distance from the cave that could be seen from the surface (Mary Kawena Pukui, 29 March 1954 in Sterling and Summers 1978:56). J.S. Emerson (1892:11) wrote in the late nineteenth century that Kahi‘ukā’s keeper, Kimona, would often find fish nets missing and knew that Kahi‘ukā had carried them up the shore to a place of safety. Pukui also relates that the shark was named “smiting tail” because one side was longer than the other, and the shark would use his tail to smite unfriendly sharks.

Others have placed a home for Kahi‘ukā at a cave above the old Ewa Protestant Church in Waiawa (*Ke Au Hou* 1910 in Sterling and Summers 1978:18). Kuhialoko, a fishpond on the Waiawa coastline, was named for Kuhia, a servant or retainer to Kahi‘ukā (*Saturday Press*, 12 January 1884 in Sterling and Summers 1978:17). Maly also noted that “Kahi‘ukā was a good shark . . . he is the guardian of Waiawa and Mānana” (Maly and Maly 2003:102–103).

One of the shark ‘aumakua (family god) associated with Pearl Harbor was the little yellow shark called Ka‘ehu, who was born on the Big Island, but later traveled to O‘ahu and settled at Pu‘uloa. His ancestor was Kama‘ili‘ili, the Hawaiian shark god, brother of the Hawaiian volcano goddess, Pele. Ka‘ehu was a guardian of the Hawaiian people and once saved several surf riders at Waikīkī from a man-eating shark called Pehu (Knudsen 1946:9–13; Westervelt 1963:55–58).

In Thrum’s translation of this legend, the shark’s name is Ka-ehu-iki-manō-o-Pu‘uloa, meaning “the small, blonde shark of Pu‘uloa.” He was born in Puna, Hawai‘i, but soon left on a tour of all of the islands, so that he could call and pay respects to all of the king-sharks of Hawai‘i.

. . . Puuloa, Oahu, was the next objective. Reaching its entrance they visited the pit of Komoawa, where Kaahupāhau’s watcher lived. Here the young shark made himself known, as usual; the object of the journey, and the desire to meet the famous queen-shark protector of Oahu’s water. . . . Welcome greetings were sent by the messenger, who was bid to entertain the visitors in the outer cave, and on the

morrow the party could come up the lochs to meet the queen. . . . The company then repaired to the royal cave at Honouliuli, where the visitors were supplied with soft coconut and *awa*, their home food and beverage. [Thrum 1923:301–302]

According to Thrum's version (Thrum 1923:301), Ka'ehu found Ka'ahupāhau and her entourage at Waiawa. Other references associating the Ka'ahupāhau shark royal court with Waiawa include the naming of a fishpond at Pearl Harbor "Kuhialoko" after the name of a butler or purveyor to the shark queen (*Saturday Press*, 12 January 1884). Ka'ahupāhau's brother, Kahi'uka was said to have a cave in Waiawa below the former home of the Reverend Bishop, who was the pastor in 'Ewa (*Ke Au Hou*, 14 December 1910, translation in Sterling and Summers 1978:18).

The cave of Komoawa may be the Hawaiian words for "channel" or "harbor" entrance (Pukui and Elbert 1986:164). In another version of this story, the shark watcher himself is named Komoawa and the cave that he lives in is called Kea'ali'i. Kea'ali'i guards the entrance to Pearl Harbor, while the home of Ka'ahupāhau is deeper into Honouliuli lagoon (Sheldon 1883).

In 1823, the missionary Hiram Bingham accompanied Liholiho (King Kamehameha II) and his company to the royal compound at Pu'uloa, where he was shown a cave that was home to a shark god.

I one day accompanied the king and others by boat to see the reputed habitation of an Hawaiian deity, on the bank of the lagoon of 'Ewa. It was a cavern or fissure in a rock, chiefly under water, where, as the traditions teach, and as some then affirmed, a god, once in human form, taking the form of a shark, had his subterraqueous abode. Sharks were regarded by the Hawaiians as gods capable of being influenced by prayers and sacrifices, either to kill those who hate and despise them, or to spare those who respect and worship them. [Bingham 1847:177]

Although Bingham stated in this year that no one any longer believed these stories, there were some who kept the beliefs of the guardian sharks alive. In 1912, dredging in Pearl Harbor was completed and a large dry-dock was completed, but collapsed the very next year. The Native Hawaiians believed the dock had collapsed because it had been built over the home of Kūpīpī the shark son of Ka'ahupāhau's, who lived in a cavern near the harbor entrance at Pu'uloa. "Angered by the violation of his home, the shark prince destroyed the imposing structure" (Clark 1977:69–70). The dock was rebuilt in the same year, but this time only after a blessing on the construction site was made by Hawaiian traditional practitioners.

In other versions of this story, the name of the shark is interpreted as "the little ruddy shark" (Emerson n.d.), or the "little reddish-haired shark," named for the reddish ('ehu) hair of Ka'ehu. In this version, the cave of Ka'ehu is called Pānau, and the human mother and father of the little shark are Kapukapu and Hōlei of Pānau, in Puna, Hawai'i (Emory et al. 1959:63).

3.1.1.3 Kāne and Kanaloa and the Loko I'a of Pu'uloa

According to an account in the Hawaiian newspaper *Ka Loea Kālai'āina* (10 June 1899), several of the fishponds in the Pu'uloa area were made by the brother gods, Kāne and Kanaloa. A fisherman living in Pu'uloa, named Hanakahi, prayed to unknown gods, until one day two men came to his house. They revealed to him that they were the gods to whom he should pray. Kāne and Kanaloa then built fishponds at Ke'anapua'a, but were not satisfied. They built the fishpond,

Kepo'okala, but were still not satisfied. Finally they made the pond Kapākule, which they stocked with all manner of fish. They gifted all of these fishponds to Hanakahi and his descendants (Handy and Handy 1972:473; *Ka Loea Kālai'āina*, 8 July 1899).

According to Mary Pukui (1943:56–57), who visited Kapākule fishpond when she was young, the pond was built by the legendary little people of Hawai'i, the *menehune*, under the direction of the gods Kāne and Kanaloa. Pukui describes several unique aspects of this pond:

On the left side of the pond stood the stone called Hina, which represented a goddess of the sea by that name. Each time the sea ebbed, the rock became gradually visible, vanishing again under water at high tide. Ku, another stone on the right, was never seen above sea level. This stone represented Ku'ula, Red Ku, a god for fish and fishermen. From one side of the pond a long wall composed of driven stakes of hard wood, ran toward the island [Laulaunui] in the lochs. When the fish swam up the channel and then inside of this wall, they invariably found themselves in the pond. A short distance from the spot where the pond touched the shore was a small koa or altar composed of coral rock. It was here that the first fish caught in the pond was laid as an offering to the gods. [Pukui 1943:56]

The fishpond contained many fish, especially the *akule* (scad fish, *Trachurops crumenophthalmus*), thus its name, “the enclosure for *akule* fish” (Pukui 1943:56–57). The pond was destroyed when the channel to Pearl Harbor was dredged in the early twentieth century. The caretaker of the pond took the stones Kū and Hina to a deep place in the ocean and sunk them so “none would harm or defile them.” Cobb (1903:733) says the pond was used to catch the larger *akule* (gogglers), *ōpelu* (mackerel scad), *weke* (goat fish), *kawakawa* (bonito), and sharks. It was unusual for having walls made of coral. This contradicts much of the legendary material that says that sharks were not killed within Pearl Harbor; however, Kamakau does relate that Kekuamanoha and Kauhiwawaeono, two conspirators against Kamehameha I, lived at Pu'uloa. The chief Kauhiwawaeono was known to murder people and use their bodies as shark bait (Kamakau 1992:182, 232).

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

At Pu'uloa on Oahu were two unusual ponds [fish traps]—Kapakule and Kepoolala. Kapakule was the better one. The rocks of its walls, *kuapa*, could be seen protruding at high tide, but the interlocking stone walls (*pae niho pohaku*) of the other pond were still under water at high tide. . . . It [Kapakule] was said to have been built by the *'e'epa* people [mysterious people] at the command of Kane ma.

This is how the fish entered the pond. At high tide many fish would go past the mauka side of the pond, and when they returned they would become frightened by the projecting shadows of the trunks, and would go into the opening. The fish that went along the edge of the sand reached the seaward wall, then turned back toward the middle and entered the anapuna (the arched portion of the trap). A man ran out and placed a 'cut-off' seine net ('omuku lau) in the opening, and the fish shoved and crowded into it. The fish that were caught in the net were dumped out, and those not caught in the net were attacked with sharp sticks and tossed out, or were seized by those who were strong. [Kamakau 1976:88]

3.1.1.4 Kaihuopala'ai and the Traveling 'Anae of Pu'uloa

Fornander (1919a:270–271) recorded a *mo'olelo* of Maikohā, a deified hairy man who became the god of *kapa* (tapa cloth) makers. This *mo'olelo* describes Maikohā's sister, Kaihuopala'ai, who journeyed to O'ahu:

'Ike aku la o Kaihuopala'ai i ka maikai o Kapapaapūhi, he kāne e noho ana ma Honouliuli ma 'Ewa. Moe iho la lāua, a noho iho la o Kaihuopala'ai i laila a hiki i kēia lā. 'Oia kēlā loko kai e ho'opuni ia nei i ka 'anae, nona nā i'a he nui loa, a hiki i kēia kākau ana.

Kaihuopala'ai saw a goodly man by the name of Kapapaapuhi who was living at Honouliuli, 'Ewa; she fell in love with him and they were united, so Kaihuopala'ai has remained in 'Ewa to this day. She was changed into that fishpond in which mullet are kept and fattened, and that fish pond is used for that purpose to this day. [Fornander 1919a:5(2):270]

The name of Maikohā's sister, Kaihuopala'ai, which means “the nose of Pala'ai” (Pukui et al. 1974:68), is also the name the Hawaiians used for the west loch of Pu'uloa. Yet, McAllister (1933:108) recorded that other Hawaiians claim there never was a fishpond by that name. Beckwith (1918:354) says that Kaihuopala'ai changed into the fishpond near the place called Kapapapūhi (the eel flats). This fishpond is identified on old maps as the peninsula that juts into the west side of West Loch (and sometimes spelled Kapapa'apūhi).

The story of Kaihuopala'ai, or Ihuopala'ai, is also associated with the tradition of the *'anaeholo*, the traveling mullet of Pearl Harbor (Nakuina 1998:270–272):

The home of the *'anae-holo* is at Honouliuli, Pearl Harbor, at a place called Ihuopala'ai. They make periodical journeys around to the opposite side of the island, starting from Pu'uloa and going to windward, passing successively Kumumanu, Kalihi, Kou, Kālia, Waikīkī, Ka'alāwai, and so on, around to the Ko'olau side, ending at Lā'ie, and then returning by the same course to their starting point. [Nakuina 1998:271]

In Nakuina's account, Ihupala'ai was a male who possesses a *kū'ula* (fish god) that supplied the large mullet known as *'anae* (*Mugil cephalus*). His sister lived in Lā'ie and there came a time when there were no fish to be had. She sent her husband to visit Ihupala'ai, who was kind enough to send the fish following his brother-in-law on his trip back to Lā'ie. This story is associated with a proverb or poetical saying identified with Honouliuli:

Ka i'a hali a ka makani

The fish fetched by the wind.

The *'anaeholo*, a fish that travels from Honouliuli, where it breeds, to Kaipāpa'u, on the windward side of O'ahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong. [Pukui 1983:145]

Pukui et al. (1974:68) give the name of the husband in this story as Lā'ie and the name of the wife as Pala'ai, which ties into the name of the west loch of Pearl Harbor, called Kaihu o Pala'ai (the nose of Pala'ai). Another version has a woman named Awawalei (an alternate version for the name of Pearl Harbor), who had a brother named Laniloa (the point on Lā'ie at which the mullet stops its migration and makes its way back to Pearl Harbor), and another brother (a mullet) who

lived with an eel named Papapūhi (*Ka Loea Kālai'āina*, 21 October 1899, translated in Sterling and Summers 1978:34).

There is also a famous *pōhaku* (stone) associated with the traveling mullet of Pearl Harbor.

. . . I . . . asked the person sitting on my left, 'What place is this?' Answer—'This is Pearl City.' It was here that mullets were bred in the ancient times and that flat stone there was called Mullet Rock or Pōhaku Anae. It lies near the beach by Ewa mill. [*Ka Nūpepa Kū'oko'a* 1908, translation from Sterling and Summers 1978:53]

3.1.2 Mo'olelo of Honouliuli

3.1.2.1 Pu'uokapolei, Astronomical Marker and Heiau

Pu'uokapolei was the primary landmark for travelers on the cross-*ahupua'a* trail that ran from Pearl Harbor in the east to Wai'anae in the west ('Ī'ī 1959:27, 29; Nakuina 1992:54; E.M. Nakuina 1904 in Sterling and Summers 1978:34). *Pu'u* means hill and *Kapolei* means "beloved Kapo," a reference to the sister of the Hawaiian volcano goddess, Pele. Kamakau says ancient Hawaiians used Pu'uokapolei as an astronomical marker to designate the seasons:

. . . the O'ahu people who reckoned the time (Oahu po'e helu) called the season Kau for the setting of the sun from Pu'uokapolei, a hill in Honouliuli, 'Ewa, to the opening of Mahinaona (i ke kawaha o Mahinaona). When the sun moved south from Pu'uokapolei—and during the season of the sun in the south—for the coming of coolness and for the sprouting of new buds on growing things—the season was called Ho'oilō [winter, rainy season]. [Kamakau 1976:14]

A *heiau* was once on Pu'uokapolei, but had been destroyed by the time of McAllister's (1933:108) survey of the island in 1930. The hill was used as a point of solar reference or as a place for making astronomical observations (Fornander 1919b:6[2]:292). Pu'uokapolei may have been regarded as the gate of the setting sun, just as the eastern gate of Kumukahi in Puna is regarded as the rising sun; both places are associated with the Hawaiian goddess Kapo (Emerson 1993:41). This somewhat contradicts some Hawaiian cosmologies, in which Kū was the god of the rising sun, and Hina, the mother of Kamapua'a was associated with the setting sun. Fornander (1919b:6[2]:292) states that Pu'uokapolei may have been *leina* (a jumping off place) (also connected with the setting sun) and associated with the wandering souls who roamed the plains of Kaupē'a and Kānehili, *makai* (toward the ocean) of the hill.

3.1.2.2 Kamapua'a and Kamaunuaniho at Pu'uokapolei

Pu'uokapolei was also known to be the home of Kamapua'a's grandmother, Kamaunuaniho, one of the three migrants from Kahiki who were ancestors to the people of O'ahu (Fornander 1919c:5[2]:318; Kahiolo 1978:81, 107). Kamapua'a, the Hawaiian pig god, once lived in Kaluanui on the windward side of O'ahu, but he escaped to 'Ewa when he was pursued by the chief Olopana.

Kamapua'a subsequently conquered most of the island of O'ahu, and, installing his grandmother [Kamaunuaniho] as queen, took her to Pu'uokapolei, the lesser of the two hillocks forming the southeastern spur of the Wai'anae Mountain Range, and made her establish her court there. This was to compel the people who were to pay tribute to bring all the necessities of life from a distance, to show his absolute power over all. [Nakuina 1904:50]

Emma Nakuina goes on to note, “A very short time ago [prior to 1904] the foundations of Kamaunuanoho’s house could still be seen at Puuokapolei” (Nakuina 1904:50).

Another account (*Ka Loea Kālai'āina*, 13 January 1900 in Sterling and Summers 1978:34) speaks of Kekele'aikū, the older brother of Kamapua'a, who also lived on Pu'uokapolei. In Lilikalā Kame'eiehiwa's version of the *mo'olelo* of Kamapua'a, Pele and Kamapua'a meet and a battle ensues on Hawai'i Island between the two. Kamapua'a tells Kekele'aikū,

'Listen to me, elder brother. You wait here. When you smell the stench of burning bristles, then you must assume I am dead. However, if indeed you do not smell the stench of the bristles, you will know that your younger brother has not been harmed and that he has “eaten of the cooked taro.”' [Kame'eiehiwa 1996:62]

Kamapua'a travels to Hawai'i Island where Pele chases him with fire out of the *lehua* (*Metrosideros polymorpha*) forest. Kamapua'a ran from Pele but could only cling to an 'ama'uma'u (*Sadleria cyatheoides*) fern (Kame'eiehiwa 1996:95). The fire continued to burn around Kamapua'a as he clung on for his life. His bristles began to burn as well, sending a stench of burning pig bristles around the Hawaiian Islands. Kekele'aikū smelled the stench of burning pig bristles and began to cry, thinking that his brother perished in battle with Pele (Kame'eiehiwa 1996:95). Kekele'aikū then hung himself, deeply saddened for the loss of his beloved brother, Kamapua'a. Kekele'aikū's body was left at Pu'uokapolei with his grandmother.

3.1.2.3 The Plains of Kaupe'a, Pu'uokapolei, and the Realm of Homeless Souls

There are several places on the 'Ewa coastal plain associated with *ao kuewa*, the realm of the homeless souls. Samuel Kamakau (1991b:47–49) explains the Hawaiian beliefs in the afterlife:

There were three realms (*ao*) for the spirits of the dead. . . . There were, first, the realm of the homeless souls, the *ao kuewa*; second, the realm of the ancestral spirits, the *ao 'aumakua*; and third, the realm of Milu, *ke ao o Milu* . . .

The *ao kuewa*, the realm of homeless souls, was also called the *ao 'auwana*, the realm of wandering souls. When a man who had no rightful place in the 'aumakua realm (*kanaka kuleana 'ole*) died, his soul would wander about and stray amongst the underbrush on the plain of Kama'oma'o on Maui, or in the *wiliwili* grove of Kaupe'a on Oahu. If his soul came to Leilono [in Hālawa, 'Ewa near Red Hill], there he would find the breadfruit tree of Leiwalo, *ka'ulu o Leiwalo*. If it was not found by an 'aumakua soul who knew it (*i ma'a mau iaia*), or one who would help it, the soul would leap upon the decayed branch of the breadfruit tree and fall down into endless night, the *pō pau 'ole o Milu*. Or, a soul that had no rightful place in the 'aumakua realm, or who had no relative or friend (*makamaka*) there who would watch out for it and welcome it, would slip over the flat lands like a wind, until it came to a leaping place of souls, a *leina a ka 'uhane*. . . . [Kamakau 1991a:47]

On the plain of Kaupe'a beside Pu'uoloa [Pearl Harbor], wandering souls could go to catch moths (*pulelehua*) and spiders (*nanana*). However, wandering souls could not go far in the places mentioned earlier before they would be found catching spiders by 'aumakua souls, and be helped to escape. [Kamakau 1991a:49]

The breadfruit tree Leilono was said to have been located on the 'Ewa-Kona border, above Āliamanu. In another section of his account of the dead, Kamakau (1991a:29) calls the plain of wandering souls the “plain at Pu‘uokapolei.”

There are many who have died and have returned to say that they had no claim to an ‘aumakua [realm] (*kuleana'ole*). These are the souls, it is said, who only wander upon the plain of Kama‘oma‘o on Maui or on the plain at Pu‘uokapolei on Oahu. Spiders and moths are their food. [Kamakau 1991a:29]

This association of Pu‘uokapolei and Kānehili with wandering souls is also illustrated in a lament on the death of Kahahana, the paramount chief of O‘ahu, who was killed by his foster father, the Maui chief Kahekili, after Kahahana became treacherous and killed the high priest Ka‘opulupulu.

<p><i>E newa ai o hea make i ka la, Akua noho la i Puuokapolei. E hanehane mai ana ka la i na wahine o Kamao, Akua pee, pua ohai o ke kaha, I walea wale i ke a- I ka ulu kanu a Kahai. Haina oe e ka oo— E ka manu o Kanehili. [Fornander 1919b:6(2):297]</i></p>	<p>Go carefully lest you fall dead in the sun, The god that dwells on Kapolei hill The sun is wailing on account of the women of Kamao, A hiding god, blossoming <i>ohai</i> of the banks, Contented among the stones— Among the breadfruit planted by Kahai. Thou wast spoken of by the <i>oo</i>— By the bird of Kanehili.</p>
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Fornander provides some notes on this lament. The god dwelling at Kapolei is Kahahana, stating that this is where his soul has gone. Kamao is one of the names of the door to the underworld. This lament draws an association with wandering souls and the place where the first breadfruit tree was planted by Kaha‘i at Pu‘uloa (Fornander 1919b:6[2]:304).

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

Ka wiliwili of Kaupe‘a. The *wiliwili* grove of Kaupe‘a.

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

Pukui also shared her personal experience with the wandering spirits on the plain of Kaupe‘a.

A wide plain lies back of Keahi and Pu‘uloa where the homeless, friendless ghosts were said to wander about. These were the ghosts of people who were not found by their family ‘aumakua or gods and taken home with them, or had not found the leaping places where they could leap into the nether world. Here [on the plain of Honouliuli] they wandered, living on the moths and spiders they caught. They were often very hungry for it was not easy to find moths or to catch them when found.

Perhaps I would never have been told of the plain of homeless ghosts if my cousin’s dog had not fainted there one day. My cousin, my aunt and I were walking to Kalaeloa, Barber’s Point, from Pu‘uloa accompanied by Teto, the dog. She was a native dog, not the so-called poi dog of today, with upright ears and body and size

of a fox terrier. For no accountable reason, Teto fell into a faint and lay still. My aunt exclaimed and sent me to fetch sea water at once which she sprinkled over the dog saying, 'Mai hana ino wale 'oukou i ka holoholona a ke kaikamahine. Uoki ko 'oukou makemake 'ilio.' 'Do not harm the girl's dog. Stop your desire to have it.' Then with a prayer to her 'aumakua for help she rubbed the dog. It revived quickly and, after being carried a short way, was as frisky and lively as ever.

Then it was that my aunt told me of the homeless ghosts and declared that some of them must have wanted Teto that day because she was a real native dog, the kind that were roasted and eaten long before foreigners ever came to our shores. [Pukui 1943:60–61]

Beckwith (1940:154) has stressed that "the worst fate that could befall a soul was to be abandoned by its 'aumakua and left to stray, a wandering spirit (*kuewa*) in some barren and desolate place." These wandering spirits were often malicious, so the places where they wandered were avoided.

3.1.2.4 The Plain of Pukaua

The Hawaiian language newspaper *Ka Loea Kālai'āina* (13 January 1900) relates that near Pu'uokapolei, on the plain of Pukaua, on the *mauka* side of the road, there was a large rock. This legend suggests the plain around Pu'uokapolei was called Pukaua. The legend is as follows:

If a traveler should go by the government road to Waianae, after leaving the village of gold, Honouliuli, he will first come to the plain of Puu-ainako and when that is passed, Ke-one-ae. Then there is a straight climb up to Puu-o-Kapolei and there look seaward from the government road to a small hill, That is Puu-o-Kapolei. . . . You go down some small inclines, then to a plain. This plain is Pukaua and on the mauka side of the road, you will see a large rock standing on the plain. . . . There were two supernatural old women or rather peculiar women with strange powers and Puukaua belonged to them. While they were down fishing at Kualaka'i [near Barbers Point] in the evening, they caught these things, 'a'ama crabs, *pipipi* shellfish, and whatever they could get with their hands. As they were returning to the plain from the shore and thinking of getting home while it was yet dark, they failed for they met a one-eyed person [bad omen]. It became light as they came near to the plain, so that passing people were distinguishable. They were still below the road and became frightened lest they be seen by men. They began to run—running, leaping, falling, sprawling, rising up and running on, without a thought of the 'a'ama crabs and seaweeds that dropped on the way, so long as they would reach the upper side of the road. They did not go far for by then it was broad daylight. One woman said to the other, 'Let us hide lest people see us,' and so they hid. Their bodies turned into stone and that is one of the famous things on this plain to this day, the stone body. This is the end of these strange women. When one visits the plain, it will do no harm to glance on the upper side of the road and see them standing on the plain. [*Ka Loea Kālai'āina*, 13 January 1900, translation in Sterling and Summers 1978:39]

In another version of this story, the two women met Hi'iaka as she journeyed toward the 'Ewa coast. The women were *mo'o* and were afraid that Hi'iaka would kill them, so they changed into

their lizard form. One of the lizards hid in a little space on a stone beside the coastal trail, and the other hid nearby (*Ka Hōkū o Hawai'i*, 15 February 1927, translated in Maly 1997:19). From that time on the stone was known as *pe'e-kāua*, meaning “we two hidden.” Hi'iaka greeted the two women but did not harm them, and passed on.

When she reached Pu'uokapolei, she also greeted two old women who lived at an 'ohai (Samanea saman) grove on the hill. These women were named Pu'uokapolei and Nāwahineokama'oma'o (*Ka Hōkū o Hawai'i*, 22 February 1927, translated in Maly 1997:19). As she continued her travels, she looked to the ocean and saw the canoe carrying Lohi'au.

<i>Ku'u kāne i ke awa lau o Pu'uloa</i>	My man on the many harbored sea of Pu'uloa
<i>Mai ke kula o Pe'ekāua ke noho</i>	As seen from the plain of Pe'ekāua
<i>E noho kāua i ke kaha o ka 'ōhai</i>	Let us dwell upon the 'ōhai covered shore
<i>I ka wiliwili i ka pua o ka lau noni</i>	Where the noni blossoms are twisted together
<i>O ka ihona i Kānehili la</i>	Descending along Kānehili
<i>Ua hili ho'i au-e</i>	I am winding along.

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

3.1.2.5 The Caves of Honouliuli

'Ewa was famous for the many limestone caves formed in the uplifted coral, called the “Ewa Karst.” This Pleistocene limestone outcrop, where not covered by alluvium or stockpiled material, has characteristic dissolution “pit caves” (Mylroie and Carew 1995), which are nearly universally, but erroneously, referred to as “sink holes” (Halliday 2005). These pit caves, or sinkholes, vary widely in areal extent and depth, with some of the more modest features comparable in volume to 5-gallon buckets, while some of the larger features, although usually irregularly shaped, are several meters wide and several meters deep. In traditional Hawaiian times, the areas of exposed coral outcrop were undoubtedly more extensive.

Some of these caves, called *ka-lua-ōlohe* were inhabited by the *ōlohe*, a type of people that looked like other humans but had tails like dogs (Beckwith 1940:343). These people were skilled in wrestling and bone-breaking and often hid along narrow passes to rob travelers. They were also reputed to be cannibals. One famous cannibal king, Kaupe, who lived in Līhu'e in upland Honouliuli, was an *ōlohe*.

The caves of Pu'uloa were sometimes also used as burial caves. In 1849, Keali'iahonui, son of Kaua'i's last king, Kaumuali'i, died. He had once been married to the chiefess Kekau'ōnohi, who had stayed with him until 1849. She wanted to bury her ex-husband at sea.

It seems that by Kekauonohi's orders, the coffin containing her late husband's remains was removed to Puuloa, Ewa, with the view of having it afterwards taken out to sea and there sunk. It was temporarily deposited in a cavern in the coral limestone back of Puuloa, which has long been used for a burial place, and has lately been closed up. [Alexander 1907:27]

After some initial objections by the niece of Keali'iahonui, the body was removed from the outer coffin, the rest was sunk, and the coffin was later buried somewhere in Pu'uloa.

3.1.2.6 The Inland Plain of Keahumoa

In several legends of 'Ewa, mention is made of the "plain of Keahumoa." John Papa 'Ī'ī (1959:96) has this plain opposite the trail to Pohakea Pass, stretching across the *ahupua'a* of Honouliuli and Hō'ae'ae. McAllister (1933:107) states the plain was west of Kīpapa Gulch in Waikele. It is also mentioned in legends of Waipi'o. Thus, this is probably a general name for the flat plain *mauka* of the productive floodplain area directly adjacent to Pearl Harbor. This plain would have been *mauka* of the present corridor alignment.

3.1.2.6.1 Legend of Nāmakaokapao'o

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

3.1.2.6.2 Legend of Pikoī

Pikoī was a legendary hero, the son of a crow (*'alalā*) and brother to five god-sisters in the form of rats. He was famous for his ability to shoot arrows, and often made bets that he could hit rats from a long distance (Fornander 1917a:4[3]:450–463). Pikoī's skill was commemorated in a saying (Pukui 1983:200):

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

3.1.2.6.3 Story of Palila

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

Ha'alele keia ia Ka'ena, hele mai la a Kalena, a Pōhākea, Maunauna, Kānehoa, a ke kula o Keahumoa, nana ia 'Ewa. Kū kēia i laila nānā i ke kū a ka ea o ka lepo i nā kānaka, e pahu aku ana kēia i ka la'au palau aia nei i kai o Honouliuli, kū ka ea o ka lepo, nu lalo o ka honua, me he olai la, makau nā kānaka holo a hiki i Waikele. A hiki o Palila, i laila, e pa'apu ana nā kānaka i ka nānā lealea a ke 'li'i o O'ahu nei, oai o Ahuapau.

After leaving Ka'ena, he came to Kalena, then on to Pōhākea, then to Manuauna [a peak in Honouliuli], then to Kānehoa [a peak in Honouliuli], then to the plain of Keahumoa [upland plain from Honouliuli to Waipi'o] and looked toward 'Ewa. At

this place he stood and looked at the dust as it ascended into the sky caused by the people who had gathered there; he then pushed his war club toward Honouliuli. When the people heard something roar like an earthquake they were afraid and they all ran to Waikele. When Palila arrived at Waikele he saw the people gathered there to witness the athletic games that were being given by the king of O'ahu, Ahupau by name. [Fornander 1918a:5(1):142–143]

3.1.2.6.4 *The Demi-god Māui*

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

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

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

3.1.3 *Mo'olelo of Waikele*

3.1.3.1 The Kapa Board at Waipahu Spring

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

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

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

3.1.3.2 Kuolohele

A famous *pōhaku*, known as Kuolohele (or Kuolo-kele), was located in Waikele Ahupua'a. According to the *mo'olelo*, penned by G.W. Kahiolo and which appeared in the Hawaiian newspaper *Ka Hae Hawaii* on 27 August 1861, Kamapua'a spotted a lump on Kuolohele's back as he bathed in the stream. Kamapua'a threw a stone on Kuolohele's back to heal him. Kuolohele took the stone and placed it on the cliff where it is located to this day.

. . . Kamapuaa returned and meeting Kuolohele, he asked 'Is that you?' He said, 'Yes.' 'Let us go together.' They went together as far as Waiawa and from thence to Waipahu. Kamapuaa stood on this side of the stream while Kuolohele bathed below. He had put down his bundle and Kamapuaa spied a lump on his back. He picked up a stone and threw it on Kuolohele's back. He cried aloud that he was being killed and Kamapuaa said, 'You are not being killed. You are healed.' He took up the stone and stuck it on the cliff and there it is to this day, a stone visited by strangers. [Sterling and Summers 1978:26–27]

3.1.3.3 Pōhakupili

Another famous *pōhaku* named Pōhakupili was located in Waikele. The *pōhaku* was placed by Kāne and Kanaloa to denote the boundaries between Waikele and Hō'ae'ae Ahupua'a.

Pohaku-pili is a stone that belonged to Kane and Kanaloa, gods. It was they who divided the lands of Ewa when they came to earth. The divisions of the boundaries they made remained the same to this day. This stone is said to be a supernatural one and lies on the boundary of Waikele and Hoaeae and is on the edge of the cliff. There is nothing to hold it in place for it is on a sheer precipice but it has remained unmoved to this day. The spot in which it was placed is on the other side of Waipahu, mauka of Waiahu'alele (Water-of-flying-sprays). [Sterling and Summers 1978:29]

3.1.4 Mo'olelo of Waipi'o

3.1.4.1 The Hidden Palaoa of Pānakauahi Gulch in Waipi'o

Ke akua 'ōlelo is described as a local god of Pānakauahi Gulch, who from his *heiau* in Pānakauahi spotted a woman of high rank from Hawai'i hide her *lei niho palaoa* (whale bone pendant) in a hole of a rock, a rock named *pōhaku huna palaoa*, located on the plain of Punahawele. Ke akua 'ōlelo assured the woman that when the time came for her descendants to

find the necklace, he would guide them (*Ka Loea Kālai'āina*, 22 July 1899, translation in Sterling and Summers 1978:22).

Ke akua 'ōlelo also appears in another *mo'olelo*, the legend of the children and the secret eating place, Ka'aimalu. Pūpūkanioe, a boy and Nāuluahōkū, a girl who grew up with Pana'iahakea, a tributary gulch located on the boundary of Waipi'o and Waiawa, traveled frequently to Kualaka'i to fish. They usually caught plenty of fish. However, on one particular day, they only caught one fish, a *palani* (surgeonfish, *Acanthurus dussumieri*) which was considered a woman's fish. As they were on their long journey home, they were both hungry and the girl insisted they both eat the *palani* secretly. However, Ke akua 'ōlelo was watching and announced their sharing of the woman's fish. This was considered the first time the eating *kapu* (taboo) was broken, and the spot where they ate is called Ka'aimalu, the secret eating place (*Ka Loea Kālai'āina*, 22 July 1899, translation in Sterling and Summers, 1978:7).

3.1.4.2 Stories of the Gods in Waipi'o

There was a cave named Kapuna on Waipi'o Peninsula associated with a famous riddle: *No Kapuna ka hale noho ia e ke kai*, or "To Kapuna belongs the house, the sea dwells in it."

This cave is on the Waipio side and a sea passage separates Waipio and Waikele and Waikele and Honouliuli. The passage is obstructed by three small islands, a middle one and Manana and Laulaunui. These small islands in the middle of the passage to Honouliuli and inside and outside of these small islands is the sea of Kaihuopalaai [Hawaiian name for West Loch] where mullet lived till they whitened with age. [*Ka Loea Kālai'āina*, 7 October 1899, translation in Sterling and Summers 1978:24]

Another famous cave of the area was Keanapua'a, in Hālawā, opposite Waipi'o Peninsula, which means "the pig's cave," so named because Kamapua'a once slept there (Pukui et al. 1974:103). This cave was one of the places where the high king of O'ahu, Kahahana, hid after he had killed the priest Ka'opulupulu, thus angering the high chief of Maui, Kahekili.

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

3.1.4.3 The Sport of Spear Throwing

Waipi'o Ahupua'a is associated with *'ō'ō ihe* (the sport of spear throwing). An article published in Hawaiian newspaper *Kuokoa* on 26 August 1865 described a spear throwing contest held by Piliwale, the ruling chief of 'Ewa.

The ruling chief of Ewa, named Piliwale, (of the royal family of Kumuhonua of Kukaniloko) had two daughters. The older was Kukaniloko, and the younger Kohepalaoa. The former was betrothed to the son of the chief of Maui, whose name was Luaia.

The chief had declared that if any man be found who was skilled in spear throwing and could out-match his instructor then the reward would be his daughter. The chief's spear throwing instructor was Awa. He could hold ten spears in his right hand and ten in his left. He could, with two thrusts send ten at the back, two to trip

his opponent and two at the navel (The skill of the ancients could not be surpassed).
[Sterling and Summers 1978:22–23]

After two days, no one could defeat Awa. A young chief named Kaholialale had been carefully studying Awa and on the third day, he took up the challenge:

There the young chief of Lihue showed his unequalled skill in parrying. The strokes by which he won was the pane (skull top) from above and the hu'alepo (dust scattering) from below. Two places were then named Ka-pahu (The thrust) and Hana-pouli (making-a-darkness) and they are at Waipio in Ewa.

Kohe-palaoa became the wife of Kaholialale and that was the beginning of the combination of the ranks of the Lo and Wohi. Those were the ranks held by Kaholialale. Kohe-palaoa held the rank of the Kumuhonua chiefs of Kukaniloko. She was of a Ni'aupi'o rank. To them was born a son, Kanehoalani who became a chief of Koolau. [Sterling and Summers 1978: 23]

3.1.5 Mo'olelo of Waiawa

3.1.5.1 The Hero Kawelo in Waiawa

Kawelo, called “The Roving Chief,” lived for a time at Waiawa in 'Ewa.

O kahi nae a lakou e noho nei, aia no ma Waiawa, Oahu. O ko ianei hele aku la no ia e halawai me ka lawaia a ianei, a o ko laua nei holo aku la no ia, a hiki no ma kahi, a laua nei i lana mua ai. O ko laua nei kuu iho la no ia i ka upena, ahiu aku la ua i'a nei aohe kokoke mai i ka upena. Pane aku o Kawelo: “Aole e loaa ana ka i'a ia kaua. Ina e loaa kekahi uhu okoa ia kaua, alaila, loaa ka pakali nana e hoowalewale.” Oia kekahi mea i olelo ia e ka poe haku-mele, penei: “I laka no ka i'a i ka pakali,” a pela aku.

Now the place they were then residing was at Waiawa, Oahu. He [Kawelo] immediately set out to join his fishing companion [Makuakeke], and both sailed out and arrived at the place where they had formerly floated. They lowered the net, but the fish became shy and kept away from the net. Kawelo remarked: ‘We shall not be able to catch the fish. If we can secure an uhu [parrotfish], then, we can have a bait that will tempt it. This is a fact that has found expression among the composers of chants, in this manner: “The fish are tamed by the tempting bait,” ’ etc. [Fornander 1919e:5(3):700–701]

Fornander (1919e:5[3]:700) explains that this is in reference to the Hawaiian practice of using a tame *uhu* (parrotfish) as a decoy to lure other *uhu* to an area for netting.

This netting method, and other fishing practices, were described by a Lāhainā resident, Daniel Kahā'ulelio, in a series of articles on traditional Hawaiian fishing practices written for the Hawaiian language newspaper, *Ka Nūpepa Kū'oko'a* in 1902.

O kekahi upena o ka uhu kaka, he wahi upena poepoe, a he makolu a malua ka upena . . . a me na hanai kaula aho eha e hoopaa ana i ka pu e paa iho ai ke aho e huki ae ai ka lawaia, a laila, o ka hana koe, o kou imi i lehu maunu hoowalewale, a hoohaehae i mea e laka mai ai na uhu okoa, a ua kapa ia kona inoa he pula a he

pakahi, a he uhu pakahi, a ua puana hula ia no hoi, pakalikalī ka loa, a o ka maunu ekaeka. I ka loa ana o ka uhu pakahi . . .

. . . akahi no hoi e lawaia ai, . . . a laila hooku'u no i ua uhu pakahi ala, ina e ike ana ka lawaia ua hae ka uhu, a laila, hooku'u ka upena, me ka hoopaa i ua uhu pakahi ala ma ka pu o ka upena. A i ka manawa i komo ai ka uhu hou e pili me kela uhu pakahi, o ka manawa ia e huki ai ka lawaia i ka upena me ka ikaika, o ka paa ihola no ia; . . .

One of the nets used was rounded and compact, having meshes of two or three fingers width. . . . Four cords were tied to the corners and fastened together in the center. There a drawing cord was attached for the fisherman to pull it up. Then the next thing was to seek a living decoy to lure other *uhu* in. It is called a *pula*, a *pākahi* or an *uhu pākahi*.

When a decoy was secured, the fisherman sailed out to the fishing spot he had selected . . . then the decoy was lowered. As soon as the fisherman saw that the other *uhu* had rushed to the spot, then he lowered the net with the fish decoy tied where the four cords met on the net. When the new *uhu* came in to be close to the decoy then the fisherman pulled in the net as hard as he could. It was then caught fast. [*Ka Nūpepa Kū'oko'a* 1902 in Kahā'ulelio 2006:150–153]

Kawelo was famous for catching the supernatural parrotfish called Uhu'maka'ika'a, the father of all fish. One day, when fishing off the Wai'anae coast:

At dawn Kawelo awakened his teacher with these words: 'Makuakeke, awake! The sun is high. Bring the fishhooks and the nets. Let us fish. . . .'

Then with one mighty stroke of the paddle the canoe lay off Honolulu harbor, with two strokes it neared Puuloa, and with three it reached Waianae. There Kawelo chewed some *kukui* nuts and blew the oil over the sea so that the water became calm and they could see the bottom. The canoe drifted from the shallow water into the deep as the men fished for *ulua* [crevalle, jack, or pompano].

As it grew late Makuakeke urged Kawelo to return home, for he knew that it was time for Uhumakaikai, the fish god, to appear and he greatly feared this fish. So the tired fishermen went home. . . .

Early the next morning Kawelo called the fishermen and paddled out to their fishing waters. Soon Makuakeke saw the storm clouds gather in the sky and knew that the fish god was coming. As the huge fish swam toward them Kawelo threw his net and caught him. Then the fish, pulling the canoe with him, swam out to sea until the men could no longer see their homes or the surf beating on the shore. They went so rapidly that they soon came to Kauai, where the fish turned and swam back with them to Waikiki. There at last the men were able to kill him. [Rice 1977:68, 70]

3.1.5.2 Stone Markers on the Trail through Waiawa

Along the coastal trail through 'Ewa described by John Papa 'Ī'ī were several stone markers, called Nāpōhaku-luahine. These are described as old women who were changed into stones:

The names of these royal stones were Kahoaiiai (also the name of an 'ili [land division smaller than an *ahupua'a*] in Waiawa), Waiawakalea, Piliaumoa, Kahe'ekuluaikamoku, all chiefesses. Their four servants were Nohoana, Kikaeleke, Piliamo'o, Nohoanakai. These were the guardians of the trail. [*Ka Loea Kālai'āina*, 29 June 1899, translation in Sterling and Summers 1978:6]

The writer describes the location of the stones:

Here is how the traveler can locate them. When you leave the bridge of Waiawa, for Honolulu, go up and then down an incline. The hill standing on the seaward side is Nuku-o-ka-manu. The next incline is Waiawa. Go up the ascent till you reach the top and above that, about two chains from the road you will find the stones. [*Ka Loea Kālai'āina*, 29 June 1899, translation in Sterling and Summers 1978:6]

3.1.5.3 Maihea and the Cultivation of 'Awa in Waiawa

One *mo'olelo* that suggests that Waiawa was named for the 'awa plant in the legend of Maihea.

. . . it was here in 'Ewa that Kāne and Kanaloa were invoked by a planter of sweet potatoes, taros, and 'awa named Maihea. This man, living in the upland of Wai'awa, [Handy and Handy use the glottal stop] when he had prepared his meal and his 'awa, would pray:

O unknown gods of mine,
 Here are 'awa, taro greens and sweet potatoes
 Raised by me, Maihea, the great farmer.
 Grant health to me, to my wife and to my son.
 Grant us *mana*, knowledge and skill.
Amama. It is freed.
 [Handy and Handy 1972:472]

Another version of the *mo'olelo* of Maihea is published in *Ka Loea Kālai'āina* (1899, translated in *Hawaiian Ethnological Notes*). In this rendition, Maihea lived at Waimalu, where he cultivated sweet potatoes and taro. However, it was on a hill in the upland of Waiawa where he planted his 'awa. He prayed daily to the unknown gods with his offering of 'awa, taro greens, and sweet potatoes. In answer to his prayer, the gods Kāne and Kanaloa sent a whale to Waimalu. All the people of the area came to marvel at the sight. The beached whale waited almost four weeks until the son of Maihea, Ula-a-Maihea, could resist no longer. Against the wishes of his parents, he went down to the shore to see the spectacle. Once there, he followed the children climbing on to the whale. The whale began to move and Ula-a-Maihea was taken to Kahiki, where he was trained in the *kahuna* (priest) arts under Kāne and Kanaloa. The parents grieved for the boy until two strangers came to the door. Maihea invited them into his house and offered them 'awa, saying his usual prayer to the unknown gods. At this time, Kāne and Kanaloa revealed that they were the unknown gods and that they had answered his prayer by sending their son to Kahiki to learn the arts of the *kahuna*.

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

Protestant Church in Waiawa] they turned to look at 'Ewa and when they saw the fish ponds at Waiawa, they said, 'May the fish ponds down at Waiawa be as the stars in the sky above. May there be mullets at Kuhia-loko [fishpond and 'ili of Waiawa], fine sea weed at Kuhia-waho ['ili of Waiawa], salt at Ninauele, the single fruited coconut at Hapenui, the taro greens at Mokaalika and the water of Kaaimalu [garden area in Waiawa], to remove the bitterness of the 'awa of Kalahikuola.' [Ka Loea Kālai'āina, 1 July 1899, translated in Sterling and Summers 1978:5]

In a different version of the *mo'olelo*, translated by Maly, Kāne and Kanaloa tell Maihea that his wife will have a son who must come to Kahiki to learn the practices of the priests. When Kāne and Kanaloa send a whale to fetch Maihea's son, Nauluaamaihea, and take him to Kahiki, Maihea forbids his son from going, however, after three weeks, Nauluaamaihea disobeys his father and gets on the back of the whale.

When Naulaamaihea was born, he lived with his parents until he was fifteen years old, and then Naulaamaihea was taken to Kahiki. It was a whale that fetched him and took him to Kahiki. The whale came near the shore of Waimalu, just outside of the walled fishpond called Paakea. For three weeks the whale lay outside, but Naulaamaihea did not go to the shore because Maihea forbade him from going. This was because of Maihea's great love for his son. But in the fourth week, Naulaamaihea went down to the shore and got on the back of the whale. Thus, he was taken to Kahiki where he learned the practices of the priests. He is still remembered in the genealogies of the priests to this day. [Maly and Maly 2003:95]

Maihea sent his two sons down to the spring at Punanaloa to fill their water gourds. The necks of the gourds were very narrow and it took a long time to fill them. In frustration, the boys dashed the gourds to the ground and broke them, so the place was called Huewaiipi (stingy-water-bottle). The boys ran over the plain and were turned into two stones, called Na-keiki-pōhaku-a Maihea (the stone sons of Maihea). Later, the stones were called Napōhaku-kū-loloa (the long standing stones) and the spring's name was contracted to Kawaiipi. There is an 'ili called Kauhiau on the east edge of Waiau, so the gulch may have been located there. Sterling and Summers (1978:15) place the spot called Punanaloa and the Huewaiipi Spring in Waimalu, the *ahupua'a* to the east of Waiau.

Author Moses Manu also notes a dark 'awa (*pu'awa popolo*) which was grown in the uplands of Waiawa:

. . .When the wondrous maiden Ke-ao-melemele arrived at the entrance to the mountain of Konahuanui, all the offerings were in charge of Ke-anuenu, a puko'a or reddish brown pig, a clump of dark 'awa (*pu'awa popolo*) which was not common in these islands. This variety of 'awa now grows in the uplands of Waiawa, down here in Ewa. [Sterling and Summers 1978:19]

3.1.6 *Mo'olelo* of Mānana

3.1.6.1 The Eel Boy of Pilimo'o in Mānana

The following is the story of the "Eel Boy of Pilimo'o," a pool in Pearl City, Mānana Ahupua'a:

This pool had an underground tunnel that led to the sea. For a long time there was no danger to the children that came to swim in the pool until a man-eating shark discovered the tunnel and slipped in and out at will.

One day, a boy went to the pool and disappeared. No trace of him was found. His father was so worried that he went to consult a Makaula or prophet. The makaula asked his gods, who told him that it was the will of the gods to change him into a small eel, so that he could live in the depth of the pool and warn the children of danger.

The father of the boy went to the pool to see if it were so. He sat there for a long time and neither saw nor heard anything. Then the children gathered at the opposite side of the pool from him and began to dive and play.

Suddenly he heard a whistle which sounded so like the whistling of his son when he went home every day after playing. 'That sounds very much like my son's whistling,' he said to himself. He looked around and saw nothing. The whistling was repeated. Then looking toward a ledge under some hau trees, he noticed the head of an eel. Every now and then it whistled. He drew closer to it and spoke to it, 'Can it be that you are my son? How did your human body change to an eel?' The boy replied, 'Yes I was once a boy, now I am an eel because the gods have willed it, so that I may save human lives from the wicked sharks of the deep that come here. Go and tell those children to go home. Tell them to listen and if they hear whistling that it is a warning that they are in danger.'

The man went as he was told to do. He told them to listen for a shrill whistle every now and then. That was a signal to go away at once.

The eel whistled again so loudly that the children heard him and went away. The father remained to see if a shark would appear. A little while later he saw the dark form of a big shark swim about in the pool.

So it was that ever after, a whistle was a signal of danger.

This is the story of Pilimoo pool. [Namau 1940a, in Sterling and Summers 1978:16–17]

3.1.6.2 Pearl City Stone in Mānana

The "Pearl City Stone" myth tells of a "supernatural" rock located at the site of the Pearl City Mormon Church:

When the church was built the stone remained undisturbed until some of the Hawaiians began to talk about it and call the attention of the visitors to this 'female' rock. True, it was regarded as a sacred rock by the ancients but no one was worried about it in particular except to stare at it in curiosity and think what it must have meant to their ancestors.

Then some of the 'higher ups' in the church heard it. These were Hawaiians who looked upon anything that the ancients revered as detrimental to their own faith

when brought in such close contact as this. They insisted that it be thrown out to the road side.

Waiwaiole, a man who lived in the neighborhood and knew the legend of this rock was assigned the work of removing it to the roadside. He put it off from week to week as he hoped that his friends would forget about it, but they did not. They became more insistent until he found someone to help him to carry it out. At first he tried to lift it but it would not move until he talked to it. He told it that it was unwelcome in the church yard and it would be better for it to be by the roadside. After that, the two men had no trouble in moving it.

Some years later the road was widened where the stone stood and it was blasted. Part of it is gone and a part remains to this day.

Waiwaiole, the man who removed it fell sick and gradually grew worse until he was brought to the Queen's Hospital where he died.

The man who helped him also became sick with a disease that made him look bloated and dark. He became an inmate of the Mino'aka Home until death took him. Waiwaiole's beautiful home was burned down with fire. No one knew what caused it. His widow is still at Pearl City and expects to build a new home ere long. [Naumau 1940b, in Sterling and Summers 1978:17]

3.1.6.3 Maka'ioulu and the Battle of Kapoluku

In *Ruling Chiefs of Hawai'i*, Kamakau discussed an important battle which took place in Mānana where Maka'ioulu, a brave warrior, fought off many warriors before fleeing to Wahiawa where he was betrayed and killed.

Maka'i-oulu was among the brave warriors who fought in the battle called Ka-poluku. Had it not been for Pupuka he might have had trouble. At Manana in 'Ewa, at Kulana, and in the ravines beyond Napohakuhelu he was hemmed in by warriors who stabbed at him on all sides but without hurting him in the least, and so many were killed that they finally left off fighting. He himself fled exhausted and battle-weary to the uplands of Wahiawa and hid among the potato vines where he was betrayed by a certain farmer to those who sought to kill him, and so died. He was a brave warrior. [Kamakau 1992:139]

3.1.6.4 Pōhaku o Kāne

A *Pōhaku o Kāne* was located in Mānana Ahupua'a, at the southernmost tip of Mānana Peninsula. This *pōhaku* had a companion stone named Pipila'a located a short distance away. The *Pōhaku o Kāne* was believed to have the ability of tell the future. These *pōhaku* disappeared shortly before the overthrow of the Hawaiian Monarchy in 1893.

This particular 'Stone of Kāne' was situated on the shore, and noted for its ability to prophecy. It is said that the stone disappeared in 1891, and its disappearance was believed to be a sign of the overthrow of the Hawaiian Monarchy in 1893. There was also a companion stone to this Pōhaku o Kāne called Pipila'a, a short distance away. This stone also had supernatural powers, and it also disappeared shortly

before the overthrow of the Hawaiian Monarchy. . . Cited in Na Wahi Pana o Ewa (1899). [Maly and Maly 2012:39]

3.1.7 *Mo'olelo of Waimano*

3.1.7.1 Lauka'ie'ie

The *ahupua'a* of Waimano is mentioned in the *mo'olelo* of Lauka'ie'ie.

When Makanikeoe arrived at the place where the youth were playing, he was saddened at seeing the young boy crying. This was because the older children had taken all the arrows, and left none for the younger child to play with. Makanikeoe took the young boy away from the group to a place off to the side. He told the boy “Stop crying and I will give you an arrow of your own. This arrow will fly farther than any of the arrow of your friends.” Makanikeoe then gave the boy an arrow like none other he'd seen. Now Kanukuokamanu was the son of the chief of Waiawa . . . When he returned to the group of other children who were still playing, he prepared to compete as well. He chanted first to his arrow:

Kaailehua flies,
Kainiki flies,
Ahuahu flies. . .

Kanukuokamanu shot his arrow and it flew beyond all the other arrows of the competitors. It flew all the way to “the end of the nose of the pig” at Waimano, and then returned to the youth who had shot it. . . [Maly and Maly 2003:102]

3.1.7.2 Hilo-a-Lakupu

Waimano Ahupua'a was also the location where Hilo-a-Lakupu, a chief from the island of Hawai'i, was slain. Following his death, his head was taken to Honouliuli where it was placed on a pole “for the birds to feed upon” (Beckwith 1970:442).

3.1.8 *Mo'olelo of Waiau*

3.1.8.1 The Dog Kū'īlioloa on the Plain of Kalua'ōhole in Waiau

The high chief Kūali'i conquered the Kona and 'Ewa District chiefs in the early eighteenth century, ruling as *mō'ī* (king) of O'ahu from 1720 to 1740 (Cordy 2002:19). According to a source from a Hawaiian language newspaper (*Ka Loea Kālai'āina* 1899), Kūali'i's father was a chief of the Ko'olau District, but his mother was raised in Waiau in 'Ewa, and Kūali'i himself was born in Waiau, which was noted as a favored place for the Waiau royal high chiefs. The plain of Kalua'ōlohe was the noted residence of the dog Kū'īlioloa, who was also of the royal lineage of Waiau.

There was a pit where the hairless dog, seen in the olden days, lived. The name of the dog was Ku-ilio-loa and he was hairless. He often met with those who went on the plain at night and he changed his colors from black to brown, to white or to brindle. He showed himself when something was going to happen, such as the death of a ruling chief or other things pertaining to the government such as disagreements

and so on. [*Ka Loea Kālai'āina*, 29 July 1899, translation in Sterling and Summers 1978:15]

3.1.8.2 Honokawailani

A *ki'owai* (pool of water) named Honokawailani was located in Waiau Ahupua'a. According to the *mo'olelo*, which was written by Sarah Nākoa (1993:6-9), Honokawailani was a deep pool filled with water which came up from the ground. It notes that Honokawailani was also a popular swimming area filled with fragrant water lilies. The following excerpt is from a version of the *mo'olelo* written by students from Waiau; the original version of the *mo'olelo* can be found in "Lei Momi o 'Ewa" (Nākoa 1993).

Here in Waiau there is a pond named Honokawailani. It is a mysteriously deep *ki'owai* filled with water that wells up from the ground. It was beautiful in the olden days. When you stood on a hillside, you could look down at Honokawailani, filled with fragrant water lilies and surrounded by grass. Honokawailani was famous for being a favorite swimming area for our kūpuna. [*Ke Kula Kaiapuni O Waiau* 2017]

3.1.9 Mo'olelo of Waimalu

3.1.9.1 Maihea and Naulu-a-Maihea

The following legend, which appeared in a Hawaiian language newspaper, also describes Waimalu taro cultivation, as well as sweet potato and *'awa*:

Maihea, a man, resided at Waimalu at a place called Punanalo. He cultivated sweet potatoes, taros and planted *awa*. The place where he planted the *awa* was on a hill in the upland of Waiawa. This is what he did up to the time when the gods [Kāne and Kanaloa] came to earth. He chewed the *awa*, cooked young taro leaves and strained the *awa* into coconut shells that had been polished till they shone. With the *awa* in cups, the taro greens in a dish made of gourd, and sweet potatoes in a shallow calabash, he called on the gods whose names he did not know, 'O unknown gods of mine, here is *awa*, taro greens and sweet potatoes raised by me, Maihea, the great farmer. Grant health to me, to my wife, and to my son. Grant us mana, knowledge and skill. Amama, it is freed.' Then he drank the *awa*. He did this a long time without knowing of the gods upon whom he called. . . . [*Ka Loea Kalai'aina*, 1 July 1899]

Another portion of the same legend concerning Waimalu relates how the gods Kāne and Kanaloa responded to Maihea's prayers:

Kāne and Kanaloa sent ashore at Waimalu a great whale. It lay there many days. Children climbed on it. Maihea's son did likewise. One day the whale moved into the water. The other children jumped off, but Maihea's son remained on the whale's back. It swam out to sea, and on to Kahiki. There 'Ula-a-Maihea, the farmer's son, 'was trained in priestly lore and all of its arts through the instructions of these gods, Kāne and Kanaloa.' [*Ka Loea Kalai'aina*, 10 June 1899]

Handy and Handy (1972) presented a final portion of the legend of Kāne and Kanaloa:

One day two strangers appeared at his door as Maihea was about to pray to his unknown gods. He poured 'awa into three cups and said, 'Let me pray to my unknown gods.' Then the two strangers revealed that they were his 'unknown gods,' Kāne and Kanaloa, and instructed him to call upon them by name. 'This was the beginning of the travels of these gods on earth. . . .' [Handy and Handy 1972:473]

The traditions of 'Ula-a-Maihea and Maihea likely relate to Site 112, Naulu-a-Maihea Heiau, located approximately 400 m northwest of the present study area. Site 112, as identified by McAllister (1933:104–105), is "destroyed" (Sterling and Summer 1978:14).

Fornander (1996) discusses a legend involving Naulu-a-Maihea and his ability to end a drought:

The legend further tells that the drought and famine further spread to the other islands, and that Naulu-a-Maihea, the famous prophet and seer who dwelt at Waimalu, Ewa district, Oahu, became concerned for the fate of the entire Hawaiian people. Seeing no signs of rain on the Kauai mountains, and none on the Kaala mountains of Oahu, he looked towards Maui and there on the peaks of Hanaula he saw a dark spot where the rain was concentrated. He knew at once that there the sons of Luahoomoe had taken up their abode, and he proceeded thither with offerings of pig, fowl, & c [sic] to appease their anger and procure rain. The sons of Luahoomoe, seeing Naulu arriving, descended from the mountain and met him at Kula. The meeting was cordial, rain followed and the country was relieved of the curse. . . .

Naulu-a-Maihea is said to have accompanied La'a-mai-kahiki from Kahiki, the southern groups. He was noted and feared as a sorcerer and a prophet, traits strongly characteristic of the priestly class of the southern immigrants. He built a Heiau at Waimalu, Ewa, Oahu, the foundation of which can still be seen. [Fornander 1996:42]

King Kalākaua's (1990) version of the drought provides additional details of Naulu-a-Maihea:

At that time there lived at Waimalu, in the district of Ewa, the celebrated priest and prophet Naulu-a-Maihea. No one in the Hawaiian priesthood of the past was ever more feared or respected. It was thought by some that he had visited the shadowy realms of *Milu*, and from *Paliuli* had brought back the waters of life. He must have been well on in years, for, as already mentioned, he is credited with having been the priest of Laa-mai-kahiki on the romantic journey of that prince from the southern islands.

In evidence of the great sanctity of Naulu, tradition relates that his canoe was upset during a journey from Waianae, Oahu, to Kauai. He was swallowed by a whale, in whose stomach he remained without inconvenience until the monster crossed the channel and vomited him up alive on the beach at Waialua, Kauai, the precise place of his destination. At another time, when crossing to Hawaii, and beset with adverse winds, two huge black sharks, sent by *Mooalii*, the shark-god of Molokai, towed him to Kohala so swiftly that the sea-birds could scarcely keep him company.

He built a *heiau* at Waimalu, the foundations of which may still be traced, and in the inner temple of the enclosure it is asserted that *Lono* conversed with him freely; and at his bidding the spirits of the living (*kahaoka*) as well as the shades of the dead (*unihipili*) made their appearance; for it was believed by the ancient Hawaiians that the spirits or souls of the living sometimes separated themselves from the body during slumber or while in a condition of trance, and became visible in distant places to priests of especial sanctity. [Kalākaua's 1990:169–170]

3.1.10 Mo'olelo of Kalauao

3.1.10.1 Opelemoemoe of Kalauao

Fornander relates an account of a resident of Kalauao named Opelemoemoe:

O Kalauao i Ewa, kahi noho o Opelemoemoe. He kanaka hana kupanaha loa ia, aohe ona lua mamua aku ona, a mahope mai ona a hiki i keia mau la hope. E hiki ia ia ke moe mai ka la mua o ka malama a ka la hope, a, ina nae e kui ka hekili, alaila ala; a i ole e kui ka hekili, aole oia e ala a hala ka makahiki.

Kalauao in 'Ewa was where Opelemoemoe made his home. This man performed some very extraordinary things, things the like of which had not been seen before or since. He could keep asleep from the first day of the month to the end of the month; but if a thunder storm occurred he would then wake up; otherwise he would keep on sleeping for a whole year. [Fornander 1918b:5(1):168–169]

One day Opelemoemoe traveled from his home in Kalauao west to the hill Pu'u o Kapolei in Honouliuli Ahupua'a. He fell asleep and appeared as if dead. Two men from Kaua'i, who were looking for a sacrifice for their *heiau*, came across the body and carried it back to Kaua'i in their canoe. During a thunderstorm, Opelemoemoe awoke, untied himself, and traveled to Waimea, where he married a local woman named Kalikookalauae. Sometime later, he told his wife that he was returning to O'ahu, and that if she had a son by him to name him Kalelealuaka and to give him his father's spear. As a mischievous child, Kalelealuaka's stepfather often punished him. He asked his mother about his real father, and she eventually told him.

'Ae, he makuakane kou, o Opelemoemoe ka inoa. Aia i Oahu i Kalauao, i Ewa ka aina, o Kahuoi nae ke kulanahale.' Haawi mai la o Kalikoolalauae i ka ihe ia Kalelealuaka, o ia ka maka a Opelemoemoe i waiho ai mahope no ke keiki.

Haalele aku la o Kalelealuaka ia Kauai, holo mai la a pae ma Pokai, i Waianae, hele mai la mauka a Ewa, a Kalauao, hiki i Kahuoi.

'Yes, you have a different father; he is in Kalauao, Oahu, in the district of Ewa, in the village of Kahuoi; his name is Opelemoemoe.' Kalikookalauae then handed Kalelealuaka the spear left by Opelemoemoe as the token by which he was to recognize his son.

Kalelealuaka then left Kauai and set sail, first landing at Pokai, in Waianae, and from there proceeded overland to Kalauao, Ewa, and then to Kahuoi. [Fornander 1918b:5(1):170–171]

The boy found his father working in his taro patches in Kalauao, and after proving that he was his son, they returned to the father's house in the village of Kahuoi together.

3.1.10.2 Keahiakahoe in Kalauao

Pu'u Keahiakahoe is a peak that divides Kalauao from Hālawā Ahupua'a along the Ko'olau Mountain Range. On the other side of the mountains at this point is the *ahupua'a* of Kāne'ōhe. In a condensed *mo'olelo*, Catherine Summers (Sterling and Summers 1978:206) explains that the peak was named for sibling quarrels that took place between two farmers, Kahoe and Kahuanui, living in or near Kāne'ōhe, their brother, a fisherman named Pahu, and their sister, Lo'e, who lived on Moku o Lo'e (Coconut Island) in Kāne'ōhe Bay. Pahu traveled to his brother's inland taro fields to exchange fish for *poi* (the Hawaiian staff of life, made from coked taro corms, pounded and thinned with water). Kahoe generously gave him all he needed, but Pahu only gave his brother the less desirable bait fish from his catch. Lo'e told Kahoe of their brother's deception, and although Kahoe continued to give his brother vegetables, he let Pahu know that he was aware of his lack of generosity. In time, a famine occurred. People cooked their vegetables in *imu* (earth ovens) at night so their neighbors could not see the smoke and come to ask for part of the food. Kahoe cleverly masked his fire so that the smoke traveled a half a mile inland, seeming to come from the mountain range summit. Pahu could not figure out where the *imu* was located. As he was gazing at the mountains, Lo'e saw him, and said, " 'So, standing with eyes gazing at Ke-ahi-a-Kahoe (Kahoe's fire).' Pahu, thinking of his past deeds had nothing to reply. This peak has been called Ke-ahi-a-Kahoe to this day" (Catherine Summers in Sterling and Summers 1978:206).

3.1.11 Mo'olelo of 'Aiea

3.1.11.1 Pōhaku o Ki'i (Stone of Ki'i) in 'Aiea

There are very few specific *mo'olelo* about the *ahupua'a* of 'Aiea. One *mo'olelo*, told by John Ka'imikaua, tells of Pōhaku o Ki'i, or the Stone of Ki'i. According to Mr. Ka'imikaua, a beautiful woman of chiefly rank named La'a fell in love with a handsome commoner named Ki'i. Her father, a high chief, forbade the marriage, but would relent if Ki'i could fulfill his wish. The high chief instructed Ki'i to go into the Ko'olau mountains and make a *lei* from the rare white *lehua* blossoms. If he returned before sunrise on the third day with the *lei* he could marry La'a. Ki'i gathered the *lehua* blossoms and rushed down to the high chief's home near a sacred bathing pond on the third day. He was within sight of the pond when the first rays of the sun rose over the Ko'olau mountains. He was turned to stone just above the pond, Pōhaku o Ki'i. La'a never married. She became the *mo'o wahine* (demi-goddess) of the pond, which was named Waiola'a, or the waters of La'a. She would pull down and drown any commoner who swam in the waters—only male chiefs could use the sacred pond, including Kakuhihewa and Kūali'i, as well as the god Kamapua'a. The last chief to bathe here was David Kalākaua while on his way to Honouliuli. Two palms were planted in historic times to mark the sacred pond, which now mark the entrance to the post office in 'Aiea (paraphrased from Napoka 1994:2).

Pōhaku o Ki'i was moved to the entrance of the 'Aiea post office due to the widening of Moanalua Road in 1994. This final resting place of Pōhaku o Ki'i is near the historic site of Waiola'a pond, which was reserved for royalty, but has since been filled in. Thus, the two lovers Ki'i and La'a have finally been reunited (Aiea High School and Alumni and Community Association 2009).

3.1.11.2 Keaiwa, the Healers' Heiau in 'Aiea

In ancient times, Keaiwa Heiau in 'Aiea was the site of a medicinal herb garden and training area for traditional healers:

At the time the Keaiwa heiau at the top of Aiea Heights was discovered in 1951 to be the ruins of an ancient medical center, few Hawaiians knew of its ancient usage.

Eminent anthropologists acknowledged that they had never heard of such centers but were convinced when several Hawaiians independently told of them.

In telling of these centers, Mrs. Mary Kawena Pukui, associate in Hawaiian culture at the Bishop Museum, translated the name Ke-a-iwa as 'Incomprehensible.'

The thought being that no one could explain the powers of the priests or the herbs used in healing.

She said Ke-a-iwa came from an obsolete word aiwa-iwa which means the mysterious or the incomprehensible.

Further confirmation of the use of Ke-a-iwa has lately been given me by Paul Keliikoa, a Hawaiian living in Aiea.

Mr. Keliikoa has the story from his grandmother Kamoekai.

In her day Ke-a-iwa was interpreted as 'a period of fasting and meditation' and the heiau was so named because novitiates in the art of healing spent long hours in fasting, praying and meditation.

Kamoekai also told her grandson that the very young were taken to Ke-a-iwa to be trained as kahuna lapaau. There they were taught the prayers needed to compound medicines and heal the sick.

They cared for the great herb garden which lay beyond the heiau walls.

After the novice learned his first steps in the art of the kahuna lapaau, he was sent out to other medical centers to learn the advanced art of diagnosis and other treatments.

Mr. Keliikoa's interpretation of the name means a change in the pronunciation. Not Ke-a-iwa, but Ke-ai-wa.

Ke-ai is the Hawaiian word for fasting. [Taylor 1959, reprinted in Sterling and Summers 1978:11-12]

3.1.12 Mo'olelo of Hālawa

3.1.12.1 Cultivation of 'Awa in Hālawa

In traditional lore, Hālawa was one of several places noted and remembered for its 'awa (Fornander 1919f:5[3]:610). One account tells us that the first 'awa plant was brought to Hawai'i by Oilikūkaheana from Kahiki (possibly Tahiti) and planted on Kaua'i. He brought it to Hawai'i for use in fishing. The use of 'awa as an offering to a shark guardian by fishermen is noted in Handy and Handy 1972:192. Mō'īkehā brought some 'awa plants with him to O'ahu and planted them at Hālawa. When they grew, he mentioned it to Oilikūkaheana who told him the name of

these 'awa plants was called Paholei. Mō'ikehā forgot the name and later, when the plants were much larger, he went to 'Ewa and told her about the plants. 'Ewa sent Mō'ikehā to get some plants. 'Ewa said,

'Let me first eat of this plant, and should I die, do not plant it for it would be valueless; but should I not die, then we will be rich.' When 'Ewa ate it she became drunk and was intoxicated all day. When she awoke she called the plant 'awa'; from thence forward this plant was called 'awa, the awa of Kaumaka'eha, the chief. [Fornander 1919f:608]

The story talks of 'Ewa and Hālawa as if they were two people separated and living apart. Fornander suggests that these sentences refer to a time when Hālawa was not an *ahupua'a* of 'Ewa, but was "apart" and at the "end of 'Ewa." After this, Hālawa was one of the noted places for the cultivation of 'awa (Fornander 1919f:5[3]:610).

3.1.12.2 Leilono, then entrance to Milu, the Underworld, in Hālawa

Leilono was a supernatural breadfruit tree ('Ulu o Leiwalo) whose branches appeared through a hole or crater in the ground. This hole (also called Leilono) was said to be the entrance whereby wandering spirits could enter the afterworld of Milu (*pō pau 'ole*), the *ao kuenta* or realm of wandering spirits, or the *ao 'aumakua* (ancestral spirit realm). The tree had two branches which were deceiving to look at, one on the east side of the tree and one on the west side. If a spirit climbed onto the west branch, it would wither and break off and he would plunge into the realm of Milu. If a spirit climbed onto the branch on the east, he would be able to see the '*aumākua* realm and receive help from his ancestors. This hole is described as being round and approximately 2 ft wide, on a piece of *pāhoehoe* lava. Leilono is in the neighboring district of Moanalua. However, very specific boundaries are given for it. Kamakau says it was

. . . close to the rock Kapūkakī and easterly of it . . . directly in line with the burial mound of Āliamanu and facing toward the right side of the North Star. . . . The boundaries of Leilono were Kapapakōlea on the east, [with] a huge caterpillar (*pe'elua nui*) called Koleana as its eastern watchman, and the pool Napeha on the west, with a *mo'o* [water spirit, lizard] the watchman there. If the soul was afraid of these watchmen and retreated, it was urged on by the '*aumakua* spirits, then it would go forward again and be guided to the '*aumakua* realm. If a soul coming from the Ālia (Āliapa'akai) side was afraid of the caterpillar, whose head peered over the hill Kapapakōlea, and who blocked the way, it would wander about close to the stream by the harness shop. This was not the government road (*alanui aupuni*) of former times, but was a trail customarily used by 'those of Kauhila'ele' [figuratively, the common people; the *la'ele*, old taro leaves, as contrasted with the *liko*, the new and choicer leaves — that is, the chiefs]. It was said that if a wandering soul entered within these boundaries it would die by leaping into the *pō pau 'ole*; but if they were found by helpful '*aumākua* souls, some wandering souls were saved. Those who had no such help perished in the *pō pau 'ole* of Milu. [Kamakau 1991a:48–49]

3.1.12.3 The Gods in Hālawā

Oral tradition tells us that Hālawā was the home of Papa, where she lived in the uplands with her parents, Kahakauakoko and Kūkalani'ehu. Papa is known for her generative role as the “earth mother.” Together with her husband, Wākea, they were the progenitors of the Hawaiian race. The Hale o Papa Heiau and ritual, which is the female component of the ancient *luakini* (large *heiau* where ruling chiefs prayed and human sacrifices were offered) ritual, probably takes its name from her. The Hale o Papa was the *heiau* for the female deities. Only chiefesses of the highest ranks were allowed to enter and partake of the specially dedicated foods (‘Īī 1959:39; Kamakau 1992:179, 380; Valeri 1985:245).

The Hawaiian pig-god, Kamapua‘a, made a stop in Hālawā and spent the night in a cave in Hālawā opposite Waipi‘o Peninsula at a place now called Hospital Point. He woke and then urinated in the sea, which “is why the fish of Pu‘uloa [Pearl Harbor] have such a strong odor.” The cave Keanapua‘a, which means “the pig’s cave” was named for this incident (Sterling and Summer 1978:10). The strong odor of fish only applied to fish caught on the eastern side of Pearl Harbor. In contrast, the fish from the western shore, at Pu‘uloa, were renowned for their good fragrance. All the market man had to say was, “these are from Ke Ahi [coastal point in Pu‘uloa/Honouliuli] and his supply would vanish in a short time” (Sterling and Summer 1978:44). Fishermen once used Keanapua‘a Cave for temporary habitation (Sterling and Summers 1978:59).

The gods Kāne and Kanaloa also came to Hālawā to visit a fisherman named Hanakahi. They built a fishtrap along the shore at Keanapua‘a Point in Hālawā, but “found it unsatisfactory.” They moved west across East Loch to the southern tip of Waipi‘o Peninsula at Po‘okala and built a second fishtrap, but also found it unsatisfactory. They then moved to the western shore at Pu‘uloa and built the fishtrap called Ka Pakule. They were pleased with this fishtrap, and they stocked it with every kind of fish. They returned to the house of Hanakahi and “told him of the enclosure they built for fish for him, that he and his descendants might be benefited” (Ka Wahi Pana o Ewa, *Ka Loea Kalaiaina* 8 July 1899, translation in Sterling and Summers 1978:43). The “tabu enclosure” was dedicated to Kū‘ulakai (a Hawaiian fishing deity) and seems to have had a resident *kahuna* (priest) until 1891 (Stokes 1908:211). Pu‘uloa was symbolic of the blessing and bounty of the gods and of the successful transactions between men and the gods. In each of these stories, the superiority of the marine resources and ceremonial importance of the western shore at the Pearl River mouth at Pu‘uloa is contrasted favorably with the less pleasant central section (Waipi‘o Peninsula) and the eastern shore (Hālawā).

3.2 Wahi Pana

Hawaiians recognize several land divisions in varying scales, including the *moku*, the *kalana* (smaller land division than a *moku*), the *ahupua‘a*, and the *‘ili* (Malo 1976:16). S.K. Kuhano wrote in 1873 (cited in Kame‘eleihiwa 1992:330) that O‘ahu was divided into six *kalana* (although later scholars refer to these same divisions as *moku*)—Kona, ‘Ewa, Wai‘anae, Waialua, Ko‘olau Loa and Ko‘olau Poko—that were further divided into 86 *ahupua‘a*. Within ‘Ewa, there were 12 *ahupua‘a* including (from west to east) Honouliuli, Hō‘ae‘ae, Waikele, Waipi‘o, Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, ‘Aiea, and Hālawā (Kame‘eleihiwa 1992:330) (Figure 21). Modern maps and land divisions still generally follow the ancient system and use the same land divisions. This report covers 11 of the 12 of the *ahupua‘a* of ‘Ewa, from Honouliuli east to Hālawā, excluding the *ahupua‘a* of Hō‘ae‘ae.

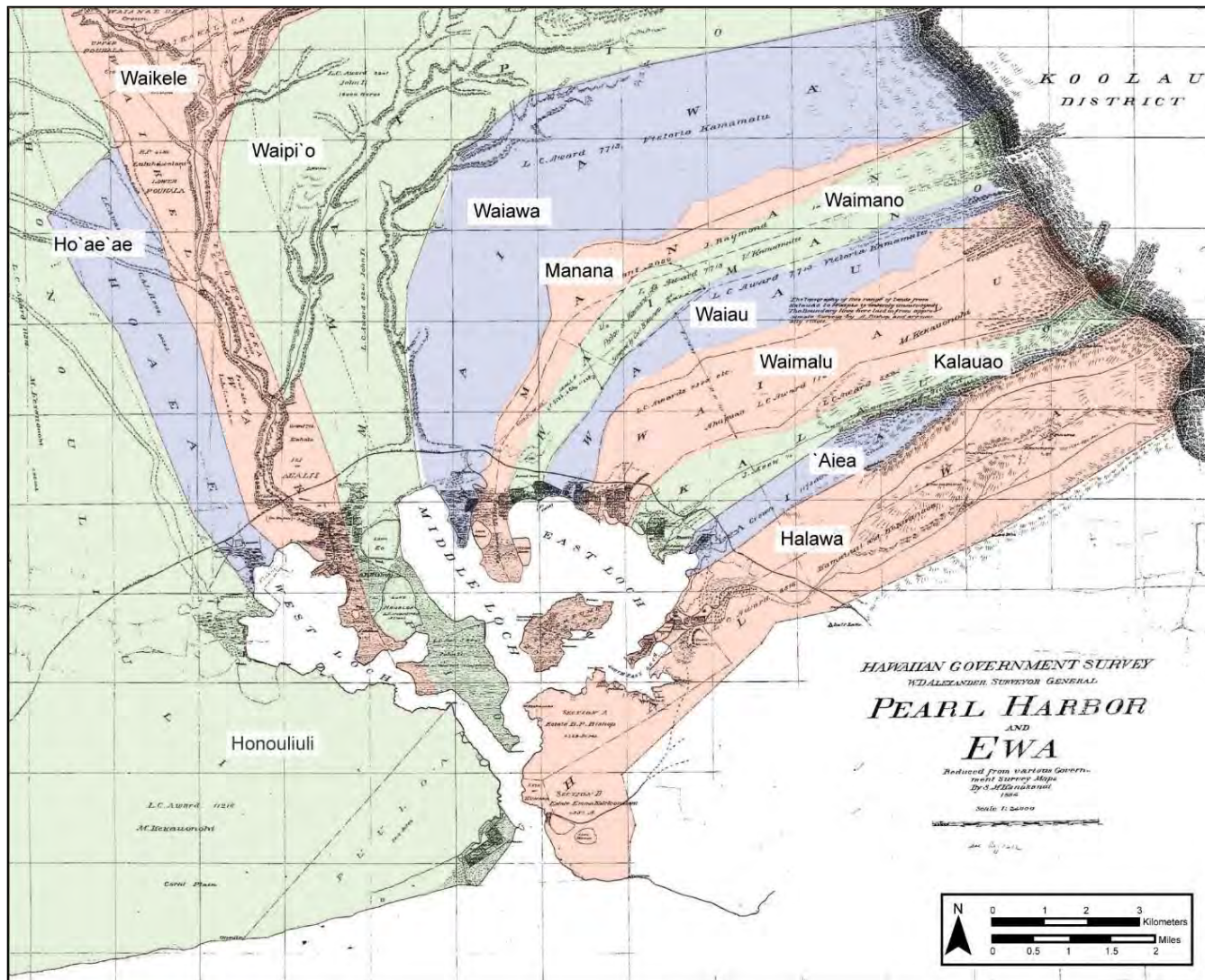


Figure 21. Map of Pearl Harbor, Ewa by S.M. Kakanui (1894) showing the 12 ahupua'a in the moku of 'Ewa (Registered Map 1739)

‘Ewa is depicted as an abundant and populated land where chiefs of distinguished lineages were born and resided. The land was fertile and well-fed by mountain streams that helped sustain the agricultural lifestyle needed to support the elaborate social systems of chiefs, their households, and their people. An examination of the place names reveals that water was a very important factor in this district. Six of the 12 *ahupua‘a* in ‘Ewa—Waikele, Waipi‘o, Waiawa, Waimano, Waiiau, and Waimalu—begin with *wai*, the Hawaiian word for water. The fact that there were so many fishponds in ‘Ewa, more than any other district on O‘ahu, indicates that agricultural and aquacultural intensification was a direct link to the chiefs who resided there and to the increasing needs of the population.

Place names, or *wahi pana*, are an integral part of Hawaiian culture. “In Hawaiian culture, if a particular spot is given a name, it is because an event occurred there which has meaning for the people of that time” (McGuire 2000:23). The *wahi pana* were then passed on through language and the oral tradition, thus preserving the unique significance of the place. Hawaiians named all sorts of objects and places, points of interest that may have gone unnoticed by persons of other cultural backgrounds. Hawaiians named taro patches, rocks, and trees that represented deities and ancestors, sites of houses and *heiau*, canoe landings, fishing stations in the sea, resting places in the forests, and the tiniest spots where miraculous or interesting events are believed to have taken place (Pukui et al. 1974:x).

3.2.1 Place Names

Place names and their meanings in this section are compiled from a number of sources. The primary compilation source is Lloyd Soehren’s online database “Hawaiian Place Names.” Soehren has compiled all names from mid-nineteenth century land documents, such as Land Commission Awards (LCA) and Boundary Commission (BC) reports. The database also includes place name meanings from the definitive book on Hawaiian place names, Pukui, Elbert, and Mookini’s *Place Names of Hawaii* (Pukui et al. 1974). In the general text, all place name meanings are from this source, unless otherwise noted.

When Pukui et al. 1974 did not give a meaning to a place name, Soehren sometimes suggests a possible meaning for simple (non-compound) words using Pukui and Elbert’s *Hawaiian Dictionary*. The tables on place names in this report list all of the important topographic and land division place names in Soehren’s list, plus additional place names found on historic maps in the CSH library. Additional meanings were added from a 1922 list of place names compiled by Thomas Thrum, which was published in the 1922 edition of Lorrin Andrew’s *A Dictionary of the Hawaiian Language*.

3.2.1.1 Place Names of Honouliuli

Honouliuli is the largest *ahupua‘a* in the *moku* of ‘Ewa. One translation of the name for this district is given as “unequal” (*Saturday Press*, 11 August 1883). Others translate the word as “strayed” and associate it with the legends of the gods, Kāne and Kanaloa:

When Kane and Kanaloa were surveying the islands they came to Oahu and when they reached Red Hill saw below them the broad plains of what is now Ewa. To mark boundaries of the land they would throw a stone and where the stone fell would be the boundary line. When they saw the beautiful land lying below them, it was their thought to include as much of the flat level land as possible. They hurled

the stone as far as the Waianae range and it landed somewhere, in the Waimanalo section. When they went to find it, they could not locate the spot where it fell. So Ewa (strayed) became known by the name. The stone that strayed. [Sterling and Summers 1978:1]

Honouliuli means “dark water,” “dark bay,” or “blue harbor” and was named for the waters of Pearl Harbor (Jarrett 1930:22), which marks the eastern boundary of the *ahupua'a*. The Hawaiians called Pearl Harbor Pu'uloa (*lit.* long hill). Another explanation for the names comes from the “Legend of Lepeamoā,” the chicken-girl of Pālama. In this legend, Honouliuli is the name of the husband of the chiefess Kapālama and grandfather of Lepeamoā. The land district Honouliuli was named for the grandfather of Lepeamoā (Westervelt 1923:164–184).

It seems likely the boundaries of the westernmost *ahupua'a* of 'Ewa were often contested with Wai'anae people. The 'Ewa people could cite divine sanction that the dividing point between Wai'anae and 'Ewa was between two hills at Pili o Kahe:

The ancient Hawaiians said the hill on the 'Ewa side was the male and the hill on the Wai'anae side was female. The stone was found on the Waianae side hill and the place is known as Pili o Kahe [Pili=cling to, Kahe=flow]. The name refers, therefore, to the female or Waianae side hill. And that is where the boundary between the two districts runs. [Sterling and Summers 1978:1]

Honouliuli has a number of topographic features, peaks, streams, gulches, coastal points, and a number of ancient villages. The place names, the types of features, and name meanings are listed in Table 2. Besides the topographic points, there are 21 *'ili* names listed in Māhele documents. It is possible there were more *'ili* in Honouliuli (and other *ahupua'a*), but if no lands were claimed or awarded in these *'ili*, they are not present in the Māhele records.

The 21 *'ili* in Honouliuli were all *'ili āina* lands, which is a land in which the chief of the *'ili* owed tribute to the chief of the *ahupua'a*. There was a second type of common *'ili* in other *ahupua'a*, called an *'ili kū*, short for *'ili kūpono*. This type of *'ili* was nearly independent of any specific *ahupua'a* (although it was usually within the boundary of a specific *ahupua'a*). Tribute for this type of land was usually owed directly to the king, not to the chief of the *ahupua'a*.

Table 2. Honouliuli place names

Place	Type	Meaning	Source
Akupu	Peak, spring		
Anianikū	Cove		
Awanui	Gulch	Big harbor, or big <i>kawa</i> plant	Pukui and Elbert 1986
'Ēkahanui	Gulch	Large bird's nest fern	Pukui et al. 1974
Hāpapa, Pu'u	Peak	Rock stratum hill; a shallow	Thrum 1922
Hoakalei	Spring	<i>Lei</i> reflection	Pukui et al. 1974
Honouliuli	Stream, gulch	Dark bay; blue harbor	Thrum 1922
Huliwai	Gulch	Water search	Pukui et al. 1974
Hunehune	Gulch	Tiny	Pukui et al. 1974

Place	Type	Meaning	Source
Ka'ākau	<i>'Ili 'āina</i>	The right, or the north	Pukui and Elbert 1986
Ka'aikukui	Gulch	The candlenut root	Pukui et al. 1974
Ka'aيمانō	Pond	Possibly, the shark food	Pukui and Elbert 1986
Ka'aumakua	<i>Pu'u</i> (peak), <i>'ili 'āina</i>	The family god	Pukui et al. 1974
Kahe	Point	Flow	Pukui et al. 1974
Kahe, Pu'u		Flow	Pukui et al. 1974
Kaihuopala'ai	West Loch	The nose of Pala'ai	Pukui et al. 1974
Kaihuopala'ai	<i>'Ili 'āina</i>	The nose of Pala'ai	Pukui et al. 1974
Kā'ilikahi	<i>'Ili 'āina</i>	Snatch once	Pukui et al. 1974
Kalaeloa	<i>'Ili 'āina</i>	The long point	Pukui et al. 1974
Kalaeloa	Point	The long point	Pukui et al. 1974
Kalahu	Pond		
Kalo'i	Gulch	The taro patch	Pukui et al. 1974
Kalua'a	Gulch		
Kaluamo'oiki	<i>'Ili 'āina</i>		
Kama'ipipipi	<i>'Ili 'āina</i>		
Kamilomilo	<i>'Ili 'āina</i>	To twist	Thrum 1922
Kamoku	<i>'Ili 'āina</i>	The district, or the cut-off portion	Pukui et al. 1974
Kānehili	Plain		
Kānehoa, Pu'u	Peak	A native shrub; Kāne's friend	Thrum 1922
Kanukuopu'uloa	Point	The entrance of Pearl Harbor	
Kapākule	<i>Loko</i> (pond)	The <i>akule</i> fish enclosure	Pukui et al. 1974
Kapāmuku	<i>Loko</i>	The short wall	Pukui and Elbert 1986
Kapapapuhi	Point, <i>'ili 'āina</i>	The numerous eels	Thrum 1922
Kapolei	Gulch	Beloved Kapo, a sister of Pele	Pukui et al. 1974
Kapolei, Pu'u o	Hill	Beloved Kapo, a sister of Pele	Pukui et al. 1974
Kapuai, Pu'u	<i>Pu'u</i>	Footstep	Thrum 1922
Kaua, Pu'u	<i>Pu'u</i>	War hill or fort hill	Pukui et al. 1974
Kaula	Bay		
Kaulaula	<i>'Ili 'āina</i>	The red one	Thrum 1922
Kaupe'a	Plain		
Keahi	Point	The fire	Pukui et al. 1974
Keka'a	Point	The rumble	Pukui et al. 1974
Keon'ō'io	Gulch	The sandy place with bonefish (<i>'ō'io</i>)	Pukui et al. 1974

Place	Type	Meaning	Source
Kepoe	<i>'Ili 'āina</i>		
Kīhewamakawalu	<i>Loko</i>		
Kolekole	Pass	Raw, scarred	Pukui et al. 1974
Ko'olina	Village		
Kualaka'i	Village, <i>'ili 'āina</i>	<i>Tethys</i> sp.	Pukui et al. 1974
Ku'ina, Pu'u	<i>Pu'u, heiau</i>		
Kunia	<i>'Ili 'āina</i>	Burned	Pukui and Elbert 1986
Kupaka'akahi	Beach		
Ku'ua, Pu'u	<i>Pu'u, heiau</i>	Relinquished hill	Pukui et al. 1974
Laulaunui	Islet	Large leaf package	Pukui et al. 1974
Līhe'e	<i>'Ili 'āina</i>	Cold chill	Pukui et al. 1974
Limaloa	Gulch	Long arm	Pukui et al. 1974
Loloulu	<i>'Ili 'āina</i>		
Makai'i	<i>'Ili 'āina</i>		
Makaīwa	Gulch	Mother of pearl eyes	Pukui et al. 1974
Makakilo, Pu'u	<i>Pu'u</i>	Observing eyes	Pukui et al. 1974
Makalapa	Gulch	Ridge features	Pukui et al. 1974
Manawahua, Pu'u	<i>Pu'u</i>	Great grief hill, or nausea hill	Pukui et al. 1974
Manawaiahu	Gulch	Bird water pool	Pukui et al. 1974
Manawai'elelū	Gulch	Cockroach water branch	Pukui and Elbert 1986
Manuwaikealae	Gulch		
Maui	<i>'Ili 'āina</i>		
Maunakapu	Peak	Sacred mountain	Pukui et al. 1974
Maunauna	<i>Pu'u, gulch</i>	Mountain sent on errands	Pukui et al. 1974
Ma'ūakapua'a	<i>'Ili 'āina</i>		
Mo'opunea Pu'u	<i>Pu'u</i>	Grandchild hill	
Nalowale	<i>Heiau</i>	Lost, forgotten	Pukui and Elbert 1986
Nāmo'opuna	Gulch	The grandchildren	Pukui and Elbert 1986
Nāpepeiao'ōlelo	<i>'Ili 'āina</i>		Pukui and Elbert 1986
Niuke'e	<i>'Ili 'āina</i>	Bent coconut tree	
'Oki'okilepe	<i>Loko</i>	Cut strips	Pukui et al. 1974
One'ula	Village, beach	Red sand	Pukui et al. 1974
Pālailai	Gulch	Young <i>lai</i> fish	Pukui et al. 1974
Pālailai, Pu'u	<i>Pu'u</i>	Young <i>lai</i> fish hill	Pukui et al. 1974

Place	Type	Meaning	Source
Pālāwai	Gulch	Kind of sea moss	Thrum 1922
Pālehua	<i>Pu'u</i>	<i>Lehua</i> flower enclosure	Pukui et al. 1974
Palikea	<i>Pu'u</i> , ridge	White cliff:	Pukui et al. 1974
Pāmoku	<i>Loko</i>		
Paupauwela (Poupouwela)	<i>'Ili 'āina</i>	An angry person	Thrum 1922
Pili o Kahe	Point	Clinging to Kahe	Pukui et al. 1974
Pilo o Koe	Gulch		
Pōhākea	Pass	White stone	Pukui et al. 1974
Pōhaku Palaha	<i>Pōhaku</i>	Broad rock	Thrum 1922
Pō'aiwaikēle	<i>'Ili 'āina</i>	(spelling from Soehren 2009)	
Polapola	<i>'Ili 'āina</i>	Improved in health	Pukui et al. 1974
Poliwai	Gulch	Water bosom	Pukui et al. 1974
Po'ohilo	<i>'Ili 'āina</i>		
Poulihale	Gulch	Dark house	Pukui et al. 1974
Poulihale, Pu'u	<i>Pu'u</i>	Dark house hill	Pukui et al. 1974
Puali'i	Gulch	Small flower	Pukui and Elbert 1986
Pua'alu'u	<i>'Ili 'āina</i>	Diving pig	Pukui et al. 1974
Pu'uloa	<i>'Ili 'āina</i> , beach	Long hill	Pukui et al. 1974
Pu'umai'alau	Gulch	Hill of many bananas, or many banana stalks	Pukui and Elbert 1986
Wai'eli	Gulch	Dug water	Pukui et al. 1974
Waimānalo	Gulch	Potable water:	Pukui et al. 1974
Waimanana	<i>'Ili 'āina</i>	Extended water	Pukui and Elbert 1986

3.2.1.2 Place Names of Waikele

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

The most famous location in Waikele is Waipahu Spring (“bursting water”); the waters of this spring were used to irrigate many of the ancient taro patches on the Waikele flood plain and later the rice and sugarcane crops. It was originally spelled Waipahū, and was the home of the shark goddess Ka'ahu'pāhau. As a town and sugar mill expanded around the spring, the entire *makai* area of Hō'ae'ae and Waikele became known as Waipahu, and the older names were no longer used.

A resident clarified this change in names:

‘Waipahu’ . . . is not a tract of land, but only a spring located in Waikele. The Oahu Railway Company is the culprit responsible for misuse and confusion, when it built its station at Kaohai and called [it] ‘Waipahu Station.’ The Oahu [Sugar Plantation] Mill is situated on the plateau of ‘Keonekuilimalaulaoewa’ (the arm-in-arm-plateau of ewa [‘Ewa]), Waikele. [Simeon Nawaa, Honolulu Star-Bulletin, 16 October 1956 in Sterling and Summers 1978:1]

Above Waipahu Spring was a rock face called Pōhaku pili (clinging stone), which was said to have been placed there by the Hawaiian pig-god, Kamapua'a (Mauricio 1997:7). The taro lands along Waipahu Spring and the coast were divided among at least 34 'ili, 14 'ili 'āina, and 20 'ili kū. The large number of 'ili, especially the large number of 'ili kū, which were often associated with high *ali'i* or the king, emphasize the richness and importance of the fertile taro lands and fishponds of Waikele.

Table 3. Waikele place names

Place Name	Type	Meaning	Source
Ahualii	'Ili kū		
Apokaa	Lele		
Aualii	'Ili kū	Reign of the chief	Thrum 1922:627
'Aui'ole	'Ili kū	Unswerving	Thrum 1922:627
Hananu	<i>Pu'uone</i> (beach dune)		
Hanohano	'Ili kū		
Hapupu	<i>Heiau</i>		
Hopenui	'Ili 'āina	Big behind	Pukui and Elbert 1986
Hulumanu	'Ili 'āina	1. bird feathers. 2. green seaweeds (<i>Caulerpa</i> spp.)	Pukui and Elbert 1986
Ipupala'ai	'Ili 'āina		
Ka'auku'u	<i>Loko</i>		
Ka'elekū	Lele	The basaltic rock	Pukui et al. 1974
Kahaku'ōhi'a	'Ili kū	1. the 'ōhi'a log to be caved into a canoe; 2. main 'ōhi'a image in a <i>heiau</i>	Pukui and Elbert 1986
Kahāpu'upu'u	'Ili kū		

Place Name	Type	Meaning	Source
Kahiena	<i>Kū'ula</i> (fishing shrine)	The soft, porous stone used to polish	Pukui and Elbert 1986
Kanupo'o	<i>'Ili kū</i>	Head planting	Thrum 1922 624
Kaohai	<i>'Ili kū</i>	1. monkeypod (<i>Samanea saman</i>). 2. A native legume (<i>Sesbania tomentosa</i>)	Pukui and Elbert 1986
Kapakahi	<i>'Ili kū</i>	Crooked	Pukui et al. 1974
Kapakahi	Stream	Crooked	Pukui et al. 1974
Kapuna	<i>'Ili 'āina</i>	The spring	Pukui et al. 1974
Kauhakiniau	<i>Kū'ula</i>		
Kauhiumauma	<i>'Ili 'āina</i>	The chest cover	Pukui and Elbert 1986
Kawelowahine	<i>Loko</i>		
Kea'akukui	Stream	The candlenut tree root	Pukui and Elbert 1986
Keahupuaa	<i>'Ili 'āina</i>	1. land division. 2. the pig altar	Pukui and Elbert 1986
Keonekuilima-laulāo'ewa	<i>Kū'ula</i>		
Kepo'o	<i>Pu'uone</i>	The head	Pukui and Elbert 1986
Koalipe'a	<i>'Ili 'āina</i>		
Koheo'o	<i>'Ili 'āina</i>		
Kukapoholani	<i>Loko</i>		
Kūlokele	Boundary point, stone		
Līhu'e	<i>'Ili 'āina</i>	Cold chill	Pukui et al. 1974
Loko Hanahou	<i>Loko</i>	New pond	Pukui and Elbert 1986
Loko Kahaku'ōhi'a	<i>Loko</i>	The lord of 'ōhi'a trees	Thrum 1922:636
Loko Keālialia	<i>Loko</i>	The salty pond	Pukui and Elbert 1986
Loko Kepoe	<i>Loko</i>		
Loko Kuhena	<i>Loko</i>		
Loko Kūhewa	<i>Loko</i>	Sudden attack, as of stroke or heart failure—pond	Pukui and Elbert 1986
Loko Kūpelo	<i>Loko</i>	Camphor pond	Pukui and Elbert 1986
Loko Lilio	<i>Loko</i>	Tight, taut as a rope - pond	Pukui and Elbert 1986
Loko Mokuola	<i>Loko</i>	Island of safety or recovery	Thrum 1922:660
Loko o Ma'aha	<i>Loko</i>		
Loko o Pouhalaiki	<i>Loko</i>		
Loko Paukamumu	<i>Loko</i>		

Place Name	Type	Meaning	Source
Loko Pūhau	<i>Loko</i>	Icy spring pond	Pukui and Elbert 1986
Malau	<i>Loko</i>	Calmness	Thrum 1922:658
Māpuna	<i>'Ili 'āina</i>	Bubbling spring	Pukui and Elbert 1986
Mauakapuaa	<i>Lele</i>		
Miki	<i>'Ili 'āina</i>	Quick, active, nimble	Pukui and Elbert 1986
Moko'ula	<i>Heiau</i>	Red lizard	Pukui and Elbert 1986
Moku'ula	<i>Loko</i>		
Mo'olea	<i>Kū'ula</i>		
Nalowale	<i>Heiau</i>	Lost, forgotten	Pukui and Elbert 1986
Ni'o	<i>'Ili 'āina</i>		
O'ahunui	Stone, boundary point		
'Ōhua	<i>'Ili kū</i>	1. retainer; 2. young of certain fish	Pukui and Elbert 1986
'Ōni'o	<i>'Ili kū</i>	Spotted, streaked with various colors	Pukui and Elbert 1986
Pāhao	<i>'Ili kū</i>	1. iron fence or dish. 2. mysterious, puzzling	Pukui and Elbert 1986
Pahuwiliwili	<i>lele</i>	Box or stake or wiliwili wood	Pukui and Elbert 1986
Pāiwa	<i>'Ili kū</i>	Nine times, nine at a time	Pukui and Elbert 1986
Pāpa'a	<i>'Ili kū</i>		
Pōhaku Pili	Stone, boundary point	Clinging stone	Pukui et al. 1974
Pōniu'ōhua	Stone, boundary point		
Poniohua	Stream	Anointed on the night of Hua	Thrum 1922:667
Pouhala	<i>'Ili kū</i>	Pandanus point	Pukui et al. 1974
Pouhala	<i>Loko</i>	Pandanus point	Pukui et al. 1974
Ulemoku	<i>'Ili kū</i>	Severed penis	Pukui and Elbert 1986
Ulumalu	<i>'Ili kū</i>	Peaceful grove	Pukui and Elbert 1986
Ulumoku	<i>'Ili 'āina</i>	Island growth	Thrum 1922:671
Ulumoku	<i>Loko</i>	Island growth	Thrum 1922:672
Wai'eli	Stream		
Waikakalaua	<i>'Ili kū</i>	Water rough [in] rain	Pukui et al. 1974
Waikakalaua	Stream, ditch	Water rough [in] rain	Pukui et al. 1974
Waikele	<i>'Ili kū</i>	Muddy water	Pukui et al. 1974
Waikele	<i>Ahupua'a</i>	Muddy water	Pukui et al. 1974

Place Name	Type	Meaning	Source
Waikele	Stream	Muddy water	Pukui et al. 1974
Waipahu	<i>'Ili kū</i> , town	Bursting water	Pukui et al. 1974

3.2.1.3 Place Names of Waipi'o

To the east of Waikele is Waipi'o, which means “curved, winding water” (Sterling and Summers 1978:1), probably a reference to the curving shorelines of the Middle Loch of Pearl Harbor, with its many adjacent fishponds. The loch waters were extensively used for gathering *limu* (seaweed), shellfish and other invertebrates, and fish. After Honouliuli, Waipi'o is the next largest *ahupua'a* in 'Ewa, extending all the way from the tip of Waipi'o Peninsula between the West and Middle lochs up to the boundary with the Ko'olau Mountains. In Waipi'o Ahupua'a, the major stream/gulch is called Kīpapa (“placed prone”), but there are two other gulches in the upland area, Panahakea and Pānakauahi (“touched by the smoke”). Pu'u Ka'aumakua is the highest peak; it marks the boundary point between Waipi'o, Wahiawā District, and the Ko'olaupoko District at the *mauka* western corner of the *ahupua'a*. A secondary peak on the Waipi'o/Waiawa border was called Pu'u Kamana (“hill [of] the supernatural power”). Forty-three *'ili* are mentioned in Māhele documents, comprised of 39 *'ili 'āina* and four *'ili kū*.

Table 4. Waipi'o place names

Place Name	Type	Meaning	Source
Ahu'ena	<i>Heiau</i>	Red-hot heap	Pukui et al. 1974
'Aiali'i	<i>Loko</i>	Chiefly food	Pukui and Elbert 1986
Aimalino	<i>'Ili 'āina</i>		
'Ainai'a	<i>Loko</i>	Eat porpoise	Pukui and Elbert 1986
Ala	<i>'Okipu'u</i> (forest clearing)		
'Ēo	<i>'Ili 'āina</i>	Container full of food	Pukui and Elbert 1986
'Ēoiki	<i>'Ili 'āina</i>	Small container full of food	Pukui and Elbert 1986
Hala'ula	<i>'Ili 'āina</i>	Red pandanus	Pukui et al. 1974
Hālaulani	Place	High-born chief's large house	Pukui et al. 1974
Hanaloa	<i>'Ili kū</i>	Long bay	Pukui et al. 1974
Hanaloa	<i>Loko</i>	Long bay	Pukui et al. 1974
Hanapouli	<i>'Ili 'āina</i>	Dark bay	Pukui and Elbert 1986
Hanauaka	<i>'Okipu'u</i>		
Heiau o Umi	<i>Heiau</i>	Temple of 'Umi	Pukui and Elbert 1986
Hōmaikai'a	<i>'Ili 'āina</i>	Perhaps, give me the fish	Pukui and Elbert 1986
Honopue	<i>'Ili kū</i>	Many hill plantings	Thrum 1922:633
Hopenui	<i>'Ili 'āina</i>	Big behind	Pukui and Elbert 1986
Huaka	<i>Kahua hale</i> (residence)		

Place Name	Type	Meaning	Source
Ka'ahukahua	<i>Ku'ula</i>	The memorial pile	Thrum 1922:635
Kaakaulani	<i>'Ili 'āina</i>		
Ka'alakea	<i>'Ili 'āina</i>	The white path	Thrum 1922:635
Kahaole	<i>'Ili 'āina</i>	The foreigner	Thrum 1922:637
Kahema	<i>'Ili 'āina</i>	The left, or the south	Pukui and Elbert 1986
Kahui	<i>Loko</i>	Junction	Thrum 1922:638
Kakaia	<i>'Ili 'āina</i>		
Kalua'alaea	<i>'Ili 'āina</i>	The ochorous earth pit	Pukui and Elbert 1986
Kalua'alaea	<i>Loko</i>	The ochorous earth pit	Soehren 2009
Kamālua	<i>'Ili 'āina</i>	Perhaps, the planting hole; or, two children	Pukui and Elbert 1986; Thrum 1922:642
Kanonokunono	<i>'Ili 'āina</i>		
Kapaoolo	<i>'Ili 'āina</i>		
Kauakā	<i>'Ili kū</i>	Perhaps, a boisterous person, or upheld shadow	Pukui and Elbert 1986; Thrum 1922:646
Kauakahilolo	<i>'Ili 'āina</i>		
Keakialua	<i>'Ili 'āina</i>		
Keio	<i>'Ili 'āina</i>	An ancient game	Thrum 1922:650
Ki'ona'ole	<i>'Ili 'āina</i>	No privy	Pukui and Elbert 1986
Kipapa	Stream	Placed prone	Pukui et al. 1974
Kū'ai'ōpelu	<i>'Ili 'āina</i>	Trading in 'ōpelu (fish)	Thrum 1922:653
Kūki'o	<i>'Ili 'āina</i>	Settled dregs	Pukui et al. 1974
Kūmelewai	Place	Like water singing	Pukui et al. 1974
Kumupali	<i>'Ili 'āina</i>	Base [of] cliff	Pukui and Elbert 1986
Lā'auuli	<i>'Ili 'āina</i>		
Laehopu	Coastal point		
Lāuli	<i>'Ili 'āina</i>	Dark, overcast	Pukui and Elbert 1986
Lepau	<i>'Ili 'āina</i>		
Loko 'Ēo	<i>Loko</i>	A filled container	Thrum 1922:628
Manaloa	<i>'Ili 'āina</i>		
Mauoha	<i>'Ili 'āina</i>		
Moa'ula	<i>Heiau</i>	Red chicken	Pukui et al. 1974
Mohoa	<i>'Ili 'āina</i>		
Mokoa	<i>'Ili 'āina</i>		
Nakunui	<i>'Ili 'āina</i>		

Place Name	Type	Meaning	Source
Nāmo'oa	<i>'Ili 'āina</i>	The two <i>mo'oa</i>	Pukui and Elbert 1986
Pakikakika	<i>'Ili 'āina</i>		
Pāpōhaku	<i>'Ili 'āina</i>	Stone fence or wall	Pukui and Elbert 1986
Pookala	Coastal point		
Po'opalupalu	<i>'Ili 'āina</i>	Soft head	Pukui and Elbert 1986
Pu'ōpae	<i>'Ili 'āina</i>	Perhaps, "shrimp hill"	Pukui et al. 1974
Pu'u Koali	<i>Kū'ula</i>	Morning glory hill	Pukui and Elbert 1986
Pu'u Pōhaku	<i>Pu'u</i> (hill)	Stone hill	Pukui and Elbert 1986
Ulei	<i>'Ili 'āina</i>		
Ulu	<i>'Ili kū</i>	Growth, or breadfruit	Thrum 1922:671
Waihaka	<i>'Ili 'āina</i>		
Waihaku	<i>'Ili 'āina</i>		
Waipi'o	<i>Ahupua'a</i>	Curved water	Pukui et al. 1974
Waipio	coastal point	Curved water	Pukui et al. 1974
Walker	bay	[in West Loch]	

3.2.1.4 Place Names of Waiawa

The meaning and correct pronunciation of Waiawa is in dispute. It is variously spelled Waiawa or Wai'awa, which leads to different interpretations. *Awa* is both the word for milkfish (*Chanos chanos*) or a harbor, cove, channel or passage (Pukui and Elbert 1986:33). In a portion of a chant for Kūali'i, documented by Fornander (1917b:4[2]:394–400), Waiawa is noted for its *awa* fish, *E ku'u kaua i ka loko awa—o Waiawa*. Fornander offers the translation as "Let us cast the net in the awa-pond—of Waiawa." This would be no surprise, as there were numerous fishponds in Waiawa. With an alternate spelling, *'awa* is the word for the native plant used to make a mild sedative drink by Hawaiians. Traditional accounts suggest Waiawa may have been acknowledged in early times as the site of a special variety of the *'awa* plant:

I ka wa i hiki mai ai ua eueu nei a ku ma ka puka o kahi e komo ai i loko o ua kuahiwi nei o Konahuanui, aia noi na makana a pau ma ka lima o Keanuenu, oia hoi ka puua-pukoa, he puua ehu keia o ka hulu, a he pu awa popolo, aole i laha nui keia awa ma keia pae aina, aia nae keia awa e ulu nei i keai wa ma uka o Waiawa ma Ewa ae nei.

When the wondrous maiden [Keomelemele] arrived at the entrance to the mountain of Konahuanui, all the offerings were in charge of Ke-anuenu, a puko'a or reddish brown pig, a clump of dark *'awa* [*pu 'awa popolo*] which was not common in these islands. This variety of *'awa* now grows in the upland of Waiawa, down here in 'Ewa. [Manu 2002:50, 138]

The late Tin Hu Young, who grew up in Waiawa, suggested a different origin of the name Waiawa. During his interview, he gave this explanation:

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

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

Waiawa is bound by the shore of the Middle Loch of Pearl Harbor on the *makai* side, the Ko'olau Mountain Range on the *mauka* side, by Waipi'o Ahupua'a to the west, and by Mānana Ahupua'a to the east. Waiawa Ahupua'a is watered by Waiawa Stream, which in the upper portion splits into Waiawa and Mānana streams. The point of the ridge called Lae Pōhaku (stone point) is a boundary point between Waiawa and Mānana. *Makai* of the ridge was another boundary point called Pohakea ("white rock").

Three boundary points on the west are Pu'u Kamana (hill of the supernatural power), Pu'u Pōhaku (stone hill), and Laehopu. Panahakea Gulch (touched by the smoke) extends from the summit of Pu'u Kamana *makai* toward Waipi'o, and the east ridge of Pānakauahi Gulch in Waipi'o, defines the *makai* western border of Waiawa. Laehopu marks the coastal point (*lae*) that divides Waiawa and Waipi'o on the Middle Loch shore. The mid-nineteenth century Māhele documents concerning LCAs indicate there were at least 15 'ili in Waiawa, all of them 'ili 'āina.

There are several other topographic points listed in mid-nineteenth century documents (Soehren 2009), but these could not be found on any available historic maps. A hill called Kanukumanu (the bird's beak) served as a boundary point for Māhele award (LCA 9372, 'āpana [lot] 2; near the intersection of Waiawa Stream and the Government Road). In his discussion of trails through Waiawa, 'Īī (1959) mentions the stream Kukehi (another name for the *makai* end of Waiawa Stream) and the *maika* (ancient Hawaiian game suggesting bowling) fields of Haupū and Pueohulunui. Pueohulunui was on the border between Waiawa and Waikele at the "crossroads, where one leads to Waialua and the other branches off to Honouliuli" (Sterling and Summers 1978:18).

A translation of Moses Manu's "He Mo'olelo Ka'ao Hawai'i no Lauka'ie'ie," provided by Maly and Maly, notes that various places in Waiawa were named by Kāne and Kanaloa.

From this place, Makanikeoe then turned and looked to the calm waters of Kuhia Loko and Kuhia Waho. He went to the ponds and saw water bubbling out, and in the pond were many fish of the sea. It was of this pond, that Kane and Kanaloa spoke, while in Kahiki, as heard by the prophet Makuakaumana, who crossed the sea and traveled to Hawaii:

The mullet are at Kuhia-loko,
 The seaweed is at Kuhia-waho,
 The salt is at Ninauele,
 The nehu pala are at Muliwai
 The lone coconut tree stands at Hape,
 The taro leaves are at Mokaalika,
 The water is at Kaaimalu,
 The awa is gathered at Kalahikiola.
 Behold the land.

All of these places named by the gods can be seen, extending from the sea of Waiawa, to Halalena at Waiawa uka. [Maly and Maly 2003:89]

Table 5. Waiawa place names

Place Name	Type	Meaning	Source
'Apala	<i>Loko</i>	Apple pond	Pukui and Elbert 1986
Alae	<i>'Ili 'āina</i>	1. mudhen; 2. 'iwa, a fern	Pukui and Elbert 1986
Apalakai	<i>Loko</i>		
Apalawai	<i>Loko</i>		
Hale`aha	<i>'Ili 'āina</i>	Meeting house	Pukui et al. 1974
Hanakehau	<i>'Ili 'āina</i>	Mist bay	Pukui and Elbert 1986
Ho`opililoko	<i>Loko</i>	Ho`opili pond	Pukui and Elbert 1986
Holoipiapia	<i>'Ili 'āina</i>		
Kahoaiiai	<i>'Ili 'āina</i>		
Kalimukele	<i>'Ili 'āina</i>	The watery seaweed	Pukui et al. 1974
Kalokohanahou	<i>Loko</i>	The repaired pond	Pukui et al. 1974
Kalokoloa	<i>Pu'uone</i>	The long pond	Pukui et al. 1974
Kalona	<i>'Ili 'āina</i>		
Kama`ihi	<i>Loko</i>	The dwarf	Pukui and Elbert 1986
Kanukumanu	<i>Pu'u</i>	The bird's beak	Pukui and Elbert 1986
Kapaloa	<i>'Ili 'āina</i>	Perhaps, the long fence or enclosure	

Place Name	Type	Meaning	Source
Kapopou	<i>'Ili 'āina</i>	The cigar wrasse fish (<i>Cheilio inermis</i>)	
Kapuaihalulu	<i>'Ili 'āina</i>		
Kapuailuna	<i>Pahale</i>		
Kepoelalo	<i>Loko</i>		
Kepoeluna	<i>Loko</i>		
Kuakuanui	<i>Loko</i>		
Kuhiaakaakai	<i>Loko</i>		
Kuhialoko	<i>'Ili 'āina</i>	Inner Kuhia	Pukui and Elbert 1986
Kuhiawaho	<i>'Ili 'āina</i>	Outer Kuhia	Pukui and Elbert 1986
Kulaokamakau	<i>'Ili 'āina</i>		
Lae Pōhaku		Stone point	Pukui et al. 1974
Laehopu	Coastal point		
Laehopu	<i>Pu'u</i>		
Loko Kuhialoko	<i>Loko</i>	Inner Kuhia pond	Pukui and Elbert 1986
Mo'o	<i>Loko</i>	<i>Mo'o</i> pond	Pukui and Elbert 1986
Mokolea	<i>Loko</i>	Possibly, cut plover or plover island	Pukui et al. 1974
Ninauwale	<i>Pu'uone</i>		
Panahakea	Gulch		
Panaio	<i>'Ili 'āina</i>		
Panakauahi	Gulch	Touched by the smoke	Pukui et al. 1974
Piliaumoa	<i>'Ili 'āina</i>		
Pohakea	Boundary point	White rock	
Pu'u Kamana	<i>Pu'u</i>	Hill [of] the supernatural power	Pukui et al. 1974
Pu'u Pohaku	<i>Pu'u</i>	Stone hill	Pukui et al. 1974
Puoiki	<i>Heiau</i>		
Waiawa	<i>Ahupua'a</i>	Milkfish water	Pukui et al. 1974
Waiawa	Stream	Milkfish water	Pukui et al. 1974

3.2.1.5 Place Names of Mānana

Mānana Ahupua'a extends from the Mānana Peninsula, (presently known as the Pearl City Peninsula), between the Middle and East lochs of Pearl Harbor, to the headwaters of Mānana Stream, near the crest of the Ko'olau Range. The inland portion of the *ahupua'a* was called

Mānanauka (“upland Mānana”) or Mānananui (“large Mānana), and the coastal portion was called Mānanaiki (“little Mānana”) (Handy 1940:81). The word *manana* is translated as “to stretch out,” “to spread out,” or “to protrude” (Pukui and Elbert 1986:218). This may be a reference to the Mānana Peninsula, which protrudes into Pearl Harbor. Other sources indicate the place name means “the meeting of land” and that it was named after the convergence of two lava flows in the Pearl City area (Ching 1996:1). Mānana is bounded by Waiawa Ahupua‘a along the shore of Pearl Harbor to the west, and it shares Mānana Peninsula with Waimano Ahupua‘a to the east. The boundary between Mānana and Waimano at the *makai* end was a stone called Pōhakukane, which was in the sea “876 feet westward from the southeast point of the Mānana Peninsula” (Royal Patent 8168, reprinted in Soehren 2009).

There are 16 *'ili* mentioned in Māhele documents, seven *'ili 'āina*, eight *'ili kū*, and one *lihi 'āina*. The *lihi 'āina* was a special type of land, which is defined as an *'ili* between two *ahupua'a*.

Table 6. Mānana place names

Place Name	Type	Meaning	Source
Hi'iakalalo	<i>Loko</i>	Lower Hi'iaka	Pukui and Elbert 1986
Kahikuonālani	Church	The seventh of kings, named after the seventh Hawaiian monarch, King Kalākaua, who helped fundraise for the construction cost	Pukui et al. 1974
Kahōlona	<i>'Ili kū</i>	The funning, sailing, performance; or, one unskilled in his calling	Pukui and Elbert 1986; Thrum 1922:638
Kahui	<i>'Ili 'āina</i>	Junction	Thrum 1922:638
Kalā'aulele	<i>'Ili 'āina</i>	Land between two <i>ahupua'a</i>	
Kalanihale	<i>'Ili kū</i>		
Kaloko'eli	<i>Loko</i>	The dug pond	Pukui et al. 1974
Kamaewaewa	<i>'Ili 'āina</i>	Ill-treated child	Thrum 1922:642
Kamālua	<i>'Ili 'āina</i>	The planting hole; or two children	Pukui and Elbert 1986; Thrum 1922:642
Kamo'oloa	<i>Kū'ula</i> (fishing shrine)	The long <i>mo'o</i>	Pukui and Elbert 1986
Kamo'opili	<i>Kū'ula</i>		
Kamuliwai	<i>'Ili 'āina</i>	The estuary	Pukui and Elbert 1986
Ka'ohai	<i>'Ili 'āina</i>	1. monkeypod or rain tree (<i>Samanea saman</i>); 2. a native legume (<i>Sesbania tomentosa</i>)	Pukui and Elbert 1986
Kapa'uwela	<i>'Ili 'āina</i>	Perhaps, the hot soot; or burned up	Pukui and Elbert 1986; Thrum 1922:665
Keāhua	<i>'Ili kū</i>	The mound	Pukui et al. 1974

Place Name	Type	Meaning	Source
Keoki	<i>Pu'uone</i>		
Līhu'e	<i>'Ili kū</i>	Cold chill	Pukui et al. 1974
Lolei	<i>'Ili 'āina</i>		
Mānana	<i>Ahupua'a</i>	To stretch out, to spread out, or to protrude	Pukui and Elbert 1986
Mānana Peninsula	Place	To stretch out, to spread out, or to protrude	Pukui and Elbert 1986
Mānana Stream	Stream	To stretch out, to spread out, or to protrude	Pukui and Elbert 1986
Mānanaiki	Place	Small Mānana	Pukui and Elbert 1986
Mānanauka	<i>'Ili kū</i>	Inland or upland Mānana	Pukui et al. 1974
Mo'olau	<i>Loko</i>		
Muliwai	<i>'Ili kū</i>	River	Pukui et al. 1974
Okai	<i>'Ili kū</i>		
Pā'au'au	<i>Loko</i>	Bath enclosure	Pukui et al. 1974
Palea	<i>Kū'ula</i>	Brushed aside; amusement enclosure	Pukui et al. 1974; Thrum 1922:664
Pearl City	Residence (town)	Town on Mānana Peninsula	
Pearl City Peninsula	Place	Same as Mānana Peninsula	
Pōhakuakāne	Stone, boundary point	Stone of [the god] Kāne	Pukui and Elbert 1986
Poupouwela	<i>'Ili kū</i>	An angry, stubby person	Thrum 1922:667
Uaua	<i>Loko</i>	A variety of taro	Pukui and Elbert 1986

3.2.1.6 Place Names of Waimano

Waimano Ahupua'a extends along the east side of the Mānana Peninsula to the crest of the Ko'olau Range, generally following Waimano Stream. The word *waimano* is translated as "many waters" (Pukui et al. 1974:225). Pukui et al. (1974:225) also note "the shark demigoddess Ka'ahupāhau bathed here." Ma'ipuhi, a locality in Waimano was also mentioned as "a bathing place of the shark chiefess, Kaahupahau" (*Ke Au Hou*, 21 December 1910, in Sterling and Summers 1978:16).

There were 22 *'ili* mentioned in Māhele testimony, 15 *'ili 'āina* and seven *'ili kū*.

Table 7. Waimano place names

Place Name	Type	Meaning	Source
'Ainaio	<i>'Ili 'āina</i>		

Awaawaloa	<i>'Ili 'āina</i>	Too salty, or long valley	Pukui et al. 1974
Hopenui	<i>'Ili 'āina</i>	Great end	Thrum 1922:634
Ka'ākauwaihau	<i>'Ili 'āina</i>	Rebundle to the right	Thrum 1922:635
Kahāpapa	<i>'Ili kū</i>	The rock stratum	Pukui and Elbert 1986
Kāhei	<i>Loko (pond)</i>	To gird on, or the net, snare	Pukui et al. 1974
Kaihuokapua'a	<i>'Ili kū</i>	The snout of the pig	Pukui et al. 1974
Kakae	<i>Kahua hale</i>	Spry, lively quick	Pukui and Elbert 1986
Kaloko'eli	<i>Loko</i>	The dug pond	Pukui et al. 1974
Kalokoloa	<i>Loko</i>	The long pond	Pukui et al. 1974
Kapalai	<i>'Ili 'āina</i>	The native fern (<i>Microlepia setosa</i>)	Pukui and Elbert 1986
Kaulu	<i>'Ili 'āina</i>	Ledge; or the breadfruit, or the grove	Pukui et al. 1974
Kealapi'i	<i>'Ili 'āina</i>	The ascending road	Pukui and Elbert 1986
Kekee	<i>Loko</i>		
Kīlau	<i>'Ili 'āina</i>	1. braken or brake (<i>Pteridium aquilinum</i>); 2 ti stalk with shredded leaves	Pukui and Elbert 1986
Kūkona	<i>'Ili kū</i>	Unfriendly, cross, sullen	Pukui and Elbert 1986
Kukona	<i>Loko</i>	Unfriendly, cross, sullen	Pukui and Elbert 1986
Kumu'ulu	<i>'Ili 'āina</i>	Breadfruit tree	Thrum 1922:654
Luakaha'ole	<i>Loko</i>	Pond without relaxation	Pukui and Elbert 1986
Lōpā	<i>'Ili kū</i>	Tenant farmer	Pukui and Elbert 1986
Makiliwai	<i>Loko</i>		
Milialeha	<i>'Ili 'āina</i>	Perhaps, slow and lazy	Pukui and Elbert 1986
Nāpili	<i>Kahua hale</i>	The joining, or <i>pili</i> grass	Pukui et al. 1974
Opukaula	<i>'Ili 'āina</i>		
Pāpōhaku	<i>'Ili 'āina</i>	Stone fence	Pukui et al. 1974
Pipikai	Stream	Sprinkle of salt water	Pukui and Elbert 1986
Pipiloa	Place		
Pohe	<i>'Ili 'āina</i>	The marsh pennywort (<i>Hydroxotyle verticillata</i>)	Pukui and Elbert 1986
Pualehua	<i>'Ili kū</i>	<i>Lehua</i> flower	Pukui and Elbert 1986
Puko	<i>'Ili 'āina</i>	Perhaps <i>pūkō</i> , clump of sugar cane	Pukui and Elbert 1986

Pu'u Kapu	'Ili kū	Sacred hill	Pukui et al. 1974
Wahine	'Ili 'āina	Woman	Pukui and Elbert 1986
Waimano	Ahupua'a	Many waters	Pukui et al. 1974
Waimano	Stream	Many waters	Pukui et al. 1974
Welokā	'Ili kū	Hit float	Pukui et al. 1974
Weloka, Loko o	Loko	Pond of Weloka	Pukui and Elbert 1986

3.2.1.7 Place Names of Waiau

Waiau Ahupua'a extends from the eastern loch of Pearl Harbor, also called Waimalu Loch, upland to the Ko'olau Mountain Range along each side of Waiau Gulch. It is bounded by Waimalu Ahupua'a to the east and Waimano Ahupua'a to the west. Handy (1940:81) says the *ahupua'a* was named for the Waiau Spring and Waiau Pond near the coast. Waiau means "swirling water," but Thrum (1922:672) says the pronunciation is Wai'au, meaning "water to swim in."

Of the *ahupua'a* of 'Ewa, Waiau had the smallest floodplain and the smallest amount of offshore fisheries (Cordy 1996:5). This lack of resources probably explains why Waiau was not listed as a separate *ahupua'a* in the Māhele. This may also explain why there are few known place names for gulches, peaks, and coastal points. The only labeled peak, Waimalu, is shown on a 1947 U.S. War Department map. As this is not shown on any earlier map, this may be an historic surveyor's station rather than a traditional name.

Eleven *'ili* are mentioned for Waiau in nineteenth century Māhele land documents (Soehren 2009; Thrum 1922), Hahapo, Honokōwailani, Ka'ākauwaihau, Kalua'ōlohe, Kalua'o'opu, Kaluapālolo, Kauhihau, Kumu'ulu, Nālima, Nāono, and Waikowaha. Only three were *'ili 'āina*; the other eight were *'ili kū*.

Table 8. Waiau place names

Place Name	Type	Meaning	Source
Hahapo	'Ili 'āina		
Honokōwailani	'Ili kū	Heavenly bay drawing water	Pukui and Elbert 1986
Ka'ākauwaihau	Fishery	Rebundle to the right	
Ka'ākauwaihau	'Ili kū		
Kalua'ōlohe	'Ili kū	The robber's hole	
Kalua'o'opu	'Ili kū	The goby fish	Pukui and Elbert 1986
Kalua'o'opu	Fishery	The goby fish	Pukui and Elbert 1986
Kaluapālolo	'Ili 'āina	The clay pit	Pukui and Elbert 1986
Kauhihau	'Ili kū		
Kolokukahaku	Heiau		
Kumu'uulu	'Ili kū	Breadfruit tree	Pukui and Elbert 1986

Nalima	'Ili kū	The hand	
Nāono	'Ili kū	By sixths	
Puhikani	Place		
Waiau	Ahupua'a		
Waikowaha	'Ili 'āina	Young mulberry shoots water	Pukui and Elbert 1986

3.2.1.8 Place Names of Waimalu

Waimalu Ahupua'a extends from the East Loch of Pearl Harbor to the crest of the Ko'olau Range, generally following Waimalu Stream. The word *waimalu* is translated as "sheltered water" (Pukui et al. 1974:225), likely in reference to Pearl Harbor and the fishponds along the coast.

The offshore island of Moku'ume'ume (Ford Island) was considered part of Waimalu Ahupua'a. McAllister (1933:102) indicates the place name means "'Isle of Strife' from the fact that among former chiefs it was the center of contention over certain fishing rights." Pukui et al. (1974:156) state that the island was named for the *'ume*, a sexual game once played on the island. Pukui described the game of *'ume* in Sterling and Summers' *Sites of O'ahu*:

Moku 'Ume'ume (Island-of-attraction) was the place where the sport called 'Ume was played. No virgin or unmarried person was permitted to take part for it was only for the married who were not blessed with offspring.

On the day selected for the 'ume, every one helped to gather faggots [bundles of sticks] for a large bonfire and that night all came together to sit around the lighted bonfire. A master-of-ceremonies went about chanting gaily with a feather-tufted wand in his hand. This wand was called a maile. He would touch a man here and a woman there and the two would go elsewhere by themselves. So it went until the scrambling of the participants was completed.

If, after getting outside, the woman refused to have anything to do with her companion, they returned to the place where the 'ume was held. As a general rule, objections were not voiced after one had been touched by the maile wand.

The husband was not permitted to be jealous of his wife when she was with another, nor the wife of her husband.

The next day, the wife returned to her husband and the husband to his wife. Should a child be conceived as a result of the 'ume, it was regarded as the offspring of the husband and not of its natural father.

The 'ume was not for chiefs but for the common people. [Sterling and Summers 1978:57]

Sixteen *'ili* are mentioned in mid-nineteenth century Māhele documents, six *'ili 'āina* and ten *'ili kū*.

Table 9. Waimalu place names

Place Name	Type	Meaning	Source
Anana	<i>'Ili kū</i>	Fathom, or to strain, as juice or poi	Pukui and Elbert 1986
Ford Island	Island	Variant name for Moku'ume'ume, named for the owner of the island	Pukui et al. 1974
Ka'aka'aka	<i>Loko</i> (pond)	Perhaps, the laughter	Pukui and Elbert 1986
Kahala'ā	<i>'Ili 'āina</i>	Perhaps, the burning pandanus tree; or, the sacred mark	Pukui and Elbert 1986; Thrum 1922:637
Kahalua	<i>'Ili kū</i>		
Kahikiea	<i>'Ili kū</i>	The recovered breath	Thrum 1922:637
Kaililepo	<i>Kū'ula</i> (fishing shrine)		
Kaima'ema'e	Coastal point on Ford Island	Clean sea	
Kainakoi	<i>'Ili kū</i>		
Kalokukāha'u	<i>Heiau</i>		
Kanewahine	<i>'Ili 'āina</i>		
Ka'umi'umi	<i>'Ili kū</i>	The beard, whiskers, etc.	Pukui and Elbert 1986
Kawahauliuli	<i>Pu'uone</i> (beach dune)		
Kukahua	<i>loko</i>		
Loko Pa'akea	<i>loko</i>	Coral bed, limestone pond	PR
Lokokahi	<i>loko</i>		
Mokuiki	Islet (off Ford Island)	Small islet	Pukui and Elbert 1986
Mokunui	Islet (off Ford Island)	Large islet	Pukui and Elbert 1986
Moku'ume'ume	Islet	Named for the 'ume game	Pukui et al. 1974
Nalowale	<i>Heiau</i>	Lost, forgotten	Pukui and Elbert 1986
Naulu-a-Maihea	<i>Heiau</i>		
Pa'akai	<i>Loko</i>	1. salt; 2. a variety of taro; 3. a seaweed	Pukui and Elbert 1986
Pa'akea	<i>'Ili kū</i>	Coral bed, limestone	Pukui et al. 1974
Paepae	<i>'Ili kū</i>		
Piomowai	<i>Pahale</i> (residence)		

Place Name	Type	Meaning	Source
Pipi‘o	<i>‘Ili ‘āina</i>	Arched	Pukui et al. 1974
Pöhākupu	<i>‘Ili kū</i>	Growing rock	Pukui et al. 1974
Poka‘ailana	Island	Variant name for Ford Island “expression of disenchantment or anger”	Pukui et al. 1974
Punanalo	Stream/gulch		
Punanani	Stream/gulch		
Wahaloa	<i>‘Ili ‘āina</i>		
Waholoa	<i>‘Ili kū</i>		
Wai‘eli	<i>‘Ili kū</i>	Dug water	Pukui et al. 1974
Waimalu	<i>‘Ili ‘āina</i>	Sheltered water	Pukui et al. 1974
Waimalu	<i>Ahupua‘a</i>	Sheltered water	Pukui et al. 1974
Waimalu	Stream/gulch	Sheltered water	Pukui et al. 1974
Waimaluku	<i>‘Ili ‘āina</i>		
Waiolana	<i>Kū‘ula</i> (fishing shrine)		

3.2.1.9 Place Names of Kalauao

The *ahupua‘a* of Kalauao (“the multitude of clouds,” or “the opening leaf;” Thrum 1922:640) extends on both sides of Kalauao Creek and Gulch from the East Loch of Pearl Harbor to the Ko‘olau Mountain Range.

The boundary between the ‘Ewa District and Ko‘olaupoko District along the Ko‘olau Mountains is called the Mauna Kapu Ridge (sacred mountain). Pu‘u Kaiwipo‘o (also spelled Kawipoo) (the skull hill; Thrum 1922:629) is located near the *mauka* boundary of the *ahupua‘a* on the ridge shared with Hālawa Ahupua‘a. Pu‘u ‘Ua‘u (also spelled ‘Uua‘u or ‘Uwau on maps) marks the *mauka* boundary of ‘Aiea Ahupua‘a on the Kalauao/Hālawa boundary. It is named for ‘ua‘u (dark-rumped petrel), a seabird that travels inland to nest. It is considered an ‘*aumakua* to some Hawaiian families (Pukui et al. 1974:206; Pukui and Elbert 1986:362) and was a favored food often reserved for the *ali‘i*. The hill Maunakū‘aha is mentioned as the *mauka* boundary point of LCA 9400 in the mid-nineteenth century Māhele records, but it is not labeled on any map. The name may mean “altar mountain,” with the word *kūaha* short for *kua‘aha*, which means “altar” (Soehren 2009). LCA 9400 is near the shore west of Loko Opu and overlaps the boundary with Waimalu Ahupua‘a. This may indicate the “mountain” is a sand dune or even a fishing shrine rather than a hill. The boundary point at the Ko‘olau Mountain Range between Kalauao and Hālawa is Pu‘u Keahiakahoe (the fire of Kahoe hill), named for a legend about a farmer named Kahoe who lived in Kāne‘ohe (Pukui et al. 1974:199). West of the main stream near the coast was a small stream or ‘*auwai* (ditch) called Hanawai.

Mid-nineteenth century LCAs mention 11 ‘*ili* for Kalauao Ahupua‘a, including the large ‘*ili* of Ka‘ōnohi, which covered at least half, and possibly all, of the *mauka* section of the *ahupua‘a*. All seven are ‘*ili kū*, which in pre-Contact times were often associated with the high *ali‘i* or the king.

The eastern coastal portion of Kalauao is a promontory on the west side of 'Aiea Bay. The western promontory point is labeled as Kapuniakaia on a map of 'Aiea by Lyons (1873) and the eastern point is labeled as Nihinihina'ula on a map of Pearl Harbor by Lyons (1873). The Hawaiian word "*nihinihi*" means "edge," or "part jutting out" (Lucas 1995:79), so this name may refer to the "jutting" coastal point. On nineteenth and twentieth century maps, this last point is labeled as McGrew Point. The latter name came from Dr. John S. McGrew, a Honolulu resident who owned a house and a large estate in Kapuai 'Ili of Kalauao Ahupua'a next to 'Aiea Bay.

McAllister (1933:103) refers to three archaeological sites in Kalauao Ahupua'a. All three are connected with Kala'imanuia, a chiefess and *mō'ī* of O'ahu who lived ten generations before Ka'ahumanu in the sixteenth century (Kame'eiehiwa 1992:80). Following in her mother's (Kūkaniloko's) footsteps, Kala'imanuia lived most of the time in Kalauao. No foreign or domestic wars appear to have occurred during her reign (Fornander 1996:269). McAllister (1933) noted that the foundation of her houses at Kūki'iahu stood in Kalauao until recent times. The name of her house complex may derive from the Hawaiian words *kūki'i* (standing image) and *ahu* (cairn, mound; Pukui and Elbert 1986). Kala'imanuia was credited with having built the fishponds of Kapa'akea in Waimalu and Loko Opu and Loko Pā'aiau in Kalauao. Sterling and Summers place the house complex of Kūki'iahu somewhere near Huawai Stream, possibly near LCA 9400:2 just *mauka* of Loko 'Opu and Loko Pā'aiau. According to Kamakau (1992:169–170), when a battle was fought near the former residence of Kala'imanuia in 1794, the dead were placed in a large pile in Pā'aiau. It is unclear if this is a reference to the fishpond Loko Pā'aiau or to the 'ili of Pā'aiau in which the fishpond is located, however, the statement suggests Kala'imanuia's residence was close to Pā'aiau 'Ili.

Table 10. Kalauao place names

Place Name	Type	Meaning	Source
'Alaeau	'Ili kū (land)		
'Eli	Loko (pond)	To dig, excavate	Pukui and Elbert 1986
Hanaiki		Small job	
Hanawai	Ditch or stream		
Ka'ōkai	Loko	Perhaps, cup or ladle	Pukui and Elbert 1986
Ka'ōnohi	'Ili kū	The eyeball, or the fragment of a rainbow	Pukui and Elbert 1986
Kahawai	'Ili kū	Stream	Pukui et al. 1974
Kahawailuna	'Ili 'āina (land)	Upper Kahawai	Pukui and Elbert 1986
Kahuawai	Waterfall	Water gourd container	Pukui et al. 1974
Kalauao	Ahupua'a	The multitude of clouds	Pukui et al. 1974
Kalauao	Stream, spring	The multitude of clouds	Pukui et al. 1974
Kamaino	Kahua hale (residence)		

Place Name	Type	Meaning	Source
Kamo'olepo	Place		
Kapaele	<i>'Ili kū</i>	Black border, or variety of sweet potato	Pukui and Elbert 1986
Kapuai	<i>'Ili kū</i>		
Kapukaokiha	<i>Ku'ula</i> (fishing shrine)		
Kapuniakaia			
Kauaopai	<i>'Ili kū</i>	The drenching rain	Thrum 1922:646
Kauapolei	<i>'Ili kū</i>	The hand wreath rain	Thrum 1922:646
Kī'apu	<i>Loko</i>	Perhaps, cup or ladle	
Koloa	<i>Ku'ula</i>	Hawaiian duck, or long cane with a crook, or tall sugarcane	Pukui and Elbert 1986
Kuahulumoa	<i>'Ili 'āina</i>		
Kūki'iahu	<i>Kahua hale</i>		
Loko Opu	<i>Loko</i>		
Loko Pā'aiau	<i>Loko</i>		
Makoa	<i>Ku'ula</i>		
Mauna Kapu	Ridge	Sacred mountain	Pukui et al. 1974
Maunakū'aha	<i>Ku'ula</i>	Perhaps, altar mountain	
Maunakuaha	<i>Pu'u</i> (peak)		
McGrew	Coastal point		
Nihinihini'ula	Coastal point	Perhaps, edge, or part jutting out	
Opu	<i>'Ili 'āina</i>		
Pā'aiau	<i>'Ili kū</i>		
Pu'u 'Ua'u		Dark-rumped petrel hill	Pukui et al. 1974
Pu'u Kaiwipo'o	<i>Pu'u</i>	The skull hill	Thrum 1922:629
Pu'u Keahiakahoe	The fire of Kahoe hill		
Pu'u Makani	<i>Pu'u</i>	Windy hill	

3.2.1.10 Place Names of 'Aiea

'Aiea Ahupua'a was named after the shrub *'aiea* (*Nothocestrum*) (Pukui et al. 1974:7; Thrum 1922:626), which was used for thatching sticks and for fire-making (Pukui and Elbert 1986:10). 'Aiea Ahupua'a extends from the eastern loch of Pearl Harbor at 'Aiea Bay inland along each side

of 'Aiea Stream and Gulch, as shown on an 1874 map of 'Aiea. The *ahupua'a* does not extend to the Ko'olau Mountain Range, but is "cut off" by Kalauao Ahupua'a to the west and Hālawa Ahupua'a to the east. At the point where these three *ahupua'a* adjoin, there is a hill called Pu'u 'Uua'u. The eastern boundary with Hālawa Ahupua'a is marked by the peaks Pu'u Auwahine, Pu'u Kaulainahe'e, Pō'ohōlua and the "legendary rock" Pōhaku'ume'ume (Boundary Commission, 24, 1:335 in Soehren 2009). The correct spelling of Kaulainahe'e may be Kaula'ināhe'e, meaning "dry the octopi" (Soehren 2009). The name *pō'ohōlua* refers to the head of a *hōlua* (sledding) course (Soehren 2009; Pukui and Elbert 1986). The boundary with Kalauao Ahupua'a at the coast was marked at Kapuniakaia and the boundary with Hālawa Ahupua'a was at the wall that separated Loko Kahakupōhaku, a large fishpond in 'Aiea along the Pearl Harbor coast, and Loko Keilapeia. The wall of Loko Kakupōhaku marked the boundary between 'Aiea and Hālawa Ahupua'a.

'Aiea was a small *ahupua'a* and had only ten 'ili listed in mid-nineteenth century Māhele documents, nine 'ili 'āina and one 'ili kū.

Table 11. 'Aiea place names

Place Name	Type	Meaning	Source
'Aiea	<i>Ahupua'a</i>	<i>Nothocentrum</i> tree	Pukui et al. 1974
'Aiea	Bay, stream	<i>Nothocentrum</i> tree	Pukui et al. 1974
Kahakupōhaku	<i>Loko</i> (pond)		
Kalokopaoa	'Ili 'āina		
Kalua'ōpu'u	'Ili 'āina		
Ka'omuoiki	'Ili 'āina	The small lid, cover, plug	Pukui and Elbert 1986
Kaomuoiki	Stream	The small lid, cover, plug	Pukui and Elbert 1986
Kapakai	'Ili 'āina	Perhaps named for the <i>Amanranthus</i> sp. flower	Pukui and Elbert 1986
Kapuniakaia	Boundary point		
Keaīwa	<i>Heiau</i>	The mystery	Pukui et al. 1974
Kealapi'i	'Ili 'āina	The ascending road	Pukui and Elbert 1986
Mahaili	'Ili 'āina		
Mā'ona	'Ili kū	Satisfied after eating	Pukui and Elbert 1986
Mau'uhākai	'Ili 'āina		
Palao	'Ili 'āina		
Pōhaku o Ki'i	<i>Pōhaku</i>	Stone of Ki'i	Pukui and Elbert 1986
Pōhaku'ume'ume	<i>Stone, boundary point</i>		
Pō'ohōlua	<i>Pu'u</i>		
Pu'ukaua	'Ili 'āina	Fort, fortification, stronghold	Pukui and Elbert 1986
Pu'u Auwahine	<i>Pu'u</i>		

Place Name	Type	Meaning	Source
Pu'u Kaulainihe'e	<i>Pu'u</i>		
Pu'u 'Uua'u	<i>Pu'u</i>	Hill of the dark-rumped petrel (<i>Pterodroma phaeopygia</i>)	Pukui et al. 1974
Waiola'a	<i>Loko</i>		

3.2.1.11 Place Names of Hālawa

Hālawa Ahupua'a extends along the eastern shore of the Pearl Harbor mouth and along the East Loch of Pearl Harbor inland to the crest of the Ko'olau Range, along both banks of Hālawa Stream. The word *hālawa* is translated as "curve" (Pukui et al. 1974:36). The boundary between the 'Ewa District and Ko'olau District along the Ko'olau Mountains is called the Mauna Kapu Ridge (sacred mountain).

On the west, Pu'u Kaiwipo'o is located near the *mauka* boundary of Kalauao Ahupua'a on the ridge shared with Hālawa Ahupua'a. Pu'u 'Ua'u marks the *mauka* boundary of 'Aiea Ahupua'a on the Kalauao/Hālawa boundary. The western 'Aiea/Hālawa boundary is marked by the peaks Pu'u Auwahine, Pu'u Kaulainihe'e, Pō'ohōlua and the "legendary rock" Pōhaku'ume'ume (Boundary Commission 24, 1:335 in Soehren 2009). The coastal boundary between 'Aiea and Hālawa Ahupua'a is by marked by the wall of Loko Kakupōhaku.

Near the trail, on the high eastern rim of Aliamanu (Salt Lake) at a peak called Pu'ukapu along Kapukaki Ridge (Red Hill Ridge), were several large terraces recorded by McAllister (1933:97; Site 88) in his survey of O'ahu sites. C.J. Lyons, an early surveyor, noted that the peak marked not only the boundary between Hālawa and Moanalua, but also the boundary between the 'Ewa and Kona (Honolulu) Districts (citation as reprinted in Sterling and Summers 1978:335).

Kūāhua, a small offshore islet, considered a part of Hālawa Ahupua'a, is translated as "standing heap" (Pukui et al. 1974:118). Kūāhua was attached to the coast via the Loko Kūnana fishpond. Lloyd Soehren (2009) translated this name as Kūnana, a possible variant of *kūlana*, the Hawaiian word for "position." However, a long-time resident stated the fishpond was named after Kūanānā ('child of Nānā), the mother of Ka'ahupahau, the shark chiefess of Pu'uloa, who liked to fish there (Sterling and Summers 1978:10).

Makalapa Crater is a prominent geological feature inland of Loko Kūnana. The word *makalapa* is translated as "ridge features" (Pukui et al. 1974:140). Leilono, located on the hill of Kapukaki (Red Hill) at the boundary between Hālawa and Moanalua Ahupua'a, "was a place said to be the opening, on the island of O'ahu, for mankind to enter eternal night" (*Ka Nūpepa Ku'oko'a*, 11 August 1899 in Sterling and Summers 1978:9). There was a healing pool called Waiola in the uplands near the boundary with Moanalua. McAllister (1933:99) reported that the pool is said to have medicinal qualities. The old Hawaiians came here to bathe when they were recuperating from illness."

Sixteen *'ili* are mentioned in Māhele documents, 15 *'ili 'āina* and one *'ili kū*.

Table 12. Hālawā place names

Place Name	Type	Meaning	*Source
Bishop Point	Coastal point		
Hālawā	<i>Ahupua'a</i>	Curve	Pukui et al. 1974
Hālawā	Stream	Curve	Pukui et al. 1974
Holokahiki	Place		
Hospital Point	Coastal point		
Kailopaia	<i>'Ili 'āina</i>		
Kalo'iiki	<i>'Ili 'āina</i>	The small taro patch	Pukui and Elbert 1986
Kalokoloa	<i>'Ili 'āina</i>	The long pond	Pukui et al. 1974
Kama'ū	<i>'Ili 'āina</i>	Perhaps, the damp	Pukui and Elbert 1986
Kamanaiki	Stream	The small branch	Pukui et al. 1974
Kamananui	Stream	The large branch	Pukui et al. 1974
Kananelu	<i>'Ili 'āina</i>	The bog	Pukui et al. 1974
Kaula'iloa	<i>Pu'uone</i>		
Kaula'ināhe'e	<i>Pu'u</i>	Perhaps, dry the octopi	Pukui and Elbert 1986
Kaumahaloa	<i>Heiau</i>	Very heavy, or very sad	Pukui and Elbert 1986
Kauwamoa			
Kawahanaenae	<i>'Ili 'āina</i>		
Keanapua'a	<i>Pāhale</i>	The pig's cave	
Keaupuni	<i>'Ili 'āina</i>	The government	
Keilapaia	<i>Loko</i>		
Kī'ā	<i>'Ili 'āina</i>		
Kūāhua Island	Islet	Standing heap	Pukui et al. 1974
Kulina	<i>'Ili 'āina</i>	Deafness, disobedience, noise	Pukui and Elbert 1986
Kumu'ulu	<i>'Ili 'āina</i>	Breadfruit tree	Pukui and Elbert 1986
Kūnana	<i>'Ili kū</i>	Perhaps, variant of <i>kūlana</i> (position); or named after the mother of the shark goddess	Pukui and Elbert 1986
Leilono	<i>Lua</i> (pit)		
Loko a Mano	<i>Loko</i>	Mano's pond	
Loko Keoki	<i>Loko</i>		
Loko Kūnana	<i>Loko</i>		
Loko Loa	<i>Loko</i>	Long pond	Pukui and Elbert 1986
Loko Muliwai	<i>Loko</i>	River pond	Pukui and Elbert 1986

Place Name	Type	Meaning	*Source
Loko Pōhaku	<i>Loko</i>	Stone pond	Pukui and Elbert 1986
Loko Waiaho	<i>Loko</i>	Fishline water pond	Pukui and Elbert 1986
Makalapa Crater	Crater	Ridge features	Pukui et al. 1974
Makali'i	<i>'Ili 'āina</i>	Tiny, or Pleiades (stars)	Pukui et al. 1974
Muliwai	<i>'Ili 'āina</i>	River	Pukui and Elbert 1986
Napehā	<i>O'io'ina</i> (resting place), pool	Bend over breath	Pukui et al. 1974
Pāpio'uua	<i>Loko</i>	Red <i>pāpio</i> (young crevally fish)	Pukui and Elbert 1986
Pāpua'a	<i>'Ili 'āina</i>	Pig pen	Pukui and Elbert 1986
Pe'ahināi'a	<i>'Ili 'āina</i>	Beckon [to] the fish	Pukui et al. 1974
Piomowai	<i>Ku'ula</i>		
Po'ohōlua	<i>Pu'u</i>	Head [of] sled course	Pukui and Elbert 1986
Pohakea	<i>'Ili 'āina</i>		
Pōhaku'ume'ume	Boundary point		
Pu'u Kaiwipo'o	<i>Pu'u</i>	The skull hill	Pukui et al. 1974
Puu 'U'au	<i>Pu'u</i>	Dark-rumped petrel hill	Pukui et al. 1974
Waialua	<i>Loko</i>		
Waikahi	<i>Heiau</i>		
Wailolokai	<i>Loko</i>	Seaward Wailoko	Pukui and Elbert 1986
Wailolowai	<i>Loko</i>	Inland Wailoko	Pukui and Elbert 1986
Waipao	<i>Heiau</i>	Ccooped water	Pukui et al. 1974
Watertown	Village		

3.2.2 Heiau

Heiau were pre-Christian places of worship. Construction of some *heiau* were elaborate, consisting of large communal structures, while others were simple earth terraces or shrines (McAllister 1933:8). *Heiau* are most commonly associated with important religious ceremonies; large structures with platforms or altars of one or more terraces were indicative of such function (McAllister 1933:8).

Archaeologist Gilbert McAllister reports on two known *heiau* in the *ahupua'a* of Honouliuli, as well as two other sites that could have possibly been *heiau*. These *heiau* were located on Pu'u Ku'ua, on Pu'u o Kapolei, at the foot of Pu'u Kanehoa, and at the foot of Mauna Kapu (McAllister 1933).

Pu'u Ku'ua Heiau, located in Palikea, Honouliuli, overlooks both Honouliuli and Nānākuli, and has a height of approximately 1,800 ft. Most of the stones from the *heiau* were used for a cattle pen located on the *makai* side of the site. The part of the *heiau* that hadn't been cleared for pineapples has been planted in ironwoods (McAllister 1933:108).

By the time of McAllister's survey of the island in 1930, the *heiau* located on Pu'u o Kapolei had been destroyed. He writes that stones from the *heiau* supplied the rock crusher located on the side of this elevation, about 100 ft away on the sea side (McAllister 1933:108).

The hill of Pu'uokapolei was used as a point of solar reference or as a place for such observations (Fornander 1919b:6[2]:297). Each year in the beginning of May, a ceremony commemorating the changing of the seasons is still observed at Waikīkī and Honouliuli. This ceremony was documented in a previous cultural impact assessment conducted by CSH (Genz et al. 2012). Sam 'Ohukani 'ōhi 'a Gon III, Na Wa'a Lalani Kahuna O Pu'u Koholā, and the late Kumu Hula John Keola Lake's *hula hālau* (*hula* instruction) perform *oli* and *hula* (dance), explaining that the *kilo hōkū* (astronomers) of O'ahu observed how, from the perspective of Waikīkī, the sun sets in a southerly direction over the ocean during the winter solstice and in a northerly direction behind the 'Ewa ridgeline during the summer solstice. During the springtime, the position of the setting sun marches steadily northward each day, and at the beginning of May, the sun sets behind Pu'uokapolei, perfectly centered within its depression from the vantage point of Kūpalaha Heiau, just west of the Waikīkī Aquarium. A coinciding ceremony at a *heiau* on Pu'uokapolei similarly views the setting of the sun behind Pu'ula'ila'i farther west, and a line of sight extending eastward from Pu'ula'ila'i, Pu'uokapolei, and the former site of Kūpalaha Heiau ends at the closely associated Papa'ena'ena Heiau. Mr. Gon suggests Papa'ena'ena Heiau may have been part of the ceremonies of this astronomical event.

Located at the foot of Pu'u Kanehoa is a small enclosure thought to have possibly been a *heiau*. McAllister writes,

My informant, Reiney, recalls the respect the old Hawaiians had for the place when he was punching cattle with them in his youth. It is a walled inclosure 2 by 3 feet. On the inside the walls are between 2 and 3 feet high, and on the outside they range from 2 to 5 feet, depending upon the slope of the land. On three sides the walls are 2 feet wide, but the fourth is 3 feet wide. The walls are evenly faced with a fill of smaller stones. At present the site is surrounded with a heavy growth of Lantana; but only a thick growth of grass and two small guava bushes are in the interior, which is most unusual unless human hands keep the interior clear. Possibly this is not a *heiau* but a small inclosure considered sacred for some reason. [McAllister 1933:107]

Located in Aikukai, Honouliuli, at the foot of Pu'u Kuina, what looked to be a terrace is all that remained when McAllister cataloged Site 134. He notes of the inability to determine the size of the *heiau* or the number of terraces that once stood (McAllister 1933:107).

There were two *heiau* in Waikele, both just north of the present Interstate H-1 Freeway. The two *heiau*, Mokoula and Hapupu, had been completely destroyed by the time of McAllister's survey in the 1930. In Waipi'o, a *heiau* called Keakua'ōlelo was located in Pānakauahi Gulch. There was once a *heiau* in the area between Farrington Highway and the coast, called Ahu'ena ("red hot heap"). When Thrum (1907:46), listed it in 1907, he noted that only the foundations remained. McAllister also noted two *heiau*, Moa'ula and Heiau o 'Umi, along the main coastal trail in Waipi'o. He said both were "covered" in cane, and provided no further information on their condition. John Papa 'Ī'i was once the custodian of the idols in the *heiau*.

McAllister (1933:105) recorded a *heiau* called Puoiki located on the point of the ridge called Lae Pōhaku, the boundary point between Waiawa and Mānana Ahupua'a. The *heiau* was built on a knoll. According to McAllister (1933:105), the ceremonies at this *heiau* were performed at the base of the knoll. McAllister (1933:105) also noted a *heiau* on the ridge between Waiawa and Waimalu gulches named Kolokukahau Heiau, but it had been destroyed before his survey in 1930.

Naulu-a-Maihea Heiau is located within Waimalu Ahupua'a. Fornander noted that Naulu-a-Maihea Heiau was associated with 'Ula-a-Maihea, a "famous prophet and seer" who resided in the *ahupua'a* of Waimalu (Fornander 1996:42). The *heiau*, which McAllister identified as Site 112, has been "destroyed" (Sterling and Summers 1978:14).

Keaiwa Heiau is located at the top of 'Aiea Heights Drive. The *heiau*, which may have also been known as "heiau Hoola," or "Healing or Life Giving Heiau," was once the site of a training area for traditional healers and a medicinal herb garden (Sterling and Summers 1978:11). Another *heiau* called Kaonohiokala Heiau was also located in 'Aiea at the current location of the 'Aiea Intermediate School, however, little information regarding this *heiau* has survived (Uyeoka et al. 2018:87).

There were four *heiau* located in Hālawa Ahupua'a: Waipao Heiau, Waikahi Heiau, Hale o Papa Heiau, and Luakini Heiau. Waipao Heiau (McAllister Site 106) was a large religious structure, located "near the mouth of Kamananui Gulch" (McAllister 1933:103). Waikahi Heiau (McAllister Site 105) was a *heiau* of *po'o kanaka* (sacrificial) class associated with human sacrifice, located "on the flat area on the mountain side of the road where the two gulches of Halawa meet" (McAllister 1933:103). Both Waipao and Waikahi *heiau* were destroyed under sugarcane cultivation (Kleiger 1995:14). The Hale o Papa is located in North Hālawa Valley adjacent to the H-3 Interstate Highway. Hale o Papa was part of a large religious complex associated with a *luakini*. A *luakini* was "a heiau of the highest class, a war temple, in which human sacrifices were offered" (Malo 1951:155). A *luakini* consists of a *paehumu* (fence), a *lana nu'u mamao* (tower), four *hale* (house), *lele* (altar), images of the gods and a Hale o Papa (women's temple) (Valeri 1985:235–237). The Hale o Papa *heiau* is the female component of the *luakini*. It was the *heiau* for the female deities where only chiefesses of the highest ranks were allowed to enter.

3.2.3 Loko I'a (Fishponds)

There were several *loko* (ponds) in Waipi'o; two of the largest were Loko 'Ēo ("a filled container") and Loko Hanaloa ("long bay"). The *ahupua'a* of Waiawa also had many fishponds; 12 are mentioned in mid-nineteenth century Māhele documents. McAllister (1933:105) noted that Loko 'Āpala, Loko Kuhialoko, and Loko Mo'o were located in Waiawa Ahupua'a.

Loko Pā'au'au was a large *loko i'a* (fishpond) located on the western coast of the Mānana Peninsula. Pukui et al. (1974:173) translate *pā'au'au* as "bath enclosure." Pā'au'au was also the name of the *'ili* surrounding the pond, and the name of the home of John F. Colburn, an early resident who had a home near the pond. In Māhele documents, three other *loko i'a* are mentioned, Hi'iakalalo, Kaloko'eli, and Mo'olau in Mānana Ahupua'a.

Loko Welokā, a large fishpond with a small island in the center, was located in Waimano, along the eastern shore of the Mānana Peninsula. The word *welokā* is translated as "thrashing, smiting, as a fishtail" (Pukui and Elbert 1986:355), which may also be a reference to the shark demigoddess

associated with Waimano. Two other large fishponds in Waimano were Loko Kūkona, and Loko Luakaha'ole, which were located along the northern coast of Pearl Harbor.

In Waiau Ahupua'a, there were two fishery grounds, Kai o Kalua'o'opu and Kai o Ka'akauwaihau, which were named for their associated 'ili. Cordy (1996:5) has noted that Waiau had the smallest floodplain and the smallest of offshore fisheries of all the *ahupua'a* of 'Ewa. A favorite bathing spot of the 'Ewa shark goddess, Ka'ahupāhua was at Puhikani in Waiau (*Ke Au Hou*, 1910 in Sterling and Summers 1978:16). The location of this spring or pond could not be found on any available maps.

Loko Pa'akea, a large fishpond in Waimalu along the Pearl Harbor coast was said to have been built by the chiefess Kala'imanuia (McAllister 1933:103–104). The word *pa'akea* is translated as “coral bed, limestone” (Pukui et al. 1974:173). Kala'imanuia was also credited with having built the fishponds of Loko Pā'aiau and Loko Opu in the *ahupua'a* of Kalauao. Loko Pā'aiau was a roughly 190 by 600 ft rectangular pond surrounded by land on three sides with walls 2 ft high (Soehren 2009). McAllister (1933:103) describes it as if it was still in good condition in the 1930s. McAllister (1933:103) describes Loko Opu as partially filled in. It was once about 10 acres in size, with a wall 270 ft long that surrounded the entire perimeter. Three other ponds located in Kalauao are mentioned in the Māhele testimony, but are not labeled on any available maps.

Hālawa had numerous fishponds (from south to north). Loko Waiaho, also known as Queen Emma's Pond and Loko Ke'oki, were both located near the mouth of the Pearl River near the nineteenth century village called Watertown. Papiolua was opposite the tip of Waipi'o Peninsula. Loko A Mano (Amana), Loko Pōhaku, Ola Loko, Wailolokai, and Wailolowai were all inland of Kūāhua Island, in the bay now called the South East Loch, while Loko Kūnana and Loko Muliwai were between the east side of the island and the Hālawa shore. Loko Kahakupōhaku and Kealipaia were near the northeastern corner of the East Loch of Pearl Harbor.

3.2.4 Ala Hele (Trails)

There were several pre-Contact/early historic trails across 'Ewa: a cross-*ahupua'a* trail that crossed 'Ewa and connected Honolulu to Wai'anae; a *mauka-makai* (mountain to the sea) trail that branched off from the first trail, and followed the boundary between Honouliuli and Hō'ae'ae to the Pōhākea Pass and to Wai'anae; and a second branching *mauka-makai* trail that generally followed the path of Waikele Stream in Waikele Ahupua'a. This trail eventually led through the Kolekole Pass to Wahiawā and to Waialua District on the windward side of the island (Figure 22).

Ī'ī described the main cross-*ahupua'a* trail from west to east, beginning with the boundary of the Kona and 'Ewa districts at the Moanalua/Hālawa border. This trail was just *mauka* of the floodplains near Pearl Harbor, skirting the inland edges of the productive taro fields. The trail then dipped down toward the coast toward a prominent hill and landmark, Pu'uokapolei. The trail crossed into Wai'anae at the coast near Pili o Kahe, the stone that marked the boundary of the 'Ewa and Wai'anae districts:

From there the trail went to Kaleinakauhane [Moanalua Ahupua'a in the Kona District], then to Kapukaki [Red Hill on the Moanalua/Hālawa boundary], from where one could see the irregular sea of Ewa [Pearl Harbor]; then down the ridge to Napeha [in Hālawa], a resting place for the multitude that went diving there at a

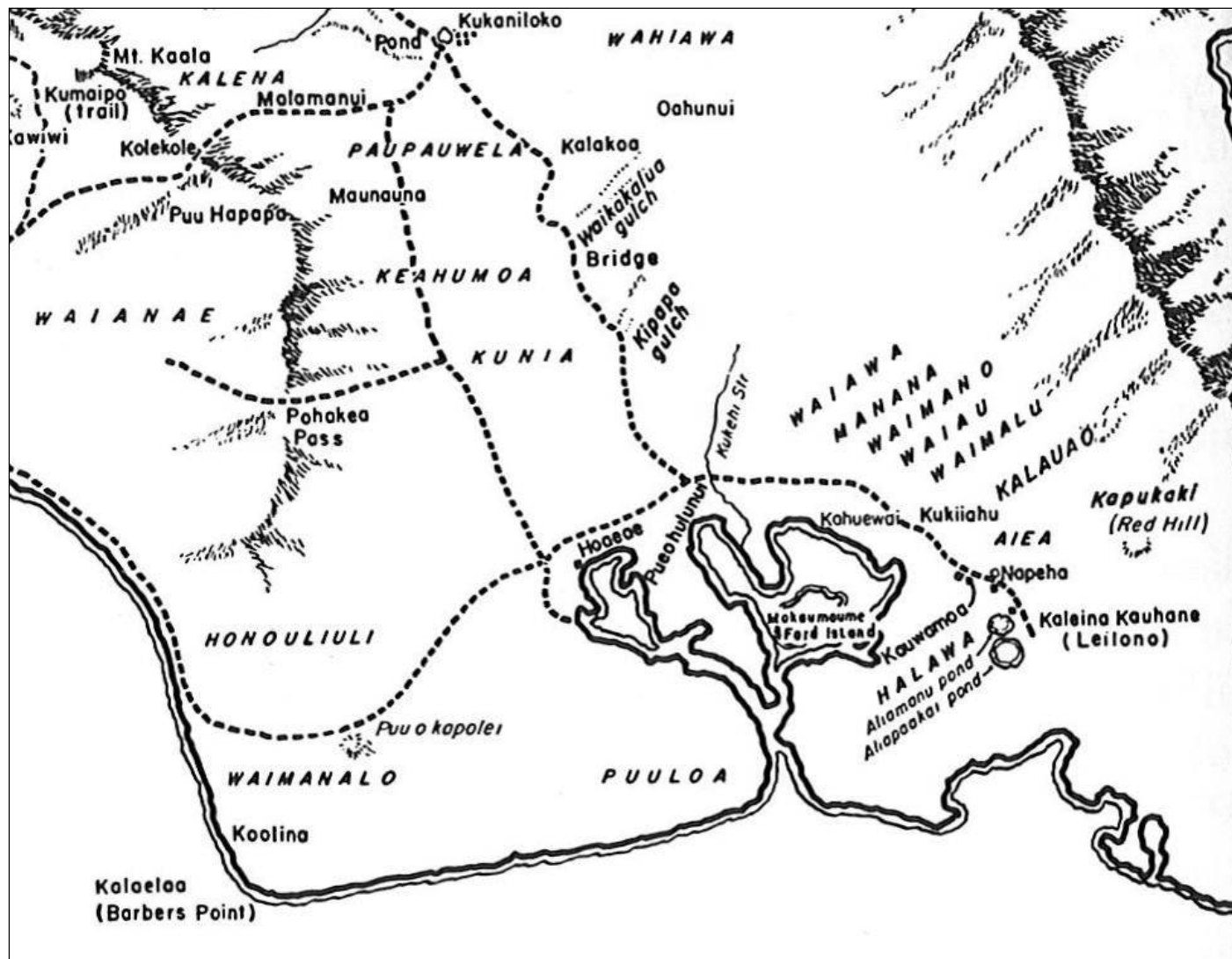


Figure 22. Map of trails in 'Ewa by Paul Rockwood (not to scale) to show O'ahu trails ca. 1810, as described by John Papa 'I'i (1959:96)

deep pool. This pool was named Napeha [Lean Over], so it is said, because Kualii, a chief of ancient Oahu, went there and leaned over the pool to drink water.

The trail began again on the opposite side of the pool and went to the lowland of Halawa, on to Kauwamoa, a diving place and a much-liked gathering place. It was said to be the diving place of Peapea, son of Kamehamehanui of Maui who was swift in running and leaping. The place from which he dove into the water was 5 to 10 fathoms above the pool.

There the trail led to the taro patches in Aiea and up the plain of Kukiiahu. Just below the trail was the spot where Kaeo, chief of Kaua'i, was killed by Kalanikupule. From there the trail went along the taro patches to the upper part of Kohokoho and on to Kahuewai [in Kalauao], a small waterfall. On the high ground above, a little way on, was a spring, also a favorite gathering place for travelers. From there it continued over a small plain down the small hill of Waimalu, and along the taro patches that lay in the center of the land. . .

. . . the trail went down to the stream and up again, then went above the taro patches of Waiiau, up to a *maika* [game with rolling stones] field, to Waimano, to Manana and to Waiawa; then to the stream of Kukehi and up to two other *maika* fields, Pueohulunui and Haupuu [in Waiawa]. At Pueohulunui [on the border of Waiawa and Waikele] was the place where a trail branched off to go to Waialua and down to Honouliuli and on to Waianae. [‘Ī‘Ī 1959:95, 97]

A *mauka-makai* (north-south) trail branched off the cross-*ahupua'a* trail into two offshoots which led to the coastal settlements of Kūalaka'i and One'ula.

Of the first *mauka-makai* trail, located in Honouliuli, 'Ī'Ī (1959:97) noted "From Kunia the trail went to the plain of Keahumoa, on to Maunauna [peak], and along Paupauwela [*'ili*], which met with the trails from Wahiawā [District] and Waialua [District]." 'Ī'Ī places the area called Kunia east of Pōhākea Pass in the *ahupua'a* of Honouliuli and Hō'ae'ae, *makai* of the modern town of Kunia, and places the plain of Keahumoa between Kunia and Paupauwela, the most *mauka* portion of Honouliuli. The trail passed near the peak called Maunauna in upper Honouliuli.

3.2.5 Resting Places

Along the trails within the *moku* of 'Ewa were a number of places where travelers could stop and rest. Along the coastal trail connecting Honolulu to Wai'anae was a small waterfall called Kahuawai (or Kahuewai) (water gourd container; Soehren 2009) along Kalauao Stream, which 'Ī'Ī (1959:95) stated was once a favorite resting place for travelers, exclusively for *ali'i*. Hawaiian language newspapers give us accounts of this bathing place. The summary translations for each account below are from Sterling and Summers (1978:13–14):

Here is another thing. I went to see the diving place of the chiefs where they used to bathe. It is very close to the pump at Kalauao. It is cemented and deep. The name of this pool is Kahuawai. On the eastern side are some taro patches that are somewhat like ponds. They were deep in the olden days and these were the taro patches owned by Kaho, in which he planted all the time. [Apuakehau, *Ka Nūpepa Kū'oko'a*, 18 July 1919, translated in Sterling and Summers 1978:13]

Kahuawai was a noted bathing place since ancient times and was guarded so that any one did not bathe in it except the chiefs. Later it was used by all. Kakuhihewa's daughters and the hero Kalelealuaka (their husband) bathed in this pool. Kaeokulani, the chief of Kauai also bathed here when he came to war here on O'ahu. He was killed at Kukiiahu. Many visitors from Hawaii to Kauai that came to see this pool and it was well known to Ewa's inhabitants. [*Ke Au Hou* 1910, translated in Sterling and Summers 1978:13]

They went to the taro patches of Aiea, up the plain of Kukiiahu, below the road where Kaeo, chief of Kauai, was killed by Kalanikupule. From there they went along the taro patches on the upper side of Kohokaho, til they came to Kahuewai, a little waterfall. A little way above it was a spring, a place where travelers sat and rested. They went up a little way to a small plain and ascended the low cliff of Waimalu and went along between the taro patches of that land. [*Ka Nūpepa Kū'oko'a*, 1 January 1870, translated in Sterling and Summer 1978:13–14]

Nineteenth century Hawaiian historian Moses Manu describes Kahuawai in “He Mo'olelo Ka'ao Hawai'i no Lauka'ie'ie” which was translated by Maly and Maly:

. . . Makanikeoe then went to the uplands, atop the cliffs and ridges of Koolau, where he looked down and chanted:

Beautiful is Halawa in the Waahila rains,
Which visits also, the heights of Aiea,
The heat and warmth travels across the plain of Kalauao.

It is true, that he then went to Kalauao, where he saw the pool of Kahuawai. He turned to the uplands and saw the source of the water coming out of the earth, near the top of the cliff of Waimalu. The source of this water, from where it flows, cannot be easily seen because it comes out from the ground in an area where there are many deep holes hidden on the side of the cliff of Waimano. [Maly and Maly 2012:101]

Along the coastal trail connecting Honolulu to Wai'anae, 'Ī'ī (1959:95) mentioned two resting places in Hālawa for travelers, Napehā and Kauwamoa. Napehā, translated as “bend over breath” (Pukui et al. 1974:163), was a pool and resting place where people went diving. The pool was said to have been named for the chief, Kūali'i, who stopped and bent over the pool to take a drink ('Ī'ī 1959:95). Sterling and Summers (1978:10) give the literal meaning as “out of breath.” Kauwamoa was also a diving place where people liked to gather, said to be a favorite diving spot of Pe'ape'a, son of Kamehamehanui of Maui ('Ī'ī 1959:95).

3.3 'Ōlelo No'eau

Hawaiian knowledge was shared by way of oral histories. Indeed, one's *leo* (voice) is oftentimes presented as *ho'okupu* (“a tribute or gift” given to convey appreciation, to strengthen bonds, and to show honor and respect); the high valuation of the spoken word underscores the importance of the oral tradition (in this case, Hawaiian sayings or expressions), and its ability to impart traditional Hawaiian “aesthetic, historic, and educational values” (Pukui 1983:vii). Thus, in many ways these expressions may be understood as inspiring growth within reader or between speaker and listener:

They reveal with each new reading ever deeper layers of meaning, giving understanding not only of Hawai‘i and its people but of all humanity. Since the sayings carry the immediacy of the spoken word, considered to be the highest form of cultural expression in old Hawai‘i, they bring us closer to the everyday thoughts and lives of the Hawaiians who created them. Taken together, the sayings offer a basis for an understanding of the essence and origins of traditional Hawaiian values. The sayings may be categorized, in Western terms, as proverbs, aphorisms, didactic adages, jokes, riddles, epithets, lines from chants, etc., and they present a variety of literary techniques such as metaphor, analogy, allegory, personification, irony, pun, and repetition. It is worth noting, however, that the sayings were spoken, and that their meanings and purposes should not be assessed by the Western concepts of literary types and techniques. [Pukui 1983:vii]

Simply, *‘ōlelo no‘eau* may be understood as proverbs. The Webster dictionary notes it as “a phrase which is often repeated; especially, a sentence which briefly and forcibly expresses some practical truth, or the result of experience and observation.” It is a pithy or short form of folk wisdom. Pukui equates proverbs as a treasury of Hawaiian expressions (Pukui 1995:xii). Oftentimes within these Hawaiian expressions or proverbs are references to places. This section draws from the collection of author and historian Mary Kawena Pukui and her knowledge of Hawaiian proverbs describing *‘āina* (land), chiefs, plants, and places.

3.3.1 Concerning Sharks

The *moku* of ‘Ewa lies adjacent to Pu‘uloa which has many *mo‘olelo* about sharks, particularly Ka‘ahupāhau, the queen shark of O‘ahu and the most famous guardian shark who lived in Pu‘uloa. Thus, ‘Ewa is closely associated with shark *‘aumakua* and *mo‘olelo* which say the people of ‘Ewa were protected by sharks. The following *‘ōlelo no‘eau* are associated with sharks.

3.3.1.1 ‘Ōlelo No‘eau #105

Alahula Pu‘uloa he alahela na Ka‘ahupāhau.

Everywhere in Pu‘uloa is the trail of Ka‘ahupāhau.

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

3.3.1.2 ‘Ōlelo No‘eau #1014

Ho‘ahewa na niuhi ia Ka‘ahupāhau

The man-eating sharks blamed Ka‘ahupāhau

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

3.3.1.3 'Ōlelo No'eau #2111

Make o Mikololou a ola i ke ale lo

Mikololou died and came to life again through his tongue

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

3.3.1.4 'Ōlelo No'eau #2152

Mehameha wale no o Pu'uloa i ka hele a Ka'ahupāhau

Pu'uloa became lonely when Ka'ahupāhau went away

The home is lonely when a loved one has gone. Ka'ahupāhau, guardian shark of Pu'uloa (Pearl Harbor), was dearly loved by the people. [Pukui 1983:234]

3.3.2 Concerning the *Pipi* or Pearl Oyster of Pu'uloa

Pearl Harbor or Pu'uloa, derived from the name Waimomi, or “water of the pearl,” an alternate name for the Pearl River. The harbor was thus named after pearl oysters of the family Pteriidae (mainly *Pinctada radiata*), which were once abundant on the harbor reefs and after which many 'ōlelo no'eau were generated.

3.3.2.1 'Ōlelo No'eau #123

Anu O 'Ewa i ka i'a hamau leo e. E hāmau!

'Ewa is made cold by the fish that silences the voice. Hush!

A warning to keep still. First uttered by Hi'iaka to her friend Wahine'oma'o to warn her not to speak to Lohi'au while they were in a canoe near 'Ewa. [Pukui 1983:16]

3.3.2.2 'Ōlelo No'eau #274

E hāmau o makani mai auane'i

Hush, lest the wind rise

Hold your silence or trouble will come to us. When the people went to gather pearl oysters at Pu'uloa, they did so in silence, for they believed that if they spoke, a gust of wind would ripple the water and the oysters would vanish. [Pukui 1983:34]

3.3.2.3 'Ōlelo No'eau #493

Haunāele 'Ewa i ka Moa'e

'Ewa is disturbed by the Moa'e wind

Used about something disturbing, like a violent argument. When the people of 'Ewa went to gather the pipi, they did so in silence, for if they spoke, a Moa'e breeze would suddenly blow across the water, rippling it, and the oysters would disappear. [Pukui 1983:59]

3.3.2.4 'Ōlelo No'eau #1331

Ka i'a hāmau leo o 'Ewa

The fish of 'Ewa that silences the voice

The pearl oyster, which has to be gathered in silence. [Pukui 1983:144]

Handy and Handy (1972:471) offer a different interpretation: "The pipi was sometimes called 'the silent fish,' or, 'i'a hāmau leo o 'Ewa,' 'Ewa's silent sea creature since the collectors were supposed to stay quiet while harvesting the shells."

3.3.2.5 'Ōlelo No'eau #1357

Ka i'a kuhi lima o 'Ewa

The gesturing fish of 'Ewa

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

3.3.3 Concerning *Nehu* of Pu'uloa

The following 'ōlelo no'eau discuss the *nehu* (anchovy; *Stolephorus pupureus*) which was once abundant in the waters of Pu'uloa.

3.3.3.1 'Ōlelo No'eau #661

He kai puhi nehu, phui lala ke kai o 'Ewa.

A sea that blows up nehu fish, blows up a quantity of them, is the sea of 'Ewa. [Pukui 1983:74]

3.3.3.2 'Ōlelo No'eau #1721

Ke kai he'e nehu o 'Ewa

The sea where the nehu come in schools to 'Ewa.

Nehu (anchovy) come by the millions into Pearl Harbor. They are used as bait for fishing, or eaten dried or fresh. [Pukui 1983:185]

3.3.4 Concerning the '*Anae-holo* of Honouliuli

The migration of the '*anae-holo* of Honouliuli is described in the following excerpt from which the 'ōlelo no'eau below derives:

The home of the '*anae-holo* is at Honouliuli, Pearl Harbor, at a place called Ihuopala'ai. They make periodical journeys around to the opposite side of the island, starting from Pu'uloa and going to windward, passing successively Kumumanu, Kalihi, Kou, Kālia, Waikīkī, Ka'alāwai, and so on, around to the Ko'olau side, ending at Lā'ie, and then returning by the same course to their starting point. [Nakuina 1998:271]

3.3.4.1 'Ōlelo No'eau #1330

Ka i'a hali a ka makani

The fish fetched by the wind

The 'anaeholo, a fish that travels from Honouliuli, where it breeds, to Kaipāpa'u, on the windward side of O'ahu. It then turns about and returns to its original home. It is driven closer to shore when the wind is strong. [Pukui 1983:145]

3.3.5 Concerning Kalo

A rare taro called the "*kāi o 'Ewa*," was grown in mounds in marshy locations in 'Ewa (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the following saying:

3.3.5.1 'Ōlelo No'eau #2770

Ua 'ai i ke kāi-koi o 'Ewa

He has eaten the kāi-koi taro of 'Ewa

Kāi is O'ahu's best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of 'Ewa, who, like the Kāi taro, is not easily forgotten. [Pukui 1983:305]

3.3.6 Concerning the Ao Kuewa, Realm of the Homeless Souls

3.3.6.1 'Ōlelo No'eau #1666

Ka wiliwili o Kaupe'a

The wiliwili grove of Kaupe'a

In 'Ewa, O'ahu. Said to be where homeless ghosts wander among the trees. [Pukui 1983:180]

Pukui (1983:180) offers this Hawaiian saying, which places the wandering souls in a "*wiliwili*" grove at Kaupe'a, a place in Honouliuli where homeless ghosts wandered among the trees.

3.3.7 Concerning the landscape of 'Ewa

3.3.7.1 'Ōlelo No'eau #80

The following proverb describes the red landscape of the 'Ewa plain.

'Āina koi 'ula I ka lepo.

Land reddened by the rising dust.

Said of 'Ewa, O'ahu. [Pukui 1983:11]

3.3.7.2 'Ōlelo No'eau #2542

The expression below describes the residents of Kaupe'a 'Ili.

'Ō'ū ō loa na manu o Kaupe'a.

The birds of Kaupe'a trill and warble.

Said of the chatter of happy people. [Pukui 1983:278]

3.3.8 Concerning the *ali'i* who resided in 'Ewa

3.3.8.1 'Ōlelo No'eau #386

'Ewa nui a La'akona.

Great 'Ewa of La'akona.

La'akona was a chief of 'Ewa, which was prosperous in his day. [Pukui 1983:47]

3.3.8.2 'Ōlelo No'eau #269

E 'Ewa e—e ku'i na lima!

O 'Ewa—join hands!

This cry was a call of the men of Kona, O'ahu, when they went with their chief to destroy his brother, the 'Ewa chief. [Pukui 1983:33]

3.3.8.3 'Ōlelo No'eau #1776

Ke one kuilima laula o 'Ewa.

The sand on which there was a linking of arms on the breadth of 'Ewa.

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

3.3.8.4 'Ōlelo No'eau #1855

The expression below discusses the boundaries between *ali'i* and *maka'āinana* lands in 'Ewa.

Ku ae 'Ewa; Noho iho 'Ewa.

Stand-up 'Ewa; Sit-down 'Ewa.

The names of two stones, now destroyed, that once marked the boundary between the chiefs' land (Kua'e 'Ewa) and that of the commoners (Noho iho 'Ewa) in 'Ewa, O'ahu. [Pukui 1983:200]

3.3.9 Concerning human sacrifice

3.3.9.1 'Ōlelo No'eau #385

The following *'ōlelo no'eau* discusses the association of 'Ewa with the practice of drowning *kauwa* (slaves) who are to be offered up in sacrifice.

'Ewa kai lumaluma'i.

'Ewa of the drowning sea.

An epithet applied to 'Ewa, where *kauwa* were drowned prior to offering their bodies in sacrifice. [Pukui 1983:47]

3.4 *Oli* (Chants)

Oli, according to Mary Kawena Pukui (Pukui 1995:xvi–xvii) are often grouped according to content. Chants often were imbued with *mana* (divine power); such *mana* was made manifest through the use of themes and *kaona*. According to Pukui, chants for the gods (*pule*; prayers) came first, and chants for the *ali'i*, “the descendants of the gods,” came second in significance. Chants “concerning the activities of the earth peopled by common humans” were last in this hierarchy (Pukui 1995:xvi–xvii). Emerson conversely states,

In its most familiar form the Hawaiians—many of whom [were lyrical masters]—used the *oli* not only for the songful expression of joy and affection, but as the vehicle of humorous or sarcastic narrative in the entertainment of their comrades. The dividing line, then, between the *oli* and those other weightier forms of the *mele*, the *inoa*, the *kanikau* (threnody), the *pule*, and that unnamed variety of *mele* in which the poet dealt with historic or mythologic subjects, is to be found almost wholly in the mood of the singer. [Emerson 1965:254]

While *oli* may vary thematically, subject to the perspective of the *ho'opa'a* (chanter), it was undoubtedly a valued art form used to preserve oral histories, genealogies, and traditions, to recall special places and events, and to offer prayers to *akua* and *'aumākua* alike. Perhaps most importantly, as Alameida (1993:26) writes, “chants . . . created a mystic beauty . . . confirming the special feeling for the environment among Hawaiians: their *one hānau* (birthplace), their *kula iwi* (land of their ancestors).”

3.4.1 *Oli* for Kūali'i

A chant for the chief Kūali'i, an ancient chief of O'ahu, mentions the *ahupua'a* names of the 'Ewa District. Each phrase usually contains a play on words, as the place name and one meaning of the word, or portion of the word, appears on each line, for example, *kele* in Waikele means “slippery.” However, these word plays are not necessarily related to the actual place name meanings of the *ahupua'a*.

<i>Uliuli ka poi e piha nei—o Honouliuli;</i>	Blue is the <i>poi</i> [pounded taro] which appeases [the hunger] of Honouliuli;
<i>Aeae ka paakai o Kahuaiki—Hoeae;</i>	Fine the salt of Kahuaike—Hoeae;
<i>Pikele ka ia e Waikele—o Waikele;</i>	Slippery the fish of Waikele— of Waikele;
<i>Ka hale pio i Kauamoa—o Waipio;</i>	The arched house at Kauamoa— of Waipio;
<i>E kuu kua i ka loko awa—o Waiawa;</i>	Let us cast the net in the <i>awa</i> -pond— of Waiawa;
<i>Mai hoomanana ia oe—o Manana.</i>	Do not stretch yourself at—Manana.

<i>He kini kahawai,</i>	Many are the ravines,
<i>He lau kamano—o Waimano;</i>	Numerous the sharks, at Waimano;
<i>Ko ia kaula e ke au—o Waiau;</i>	We are drawn by the current— of Waiau;
<i>Kukui malumalu kaula—Waimalu;</i>	In the <i>kukui</i> grove we are sheltered— in Waimalu;
<i>E ala kaula ua ao-e—o Kalauao;</i>	Let us arise, it is daylight— at Kalauao;
<i>E kipi kaula e ai—o Aiea;</i>	Let us enter and dine—at Aiea;
<i>Mai hoohalawa ia oe—O Halawa.</i>	Do not pass by—Halawa.
[Fornander 1917:4(2):400–401]	

A chant for the Kaua'i chief of Kaumuali'i, a rival of Kamehameha I, also mentions place names of the 'Ewa District. In a portion of this chant, the wind that blows from one end of 'Ewa to the other is compared to love.

3.4.2 Hi'iaka and the Plains of Keahumoa

While passing through 'Ewa, Hi'iaka, sister of the volcano goddess Pele, met women stringing *lei* with *ma'o* flowers. Desiring a *lei* of her own, Hi'iaka offered a chant:

<i>E lei ana ke kula o Ke'ahumoa i ka ma'o</i>	The plains of Keahumoa are garlanded with <i>ma'o</i>
<i>'Ohu'ohu wale nā wāhine kui lei o ka nahele</i>	The <i>lei</i> -stringing women of the forest are festively adorned
[Ho'oumāhiehiemalie 2008a:287; 2008b:268]	

In the chant, Hi'iaka mentions the plains of Keahumoa which according to McAllister (1933:107) are located west of Kīpapa Gulch in Waialeale. Keahumoa was also possibly a general name for the flat plain *mauka* of the productive floodplain area directly adjacent to Pearl Harbor.

3.4.3 Hi'iaka and the Plains of Kaupe'a

Hi'iaka sang this bitter chant addressed to Lohiau and Wahine-ōma'o, which uses the association of the Plains of Kaupe'a as a place for the wandering of lost souls:

*Ku'u aikana i ke awa lau o Pu'uloa,
Mai ke kula o Pe'e-kaula, ke noho oe,
E noho kaula e kui, e lei i ka pua o ke kauno'a,
I ka pua o ke akuli-kuli, o ka wili-wili;
O ka iho'na o Kau-pe'e i Kane-hili,
Ua hili au; akahi no ka hili o ka la pomaika'i;
E Lohiau ipo, e Wahine-oma'o,
Hoe 'a mai ka wa'a i a'e aku au.*

We meet at Ewa's leaf-shaped lagoon, friends;
 Let us sit, if you will on this lea
 And bedeck us with wreaths of Kauno'a,
 Of *akuli-kuli* and *wili-wili*,
 My soul went astray in this solitude;
 It lost the track for once, in spite of luck,
 As I came down the road to Kau-pe'a.
 No nightmare dream was that which tricked my soul.
 This way, dear friends; turn the canoe this way;
 Paddle hither and let me embark.
 [Emerson 1993:162–163]

Several other Honouliuli places are mentioned in this chant, including Pe'e-kaua, which may be a variation of Kau-pe'e or Kaupe'a, and the plains of Kānehili, the last of which again refers to wandering, as the word *hili* means "to go astray" (Emerson 1993:162). In the chant, Hi'iaka is moving downhill from Kaupe'a, probably the plains adjacent to Pu'uokapolei, toward the coast, the plain of Kānehili.

3.4.4 Ka'ao no Halemano

In the Legend of Halemano, the romantic O'ahu anti-hero, he chants a love song with a reference to Honouliuli:

Huli a'e la Ka'ala kau i luna, Waiho wale kai o Pōka'i, Nānā wale ke aloha i
 Honouliuli, Kokolo kēhau he makani no Līhu'e. . .

Search is made to the top of Ka'ala, the lower end of Pōka'i is plainly seen. Love
 looks in from Honouliuli, The dew comes creeping, it is like the wind of Līhu'e. . .
 [Fornander 1919g:5(2):252]

3.5 Mele (Songs)

The following section draws from the Hawaiian art of *mele*, poetic song intended to create two styles of meaning.

Words and word combinations were studied to see whether they were auspicious or not. There were always two things to consider the literal meaning and the *kaona*, or 'inner meaning.' The inner meaning was sometimes so veiled that only the people to whom the chant belonged understood it, and sometimes so obvious that anyone who knew the figurative speech of old Hawai'i could see it very plainly. There are but two meanings: the literal and the *kaona*, or inner meaning. The literal is like the body and the inner meaning is like the spirit of the poem. [Pukui 1949:247]

The Hawaiians were lovers of poetry and keen observers of nature. Every phase of nature was noted and expressions of this love and observation woven into poems of praise, of satire, of resentment, of love and of celebration for any occasion that might arise. The ancient poets carefully selected men worthy of carrying on their art. These young men were taught the old *meles* and the technique of fashioning new ones. [Pukui 1949:247]

There exist a number of *mele* that concern or mention the *moku* of 'Ewa. These particular *mele* may also be classified as *mele wahi pana* (songs for legendary or historic places). *Mele wahi pana* such as those presented here may or may not be accompanied by *hula* or *hula wahi pana* (dance for legendary or historic places). As the Hula Preservation Society notes,

Hula Wahi Pana comprise a large class of dances that honor places of such emotional, spiritual, historical, or cultural significance that chants were composed for them. Only the composers of the chants could know the deepest meanings, as they would be reflections of their feelings and experiences . . . Since the subjects of *Wahi Pana* compositions are extremely varied, their implementation through *hula* are as well. Coupled with the differences from one *hula* style and tradition to the next, *Hula Wahi Pana* can be exceptionally diverse. They can be done sitting or standing, with limited body movement or wide free movement; with or without the use of implements or instruments; with the dancers themselves chanting and/or playing an implement or being accompanied by the *ho'opa'a* [drummer and *hula* chanter (memorizer)]. Beyond the particular *hula* tradition, what ultimately determines the manner in which a *Hula Wahi Pana* is performed are the specific place involved, why it is significant, the story being shared about it, and its importance in the composer's view. [Hula Preservation Society 2014]

3.5.1 Pūpū o 'Ewa

The following *mele* describes the different features of the 'Ewa District. From the Moa'e wind to the shark goddess, Ka'ahupāhau, this *mele* covers all the beauty of 'Ewa.

Nani Ka'ala hemolele i ka mālie

Kuahiwi kaulana a'o 'Ewa

E ki'i anai ka makani o ka 'āina

Hea ka Moa'e, 'Eia au e ke aloha'

Hui:

Pūpū a'o 'Ewa

I ka nu'a nā kānaka

E naue mai a e 'ike

I ka mea hou o ka 'āina

A he 'āina ua kaulana

Mai nā kūpuna mai

Alahula Pu'uloa ke ala hele no Ka'ahupāhau

Alahula Pu'uloa ke ala hele no Ka'ahupāhau

Translation:

Beautiful is Ka'ala, flawless in the calm

Renowned mountain of the 'Ewa district

Fetching the wind of the land
 The Moa'e wind beckons, 'Here I am my love'
 Chorus:
 Shells of 'Ewa
 Amid throngs of people
 Hasten here and learn
 The news of the land
 A land renowned
 From the ancient ones
 Pu'uloa is a famous pathway
 The pathway for Ka'ahupāhau
 [Wilcox 2003:235]

3.5.2 *Mele no Kūali'i*

The celebrated chief, Kūali'i, is said to have led an army of twelve thousand against the chiefs of Ko'olauloa with an army of twelve hundred upon the plains of Keahumoa (Fornander 1917b:4[2]:364-401). Perhaps because the odds were so skewed the battle was called off and the *ali'i* of Ko'olau ceded the districts of Ko'olauloa, Ko'olaupoko, Wai'alua, and Wai'anae to Kūali'i. When the *ali'i* of Kaua'i heard of this victory at Honouliuli they gave Kaua'i to Kūali'i as well and thus he came to possess all the islands. The strife at Honouliuli was the occasion of the recitation of a song for Kūali'i by a certain Kapa'ahulani. This *mele* compares the king to certain places and objects in the islands, in this instance to the first breadfruit planted by Kaha'i at Pu'uloa, and a pig and a woman on Pu'u o Kapolei, possibly a reference to Kamapua'a and his grandmother.

In this *mele*, the cold winds of Kumomoku and Leleiwe, near Pu'uloa in Honouliuli are compared unfavorably to the god Kū:

<i>Aole i like Ku.</i>	Not like these are thou, Ku
<i>Ia ua hoohali kehau,</i>	[Nor] the rain that brings the land breeze,
<i>Mehe ipu wai ninia la,</i>	Like a vessel of water poured out.
<i>Na hau o Kumomoku;</i>	Nor to the mountain breeze of Kumomoku,
<i>Kekee na hau o Leleiwi,</i>	[The] land breeze coming round to Leleiwi.
<i>Oi ole ka oe i ike</i>	Truly, have you not known?
<i>I ka hau kuapuu</i>	The mountain breezes, that double up your back,

<i>Kekee noho kee, o Kaimohala,</i>	[That make you] sit crooked and cramped at Kaimohala,
<i>O Kahili i Kaupea-la</i>	The Kahili at Kaupea?
<i>Aole i like Ku</i>	Not like these are thou, Ku
[Fornander 1917b:4(2):390–391]	

A later section of this *mele* also refers to Pu'u o Kapolei and makes mention of the famous blue *poi* of Honouliuli.

<i>O Kawelo-e, e Kawelo-e,</i>	O Kawelo! Say, Kawelo!
<i>O Kaweloiki puu oioi,</i>	Kawelokiki, the sharp-pointed hill,
<i>Puu o Kapolei-e-</i>	Hill of Kapolei.
<i>Uliuli ka poi e piha nei-o Honouliuli.</i>	Blue is the poi which appeases [the hunger] of Honouliuli.

[Fornander 1917b4(2):400–401]

3.5.3 *Eia Mai Au 'o Makalapua*

This particular *mele* pays homage to the royal train called *Lanakila*. In paying homage to this train, the *mele* also pays homage to its most honored and well-known passenger, Queen Lili'uokalani. This *mele* may also be understood as a protest song.

In analyzing this *mele*, cultural historian Kīhei de Silva notes that “Eia mai Au ‘o Makalapua” is the second of three chants that make up *hō'alo i ka ihu o ka Lanakila* (Three Train Chants for Lili'uokalani). He adds that these songs, “when considered in chronological succession . . . add a Hawaiian dimension to the story of Benjamin Franklin (B.F.) Dillingham’s Oahu Railway and Land Company (OR&L), a story that otherwise reads far too much like an early script of *How the West was Won*” (de Silva 2003). De Silva provides a chronology of B.F. Dillingham’s rise to influence within Hawaiian political spheres, and his eventual founding and construction of the OR&L line. Dillingham also figures prominently within Honouliuli Ahupua'a (see Section 4.5). Dillingham’s personal history is described by de Silva as follows:

- Arrived in Honolulu in 1865 as first mate of the *Whistler*.
- He promptly fell off a horse and broke his leg. When his ship left without him, he took a job as a clerk in a hardware store.
- 20 years later, in 1885, he had become Hawai'i's first big-time land speculator, buying and leasing vast tracts of property in West O'ahu in hopes of reselling it to housing and ag. interests.
- When no one, in fact, took interest in his largely inaccessible property, he decided to build a railroad through it.
- In 1888, Dillingham convinced Kalākaua to sign a franchise giving him three years to build a line running from Honolulu to the far end of Pearl River Lagoon. His critics

called it 'Dillingham's Folly,' but Dillingham boasted that he would put his railroad into operation by Sept. 4, 1889, his 45th birthday.

- Things did not go well in the early months of construction, and in order to fulfill this boast, Dillingham had to fire up a miniscule saddle-tank engine named *Kauila*, hitch it to a flatcar that carried his passengers on jury-rigged seats, and send it bucking, wheezing, and spewing greasy foam down a mile-and-a-half of track that ended in the rice paddies of Pālama.
- Despite this farcical beginning, the construction of Dillingham's railroad then proceeded in rather impressive fashion: the line was opened to 'Aiea in November 1889, to Mānana in January 1890, to Honouliuli and 'Ewa Mill in June and July 1890, to Wai'anae in July 1895, to Waialua in June, 1898, and to Kahuku in January 1899. [de Silva 2003]

In 1890, as construction of the railway moved forward, B.F. Dillingham bought and shipped to Hawai'i a passenger coach named the *Pearl* and a locomotive named *General Valleho*. According to de Silva (2003), the *Pearl* was built in San Francisco and was "paneled in rich woods and outfitted with plush chairs, velvet drapes, electric lights, a kitchen, a lānai with a striped canvas awning, and a new-fangled contraption called a flush toilet." The *General Valleho* was renamed the *Lanakila* by Dillingham:

. . . [He] gave it the number 45, a tribute to his 45th birthday boast and erstwhile victory in the rice paddies of Pālama. The *Lanakila* became Dillingham's 4th locomotive—after the *Kauila*, *Leahi*, and *Ka'ala*—and for many years it was regarded as the most attractive engine in the OR&L stable. Dillingham apparently wasted no time in hitching the *Pearl* to the *Lanakila* and using the pair as his wine-'em and dine-'em celebrity train, the vehicle in which he wooed financial and political support for his business ventures. [de Silva 2003]

As part of Dillingham's plans to woo the influential, he invited King Kalākaua on the inaugural ride on the *Lanakila*. Dillingham also insisted the luxury coach *Pearl* serve as the king's own royal car. De Silva (2003) notes it is "safe for us to assume that Queen Lili'u[okalani] rode in the *Pearl* when the *Lanakila* took her on the train rides." With the opening of the 'Ewa Mill station, Queen Lili'uokalani once again embarked on a journey on the *Lanakila*; this particular journey took her through "the lowlands of Honouliuli, and finally to the exposed coral plain of Pōlea on which the 'Ewa Mill Station was located" (de Silva 2003).

<i>Eia mai au 'o Makalapua</i>	Here I am, Makalapua
<i>Hō'alo i ka ihu o ka Lanakila.</i>	Traveling where the <i>Lanakila</i> goes.
<i>'O ke ku'e a ka hao a i Kūwili</i>	The piston works at Kūwili
<i>Ka hiona 'olu a 'o Hālawa.</i>	And down the pleasant descent of Hālawa.
<i>Ua lawa ka 'ikena i ke awalau</i>	Satisfying is the view of the lochs
<i>Iā 'Ewa ka i'a hāmau leo.</i>	Of 'Ewa, "land of the silent fish."
<i>Ua piha ka uahi a i Mānana</i>	The smoke rises at Mānana
<i>Aweawe i ke kula o Waipi'o.</i>	And streams along at Waipi'o.

<i>I kai ho'i au a Honouliuli</i>	Then I reached the lowlands of Honouliuli
<i>Ahuwale ke ko'a o Pōlea.</i>	Where the corals of Pōlea lie exposed.
<i>Ha'ina 'ia mai ana ka puana</i>	This is the conclusion of the song
<i>Hō'alo i ka ihu a ka Lanakila.</i>	Of traveling where the <i>Lanakila</i> goes.

[de Silva 2003]

De Silva (2003) provides a remarkable breakdown of this *mele*, delving into the subtext to reveal another layer of understanding, of *kaona*:

'Makalapua' shares . . . the sense of awesome efficiency and harmony . . . These are apparent in 'Makalapua's' description of the working of the train's piston at Kūwili, in the rising and billowing of steam at Mānana and Waipi'o, and especially in the sense of speed with which the *mele* whisks us from Honolulu to Pōlea in the space of its six, two-line verses. Efficiency and harmony, however, are not at the heart of 'Makalapua;' it is inspired and driven, instead, by *aloha 'āina*—love for the land—and by *kū'ē ho'ohui 'āina*—resistance to annexation. In my reading of the *mele*, the dominant imagery is that of flower-stringing. The train and track serve as the contemporary equivalent of lei needle and thread; with them, Lili'u sews a series of beloved place-names and place-associations into a lei of adornment and protection for Ke-awalau-o-Pu'uloa. Keawalauopu'uloa, the many-harbored sea of Pu'uloa, is the old name for Pearl Harbor. The cession of Pearl Harbor to America in return for sugar reciprocity was one of the hottest political issues of 'Makalapua's' day. Lili'u was absolutely opposed to any Keawalau deals; her brother, on the other hand, had regularly waved this bait at the American nose; he was even rumored, on his Nov. 1890 departure to San Francisco, to have harbored a hidden Pearl Harbor agenda. The key lines of 'Makalapua' are 'Ua lawa ka 'ikena i ke awalau / Iā 'Ewa ka i'ā hāmau leo . . . I kai ho'i au a Honouliuli / Ahuwale ke ko'a o Pōlea.' In my reading, these lines say: 'We hold to our knowledge of Keawalau, we are like its closed-mouthed pipi, its oysters; we will never give up the pearl that we contain; here at the shoreline of Honouliuli we normally silent fish reveal this deeply held conviction.' [de Silva 2003]

3.5.4 Waipi'o

The following *mele* was composed by Mekia Kealakai with George Allen and Charles Hopkins for Irene Kahalelauokekoa Holloway, the daughter of John Papa 'Ī'ī, and their family home in Waipi'o Ahupua'a. The *mele* mentions Laulani, a place in Waipi'o, as well as, the *pipi* or pearl oyster which was once found in abundance in the waters of Pu'uloa (Huapala n.d.).

<i>'O kau hana mau no ia</i>	It has always been your way
<i>'O ka ho'okipa i ke aloha</i>	To be hospitable and welcoming
<i>A na'u i ho'oheno mua</i>	I found favor once before
<i>Ka makani 'o Laulani</i>	With the wind of Laulani
<i>Hui:</i>	Chorus:
<i>He inoa keia no Waipi'o</i>	The song is for Waipi'o
<i>'O Kahalelauokekoa</i>	A tribute to Kahalelauokekoa

<i>I puia i ke 'ala</i>	Fragrance fills the air
<i>Onaona i ke ihu</i>	So sweet and pleasing
<i>E ka i'a hamau leo</i>	The pearl oyster
<i>E hi'ipoi malie nei</i>	Held so dear
<i>I ka mea kameha'i</i>	Are wonderous creatures
<i>O ua 'āina nei</i>	From this region
[Huapala n.d.]	

3.5.5 Pa'ahana

This traditional *mele* tells the story of Pa'ahana, a young girl who ran away from her home after being mistreated by her stepmother. She lived in the hills above Wahiawā, living off of river shrimp and guava until she was found by a cowboy and taken to Mānana Ahupua'a (Huapala n.d.).

<i>He inoa kēia nō Pa'ahana</i>	This is a name song for Pa'ahana
<i>Kaikamahine noho kuahiwi</i>	The girl who lived in the hills
<i>Mele he inoa no Pa'ahana</i>	Namesong for Pa'ahana
<i>Na'u i noho aku ia wao kele</i>	I lived in the rain forests in
<i>Ia uka 'iu'iu Wahiawā</i>	The distant uplands of Wahiawā
<i>Mele he inoa no Pa'ahana</i>	Namesong for Pa'ahana
<i>'Ōpae 'oeha'a o ke kahawai</i>	Clawed shrimps of the streams and
<i>'O ka hua o ke kuawa ka'u 'ai ia</i>	Guava fruits my food
<i>Mele he inoa no Pa'ahana</i>	Namesong for Pa'ahana
<i>Mai kuhi mai 'oe ka makuahine</i>	Don't think about the mother
<i>A he pono kēia e noho nei</i>	I live here and am glad
<i>Mele he inoa no Pa'ahana</i>	Namesong for Pa'ahana
<i>'O kahi mu'umu'u pili i ka 'ili</i>	A single mu'umu'u clings to my skin
<i>'O ka lau lā'ī ko'u kapa ia</i>	My blankets are ti leaves
<i>Mele he inoa no Pa'ahana</i>	Namesong for Pa'ahana
<i>Pīlali kukui kau lā'au</i>	Kukui gum on the trees
<i>Lau o ke pili ko'u hale ia</i>	And pili grass my home
<i>Mele he inoa no Pa'ahana</i>	Namesong for Pa'ahana
<i>I hume iho au ma ka pūhaka</i>	I bind my loins
<i>I nalo iho ho'i kahi hilahila</i>	And hide my private parts
<i>Mele he inoa no Pa'ahana</i>	Namesong for Pa'ahana
<i>I ho'i iho ho'i au e pe'e</i>	I came and hid but was
<i>'Ike 'ē 'ia mai e ka 'enemi</i>	Seen by the enemy
<i>Mele he inoa no Pa'ahana</i>	Namesong for Pa'ahana

*Lawe 'ia aku au a i Mānana
Māka 'ika 'i 'ia e ka malihini
Mele he inoa no Pa'ahana*

I was taken to Mānana
And visited by strangers
Namesong for Pa'ahana

*Ha'ina 'ia mai ana ka puana
He mele he inoa no Pa'ahana
Mele he inoa no Pa'ahana*

Tell the refrain
A song, a name for Pa'ahana
Namesong for Pa'ahana

[Huapala n.d.]

3.5.6 Pā'au'au Hula

The following *mele* was written by John U. Isepa. The *mele* discusses Loko Pā'au'au, a fishpond which was located on the Pearl City Peninsula. The fishpond, which has been previously identified by McAllister as Site 117, has now been entirely filled in (Sterling and Summers 1978:48). The *mele* was dedicated to Hon. John F. Colburn whose home was called Pā'au'au in remembrance of Loko Pā'au'au (Huapala n.d.).

*Aia i ka i'a ha mau leo
Ka 'i'ini, ka hali'a, ka ha'upu 'ana ka*

There, where the silent fish is found
The desire, the interest, the
remembrance

*Ha'upu a'e ana ka mana'o e 'ike
E 'ike i ka nani o Pā'au'au o, Pā'au'au*

I yearn once more to see
To see the beauty of Pā'au'au, of
Pā'au'au

*E 'au'au ia wai kamaha'o
Ia wai ho'oheno a ka malihini*

To bathe in that wondrous pool
The pool that delights visitors

*Malihini ho'i ku'u 'ike ia 'oe
Kama'āina no na'e i ke aloha*

I was a stanger when I first saw it
But became acquainted through
friendliness

*'O mai ka wahine nona ka lei
Kūliaikanu'u e o mai*

Answer, o lady whose lei song this is
Kūliaikanu'u, answer

*A Pā'au'au au 'ike i ka nani
Ka waiho kāhela mai i ka la'i*

At Pā'au'au I saw the beauty
Lying before me in the calm

*I laila ho'ola'i ai nā manu la
Miki'ala i ka nani o nā pua*

There the birds paused
Enthralled by the beauty of the
flowers

*He ua no 'oe ua ona ia
He lei 'ā'î no ke kūpuna*

You are a very attractive flower
A neck lei for your ancestors

*Ha'ina 'ia mai ana ka puana
Kūlia ka wahine noho i ke kapu*

This is the end of our song
Kūlia is a woman who swells with
kapus

[Huapala n.d.]

3.5.7 Pā'au'au Waltz

This *mele* was also written by John U. Iosepa for Pā'au'au, a home and fishpond on the Pearl City Peninsula. The *mele* also mentions the Moa'e wind of 'Ewa and the pearl oysters which were gathered in silence (Huapala n.d.).

*Ha 'aheo Pā'au'au i ka nani
Kilikila i ka pai a ka Moa'e*

Proud is Pā'au'au in its beauty
Majestic is the stirring of the trade
winds

*E walea ana paha i ka 'olu
I ka ho'oheno a ka i'a hāmau leo*

Delighting in the pleasant comfort
Cherished for the pearl oyster sought
in silence

*Pau 'ole ko'u ho'ohihi
I ka nani o Pā'au'au*

My delight is boundless
For the beauty of Pā'au'au

*Na wai e 'ole ka 'i'ini
Ua noho a kupa i laila*

Who would not be desirous
Having lived as a familiar of that
place

*Uluwehi wale ia home
Maka'ala i ke kai o Pōlea*

That home is verdant and lush
Surrounded by the sea of Pōlea

*Ho'olale a'e ana e ike i ka nani
O Pā'au'au*

Urging one to witness the beauty
Of Pā'au'au

[Huapala n.d.]

Section 4 Traditional and Historical Background

4.1 Pre-Contact to the Mid-Nineteenth Century

4.1.1 Traditional Settlement and Agricultural Patterns

Various Hawaiian legends and early historical accounts indicate 'Ewa was once widely inhabited by pre-Contact populations, including the Hawaiian *ali'i* (chiefly class). This would be attributable for the most part to the plentiful marine and estuarine resources available at the coast, along which several sites interpreted as permanent habitations and fishing shrines have been located. Other attractive subsistence-related features of the district include irrigated lowlands suitable for wetland taro cultivation, as well as the lower forest area of the mountain slopes for the procurement of forest resources. Handy and Handy (1972) report the following:

The lowlands, bisected by ample streams, were ideal terrain for the cultivation of irrigated taro. The hinterland consisted of deep valleys running far back into the Ko'olau range. Between the valleys were ridges, with steep sides, but a very gradual increase of altitude. The lower part of the valley sides were excellent for the cultivation of yams and bananas. Farther inland grew the 'awa for which the area was famous. [Handy and Handy 1972:429]

In addition, breadfruit, coconuts, *wauke* (paper mulberry, *Broussonetia papyrifera*, used to make *kapa* for clothing), bananas, and *olonā* (*Touchardia latifoli*, used to make cordage), and other plants were grown in the interior. 'Ewa was known as one of the best areas to grow gourds and was famous for its *māmaki* (*Pipterus* spp.; used to make *kapa* for clothing). It was also famous for a rare taro called the *kāi o 'Ewa*, which was grown in mounds in marshy locations (Handy and Handy 1972:471). The cultivation of this prized and delicious taro led to the saying:

Ua 'ai i ke kāi-koi o 'Ewa. He has eaten the Kāi-koi taro of 'Ewa.

Kāi is O'ahu's best eating taro; one who has eaten it will always like it. Said of a youth of a maiden of 'Ewa, who, like the Kāi taro, is not easily forgotten. [Pukui 1983:305]

The lochs of Pearl Harbor were ideal for the construction of fishponds and fish traps. Forest resources along the slopes of the Wai'anae Range probably acted as a viable subsistence alternative during times of famine and/or low rainfall (Handy 1940:211; Handy and Handy 1972:469–470). The upper valley slopes may have also been a resource for sporadic quarrying of basalt used in the manufacturing of stone tools.

4.1.2 Māweke and Overview of the Reign of *Ali'i* in 'Ewa

There are many documented references stating that chiefs resided in 'Ewa and that it was a political center in its day. Oral accounts of *ali'i* recorded by noted Hawaiian historian Samuel Kamakau date back to at least the twelfth century.

The chiefs of Līhu'e [upland area in 'Ewa], Wahiawā, and Halemano on O'ahu were called *lō ali'i*. Because the chiefs at these places lived there continually and guarded their *kapu*, they were called *lō ali'i* [from whom a "guaranteed" chief

might be obtained, loa 'a]. They were like gods, unseen, resembling men. [Kamakau 1991:40]

In the mid-eleventh century, Māweke, a direct lineal descendant of the illustrious Nanaulu (ancestor of Hawaiian royalty), was a chief of O'ahu (Fornander 1996:47). Keaunui, the second of his three sons, became the head of the powerful 'Ewa chiefs. Tradition tells of him cutting of a navigable channel through the Pearl River using his canoe. Keaunui's son, Lakona, became the progenitor of the 'Ewa chiefs around 1400 (Fornander 1996:224–226). Chiefs within his line, the Māweke-Kumuhonua line, reigned until about 1520-1540, with their major royal center in Līhu'e in 'Ewa (Cordy 2002:24). Haka was the last chief of the Māweke-Kumuhonua line. He was slain by his men at the fortress of Waewae near Līhu'e (Kamakau 1991:54; Fornander 1996:88). Power shifted among the chiefs of different districts from the 1500s until the early 1700s, when Kūali'i achieved control of all of O'ahu by defeating the Kona chiefs. He then defeated the 'Ewa chiefs and expanded his control on windward Kaua'i. Peleihōlani, the heir of Kūali'i, gained control of O'ahu about 1740, and later conquered parts of Moloka'i. He ruled O'ahu until his death in about 1778 when Kahahana, of the 'Ewa line of chiefs, was selected as the ruler of O'ahu (Cordy 2002:24–41). Somewhere between 1883 and 1885, Kahahana was killed by Kahekili of Maui. The subsequent rebellion amongst the chiefs resulted in a near genocide of the line of monarchy on O'ahu. Oral reports also tell of how the stream of Hō'ai'ai in 'Ewa was choked with the bodies of the slain (Fornander 1996:224–226). Kahekili and the Maui chiefs retained control of O'ahu until the 1790s. Kahekili died at Waikīkī in 1794. His son, Kalanikūpule, was defeated the following year at the Battle of Nu'uaniu by Kamehameha (Kamakau 1992:376–377). Thus, the supremacy of the 'Ewa chiefs came to a final end.

4.1.3 Mā'ilikūkahi and the Battle of Kīpapa

The rich resources of Pu'uloa—the fisheries in the lochs, the shoreline fishponds, the numerous springs, and the irrigated lands along the streams—made 'Ewa a prize for competing chiefs. Battles were fought for the 'Ewa lands, sometimes by competing O'ahu chiefs and invading chiefs from other islands.

Mā'ilikūkahi, who was born *ali'i kapu* at the birthing stones of Kūkaniloko (Kamakau 1991:53), became *mō'ī* of O'ahu between 1520-1540 (Cordy 2002:19). Mā'ilikūkahi was popular during his reign and was remembered for initiating land reforms, which brought about peace, and for encouraging agricultural production, which brought about prosperity. He also prohibited the chiefs from plundering the *maka'āinana* (common people), a prohibition punishable by death (Kamakau 1991:55).

Upon consenting to become *mō'ī* (supreme chief) at the age of 29, Mā'ilikūkahi was taken to Kapukapuākea Heiau at Pa'ala'akai in Waialua to be consecrated. Soon after becoming king, Mā'ilikūkahi was taken by the chiefs to live at Waikīkī. He was probably one of the first chiefs to live there, as the chiefs had previously always lived at Waialua and 'Ewa. Under his reign, the land divisions were reorganized and redefined (Pukui et al. 1974:113).

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

In the time of Mā'ili-kūkahi, the land was full of people. From the brow, lae, of Kuliheмо to the brow of Maunauna in 'Ewa, from the brow of Maunauna to the

brow of Pu'ukea [Pu'u Ku'ua] the land was full of chiefs and people. From Kānewai to Halemano in Wai'alua, from Halemano to Paupali, from Paupali to Hālawā in 'Ewa the land was filled with chiefs and people. [Kamakau 1991:55]

Mā'ilikūhahi's peaceful reign was interrupted by an invasion that changed 'Ewa forever. Fornander describes the Battle of Kīpapa (to be paved [with the corpses of the slain]) at Kīpapa Gulch in Waipi'o Ahupua'a by Fornander:

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

The location of the Battle of Kīpapa (and any attendant burial of war dead) remains unknown. It is understood that Kīpapa Stream is a tributary of Waikele Stream entering West Loch a kilometer southwest of the Waipahu WWPS so that may be a non-issue for this project.

4.1.4 Ka'ihikapu and Chiefly Rivalry

Around 1600-1620, the entire island of O'ahu was united under the rule of one woman, an *ali'i* named Kala'imānuia (Cordy 2002:30). Before her death, she divided her kingdom among four of her children. She gave the districts of Kona and Ko'olaupoko to Kū-a-Manuia; the *ahupua'a* of Kalauao, 'Aiea, Moanalua, and Hālawā to Ka'ihikapu-a-Manuia; the districts of 'Ewa and Wai'anae to Ha'o; and the districts of Waiālua and Ko'olaupoko to her daughter Kekela. To Kū, she passed on her title of *mō'i* so that the other three were still subject to their eldest brother. Kū, however, was greedy and began to try to take the lands allotted to his siblings away from them. Ha'o joined with his brother Ka'ihikapu in a battle defending against an attack by Kū, a battle in which Kū was slain. Ka'ihikapu then became *mō'i* and was a benevolent king, taking care of his subjects and making frequent tours around the island to observe the people. On one of these circuits, he visited his brother Ha'o at his court in Waikele and grew jealous of the riches of his brother's home in 'Ewa. Ka'ihikapu sent the carcass of a large man-eating shark that had been caught near his court in Waikīkī to his brother as a gift so that Ha'o could use it as a sacrifice to dedicate to the gods at his *heiau* (pre-Christian place of worship) in Waikele. Ka'ihikapu's forces attacked Ha'o and his priests at the temple, as they were unarmed and busy with the dedication ceremonies (Fornander 1996:270–271).

There are other versions of this *mo'olelo* that describe the shark as similar to the gift of the Trojan Horse, but Fornander (1996:271) believes these "embellishments" may have been made in the post-Contact period. In one version of this *mo'olelo* (Pukui 1983:191), Ka'ihikapu took Ha'o's lands from him.

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

There is a saying concerning this rivalry between the two brothers, "*Ke one kuilima laula o 'Ewa*. The sand on which there was a linking of arms [kuilima] on the breadth of 'Ewa" (Pukui 1983:191).

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

O'ahu was unified once more when Ka'ihikapu's son, Kākuhihewa, married his aunt's (Kekela) daughter, Nāpūlānahu. Kākuhihewa had royal residences at Waikīkī, Kailua, and 'Ewa. His descendants lost most of this unified power to the district chiefs over the next three generations (Cordy 2002:31).

4.1.5 Kūali'i's Defeat of the 'Ewa Ali'i

In the first half of the eighteenth century, the island of O'ahu was ruled by the chief Kūali'i, who consolidated his supreme power over the entire island by defeating the Kona chiefs and then the 'Ewa chiefs in battle (Cordy 2002:32). Kūali'i met 'Ewa's competing army on the plains of Keahumoa, but the 'Ewa chiefs surrendered when they saw Kūali'i's overwhelming forces, and they ceded the lands of Ko'olauloa, Ko'olaupoko, Waialua, and Wai'anae to him (Fornander 1917:2:366, 400).

4.1.6 The Overthrow of Kahahana and the Rule of Kahekili

O'ahu was ruled by Kūali'i's son and grandson, and then by Kahahana, the son of the 'Ewa chief Elani and the sister of Kūali'i's son Peleiōhalani (Fornander 1919:6[2]:282). Kahahana had been raised in the court of the powerful Maui chief, Kahekili.

Thomas Thrum (1998:203–214) translates the legend of the *kahuna* Ka'ōpuluhulu, who lived in Waimea. Kahekili, the king of Maui, sent his foster son Kahahana to rule O'ahu, around the year 1779 (Cordy 2002:42). Kahahana set up his royal compound in Waikīkī and commanded the priest Ka'ōpuluhulu to attend him there. At first Kahahana valued the wisdom of this wise priest, but after several years, Kahahana began to be cruel to the people, and in protest Ka'ōpuluhulu left Waikīkī to return to his home in Waimea. This angered the king, who sent messengers to order

Ka'ōpulupulu and his son Kahulupue to come to Wai'anae where Kahahana then resided. They were placed into a special grass hut, one tied to the end post and one tied to the corner post of the house. The next day, Kahahana ordered his men to torture the son, stabbing his eyes and stoning him while his father watched. When Ka'ōpulupulu saw this, he commanded his son to flee into the sea, saying these words, which contained a prophecy.

E nui ke aho, e ku'u keiki, Take a deep breath, my son, and lay
a moe i ke kai, no ke kai la yourself in the sea, for then the land
ho'i ka 'āina. shall belong to the sea.
 [Pukui 1983:44]

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

Upon the arrival here at Oahu of Kahekili, Kahahana fled, with his wife Kekuapoi, and friend Alapai, and hid in the shrubbery of the hills. They went to Aliomanu, Moanalua, to a place called Kinimakalehua; then moved along to Keanapuaa and Kepookala, at the lochs of Puuloa, and then from there to upper Waipio; thence to Wahiawa, Helemano, and on to Lihue [upper plain of Honouliuli, Hō'ae'ae, and Waipi'o]; thence they came to Poo'hilo, at Honouliuli, where they first showed themselves to the people and submitted themselves to their care. [Thrum 1998:213–214]

Through treachery, Kahahana was induced to leave Pō'ohilo, Honouliuli and was killed on the plains of Hō'ae'ae. While hiding in Pō'ohilo, and *'ili* of Honouliuli:

. . . report thereof was made to Kahekili, the king, who thereupon sent Kekuamanoha, elder brother of Kekuapoi, the wife of Kahahana, with men in double canoes from Waikiki, landing first at Kupahu, Hanapouli, Waipio, and had instructions to capture and put to death Kahahana, as also his friend Alapai, but to save alive Kekuapoi. When the canoes touched at Hanapouli, they proceeded thence to Waikele and Hoaeae, and from there to Poo'hilo, Honouliuli, where they met with Kahahana and party in conference. At the close of the day Kekuamanoha sought by enticing words to induce his brother-in-law to go on with him and see the father king and be assured of no death condemnation, and by skilled flattery he induced Kahahana to consent to his proposition, whereupon preparation was made for the return. On the following morning, coming along and reaching the plains of Hoaeae, they fell upon and slew Kahahana and Alapai there, and bore their lifeless bodies to Halaulani, Waipio, where they were placed in the canoes and brought up to Waikiki and placed up in the coconut trees by King Kahekili and his priests from Maui, as Kaopulupulu had been. Thus was fulfilled the famous saying of the Oahu priest in 'all its truthfulness.' According to the writings of S.M. Kamakau and David Malo, recognized authorities, the thought of Kaopulupulu as expressed to his son Kahulupue, 'This land is the sea's,' was in keeping with the famous prophetic vision of Kekiopilo that 'the foreigners possess the land,' as the people of Hawaii now realize. [Manu 1904:112–113]

Sometime between 1883 and 1885, Kahahana was killed by Kahekili of Maui. Kahahana's father, 'Elani, along with other O'ahu chiefs, plotted to kill Kahekili and his chiefs who were residing at Kailua, O'ahu, as well as his chiefs residing at 'Ewa and Wai'alua. The plot was discovered by Kahekili, and a messenger was sent to warn Hū'eu at Wai'alua. For some reason, the messenger never reached Hū'eu and he and his retinue were killed. The murderers of Hū'eu were found in Waipi'o, "therefore Ewa became famed as a land of deadly plots" (*Ka Nūpepa Kū'oko'a*, 5 December, 1868, translated in Sterling and Summers 1978:3). This slaughter became known as the Waipi'o *kīmopō*, or the Waipi'o assassination, because it originated there. Kahekili avenged the death of Hū'eu by pillaging and destroying the districts of Kona and 'Ewa. It is said that the streams of Makaho and Niuhelewai in Kona, as well as Hō'ae'ae in 'Ewa were "choked with the bodies of the slain, and their waters became bitter to the taste, as eyewitnesses say, from the brains that turned the water bitter" (Kamakau 1992:138). It was during this time that the O'ahu chiefly lines were nearly exterminated. It is said that one of the Maui chiefs, Kalaikoa, used the bones of the slain to build a wall around his house at Lapakea in Moanalua. The house was known as Kauwalua and could be seen as one passed by the "old upper road to 'Ewa" (Fornander 1996:290). Hō'ae'ae Stream, associated with war dead in the account above, is just to the west of Waipi'o Peninsula and is not an issue for this project.

4.1.7 The Battle of Kūki'iahu in Kalauao and Refuge in Hālawā

Kahekili and the Maui chiefs retained control of O'ahu until the 1790s. In 1794, Kahekili died at Waikīkī. His heir and son, Kalanikūpule, retained supremacy over Maui and O'ahu, but Kā'eokulani, the half-brother of Kahekili, ruled Kaua'i. After fighting against the Hawaiian chief Kamehameha on Hawai'i, Kā'eokulani began sailing his canoe fleet to Kaua'i, but dissension among his followers made him to decide to land on O'ahu and challenge his brother's rule by joining with the Wai'alua and Wai'anae chiefs. In this battle, Kalanikūpule gained the support of a foreign ship captain named Captain Brown. On the opposing side, Kā'eokulani was aided by a foreign gunner called Mare Amara. Fornander has suggested the last name is actually the Hawaiian corruption of the English title "Armourer" (Fornander 1996:241). Four battles were fought in 'Ewa, and in the fourth, the Kaua'i chief was defeated.

The Hawaiian historian Samuel M. Kamakau gives the following account of the battles in 'Ewa fought in 1794, including the last, which was fought in Kalauao.

A battle was fought on the plains of Pu'unahawele in which some foreigners were killed by Mare Amara. Natives also fell, and Ka-lani-ku-pule was forced to retreat. Some six days later another battle was fought in which Ka-'eo was again victorious. This gain he followed up by approaching further upon 'Ewa, hoping to push on to Waikiki which was at that time the center of government. On December 12, 1794, a great battle was fought on the ground of Ka-lani-manuia between Kalauao and 'Aiea in 'Ewa. The heights of Kuamo'o, Kalauao, and 'Aiea were held by the right wing of Ka-lani-ku-pule's forces commanded by a warrior named Koa-lau-kani; the shore line of Malie [was held] by the left wing under the command of Kamohomoho, Ka-lani-ku-pule himself with the main army held the middle ground between 'Aiea and the taro patches; Captain Brown's men were in boats guarding the shoreline. Thus surrounded Ka-'eo found his men fighting at close quarters and cut off by Koa-lau-kani between Kalauao and Kuamo'o, he was hemmed in on all

sides and compelled to meet the onset, which moved like the ebb and flow of the tide. Shots from guns and cannon, thrusts of the sword and spear fell upon his helpers. Ka-‘eo with six of his men escaped into a ravine below ‘Aiea and might have disappeared there had not the red of his feather cloak been seen from the boats at sea and there shots drew attention to those on land. Hemmed in from above, he was killed fighting bravely. His wives were killed with him, and his chiefs and warriors. This war called Kūki‘iahu, was fought from November 16 to December 12, 1794 at Kalauao in ‘Ewa. [Kamakau 1992:169]

The battle was given the name of Kūki‘iahu as the battle was fought near the former residence (called Kūki‘iahu) in Kalauao of the chiefess Kala‘imanuia, who ruled O‘ahu in the seventeenth century. Kamakau (1992:169–170) said the dead bodies were gathered up and taken to Pā‘aiau (an ‘ili and fishpond in Kalauao) where they were piled in a great heap. Among the piled-up bodies was Kahulunuika‘aumoku, daughter of Kū‘ohu, a Kaua‘i *kahuna* who had been slain with Ka‘eokūlani. Late at night an owl woke her up by flying over and beating its wings on her head. The owl flew *makai* and she crawled after it until reaching the sea. She then swam to the other side at ‘Aiea where the owl appeared once more and led her up to the mountains in Hālawa valley. There, she took shelter in a cave and fell into an unconscious sleep. The owl flew to a former *kahu* (caretaker) of hers who “knew the country well around Hālawa.” This *kahu* brought her food and nursed her back to health. (Kamakau 1992:169–170) The general location of this “great heap” of war dead in the battle of Kūki‘iahu is understood as on the west side of McGrew Point (just southeast of the Pearl Ridge shopping center). The location is not known. Perhaps it was *makai* of the study corridor.

During the construction of the H-3 freeway, Mālama o Hālawa protesters used this story as basis for claiming Hālawa’s importance to women. They maintained that Hālawa was an important and special healing site for women in times past and that it was also home of the protective ‘aumakua (guardian), the *pueo* (owl).

4.1.8 Kamehameha’s Conquest of O‘ahu

Kalanikūpule was defeated the following year at the battle of Nu‘uanu when the Hawai‘i Island chief, Kamehameha, invaded O‘ahu and conquered the opposing forces. Kamehameha distributed the O‘ahu lands among his favorite followers, which resulted in the displacement of many families: “Land belonging to the old chiefs was given to strange chiefs and that of old residents on the land to their companies of soldiers, leaving the old settled families destitute” (Kamakau 1992:376–377).

The main battle was fought from the Honolulu shore past the forts of Pūowaina (Punchbowl) and into the valley of Nu‘uanu. By tradition, one warrior with Kamehameha fought a series of one-man battles from Honolulu to Wai‘anae. This individual, Makaioulu, killed a champion of O‘ahu in Waikīkī by standing in front his companion who threw a spear at him, then dodging at the last second so the spear killed his opponent instead. In Kalauao, he met a party of men, and shamed them into fighting him one at a time rather than as a group. He defeated and killed each warrior. He then killed a robber at Kapolei in Honouliuli and two women famed for bone-breaking in Mākua in the *moku* (district) of Wai‘anae (Fornander 1919:5[2]:488). There is no direct connection between the invasion of Kamehameha in 1795 and the present study area.

4.1.9 Observations of Early Explorers and Visitors

Captain James Cook landed in the Hawaiian Islands in 1778, and ten years later the first published description of Pearl Harbor appeared. Captain Nathaniel Portlock, observing the coast of Honolulu for Great Britain, recorded the investigation of a “fine, deep bay running well to the northward” around the west point of “King George’s Bay” in his journal (Portlock 1789:74). Portlock’s description matches the entire crescent-shaped shoreline from Barbers Point to Diamond Head.

Captain George Vancouver made three voyages to the Hawaiian Islands between 1792 and 1794. In 1793, the British captain recorded the name of the harbor opening as “O-poo-ro-ah” and sent several boats across the sand bar to venture into the harbor proper (Vancouver 1798:884). The area known as “Pu‘u-loa” was comprised of the eastern bank at the entrance to Pearl River. George Vancouver anchored off the entrance to West Loch in 1793, and the Hawaiians told him of the area at “a little distance from the sea, [where] the soil is rich and all the necessaries of life are abundantly produced” (Vancouver 1798, in Sterling and Summers 1978:36). Mr. Whitbey, one of Vancouver’s crew, observed, “from the number of houses within the harbor it should seem to be very populous; but the very few inhabitants who made their appearance were an indication of the contrary” (Vancouver 1798, in Sterling and Summers 1978:36).

Captain Vancouver sailed by Kalaeloa (Barbers Point) in 1792, and recorded his impression of the small coastal village of Kualaka‘i and the arid Honouliuli coast.

The point is low flat land, with a reef round it . . . Not far from the S.W. point is a small grove of shabby cocoa-nut trees, and along these shores are a few struggling fishermen’s huts. [Vancouver 1798:1:167]

. . . from the commencement of the high land to the westward of Opooroah [Pu‘uloa], was composed of one very barren rocky waste, nearly destitute of verdure, cultivation or inhabitants, with little variation all the way to the west point of the island . . . [Vancouver 1798:2:217]

. . . This tract of land was of some extent but did not seem to be populous, nor to possess any great degree of fertility; although we were told that at a little distance from the sea, the soil is rich, and all necessaries of life are abundantly produced . . . [Vancouver 1798:3:361–363]

During the first decades of the nineteenth century, several western visitors described the ‘Ewa landscape near Pearl Harbor. Archibald Campbell, an English sailor, spent some time in Hawai‘i during 1809-1810. He had endured a shipwreck off the Island of Sannack on the northwest coast of America. As a result, both his feet became frost-bitten and were amputated. He spent over a year recuperating in the Hawaiian Islands. His narrative is considered noteworthy because it describes life before the missionaries arrived. During part of his stay, he resided with King Kamehameha I, who granted him 60 acres in Waimano Ahupua‘a in 1809. Campbell described his land:

In the month of November the king was pleased to grant me about sixty acres of land, situated upon the Wymummee [traditional Hawaiian name for Pearl River], or Pearl-water, an inlet of the sea about twelve miles to the west of Hanaroora [Honolulu]. I immediately removed thither; and it being Macaheite time

[Makahiki], during which canoes are tabooed, I was carried on men's shoulders. We passed by footpaths winding through an extensive and fertile plain, the whole of which is in the highest state of cultivation. Every stream was carefully embanked, to supply water for taro beds. Where there was no water, the land was under crops of yams and sweet potatoes. The roads and numerous houses are shaded by coconut trees, and the sides of the mountains are covered with wood to a great height. We halted two or three times, and were treated by the natives with the utmost hospitality. My farm, called Wymannoo [Waimano], was upon the east side of the river, four or five miles from its mouth. Fifteen people with their families resided upon it, who cultivated the ground as my servants. There were three houses upon the property; but I found it most agreeable to live with one of my neighbours, and get what I wanted from my own land. This person's name was William Stevenson a native of Borrowstouness. [Campbell 1967:103–104]

Of the Pearl River area, Campbell wrote,

Wymumme, or Pearl River, lies about seven miles farther to the westward. This inlet extends ten or twelve miles up the country. The entrance is not more than a quarter of a mile wide, and is only navigable for small craft; the depth of water on the bar, at the highest tides, not exceeding seven feet; farther up it is nearly two miles across. There is an isle in it, belonging to Manina, the king's interpreter, in which he keeps a numerous flock of sheep and goats. (Campbell 1967:114) The flat land along shore is highly cultivated; taro root, yams, and sweet potatoes, are the most common crops; but taro forms the chief object of their husbandry, being the principal article of food amongst every class of inhabitants. [Campbell 1967:115]

The botanist F.J.F. Meyen, visiting in 1831, confirms the abundant vegetation described by Campbell in the vicinity of Pearl Harbor:

At the mouth of the Pearl River the ground has such a slight elevation that at high tide the ocean encroaches far into the river, helping to form small lakes which are so deep, that the long boats from the ocean can penetrate far upstream. All around these water basins the land is extraordinarily low but also exceedingly fertile and nowhere else on the whole island of Oahu are such large and continuous stretches of land cultivated. The taro fields, the banana plantations, the plantations of sugar cane are immeasurable. [Meyen 1981:63]

A contrasting picture of 'Ewa is recorded in the missionary William Ellis' description from 1823-1824 of the 'Ewa lands away from the coast:

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

The Malden map of Map of the South Coast of Oahu (Figure 23) is one of the first detailed maps depicting the study area. Malden was clearly focused on the hydrology of Pearl Harbor and

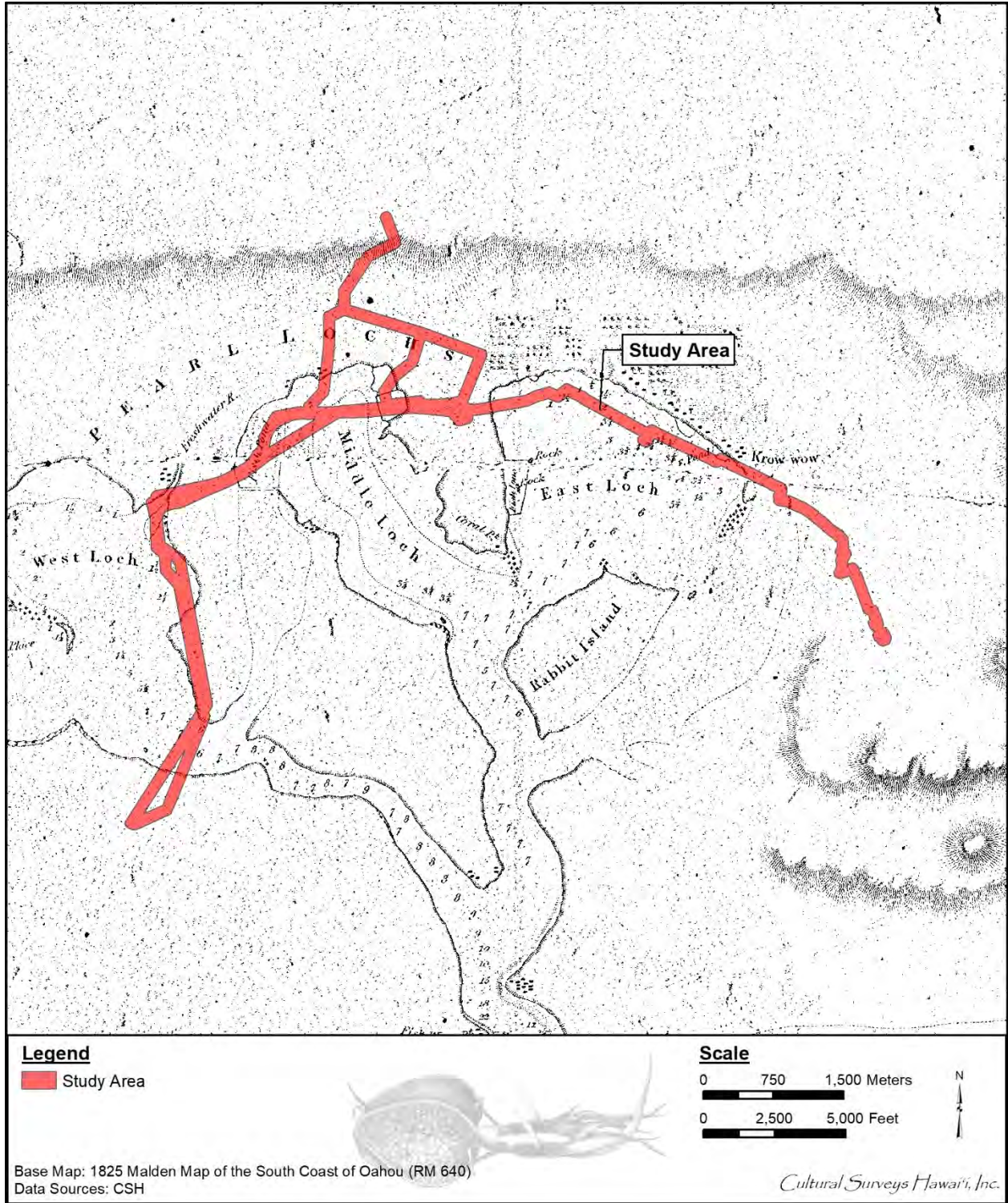


Figure 23. 1825 Malden map of the South Coast of Oahu showing the study area (best fit of study area is shown, this early map is imprecise)

may in fact have been the first to use the West Loch, Middle Loch, East Loch terminology used to this day. Thus he may have had only secondary interest in depicting developments on the coast. Given the early date, it is no surprise that the map's accuracy is not spot-on and hence the overlay of the present study area is only approximate. Malden depicts no human enterprise on the southwest (Honouliuli) side of West Loch and virtually none on Waipi'o Peninsula. Pretty clearly the freshwater stream with associated houses he calls out on the west side of the base of Waipi'o Peninsula is the mouth of Waikele Stream which is actually a kilometer west of the study area. Pretty clearly the fishpond he calls out on the east side of the base of the Waipi'o Peninsula is Loko Eo. Approximately five houses are shown at the north end of Middle Loch. Basically no enterprise is depicted in coastal Waiawa and Mānana (east side of Middle Loch and the Pearl City Peninsula). From the east side of the Pearl City Peninsula (Waimano Ahupua'a) to the east extensive agricultural fields (*lo'i kalo*) appear to be depicted. A continuous line of houses along the coast appears to be depicted in Waimalu and Kalauao (the east *mauka* side of East Loch). The only traditional Hawaiian place name offered is "Krow-wow"—which is pretty certainly Kalauao. This suggests the importance of Kalauao, also suggested by its relatively great width compared to the smaller neighboring Waiawa, Waimalu, and 'Aiea *ahupua'a*. Basically no development is shown within Hālawa Ahupua'a and the east end of the study corridor.

4.1.10 Missionary Stations and the Population Census

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

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

In the following years, the Protestant missionaries established smaller churches in outlying areas, sometimes presided over by a foreign missionary or led by a Hawaiian convert, with periodical visits by a visiting pastor from one of the main churches. The first mission in 'Ewa was established in 1834 in Waiawa. Two

missionaries, Lowell and Abigail Smith, were assigned to the station and were in charge of building a church and a house for themselves. [Hawaiian Mission Children's Society 1969:3–9]

The *ali'i*, Kīna'u, daughter of Kamehameha I and an early Christian convert, offered the missionaries to “settle upon her land, will build us a house and do anything to promote our happiness” (letter from Lowell Smith 1833 in Frear 1934:69). Citing his wife's poor health, the Smiths went to Moloka'i instead. But at the General Meeting of the missionaries in June and July 1834, the board decided the Smiths should be transferred to 'Ewa to a place 3 miles from the king's favorite country seat (Frear 1934:93). Lowell selected the site for the new church on a hill called Haupū'u (built-up hill) that was elevated 200 ft above the 'Ewa plain. This 'Ewa Church was in many ways the foci for 'Ewa District for decades.

The reports left by Artemas Bishop of the Ewa Protestant Station in Waiawa sheds light on the massive impact disease was having on the Hawaiian people in the 'Ewa District. The 1831-1832 census of O'ahu recorded a population of 4,015 within the 'Ewa District. Four years later, in 1836, the 'Ewa population had dropped to 3,423 (Schmitt 1973:9, 36), “a decrease of 592 in 4 years” (Ewa Station Report 1836). Reverend Lowell Smith noted in 1836:

The people of Ewa are a dying people. I have not been able to obtain an exact count of all the deaths & births since the last general meeting. But my impression is that there have been as many as 8 or 10 deaths to one birth. I have heard of but 4 births on Waiawa during the year, & all of these children are dead. I have attended about 20 funerals on that one land, & 16 of these were adults. [Ewa Station Report 1836]

The population stabilized in the 1830s and early 1840s. In January 1849, the population was 2,386 people, but the population dropped with a measles epidemic in October 1849. Although Bishop made an attempt to vaccinate as many individuals as possible, the smallpox epidemic of 1853-1854 killed upwards of 400 people in the 'Ewa District. The comments of Artemas Bishop reflect the destitution people were suffering district wide:

It is not necessary that I go into detail of that season of sorrow and trial which we passed through, and from which I did not myself escape without feeling its influence in my own person. Let it suffice here, that not a house or family in Ewa escaped. In many cases, whole families were cut off. Husbands and wives parents and children, were separated by death. The whole state of society became disorganized, almost every family was broken up. In the whole district between July and October inclusive, upwards of half of the people died and of those who escaped, many are still enfeebled in consequence. In the church we have lost upwards of 400 members, including several of my best men. We feel ourselves very much crippled in consequence. Many sad and affected feelings, mingled with discouragement have followed my labors through the year, and that to a degree far beyond what I ever before suffered. [Ewa Station Report 1854]

Sereno Bishop also remembered his father's efforts to save his congregation, but with limited success in 'Ewa.

The greatest destruction of Hawaiian population took place in the summer of 1853, by an invasion of small-pox. This broke out in Honolulu. Rev. A. Bishop

immediately procured a supply of vaccine matter, which proved to be spurious. He then proceeded to inoculate the people with small-pox, thus saving hundreds of lives, and himself coming down with varioloid, having formerly been vaccinated. But more than half of the population of Ewa perished in a few weeks. The earliest cases were pathetic. A young woman in Kalauao was visiting in Honolulu, and contracted the malady. She hastened home in terror and summoned her friends and kindred from all the villages of Ewa to bid her farewell. They all came and kissed her, then returned to their homes and all died. The young woman herself recovered. [Bishop 1916:46]

In 1860, Artemas Bishop reported,

The people of the district are rapidly diminishing, and whole neighborhoods where in former years were numerous families and cultivated lands, there are now no inhabitants, and the land is left to run to waste. The fathers have died off, and the children wander into other parts, and there are none to fill their places. [Ewa Station Report 1860]

Sereno Bishop, recollecting his life at the mission station in 'Ewa in the mid-eighteenth century, commented on the population decline: "Throughout the district of Ewa the common people were generally well fed. Owing to the decay of population great breadths of taro marsh had fallen into disuse, and there was a surplus of soil and water for raising food" (Bishop 1916:44).

At Contact, the most populous *ahupua'a* on the island was Honouliuli, with the majority of the population centered on Pearl Harbor. In 1832, a missionary census of Honouliuli recorded the population as 1,026. Within four years, the population was down to 870 (Schmitt 1973:19, 22). In 1835, there were eight to ten deaths for every birth (Kelly 1991:157–158). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages. In 1853, the population of 'Ewa and Wai'anae combined was 2,451 people. In 1872, it was 1,671 (Schmitt 1968:71). The inland area of 'Ewa was probably abandoned by the mid-nineteenth century, due to population decline and consolidation of the remaining people in the towns of Honouliuli, Waipahu, and Waiawa.

4.2 Mid-Nineteenth Century and the Māhele

In 1845, the Board of Commissioners to Quiet Land Titles, also called the Land Commission, was established "for the investigation and final ascertainment or rejection of all claims of private individuals, whether natives or foreigners, to any landed property" (Chinen 1958:8). This led to the Māhele, the division of lands among the king of Hawai'i, the *ali'i* (chiefs), and the common people, which introduced the concept of private property into the Hawaiian society. Kamehameha III divided the land into four categories: Crown Lands reserved for the king and the royal house; Government Lands set aside to generate revenue for the government; Konohiki Lands claimed by *ali'i* and their *konohiki* (supervisors); and *kuleana*, habitation and agricultural plots claimed by the common people (Chinen 1958:8–15).

In 1848, the crown and the *ali'i* received their land titles, known as Land Commission Awards (LCA). Members of the royal family were awarded entire *ahupua'a*, while high-ranking *ali'i* were awarded entire *'ili* (land section within an *ahupua'a*), and lesser *konohiki* were awarded half of an *'ili* (Kame'eiehiwa 1992:269, 279). Title to an *ahupua'a* or *'ili* typically included ownership of

the area's fishpond and offshore fishing rights (Devaney et al. 1982:143). The lands awarded as Crown Lands and Konohiki Lands, as well as lands designated as Government Lands, were "subject to the rights of native tenants." The Kuleana Act of 1850 "authorized the Land Commission to award fee simple titles to all native tenants who occupied and improved any portion of Crown, Government, or Konohiki Lands" (Chinen 1958:29). It is through records for LCAs generated during the Māhele that the first specific documentation of life in 'Ewa, as it had evolved up to the mid-nineteenth century, come to light. The LCA parcels adjacent to the west portion of the current study area are shown on Figure 24, and an overview of the neighboring LCA pattern is discussed by *ahupua'a*.

4.2.1.1 Honouliuli

Only a small portion of the southwest end of the present study area (southwest of West Loch) lies in Honouliuli Ahupua'a (see Figure 2). In AD 1795, 17 years after Captain James Cook made the first Western Contact with the Hawaiian Islands, the great Hawaiian warrior Kamehameha completed his conquest of the island of O'ahu and then went on to consolidate his rule over all of the Hawaiian Islands. He gave the *ahupua'a* of Honouliuli to Kalanimōkū, an early supporter, as part of the *panalā'au*, or conquered lands, with the right to pass the land on to his heirs rather than having it revert to Kamehameha (Kame'eleihiwa 1992:58, 112). Kalanimōkū subsequently gave the *ahupua'a* to his sister, Wahinepi'o.

In 1855, the Land Commission awarded all of the unclaimed lands in Honouliuli, 43,250 acres, to Miriam Ke'ahikuni Kekau'ōnohi (LCA 11218), a granddaughter of Kamehameha I, and the heir of Kalanimōkū (Indices of Awards 1929; Kame'eleihiwa 1992). Kekau'ōnohi was one of Liholiho's (Kamehameha II's) wives, and after his death, she lived with her half-brother, Luanu'u Kahalai'a, governor of Kaua'i (Kelly 1985:21). Subsequently, Kekau'ōnohi ran away with Queen Ka'ahumanu's stepson, Keli'iahonui, and then became the wife of Chief Levi Ha'alelea. Upon her death on 2 June 1851, all her property passed on to her husband and his heirs. In 1863, the owners of the *kuleana* lands deeded their lands back to Ha'alelea to pay off debts owed to him (Frierson 1972:12). In 1864, Ha'alelea died, and his second wife, Anadelia Amoe, transferred ownership of the land to her sister's husband John Coney.

During the Māhele of 1848, 96 individual claims were made and 72 individual claims in the *ahupua'a* of Honouliuli were registered and awarded by King Kamehameha III to commoners (Tuggle and Tomonari-Tuggle 1997:34). The 72 *kuleana* awards were almost all made in the former rich taro lands adjacent to Honouliuli Gulch, which contained fishponds and irrigated taro fields. They awards ranged in size from 0.1 to 5.5 acres in size.

None of the LCA *kuleana* (commoner) claims within Honouliuli Ahupua'a (west of West Loch) was near the present study area (Figure 24). The study area within Honouliuli Ahupua'a was within the *ahupua'a* award to Kekau'ōnohi.

The absence of LCA claims in the Honouliuli Ahupua'a portion of the study area indicates a lower likelihood of traditional Hawaiian cultural properties in that area.

4.2.1.2 Waikele

The study area traverses Waikele Ahupua'a on the west side of the Waipi'o Peninsula (see Figure 2). In the Māhele, the *ahupua'a* of Waikele was awarded to the *ali'i* Nahuina; he returned it to the government as a commutation fee to pay for the lands he kept for himself. Much of the

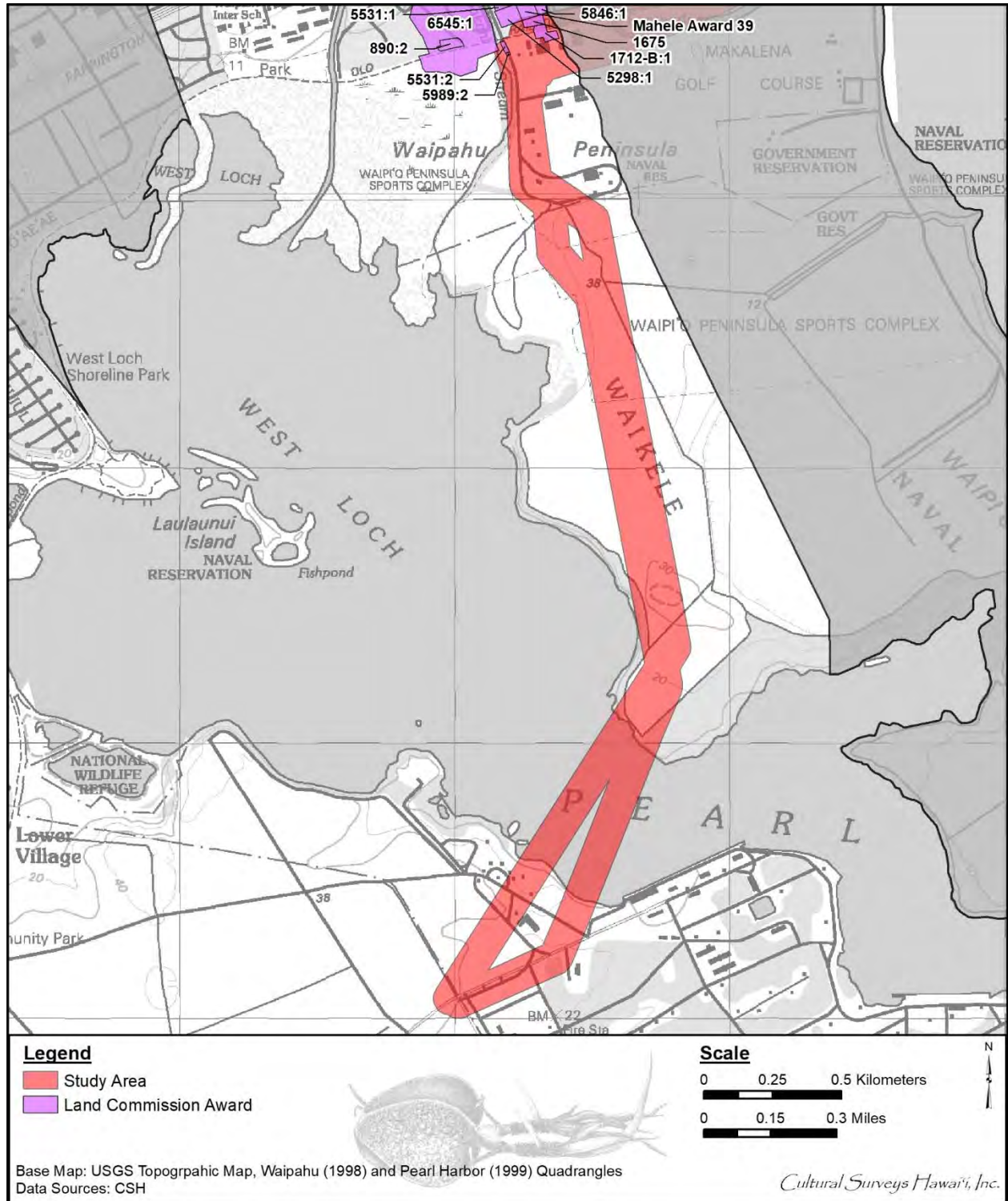


Figure 24. Locations of Land Commission Awards near the west portion (Honouliuli, and Waikele Ahupua‘a) of the study area

Much of the most productive agricultural lands were awarded to several *ali'i* as *'ili* awards, such as the 199-acre award of the *'ili* of Auiole to Nāmāhana and Maawe, the 252-acre award for the *'ili* of Koalipea to Nāmākehā, and the 2,829-acre award of Pouhala *'Ili* to Lūlūhiwalani. In all, 119 claims were made for the *ahupua'a* and 73 of these were awarded. As shown in Table 13, nine LCA parcels in Waikele Ahupua'a are adjacent to the study area (see Figure 24). Information in the award records indicates the *makai* region contained agricultural land used most often for growing taro, pasturelands, abundant *loko* (fishponds), sand dunes, *'auwai* (ditches), and *muliwai* (estuary or river mouth).

The *kuleana* LCA pattern in Waikele Ahupua'a (see Figure 24) notably does not extend down Waipi'o Peninsula suggesting a lower probability of traditional Hawaiian occupation on the west side of the peninsula. Conversely, a high probability of traditional Hawaiian occupation is indicated at the base of Waipi'o Peninsula where the study area takes a right angle turn to the east. Thus while the LCA density is quite low along the study area in Waikele Ahupua'a, it is notably high in the immediate vicinity of the existing Waipahu WWPS and the two neighboring alternative Waipahu WWPS locations.

Table 13. Land Commission Awards in Waikele

LCA	Awardee	'Ili	LCA	Awardee	'Ili
39 MA	Kauliokam oa	Kapakahi	5531:1-2	Keawe	Kapakahi
890:2	Kuhano	Ohua	5846:1	Kalou	Kapakahi, Kapuna
1675	Mahoe	Kamohai	5989:2	Makole	Kapakahi
1712b:1	Hopu	Kaokai	6545:1	Haalilio, Hana Hupa	Ohua
5298:1	Puhi	Kapakahi			

4.2.1.3 Waipi'o

The study area traverses Waipi'o Ahupua'a as it crosses the eastern half of the base of Waipi'o Peninsula (see Figure 3). The *ahupua'a* of Waipi'o was awarded to John Papa 'I'i in the Māhele (LCA 8241) comprising approximately 20,540 acres. In addition four *'ili* were awarded to *ali'i* as *konohiki* awards. Two of the *ali'i* kept all of their lands, and two returned half of their *'ili* awards to the government. 'I'i, who was born in Waipi'o, was a companion to the young Liholiho (Kamehameha II). He was an early Christian convert, a member of the house of nobles during the Kamehameha III reign, and an early chronicler of Hawaiian customs and history (Day 1984:55). In all, 121 claims were made for land in Waipi'o, but only 80 were awarded. Including the *ahupua'a* award to John Papa 'I'i, 20 LCA awards in Waipi'o are adjacent to the present study area (Table 14 and Figure 25).

The majority of awarded land parcels were located in the *makai* portions of Waipi'o, at or just above the Waipi'o Peninsula. Predominant among the claimed land usages in Waipi'o are 312 *lo'i* (irrigated taro patches) of various sizes. Wetland taro cultivation was the primary agricultural pursuit within the *ahupua'a* during the mid-nineteenth century, and likely reflects a long history of taro farming. At the coast, four fishponds were claimed.

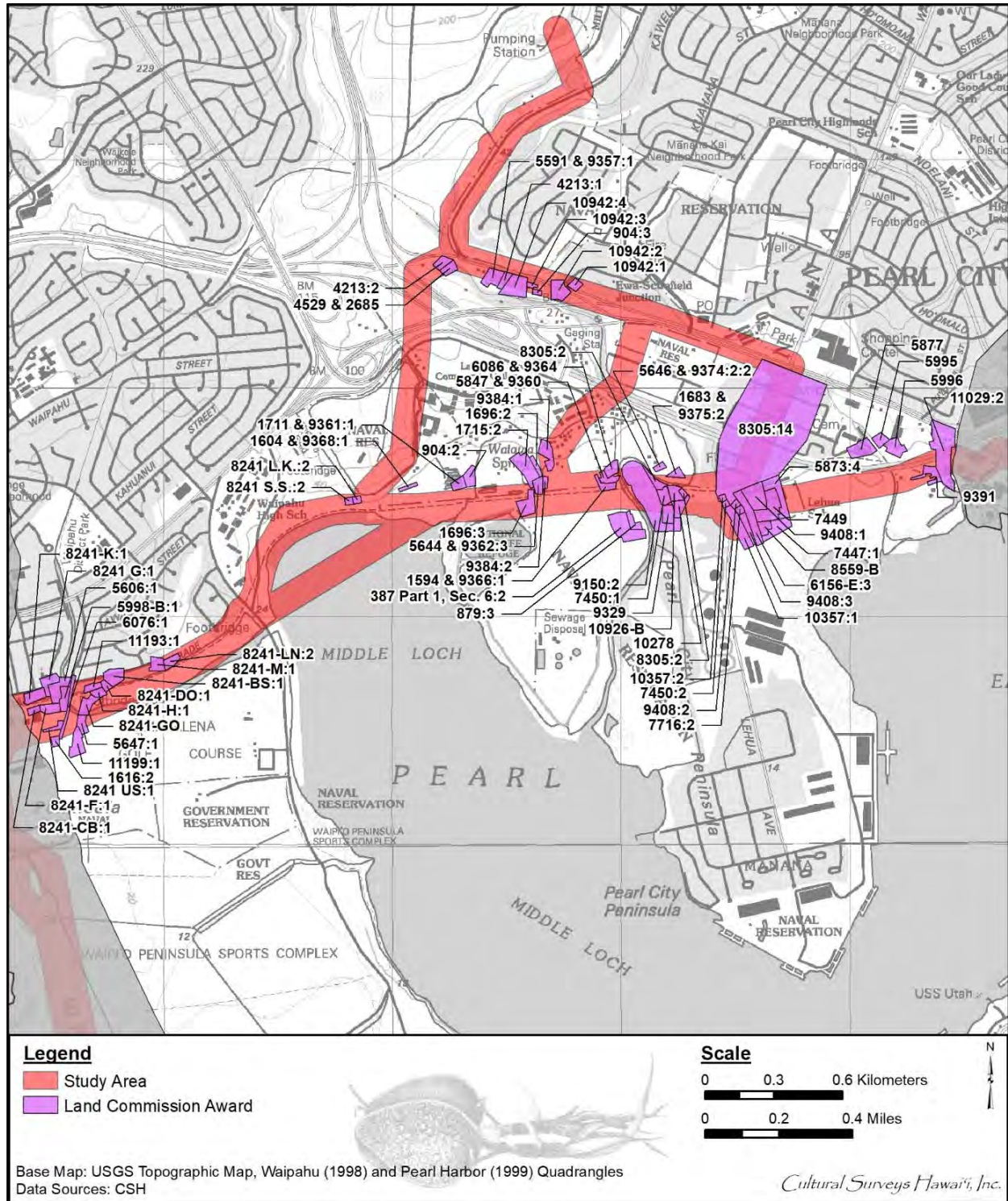


Figure 25. Locations of Land Commission Awards adjacent to the central portion (Waipi‘o, Waiawa, Mānana, Waimano, Ahupua‘a) of the study area

Table 14. Land Commission Awards in Waipi'o

LCA	Awardee	'Ili	LCA	Awardee	'Ili
1616:2	Kaluahinenui	Homaikaia	8241-GO:1	Kawahinelaw aia	Keio
5606:1	Kapela	Homaikaia, Hanaloa	8241-H:1	Kamaka	Lepau, Kauakahiki
5647:1	Kaia	Kalualaea, Eo, Hanaloa	8241K: 1	Kuhiwahiwa	Homaikaia, Hanaloa
5998-B:1	Puou	Homaikaia	8241-L.K.:2	Kaholohana	Hanaupouli
6076:1	Humehume	Puopae	8241L N:1	Nahua	Kaakaulani, Kanonoukuono, Nakumei, Waihaka
8241-BS:1	Kahuailana	Kukina,waihaka	8241-M:1	Kupokii	Eo
8241-CB:1	Keawekolohe	Homaikaia, Hanaloa	8241-S.S.:2	Kauhiohewa	Hanapouli
8241-DO:1	Hana	Pakikakika, Puopae, Eo	8241-US:1	Nahola	Homaikaia
8241-F:1	Kaumiumi	Hoomaikaia, lepau, Keakiula	11193: 1	Kailianu	Lepau, Kanakahiloko]
8241G:1	Ope	Homaikaia, Lepau	11199: 1	Kauaila	Kalualaa, Puuopae

In the *mauka* reaches of Waipi'o, 53 claims were made for portions of *kula* (pasture land) and 25 for "*okipu*" (forest clearings). The fact that several claims were made in the *mauka* regions suggests Waipi'o residents had particular locales they traveled to regularly. This also confirms other accounts (Handy and Handy 1972:469–470) suggesting this area had especially abundant and diverse uplands. *Kula* land is a general term for open fields, pastures, uncultivated fields, or fields for cultivation, and upland (drier), which is distinct from meadow or wetland (Lucas 1995:60). *Kula* lands were often used for opportunistic plantings such as bananas, sugarcane, sweet potatoes, dry land taro, and other crops that did not depend on a consistent source of water. *Okipu* is defined as a forest clearing (Lucas 1995:82), a place presumably used to gather forest products and medicinal herbs or for pasture.

In contrast to the well-populated *makai* lands of Waipi'o, the *mauka* regions were often described in nineteenth century accounts as virtually uninhabited. The missionary William Ellis described the interior regions of 'Ewa in 1823-1824:

The plain of Eva is nearly twenty miles in length, from the Pearl River to Waialua, and in some parts nine or ten miles across. The soil is fertile, and watered by a number of rivulets, which wind their way along the deep water-courses that intersect its surface, and empty themselves into the sea. Though capable of a high

state of improvement, a very small portion of it is enclosed or under any kind of culture, and in traveling across it, scarce a habitation is to be seen. [Ellis 1963:7]

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

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

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

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

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

Here is a wonderful thing about the land of Waipi'o. After a famine had raged in that land, the removal of new crops from the taro patches and gardens was prohibited until all of the people had gathered and the farmers had joined in thanks to the gods. This prohibition was called '*kapu 'ohi'a*' because, while the famine was upon the land, the people had lived on mountain apples [*'ohi'a 'ai*], *ti*, yams, and other upland foods. On the morning of Kane, an offering of taro greens and

other things was made to remove the *'ohi'a* prohibition, after which each farmer took of his own crops for the needs of his family. [Ī'ī 1959:77]

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

Our family made repeated trips to the home of Rev. John S. Emerson at Waialua during those years. There was then no road save a foot path across the generally smooth upland. We forded the streams. Beyond Kīpapa Gulch the upland was dotted with occasional groves of Koa trees. On the high plains the *ti* plant abounded, often so high as to intercept the view. No cattle then existed to destroy its succulent foliage. According to the statements of the natives, a forest formerly covered the whole of the then nearly naked plains. It was burned off by the natives in search of sandalwood, which they detected by its odor burning. [Bishop 1901 in Sterling and Summers 1978:89]

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

The pattern of *kuleana* LCA parcels is again somewhat clumped on the west side of the study area within Waipi'o Ahupua'a (adjacent to the clump of LCA parcels in the neighboring portion of Waikele Ahupua'a to the west) (see Figure 25). The portion of the study area on the northwest edge of Middle Loch is relatively free of *kuleana* LCAs. In general terms, an attendant pattern in any archaeological evidence of traditional Hawaiian occupation would be expected, with a higher probability in the west portion where the study area crosses Waipi'o Ahupua'a and a lower probability in the east portion where the study area crosses Waipi'o Ahupua'a.

4.2.1.4 Waiawa

Coastal Waiawa Ahupua'a extends from approximately the middle of the north side of Middle Loch to approximately the middle of the Pearl City Peninsula (see Figure 3). During the Māhele in 1848, Waiawa Ahupua'a was awarded to Princess Victoria Kamāmalu (sister of Kamehameha IV and V) as part of LCA 7713. During the second half of the nineteenth century, Waiawa passed on to successive members of the *ali'i*: Victoria Kamāmalu died in 1866 at the age of 27. Her entire estate was inherited by her father, Mataio Kekūanao'a, who died two years later and the estate went to Kekūanao'a's son Lota Kapuāiwa, who by that time reigned as Kamehameha V. Kapuāiwa died intestate in 1872, whereupon Ruta Ke'elikōlani, Kapuāiwa's half-sister, petitioned for and received in 1873 the entire estate. By 1883, Ruta Ke'elikōlani died, leaving all of her estate to her cousin Bernice Pauahi Bishop (Kame'eleihiwa 1992:309–310). The Kamehameha Schools (Bernice Pauahi Bishop Estate) presently retains ownership of most of the *ahupua'a*.

Fifty-seven *kuleana* claims were made and 31 were awarded, ranging in size from 0.2 to 3.9 acres in size. One of these was an award to the ABDFM: LCA 387 comprised 4.13 acres in the

makai portion of Waiawa and included a salt pond, a *mo'o* (land strip) for the church, and a house lot. Making the application was Artemis Bishop, the Protestant missionary stationed at 'Ewa from 1836–1856. Another claim by a non-Hawaiian was made by William Wallace in LCA 10942, which comprised 3.2 acres including a house lot, two *mo'o*, and six *lo'i*. The remaining 50 claims (for individual *'āpana* or lots) by 29 claimants in Waiawa were for *kuleana*; the claims included 28 house lots, 176 taro *lo'i*, 20 fishponds, 23 *kula* or pasture, eight *paukū 'auwai* (length of ditch), and seven banana *kula*. Modern tax maps show the 31 claims actually awarded all located in the *makai* portion of the *ahupua'a*. While the uplands of Waiawa were probably used for the procurement of resources, we have no evidence anyone actually lived there permanently in traditional Hawaiian times. Twenty-nine LCA parcels in Waiawa, including the *ahupua'a* award to Victoria Kamāmalu, are within the study area, as shown on the previous Figure 25 and summarized in Table 15.

The pattern of *kuleana* LCAs within the Waiawa Ahupua'a portion of the study area (see Figure 25) is of a lower density on the west side (north of the north end of Middle Loch) and higher closer to the “reverse S” bend of Waiawa Stream. This pattern continues on both sides, with a relatively low density of *kuleana* LCA parcels in the eastern Waipi'o Ahupua'a portion of the study area abutting a relatively lower density in west Waiawa Ahupua'a and a higher density in east Waiawa abutting a relatively high density in west Mānana Ahupua'a (on the east side of the “reverse S” bend of Waiawa Stream). The archaeological potential would be expected to reflect this.

Most of the *mauka* extension corridors in the present study area are in Waiawa Ahupua'a including the western and central *mauka* extensions (on either side of Leeward Community College [LCC]), most of the alignment along Kamehameha Highway and the northern extension up Waihona Street. The *mauka* extensions within Waiawa Ahupua'a are relatively free of LCA parcels (and attendant heightened concern for traditional Hawaiian archaeological resources) with the exceptions being near the *makai* end of the central *mauka* corridor (near Waiawa Spring) and the western portion of the Kamehameha Highway corridor within Waiawa Ahupua'a.

Table 15. Land Commission Awards in Waiawa

LCA	Awardee	'Ili	LCA	Awardee	'Ili
387 Part 1 sec. 6:2	ABCFM	Beretania St., Punahou, Kawaihoa, Kukuluaeo, Kamakapili	5646	Kaionio	Panaio
879:3	Puakai	Panaio, Kapuaihalulu	6086	Makanui	Hanakehau, Ananakehau
904:2 -3	Naheana, Noa	Panio, Kahoaiiai, Kuhia, Panaio	8305: 2	Kanoa, Paulo	Muliwai
1594	Keawe	Honokehau	9357: 1	Kekua	Kahoaeae
1604	Kakoo	Kuhiawaho	9360	Kapaa	Hanekehau

LCA	Awardee	'Ili	LCA	Awardee	'Ili
1683	Peahi	Panaio	9361: 1	Hanamaulu	Kuhiawaho
1696: 2-3	Namomoku		9362: 2	Kamalii	Kuhia
1711	Hanamaulu	Kuhiawaho	9364	Makanui	Hanakehau, Ananakehau
1715: 2	Haa	Kuhouloko	9366: 1	Keawe	Honokehau
2685	Ohia	Holopiapia, Kapuaihalulu	9368: 1	Waiawa	Kuhiawaho
4213: 1-2	Kauhi	Holopiapia, Kahoaiia, Kapuaihalulu, Kalona	9374: 2:2	Kaionio	Panaio
4529	Ohia	Holopiapia, Kapuaihalulu	9375: 2	Peahi	Panaio
5591	Kekua	Kahoaeae	9384: 1-2	Nahalepili	Kapoupou
5847	Kapaa	Hanakehau	10942 :1-4	Wallace	Kahoaiia
5644	Kamalii	Kuhia			

4.2.1.5 Mānana

The study area crosses a narrow neck of Waiawa Ahupua'a between the "reverse S" bend of Waiawa Stream on the west and north of East Loch (just east of Lehua Avenue) (see Figure 3). The existing Pearl City WWPS and the three alternative Pearl City WWPS are all in Mānana Ahupua'a as is the eastern, *mauka* alignment extending north along Lehua Avenue.

Prior to the Māhele, it was documented that Mānana was retained as one of the few O'ahu *'āina* (land holdings) of Ruth (Ruta) Ke'elikōlani, a great-granddaughter of Kamehameha. Ke'elikōlani became one of the largest landholders up to the time of her passing in 1883. Subsequently her heir, Bernice Pauahi Bishop, endowed Kamehameha Schools (Kame'eleihiwa 1992:246).

The productivity of the land of Mānana is indicated in the Māhele records, as a large number of *'ili* were awarded to various *ali'i* as Konohiki Lands. The *'ili* of Kaholona, Kalanihale, Paauau, Weloka, and Keahua were all awarded and retained by members of the *ali'i*, in addition to the large awards of the entire *'ili* of Poupouwela to Victoria Kamāmalu (sister of Kamehameha IV and V) and the entire *'ili* of Mānana Nui to Ruth Ke'elikōlani, the great-granddaughter (or great grandniece) of Kamehameha I and half-sister of Kamāmalu.

Forty-eight claims were made for land in the Māhele, and 33 were awarded, including seven *'ili* awards to the *ali'i*. Fourteen of these awards in Mānana are adjacent to the wastewater study area, as summarized in Table 16 and shown on the previous Figure 25.

Table 16. Land Commission Awards in Mānana

LCA	Awardee	'Ili	LCA	Awardee	'Ili
5873:4	Kahanaumaikai	Keahua	8559-B	William C. Lunalilo	Kamoku, Pau, Kalauakou, Laiwai, Laiemaloo
6156-E:3	Naue	Lole, Kaholana	9150:2	Kupa	Paauau
7447:1	Kuheleloa	Kamuliwai, Kaohai	9329	Nuka	Paanau
7449	Kaoaua	Keahua	9408:1-3	Kauhale	Lohe, Lolei
7450:1-2	Kawaakaukahi	Kaholona	10278	Makole	Maewaiena
7716:2	Keelikolani, Ruth	Manana	10357:1-2	Naheana	Kaolana
8305:2, 14	Kanoa, Paulo	Kahonola	10926-B	Kanana, Maria	Kaholona

4.2.1.6 Waimano

The study area crosses the narrow coastal portion of Waimano Ahupua'a north of the western portion of East Loch (see Figure 3).

The *ahupua'a* of Waimano was awarded to Victoria Kamāmalu during the Māhele as part of LCA 7713. The *'ili* of Kūkona was awarded to John Stevenson (LCA 11029) as a *konohiki* award, but he returned a portion to the government. Only 12 claims were made in Waimano (including the *konohiki* awards) and only nine were awarded. LCA 5662 and portions of the awards of Kamāmalu and Stevenson in Waimano are adjacent to the study corridor, as shown on the previous Figure 25 and summarized in Table 17.

Table 17. Land Commission Awards in Waimano

LCA	Awardee	'Ili		LCA	Awardee	'Ili
5877	Kamauoha	Pulehua		8305:14	Kanoa, Paulo	Kahonola
5995	Laanui	Kaihuaakapuaa, Kukaemoa		9391	Keo	Lopa, Kahapapa
5996	Lua	Kahapapa		11029:2	Stevenson, John	Kukona
7713	Victoria Kamāmalu	<i>Ahupua'a</i>				

4.2.1.7 Waiau

The study area crosses the narrow coastal portion of Waiau Ahupua'a crossing through the HECO Waiau Powerplant (see Figure 4).

Victoria Kamāmalu (LCA 7713, 'Āpana 35) was awarded almost all of the land in Kumu'ulu, a large 'ili which seems to include the entire inland section of Waiau from the government road to the Ko'olau Mountains. Originally the 'ili of Kauhīhau, Nāono, Nālima, and Ka'ākauwaihau in Waiau were all awarded to the *ali'i* Puhī as part of LCA 3834, but he returned three of the 'ili to the government to pay the commutation fees for the Waiau land he kept, which was an 11.94-acre 'ili of Ka'ākauwaihau (Barrère 1994:542). Another Māhele award (MA 18) was to the *konohiki* Paewahine, who claimed the 'ili of Kalua'ōlohe, kept half (3.25 acres; R.P. 4526), and returned the remaining half to the government. The largest claim of 35.7 acres went to Iona (Jonah) Pi'ikoi, a high Kaua'i chief who was a childhood retainer to Liholiho (Kamehameha II). He had first married the Hawaiian chiefess Kekahili, which made him the brother-in-law to the father of the future monarch David Kalākaua. His second wife was the chiefess Kamake'e, with whom he shared LCA 10605. This award included a claim in the 'ili of Kalua'o'opu in Waiau and large awards in other sections of O'ahu, Kaua'i, and Maui. The remaining land in Waiau became government land. Twenty-three claims by commoners were made for Waiau, and 17 were awarded. Including the Kumu'ulu 'Ili claim to Victoria Kamāmalu, 12 LCA *kuleana* parcels in Waiau are adjacent to the study area, as shown on Figure 26 and summarized in Table 18.

Coastal Waiau had a relatively high density of *kuleana* LCA parcels probably owing at least in part to the presence of coastal Waiau Spring. All things being equal, a relative richness of archaeological resources relating to traditional Hawaiian habitation might be anticipated.

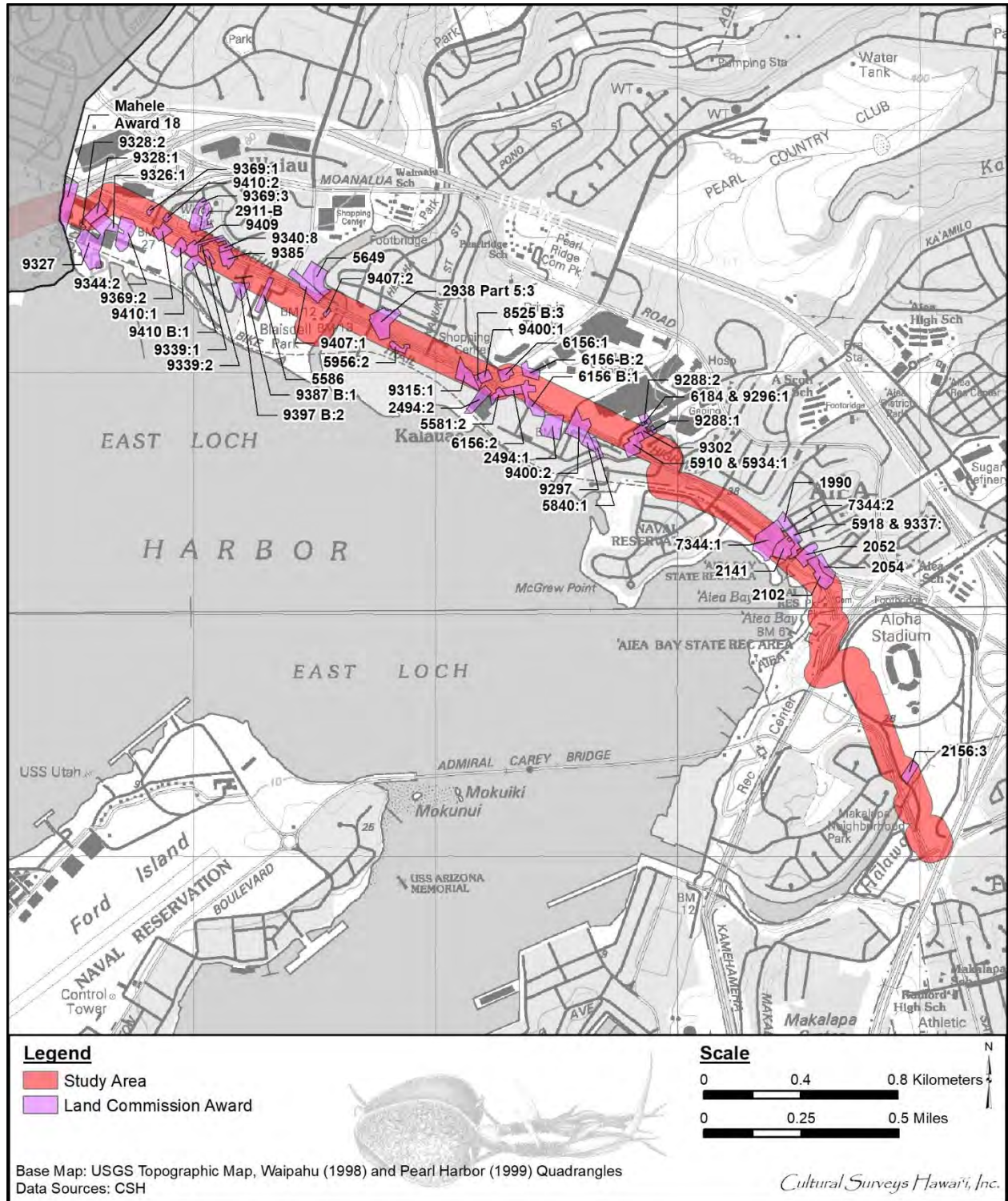


Figure 26. Locations of Land Commission Awards adjacent to the east portion (Waiiau, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a) of the study area

Table 18. Land Commission Awards in Waiau

LCA	Awardee	'Ili		LCA	Awardee	'Ili
18 MA	Paewihine	Kalua'ōlohe		9344:2	Liliu	Honokōwailani
2911-B	Kauluokeahi-amoku	Kumu 'ulu		9369:1-3	Kanealii	Kumu 'ulu, Hahapo
LCA 7713, 'Āpana 35	Victoria Kamāmalu	<i>Ahupua'a</i>				
9326:1	Kekaina	Kalua 'o 'opu		9385	Palea	Kauhihau
9328:1-2	Kaeka	Kalua 'o 'opu		9409	Puhiki	Ka 'akauwaihau
9339:1-2	Nonoaea	Nāono		9410:1-2	Hema	Ka'ākauwaihau Waikowaha
9340:8	Kekalohi	Kauhihau		9410 B:1	Wahaolelo	Ka'ākauwaihau (ap. 1-2); Kumu'ulu ('āp. 3)

4.2.1.8 Waimalu

The study area crosses the narrow coastal portion of Waimalu Ahupua'a that includes the lower reaches of Waimalu Stream and modern Neal S. Blaisdell Park and the existing Waimalu WWPS and proposed alternative WWPS (see Figure 4).

Waimalu was awarded to the *ali'i* Miriam Kekau'ōnohi in the Māhele (LCA 11216). Biographical information on this *ali'i* was discussed in the Honouliuli Māhele section of this report. Fifteen other *'ili* (or half an *'ili*) were awarded to *ali'i* as *konohiki* awards, but only ten were retained. In all, 93 people claimed land in Waimalu, and 63 claims were awarded. Nine LCA parcels in Waimalu are within the study area, as shown on the previous Figure 26 and summarized in Table 19. Waimalu Ahupua'a had a moderate to high density of *kuleana* LCA parcels.

Table 19. Land Commission Awards in Waimalu

LCA	Awardee	'Ili		LCA	Awardee	'Ili
2938 Part 5:3	Huanu, Heirs of Lahilahi	Pohakupu 1		9387 B:1	Keaula	
5586	Kahiki	Pipio		9397 B:2	Kekaula	Pipio
5649	Kahanaipuaa	Kumupali, Aipuaa		9407:1-2	Kuaalu	Pipio

LCA	Awardee	'Ili	LCA	Awardee	'Ili
5956:2	Makaike	Paukea, KaloKola, Waieli	11216	Miriam Kekau'ōnohi	Ahupua'a
9315:1	Haki	Waieli			

4.2.1.9 Kalauao

Kalauao Ahupua'a has a relatively wide frontage on the East Loch of Pearl Harbor and includes the Pearl Ridge Shopping Center, McGrew Point Navy housing, and the northwest side of 'Aiea Bay (see Figure 4).

In the Māhele land division of 1848 and the subsequent Kuleana Act, 36 LCAs were granted within Kalauao Ahupua'a. Seven of these were *konohiki* awards to *ali'i*, some of them for half or an entire 'ili. Virtually all of the *konohiki* and *kuleana* LCA parcels were located within 500 m of the coast. The awards ranged from 0.1 to 5.0 acres in size. Ten LCA awards in Kalauao are within the present study area, as shown on the previous Figure 26 and summarized in Table 20.

The largest award in Kalauao (LCA 5524; 1603 acres), for half the 'ili of Ka'ōnohi, went to Laura Konia, the ninth largest landholder in the Kingdom. She was a daughter of Pā'uli Ka'ōleiokū, reputed *po'olua* (child with "two fathers") son of Kamehameha I and Kalaniōpu'u by Kānekapolei (Kame'eleihiwa 1992:228). Thus, she was either a granddaughter or grandniece of Kamehameha the Great. She was also the mother of Bernice Pauahi Bishop, who inherited the lands at her mother's death.

She received 22 *ahupua'a*-sized lands in the Hawaiian Islands, of which she relinquished 11 back to the Kingdom by way of taxes. She was given the west side of the large 'ili of Ka'ōnohi (Barrère 1994:372), which stretched from the coastal trail to the *mauka* boundary of Kalauao at the Ko'olau Mountains. The fact that she retained her Kalauao lands suggests she may have regarded them as particularly good lands.

The second largest landholder at Kalauao was John Meek, an important merchant involved in the early sandalwood trade, who was awarded a long narrow strip of 1,300 acres on the east side of Kalauao Ahupua'a (Kuykendall 1967:435). This is presumably the eastern section of the large 'ili of Ka'ōnohi, although this is not labeled on any available historic map. Little data are supplied in association with Meek's claim, but it appears he resided there from 1824 to 1853. The Native Register account supporting his Kalauao lands claim is given below:

N.R. 768v3 No. 591, John Meek, Parcel 6

I, Kamehameha III, the King of the Hawaiian Islands, do hereby give a certain parcel of land, bounded as follows: The stream in the middle of Kalauao is the boundary on the west, there also it adjoins the leased land of John Meek. The division between Kalauao and Aiea is the boundary on the east. The highway is the makai boundary and the mountain is the mauka boundary. The length measured from the highway is one hundred and ninety six fathoms. To John Meek and his heirs born under the King of Hawaii and living in these islands. This land shall not be conveyed to a foreigner, nor shall spirit be distilled or vended on said land, but

he shall live on it in righteousness under the law of the land. In witness whereof I set my hand in Honolulu on this day.

KAMEHAMEHA III (seal)

Only one other land award at Kalauao was greater than 5 acres. This land, LCA 5365, was awarded to Colonel William Stevens. His claim follows:

No. 5365, K.U. Giwini /William Stevens/ February 2, 1848 N.R. 44-45v5 To the Honorable and Esteemed Land Commissioners, Greetings: I, Colonel William Stevens, have thought of telling you correctly of my claim for land, in accordance with the law which designated Ministers for the Government and which says for claimants to petition for their land claims. Therefore, I hereby petition for my land claim which was from King Kamehameha III, as follows: Paaiau 'Ili in the Ahupua'a of Kalauao, Ewa, Island of Oahu, described as follows: North, Kauapooli and Keahua, along the Muliwai, south, the edge of the sea of Kapaeli and the edge of the sea of Kapuai, east, Kauapoi and the kula from thence to the far upland of the pali [cliff] of Koolau, south, the edge of the kula of Aiea, north, the edge of the kula of Kalauao. The nature of the kula on the west of Paaiau, is that the people must wade in the sea outside the western boundary of this 'ili. Colonel William Stevens N.T. 428v10 No. 5365, Wm. E. Stevens (he is U.K. Guvini) Wm. Stevens land distribution. Paaiau 'Ili for Kalauao, Ewa, Oahu [Kalauao] True Copy Honolulu, 11 November 1854 A.G. Thurston, Chief Clerk [Award 5365; R.P. 5687; Paaiau Kalauao Ewa; 1 'āp.; 62.15 Acs]. [Native Testimony 1847]

William Poomuku Stevens claimed Pā'aiau, an 'ili of Kalauao, as his Māhele award. Kame'eleihiwa (1992:280) lists Stevens as a mid-level *ali'i*. Of his award, Stevens notes, "The nature of the *kula* on the west of Paaiau is that the people must wade in the sea outside the western boundary of this 'ili" (Barrère 1994:554).

Most of these early landowners probably planted taro and other crops along the streams and springs and used the *kula* as pasture. It has already been noted that John Meek used his land in Kalauao as a cattle ranch. In addition, Lincoln McCandless imported Angora goats to Hawai'i in 1898 and put them with some other goats to improve his stock on some land he owned in Kalauao, but "his purpose was foiled by the destruction brought about by dogs, who used to get into the pens at night, as many as 50 goats being killed in one night" (Marques 1906:52).

Kalauao Ahupua'a had a relatively high density of *kuleana* LCAs within the west half of the study area with a notably lower density north and east of McGrew Point (see Figure 26). All things being equal the archaeological resources relating to traditional Hawaiian occupation might be expected to reflect this.

Table 20. Land Commission Awards in Kalauao

LCA	Awardee	'Ili		LCA	Awardee	'Ili
2494:1-2	Julia Kekoa	Ka'ōnohi		6184	Ino	Ka'ōnohi
5581:2	Kalaimanuia	Ka'ōnohi		8525 B:3	Kauwa, J.A.	Waieli, Kainakoi
5840:1	Kuahao	Ka'ōnohi		9288:1- 2	Kaina	Ka'ōnohi
5910	Piko	Ka'ōnohi		9296:1	Ino	Ka'ōnohi
5934:1	Piko	Ka'ōnohi		9297	Kanikela	Ka'ōnohi
6156:1-2	Nua	Ka'ōnohi		9302	Aluli(Kukai)	Ka'ōnohi
6156 B:1-2	Mahoe	Ka'ōnohi		9400:1- 2	Hilo for Kaoio	Ka'ōnohi

4.2.1.10 'Aiea

'Aiea Ahupua'a had a relatively narrow coastal exposure limited to the northeast side of 'Aiea Bay of East Loch (see Figure 4)

The *ahupua'a* of 'Aiea was initially awarded to Charles Kana'ina, a friend of Kamehameha I and the father of Lunalilo (Kamehameha IV). He returned this land to the Crown. Thirty claims were made in 'Aiea, and 20 were awarded. All of these were small claims ranged from 0.56 to 2.67 acres in size. Eight LCA parcels in 'Aiea are within the study corridor, as shown on the previous Figure 26 and summarized in Table 21.

The northeast side of 'Aiea Bay in 'Aiea Ahupua'a had a notable density of *kuleana* LCA parcels; all things being equal, the archaeological resources relating to traditional Hawaiian occupation might be expected to reflect this.

Table 21. Land Commission Awards in 'Aiea

LC A	Awardee	'Ili		LCA	Awardee	'Ili
1990	Naihe	Kepoho		2141	Keapoahiwa	Kapakai
2052	Kekoanui	Kapalakai		5918	Pua	Kealapii
2054	Kaapuni	Kalawaha		7344:1-2	Kulani	Kaomuoiiki, Waihiluna
2102	Kaohe	Kalokopaoa		9337:	Pua	Kealapii

4.2.1.11 Hālawa

The north boundary of Hālawa Ahupua'a lies along the northwest side of Aloha Stadium and the portion of the study area to the southeast end of the study corridor. The existing Halawa WWPS and the proposed Halawa WWPS lie within Hālawa.

Sometime after Kamehameha conquered O'ahu in the battle of Nu'uaniu in 1795, he gave his most trusted foreign advisors, Isaac Davis and John Young, some lands as a reward for their loyal service to him. As part of this award, each one received half of the *ahupua'a* of Hālawa. As was the usual custom at the time, the king divided the land among his chiefs who supported him throughout his conquests of the islands.

These lesser chiefs (Young and Davis) were allowed to work the land as long as they lived. But, as was the traditional custom, upon their death the land reverted back to the *ali'i nui*. This rule held true even for these two most faithful advisors. John Young tried to make his lands inheritable by requesting that his children, and those of Isaac Davis, whom he had adopted, be allowed to retain the lands given to him by the king upon his death. Even by the late date of 1834, Kamehameha III refused to honor Young's request. It is interesting to note that even though his request was denied, in the Māhele, John Young's children were allowed to keep lands as *'āina ho'oloina* or inherited lands. Lilikalā Kame'eiehiwa notes that in all of the Buke (book) Māhele, these were the only lands given under this designation (Kame'eiehiwa 1992:60).

Prior to John Young's death in 1835, he attempted to make his lands inheritable by willing Hālawa to his daughter, Grace Kama'iku'i. His will states,

. . . in behalf of my deceased friend Isaac Davis and for his children as he died without will, the King Kamehameha gave me all the said Isaac Davises [Davis'] lands to take care of them and his children until the children came of age, and now they are come of age so I think it right to leave my last wishes and will that the King, Ka'ahumanu, Adams and Rooke and all the Chiefs will let Isaac Davises children keep their father's lands that King Kamehameha gave to him as a reward for assisting the King in his wars in conquering the islands of Hawai'i, Maui, Molokai, and O'ahu, and which we have an undoubted right to leave to our children, which I hope in God our young king will fulfill the wishes of his honored father. My own lands, I wish my children to enjoy as I have done, likewise my wife . . .
[Claim: #595 F.R. 67-72 V2]

Kekūanaō'a ended up with Davis' Hālawa portion (LCA 7712) at the end of the Māhele and Grace Kama'iku'i Young Rooke (John Young's daughter) retained the John Young portion (LCA 8516-B). Isaac Davis' portion of Hālawa passed from Kekūanaō'a to Ruth Ke'elekōlani and on to Bernice Pauahi Bishop. Upon Bernice's death, her lands become part of the Bishop Estate Trust.

In 1852, Kekūanaō'a wrote a letter to the Minister of Interior requesting that a list of the *kapu* (forbidden) fish for Victoria Kamāmalu's lands on O'ahu be published in the newspaper. The *kapu* fish for Hālawa was the *'anae* or full-sized mullet (Kekūanaō'a 1852).

In 1862, Mataio Kekūanaō'a and Kama'iku'i Rooke (John Young's daughter) leased a portion of *ahupua'a* of Hālawa to a Manuel Paiko of Honolulu for the purpose of cattle ranching (Boundary Commission Liber 9:174-179).

In 1866, Kama'iku'i willed to her sister, Fanny Na'ea, her interest in her portion of Hālawa.

In 1879, Fanny gave her interest of Hālawa to her daughter, Emma Kaleleonālani Na'ea Rooke, Queen of Kamehameha IV, by way of a deed, which stated,

. . . the undivided ½ interest of and in to the Ahupua'a of Hālawa situate in 'Ewa, Island of Oahu, and more fully described in Royal Patent 6717 to Grace Kamaikui and being the same premises devised to me the said Fanny Young Kaleleonalani by the said Grace Kamikui. [Boundary Commission, Liber 59:285]

Fanny died one year later in 1880. A listing of *konohiki* lands on the island of O'ahu reflects the joint tenancy of Hālawa. Both Ruth Ke'elikōlani and Queen Emma are listed as owners. The document also lists the lands on O'ahu that abut the ocean, including the length and whether the land is a lagoon, reef or open sea. The length of the land abutting the sea at Hālawa is 8.52 miles and it is listed as being a reef and a lagoon (Interior Department Letters, Document No. 15). Five years later, Queen Emma died in 1885, leaving no heirs. All of her lands became part of the Queen Emma legacy.

Throughout the years, there seems to have been dispute over the joint tenancy of Hālawa between the families of Kekūanaō'a and Young. In 1888, after a new survey was completed, Sanford B. Dole settled the matter by giving the northern portion of Hālawa to the Bishop Estate and the southern portion to the Queen Emma Trust. From this time on, the boundaries have been distinct and the two portions recognized independently of each other.

Besides the two *konohiki* awards to Kekūanaō'a and Grace Kama'iku'i Young Rooke, 26 commoner lands were claimed in Hālawa and 19 were awarded. The *kuleana* awards ranged from 0.16 to 3.9 acres in size. There is only one *kuleana* LCA award in Hālawa within the study corridor as depicted in the previous Figure 26 and summarized in Table 22.

This low density of LCA awards within this portion of the study area suggests an attendant low density of archaeological resources relating to traditional Hawaiian occupation.

Table 22. Land Commission Awards in Hālawa

LCA	Awardee	'Ii
2156:3	Oponui	Kaloiiki, Piomoewai

4.3 Ranching

The development of the huge sugarcane plantations that would come to dominate life in the study area was actually later than many might think. The Ewa Plantation Company was founded in 1890 (last date 1970) and the Oahu Sugar Company was founded in 1898 (last date 1994) (Dorrance and Morgan 2000:41). While rice cultivation was earlier, and of surprisingly large extent, it tended to be a relatively compact crop along the stream-fed coastal margins of 'Ewa. The uplands of Ewa, and most of the lands of 'Ewa, were in ranching for most of the 1800s.

4.3.1 Ranching in Lower Honouliuli

While most ranch lands were at least a little upslope, Honouliuli Ahupua'a (including the west end of the study area) included many areas of ranch land on the flat coastal 'Ewa plain.

In 1871, John Coney rented the lands of Honouliuli to James Dowsett and John Meek, who used the land for cattle grazing. In 1877, James Campbell purchased most of Honouliuli Ahupua'a—except the *'ili* of Pu'u'uloa—for a total of \$95,000. He then drove off 32,347 head of cattle belonging to Dowsett, Meek, and James Robinson, and constructed a fence around the outer boundary of his property (Bordner and Silva 1983:C-12) (Figure 27). He let the land rest for one year and then began to restock the ranch, so that he had 5,500 head after a few years (Dillingham 1885 in Frierson 1972:14).

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

I took a ride over the Honouliuli Ranch which is quite romantic. The soil is a deep, reddish loam, up to the highest peaks, and the country is well-grassed. Springs of water abound. The *'ilima*, which grows in endless quantities on the plains of this ranch, is considered excellent for feeding cattle; beside it grows the indigo plant, whose young shoots are also good fodder, of which the cattle are fond. Beneath these grows the manieizie grass, and Spanish clover and native grasses grow in the open; so there is abundant pasturage of various kinds here. As I rode, to the left were towering mountains and gaping gorges; ahead, undulating plains, and to the right, creeks and indentations from the sea. A wide valley of fertile land extends between the Nuuanu Range and the Waianae Mountains and thence to the coast of Waialua. There are many wild goats in this valley, which are left more or less undisturbed because they kill the growth of mimosa bushes, which would otherwise overrun the country and destroy the pasturage for cattle. [Briggs 1926:62–63]

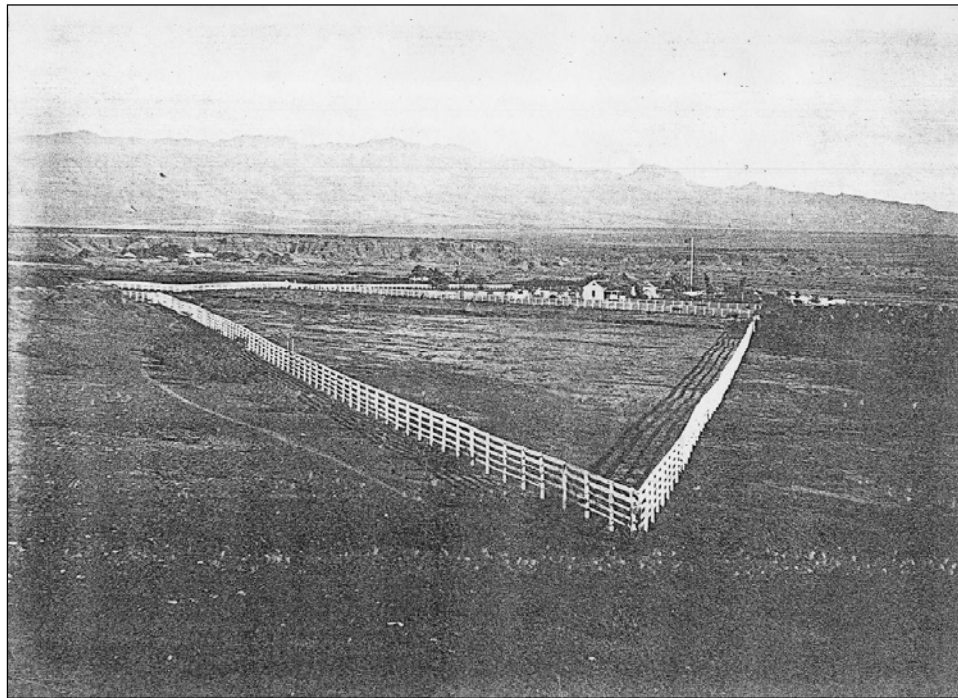


Figure 27. 1880s photograph of James Campbell's residence on the 'Ewa Plain (Hawai'i State Archives)

In 1880-1881, the Honouliuli ranch was described as follows:

. . . Acreage, 43,250, all in pasture, but possessing fertile soils suitable for agriculture; affords grazing for such valuable stock. The length of this estate is no less than 18 miles. It extends to within less than a mile of the sea coast, to the westward of the Pearl River inlet. . . . There are valuable fisheries attached to this estate . . . [Bowser 1880:489]

From Mr. Campbell's veranda, looking eastward, you have one of the most splendid sights imaginable. Below the house there are two lochs, or lagoons, covered with water fowl, and celebrated for their plentiful supply of fish, chiefly mullet. . . . Besides Mr. Campbell's residence, which is pleasantly situated and surrounded with ornamental and shade trees, there are at Honouliuli two churches and a school house, with a little village of native huts. [Bowser 1880:495]

Most of Campbell's lands in Honouliuli were used exclusively for cattle ranching. At that time, one planter remarked "the country was so dry and full of bottomless cracks and fissures that water would all be lost and irrigation impracticable" (Ewa Plantation Company 1923:6-7). In 1879, Campbell brought in a well-driller from California to search the 'Ewa plains for water, and the well, drilled to a depth of 240 ft near Campbell's home in 'Ewa, resulted in "a sheet of pure water flowing like a dome of glass from all sides of the well casing" (The Legacy of James Campbell n.d. in Pagliaro 1987:3). Following this discovery, plantation developers and ranchers drilled numerous wells in search of the valuable resource.

4.3.2 Ranching in the Uplands of 'Ewa

Between 1861 and 1873, parcels of Waiawa were leased to Valdemar Knudsen for use as grazing lands for livestock. A 50-year lease and leaseholds were granted to James Robinson in 1868. After James Robinson's death in 1890, his son, Mark P. Robinson, acquired a 25-year lease. Overwritten on the lease was the "permission granted to assign the lease to the Oahu Railway and Land Company" (Hawai'i Bureau of Land Conveyances 115:496). This lease was subleased from Oahu Railway and Land Company to the Oahu Sugar Company for 43 years on 1 January 1897. It is probable that much of the upper grasslands of Hō'ae'ae, Waikele, Waipi'o, and Waiawa were all used for cattle pasture.

Sereno Bishop stated that his father was the first to bring cows to 'Ewa:

Waiawa valley above us lay knee deep with the richest of grass, where our cows rioted. Out goats took to the higher ground, where they flourished, being driven in and penned at night. . . . The herd gradually multiplied and in a few years became large. [Bishop 1916:42]

These herds contributed to the deforestation of the upper valley, as noted by Bishop:

There was a very passable road down Ewa and Waianae way. Once while making the trip down to Waialua, to which there was a good horse trail, I discovered that even at that early day [ca. 1858] that cattle had made great inroads into the forests of ti plants which had theretofore clad the foothills and upland pasturages, even to the highest tracts. [Bishop 1916:60]

Subsequent to Western Contact in the area, the landscape of the 'Ewa plains was adversely affected by the removal of the sandalwood forest, and the introduction of domesticated animals and new vegetation species. Domesticated animals, including goats, sheep and cattle, were brought to the Hawaiian Islands by Vancouver in the early 1790s, and allowed to graze freely about the land for some time after. It is unclear when the domesticated animals were brought to O'ahu; however, L.A. Henke reports the existence of a longhorn cattle ranch in Wai'anae by at least 1840 (Frierson 1972:10). During this same time, perhaps as early as 1790, exotic vegetation species were introduced to the area. These typically included vegetation best suited to a terrain disturbed by the logging of sandalwood forest and eroded by animal grazing. Within the current study area, the majority of the (non-cultivated) vegetation is comprised of introduced species, mainly grasses.

A long narrow strip of 1,300 acres on the east side of Kalauao Ahupua'a was awarded to John Meek in the Māhele. John Meek was an important merchant involved in the early sandalwood trade (Kuykendall 1967:435). He and his brother Thomas Meek were Massachusetts ship captains who ran the early trade route between the Northwest Coast and China. They traded furs and other products from the Pacific Coast for luxury goods such as silk and ceramics in China and made stops at Hawai'i for water, food, and salt, and other supplies. Sandalwood, whose fragrant wood was used for boxes and incense, was one of the few products the Chinese would accept in trade for their goods. When it was discovered that there were large stands of the trees in Hawai'i, the islands became not only a resupply stop, but also a place where goods could be gathered and sold.

John Meek's first trip to Hawai'i was in 1809, and there are accounts of him trading directly with Kamehameha I. In 1819, Meek was a captain of the *Peddler*, which was owned by the fur trader John Jacob Astor. He landed in 1820 in Honolulu with a cargo of "gin, brown sugar, cloth and other goods" and left the islands with a cargo of 191 piculs (wood measurement) of sandalwood obtained by trade with the king of Kaua'i (Bockstoce 2005:32). John Meek decided to make Hawai'i his home in 1824, and eventually he became a pilot and harbor master of Honolulu Harbor (Joerger 1982:75–76). He married two Hawaiian women, Elizabeth Kaluapapohana Betsy Kamsi and Kepookalani, daughter of Unualoha and Kaikainalii (Kane 2009). Betsy (Elizabeth) may have been a daughter of the Spaniard Don Francisco de Paula Marin (Gast and Conrad 1973:144), another early friend of Kamehameha I, who was awarded a large land claim in Waipi'o in 'Ewa. Meek was one of several early ship captains who settled in Hawai'i and were given large land awards for their service to the Hawaiian government and for their friendships with early Hawaiian monarchs.

Meek brought a bull and three heifers to Hawai'i in 1832, the nucleus for a cattle ranch on his land, and in the 1850s brought in sheep, which were probably bought from the Hudson Bay's holding at Puget Sound (Lomax 1940:44). Meek was known for his hospitality and maintained friendships with members of the royal family. He was known as "The Lord of Lihue Ranch" (Taylor 1922:221). In addition to owning lands in Kalauao, he also leased land in the uplands of 'Ewa and Wahiawā. In 1856, he rented the 2,829.20-acre award given to the *ali'i* Luluhiwalani (Māhele Award 4) in Waikele, and used the land as part of his ranch. His main ranch house was in the uplands of Honouliuli and is marked on several early maps. There is no corresponding house site shown on maps for his Kalauao lands, so it is possible he used his Kalauao estate mainly as grazing land for his cattle and horses.

In 1858, King Liholiho and Queen Emma stopped at Meek's ranch during a 13-day trip to 'Ewa. They had taken a steamer to Pearl Harbor and then rode in carriages or on horses on the 8-mile trip to Meek's ranch house in Honouliuli. The next day they rode 25 miles to Kahuku on the windward side of the island to the home of Francisco de Paula Marin (Kanahele 1999:83). These royal excursions were often accompanied by women *pā'ū* (skirt worn by women horseback riders) riders, in their colorful split skirt riding outfit. As one author remembered,

This recalls the days when Captain Meek controlled Lihue and Wahiawa on Oahu under lease from the government. He raised thorough-bred horses and his daughters rode the finest in the land. The Meek animals were known all over the Islands, especially his white horse called 'Pu'a.' His oldest daughter Eliza was often seen riding the horse through the streets of Honolulu garbed in a wonderful pa-u, with a dozen or more followers riding behind her wearing the same color of garment. Eli Meek, his son, was a magnificent horseman and the beau of the day. His youngest daughter, Becky, married Horatio Crabbe, chamberlain of Kamehameha [I] and Lunalilo [Kamehameha II]. [Taylor 1922:223]

Meek is also noted as the man to bring the first turkey to the islands, to plant the first mango tree (Thrum 1900:60), and the first to bring a large land tortoise to the Islands, which he kept as a curiosity at his Honolulu home (Thrum 1904:73). He died and was buried in O'ahu Cemetery in 1875 (Kane 2009).

John Meek was 'noted for his probity of character and genial disposition,' was a friend and adviser of chiefs, and introduced improved breeds of cattle and horses to Hawaii. John Jacob Astor is said to have thought so highly of him as to build a ship especially for this command. [Kamakau 1992:251]

4.3.3 Ranching in Hālawā

In 1862 Kama'iku'i Rooke and Mataio Kekūanaō'a leased much of Hālawā to a Manuel Paiko, a Portuguese rancher (Klieger 1995:76). The lease document reads that the boundaries begin at "a small brook which forms the boundary between Hālawā and Moanalua" and continue "along the ridge of the mountain bordered on the north by 'Aiea and Kalauao, and on the west by Ko'olau, to the top of a peak called Aloheo; which forms the boundary between Moanalua and Hālawā." The leased area consisted of approximately 10,000 acres. However, excluded from the lease was the "sea, the lagoons, the fish and all ponds, the enclosed *kalo* lands, all kuleanas awarded by the Land Commission, and so much of the *kula* lands adjoining the pond Ka Waiāho." The lease was taken out for 15 years with a rent of \$500 per year (Boundary Commission, Liber 9:174–179). Manuel Paiko took on a business partner, James Dowsett of 'Ulupalakua Ranch fame. By 1870, their herd consisted of 1,400 head (Boundary Commission, Liber 29:239). James Dowsett and another partner, J.R. Williams, tried unsuccessfully to raise sugar. Due to lack of a railroad to haul cane and the mill burning down three times, they gave up trying to raise sugar in 1875. Altogether, about 100 acres had been planted in cane (Condé and Best 1973:327).

4.4 Rice Cultivation in Former Taro Fields

As the sugar industry throughout the Hawaiian kingdom expanded in the second half of the nineteenth century, the need for increased numbers of field laborers prompted passage of contract labor laws.

In 1852 the first Chinese contract laborers arrived in the Islands. Contracts were for five years, and pay was \$3 a month plus room and board. Upon completion of their contracts, a number of the immigrants remained in the Islands, many becoming merchants or rice farmers. As was happening in other locales, in the 1880s, groups of Chinese began leasing and buying—from the Hawaiians of 'Ewa—former taro lands for conversion to rice farming. The taro lands' availability throughout the Islands in the late 1800s reflected the declining demand for taro as the Native Hawaiian population diminished.

The Hawaiian Islands were well-positioned for rice cultivation. A market for rice in California had developed as increasing numbers of Chinese laborers immigrated there since the mid-nineteenth century. Similarly, as Chinese immigration to Hawai'i also accelerated, a domestic market opened.

Considerable effort has been made to induce the natives to be more industrious to cultivate the soil and particularly to try to [sic] the cultivation of rice . . . Foreigners too have begun the culture of rice in this district extensively and it was hoped their example would stimulate the natives to cultivate their own lands, but most of them choose to hire themselves to the foreigners at low wages and put their lands in the hands of the foreigners for a few dollars rather than cultivate or improve it themselves. [Mission Station Report 1862:1 in Devaney et al. 1982:49]

Following the completion of their plantation labor contracts, some Chinese immigrants began rice farming, to which they were accustomed in their native land (Figure 29). Chinese rice farmers acquired lands by leasing small plots of land for individual farms, or by forming *hui* (partnerships) with other farmers and acquiring large tracts of land (Coulter and Chun 1937:17–18). During the height of rice cultivation (ca. 1880-1920), the industry was dominated by Chinese firms who controlled the growing and milling of rice (Devaney et al. 1982:49).

Damon in *The Friend* states that on O'ahu the rice plantations began a few miles west of Honolulu and formed a fringe bordering the shore for a long distance.

Every available inch of ground seemed to be utilized. At Ewa the Chinese had entered in most emphatically, to possess the land and their rice fields stretched in every direction. Towards Waianae there was one rice plantation after another. [Coulter and Chun 1937:20]

By 1885, 200 acres in Honouliuli were used for rice and 50 acres were used to grow bananas (*Pacific Commercial Advertiser*, 15 August 1885, summarized in Silva 1987:A-12). These rice fields were planted in former taro fields or in undeveloped swamps, such as those near the former Honouliuli Taro lands. The rice fields in 1882 were described by Frank Damon, during a tour of the area.

. . . Towards evening we reached Honouliuli, where the whole valley is leased to rice planters . . . This was one of the largest rice plantations we visited. Sometimes two or three men only, have a few fields which they cultivate for themselves, and we often too came upon houses where there were eight or ten men working their own land. But the larger plantations are owned by merchants in Honolulu, who have a manager acting for them. . . . [Damon 1882:37]

Rice cultivation replaced much of the former taro lands and became widespread in the lowlands surrounding Pearl Harbor. By 1892, approximately 262 acres were under rice cultivation in Waiawa, Mānana, and Waiāu, 135 acres in Waimālu, 76 acres in Kalāuao and 'Aiea, and 117 acres in Hālawā (Figure 28 and Figure 29) (Coulter and Chun 1937:21). The ancient taro *lo'i* and *'auwai* (irrigation ditches) were modified and expanded to support rice cultivation:

The great demand for rice land brought disused taro patches into requisition—especially because water rights attached to them. Such was the desire of the Chinese to use every piece of land to its fullest extent for paddy that they cut away the paths which the Hawaiians had used between taro patches to strips so narrow that a man could walk along them only with difficulty . . . As the demand for rice continued, it became profitable to bring into use land hitherto unused. The land most easily rendered fit for rice cultivation was swamp or marsh land of which there was a large amount in the islands. Most of such land was at or near sea level—undrained areas at the mouths of streams: lowlands, which could be reclaimed without great expense . . . lands hitherto unused became fields of waving grain. [Coulter and Chun 1937:11]

The following account describes a visit to the rice fields of 'Aiea, ca. 1904:

On the morning of June 2nd, for instance, our destination was Aiea. At ten minutes past seven we boarded the first passenger train going towards Honolulu. For a distance of eight miles the road skirts the shore and then turns landwards or mauka through rice and sugar plantations, Ewa Mill, Waipahu, Pearl City. We reached Aiea at eleven minutes past eight. Like all rice fields in Hawaii, this one is worked entirely by Chinamen, they alone being able to endure the conditions of location and climate necessary for the cultivation of this cereal. On one side of the railroad track was the broad, muddy inland lake or bay of salt water, Pearl Harbor; on the other side were the terraced plots or fields, flooded to a depth of several inches with water and separated by narrow raised earthen ridges on which the careful Chinaman doubtless succeeded in walking, but which many times proved treacherous to our unsteady feet. A rice plantation, laid out as it generally is on the low flats at the foot of a valley, where mountain streams empty into the sea, is an ideal collecting ground for certain kinds of algae. [Tilden 1905:134]

By the early decades of the twentieth century rice farming in the Hawaiian Islands was in decline, beset by crop diseases and cheaper prices for mainland-grown rice. Commercial agriculture in 'Ewa became dominated by sugar with the development of the three sugar companies of 'Ewa (Nedbalek 1984:13).

4.5 History of the Oahu Railway and Land Company (OR&L)

In 1886, Campbell and B.F. Dillingham put together the “Great Land Colonization Scheme,” which was an attempt to sell Honouliuli land to homesteaders (Thrum 1887:74). This homestead idea failed; two factors for the failure were the lack of water and the distance from 'Ewa to Honolulu. The water problem was solved by the drilling of artesian wells, and Dillingham decided the area could be used instead for large-scale cultivation (Pagliaro 1987:4). The transportation problem was to be solved by the construction of a railroad, which B. Franklin

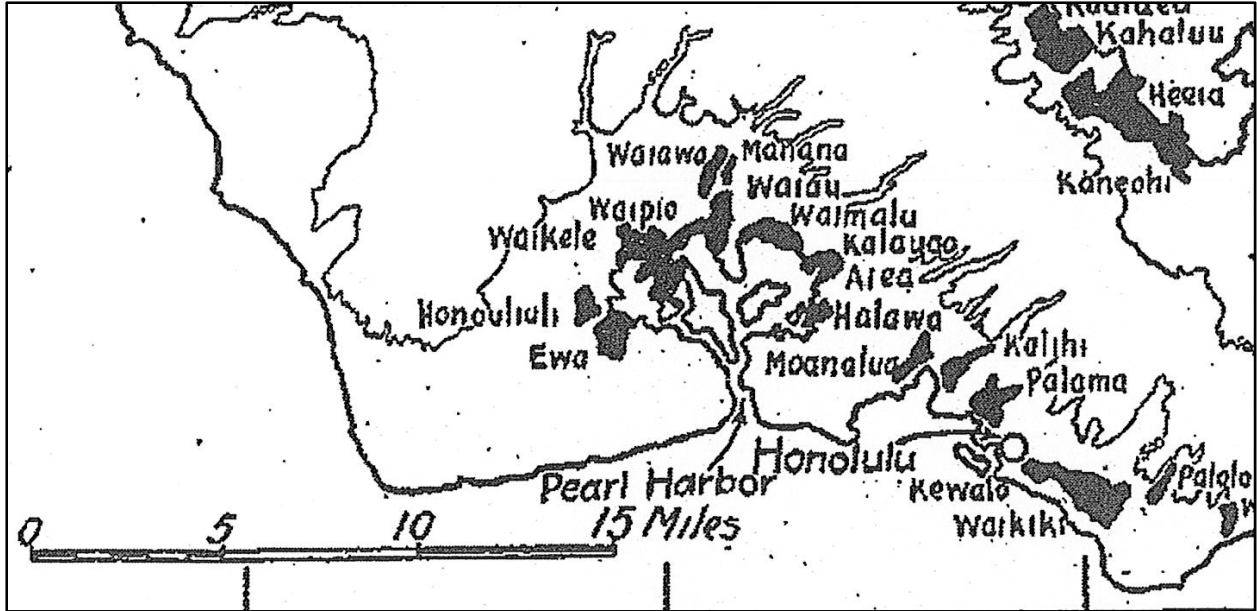


Figure 28. Rice farming districts on south O’ahu in 1892 including Honouliuli, Waikalele, Waipi’o, Waiawa, Mānana, Waiāu, Waimalu, Kalauao, ‘Aiea, and Hālawa (adapted from Coulter and Chun 1937:12)



Figure 29. Waikalele Rice Fields below the Oahu Sugar Co. Mill (Hawai’i State Archives)

Dillingham soon began to finance under the company name of the Oahu Railway and Land Company (OR&L).

During the last decade of the nineteenth century, the railroad would reach from Honolulu to Pearl City in 1890, to Wai'anae in 1895, to Wai'alua Plantation in 1898, and to Kahuku in 1899 (Kuykendall 1967:III, 100). The OR&L line was developed across the present study area very rapidly, mostly in 1890. Particularly in the east portion of the project area, from 'Aiea to Waipi'o, much of the OR&L alignment was developed smack on the coast as shown in Figure 30.

This railroad line eventually ran across the center of the 'Ewa Plain at the lower boundary of the sugar fields. To attract business to his new railroad system, Dillingham subleased all land below 200 ft to William Castle, who in turn sublet the area to the newly formed Ewa Plantation Company (Frierson 1972:15). Dillingham's Honouliuli lands above 200 ft that were suitable for sugarcane cultivation were sublet to the Oahu Sugar Company. Throughout this time, and continuing into modern times, cattle ranching continued in the area, and Honouliuli Ranch—established by Dillingham—was the “fattening” area for the other ranches (Frierson 1972:15).

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

In August 1945, the war ended and so did OR&L's heyday as a military transport line.

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

There was no choice but to abandon the OR&L main line, and in 1946 Walter F. Dillingham, son of B.F. Dillingham, wrote,

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



Figure 30. 1890 photograph of Pearl Harbor with OR&L railroad tracks along the coast (Honolulu Advertiser Archives)

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

4.6 The Study Area as Depicted in Mid- to Late-1800s Maps

The available assemblage of maps of the study area in the 1800s is something of a hodgepodge but presented collectively in chronological order they provide us with a wealth of detail about the changing study area moving through the last half of the 1800s.

The 1848 Rooke map of Hālawā (Figure 31) depicts the east end of the study area in Hālawā Ahupua'a (extending northwest into 'Aiea Ahupua'a). The stream shown is Hālawā Stream but no associated enterprise is depicted. Three place names are indicated at the mouth of Hālawā Stream, a kilometer west of the southeast end of the study area. The reference to the Loko Kunana fishpond

is clear but the other somewhat illegible references (“Kuohou”?, “Keaeponi”?) are obscure (compare with Klieger 1995:61). At the ‘Aiea boundary, the place name “Kohaku” is pretty clearly a reference to the Loko Kahakupōhaku fishpond but the reference to “Keinaleia “ (spelling uncertain) is obscure. Aside from coastal fishponds no human enterprise is indicated.

The 1851 Bishop map of Waipi‘o (Figure 32) depicts the Waipi‘o portion of the project area (at the northeast base of Waipi‘o Peninsula) and a bit of Waikele Ahupua‘a to the west and Waiawa Ahupua‘a to the east. The Loko Eo fishpond, crossed by the present study area, and the Loko Hanaloa fishpond, to the east and south of the study area, are prominent and well known landmarks. The seeming call-out of the sea of Waipi‘o and the edge of the sea of Waipi‘o and the reference (“Kui o He napouli”?) at the northwest corner of Middle Loch are not completely clear. The *Ala Aupuni* or government road is prominent, approximating the alignment of the present day Queen Lili‘uokalani Freeway (H-1) west of Kamehameha Highway. Four houses are depicted *mauka* of the study area (three appear in the vicinity of present-day Waipahu District Park). This map depicts a large area for only showing four residences.

The 1872 Lyons map of Kalauao (Figure 33) appears to have been a delineation of the perimeter of this important *ahupua‘a* and provides little detail. A place name “Kila” is indicated close to the study area at the Kalauao/‘Aiea boundary and three place names are indicated at the coast (west to east, Kuapa, Nukumuliwai, and Kuaana). The meaning of “Kila” is unclear but it may refer to a high place or cliff at the ‘Aiea/Hālawa boundary (near the ‘Aiea Cemetery). The place name “Kuapa” suggests a *kuapā* or fishpond wall and this would seem to be the location of the Loko Opu fishpond. Nuku Muliwai is a reference to the mouth of Kalauao Stream. The place name “Kuaana” is on the southeast side of McGrew Point and the northwest side of ‘Aiea Bay and may be a name for that place.

The 1873 Lyons map of Pearl Lochs and Puuloa Entrance (Figure 34) shows the entire study area. Like many maps of the Pearl Lochs (Pearl Harbor), the focus is much more on the harbor itself than the surrounding area. The fishpond known as “Fresh pond” on Waipi‘o Peninsula is depicted but is not called out. An illegible word (“church”?), a path, and possibly two houses are depicted near the Waipahu WWPS portion of the study area where it takes a 90° turn east. Loko Eo is prominent at the northeast corner of the Waipi‘o Peninsula with taro *lo‘i* (or salt pans?) indicated on the west margin of Loko Eo within the study corridor and a house or two (possibly one in the study area) are indicated at the northeast corner of Loko Eo. Houses and fields are indicated near that portion of the study area where Kamehameha Highway meets the *mauka* extension along Waihona Street and to the southeast along today’s Kamehameha Highway. The main south shore trail of O‘ahu is depicted as roughly following the Kamehameha Highway portion of the present study area. Development is indicated around the Ewa Church on the central of three *mauka* extensions (near the east side of today’s LCC campus), and significant agriculture is indicated along the northeast side of East Loch from Waiawa to ‘Aiea. Again the Hālawa, southeast end of the study area appears to be without enterprise.

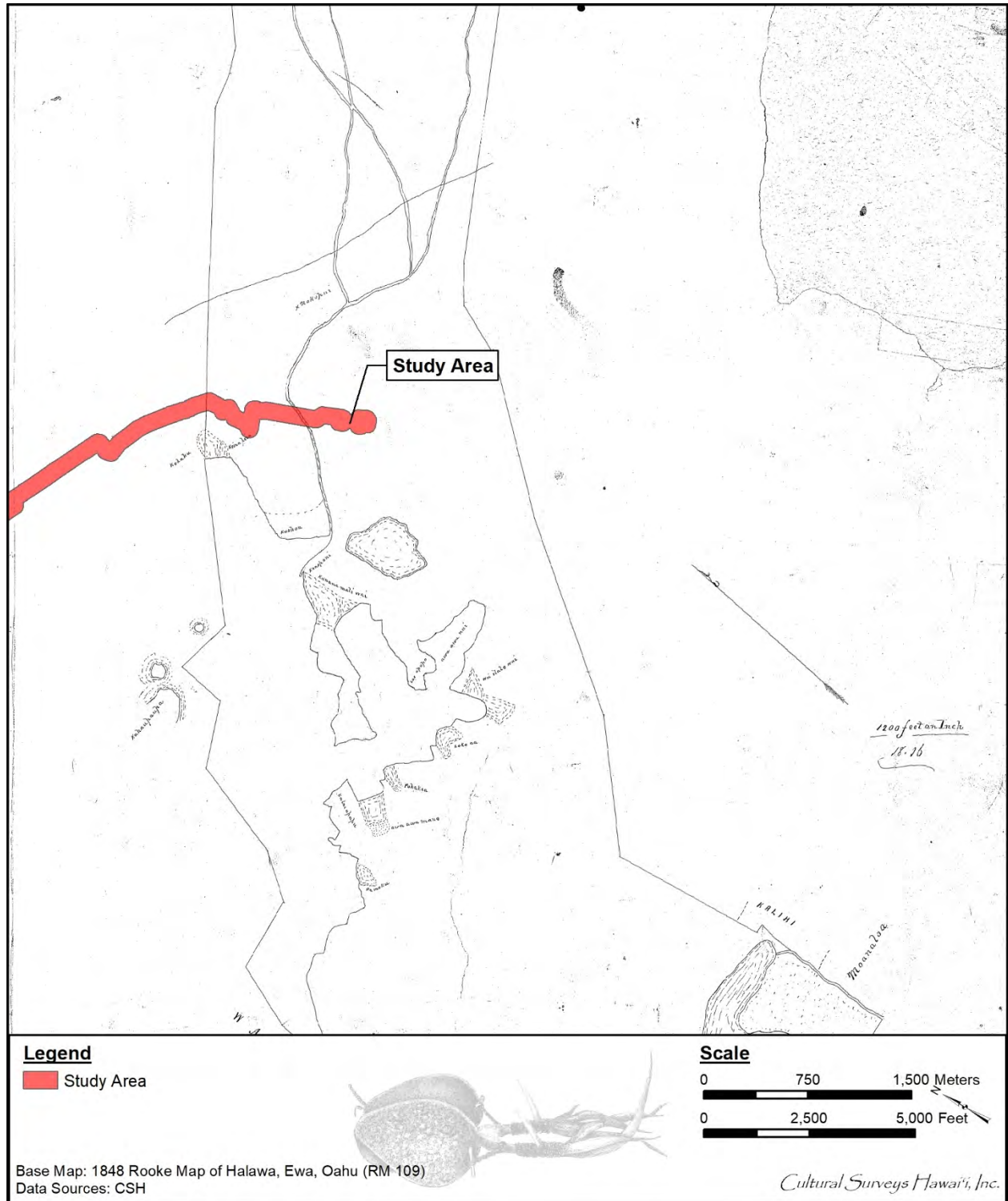


Figure 31. 1848 Rooke map of Halawa, Ewa, Oahu showing the east end of the study area

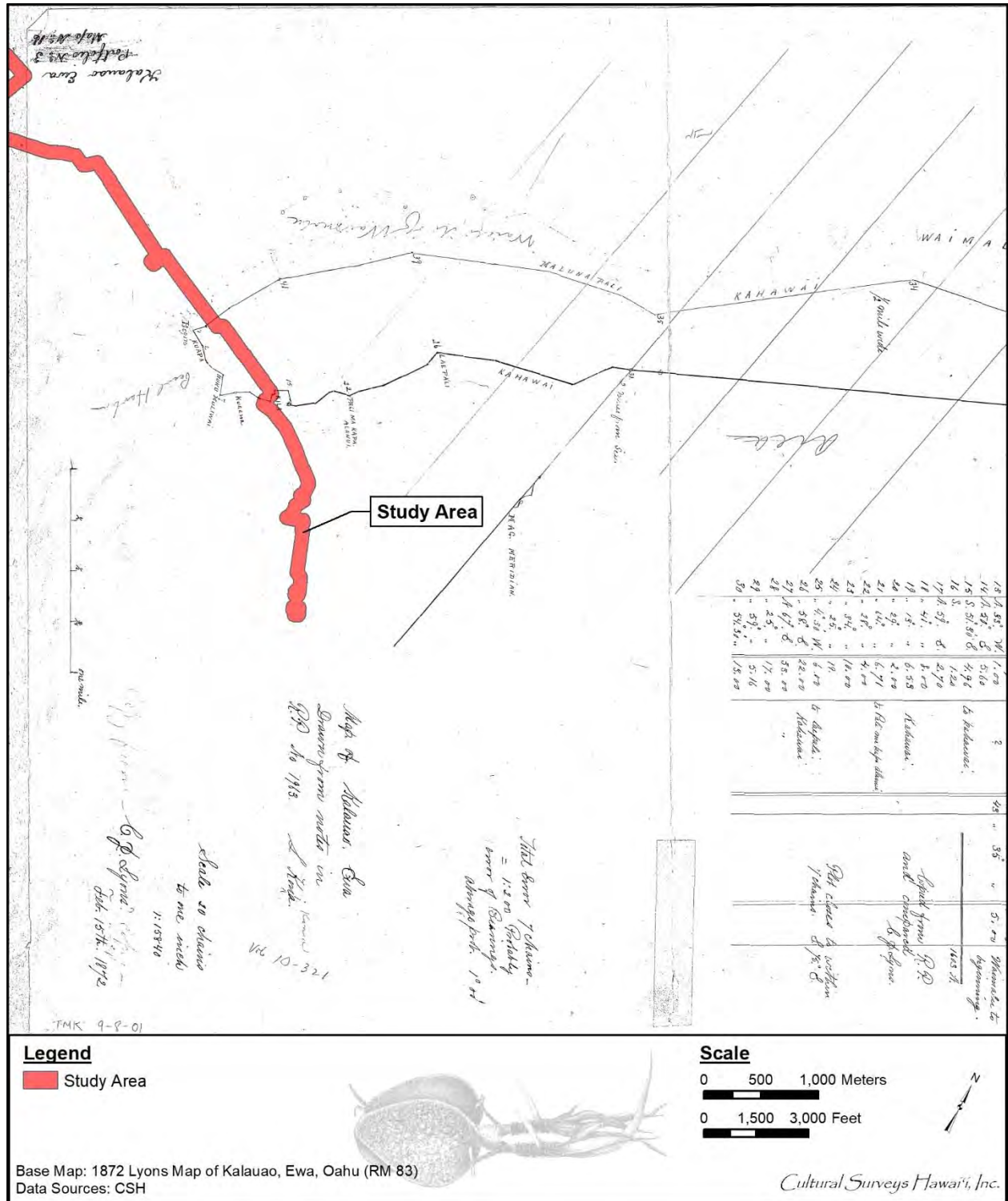


Figure 33. 1872 Lyons map of Kalauao, Ewa, Oahu showing the east end of the study area

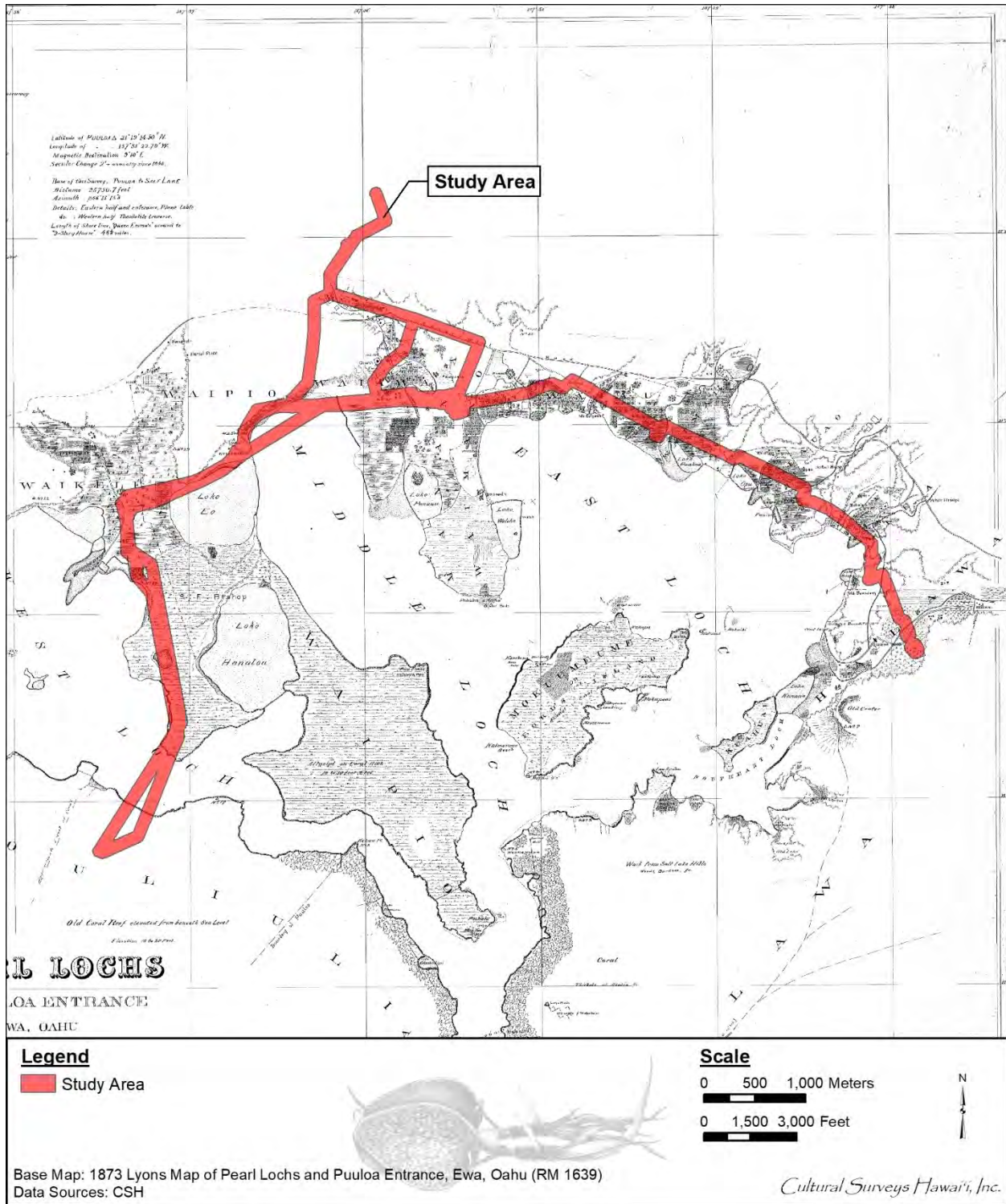


Figure 34. 1873 Lyons map of Pearl Lochs and Puuloa Entrance, Ewa, Oahu showing the study area

The 1873 Alexander map of Honouliuli (Figure 35) depicts the west and central portion of the study area. No enterprise is shown on the southwest (Honouliuli) side of West Loch. The “Fresh Water” pond is within the study corridor on Waipi‘o Peninsula. The area west of Eo (Loko Eo) fishpond is shown as a marsh. The Ewa Church is a prominent landmark north of the Pearl City peninsula. The “Road,” understood as the main east/west trending trail on the south shore of O‘ahu, is depicted as roughly approximating the Kamehameha Highway portion of the study area.

The 1873 Sands map of Pearl Lochs (Figure 36) is somewhat “broad brush” and depicts much the same scene as described above. The Honouliuli portion of the study area is called out as “Coral Rocks Plateau” and lacks development. Waipi‘o Peninsula is “Grazing Land.” *Lo‘i* (or salt pans) are prominent immediately west of Loko Eo. While a kilometer outside the project area, the call-out of a “Burial Ground” north of Loko Eo is of passing interest. A “School House” is called out on the east side of the Ewa Church near the central *mauka* corridor. Fields are indicated in Kalauao (at a place called out as “Kapau”) and in ‘Aiea (at a place called out as “Kalola”?)

The 1874 Alexander map of the lower part of Waimalu (Figure 37) provides good detail for a small area on the west bank of the Waimalu River in the immediate vicinity of today’s Blaisdell Park and the Waimalu WWPS. The entire width of the project area is shown as in “Rice Fields” at that time. Almost certainly this specific area had been in taro cultivation in traditional Hawaiian times.

The 1874 Lyons map of ‘Aiea (Figure 38) depicts fields and possibly one house where the study area crosses central ‘Aiea Ahupua‘a close to the sea. The “Road to Honolulu” approximates the present Queen Lili‘uokalani Freeway (H-1) alignment.

The 1875 Alexander map of part of Waikele (Figure 39) provides good detail for the vicinity of the Waipahu WWTP and the adjacent east bank of Kapakahi Stream. Fields associated with the name “Kaohai” are indicated. “Kaokai” is understood as the name of an *‘ili* at this location.

The 1877 Brown map of Waipi‘o (Figure 40) lacks detail in its depiction of the central portion of the study area. Extensive wetlands are indicated extending *mauka* into the project area northwest of the Pearl City peninsula.

The 1879 Monsarrat map of Waipi‘o taro land (Figure 41) provides a great deal of detail for where the present study area crosses Waipi‘o Ahupua‘a on the east side of Waipi‘o Peninsula by Loko Eo. The relationship of the study area to Loko Eo is depicted in detail. The adjacent area to the west shows a quilt of cultivated fields. The OR&L railroad is prominent extending along the middle of this portion of the project area.

The 1887 Bishop “Map of the Lower Lands of the Ahupuaas of Waiawa, Manana and a Part of Waimano” (Figure 42) provides wonderful detail for the central portion of the study area. Virtually the entirety of the study area within Waiawa and Mānana ahupua‘a is a quilt of fields. The relationship of the project corridor cutting across the middle of the large Loko Kuhia (Kuhialoko) fishpond is clear. The western *mauka* corridor (west of today’s LCC campus) is lacking in development but the central and eastern corridors have many fields. The western portion of the Kamehameha Highway alignment in the central portion of the study area is shown with extensive fields.

The 1887 Bishop map of the “Lower Lands of the Ahupuaas of Waimano and Waiau” (Figure 43) is really an eastern extension of the previously described map with a similar great depth of detail. The Waimano and Waiau *ahupua‘a* portions of the study area are a quilt of fields.

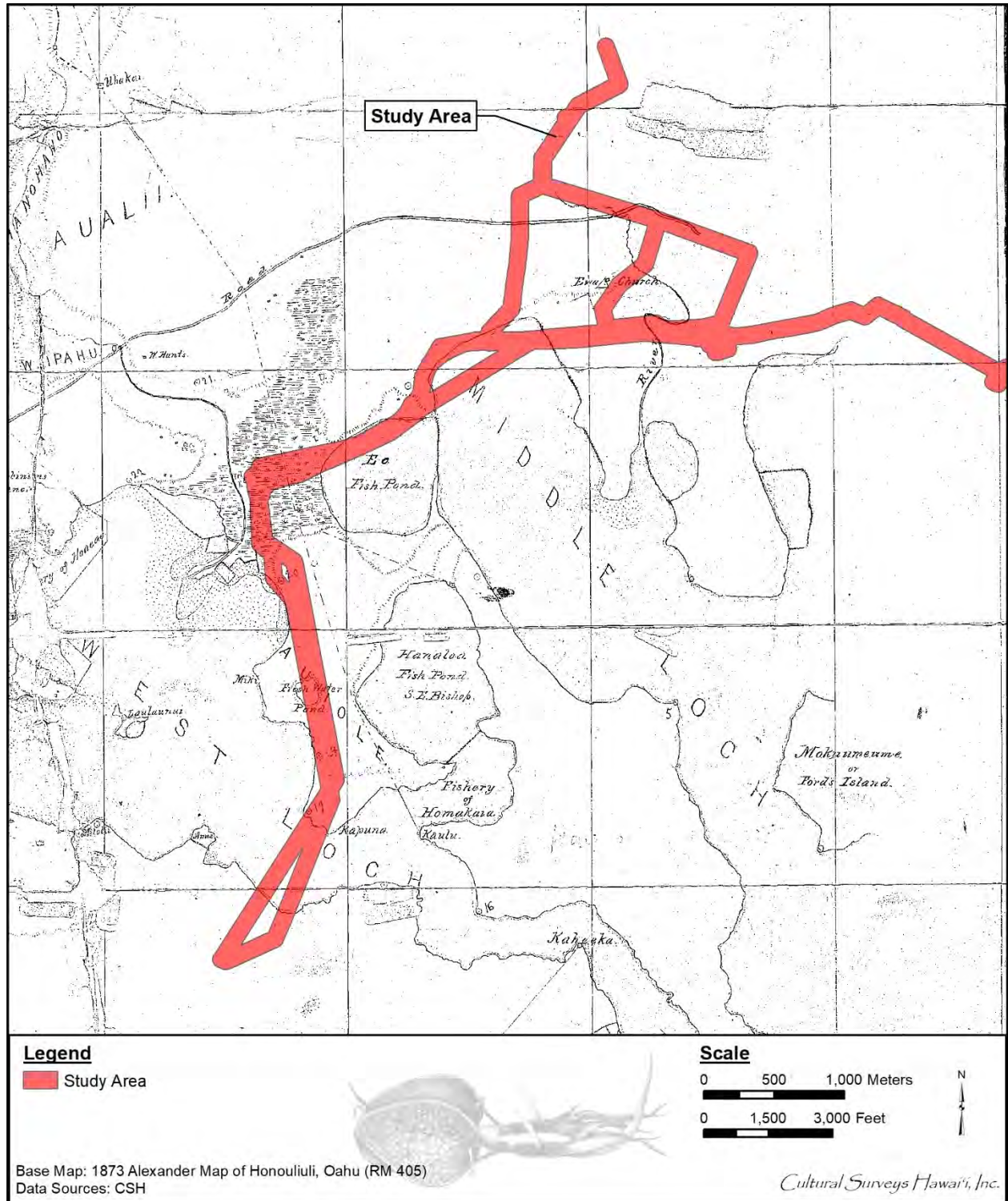


Figure 35. 1873 Alexander map of Honouliuli, Oahu showing the west and central portions of the study area

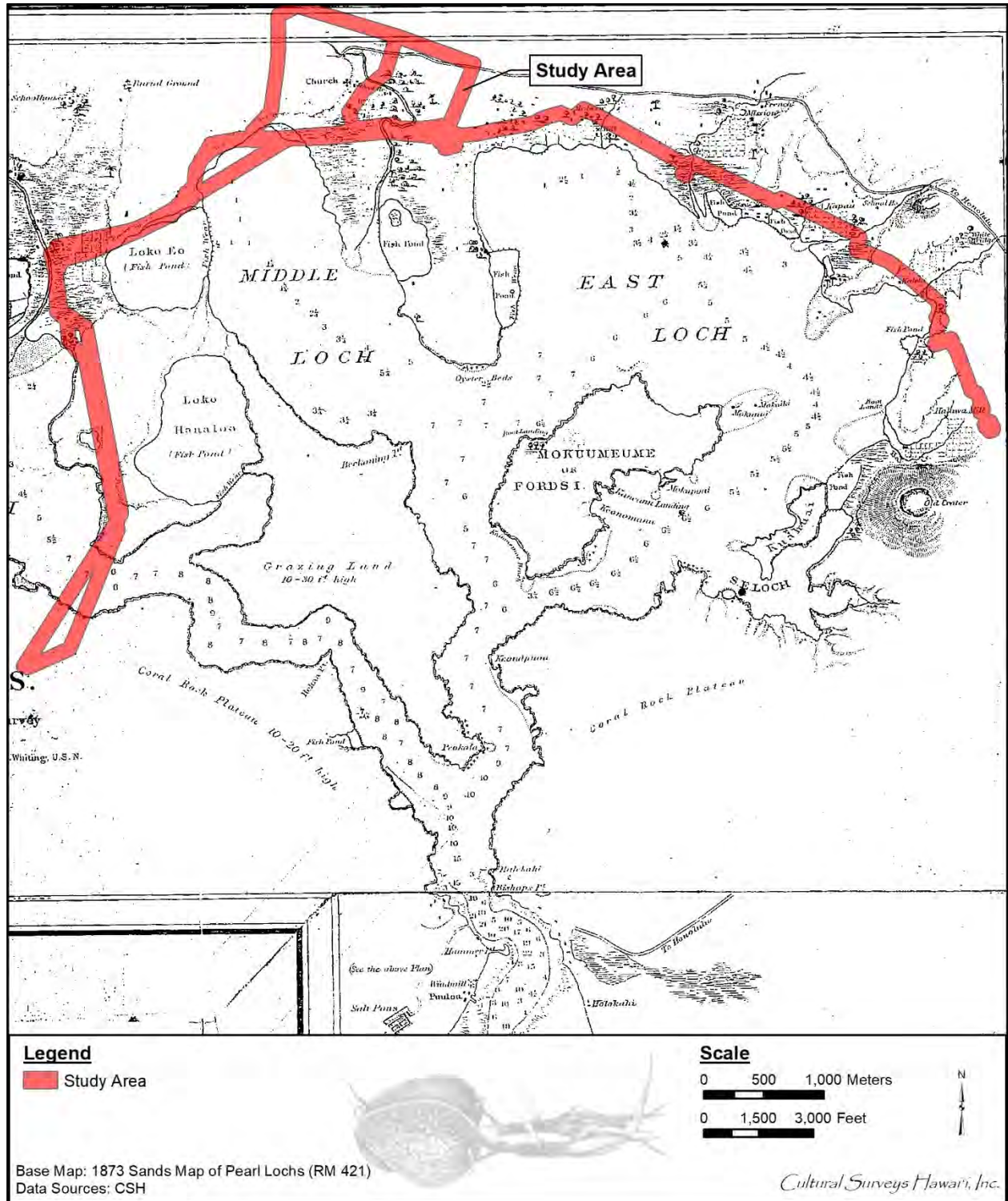


Figure 36. 1873 Sands map of Pearl Lochs showing the study area

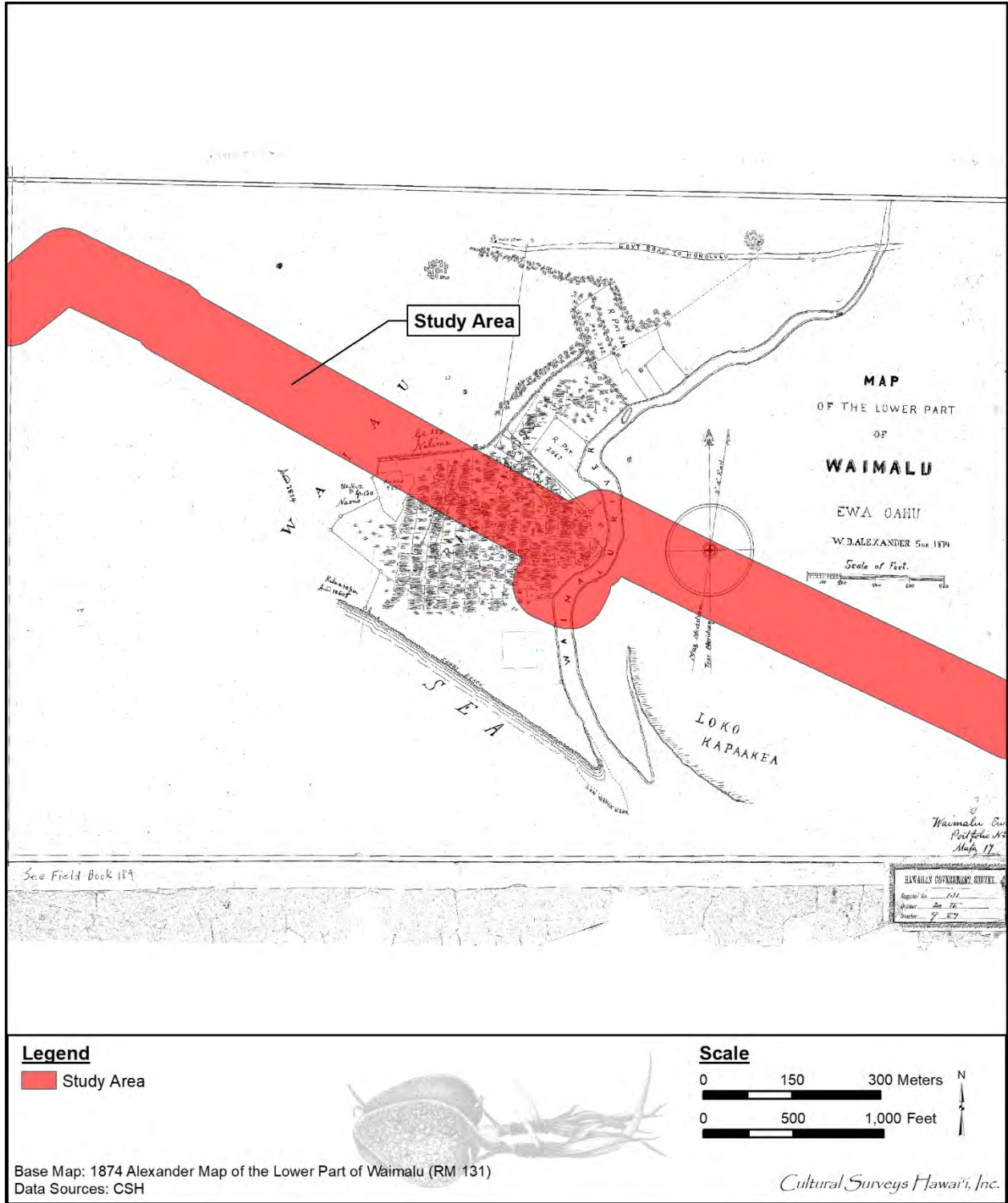


Figure 37. 1874 Alexander map of the Lower Part of Waimalu showing an east portion of the study area in the immediate vicinity of the Waimalu WWPS

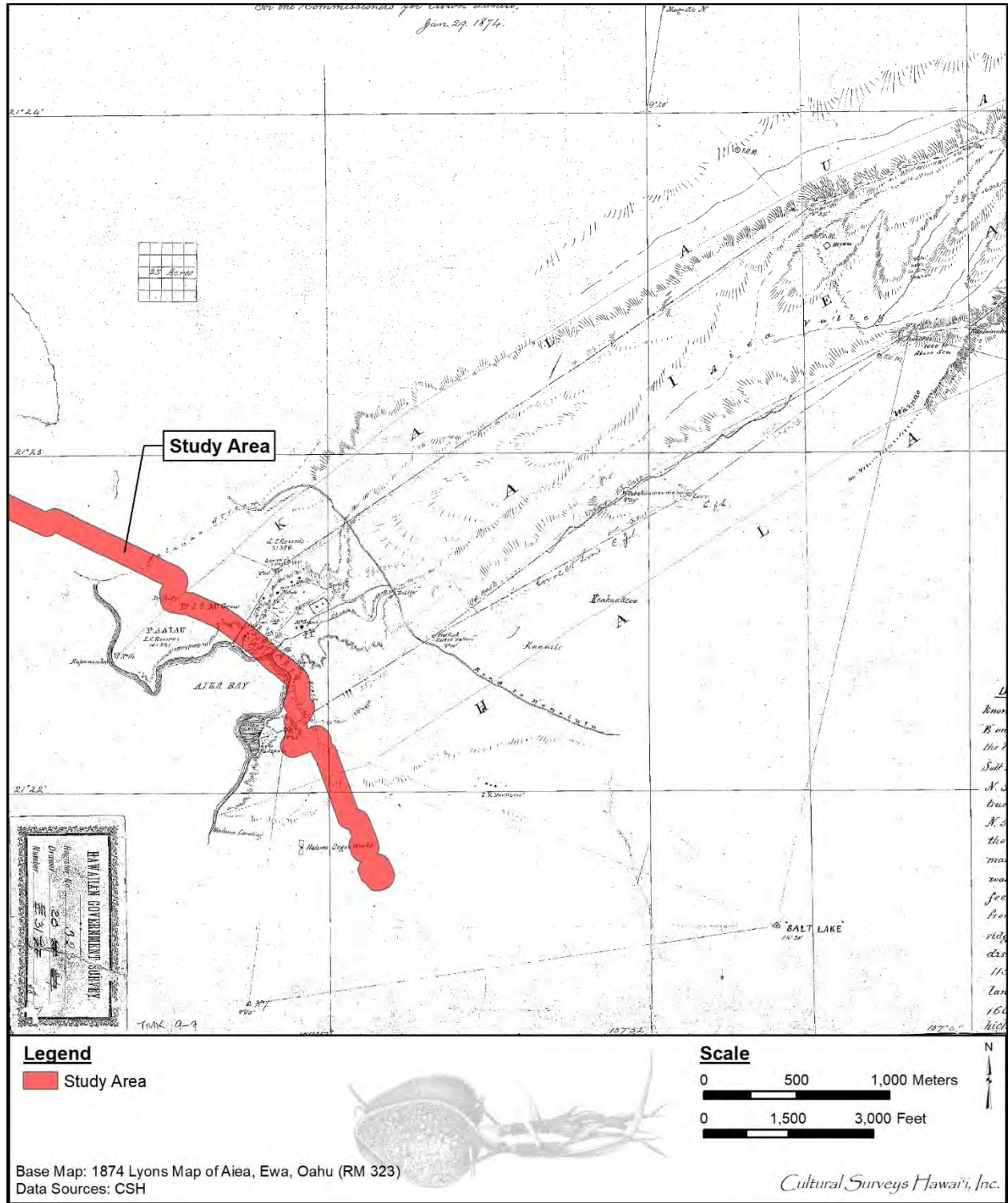


Figure 38. 1874 Lyons map of Aiea, Ewa, Oahu showing the east end of the study area

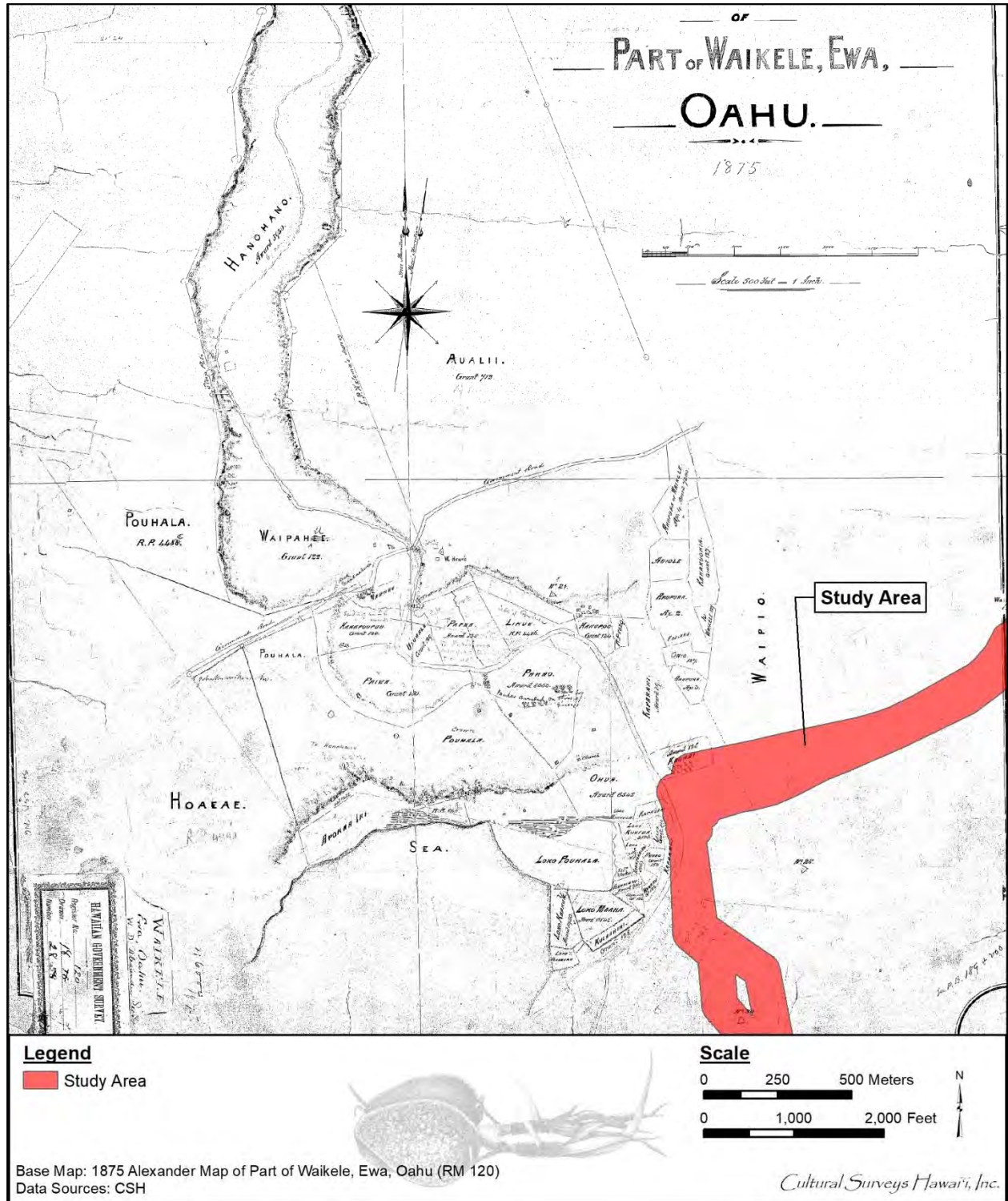


Figure 39. 1875 Alexander map of Part of Waikele, Ewa, Oahu showing a west portion of the study area in the immediate vicinity of the Waipahu WWPS

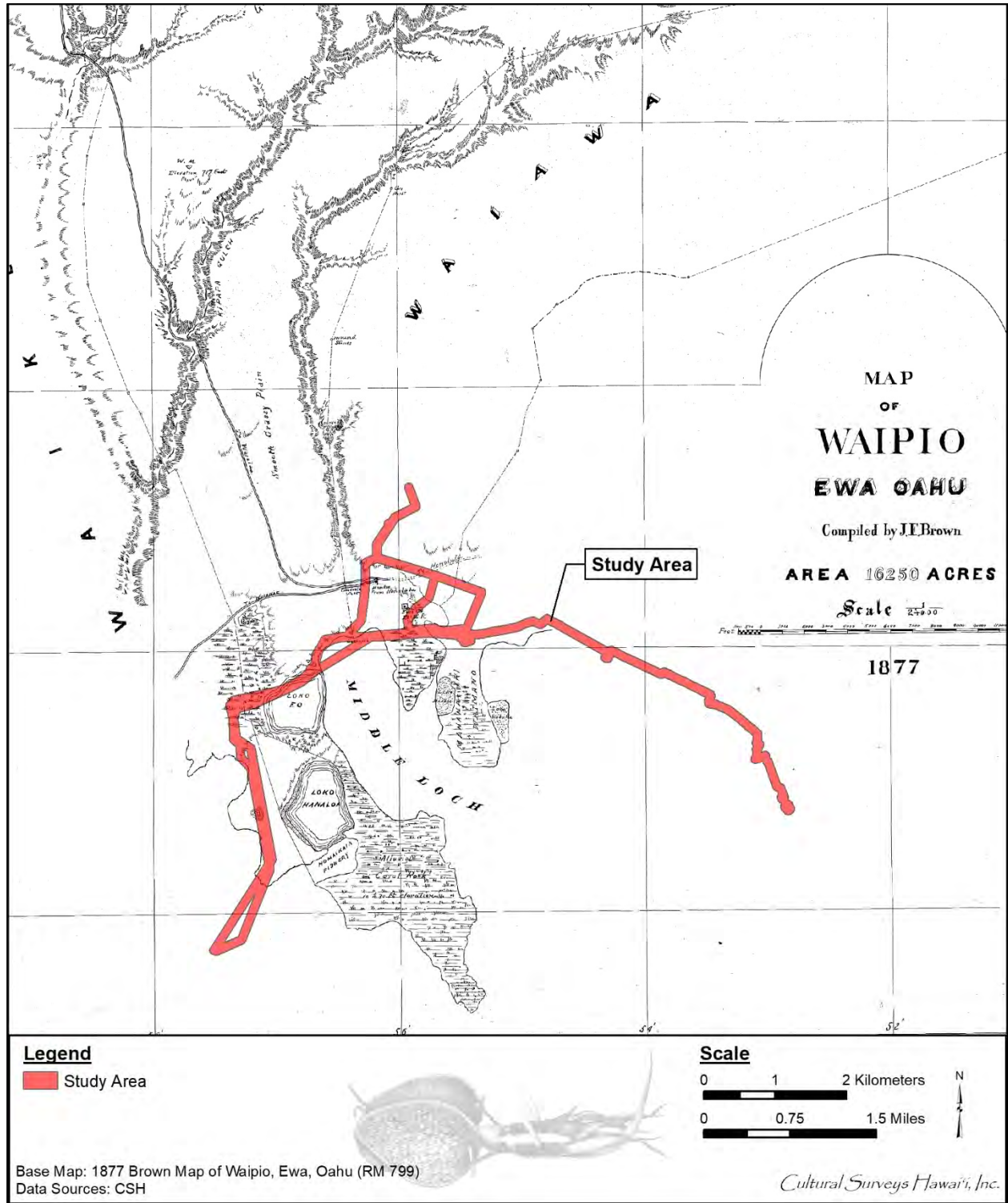


Figure 40. 1877 Brown map of Waipio, Ewa, Oahu showing the west and central portions of the study area

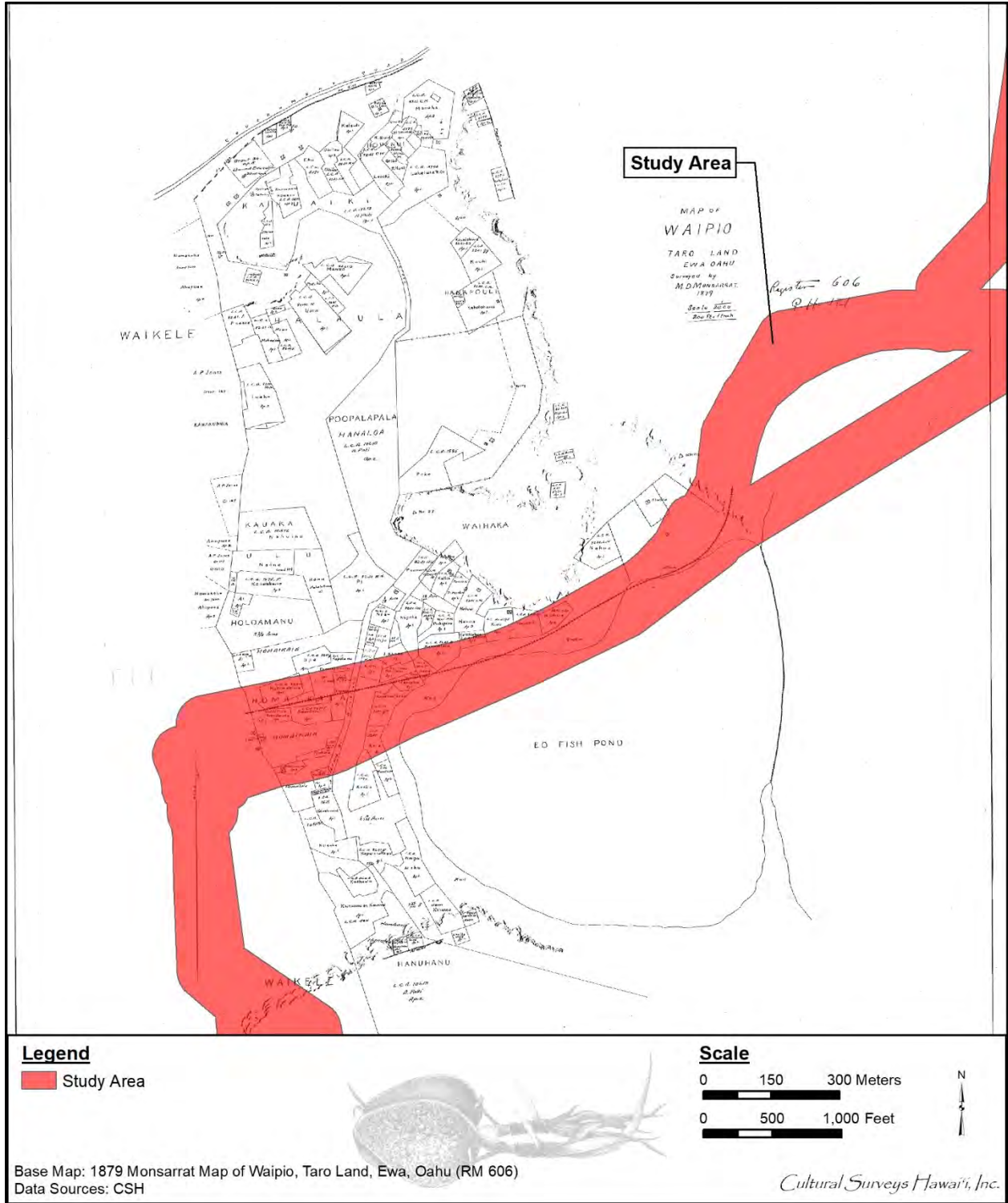


Figure 41. 1879 Monsarrat map of Waipio, Taro Land, Ewa, Oahu showing a central portion of the study area

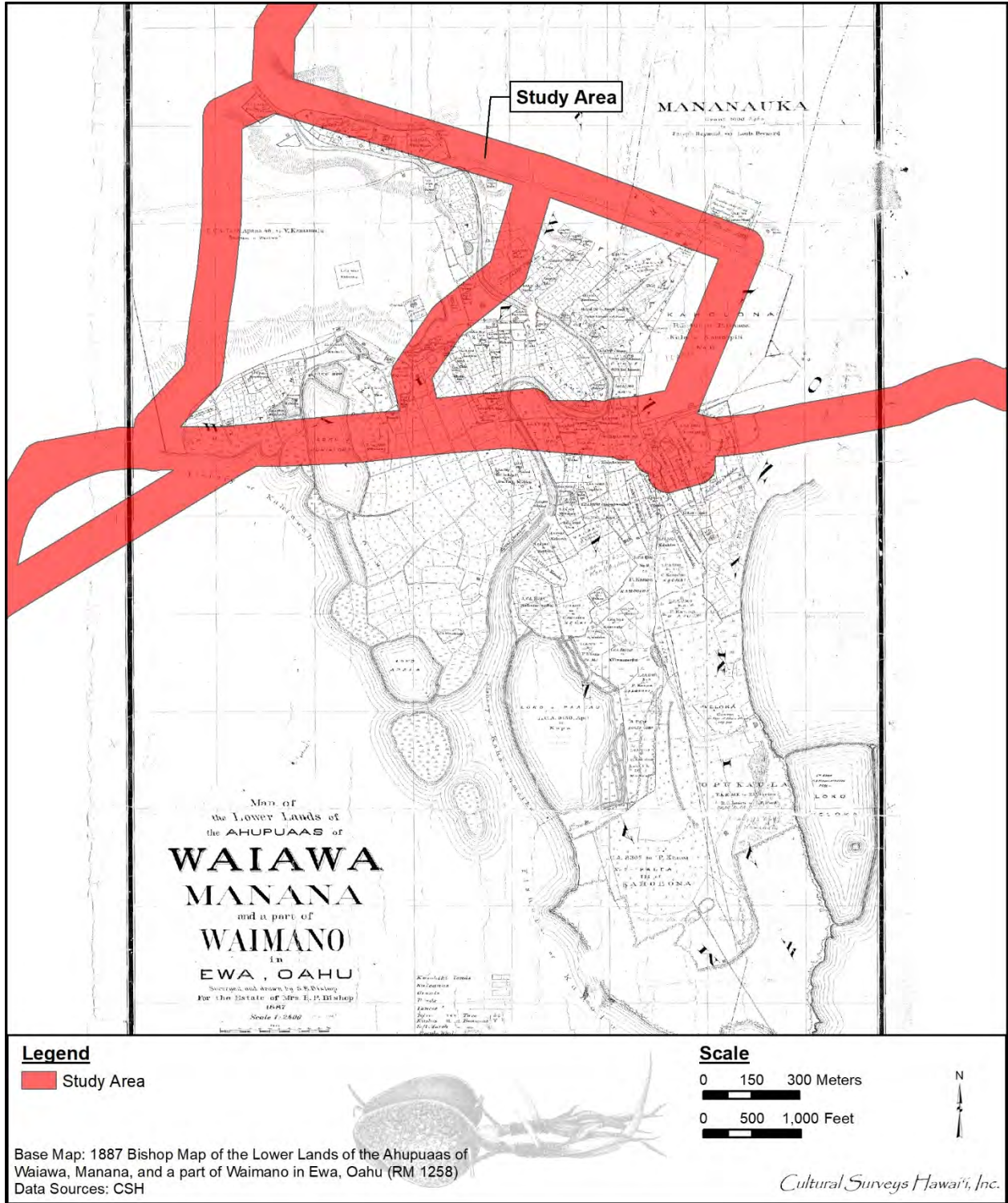


Figure 42. 1887 Bishop map of the Lower Lands of the Ahupuaas of Waiawa, Manana and a Part of Waimano in Ewa, Oahu showing a central portion of the study area

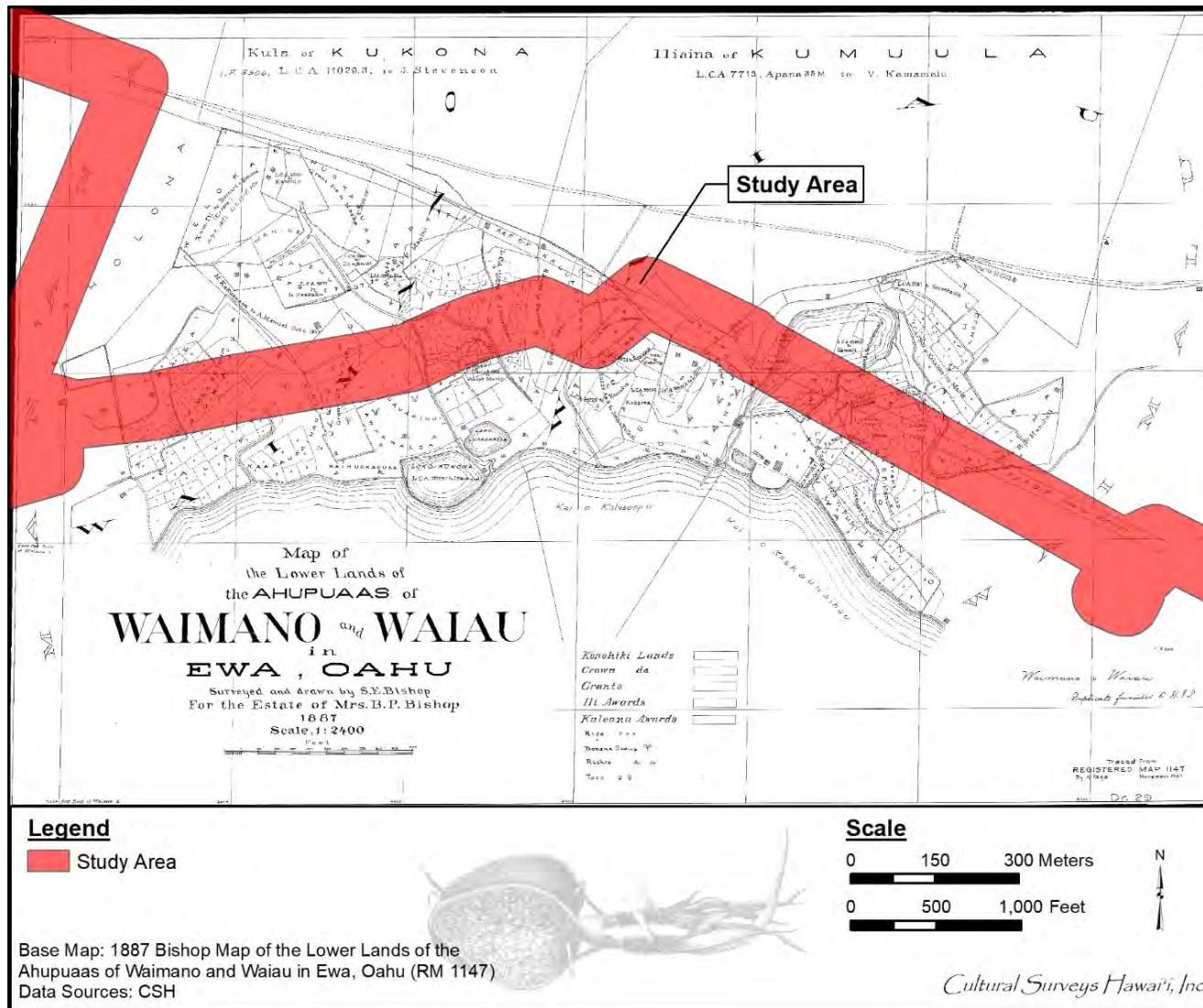


Figure 43. 1887 Bishop map of the Lower Lands of the Ahupuaas of Waimano and Waiau in Ewa, Oahu showing a central portion of the study area

The 1888 Monsarrat map of Hālawā (Figure 44) offers hardly any detail but is of note for calling out rice cultivation at the extreme south end of the project area along Hālawā Stream. Of interest is the notation that further downstream was still “Kalo Land.”

The 1889 Bishop “Map of the Makai Part of the Ahupuaa of Waikele” (Figure 45) provides detail of the immediate vicinity of the existing Waipahu WWPS where the study area turns east at the base of the Waipi‘o Peninsula. This area appears to have been under intensive cultivation.

The 1890 “Oahu Railway and Land Co. Map of Pearl City” (Figure 46) is understood as a promotional map touting the creation of a new residential area to be known as Pearl City. The area depicted is within Mānana Ahupua‘a, in the central portion of the study area with the location of the existing Pearl City WWPS and three alternate WWPS locations on the west (left) side. Prominent features on this map include the northeast corner of the Pearl City Peninsula with the adjacent northwest corner of East Loch, the indicated Oahu Railway alignment approximating the study area with a “Pearl City Branch Oahu Railway” taking a right angle turn to the south to extend down the Pearl City Peninsula. Lehua Avenue is depicted extending north, as it does today, and several numbered streets are shown (First Street through Eighth Street), some of which exist to this day.

Both the Oahu Railway alignment and the town/city of Pearl City date to 1890. The “Great Land Colonization Scheme” of James Campbell and B.F. Dillingham was to have widespread impacts on the landscape of O‘ahu. For example, this “scheme” led to a new name “Pearl City” for the *makai* lands of Manana and adjacent areas. A contest was held starting on 9 May 1890 for “the best name for the town recently laid out at Ewa.” Submitted names included “Dillingham,” “Dillinghampton,” “Dillinghamsville,” “Dilinama,” “St. Dillingham Pearl,” “Dillingmania,” and “Manana” but on 16 May 1890 the award committee unanimously selected a submittal by Mr. J.M. McChesney, Edw. P. Olesen, and Fred Peterson that the town shall be called “Pearl City” (*Pacific Commercial Advertiser*, 17 May 1890). Pearl City as we know it is largely a result of this vision of James Campbell and B.F. Dillingham. Several of the brand new subdivisions of this “Great Land Colonization Scheme” are shown on Figure 46 including one along Lehua Avenue from the Oahu Railway alignment north to the Government Road that would become Kamehameha Highway.

The 1894 Kananui map of Pearl Harbor (Figure 47) shows the entirety of the study area immediately following the overthrow of the Kingdom of Hawai‘i. The “Road to Honolulu” arcs around Pearl Harbor approximating the alignment of present day Kamehameha Highway within the central portion of the study area. The extensive hatching within the study area along the coast from the Pearl City Peninsula (Mānana Ahupua‘a) east to Aiea Ahupua‘a is understood to indicate rice cultivation areas at that time.

The 1897 Nichols map of the Pearl River and Lochs (Figure 48; Figure 49) features a close-up of a portion of a different Nichols map of the same year) shows the entire study area on the eve of annexation. Superficially this appears to be pretty much an unmodified traditional Hawaiian landscape dominated by the coastal fishponds. The new Pearl City subdivisions depicted on Pearl City Peninsula and the Lehua Avenue portion of the study area (easternmost of the three *mauka* extensions) are certainly a harbinger of changes to come. The development of these subdivisions (and a new entity of Pearl City) appears to have been associated with a significant straightening of what is now Kamehameha Highway within the central portion of the study area. A big change is

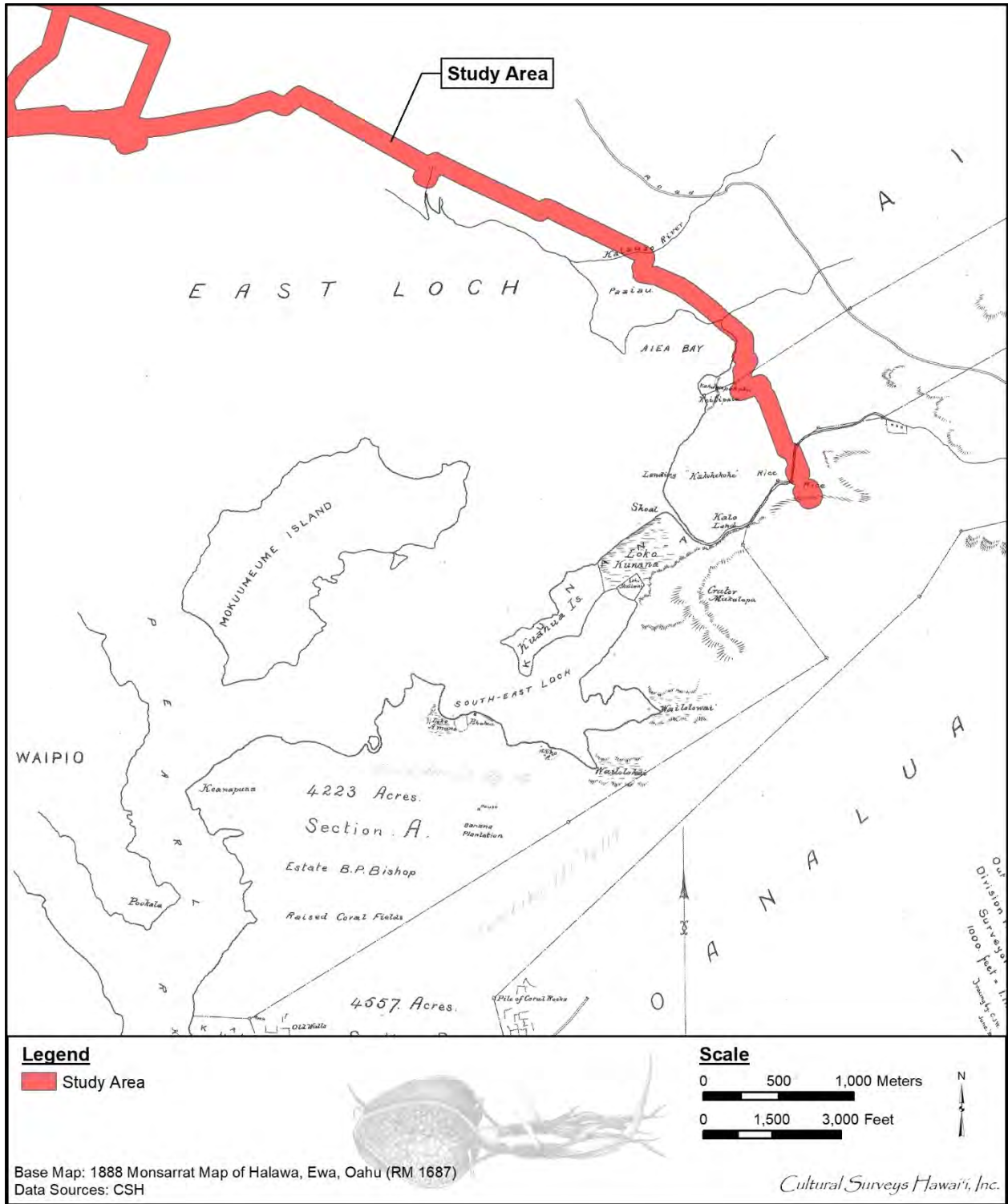


Figure 44. 1888 Monsarrat map of Halawa, Ewa Oahu showing the east end of the study area

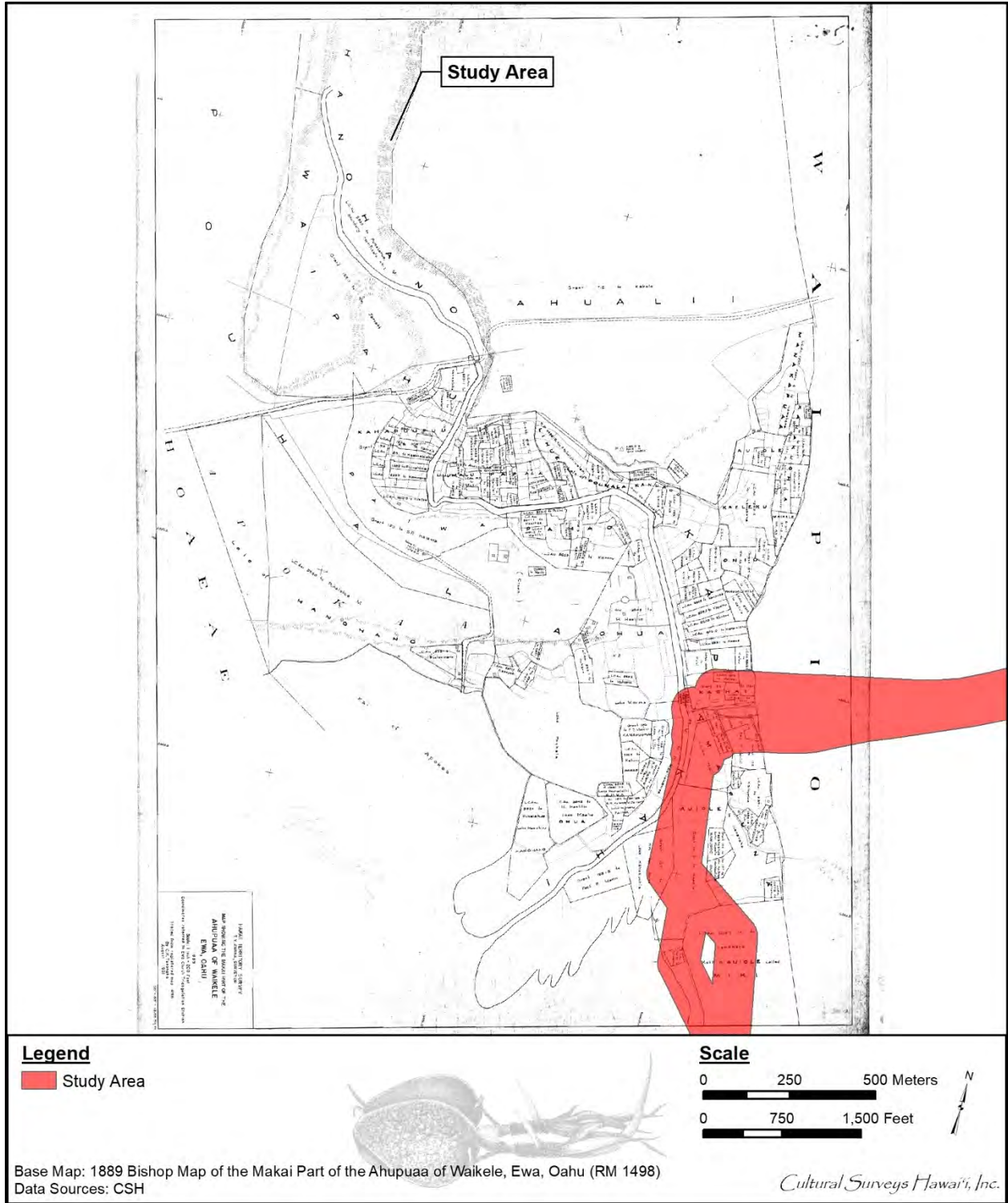


Figure 45. 1889 Bishop map of the Makai Part of the Ahupuaa of Waikele, Ewa, Oahu showing a west portion of the study area in the immediate vicinity of the Waipahu WWPS

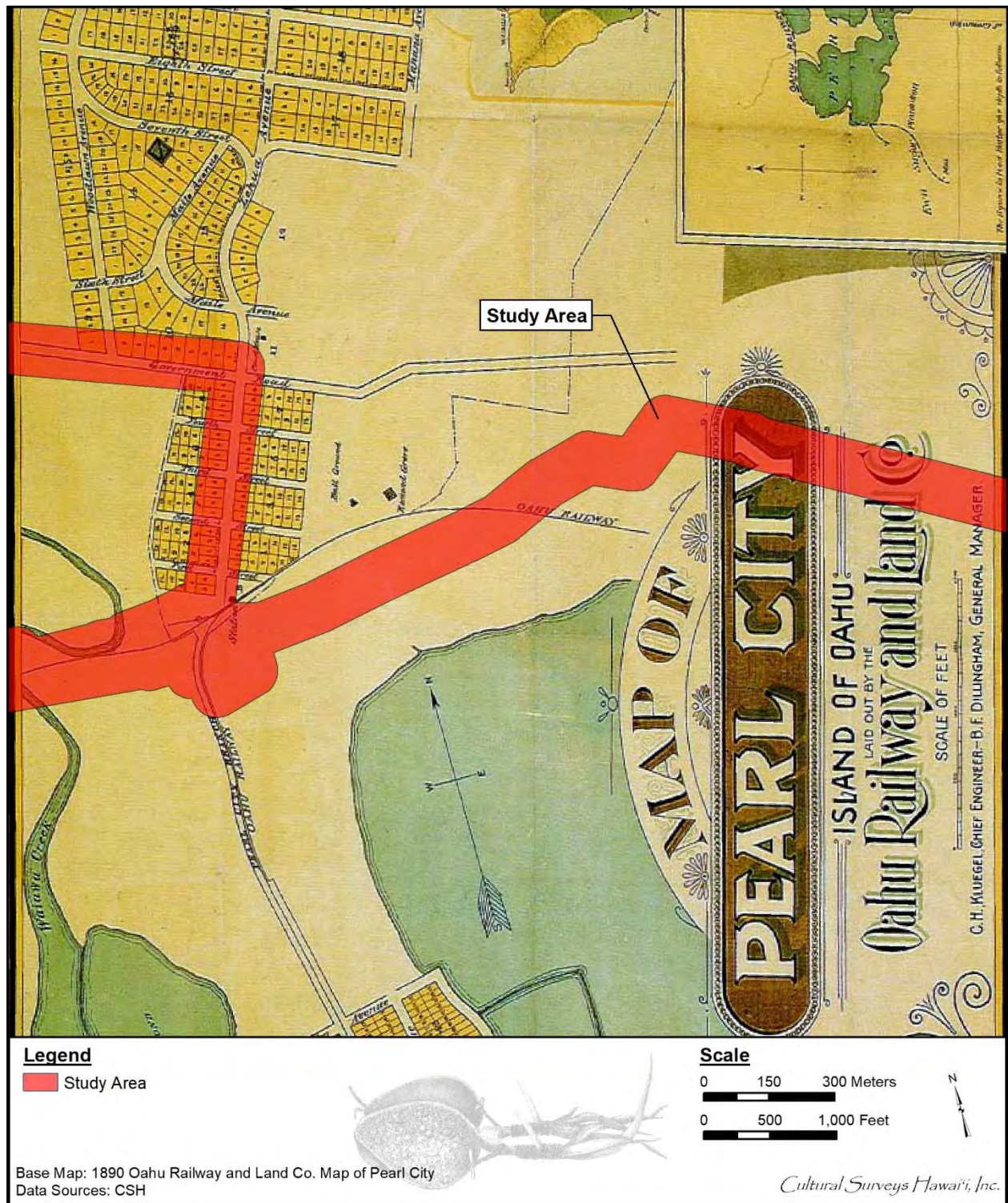


Figure 46. 1890 OR&L map of Pearl City showing a central portion of the study area

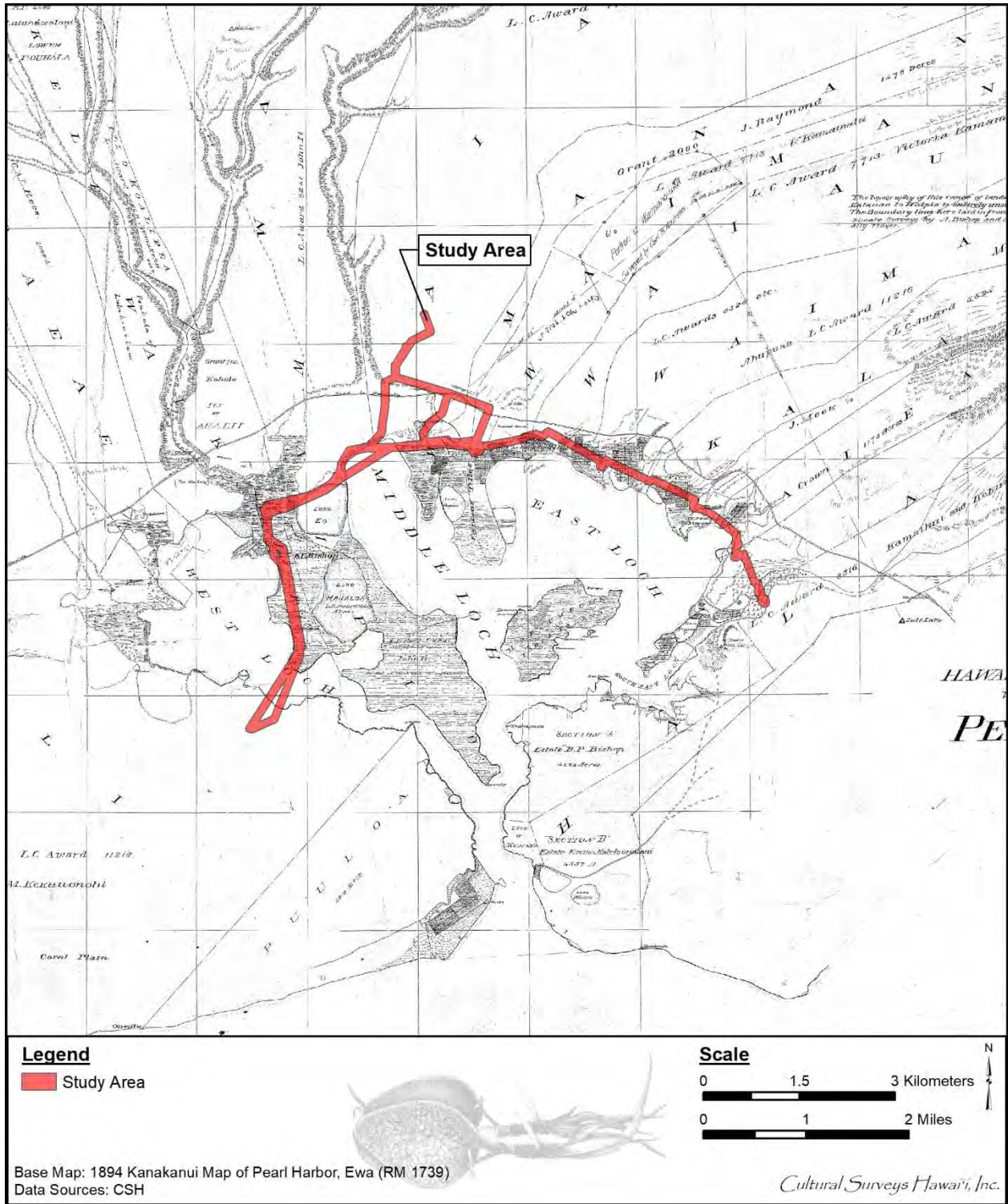


Figure 47. 1894 Kananui map of Pearl Harbor, Ewa showing the study area

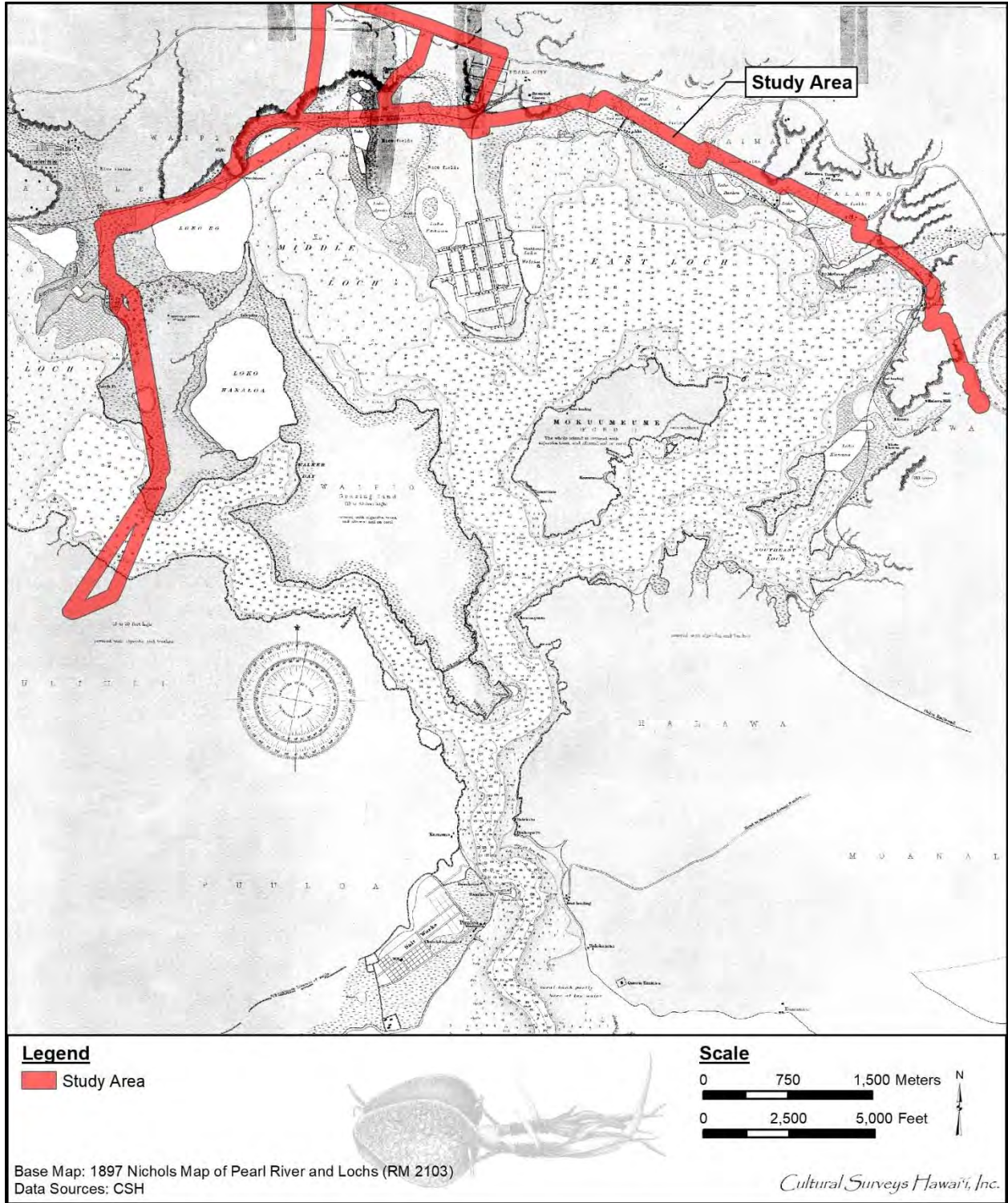


Figure 48. 1897 Nichols map of Hawaii Islands South Coast of Oahu, Pearl Lochs showing the study area

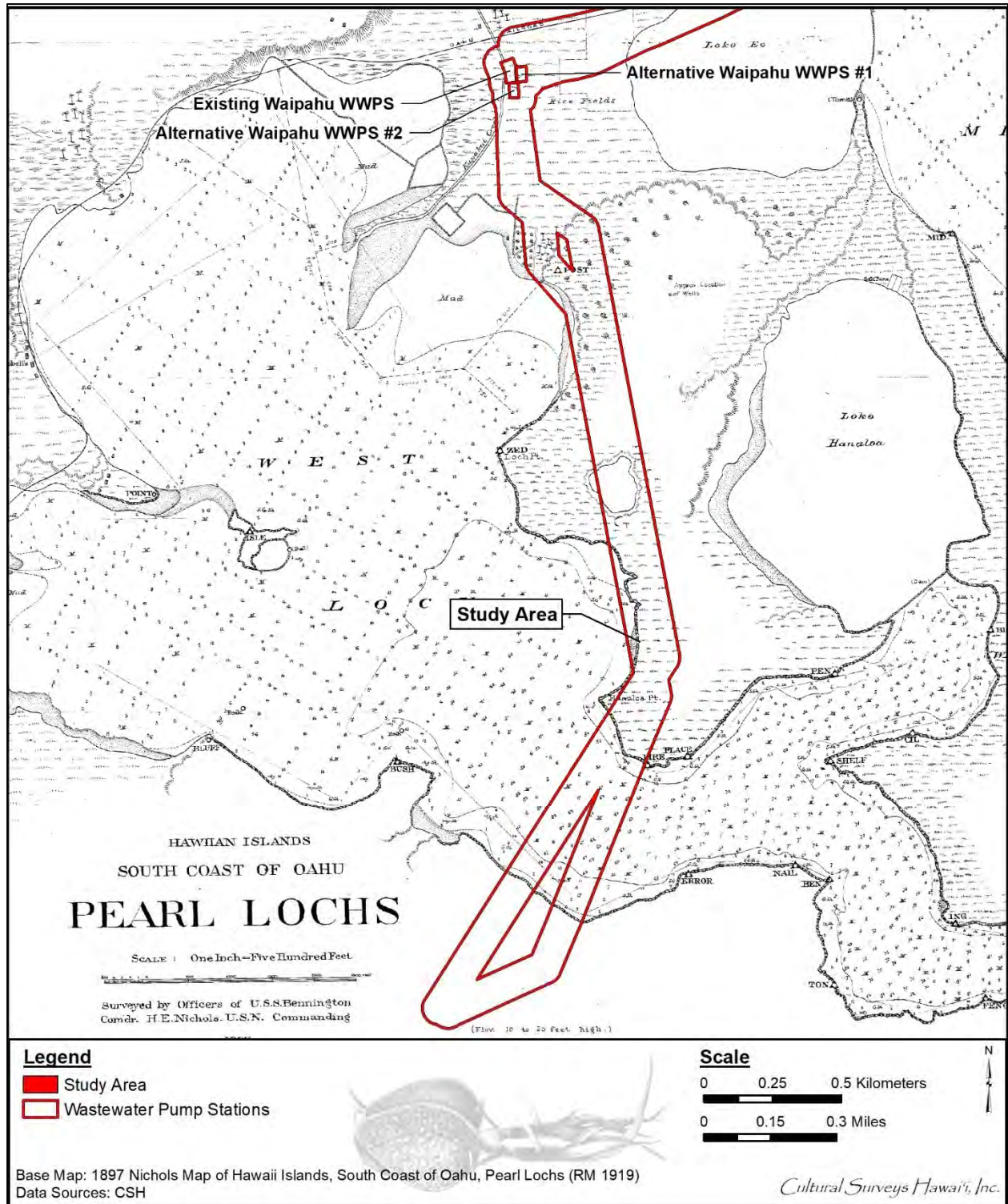


Figure 49. 1897 Nichols map of Hawaiian Islands, South Coast of Oahu, Pearl Lochs close-up of a portion of the map showing the west portion of the study area

the many annotations of “Rice Fields” within the study area. A close-up of a portion of a different Nichols map of the same year in the vicinity of the Waipahu WWPS (see Figure 49) gives some feeling for how extensive the rice fields had become. The quilt of small independent Hawaiian taro patches shown on the 1879 (see Figure 41) and 1889 (see Figure 45) maps is being absorbed by Chinese rice agribusiness. In several locations rice fields are indicated in the study corridor.

The 1897 Nichols map (see Figure 48) clearly shows the new OR&L alignment. From the vicinity of the Waipahu WWPS east to where a spur runs south down the Pearl City Peninsula the railroad is within the study corridor. East of the Pearl City Peninsula spur, the railroad is depicted as only approximately paralleling the study area (typically running well *makai* of the study corridor) until it reaches ‘Aiea where the railroad is again within the study corridor rounding ‘Aiea Bay.

The 1898 Monsarrat map of ‘Aiea taro lands (Figure 50) provides detail for a small portion of the study area in ‘Aiea Ahupua‘a, rounding ‘Aiea Bay, depicting LCA parcels, a few houses, an old ditch, and areas of rice cultivation. The “Oahu Railroad” runs down the middle of the project corridor. Of interest is the call-out of a “hospital” as nineteenth century hospitals could be associated with burials. In this case unsuccessful cases may have ended up in the ‘Aiea Cemetery which, although not depicted, should have been developed just to the southeast. While this is a map of “taro lands” there are a large number of call-outs of rice fields.

Monsarrat did another map of a portion of ‘Aiea in 1898 (Figure 51) that also depicts the hospital as within the study corridor and shows a stable and a few other buildings near the Hālawa Ahupua‘a boundary near where the OR&L follows the coastline *makai* (west, outside) of the study corridor.

4.7 History of the Sugar Plantations of ‘Ewa

Although sugarcane was already being grown as far back as the early 1800s, the industry revealed its economic potential in 1879 when the first artesian well was drilled in ‘Ewa (Ellis 1995:22). The availability of subsurface water resources enabled greater irrigation possibilities for expanding plantations besides the use of water diversions from the surrounding stream systems. This prompted the drilling of many other wells in the Hawaiian Islands, thereby commencing the Hawai‘i sugar plantation era. By the early 1900s, all the main Hawaiian Islands had land devoted to the sugarcane production.

Agricultural field systems, railroads, and residential areas in ‘Ewa were developed by three sugarcane companies: the Ewa Plantation, located largely in the *ahupua‘a* of Honouliuli and Hō‘ae‘ae in the western section of the ‘Ewa; the Oahu Sugar Company, extending in the areas upland of the Ewa Plantation in central ‘Ewa, including a portion of the uplands of Waiawa; and the Honolulu Plantation Company, with fields extending through Mānana to Hālawa in the eastern section of ‘Ewa.

4.7.1 The Ewa Plantation Company

The Ewa Plantation Company was incorporated in 1890 for sugar cane cultivation (Figure 52). The first crop, 2,849 tons of sugar, was harvested in 1892. Ewa Plantation was the first all-artesian plantation and it gave an impressive demonstration of the part artesian wells were to play in the later history of the Hawaiian sugar industry (Kuykendall 1967:3:69). As a means to generate soil

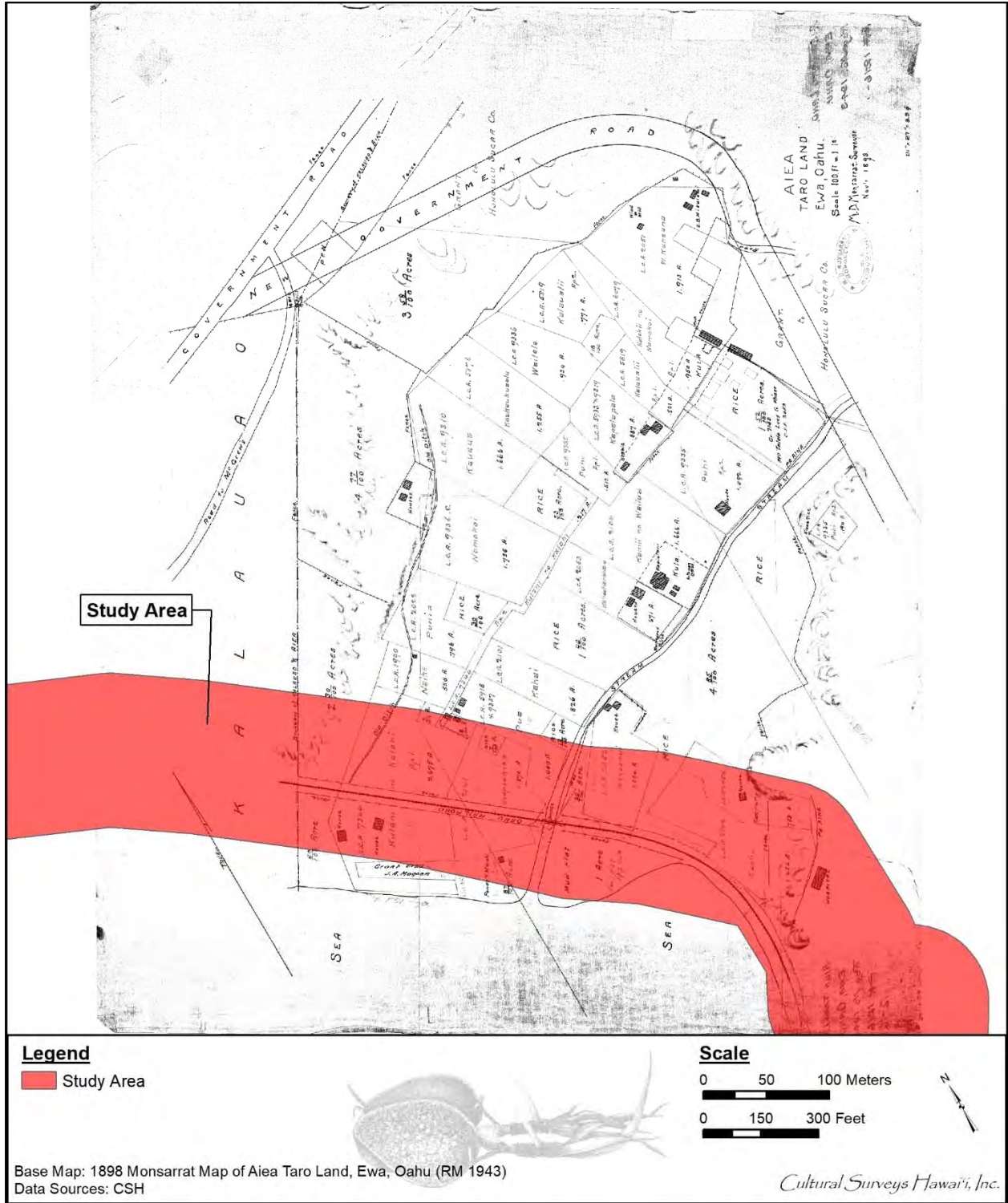


Figure 50. 1898 Monsarrat map of Aiea Taro Lands, Ewa, Oahu showing an eastern portion of the study area rounding 'Aiea Bay

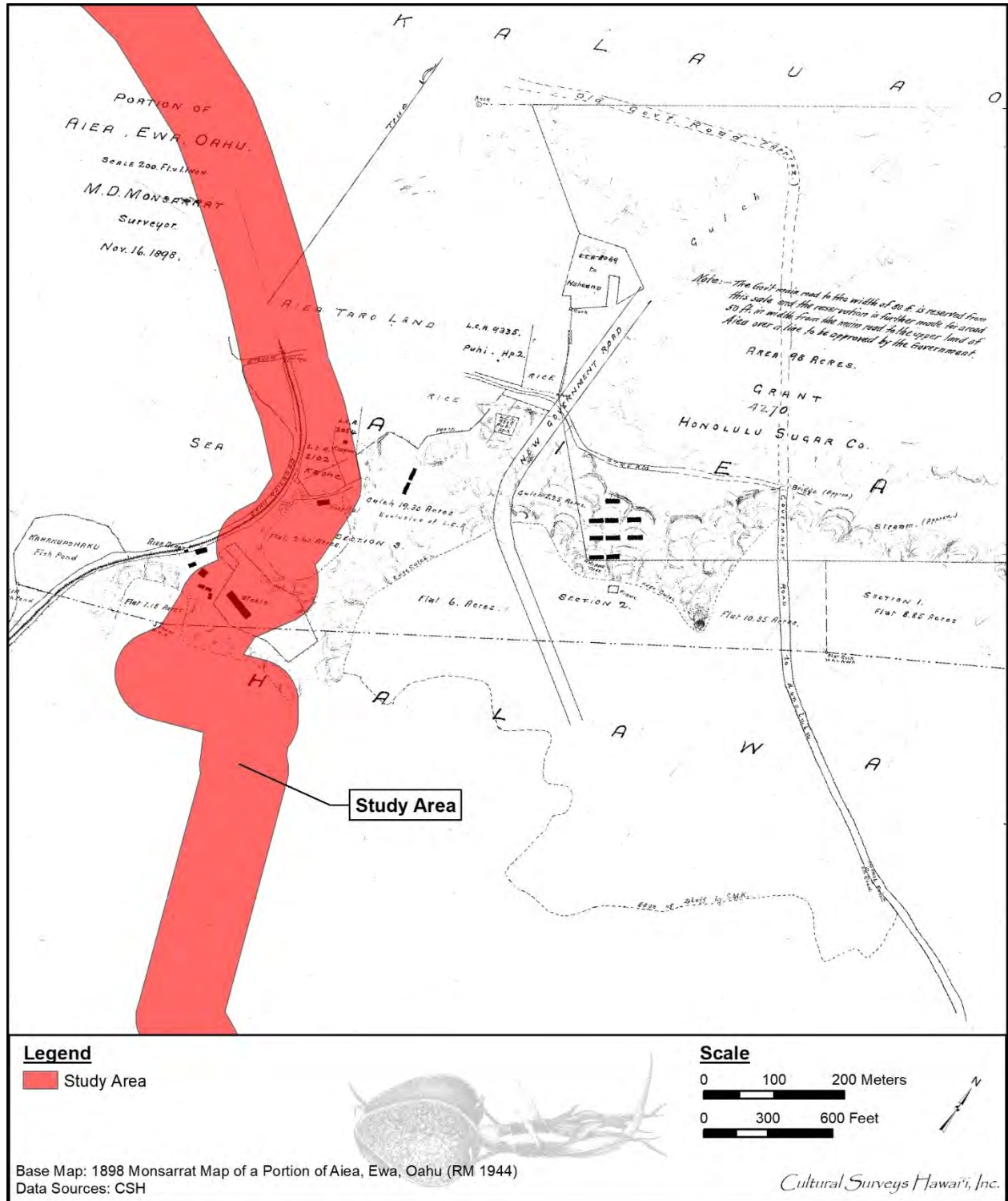


Figure 51. 1898 Monsarrat map of a portion of Aiea, Ewa, Oahu showing an eastern portion of the study area just northwest of today's Aloha Stadium



Figure 52. Ewa Plantation Company sugarcane fields, Filipino Camp area, ca. 1925 (University of Hawai'i at Mānoa Digital Photograph Collection)

deposition on the coral plain and increase arable land in the lowlands, the Ewa Plantation Company installed ditches running from the lower slopes of the mountain range to the lowlands. When the rainy season began, they plowed ground perpendicular to the slope so that soil would be carried down the drainage ditches into the lower coral plain. After a few years, about 373 acres of coral wasteland were reclaimed in this manner (Immisch 1964:3). By the 1920s, Ewa Plantation was generating large profits and was the “richest sugar plantation in the world” (*Paradise of the Pacific*, December 1902:19–22 in Kelly 1985:171).

During the twentieth century, the Ewa Plantation continued to grow and by the 1930s it encompassed much of the eastern half of Honouliuli Ahupua‘a. This growth impelled the creation of plantation villages to house the growing immigrant labor force working the fields. After the outbreak of World War II, which siphoned off much of the plantation’s manpower, along with the changeover to almost complete reliance on mechanical harvesting in 1938, there was little need for the large multi-racial (Japanese, Chinese, Okinawan, Korean, Portuguese, Spanish, Hawaiian, Filipino, European) labor force that had characterized most of the early history of the plantation. The Oahu Sugar Company took control over the Ewa Plantation lands in 1970 and continued operations until 1995, when they decided to shut down sugarcane production in the combined plantation areas (Dorrance and Morgan 2000:45, 50).

4.7.2 The Oahu Sugar Company and the Waiahole Ditch

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

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

Prior to commercial sugar cultivation, these lands were described as being "of near desert proportion until water was supplied from drilled artesian wells and the Waiahole Water project" (Condé and Best 1973:313). Dillingham had successfully promoted the Ewa Plantation Company in 1890; the sprawling sugar company was just south of and adjacent to the OSCo. Artesian wells had converted those arid 'Ewa lands into a thriving plantation, and Dillingham recognized the same potential in the northern area.

Water to irrigate the upper cane fields was initially pumped to levels of 150 m (500 ft) by some of the "largest steam pumps ever manufactured" (Dorrance and Morgan 2000:49). The expense of pumping water to the high elevations of the plantation led to the proposal to transport water from the windward side of the Ko'olau Mountains. The Waiahole Water Company was formally incorporated in 1913 and was originally a subsidiary of the Oahu Sugar Company. The Waiahole Ditch was designed by engineer Jorgen Jorgensen, with recommendations by engineer J.B. Lippencott and assisted by W.A. Wall. When completed, the original system included 27 tunnels connecting with 37 stream intakes on the north side of the Ko'olau, with the main bore through Waiāhole Valley, then connecting it to the 14 tunnels on the southern side of the Ko'olau at Waiawa, and thence by ditch westward to Honouliuli, covering a total of 13.6 km (Condé and Best 1973:37). Upon its completion in 1916, the Waiahole Ditch was 35 km (21.9 miles long) and cost \$2.3 million. The 32 million gallons of daily water enabled the Oahu Sugar Company to grow to "some 20 square miles . . . ranging in elevation from 10 feet at the Waipio Peninsula . . . to 700 feet at the Waiahole Ditch" (Condé and Best 1973:313). The ditch system, with some modifications, is still in use. It is included on the state inventory of archaeological sites as State Inventory of Historic Places (SIHP) # 50-80-09-2268.

This ditch complex first passed through Hō'ae'ae, bringing much needed water to the area.

West of Waikakalaua Gulch, through Hoaeae and to the upper boundary of Oahu Plantation in Honouliuli, the conduit consists of 12,650 feet of cement-lined ditches, and three redwood pipes 5 feet in diameter, having an aggregate length of 2,830 feet. [Kluegel 1917:96]

The Waiahole Water Co. has taken over from the Oahu Sugar Co. the Ahrens Ditch in Waiawa, the Kipapa Ditch, the Waikakalaua Ditch in Waipio, and the Hoaeae Ditch. Two redwood pipes having a total length of 1,223 feet have been laid across two gulches on the line of Hoaeae Ditch, cutting out 2 1/4 miles of ditch. The water delivered by the Waiahole System is chiefly used on newly planted cane on land above the lift of the pumps. [Kluegel 1917:107]

4.7.3 The Honolulu Sugar Plantation

The eastern section of 'Ewa was largely developed by the Honolulu Plantation Company. Commercial sugarcane cultivation began in Waimalu and Hālawā in the 1850s, on the estate of Mr. J.R. Williams (Condé and Best 1973:327). The plantation was first known as the Honolulu Sugar Company. In 1900, along with a change in ownership, the name of the company was changed to the Honolulu Plantation Company. The plantation's mill and refinery were located in 'Aiea, with the plantation's fields stretching across the plains and foothills *mauka* of Pearl Harbor (Figure 53). The expanse of the Honolulu Plantation Company lands seems to extend from 'Aiea westward as far as Mānana and Waiawa streams. Additionally, several land sections lay southeast of Pearl Harbor where the present Honolulu International Airport and Hickam Air Force Base are located. In 1914, the company harvested 19,000 tons of sugar. It was taken over by the Oahu Sugar Company in 1947 (Condé and Best 1973:313).

The increased productivity of the sugarcane industry relied heavily on transporting the raw product from the field to the mills, including the 'Aiea sugar mill, as well as then taking the processed sugar to port for loading onto ships (or to storage facilities). Railway lines, which were established in the Honolulu Plantation Company fields by OR&L in 1901, provided a means to transport material, workers, and goods in an adequate amount of time. By 1910, the network of railways circumnavigated the plantation with over 36 miles of main railroad, utilizing four locomotives and 500 cane cars. This transportation system greatly enhanced the plantation's product output and economic growth, having taken in 900 tons of raw sugar per week and producing 1,100 tons of processed sugar daily (Condé and Best 1973:328).

Despite its economic promise and gains, gradual land condemnation of Honolulu Plantation lands by the government caused declines in production and removal of rail lines. Continued pressure by the U.S. military proved to be too much. Large shares of Honolulu Plantation land were gradually turned over to the government for military use. In 1907, a sizeable portion was used for the expansion of the U.S. Naval Facilities at Pearl Harbor. In 1935, all of the Pu'uloa lands (approximately 15% of the plantation) were handed over for the construction of Hickam Air Field. The plantation lands were given up during World War II and post-war urbanization brought an end to the Honolulu Plantation Company in 1947. The plantation equipment and remaining land were sold to the neighboring Oahu Sugar Company, and the mill was dismantled and shipped to the Philippines. However, the refinery continued to operate, producing a liquid sugar product for canners and bottlers until the Hawai'i bottlers switched to corn syrup and the operation shut down in 1996. The refinery building is now the site of the Hawai'i Agriculture Research Center (Dorrance and Morgan 2000:50).

4.8 The Military Development of 'Ewa

4.8.1 Early Evaluations of Pearl Harbor

In 1891, Russian explorer Otto Von Kotzebue tried to observe Pearl River, but his group could not obtain a canoe. What he was told led him to speculate on the possible importance of Pearl Harbor to the future.

In the mouth of this river are several islands; it is so deep, that the greatest ship of the line can lie at anchor a few fathoms from the shore; and so broad, that a hundred vessels can conveniently find room in it. The entrance into the Pearl Rivers is in the



Figure 53. Photograph of Pearl Harbor in 1932 with the 'Aiea Sugar Mill in the foreground (Hawai'i State Archives, reprinted in Scott 1968:822)

same situation as the harbor of Hana-rura; but the windings between the reefs are, however, said to render a passage more difficult. If this place were in the hands of the Europeans, they would certainly employ means to make this harbour the finest in the world. [Kotzebue 1821:338–348]

The early missionary Levi Chamberlain was able to take an outrigger canoe trip to Pearl River, and noted the difficulty of access for larger ships.

Kawaa took passage in our canoe to go down the harbor to a place where oysters are abundant to give orders to his people to gather a mess. The sail down the harbor was delightful . . . The passage down the creek for a number of miles was very pleasant till we got down near the reef and our course altered. We then could sail no longer as the wind was against us. The sail was lowered the mast taken down and secured across the outrigger and the rowers plied their paddles. (Chamberlain 1822-1849 in Sterling and Summers 1978:51)

The first foreign attempt to survey Pearl Harbor was made in 1840 during the U.S. Exploring Expedition, led by Charles Wilkes.

In this district is a large inlet of the sea, into which the river Ewa empties; at the entrance of this inlet is the village of Laeloa (at Kalaeloa Pont): the shore is known by the name of Pearl River or harbour, from the circumstance that the pearl oyster is found here; and it is the only place in these islands where it occurs.

The inlet has somewhat the appearance of a lagoon that has been partly filled up by alluvial deposits. At the request of the king, we made a survey of it: the depth of water at its mouth was found to be only fifteen feet; but after passing this coral bar, which is four hundred feet wide, the depth of water becomes ample for large ships, and the basin is sufficiently extensive to accommodate any number of vessels. If the water upon the bar should be deepened, which I doubt not can be effected, it would afford the best and most capacious harbour in the Pacific. . . . [Wilkes 1970:79]

Although Wilkes was impressed by the harbor, he was not at this time thinking of how this survey could benefit the American government in the future. In fact, Wilkes (1970:79) concluded, “As yet there is no necessity for such an operation, for the port of Honolulu is sufficient for all the present wants of the islands, and the trade that frequents them.”

Wilkes' low impression of the use of Pearl Harbor changed in less than 30 years. The U.S. Navy had tried to make a coaling station on Midway Island in 1869 by blasting through the coral reef to make a harbor, but the plan failed. In 1873, General Schofield presented a confidential report to the U.S. Secretary of war, recommending that Pearl Harbor should be available to the U.S. Navy. Schofield wrote,

In case it should become the policy of the Government of the United States to obtain the possession of this harbor for naval purposes, jurisdiction over all the waters of Pearl River with the adjacent shores to the distance of 4 miles from any anchorage should be ceded to the United States by the Hawaiian Government. . . .

The cession of Pearl River could probably be obtained by the United States in consideration of the repeal of the duty of Sandwich Island sugar. Indeed, the sugar—planters are so anxious for a reciprocity treaty, or so anxious rather for free trade in sugar with the United States, that many of them openly proclaim themselves in favor of annexation of these islands of the United States. [Sen. Ex. Docs, 52nd Cong. 2nd Sess. No. 77, pp. 150–154, reproduced in Judd 1971:Appendix 3]

4.8.2 The U.S. Military and the Development of Pearl Harbor

The reciprocity treaty was concluded in 1876 with the provision that Hawai'i would not “lease or relinquish sovereignty to another country or any harbor, etc.” In 1887, the treaty was renewed and amended and allowed the United States the “exclusive right to enter the harbor of Pearl River, in the Island of Oahu, at to establish and to maintain there a coaling and repair station for the use of vessels of the United States” (Judd 1971:128).

The most dramatic change affecting both the use of Pearl Harbor and the growth of the sugar industry in Hawai'i occurred 7 July 1898. Following years of diplomatic pressure from delegates to Washington, the Congress of the United States approved a joint resolution of annexation that established the Republic of Hawaii as a Territory of the United States. On 30 April 1900, President William McKinley signed the Organic Act for the Territory of Hawaii, which provided a government whose leaders were appointed by the United States and otherwise defined the political structure and powers of the newly established government (U.S. Department of the Interior 1900).

After annexation of the Islands to the United States in 1899, development of a Pacific base that could be used as a staging area for the Spanish-American war began (Coletta 1985:433). Early in

the twentieth century, the U.S. Government began acquiring the coastal lands of 'Ewa for the development of a naval base at Pearl Harbor. In 1901, the U.S. Congress formally ratified the annexation of the Territory of Hawaii, and the first 1,356.01 acres of Pearl Harbor land were transferred to U.S. ownership. The U.S. Navy began a preliminary dredging program in 1901, which created a 30-ft deep entrance channel measuring 200 ft wide and 3,085 ft long. In 1908, money was appropriated for 5 miles of entrance channel dredged to an additional 35 ft down (Downes 1953) (Figure 54). Money for the funding of the construction of dry docks and other support facilities was also approved in 1908. In 1909, the government appropriated the entire Waipi'o peninsula from the 'Ī'Ī Estate for the Pearl Harbor Naval Station and Shipyard. Additional dredging to deepen and widen the channel was conducted in the 1920s. In 1931, the Navy built an ammunition depot at West Loch on a 213-acre parcel it had bought from the Campbell Estate. Construction of a new depot in Lualualei Valley and at West Loch Harbor began in 1931.

In the early 1930s, the U.S. Navy leased 700 acres of the Campbell Estate to build Ewa Field in Honouliuli, a base with a mooring mast for Navy dirigibles. Although the mast was completed, the program was abandoned before the *Akron*, the designated airship for the mast, was built. In 1937, 18 miles of roads were built in the coastal Honouliuli area, and in 1939-1940 the U.S. bought 3,500 acres of land in this area (Landrum et al 1997:62-67) to build several other military camps and installations, including Barbers Point Naval Air Station, at the site of the old mooring mast.

In the 1930s an Army Air Corps airfield was established to the west of Rodgers Airport. The Hickam Air Force Base web site offers the following brief history of this military base's early development:

In 1934, the Army Air Corps saw the need for another airfield in Hawaii and assigned the Quartermaster Corps the job of constructing a modern airdrome from tangled brush and sugar cane fields adjacent to Pearl Harbor on the island of Oahu. The site consisted of 2,200 acres of ancient coral reef, covered by a thin layer of soil, located between Oahu's Waianae and Koolau mountain ranges, with the Pearl Harbor channel and naval reservation marking its western and northern boundaries, John Rodgers Airport to the east, and Fort Kamehameha on the south. The new airfield was dedicated May 31, 1935 and named in honor of Lt. Col. Horace Meek Hickam, a distinguished aviation pioneer killed Nov. 5, 1934, at Fort Crockett in Galveston, Texas.

Hickam AFB now consists of 2,850 acres of land and facilities valued at more than \$444 million. [Hickam Air Force Base 2010]

4.9 Pineapple Cultivation

In the early decades of the twentieth century, lands in the *mauka* portion of the central and eastern sections of 'Ewa were being acquired for pineapple cultivation. There is a record of attempted pineapple irrigation utilizing water from shallow wells in Waiawa Gulch in 1893. Later attempts were made in Waiawa and Honouliuli (Figure 55). James Dole founded the Hawaiian Pineapple Company in 1901. The previous year, Dole had purchased 61 acres of land in Waiawa for growing pineapple. Prior to 1913, most of the upland plateau areas in Waiawa were planted in pineapple (Goodman and Nees 1991:59). Small plots along gullies (not appropriate for sugarcane cultivation) in several 'Ewa *ahupua'a* were planted in pineapple. Many of these small plots were



Figure 54. Dredging in Pearl Harbor ca. 1908 (Hawai'i State Archives)



Figure 55. First pineapple plantation in Kunia in Honouliuli ca. 1900 (University of Hawai'i-Mānoa Digital Photograph Collection)

cultivated by independent farmers, who sold the crops at markets or to larger companies. In 1901, the Hawaiian Pineapple Company obtained 61 acres in Waiawa through public auction. Initially, most pineapple was shipped to California for packing. In an attempt to speed up processing, save money and produce a fresher product, a cannery was constructed in Waiawa. This cannery was constructed by the Pearl City Fruit Company but became a part of the Hawaiian Pineapple Company operations after the Pearl City Fruit Company went bankrupt. The cannery was in operation from 1905 to 1935.

A 1908 lease from the John 'Ī'ī Estate, Ltd. to Yoshisuke Tanimoto and Kintaro Izumi led to formation of the Waipio Pineapple Company, which cleared and cultivated approximately 223 acres in portions of Kīpapa Gulch. In 1909, the government appropriated the Waipi'o peninsula from the 'Ī'ī Estate. The land was valued at \$10,000 for purposes of fair compensation (DLNR 1909:228–235). In 1915, Libby, McNeill & Libby took over Waipio Pineapple Company's leases and continued to cultivate pineapple in the area. By the late 1920s, James Dole's Hawaiian Pineapple Company, incorporated in 1901, was cultivating pineapple on thousands of acres leased from the 'Ī'ī Estate in the *mauka* area of Waipi'o.

Pineapples were handpicked, graded, boxed, and loaded into trucks before the introduction of machinery into the harvesting process. The introduction of the mechanical field fruit harvester in 1947 eliminated the labor-intensive process of grading, boxing, and loading. The pineapple industry employed both male and female Japanese and Filipino workers in the fields and in the cannery. Camps were set up throughout 'Ewa to house the workers and their families (Goodman and Ness 1991:165). In the 1920s, pineapple was abandoned and by 1935, much of the former pineapple lands were planted in sugarcane

4.10 Other Agricultural Enterprises

Taro and other traditional plants continued to be cultivated in some areas. John Papa 'Ī'ī associated Waiawa, 'Ewa with the brewing of intoxicants in the early 1800s and gives an account of the making of *ōkolehao*, an alcoholic drink made from brewing the roots of the native ti plant (*Cordyline fruticosa*).

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

An additional agricultural trial was conducted in the Honouliuli area for the cultivation of sisal, a plant used to make fibers for rope and other material. Some sisal was planted before 1898 and production continued until the 1920s (Frierson 1972:16). This was grown mainly on the coastal plain of Honouliuli in Kānehili, just *mauka* of Kualaka'i Beach (now Nimitz Beach). An article in the *Paradise of the Pacific* in 1902 described this venture in glowing terms.

. . . The venture was made and a tract of land containing a large percentage of disintegrated coral, in the neighborhood of Ewa Plantation, where nothing else would grow, was chosen for the planting. . . . The Hawaiian Fiber Co., which Mr. Turner organized, and of which he is now manager, has 755 acres under fence, two and a half miles of which is stone wall with good gates at convenient places. . . .

In a large field containing 130 acres, mauka of the Oahu Railway & Land Co. track, the first harvest is to be gathered in a few months. . . . Out of this section of 130 acres the company has figured on securing 50 tons of clean fiber, for which it is offered eight cents per pound in Honolulu or nine cents per pound in San Francisco. [*Paradise of the Pacific* March 1902:17]

As in Honouliuli, the cultivation of sisal was attempted on other arid lands in 'Ewa. Thrum's *Hawaiian Almanac and Annual* speaks of the prospect of sisal cultivation glowingly from 1904 to 1913, but the greater profits to be made from sugarcane cultivation eventually led to the decline of this industry.

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

Besides sisal, cotton, and pineapples, other crops were grown in central 'Ewa, such as macadamia nuts (Thrum 1927).

4.11 Development of the Study Area as Reflected in Early Twentieth Century Maps

The 1900-1925 Taylor map of the property of the Honolulu Sugar Company, 'Aiea (Figure 56) shows continued straightening of the alignment of today's Kamehameha Highway within the central portion of the study area. The modern layout of the subdivisions of the new Pearl City in Manana Ahupua'a are in striking juxtaposition with the crazy quilt layout of traditional Hawaiian *kuleana* along the coast and within the study area to the east from Waimano Ahupua'a to 'Aiea Ahupua'a. Relatively little of the study area, really only the Hālawa Ahupua'a portion, is directly impacted by sugarcane cultivation. The study area within Hālawa is labeled as under (sugarcane) "Field 2" and "Seed Cane" of the Honolulu Sugar Company.

The 1913 Monsarrat map of O'ahu Fisheries (Figure 57) is something of a throw-back to an earlier time in documenting the boundaries of the various fisheries of Pearl Harbor. Not including fishponds, some 22 fisheries are called-out at Pearl Harbor. This attests to the wealth of marine resources that the Pearl Harbor lochs had long held for the people of 'Ewa District. These exclusive fisheries were of course just about to disappear under exclusive U.S. Navy control. This map shows the "Oahu Rail Road" as previously depicted but adds the detail of three "Depots" within the study corridor: in Kaohai, Waikele very close to the Waipahu WWPS; at Mānana, very close to the Pearl City WWPS; and at 'Aiea, approximately 200 m northwest of today's Aloha Stadium. Of passing note, a Waipio Ranch headquarters is indicated in the study area just north of Loko Eo.

A 1917 Kananui and Sutton map of Waimalu Ahupua'a (Figure 58) provides details of a vanishing traditional Hawaiian pattern of land ownership in the immediate vicinity of the Waimalu WWPS.

The 1919 U.S. War Department fire control map of portions of Pearl Harbor, Barbers Point, and Honolulu Quadrangles (Figure 59) now depicts a *mauka* landscape in the uplands of Pearl Harbor dominated by plantation railroads and sugarcane cultivation symbols. A subtle change is that the former fishponds are now called-out as "Lakes." Urbanization is still largely restricted to Pearl City although a substantial plantation community is indicated at 'Aiea. The "Naval Reservation" call-out is largely restricted to the south side of East Loch.

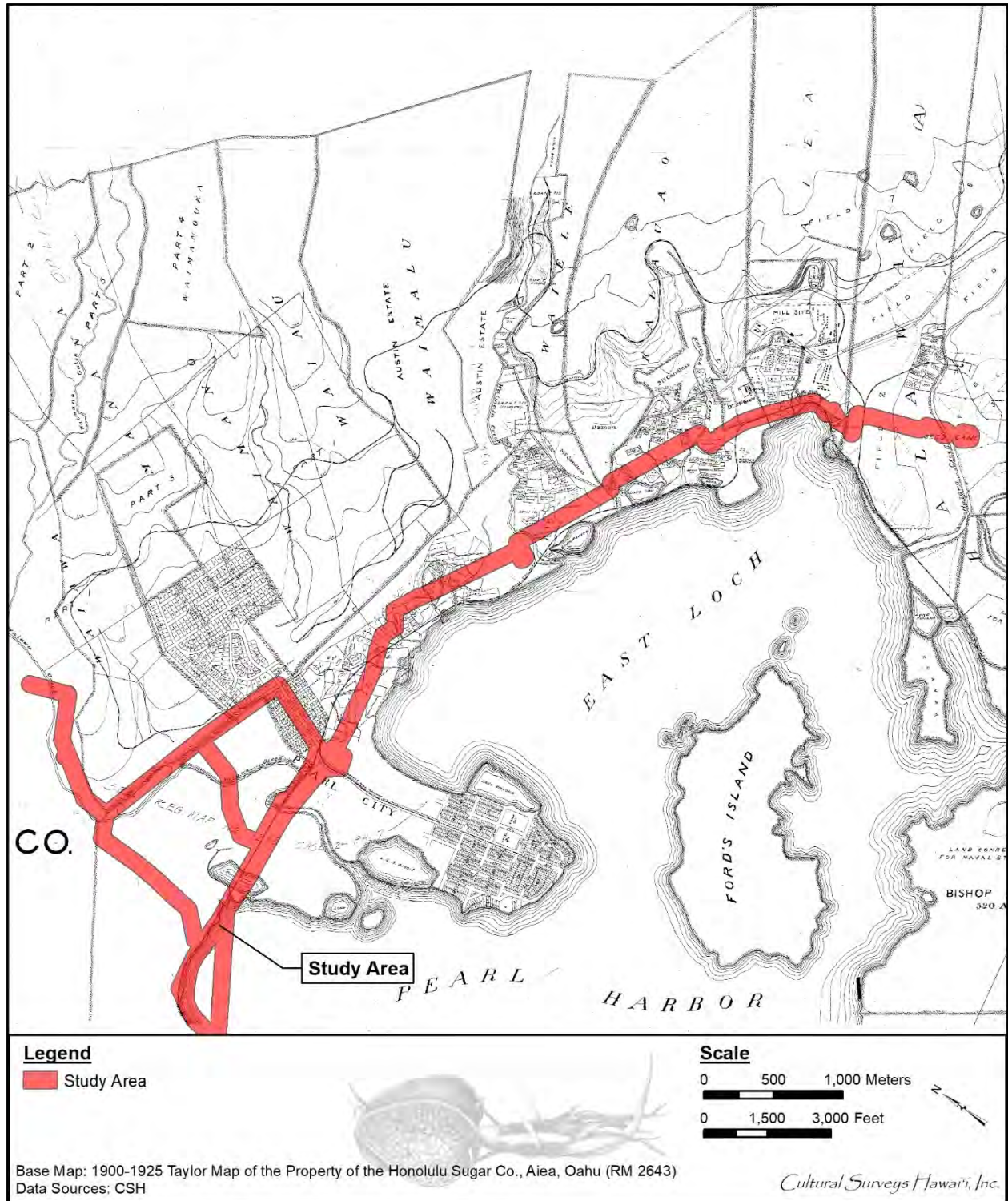


Figure 56. 1900-1925 Taylor map of the property of the Honolulu Sugar Company, Aiea, Oahu showing the central and east portions of the study area

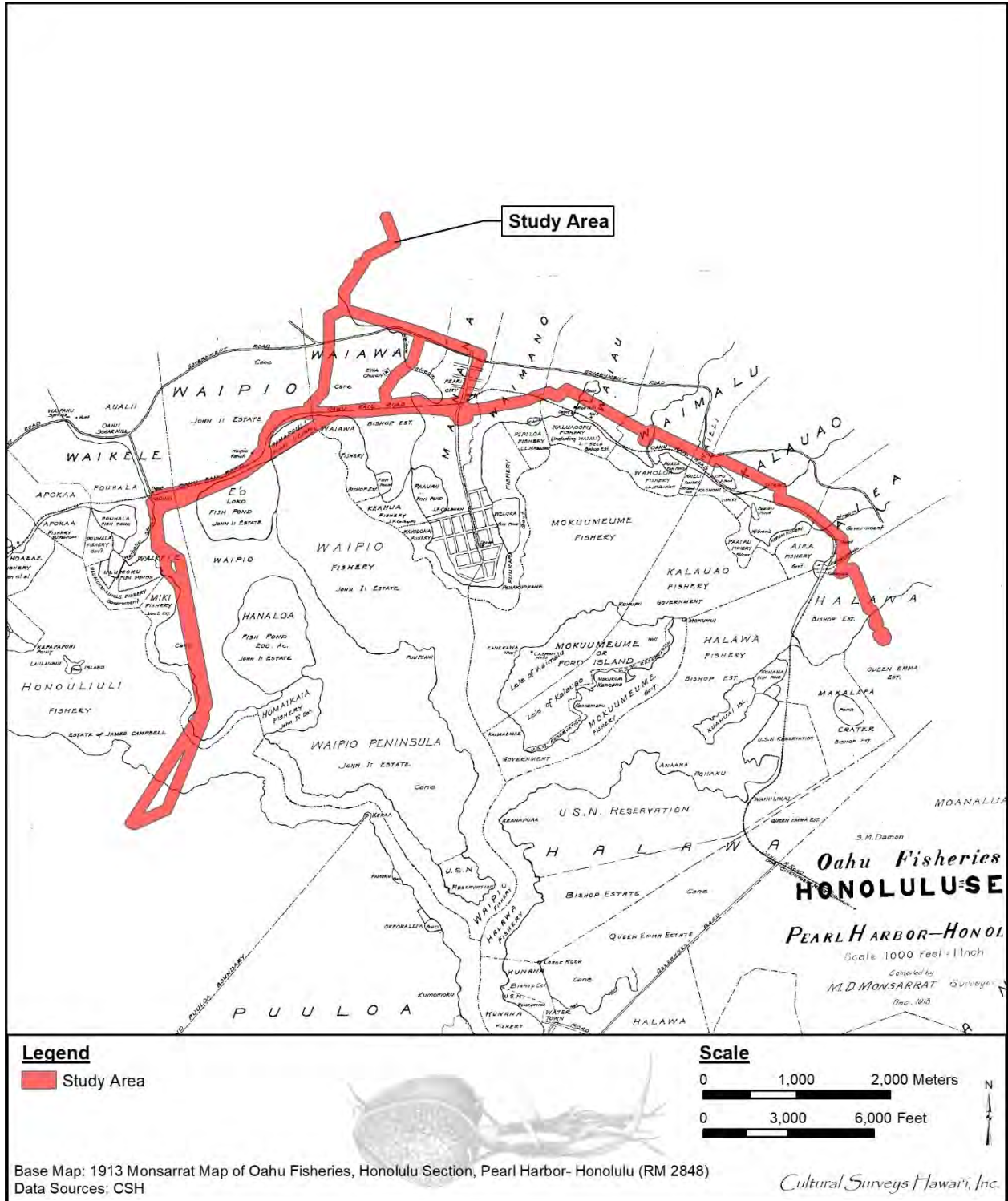


Figure 57. 1913 Monsarrat map of Oahu Fisheries, Honolulu Section, Pearl Harbor-Honolulu showing the study area

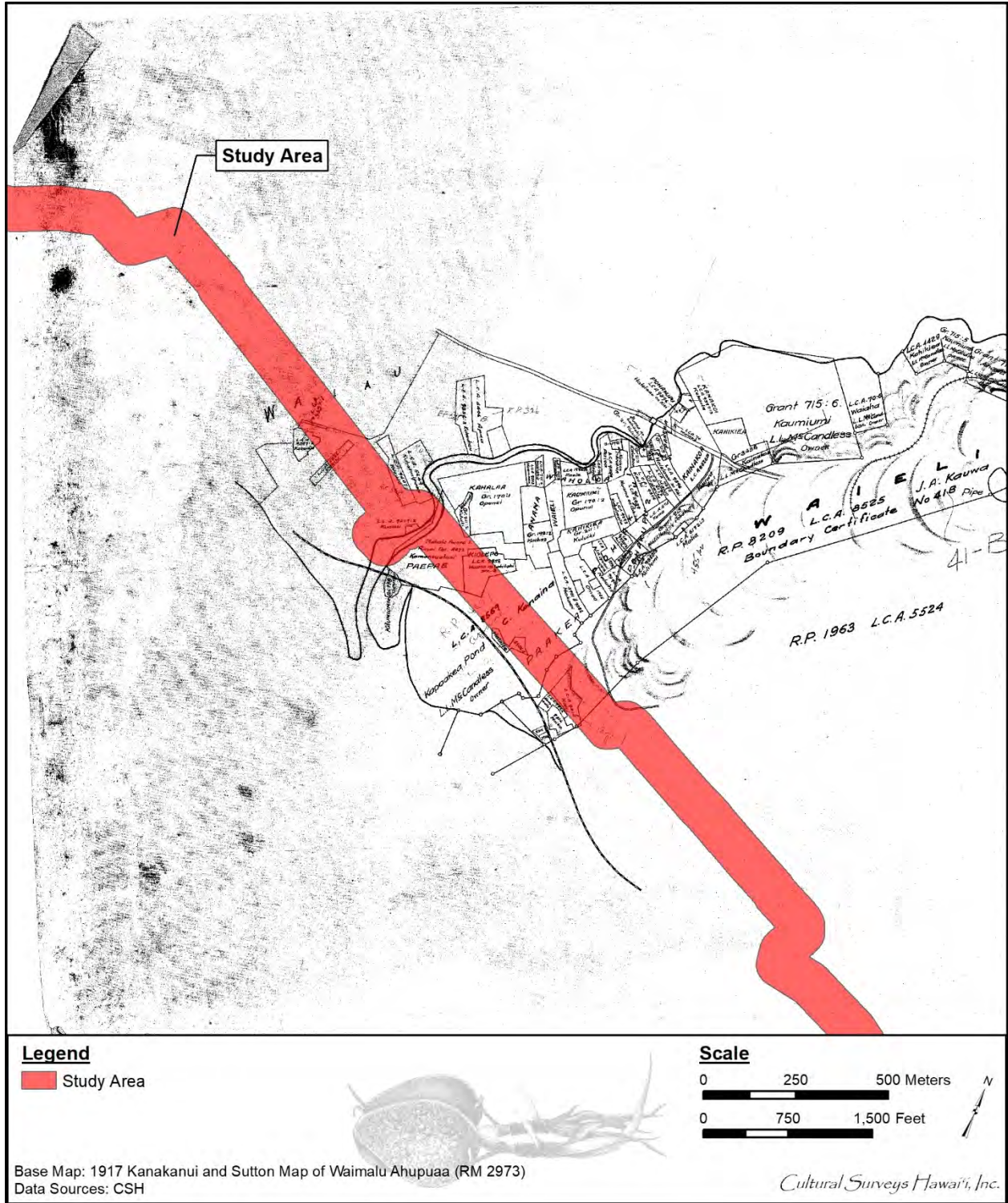


Figure 58. 1917 Kakanui and Sutton map of Waimalu Ahupuaa showing an east portion of the study area in the immediate vicinity of the Waimalu WWPS

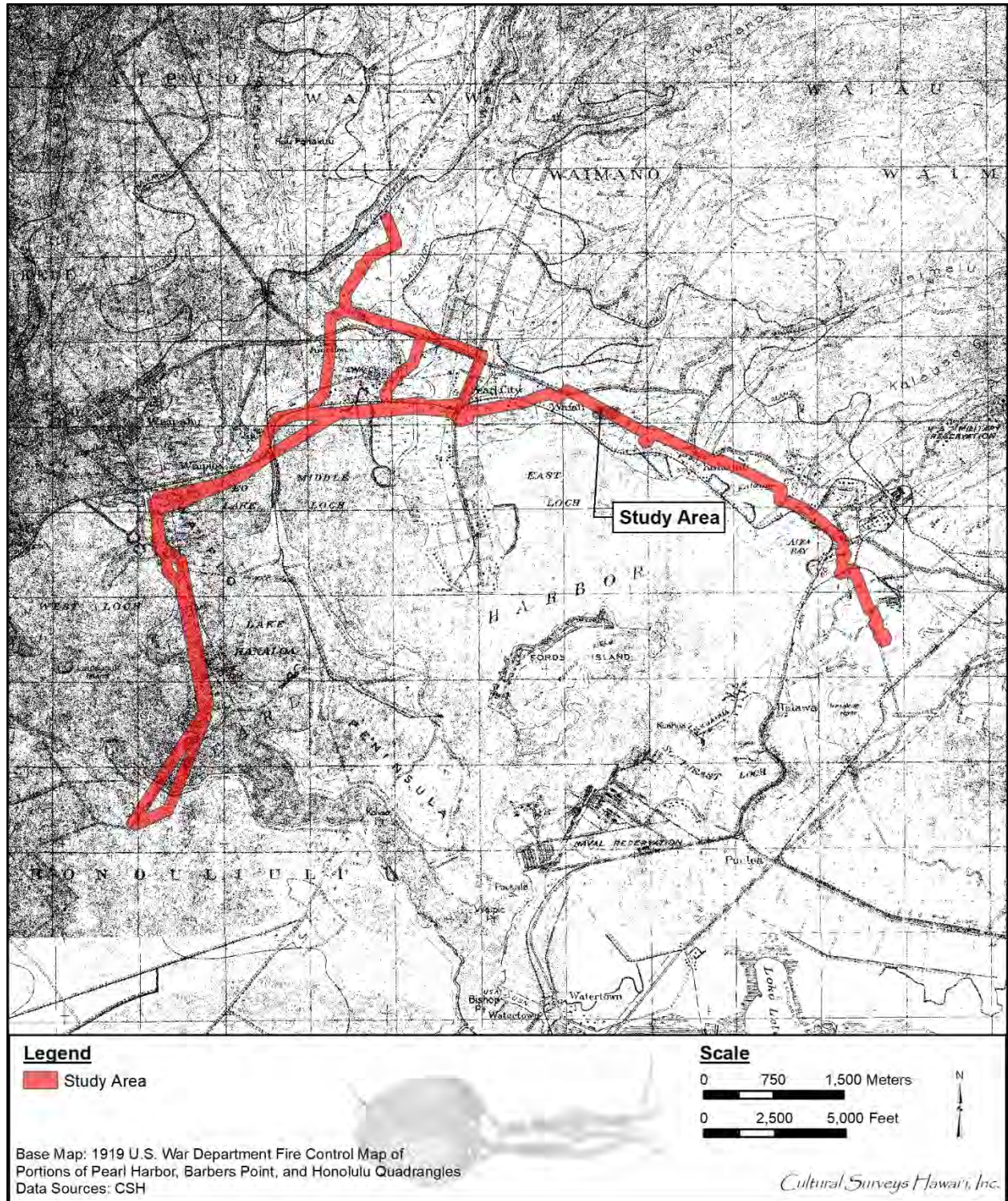


Figure 59. 1919 U.S. War Department fire control map of portions of Pearl Harbor, Barbers Point, and Honolulu Quadrangles showing the study area

The 1924 Evans map of 'Ewa and Waiahole Forest Reserves (Figure 60) provides a somewhat subtle presentation of just how extensive sugarcane plantations had become by 1924 with the annotation of "Upper Limits of Cane." The establishment of sugarcane plantations was associated with a new interest in the maintenance of forest reserves to safeguard a water supply for the thirsty cane fields. This map shows emerging communities at Waiau (within the study area) and at Waimalu (*mauka* of the study area). The 'Aiea plantation community, downslope from the mill (but *mauka* of the study area) is now substantial.

The 1928/1930 USGS topographic map, Waipahu (1928) and Ewa (1930) quadrangles (Figure 61) calls out Ewa Plantation commercial sugarcane fields and infrastructure in the west (Honouliuli) end of the study area (southeast of West Loch) and calls out Oahu Sugar Company fields and infrastructure on Waipi'o Peninsula. The OR&L railroad has three stations within the study area including the Waipahu Station (near the Waipahu WWPS), Waipio Station (on the northwest side of Loko Eo), and the Pearl City Station (near the Pearl City WWPS). OR&L stations to the east (Waiau Station, Kalauao Station) are along the track line *makai* of the study corridor.

The 1933/1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles (Figure 62; close-up views of the west, central and east portions of the study area in Figure 63, Figure 64, and Figure 65) provide a high level of detail of the study area.

In the west end of the study area in Honouliuli unimproved roads service Ewa Plantation fields (see Figure 63). A plantation company railroad appears to come within 100 m of the study area but is not clearly within the study corridor. Most of the study area southwest of West Loch appears to be in sugarcane fields. Of passing interest, an extensive "Salt Works" is noted just northwest up the coast of West Loch (outside the study area).

Within the study area on Waipi'o Peninsula a pipe line, flume, two reservoirs, an unimproved access road, Waipio Station, and several houses are indicated (see Figure 63). A spur Oahu Sugar Company railroad extends south down the Waipi'o Peninsula to the east but is not shown within the study area. The indication is that most of the Waipi'o Peninsula portion of the study area is under sugarcane cultivation at this time.

In the central portion of the study area (see Figure 64) Loko Eo is still shown as open water with the OR&L and its Waipio Station skirting the north side. A few houses are indicated at the northeast corner of Loko Eo within the study area. While the western *mauka* alignment is largely undeveloped, several houses are shown in the central *mauka* alignment and the eastern *mauka* alignment (Lehua Avenue) is quite developed. A few houses are shown at the extreme north tip of the study area near today's Waihona Street but these are seemingly accessed from the west and not the south. Scattered houses are shown in the study area east of the Pearl City peninsula (in Waimano Ahupua'a).

A big change in the east portion of the study area is that the contemporary coastal Kamehameha Highway is now shown (see Figure 65). Scattered houses are shown but the density is light except at 'Aiea where the plantation town now extends well south of the mill. The large 'Aiea Cemetery now takes up most of the width of the study area.

A sequence of high resolution aerial photos is available from 1939 of the east portion of the study area (Figure 66 through Figure 69), from the west side of the Pearl City Peninsula and Waiawa Ahupua'a across to the east end of the project area in Hālawa Ahupua'a. At least small

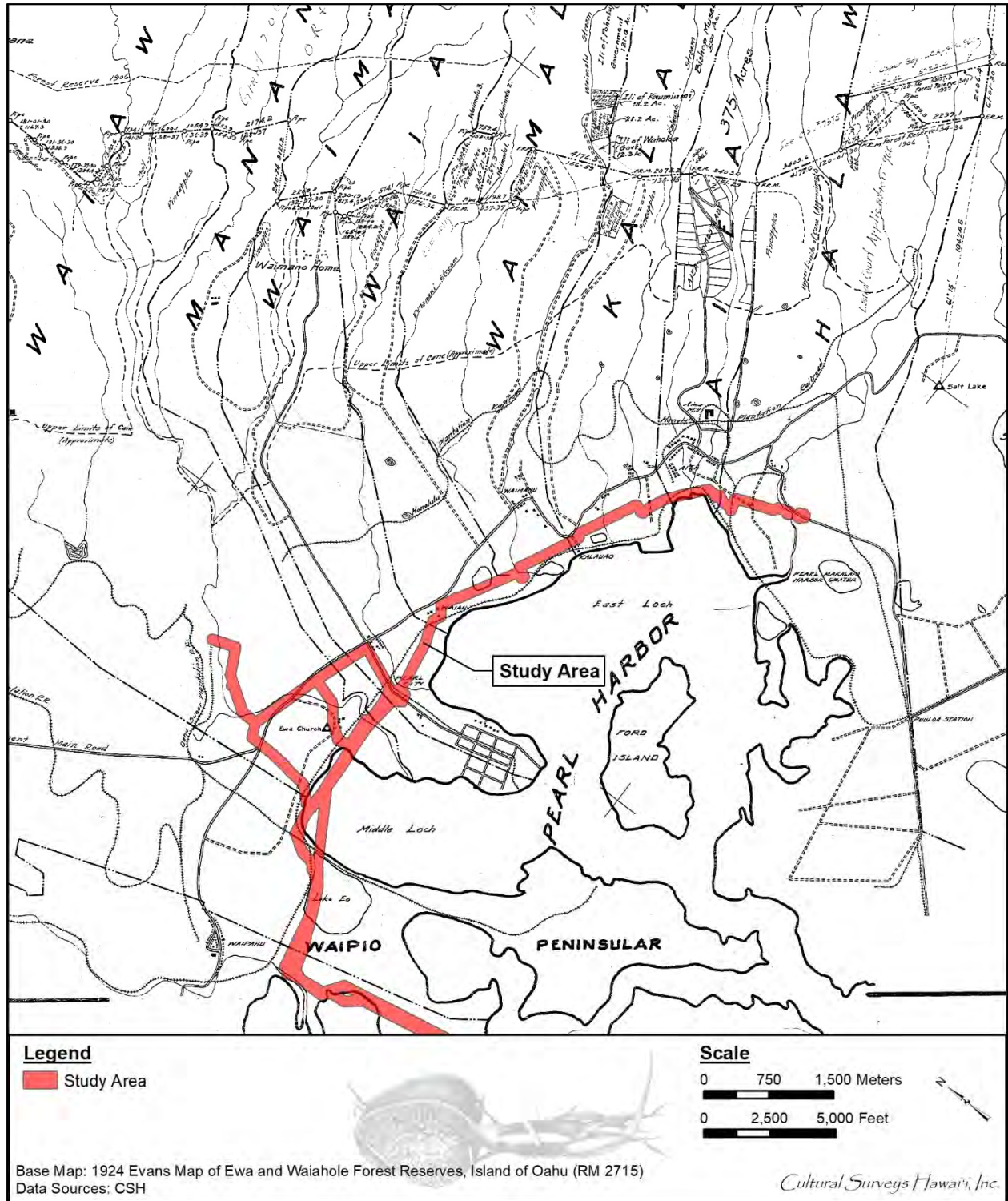


Figure 60. 1924 Evans map of Ewa and Waiahole Forest Reserves, Island of Oahu showing central and east portions of the study area (best fit, the map seems slightly off)

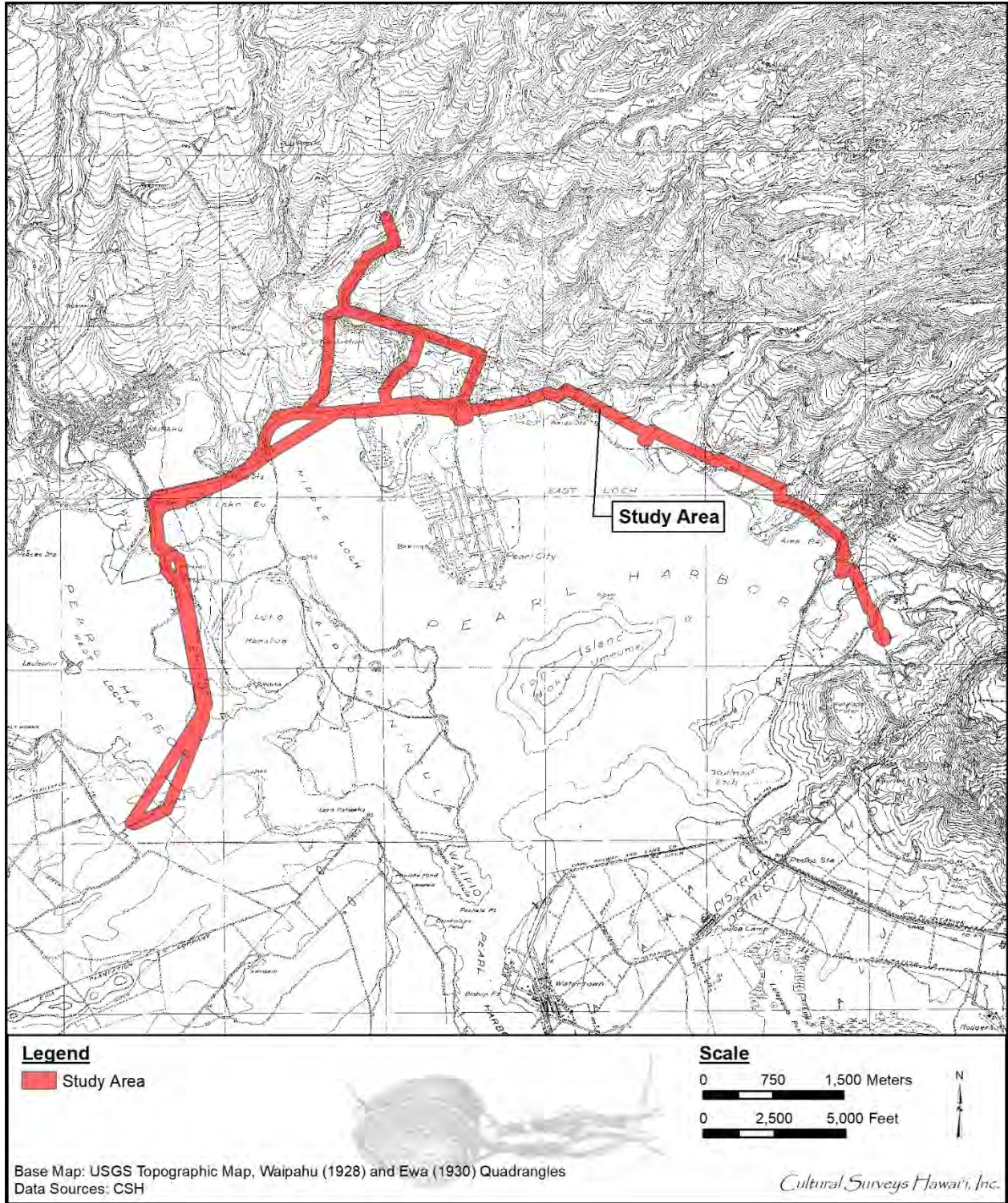


Figure 61. 1928 Waipahu and 1930 Ewa USGS topographic quadrangles showing the study area

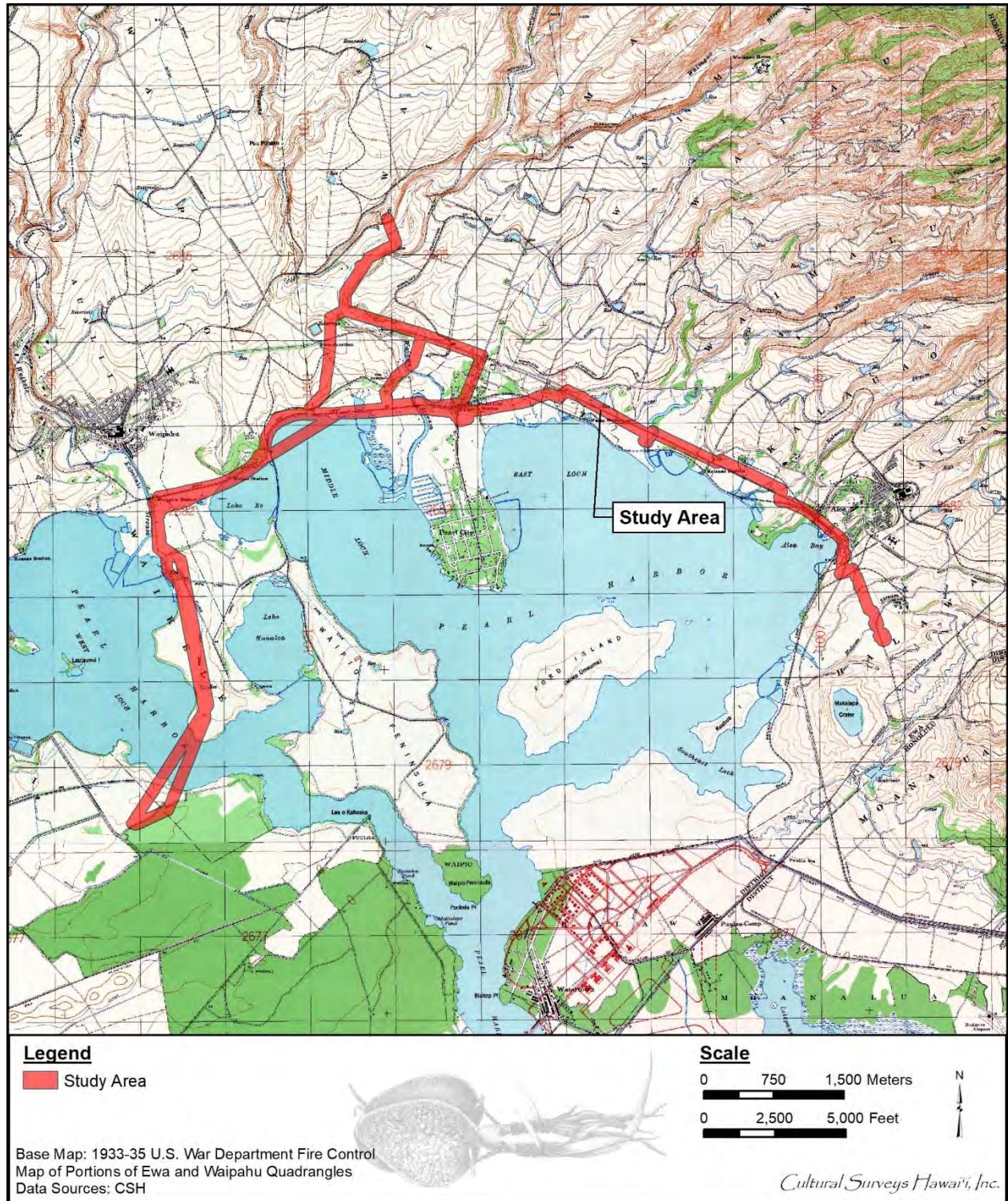


Figure 62. 1933-1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles showing the study area (see following figures for close-ups)

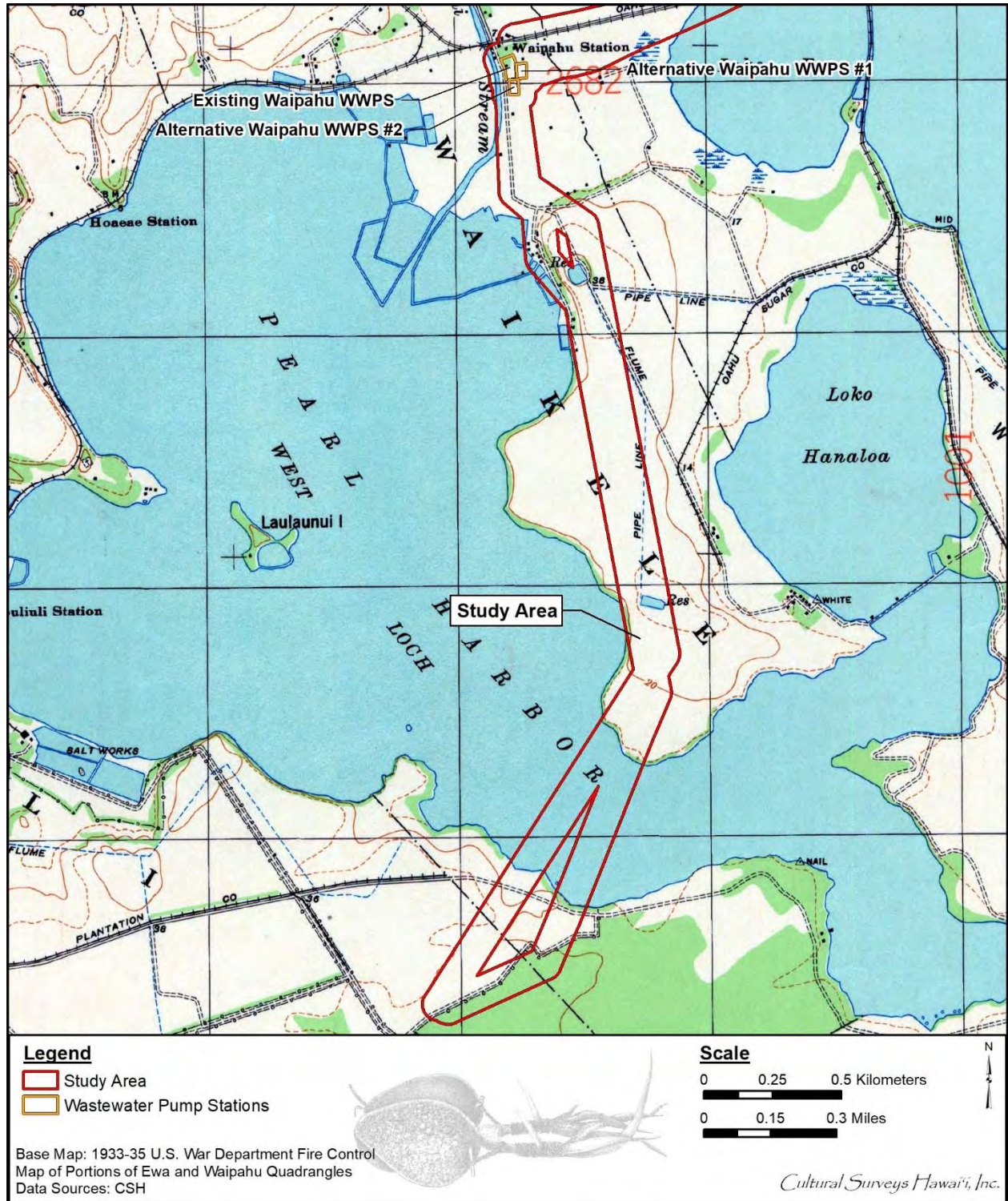


Figure 63. 1933-1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles showing the west portion of the study area

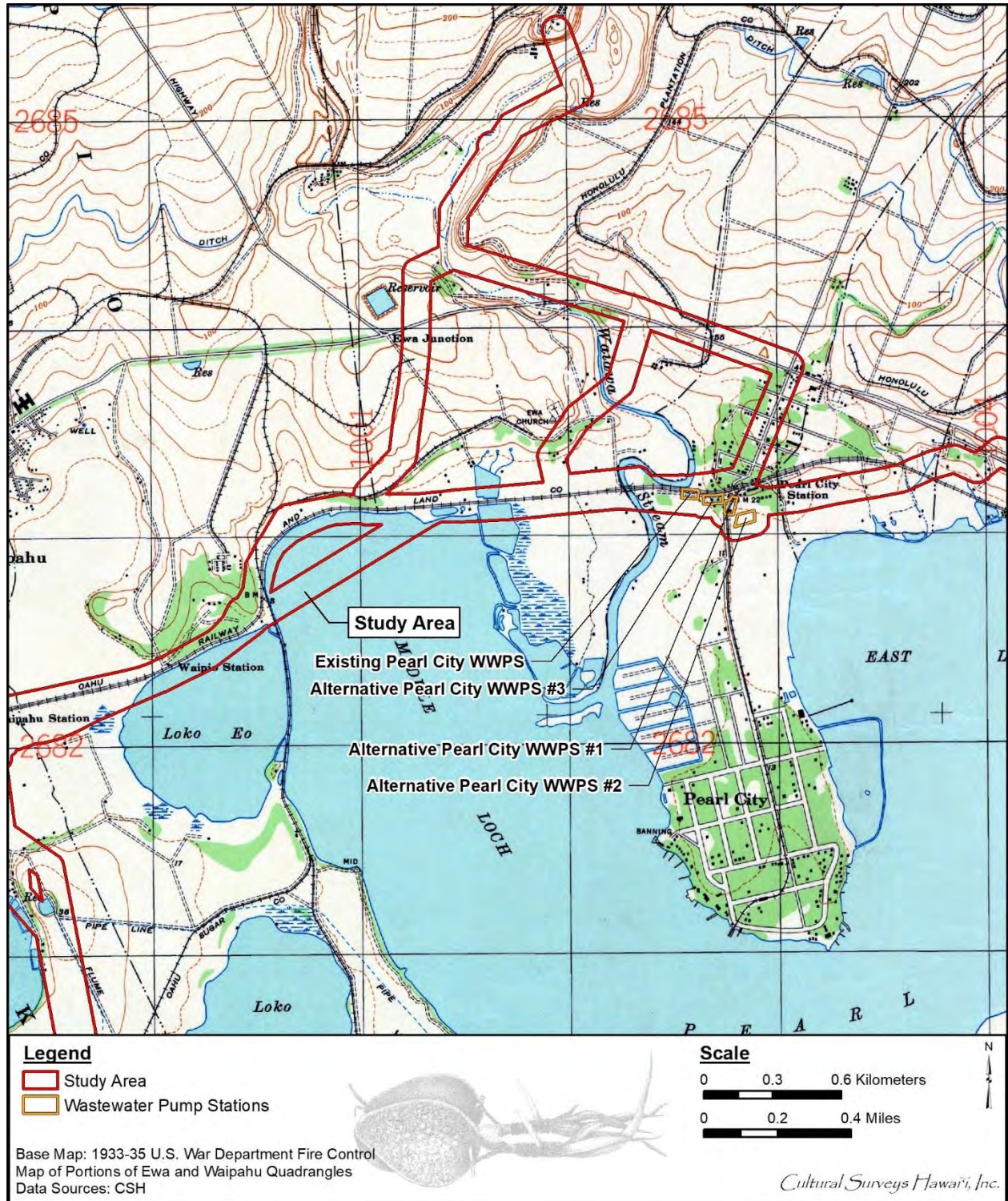


Figure 64. 1933-1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles showing the central portion of the study area



Figure 65. 1933-1935 U.S. War Department fire control map of portions of Ewa and Waipahu quadrangles showing the east portion of the study area

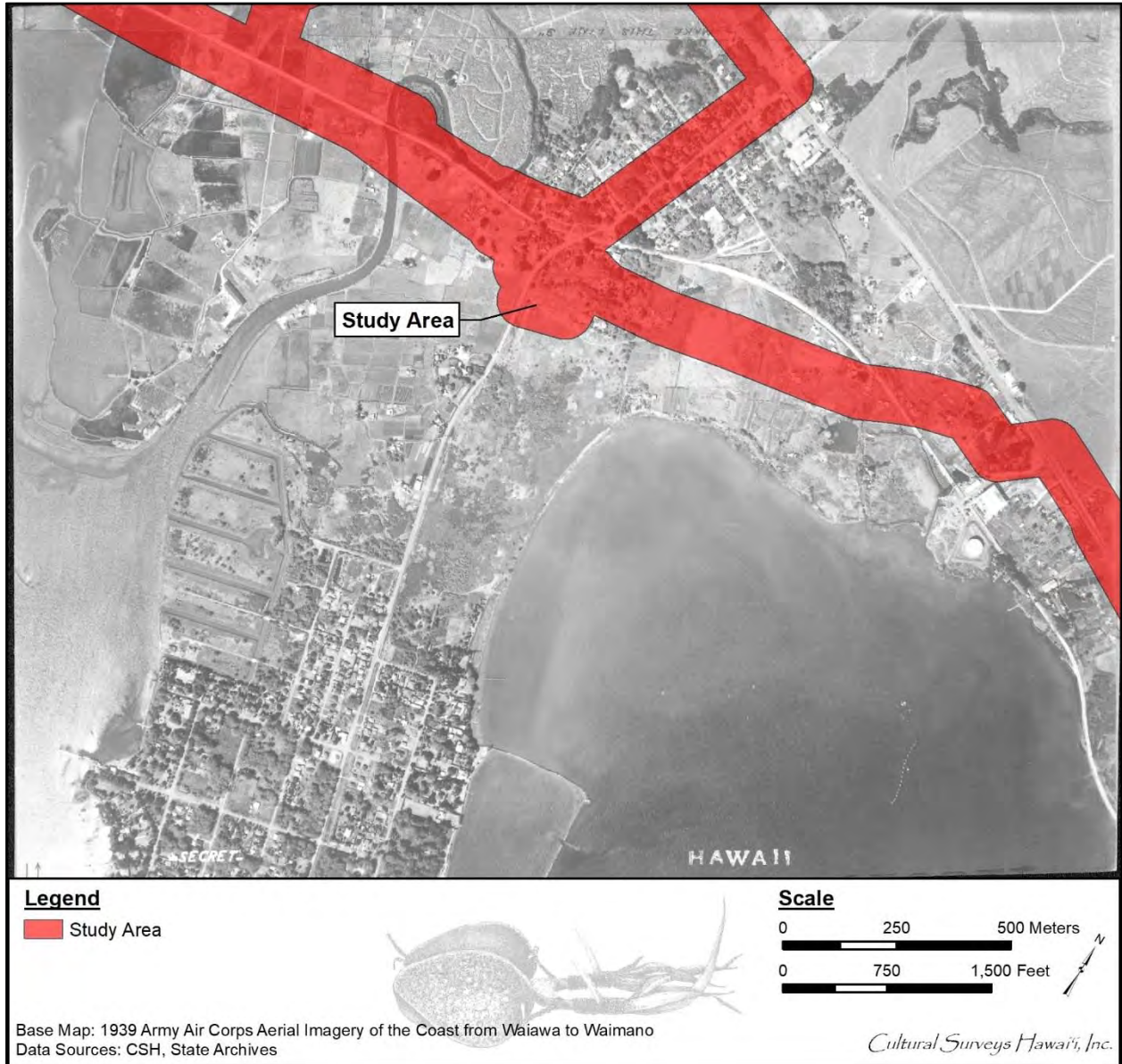


Figure 66. 1939 Army Air Corps Aerial Imagery of the coast from Waiawa to Waimano showing a portion of the central and eastern study area

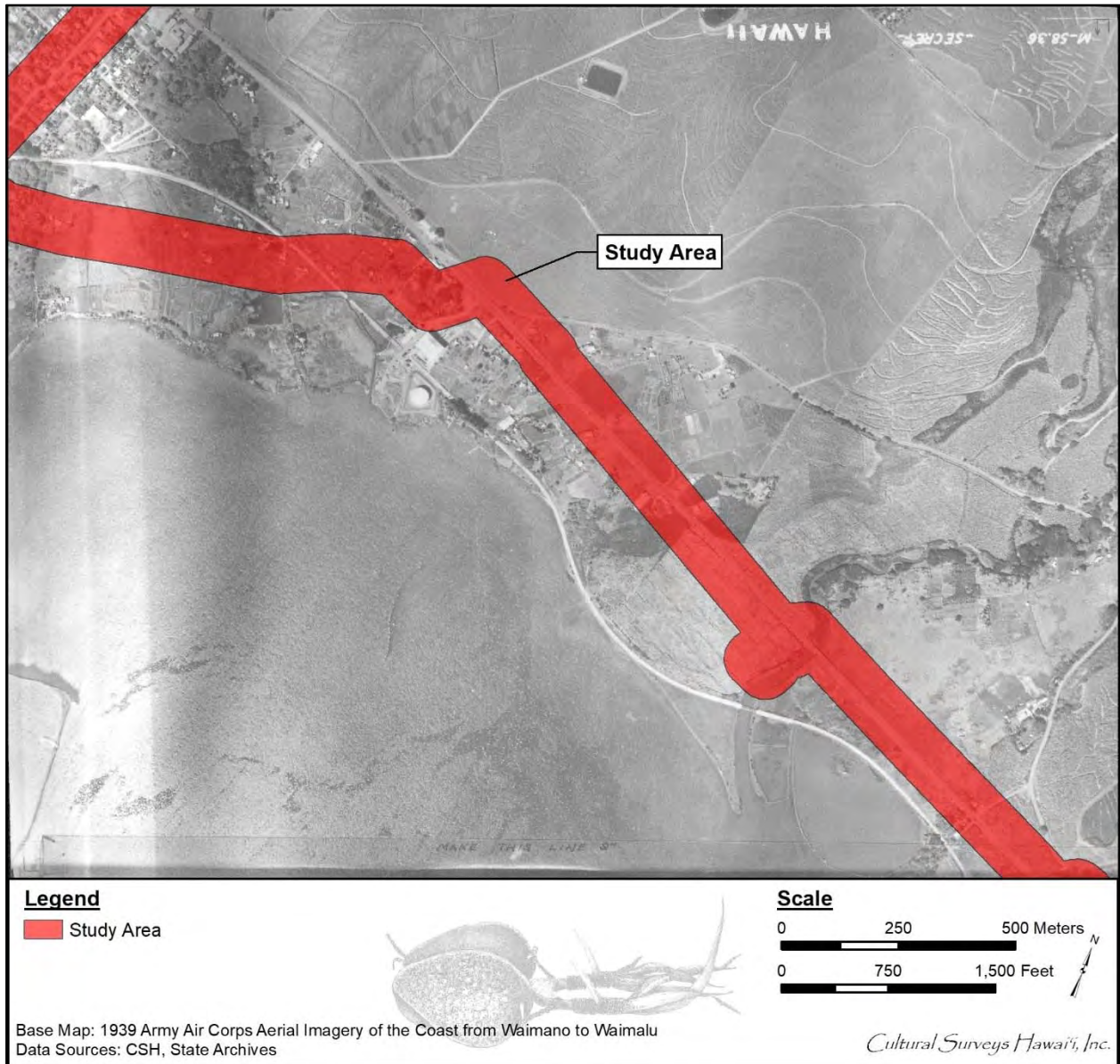


Figure 67. 1939 Army Air Corps Aerial Imagery of the coast from Waimano to Waimalu showing a portion of the central and eastern study area

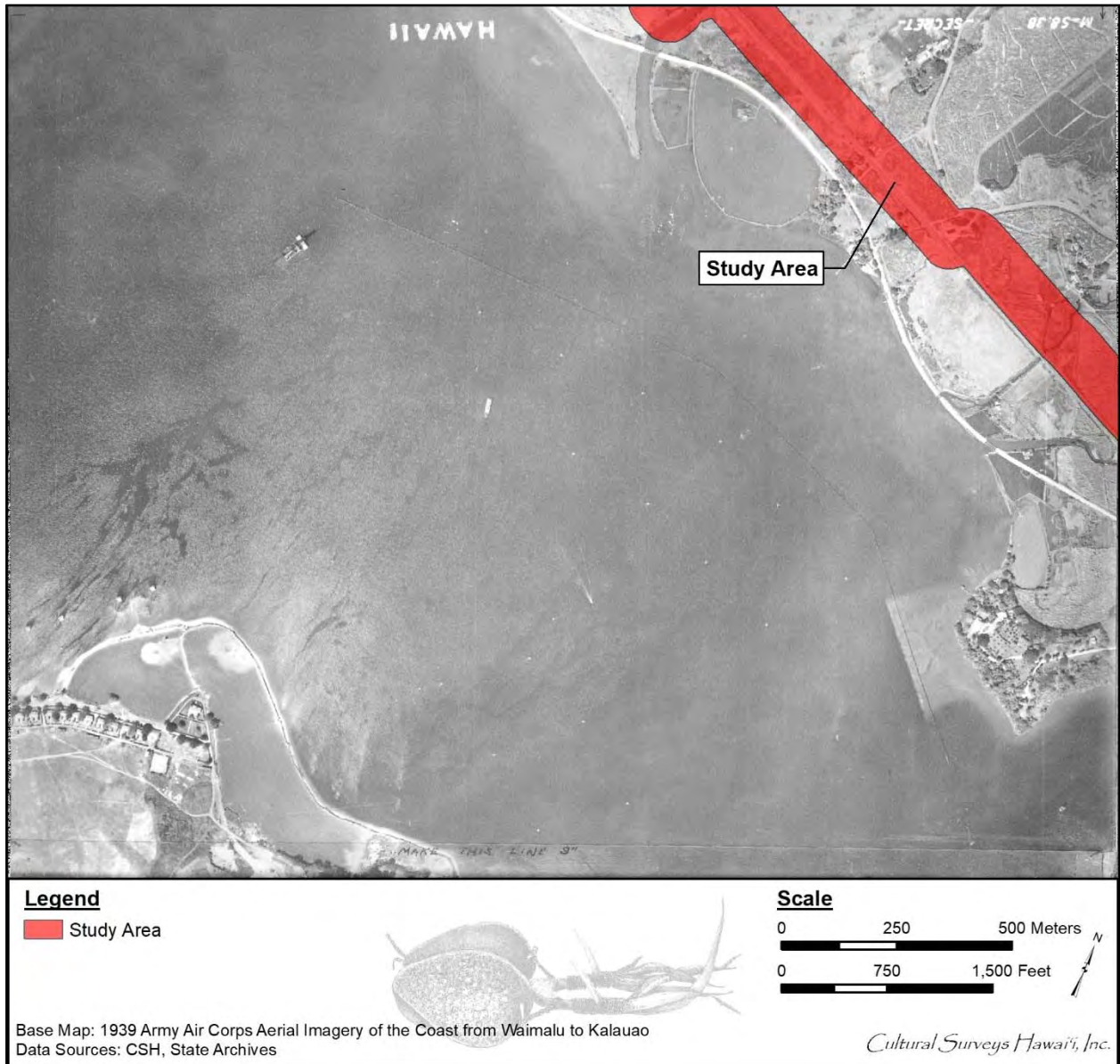


Figure 68. 1939 Army Air Corps Aerial Imagery of the coast from Waimalu to Kalauao showing a portion of the eastern study area

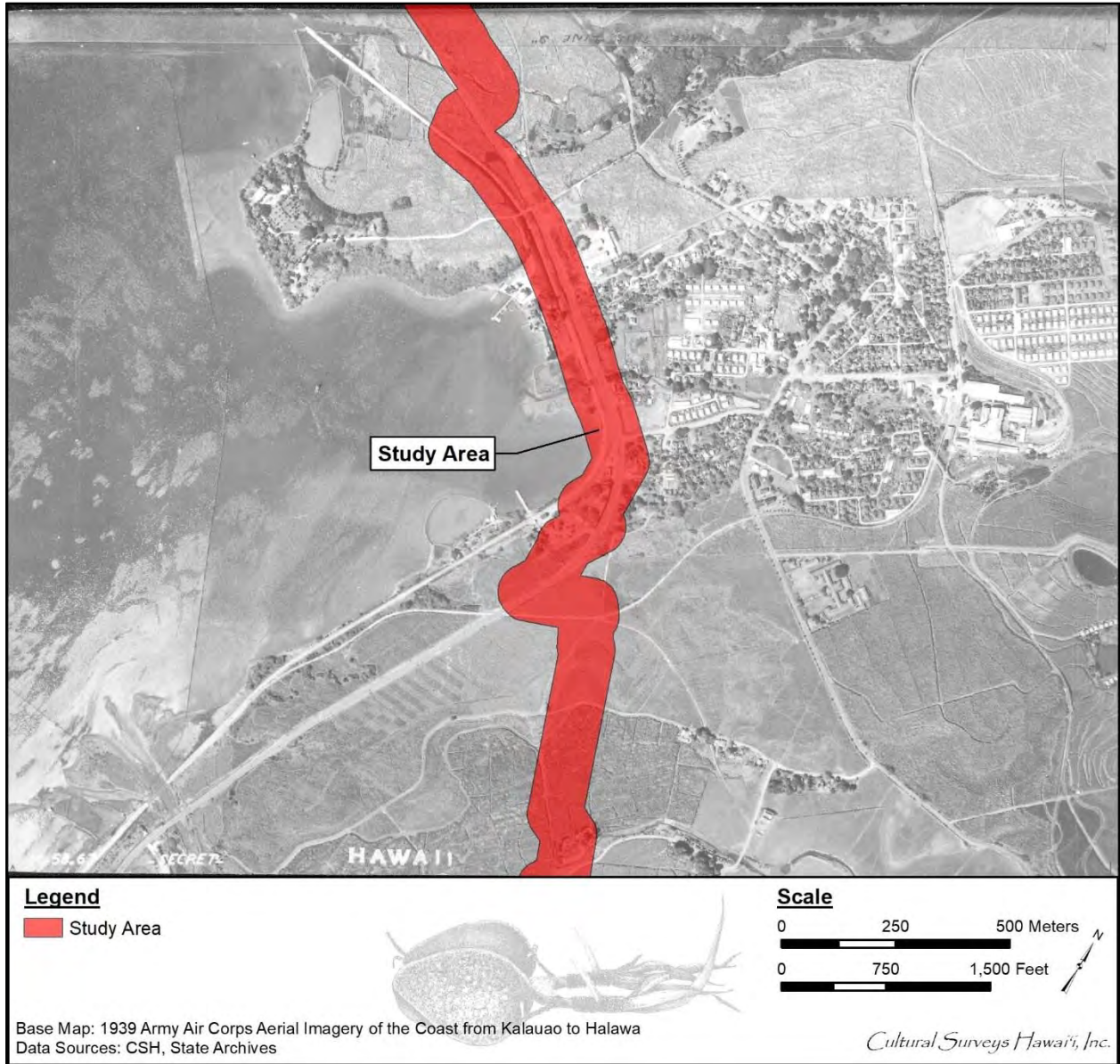


Figure 69. 1939 Army Air Corps Aerial Imagery of the coast from Kalauao to Halawa showing a portion of the eastern study area

portions of the study area in each of these *ahupua'a* (Waiawa, Mānana, Waiiau, Waimalu, Kalauao, 'Aiea, and Hālawa) appear to be in sugarcane cultivation. It appears the land near the Waimalu WWPS/ Blaisdell Park was in sugarcane as was most of the east end of the study area in Hālawa Ahupua'a. A lot of the land in the eastern study area is now in homes and under the new Kamehameha Highway, a lot is in diversified agriculture (truck crops), and a lot is undeveloped.

4.12 World War II and the Military in 'Ewa

By 1941, Pacific Naval Air Bases expenditures for new construction at Pearl Harbor were in the hundreds of millions of dollars transforming Pearl Harbor (Figure 70; the new *mauka* Waihona Street alignment is shown in this map). The Japanese attack on Pearl Harbor, 7 December 1941, damaged or destroyed much of the new construction. Reconstruction was instituted to double the Pearl Harbor's war capacity. Military planners approved a new ammunition depot in the mountainside of Waipahu, a large new hospital in 'Aiea, and thousands of additional changes to the Navy Yard to accommodate the new aircraft carrier task forces (Woodbury 1946:342–343). During World War II, the military used the sugarcane rail system to “haul large quantities of ammunition” (Condé and Best 1973:315).

By 1943, over 24,000 people were working at Pearl Harbor. Navy Housing Areas 1 and 2 and Civilian Housing Area 3 had grown large enough to be considered separate cities. Barracks and temporary housing for workers filled every available piece of land for miles between Pearl Harbor and the outskirts of Honolulu. A ring of huge barrage balloons was set up for the protection of the once-quiet waters of Waimomi, which had since become one of the greatest Navy bases in the world (Downes 1953).

Before the war, the main Pearl Harbor Naval Yard was sufficient for a staging and storage area for the Pacific fleet, but after the Japanese attack and the beginning of World War II, additional areas were needed for supply depots and warehouses. The government procured additional land after the beginning of World War II to expand the functionality of the military bases. The Navy took all of the coastline area in eastern 'Ewa District from the coast inland of the OR&L railroad tracks (Ching 1996:24). Waipi'o Point, Waiawa Gulch, Pearl City (Mānana) Peninsula, Iroquois Point in Hālawa, and small areas in Honouliuli and Hō'ae'ae were taken over as supply depots and storage areas. The OR&L railroad had built a spur from the coast to Wahiawa in 1905, to haul cane and pineapples down to the coast and later to haul men and supplies from Pearl Harbor to Schofield Barracks in Wahiawa through Waikakalaua Gulch in Waikele. During the war, the military built a “secret railroad” from the railroad terminus at Waikakalaua Gulch to join the OR&L railroad coming around Ka'ena Point at Hale'iwa, thus providing a short cut from Pearl Harbor to Army facilities at Kahuku on the north shore of O'ahu (Kneiss 1957:11–12). By 1944, the Navy had claimed close to 2,400 acres of land in the Pearl Harbor and Pearl City areas within Mānana, Waiawa, and Hālawa for use as military staging areas in the war effort (Allen 1999:234).

Four main portions of Waiawa were used by the military—the Pearl City Peninsula *makai* of Kamehameha Highway, a storage area along Waiawa Stream *mauka* of the highway, a diesel drum storage area at Ewa Junction, and a military reservation in upland Waiawa used for communications and training (Allen 1999:234). The military reservation in Waiawa was 650.0 acres consisting of both gulch and plateau lands. From 1941 to 1945, the reservation was used as a training area for tanks and personnel and as an artillery impact area. The area was also used for the storage of munitions and supplies. The primary structure built by the military was a

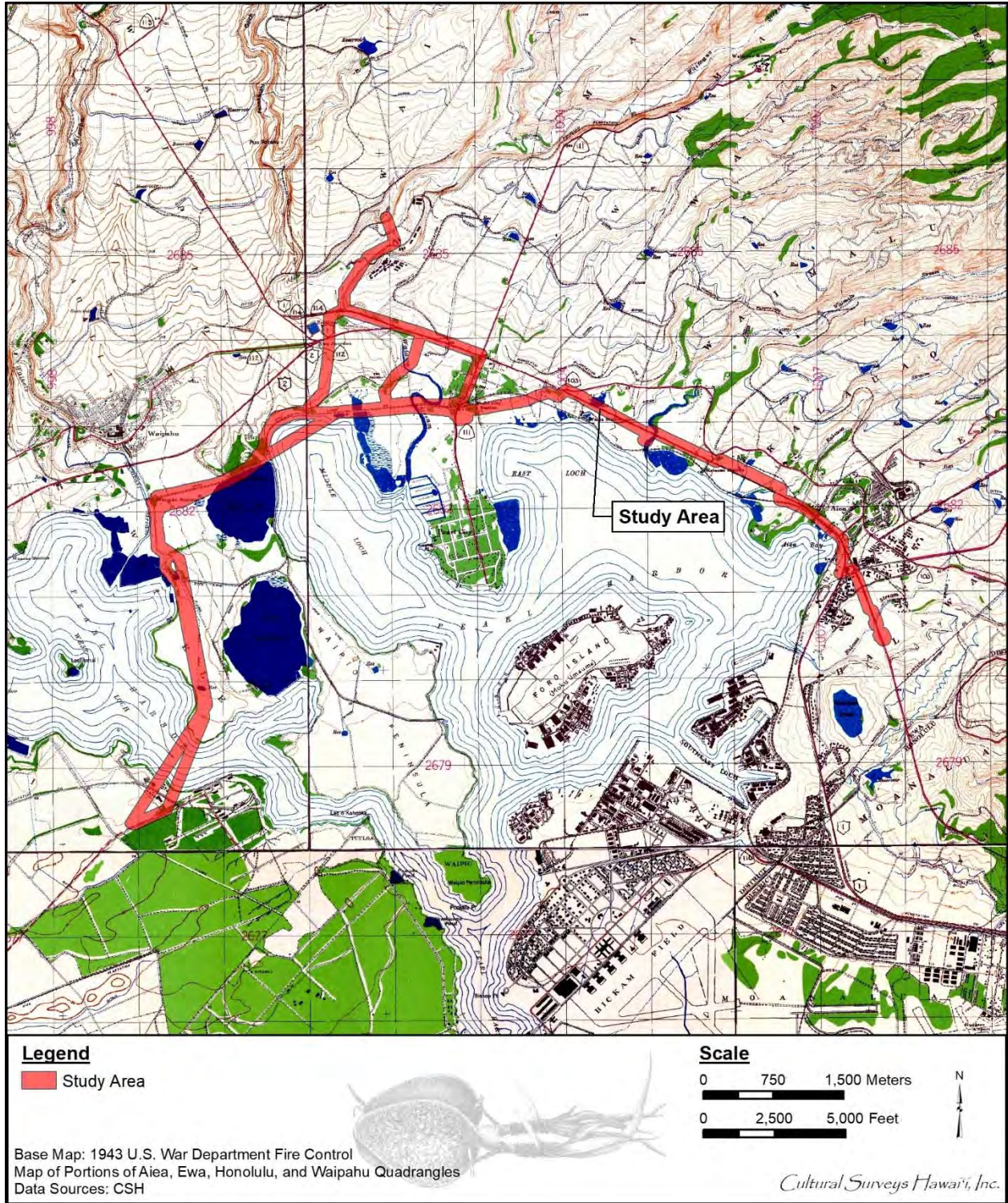


Figure 70. 1943 U.S. War Department fire control map of a portion of of Aiea, Ewa, Honolulu, and Waipahu quadrangles showing the study area

communications center. This center consists of four buildings and a tunnel system. The communications center is currently being used by the State of Hawai'i as a minimum security prison (Waiawa Correctional Facility).

On the Pearl City Peninsula in Mānana, three large warehouses were built for a storage area. Other sections of the peninsula, including the Waiawa portion, were used for supply depot warehouses and spare part distribution centers. One of these was the U.S. Navy Mānana Supply Center, now known as the U.S. Navy Mānana Storage Area. A 25-acre portion of the former Supply Center on the Waiawa side of Mānana Peninsula was set aside in 1972 as a portion of the Pearl Harbor National Wildlife Refuge. This refuge for endangered wetland water birds was set up in the former area of Loko Kuhialoko and Loko Mo'o. A non-contiguous section of the U.S. Navy Mānana Storage Area was located *mauka* of Kamehameha Highway. It began as an aviation supply depot on the border between Waiawa and Mānana. The Navy built 50 wood-frame structures and spaced open storage areas along the banks of Waiawa Stream for 2 miles (Allen 1999:238).

The Ewa Junction Fuel Drumming Facility was built on a 44-acre site in 1943 as a fuel drumming and transportation terminal at the site of the old OR&L railroad junction. Thus, it had railroad lines to the Pearl Harbor Shipyard and Hickam Air Field to the east, to Barbers Point Naval Air Station and other bases in Waianae to the west, and to Schofield Barracks and Wheeler Air Field Base to the north. The facilities consist of two 585,000-gallon fuel storage tanks, a fuel drumming building, and associated piping. The site has been inactive since the 1970s (Allen 1999).

Following World War II, much of the lower lands of Waiawa and Mānana remained part of the Naval Reservation and were used mainly as housing for military families and also sites for military warehousing. To this day, much of the Pearl City Peninsula remains in the custody of the U.S. Navy; however, in the late 1990s, much of the rest of the previous Pearl City regions were released to the state for public use (Allen 1999:239).

A supply depot for fuel drums called the Waiiau Drum Storage was also set up along the coast. This site is actually in Waimalu Ahupua'a. It was built on land the U.S. Navy purchased from the OR&L in 1942, and it was used to clean and store empty fuel drums. Between 1943 and 1963, waste oils were destroyed at the site (Dega and O'Rourke 2003:15). In 1963, the U.S. Navy gave the land to the City and County of Honolulu, which created the Neal Blaisdell Park on the property.

The peninsula on the west side of 'Aiea Bay is used for military housing. It currently consists of 140 single-unit, single-story homes, most of which were built in 1960. Upper 'Aiea, adjacent to the western border of Kalauao, was used as a base for the Aiea Anti-Aircraft Battery during World War II. 'Aiea Heights developed into a residential area in the 1930s, and the former battery area was converted into Nāpuanani Park (Dega and O'Rourke 2003:16).

Developments at Pearl Harbor during World War II were, as a sweeping generalization, focused on southeast East Loch, Ford Island, and the area of the Pearl Harbor entrance—away from the present study area. The most important event near the present study area was the West Loch Disaster of 21 May 1944 when 163 men lost their lives (estimates of deaths vary from 132 to 392), with another 400 injured (Figure 71 and Figure 72). Six Landing Ships, Tank (LSTs, 328 ft long) were destroyed, with two damaged beyond repair, and three Landing Craft Tank (LCTs, 152 ft long), lashed to the decks of sunken LSTs, were also lost, as were a number of Landing Vehicle Tracked (LVTs) parked nearby. Eleven wooden buildings on the shore were destroyed.



Figure 71. Smoke billows from ships at the Waipi'o Peninsula side of West Loch during the disaster of May 1944. The ships had been in the process of being loaded with the tanks in the foreground, which would be used for the retaking of the Mariana Islands during World War II.

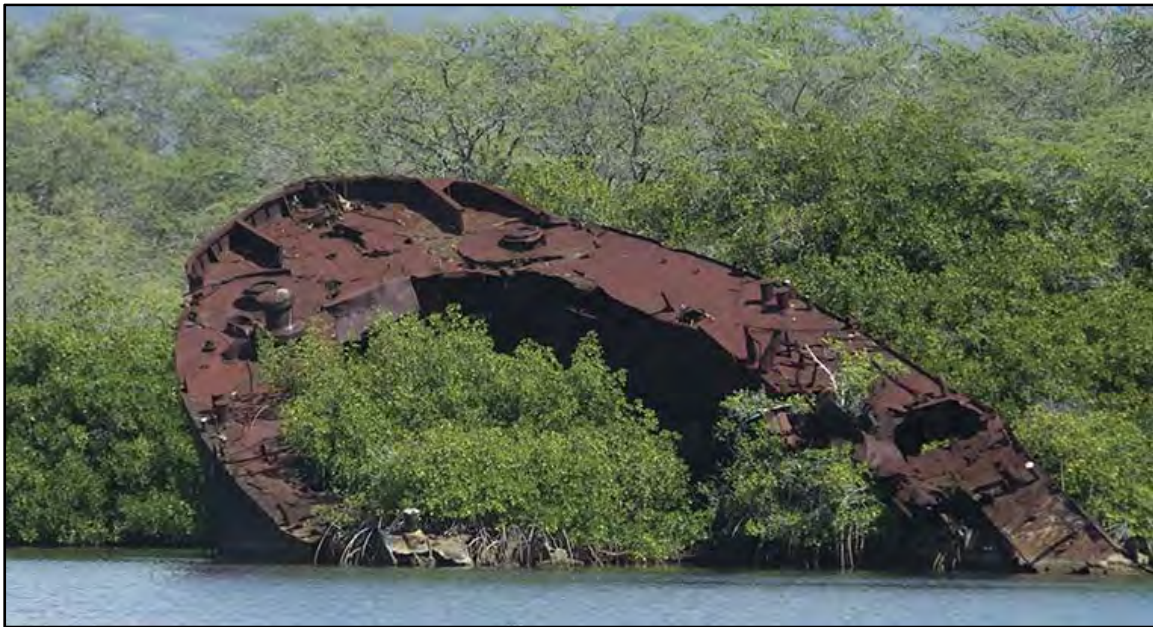


Figure 72. The hull of the partially beached LST-480 was left on Waip'io Peninsula.

This incident occurred in the Waipi'o Peninsula side of West Loch which was a staging area for the invasion fleets of the Pacific. On the morning of 21 May, 29 LSTs readied themselves for the invasion of Saipan by the Allied forces. They were to be a crucial part of Operation Forager, which was the Allied term for the Saipan invasion. A typical LST had 119 men and 200 marines, 80 to 100 drums of high-octane fuel, and its own magazine and fuel capacity of 200,000 gallons.

The disaster began at 3:08 pm, when an explosion happened on the deck of LST-353. The ammunition and fuel stores onboard were ignited. The blast originated near the bow of the LST-963, which was unloading mortar ammunition from the ship. These explosions also affected other ships berthed close nearby, igniting more explosions from the onboard ammunition. Firefighters could not reach the ships due to the high explosives and flames. Many members of the crews attempted to put out the flames but were unsuccessful. Other ships and the rescue boats suffered extreme damage from the explosions.

Eleven wooden buildings were destroyed and 20 more onshore buildings were severely damaged by the explosions that continued for 24 hours. The cause of this disaster is unknown to this day. The Navy undertook an inquiry almost immediately but issued no court-martials or reprimands. The affair was kept secret until 1960 and the relatives of dead crewmen were only informed that they were "missing." Two major reasons are generally given for the cause of the explosions: either gasoline vapor or one or more mortar shells exploded while being handled.

The sailors effected were disproportionately African American. Particularly hard hit by the disaster was the 29th Chemical Decontamination Unit. Often asked to do hard or perilous tasks that other sailors did not want to do, the Unit was called to transfer ammunition on the LST-353. In a commemorative statement, the speaker claimed they were not properly trained on how to handle the mortar munitions and may have mishandled them due to Navy racism and lack of preparation.

Though the affair was classified top secret, the Navy did make recommendations in the wake of the disaster. It was recommended that they discontinue the policy of nesting ships close together to avoid explosions spreading. This was rejected by Admiral Chester Nimitz, who believed that nesting ships was the only option due to the lack of space. A later disaster in a different port caused permanent Navy changes regarding the handling of mortar shells and properly training Navy personnel.

The West Loch Disaster is understood to have been centered approximately 500 m east of where the project area crosses West Loch. Unexploded ordinance was almost certainly widely scattered in this disaster and may be present in the study area.

4.13 Development of the Study Area as Reflected in Late Twentieth Century Maps

The 1951 map of U.S. Naval Ammunition Depot, West Loch Branch (Figure 73) shows the extensive munitions storage area at the southwest end of the study area (in Honouliuli, southwest of West Loch). Because of the munitions storage and other military considerations, much of the Honouliuli and Waipi'o Peninsula portions of the project area remain remarkably restricted up to the present day. Thus, for example, the need for special access, a special photograph permit, and Navy review of all photographs prior to release for these areas in the present study.

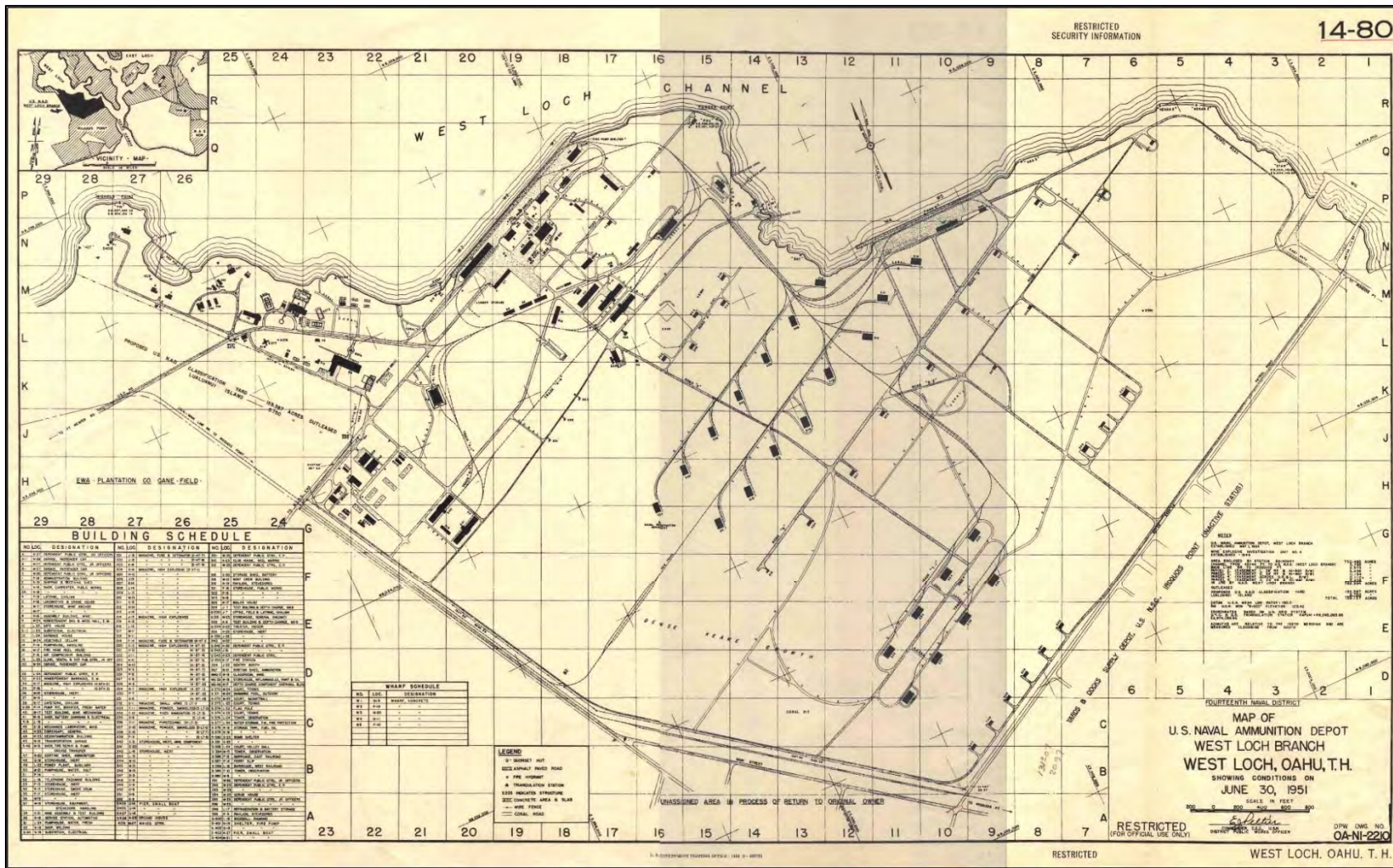


Figure 73. 1951 map of U.S. Naval Ammunition Depot, West Loch Branch, T.H. showing the area at the southwest end of the study area (in Honouliuli, southwest of West Loch)

A series of 1952 USGS high resolution aerial photos (Figure 74 through Figure 76) provide a good picture of the central and eastern portions of the study area at that time. The area north of Middle Loch and north of the Pearl City peninsula (see Figure 74) remains rather agrarian with the exception of Dillingham's Pearl City development in the vicinity of Lehua Avenue and a massive warehouse complex *mauka* of Kamehameha Highway in Waiawa and Mānana *ahupua'a*. The study area in Waiau Ahupua'a has become quite built up on both sides of Kamehameha Highway but the Waimalu and Kalauao lands to the east are relatively undeveloped (see Figure 75). 'Aiea town is remarkably developed (see Figure 75 and Figure 76) but the Hālawa end of the study area is largely in sugarcane fields (see Figure 76).

A 1953/1954 U.S. Army Mapping Service topographic map, Puuloa (1953), Waipahu (1954) quadrangles (Figure 77) includes close-ups of the western, central, and eastern portions of the study area (Figure 78, Figure 79, and Figure 80). The complexities of the Naval Ammunition Depot (as shown on Figure 67) on the Honouliuli west end of the study area are apparent (see Figure 78). Waipi'o Peninsula is now called out as a "Naval Reservation." The peninsula remains relatively undeveloped except for the vicinity of a bifurcation of study area corridors where approximately 18 structures are shown (see Figure 78). A structure is shown at the Waipahu WWPS. Crossing the north side of Middle Loch there are few buildings but Pearl City to the east is sprawling (see Figure 79). Buildings are indicated at the existing Pearl City WWPS. Further to the east the present day Blaisdell Park and existing Waimalu WWPS are shown as another "Naval Reservation," as is the McGrew Point area (see Figure 80). A couple of houses are indicated at the east end of the project area but this vicinity remains relatively undeveloped (see Figure 80).

A pair of 1962 USDA high resolution aerial photos of Pearl Harbor (Figure 81 and Figure 82) provide a wealth of detail. A large blacked-out area south of the Honouliuli end of the study area and Waipi'o Peninsula south of the study area attest to Navy security concerns (see Figure 81). This is in an odd juxtaposition with the extensive sugarcane fields shown within the vicinity of this portion of the study area. The area north and northeast of Middle Loch remains quite undeveloped. Growth in the Pearl City, Waimalu, and 'Aiea areas has taken off following Statehood (see Figure 82).

The 1968 map series (Figure 83 through Figure 85) and the 1968 aerial photo series (Figure 86 through Figure 88) show the continuing pattern of urban growth. The Honouliuli and Waipi'o Peninsula portions of the study area are still largely in sugarcane fields (see Figure 83 and Figure 86). The area north of Middle Loch is still relatively undeveloped but Leeward Community College is being established in 1968 (see Figure 84 and Figure 87). Hālawa has finally become developed (see Figure 85 and Figure 88).



Figure 74. 1952 USGS Aerial Imagery, Waiawa photo showing the central portion of the study area

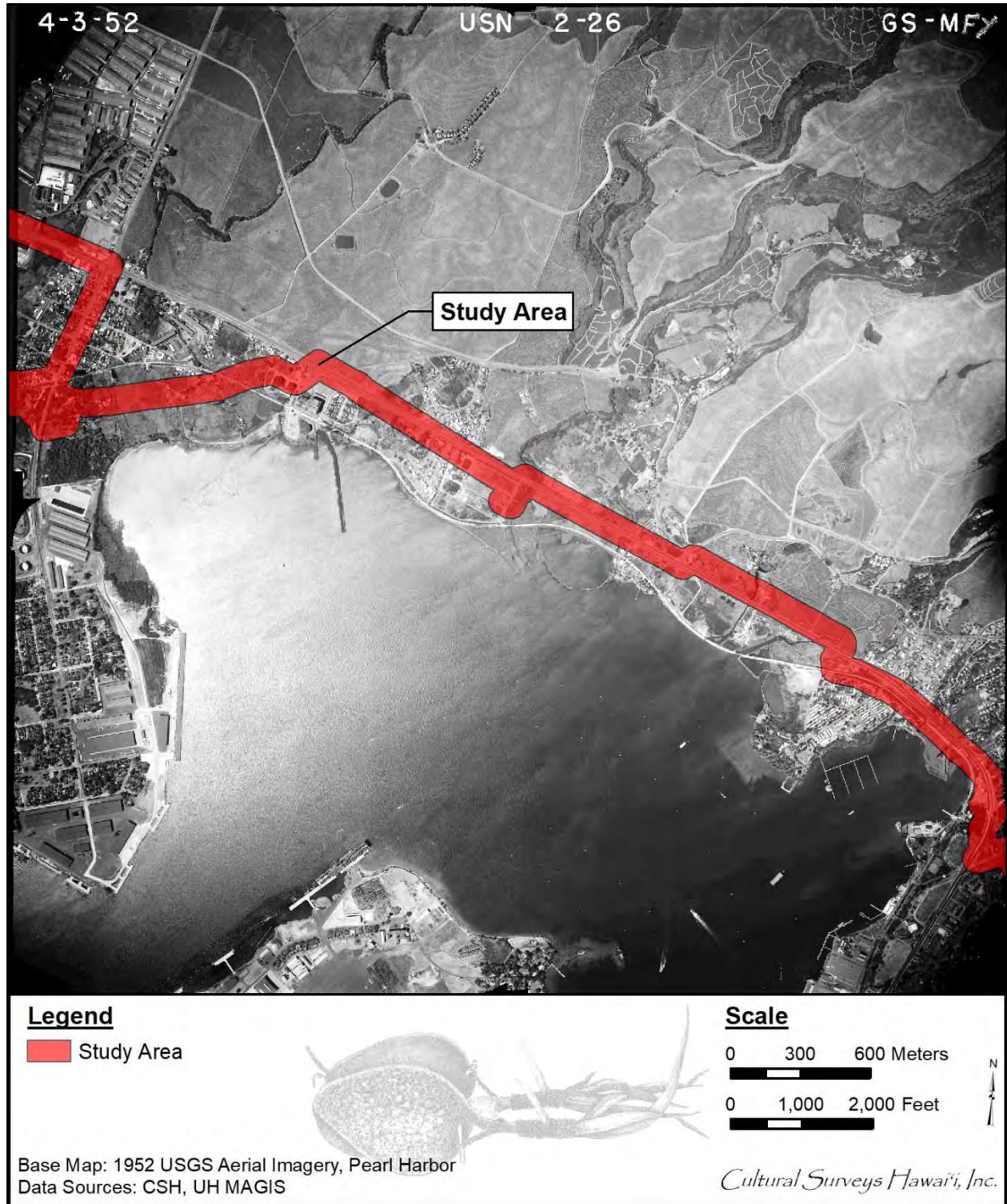


Figure 75. 1952 USGS Aerial Imagery, Pearl Harbor photo showing the east portion of the study area

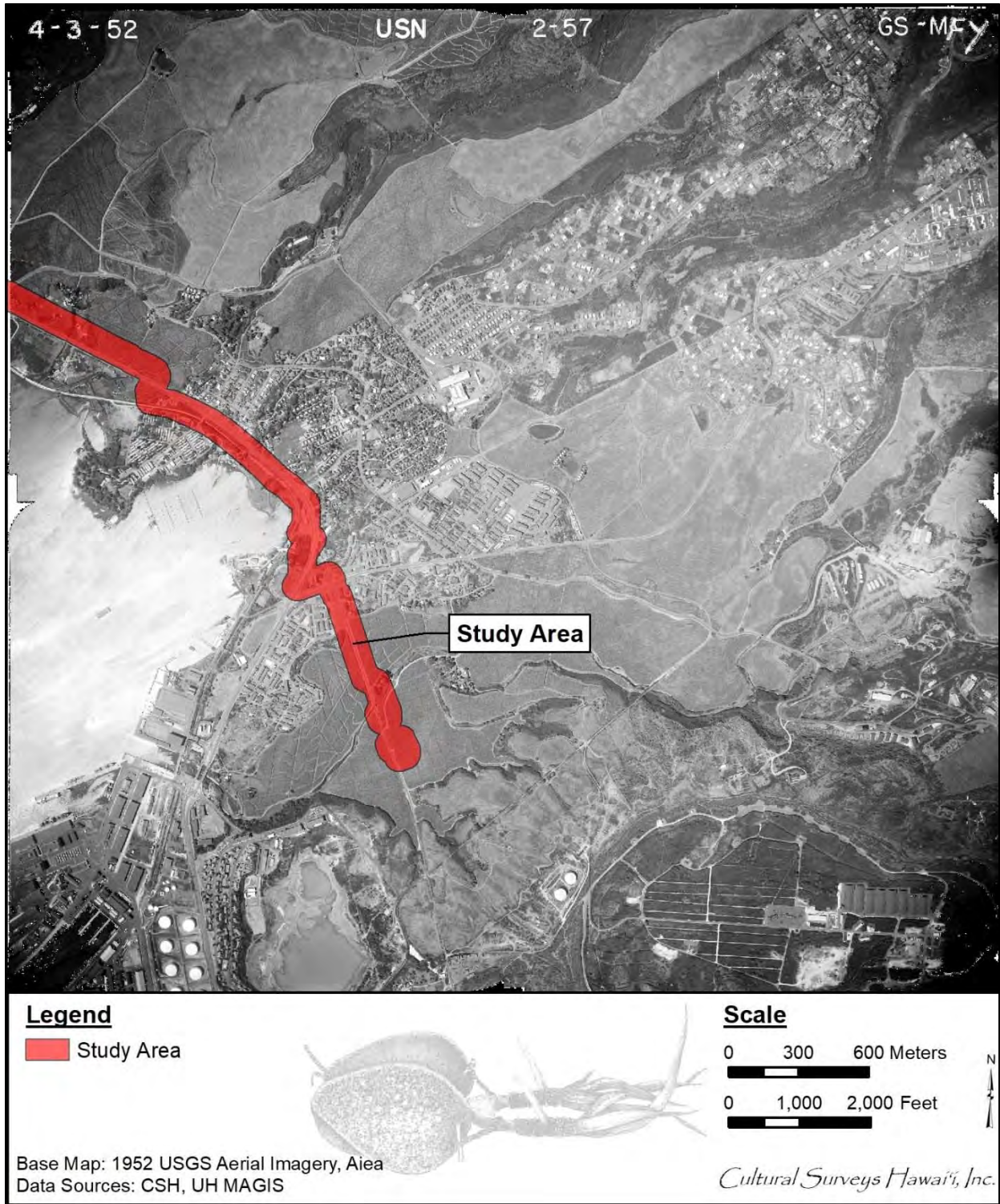


Figure 76. 1952 USGS Aerial Imagery, Aiea photo showing the east end of the study area

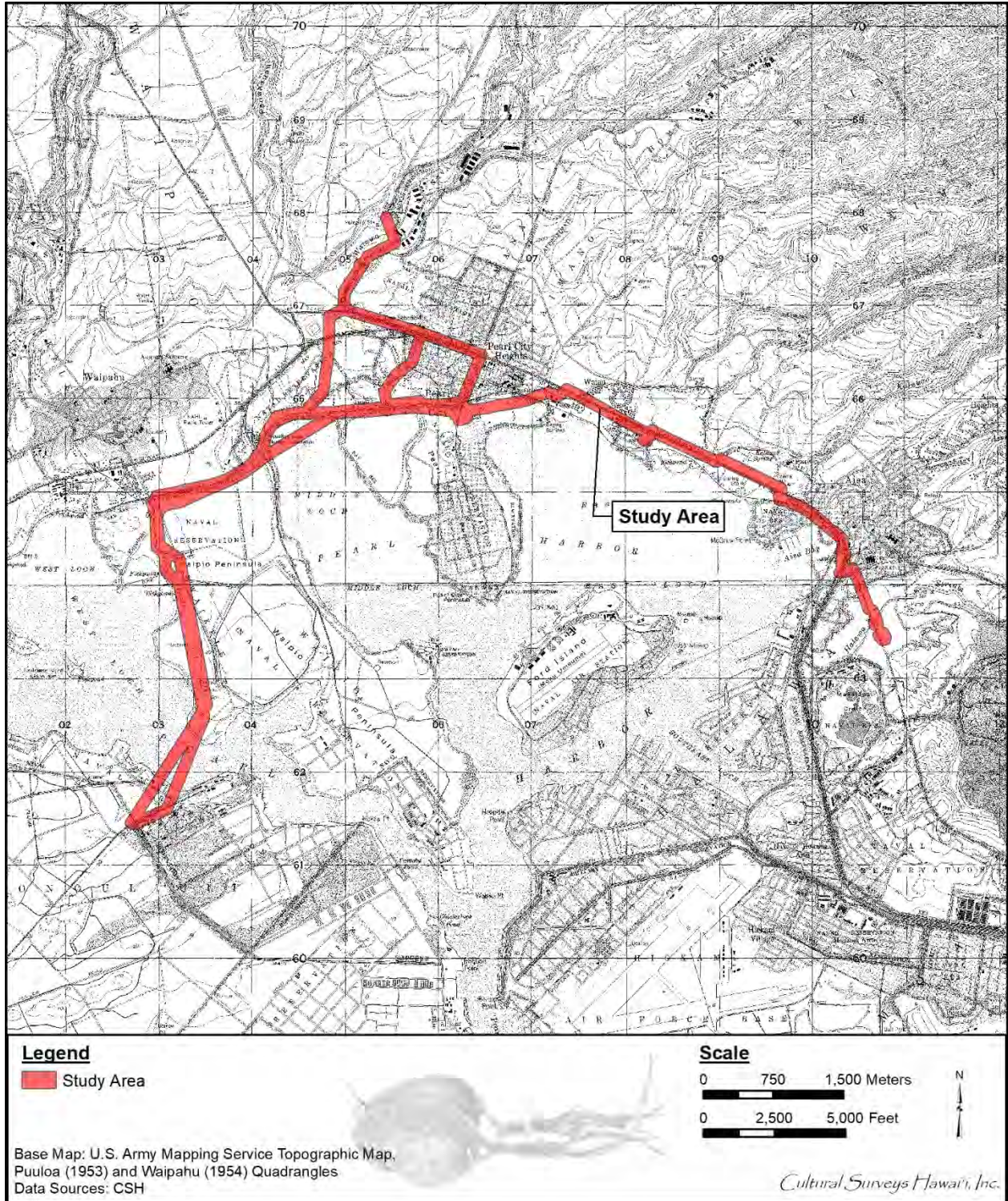


Figure 77. 1953/1954 U.S. Army Mapping Service topographic map Puuloa (1953), Waipahu (1954) quadrangles showing study area

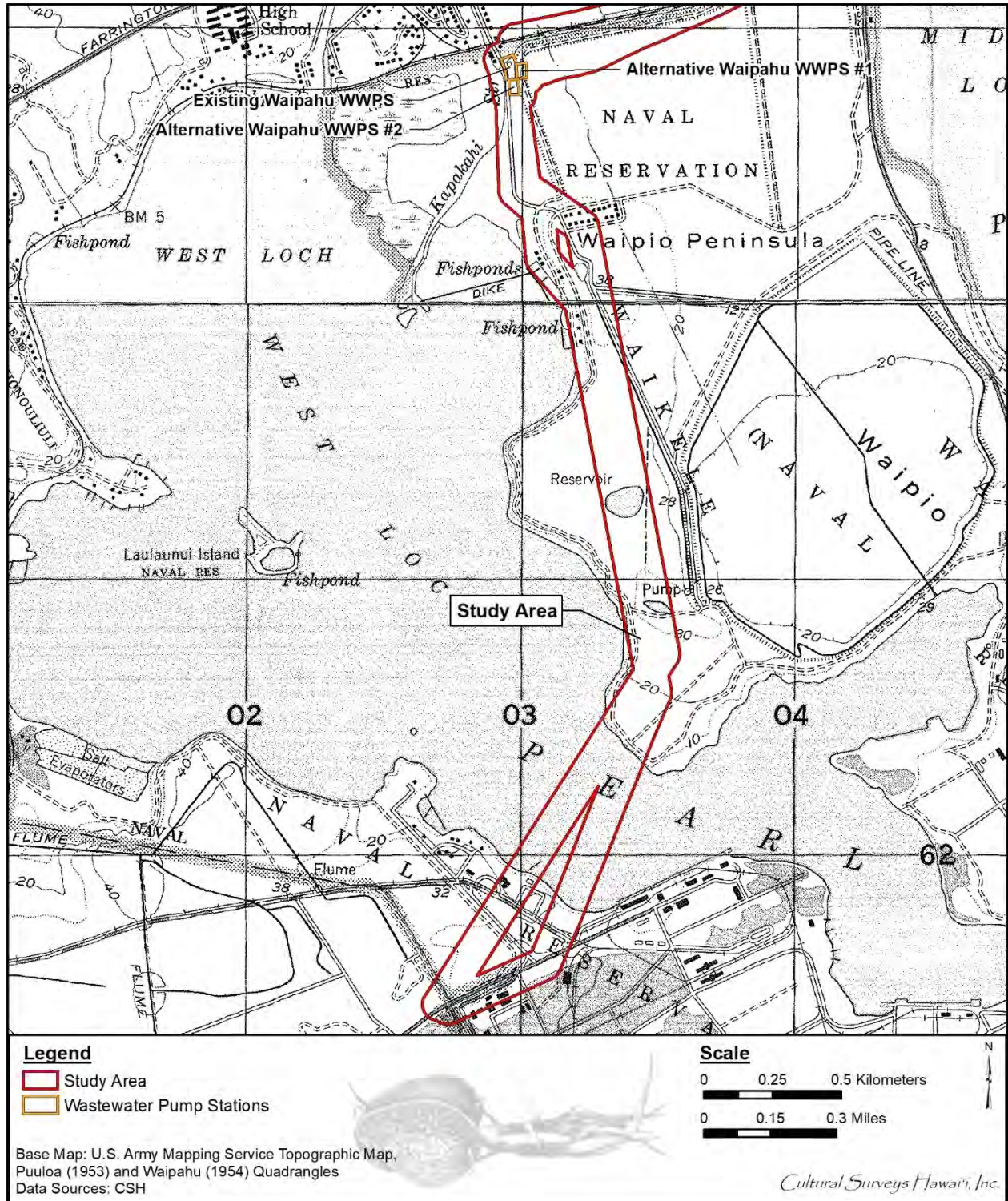


Figure 78. 1953/1954 U.S. Army Mapping Service topographic map Puuloa (1953), Waipahu (1954) quadrangles showing the west portion of the study area

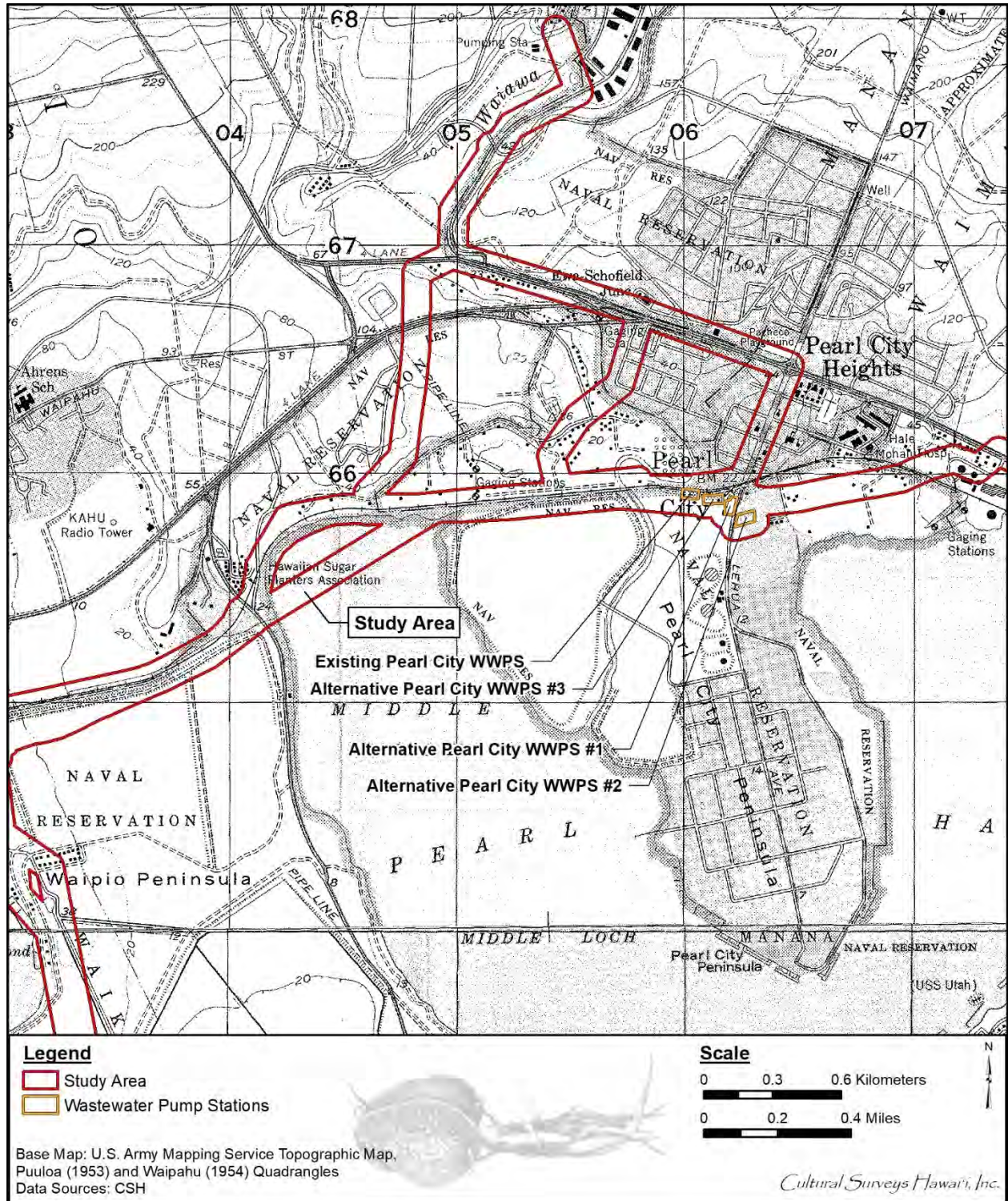


Figure 79. 1953/1954 U.S. Army Mapping Service topographic map Puuloa (1953), Waipahu (1954) quadrangles showing the central portion of the study area

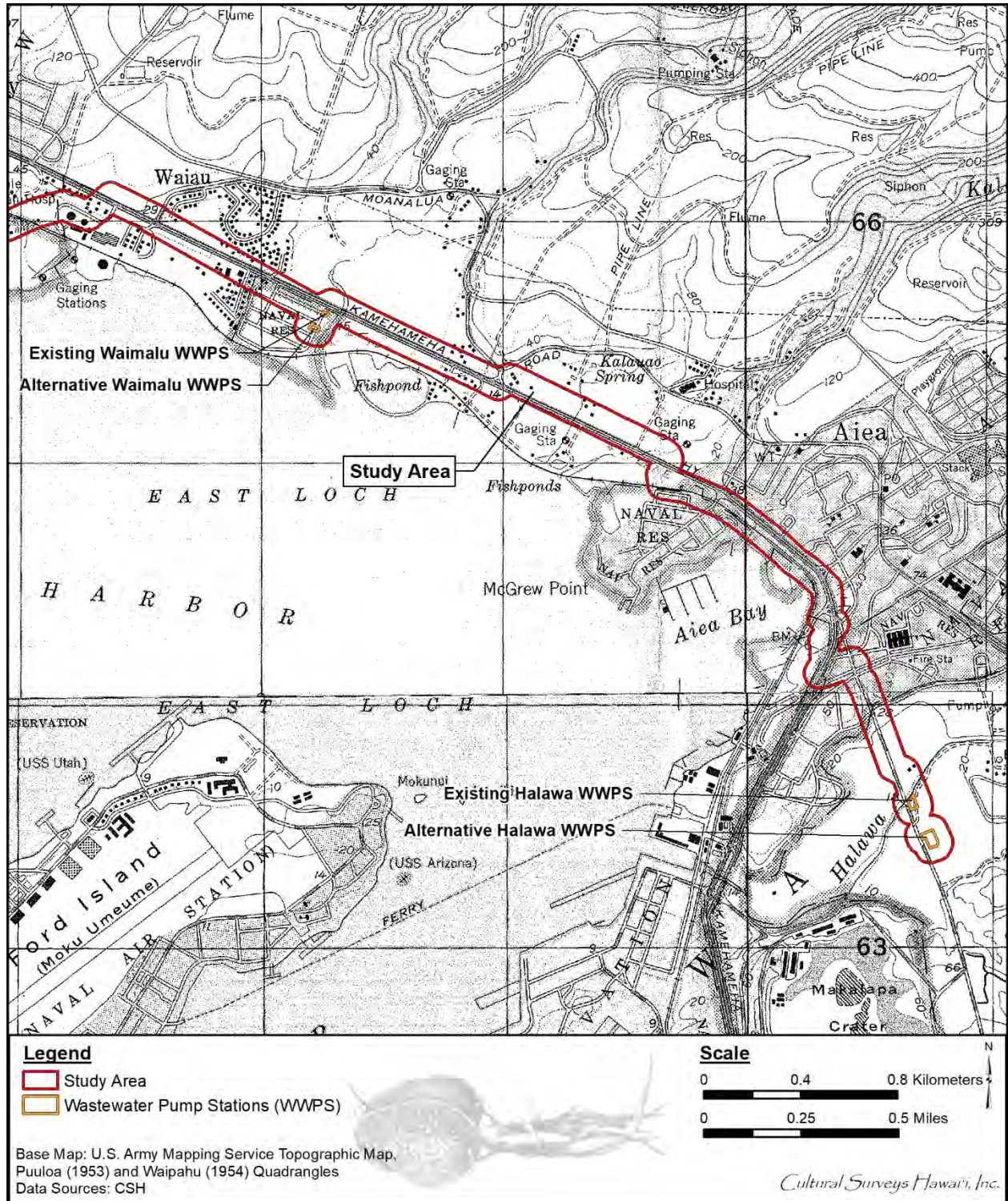


Figure 80. 1953/1954 U.S. Army Mapping Service topographic map Puuloa (1953), Waipahu (1954) quadrangles showing the east portion of the study area



Figure 81. 1962 USDA Aerial Imagery, Pearl Harbor photo showing the western and central portions of the study area

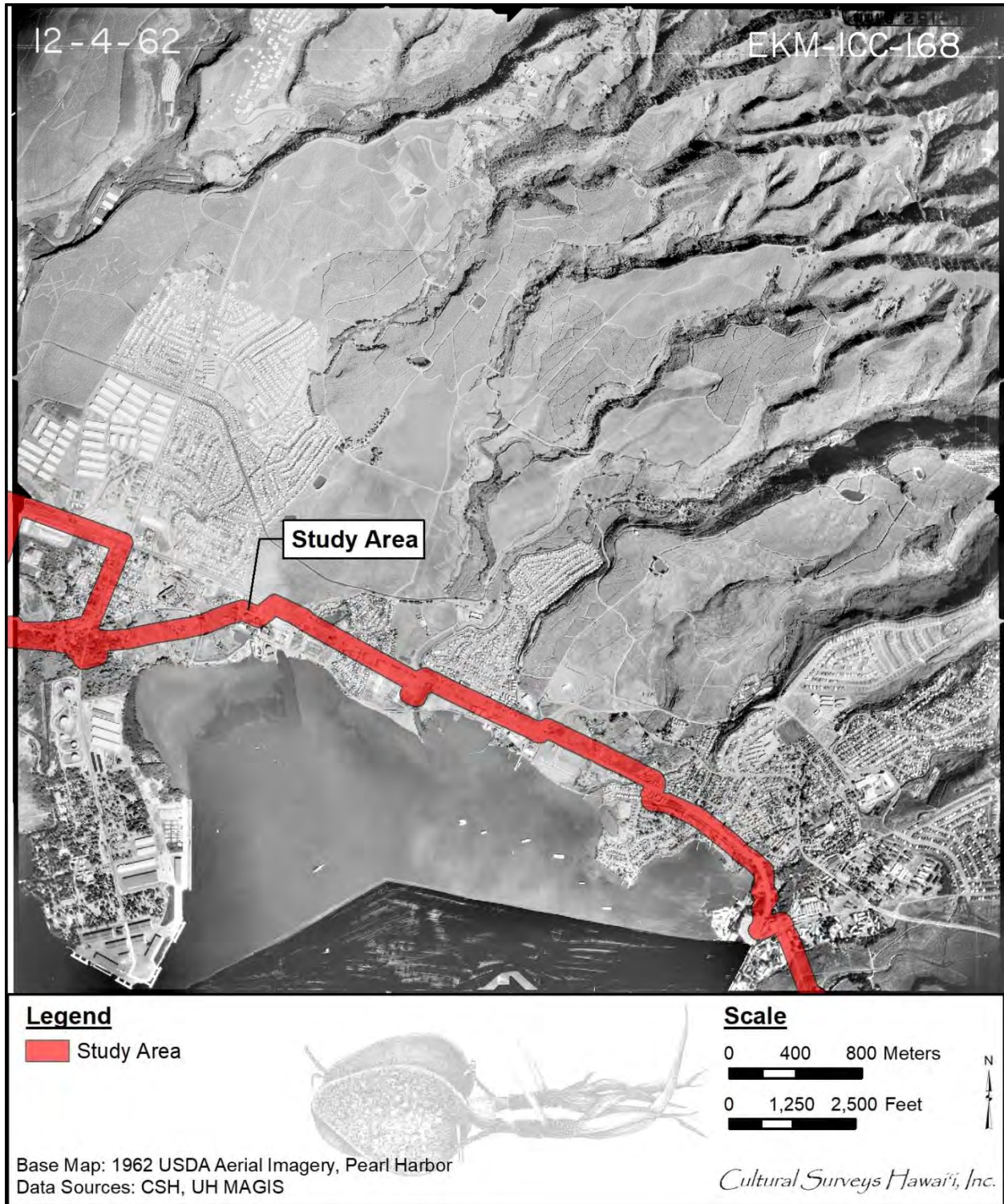


Figure 82. 1962 USDA Aerial Imagery, Pearl Harbor photo showing the central and east portions of the study area

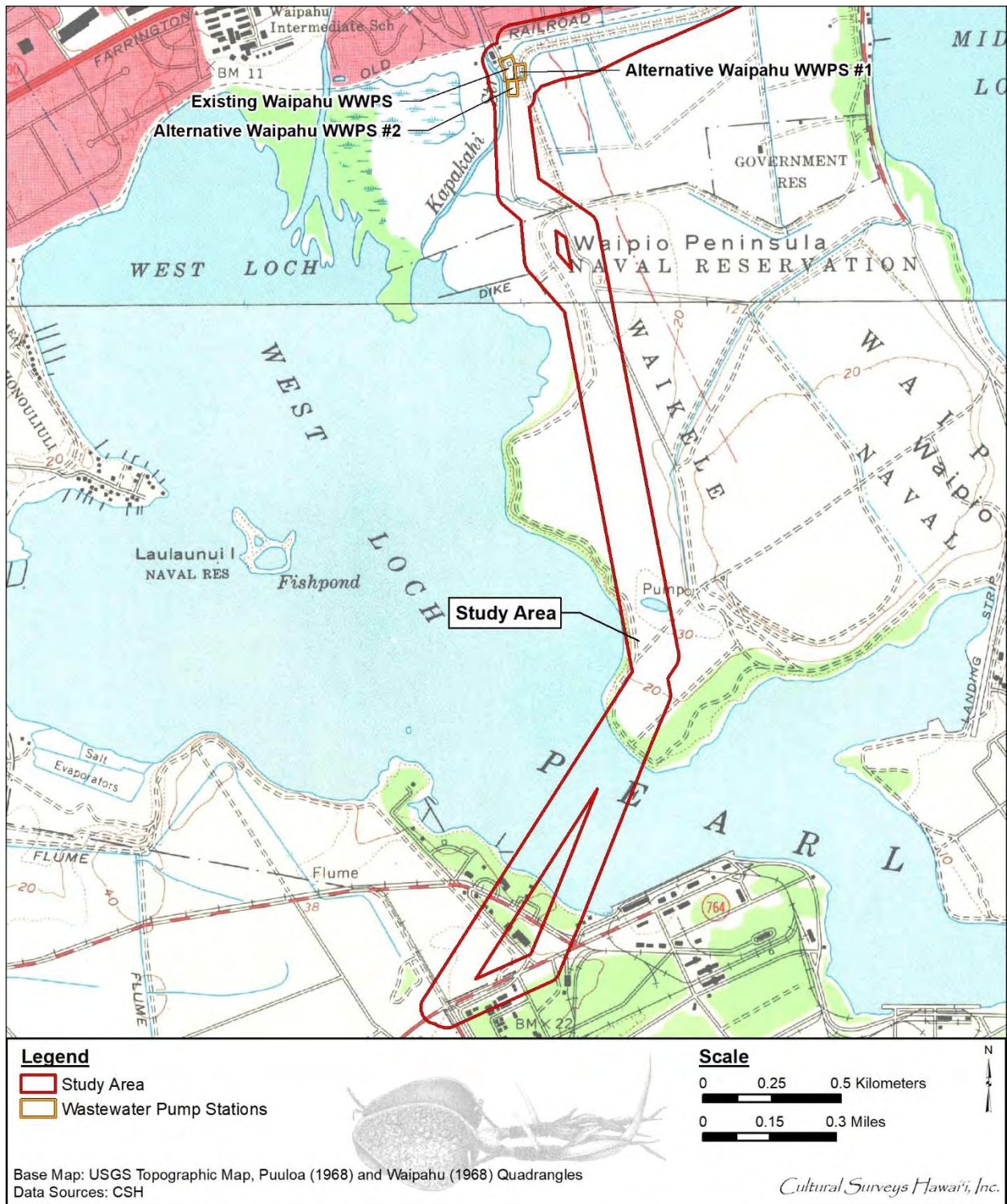


Figure 83. 1968 Puuloa and Waipahu USGS topographic quadrangles showing the west portion of the study area

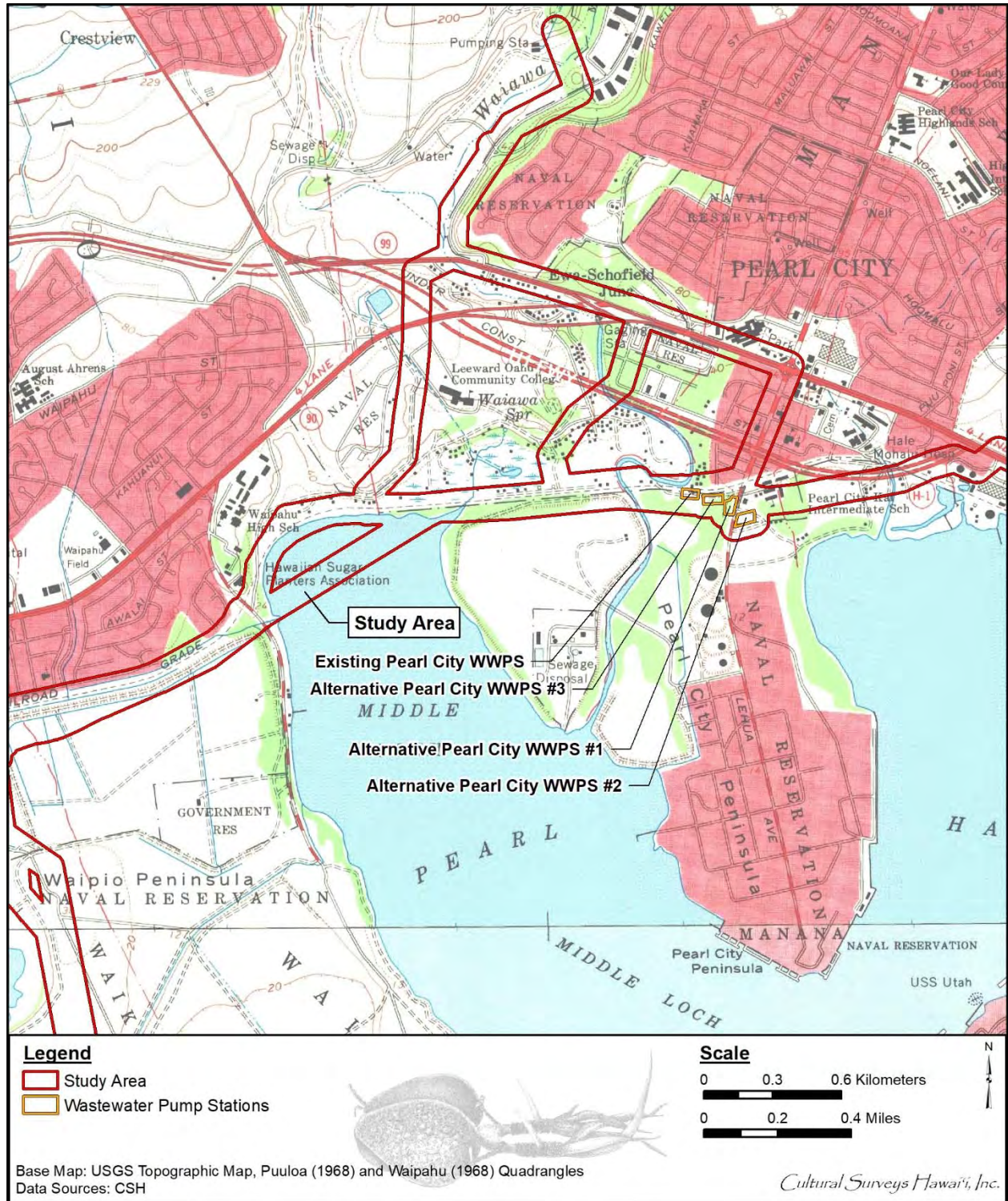


Figure 84. 1968 Puuloa and Waipahu USGS topographic quadrangles showing the central portion of the study area

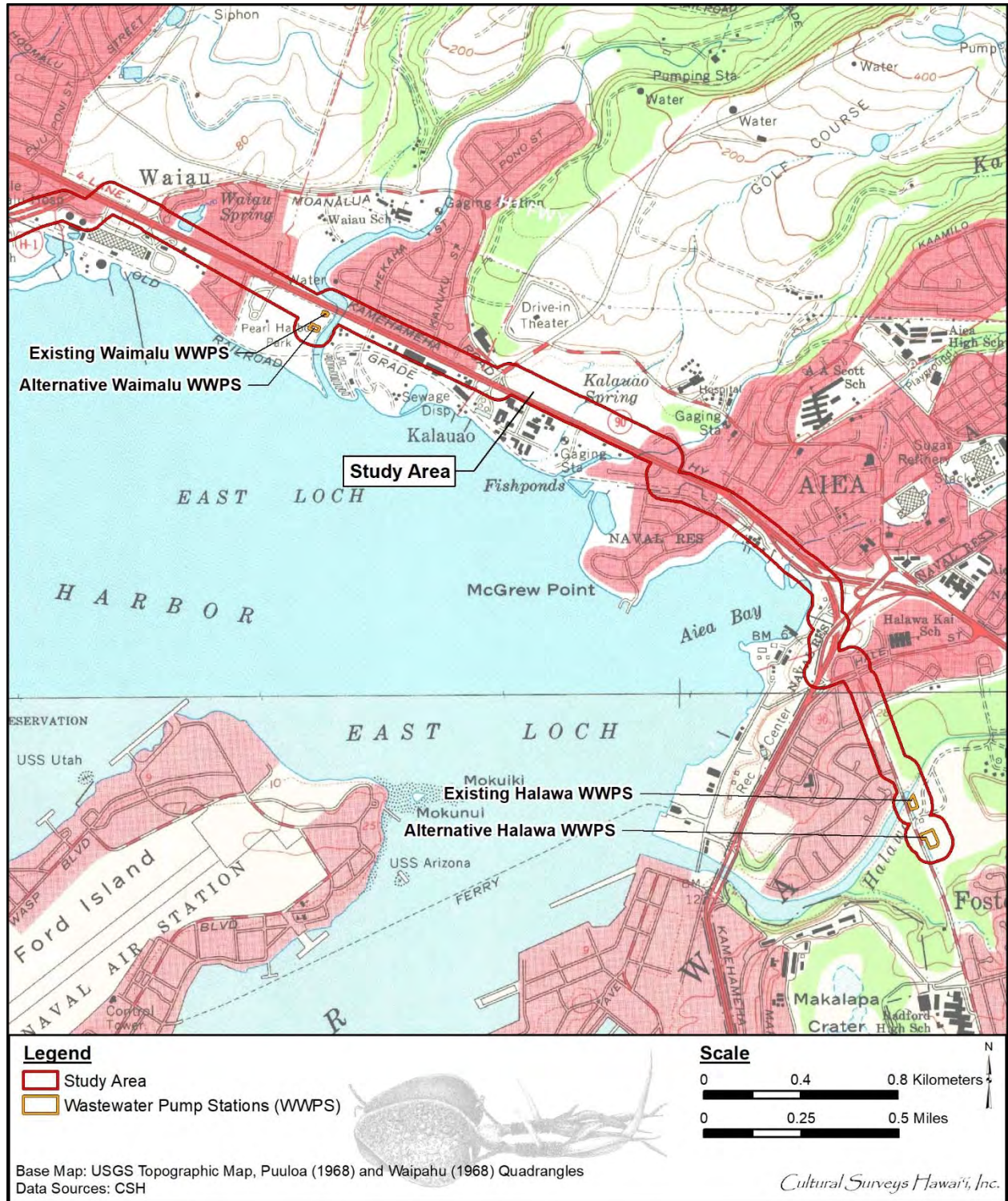


Figure 85. 1968 Puuloa and Waipahu USGS topographic quadrangles showing the east portion of the study area

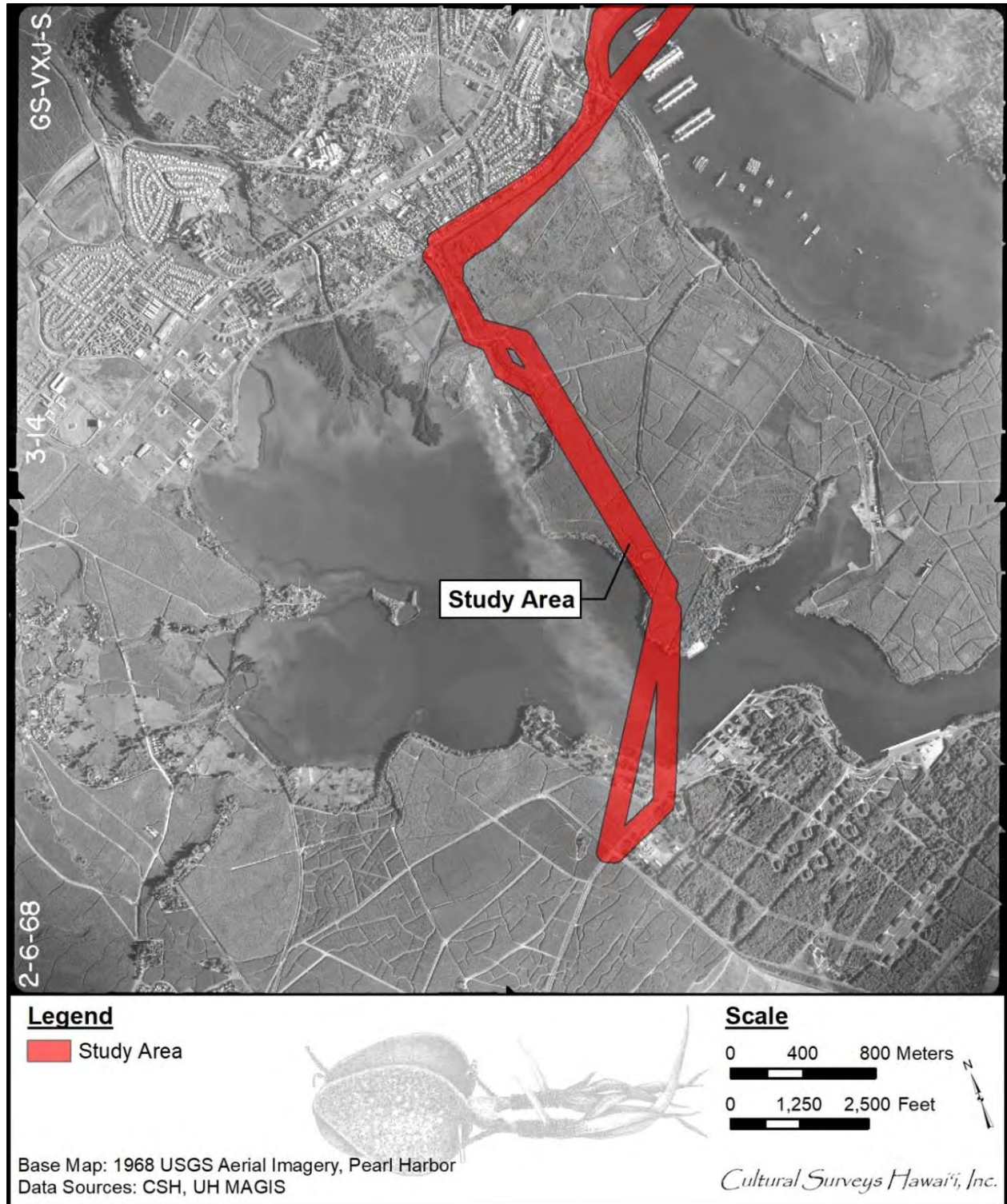


Figure 86. 1968 USGS Aerial Imagery, Pearl Harbor photo showing the west portion of the study area



Figure 87. 1968 USGS Aerial Imagery, Pearl Harbor photo showing the central portion of the study area

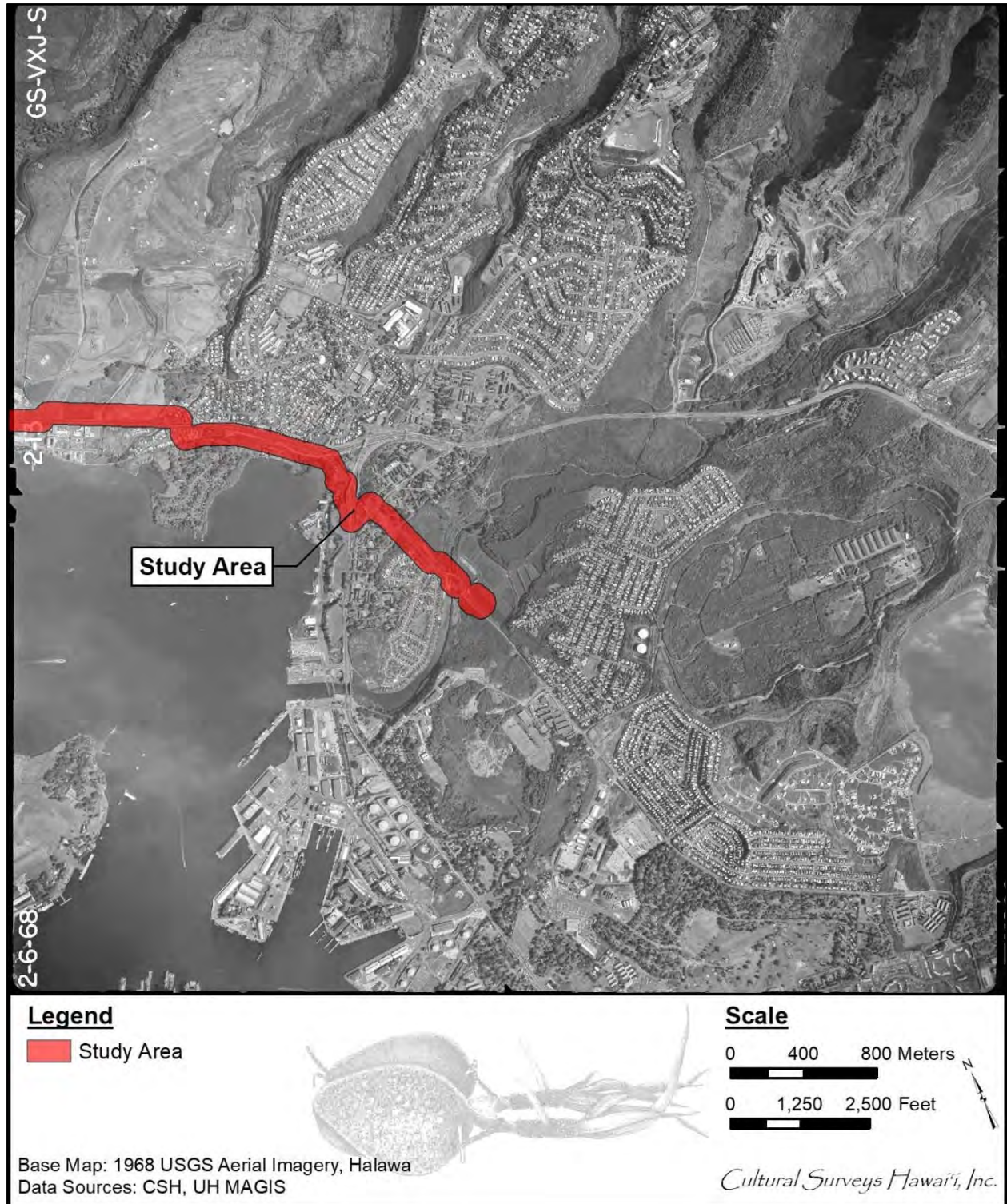


Figure 88. 1968 USGS Aerial Imagery, Pearl Harbor photo showing the east portion of the study area

Section 5 Previous Archaeological Research

5.1 Previous Archaeological Investigations in the Western Portion of the Study area from Honouliuli to Waikele

Much of the land in the vicinity of the Honouliuli to Waikele section of the study area has undergone residential, public, and military development requiring cultural resource management efforts to mitigate the impact of development on archaeological resources. As a result, many archaeological studies have been conducted in the vicinity of, and within, the current study area. These archaeological studies are depicted in Figure 89 and summarized in Table 23. Previous studies include archaeological inventory surveys (AIS), paleo-environmental studies, archaeological assessments (no finds AIS), literature review and field inspections, historic property assessments, and archaeological monitoring programs, all of which are summarized in the text below in chronological order. Archaeological finds documented during these studies include pre- and post-Contact human burials, pre- and post-Contact cultural layers, Hawaiian fishpond (*loko*) deposits, *lo'i* deposits, military infrastructure, and plantation-era agricultural components. In total, 30 archaeological sites have been documented in the Honouliuli to Waikele section of the study area. Most of which have been assigned a SIHP number and some have been listed on the National Register of Historic Places (NRHP); these are indicated on Figure 90 and described in Table 23.

5.1.1 Rosendahl 1987; Dicks et al. 1987; and Wolforth et al. 1998

An archaeological reconnaissance survey (Rosendahl 1987 [phase one] and Dicks et al. 1987 [phase two]) was conducted by Paul H. Rosendahl, Ph.D., Inc., (PHRI) in association with the development of the 232-acre “West Loch Estates” Residential Increments I and II (including golf course and parks) project, in the section of Honouliuli taro lands adjacent to Pearl Harbor and west of the current study area (in the vicinity of at Kapapapūhi Point and West Loch Community Shoreline Park). The project covered portions of the old town of Honouliuli, which was the focus of population in the early historic period (and possibly earlier). This study identified a modern cemetery (SIHP # 50-80-13-03319) with a remnant pre-Contact deposit; two historic sites of minimal integrity with some possible pre-Contact deposits (SIHP #s 50-80-13-03318 and -3320) at Kapapapūhi Point; a significant pre-Contact deposit with trash pits, fire pits, and at least one human burial (SIHP # 50-80-13-03321); a buried fishpond (SIHP # 50-80-13-03322); an historic fishpond (SIHP # 50-80-13-03323) built in the 1890s during the construction of the OR&L railroad; and a buried pond field system (SIHP # 50-80-13-03324) (Rosendahl 1987:7, 9). It was noted that some artifacts “indicate the possibility of pre-1900 occupation” (Rosendahl. 1987:8). An unsuccessful effort was also made to confirm McAllister’s Site 139, Kalanamaihihi Ko’a (fishing shrine). The archaeologists found a small boathouse and dock in the shrine’s reported location and concluded it had been destroyed since McAllister’s survey in the 1930s. Furthermore, Dicks et al. (1987) discuss two possible former cemeteries at Hō’ae’ae Point near the proposed West Loch Estates; it was not possible to confirm these during reconnaissance.

Nearly a decade after archaeological reconnaissance, archaeological data recovery was completed by Wolforth et al. (1998). Radiocarbon dates from this study resulted in the conclusion that the agricultural use of the Honouliuli Stream floodplain for pond-field cultivation of taro may have begun in the lower valley segment as early as AD 1000, while cultivation of the upper valley

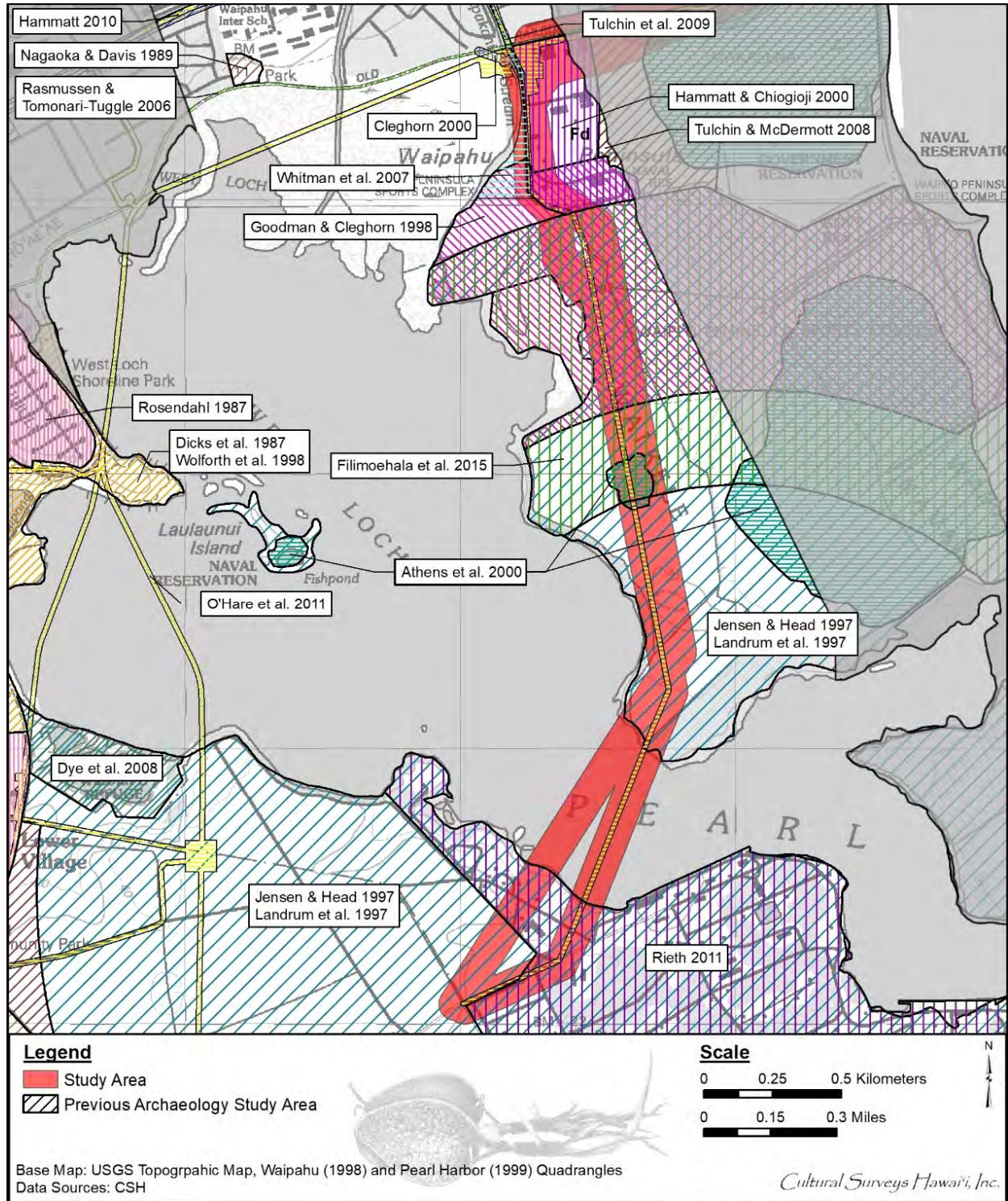


Figure 89. Previous archaeological investigations in vicinity of the western section of the study area from Honouliuli to Waikele Ahupua'a

Table 23. Previous archaeological investigation of the western section of the study area from Honouliuli to Waikele Ahupua'a

Reference	Type of Study	Location	Results
Rosendahl 1987; Dicks et al. 1987; Wolforth et al. 1998	Archaeological reconnaissance survey and archaeological data recovery	West Loch Estates – Residential Increments I and II, Golf Course, and Parks, Honouliuli Ahupua'a (in vicinity of Kapapāhūhi Point and West Loch Community Shoreline Park)	Seven historic properties identified: SIHP #s 50-80-13-3318 and -3320, pre- to post-Contact deposits at Kapapāhūhi Point; SIHP # -3319, a modern cemetery with a remnant pre-Contact deposit; SIHP # -3321, a pre-Contact deposit with trash pits, fire pits, and at least one human burial; SIHP # -3322, a buried fishpond; SIHP # -3323, a historic fishpond; and SIHP # -3324, a buried pond-field system
Nagaoka and Davis 1989	Archaeological reconnaissance survey and archaeological monitoring	Pupu'ole Park area, Waipahu	No historic properties identified; radiocarbon dates from secondary cultural deposit containing charcoal, historic artifacts, and possible shell midden indicate land use in area potentially spanning 500 years
Jensen and Head 1997; Landrum et al. 1997	Archaeological reconnaissance survey; cultural resources overview survey	Naval Magazine (NAVMAG), Lualualei Headquarters Branch (NAVMAG-LLL); West Loch Branch (NAVMAG-West Loch); and Waikele Branch (NAVMAG-Waikele); Honouliuli, Waikele, and Waipi'o Ahupua'a	Identified and evaluated 281 historic properties/features associated with both pre and post-Contact land use including military, agricultural, and traditional components
Goodman and Cleghorn 1998	Archaeological inventory survey (AIS)	Waipi'o Sports Complex, Waipi'o and Waikele Ahupua'a	Two historic properties identified: SIHP # 50-80-13-5597, a sugarcane irrigation complex consisting of two concrete pumping stations and associated irrigation ditches; and SIHP # -9714, a railroad berm remnant and an iron bridge associated with OR&L Right-of-Way (ROW)

Reference	Type of Study	Location	Results
Athens et al. 2000	Paleo-environmental study	Pearl Harbor area	Study identified eight of 21 targeted Hawaiian fishponds and provided insight into future endeavors to construct a chronological framework for fishpond construction using qualitative dating techniques and Bayesian analysis
Cleghorn 2000	Pedestrian inspection	Waipi'o Peninsula Soccer Park, Waipi'o Ahupua'a	One historic property identified: SIHP # 50-80-12-9714, OR&L Right-of-way (ROW)
Hammatt and Chiogioji 2000	Archaeological and cultural assessment	City and County of Honolulu-owned parcel on Waipi'o Peninsula, Waikele Ahupua'a	No historic properties identified; noted thick land fill up to 3 m deep
Rasmussen and Tomonari-Tuggle 2006	Archaeological monitoring	Waiau Fuel Pipeline corridor from HECO Barbers Point Tank Farm to Waiau Generating Station; Honouliuli to Waiau Ahupua'a	No historic properties identified
Whitman et al. 2007	Archaeological literature review, field inspection, and cultural impact evaluation	Waipahu Depot St, south of Farrington Hwy on Waipi'o Peninsula, Waikele Ahupua'a	One historic property identified: SIHP # 50-80-12-9714, OR&L railroad bridge and ROW
Dye et al. 2008	Historic properties assessment	Pearl Harbor National Wildlife Refuge: Waiawa, Honouliuli, and Kalaeloa units; Waiawa and Honouliuli Ahupua'a	No new historic properties identified; assessment focused on previously documented historic properties within refuge units
Tulchin and McDermott 2008	Archaeological literature review and field inspection (LRFI)	Ted Makelena Golf Course at Waipi'o Peninsula; Waipi'o Ahupua'a	No historic properties identified; noted Ted Makelena Golf Course area has been heavily modified for construction of golf course

Reference	Type of Study	Location	Results
Tulchin et al. 2009	AIS	Proposed Koa Ridge Makai Development in Waipi'o <i>mauka</i> to Waipahu Wastewater Pump Station; Waipi'o and Waikele Ahupua'a	One historic property identified: SIHP # -6959, plantation-era irrigation infrastructure including ditches and water control feature
Hammatt 2010	AIS	Western portion of Honolulu High Capacity Transportation Corridor Project (HHCTCP) (extending from Kapolei Station in the west to Pearl Highlands Station in the east); Honouliuli and Waiawa Ahupua'a	One historic property identified: SIHP # -7751, subsurface cultural deposit of <i>lo'i</i> sediments
O'Hare et al. 2011	Archaeological LRFI	Project area roughly aligned with Kamehameha Hwy and Pearl Harbor shoreline until extending into <i>makai</i> portion of Honouliuli; Honouliuli to Hālawa Ahupua'a	No historic properties identified
Rieth 2011	Archaeological relocation survey and subsurface testing	Naval Magazine West Loch; Honouliuli Ahupua'a	Identified 257 historic properties (243 previously identified and 14 newly identified) associated with both pre- and post-Contact land use including military, agricultural, and traditional components
Filimoehala et al. 2015	AIS and paleo-environmental study	Central portion of Waipi'o Peninsula	Three historic properties identified: SIHP # 50-80-13-7796, post-Contact irrigation complex covering 287-acres; SIHP # -7797, a post-Contact boat landing; and SIHP # -125, Hawaiian fishpond Loko Hanaloa

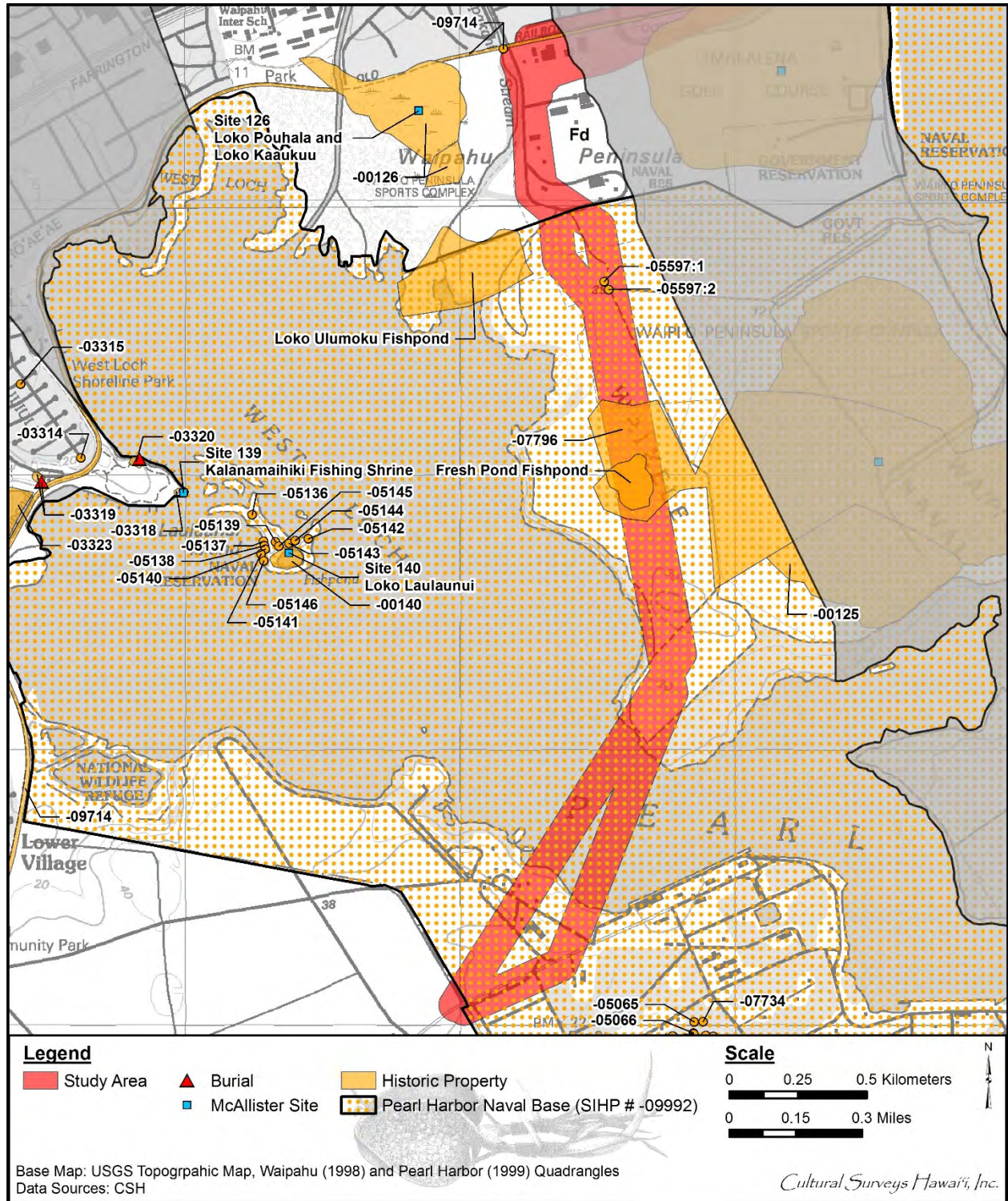


Figure 90. Previously identified historic properties in the vicinity of the western section of the study area from Honouliuli to Waikēle Ahupua'a

Table 24. Previously identified historic properties in the vicinity of the western section of the study area from Honouliuli to Waikele Ahupua'a

SIHP # (50-80-)	Formal Type	Source	Comment
09-00126	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Kaaukuu and Loko Pouhala; formerly adjoined agricultural ponds
12-09714	Railroad	Goodman and Cleghorn 1998, Cleghorn 2000, Whitman et al. 2007	OR&L ROW
13-00125	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Hanaloa; large pond at center of Waipi'o Peninsula built of coral slabs
13-00140	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Lauaunui Small; fishpond with wall
13-03314	Subsurface cultural deposit	Rosendahl 1987	Midden deposit
13-03315	Surface artifact collection	Rosendahl 1987	Post-Contact
13-03318	Subsurface artifact concentration	Rosendahl 1987	Pre- to post-Contact deposits at Kapapahu Point associated with habitation
13-03319	Complex	Dicks et al 1981	Remnant pre-Contact deposit, possible historic church and cemetery site; human burial
13-03320	Subsurface cultural deposit	Dicks et al 1981	Pre- to post-Contact deposits at Kapapahu Point associated with habitation
13-03323	Historic fishpond	Dicks et al 1981	Constructed in 1890s by OR&L
13-05065	Temporary habitation structure	Jensen and Head 1997, Rieth 2011	Circular enclosure (conjoined C- shapes) possibly associated with traditional Hawaiian habitation
13-05066	Platform and mound	Jensen and Head 1997, Rieth 2011	Traditional Hawaiian limestone cobble platform and mound possibly associated with agriculture
13-05136	Military structural remnant	Jensen and Head 1997	Post-Contact concrete slab
13-05137	Military complex	Jensen and Head 1997	Post-Contact complex with concrete slab and wall
13-05138	Military structural remnant	Jensen and Head 1997	Post-Contact concrete slab
13-05139	Military complex	Jensen and Head 1997	Post-Contact complex with concrete slab and gun emplacement

SIHP # (50-80-)	Formal Type	Source	Comment
13-05140	Military structural remnant	Jensen and Head 1997	Post-Contact concrete slab
13-05141	Military structural remnant	Jensen and Head 1997	Post-Contact concrete basement
13-05142	Military structural remnant	Jensen and Head 1997	Post-Contact metal A-frame structure
13-05143	Utility	Jensen and Head 1997	Post-Contact utility associated with military facilities
13-05144	Military barge	Jensen and Head 1997	Post-Contact metal barge/landing with wooden deck
13-05145	Retaining wall	Jensen and Head 1997	Post-Contact stacked limestone retaining wall
13-05146	Military complex	Jensen and Head 1997	Post-Contact complex with concrete paving, wall, concrete slab, wall, and concrete step
13-05597:1	Agriculture	Goodman and Cleghorn 1998	Sugarcane irrigation complex consisting of two concrete pumping stations and irrigation ditches
13-05597:2	Agriculture	Goodman and Cleghorn 1998	Sugarcane irrigation complex consisting of two concrete pumping stations and irrigation ditches
13-07734	Paving	Rieth 2011	Limestone cobble paving associated with traditional Hawaiian habitation
13-07796	Agriculture	Filimoehala et al. 2015	Large post-Contact irrigation complex
13-09992	Historic District	Apple 1978	U.S. Naval Base, Pearl Harbor Historic District (NRHP #66000940)
McAllister 139 [no SIHP # assigned]	Fishing shrine	McAllister 1933	Has not been confirmed
N/A	Hawaiian fishpond	Athens et al. 2000	Pre-Contact "Fresh Pond Fishpond"
N/A	Hawaiian fishpond	Athens et al. 2000	Loko Ulumoku

pond-fields may have begun as early as the thirteenth and fourteenth centuries (Rosendahl 1987; Dicks et al. 1987; and Wolforth et al. 1998).

5.1.2 Nagaoka and Davis 1989

In 1988, International Archaeological Research Institute, Inc. (IARII), conducted a reconnaissance and subsurface survey, as well as archaeological monitoring for the proposed Pupu'ole Park area in Waipahu, 'Ewa District. Although no historic properties were identified during this study, it was determined that the area has been utilized by pre-Contact populations for as long as 500 years prior. This is based on radiocarbon dates from secondary cultural deposits which include charcoal, historic artifacts, and high quantities of shell commonly considered midden (Nagaoka and Davis 1989).

5.1.3 Jensen and Head 1997; Landrum et al. 1997

An archaeological pedestrian survey of four parcels within the West Loch Branch of NAVMAG-Lualualei was completed by PHRI in 1995. The survey includes a large portion of the southwest section of the current study area. A total of 281 sites were recorded during the survey, 254 of which are within the "West Loch Unimproved" parcel that the current study area briefly crosses. Identified sites are associated with both the pre and post-Contact era and include military, agricultural, and traditional components. A subsequent cultural resources overview survey was conducted by Ogden Environmental and Energy Services Company, Inc. (Landrum et al. 1997) to further evaluate the cultural resources identified by Jensen and Head (1997). No additional historic properties were identified by Landrum et al. (1997). Multiple military resources that were evaluated by Landrum et al. (1997) are included within the current study area and are components of NAVMAG-Lualualei, which was determined to comprise a portion of Pearl Harbor Naval Base Historic District (SIHP # -9992).

5.1.4 Goodman and Cleghorn 1998

In 1998, Pacific Legacy conducted an AIS for the Waipi'o Sports Complex, which extends throughout the current 400-ft-wide project area corridor near the *mauka* (northern) extent of its western section. Two historic properties were identified: SIHP # 50-80-13-5597, a sugarcane irrigation complex consisting of two concrete pumping stations and associated irrigation ditches; and SIHP # 50-80-12-9714, a railroad berm remnant and an iron bridge associated with the OR&L right-of-way (ROW). Subsurface testing determined "the peninsula has at least 3.0 m of fill on it, effectively burying any evidence of prehistoric use" (Goodman and Cleghorn 1998:33).

5.1.5 Athens et al. 2000

In 1995, IARII conducted field research designed to target 21 former fishponds around the Pearl Harbor area. The project aimed to create a chronological framework for fishpond construction using qualitative dating methods and Bayesian calibration. A chronology was unable to be produced due to complications associated with methodology, however, Athens et al. (2000) offer insight into future endeavors with similar goals and the identification of fishpond sediment. Their results conclude that many of the former fishponds were heavily disturbed by historical land use and fishpond sediments were only distinguishable in eight of the 21 targeted fishponds (Athens et al. 2000). Study areas near the west portion of the present study area included the Laulaunui Island fishpond in West Loch and the Loko Hanaloa fishpond and "Fresh Pond" on the Waipi'o Peninsula. Twelve layers were identified in the Loko Hanaloa sequence. None could be clearly identified as a fishpond layer and there were problems (chronological inversions and indications

of disturbance) in the dating sequence. The Loko Lauaunui island fishpond was the subject of three sediment cores yielding two layers but it was concluded that a calibration of dates was inappropriate and thus the dating of fishpond creation is also uncertain. The small "Fresh Pond" fishpond (no SIHP # assigned) lies mostly within the present project corridor on Waipi'o Peninsula (see Figure 90). Three cores were taken but there was no indication of the presence of fishpond sediments and no chronology of use was developed.

5.1.6 Cleghorn 2000

In 1999, Pacific Legacy, Inc., conducted a pedestrian survey for a proposed irrigation line for the Waipi'o Soccer Park located at Waipi'o Peninsula. The pedestrian survey identified a portion of the OR&L Right-of-way (ROW) (SIHP # 50-80-12-9714) and determined no other cultural resource would be impacted by the proposed irrigation line (Cleghorn 2000).

5.1.7 Hammatt and Chiogioji 2000

In 2000, CSH prepared an archaeological assessment (no finds AIS) of City and County lands on Waipi'o Peninsula, adjacent to the south of the OR&L alignment, including the Waipahu Wastewater Pump Station. Although the rich cultural history is documented for the immediate area including an extensive complex of fishponds, agricultural fields, house lots, and pasture lands, the report also notes extensive fill activities during World War II and relates observation of fill 3 m deep. No further archaeological work was recommended (Hammatt and Chiogioji 2000).

5.1.8 Rasmussen and Tomonari-Tuggle 2006

In 2004, archaeological monitoring was conducted by IARII along the Waiiau Fuel Pipeline corridor from the HECO Barbers Point Tank Farm to the Waiiau Generating Station traversing most of coastal 'Ewa Moku (District). Ground disturbance within the portion of this corridor west of Kunia Road/Fort Weaver Road was not monitored since that portion of the corridor had been determined to not be archaeologically sensitive. East of Kunia Road/Fort Weaver Road, the Waiiau Fuel Pipeline corridor generally extends within the alignment of the OR&L ROW. The Rasmussen and Tomonari-Tuggle 2006 project area converges with the present study corridor at the intersection of Waipahu Depot Street and the Pearl Harbor Bike Path (along the former OR&L alignment). Monitoring results are reported for the area *mauka* (north) of the Makalena Golf Course just east of Kapakahi Stream with detailed results reported from the station sequence of 521+60 to 552+00 in the location of the former Loko Eo fishpond (Rasmussen and Tomonari-Tuggle 2006:34–52). Typically, thick fill layers were identified, from 155 to 250 cm thick (seemingly averaging more than 2 m thick) extending down to close to the water table and overlying what appeared to be a disturbed clay loam layer. Disturbed wetland clay loam sediments were observed close to the water table; typically, at depths of 2 m or greater. No cultural material or features appear to have been identified. It appears the natural land surface rises in the vicinity of Waipi'o Point Access Road in the central portion of the present project area.

5.1.9 Whitman et al. 2007

In 2007, CSH conducted an archaeological field inspection for proposed improvements to Waipahu Depot Street on Waipio Peninsula. The field inspection identified a railroad bridge and the OR&L ROW which are components of SIHP # 50-80-12-9714. This study area overlaps with the current study area near its northwest extent.

5.1.10 Dye et al. 2008 (Honouliuli Refuge Unit)

In 2008, T.S. Dye & Colleagues, Archaeologists, Inc., conducted an historic properties assessment for the Pearl Harbor National Wildlife Refuge: Waiawa, Honouliuli, and Kalaeloa units. The purpose of the assessment was to compile and synthesize the information about previously identified historic properties within the refuge units. Dye et al. (2008) concluded most of the landscape within the district of 'Ewa has been greatly impacted by the last 150 to 200 years of land use which were dominated by cattle ranching and large-scale commercial cultivation of cash crops. Due to this, few extant traditional Hawaiian surface structures remain, and none are within the assessed refuge units determined to have a low likelihood of significant cultural resources present (Dye et al. 2008).

5.1.11 Tulchin and McDermott 2008

In 2008, CSH conducted an archaeological LRFI for a Ted Makalena Golf Course Improvements project, which encompasses approximately 150 acres within the northern portion of the Waipi'o Peninsula. No historic properties were identified during the field inspection and it was determined that the absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and military operations, as well as the modern golf course development observed throughout the project area. Background research for this project also suggests the entire project area likely contains 3- to 7-m-thick deposits of fill (Tulchin and McDermott 2008).

5.1.12 Tulchin et al. 2009

In 2009, CSH conducted an AIS of a trunk sewer alignment for the proposed Koa Ridge Makai Development project, which encompasses approximately 574 acres located between Kīpapa Gulch and the H-2 Freeway. A 100% pedestrian inspection of the project area was undertaken and one historic property was identified. SIHP # 50-80-09-6959 consists of an irrigation ditch and water control box located at the northern tip of the project area, approximately 6 m southwest of Kamehameha Highway, along the upslope edge of a road cut, well north of the present study area. The dimensions of this historic property are approximately 13 m long (north-south) by 5 m wide (west-east). Of note is the fact that SIHP # -6959 extends for an undetermined distance to the north, well beyond the project area boundaries.

5.1.13 Hammatt 2010

In 2010, CSH completed an AIS for Construction Phase 1 and the western portion of Phase 2 of the HHCTCP, which runs *mauka* (typically approximately 300 m north) of the current study area before intersecting it briefly in Waiawa and Mānana Ahupua'a to the east. Fieldwork involved pedestrian inspection, ground penetrating radar (GPR) survey, and subsurface testing via backhoe. Pedestrian inspection of the Phase 2 portion of the survey area confirmed the entire survey area was previously disturbed by urban development. No surface cultural resources were identified and the results of GPR within the survey area were limited. Test excavations targeted proposed transit stations with a focus on testing areas planned for subsurface disturbance (i.e., elevator shafts, subsurface utilities). Test excavations were also located at selected guideway column foundation locations along the proposed elevated rail line.

The germane portion of the Hammatt 2010 study for the west portion of the present study area was the test excavations for the Waipahu Transit Center Station and vicinity located along Farrington Highway approximately 200 m east of Waipahu Depot Road and Kapakahi Stream and

approximately 300 m north of the present study area (the 19 test excavations in the “RW011 Construction Sheet):

In general the observed and documented stratigraphy consisted of varying imported fill layers overlying naturally deposited alluvial sediment inundated with water, suggesting the area was once a marsh prior to urban development. [Hammatt 2010:259]

Fill was commonly on the order of 175-230 cm thick with the water table at around 225-250 cmbs.

However, one historic property, SIHP # 50-80-09-7751 described as “subsurface agricultural sediment (likely from cultivation of wetland *kalo* (taro)-buried *lo'i* (irrigated pond-field) deposit” was designated on the *makai* side of Farrington Highway at the proposed Waipahu Transit Center Station location. Described as Stratum II in trenches 1–6 within the *makai* portion of the Waipahu Transit Center, this black (10 YR 2/1) clay contained noticeable, well-dispersed small flecks of charcoal and many reddish-orange mottles associated with in-use and remnant (abandoned and buried) *lo'i* sediments. (Hammatt 2010:418). While this is nearly 300 m north of the present study area (and hence not shown Figure 90 or discussed in Table 24) it does show the potential for agricultural deposits under thick fill layers.

5.1.14 O'Hare et al. 2011

In 2010, CSH conducted an archaeological LRFI for the Honouliuli/Waipahu/Pearl City Wastewater Facilities from Honouliuli to Hālawā Ahupua'a. This study area runs roughly in alignment with the current study area as far west as Waipahu Depot Street before diverging near the west side of Waipi'o Peninsula with the O'Hare et al. 2011 study area arcing around the north and west sides of West Loch. The O'Hare et al. (2011:194–199) study examined the area along Waipahu Depot street *makai* (south) of Farrington Highway and the vicinity of the Waipahu Wastewater Pumping Station (WWPS). The study notes the vicinity has been much impacted by twentieth century activities but that much of the vicinity of the Waipahu Waste Water Pumping Station appears to lie close to the water table.

No historic properties were identified during the O'Hare et al. 2011 archaeological surface survey in the vicinity of the west portion of the present study area.

O'Hare et al (2011:231) note the extensive previous disturbance but conclude the proximity to Kapakahi Stream and the coast indicates the potential for cultural resources and merits at least initial on-site monitoring. It was noted that the high water table and high berms would make archaeological inventory survey testing difficult.

5.1.15 Rieth 2011

In 2008, IARII completed an archaeological survey and test excavations in the unimproved portion of Naval Magazine (NAVMAG) West Loch, which overlaps with the current study area corridor near its southwest extent. The purpose of their study was to ground truth previously identified sites (Jensen and Head 1997) within this portion of the NAVMAG-West Loch facility. The archaeological survey resulted in the identification of 243 previously identified historic properties and 14 newly identified historic properties. Like its predecessor (Jensen and Head 1997), Rieth (2011) identified a mixture of traditional and historic sites with most of the traditional sites occurring within a high-density archaeological area near the northwest corner of the study

area, south of the current study area. Targeted test excavations within this area produced invertebrate and vertebrate faunal assemblages, a small collection of lithic tools, and radiocarbon dates indicating that occupation occurred between approximately AD 1650-1820. Rieth (2011) recommended that preservation and management actions be implemented for the sites at NAVMAG-West Loch. No historic properties were identified within 300 m of the present study area(s).

5.1.16 Filimoehala et al. 2015

In 2014, IARII completed an AIS and paleoenvironmental study of the Navy SEALs Training Area at Waipi'o Peninsula on Joint Base Pearl Harbor-Hickam (JBPHH). This work included a pedestrian survey covering 365 of 630 acres, paleoenvironmental coring, subsurface testing, and laboratory analyses of paleoenvironmental materials. Two historic properties, SIHP #s 50-80-13-7796 and -7797, were identified during the pedestrian survey. SIHP # -7796 consists of a post-Contact irrigation complex which covers 287 acres and includes ditches, settling ponds, an above-ground pipeline, and stacked limestone features. This very extensive identified historic property extends completely across the width of the present study area (see Figure 90). SIHP # -7797 is a post-Contact boat landing associated with the transportation of sugarcane from Ford Island and is not near the present study area. Furthermore, a previously identified Hawaiian fishpond called Loko Hanaloa (SIHP # 50-80-13-00125) was identified during paleoenvironmental coring (Loko Hanaloa is 200 m east of the present study area). Filimoehala et al. (2015) recommended no further mitigation for the post-Contact sites (SIHP #s -7796 and -7797) but recommended Loko Hanaloa (SIHP # -00125) as eligible for listing on the NRHP and that archaeological monitoring should be conducted in the future to mitigate potential adverse effects to the site.

5.2 Summary of Previously Identified Historic Properties within the Western Portion of the Project Corridor

Research identified four previously identified historic properties within the western portion of the study area. Summarizing these from southwest to northeast (see Figure 90) they include SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District; SIHP # 50-80-13-7796, a post-Contact commercial sugarcane irrigation complex; SIHP # 50-80-13-5597, a complex of two concrete pumping stations (designated Features 1 and 2) and irrigation ditches; and SIHP # 50-80-13-9714, the OR&L ROW. Additionally, the existence of a Hawaiian fishpond referred to as "Fresh Pond Fishpond" (no SIHP # assigned) by Athens et al. (2000) has been documented within this portion of the study but has yet to be identified in an archaeological context.

SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District, is traversed by much of the western portion of the study area corridor. The National Historic Landmark and historic property includes all waters and land areas that are associated with its historic function as an active naval base from its point of conception in 1902, until today (Apple 1978). The naval base was designated a National Historic Landmark and added to the NRHP in 1966. Many components of the historic property were determined to fall under Treatment Category I of the Archaeological Resource Protection (HARP) Plan definitions (Greenhorne and O'Mara, Inc., 1990) which means that the historic property components are "of outstanding historical, architectural, archaeological, engineering or cultural significance. Further, these resources have been evaluated as having retained their integrity i.e. original and/or authentic period materials, design and context". (Landrum et al. 1997). Landrum et al. (1997) also state that in order for individual components of

SIHP # 50-80-13-9992/ NRHP #66000940 (U.S. Naval Base, Pearl Harbor Historic District) to be considered significant, they “must have played a major role in the history of the base”. With that being said, the status of the previously evaluated individual features of the historic district are unclear at this time.

SIHP # 50-80-13-7796, post-Contact commercial sugarcane irrigation complex, covers 287 acres and includes ditches, settling ponds, an above-ground pipeline, and stacked limestone features but Filimoehala et al. (2015) recommended no further mitigation for this post-Contact site. The small “Fresh Pond” fishpond (no SIHP # assigned) lies mostly within the present project corridor on Waipi‘o Peninsula (see Figure 90). Three cores were taken but there was no indication of the presence of fishpond sediments and no chronology of use was developed (Athens et al. 2000). The Athens (2000) study was a significant effort to gain data on a history of cultural use and was basically unsuccessful in obtaining such data.

SIHP # 50-80-13-5597 is a sugarcane irrigation complex consisting of two concrete pumping stations and associated irrigation ditches; (Goodman and Cleghorn 1998) include a 1937 pumping station building (Feature 1) and 1919 pumping station (and associated ditches). Goodman and Cleghorn (1998:35) determined “This site appears to meet criteria ‘a’ and ‘d’ of the criteria for listing on the National Register of Historic Places” but conclude,

The Sugar Irrigation Complex (Site 5597) is a remnant of an important industry that helped shape modern Hawai‘i. Because the significance of these features is limited to their informational content, and that they have been adequately recorded, it is recommended that no further work is necessary for these sites. Construction plans call for this portion of the project area to be graded in excess of nine feet. Preservation of these sites does not appear to be warranted or feasible. [Goodman and Cleghorn 1998:36]

The status of this historic property at this time is unclear and we would not assume these buildings are of no further historic preservation concern.

SIHP # 50-80-13-9714 OR&L railroad ROW as it skirts the north side of Pearl Harbor has largely been redeveloped into a bike path. A long western portion of this bike path, west (outside) of the present project area, is listed on the NRHP. Although the long portion of the SIHP # -9714 OR&L railroad ROW within the present study area, west of approximately Waipahu Depot Street, is not on the NRHP, any modification of this site remnant is still a significant historic preservation issue.

5.3 Previous Archaeological Investigations in the Central Portion of the Study area from Waipi‘o to Waimano

Many archaeological studies have been conducted in the broad vicinity of the Waipi‘o to Waimano central portion of the study area (Figure 91 and Table 25). Despite this, much of the land both surrounding and within the project area, has not yet been the subject of archaeological study. Many of the archaeological studies in this area have been related to large projects with multiple concentrated studies over time, as well as long study corridors that follow modern infrastructure development such as sewer lines and roadways. These studies include archaeological inventory surveys, osteological assessments, archaeological reconnaissance surveys, archaeological assessments, paleo-environmental studies, historic property assessments, literature review and field inspections, and archaeological monitoring programs, all of which are summarized in the text

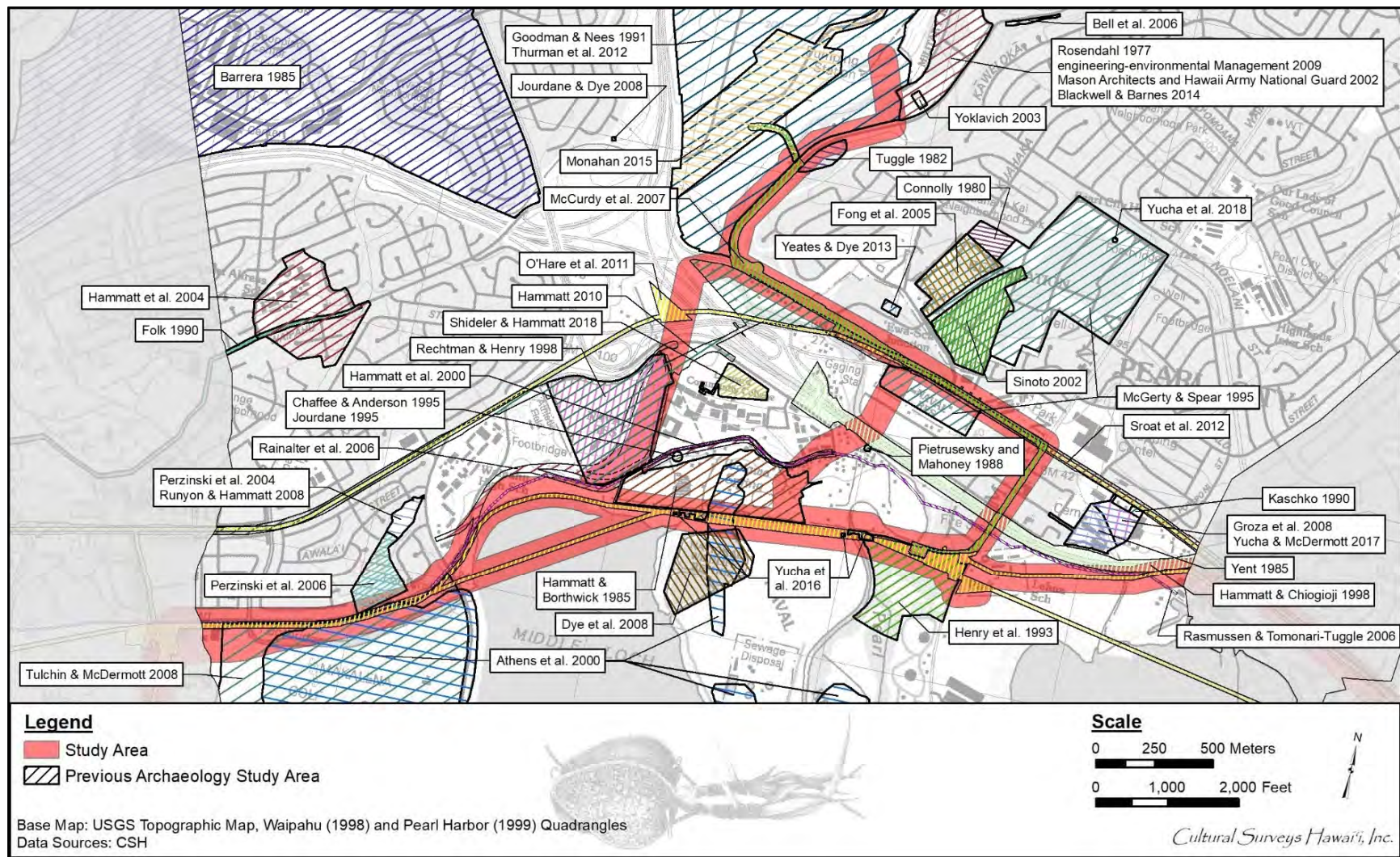


Figure 91. Previous archaeological investigations in vicinity of the central section of the study area from Waipi'o to Waimano Ahupua'a

Table 25. Previous archaeological investigation in vicinity of the central portion of the study area from Waipi'o to Waimano Ahupua'a

Reference	Type of Study	Location	Results
Rosendahl 1977	Archaeological reconnaissance	Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	No historic properties identified
Connolly 1980	Archaeological reconnaissance survey	Mānana Kai Neighborhood Park, Waiawa Ahupua'a	No historic properties identified
Tuggle 1982	Archaeological survey	Mānana Marine Housing, Waiawa Gulch, Waiawa Ahupua'a	Identified a dry stacked basalt canal and two associated modified natural terraces, likely post-Contact; no SIHP # assigned
Barrera 1985	Archaeological reconnaissance	Parcel bounded by Waikele Gulch on the west, H-1 Freeway on the south, and Kamehameha Hwy on the northeast, Waikele and Waipi'o Ahupua'a	No historic properties identified
Hammatt and Borthwick 1985	Archaeological reconnaissance	Parcel located between Leeward Community College and northern point of Middle Loch, Waiawa Ahupua'a	No historic properties identified
Yent 1985	Archaeological reconnaissance and limited subsurface testing	Former Hale Mohalu, immediately south of Kamehameha Hwy, and east of Lehua Ave, Waimano Ahupua'a	No historic properties identified
Pietrusewsky and Mahoney 1988	Osteological assessment of inadvertent burial finds	Small parcel along southern boundary of Leeward Community College, Waiawa Ahupua'a	Identified secondarily deposited post-Contact burial remains designated as SIHP # 50-80-09-3761; six to 18 individuals ranging in age from infant to fully developed adult
Folk 1990	Archaeological reconnaissance	Waipahu St from Amokii St eastward to August Ahrens School, Waikele and Waipi'o	No historic properties identified; early 1900s curbstones and rock wall facings recommended for preservation

Reference	Type of Study	Location	Results
Kaschko 1990	Archaeological subsurface survey	Loch View B Cemetery, Pearl City, Waimano Ahupua'a	One historic property identified: SIHP # 50-80-09-4349, minimally seven to 12 post-Contact burials within a historical cemetery
Goodman and Nees 1991	Archaeological reconnaissance and inventory survey	3,600-acre parcel bounded by H-2 Freeway to the south and Waiawa Gulch to the east, Waipi'o and Waiawa Ahupua'a	Identified 17 historic properties: SIHP # 50-80-09-1469 through -1472 and SIHP # -2261 through -2273, comprised of pre- and post-Contact sites and complexes
Henry et al. 1993	AIS	Parcel of land immediately southwest of Lehua Ave and Pearl Harbor Bike Path intersection, Mānana Ahupua'a	One historic property identified: SIHP # 50-80-09-4607, an earthen berm alignment of indeterminate function
Chaffee and Anderson 1995, Jourdane 1995	Excavation of inadvertent burial find	Magoon Estate, Waiawa Ahupua'a	One historic property identified: SIHP # 50-80-09-5302, post-Contact burial cluster of at least six individuals
McGerty and Spear 1995	Archaeological assessment	Mānana and Pearl City Junction Sites, Waiawa and Mānana Ahupua'a	No historic properties identified
Hammatt and Chiogioji 1998	Archaeological assessment	H-1 Freeway, Waiawa to Hālawā Ahupua'a	No historic properties identified likely due to urban development along H-1 study area
Rechtman and Henry 1998	Archaeological reconnaissance assessment	'Ewa Drum Filling and Fuel Storage Area, Waipi'o and Waiawa Ahupua'a	No historic properties identified
Athens et al. 2000	Paleo-environmental study	Pearl Harbor Area	Study identified eight of 21 targeted Hawaiian fishponds and provided insight into future endeavors to construct a chronological framework for fishpond construction using qualitative dating techniques and Bayesian analysis

Reference	Type of Study	Location	Results
Hammatt et al. 2000	Archaeological assessment	Waiawa Rd adjacent to Leeward Community College southern property boundary, Waiawa Ahupua'a	No historic properties identified
Mason Architects and Hawaii Army National Guard 2002	Historical building assessment	Portion of Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	Assessed six historical buildings (Building Nos. 13, 22, 25, 27, 28, and 65) as meeting NRHP Criterion C
Sinoto 2002	Archaeological assessment	Pearl City Wal-Mart, Waiawa and Mānana Ahupua'a	No historic properties identified
Yoklavich 2003	Historical building description	Portion of Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	Written description of Building No. 22, former Navy Aviation Supply Depot Garage
Hammatt et al. 2004	Archeological and cultural assessment	Waipahu near August Ahrens Elementary School, Waipi'o Ahupua'a	No historic properties identified
Perzinski et al. 2004	AIS	Parcel adjacent to northeast corner of Ted Makalena Golf Course, Waipi'o Ahupua'a	Three historic properties identified: SIHP # 50-80-09-6671, historical remnants of the Brown estate; SIHP # -6672, a pre- and post-Contact cultural layer; and SIHP # -6673, a pre and post-Contact cultural layer with two associated traditional Hawaiian burials
Fong et al. 2005	Archaeological LRFI	Portion of Wal-Mart Pearl City lot, Waiawa Ahupua'a	No historic properties identified
Bell et al. 2006	Archaeological field check and literature review	East side of Waihona St near Waihona Place intersection, Waiawa Ahupua'a	One historic property identified: small rock-faced earthen terrace, likely historical, no SIHP # assigned

Reference	Type of Study	Location	Results
Perzinski et al. 2006	Data recovery	Parcel adjacent to northeast corner of Ted Makalena Golf Course, Waipi'o Ahupua'a	Targeted two historic properties: SIHP # 50-80-09-6672, a pre- and post-Contact cultural layer which produced a charcoal and bi-valve midden assemblage; and SIHP # --6673, a pre- and post-Contact cultural layer with two associated traditional Hawaiian burials which were disinterred and relocated
Rainalter et al. 2006	Archaeological field inspection and literature search	Three proposed corridors immediately south/southwest of Leeward Community College, Waipi'o and Waiawa Ahupua'a	Two historic properties identified: SIHP # 50-80-09-6764, the former 'Ewa Junction Navy Fuel Drum Site, and SIHP # -5302, a previously recorded post-Contact burial cluster of at least six individuals (Chaffee and Anderson 1995)
Rasmussen and Tomonari-Tuggle 2006	Archaeological monitoring	Waiau Fuel Pipeline corridor from HECO Barbers Point Tank Farm to Waiau Generating Station, Honouliuli to Waiau Ahupua'a	No historic properties identified
McCurdy et al. 2007	Archaeological LRFI	Corridor along Lehua Ave, Kamehameha Hwy, and Waihona St, Waiawa and Mānana Ahupua'a	No historic properties identified
Dye et al. 2008	Historic properties assessment	Pearl Harbor National Wildlife Refuge: Waiawa, Honouliuli, and Kalaeloa units; Waiawa and Honouliuli Ahupua'a	No new historic properties identified; assessment focuses on previously documented historic properties within refuge units
Groza et al. 2008	AIS	Former Hale Mohalu, immediately south of Kamehameha Hwy and east of Lehua Ave, Waimano Ahupua'a	One historic property identified: SIHP # 50-80-09-6918, former WWII barracks dating to 1945; <i>lo'i</i> deposit also identified, no SIHP # assigned
Jourdane and Dye 2008	Historic property assessment	99-977 Lumipolu St, Waipi'o Ahupua'a	No historic properties identified

Reference	Type of Study	Location	Results
Runyon and Hammatt 2008	Archaeological monitoring	Parcel adjacent to northeast corner of Ted Makalena Golf Course, Waipi'o Ahupua'a	No historic properties identified
Tulchin and McDermott 2008	Archaeological LRFI	Ted Makelena Golf Course at Waipi'o Peninsula, Waipi'o Ahupua'a	No historic properties identified; noted Ted Makelena Golf Course area has been heavily modified for construction of golf course
Engineering-environmental Management 2009	Historical buildings summary and evaluation	Portion of Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	Assessed three historical buildings (Building Nos. 13, 00025, and 00065) as eligible for NRHP listing
Hammatt 2010	AIS	Western portion of HHCTCP (extending from Kapolei Station in the west to Pearl Highlands Station in the east), Honouliuli and Waiawa Ahupua'a	One historic property identified: SIHP # -7751, subsurface cultural deposit of <i>lo'i</i> sediments
O'Hare 2011	Archaeological LRFI	Project area roughly aligned with Kamehameha Hwy and Pearl Harbor shoreline until extending into <i>makai</i> portion of Honouliuli, Honouliuli to Hālawa Ahupua'a	No historic properties identified
Sroat et al. 2012	AIS	Phase 2 and western portion of Phase 3 of HHCTCP, Waiawa to Hālawa Ahupua'a	One historic property identified within Waiawa Ahupua'a portion: SIHP # 50-80-09-7150, subsurface <i>lo'i</i> deposit
Thurman et al. 2012	Archeological reconnaissance survey	1,680-acre land parcel bounded by H-2 Freeway to the south and Waiawa Gulch to the east, Waipi'o and Waiawa Ahupua'a	Three historic properties identified: CSH 1, a traditional Hawaiian petroglyph site; CSH 2, a possible rock shelter; and CSH 3, a traditional Hawaiian lithic quarry; revisited ten previously identified historic properties
Yeates and Dye 2013	Archaeological assessment	Kuala St, Pearl City, Waiawa Ahupua'a	No historic properties identified

Reference	Type of Study	Location	Results
Blackwell and Barns 2014	Historical building survey and evaluation	Portion of Waiawa National Guard, west portion of Waiawa Gulch, Waiawa Ahupua'a	Assessed three historical buildings; none evaluated as eligible for NRHP or Hawai'i Register of Historic Places (HRHP) listing
Monahan 2015	AIS	1,395-acre land parcel north of H-1 Freeway and east of H-2 Freeway, Waipi'o and Waiawa Ahupua'a	Identified three previously documented historic properties: SIHP # -2270, a network of post-Contact roads and railroad ROWs; SIHP # -2273, post-Contact irrigation system; and SIHP # -2271, post-Contact remains of plantation worker camps
Yucha et al. 2016	Archaeological monitoring	Inland border of Pearl City Peninsula along OR&L ROW	No historic properties identified
Yucha and McDermott 2017	Archaeological monitoring	Hale Mohalu II Project, 787 Kamehameha Hwy, Waimano Ahupua'a	Three historic properties identified: SIHP # 50-80-09-4349, two human burials associated with previously identified portion of former Loch View B Cemetery; SIHP # -7214, three inadvertent post-Contact coffin burials; and SIHP # -7382, a pre- to post-Contact cultural layer with human burials
Shideler and Hammatt 2018	LRFI	Leeward Community College, Waiawa Ahupua'a	No historic properties identified
Yucha et al. 2018	Archaeological evaluation	Mānana Community Park, Mānana Ahupua'a	No historic properties identified

below in chronological order. Archaeological finds documented during these studies include pre- and post-Contact burials, pre- and post-Contact cultural layers, Hawaiian fishpond (*loko*) deposits, *lo'i* deposits, historical military structures and remnant infrastructure, plantation-era agricultural components, a petroglyph field, and a rock shelter complex. In total, 22 archaeological sites have been documented in the vicinity of the Waipi'o to Waimano section of the project area (most have been assigned a SIHP number) and are indicated on Figure 92 and described in Table 26.

5.3.1 Rosendahl 1977

From 1976 to 1977, an archaeological reconnaissance survey project was conducted by the Bernice Pauahi Bishop Museum's Department of Anthropology which included all lands owned or controlled by the Army within the State of Hawai'i. The surveyed Army lands included the Waiawa National Guard unit which extends into the extreme north portion of the current study area along the western side of Waihona Street in Waiawa Ahupua'a. Rosendahl (1977) conducted a 2.5% pedestrian ground survey of the 197.94-acre parcel and concluded the area had undergone extensive land surface modification as a result of historical commercial agricultural practices. No historic properties were identified during this study.

5.3.2 Connolly 1980

In 1980, Archaeological Research Associates conducted an archaeological reconnaissance survey of the Mānana Kai Neighborhood Park in Pearl City. The study included a pedestrian survey of the park which Connolly (1980) notes had been completely graded and landscaped for the creation of the park. No surface historic properties were identified but it was recommended that should future ground disturbance occur an archaeological monitor should be present to mitigate potential adverse effects to encountered cultural remains (Connolly 1980).

5.3.3 Tuggle 1982

In 1982, Tuggle (1982) completed an archaeological survey of a parcel of land in Waiawa Gulch proposed to be out-leased for commercial development. The study included a pedestrian survey as well as three subsurface testing units that targeted a canal and two associated terraces. The canal was constructed of locally available semi-rounded cobbles; the two associated terraces were determined to likely be natural with minor modification possible. Tuggle (1982) concludes the features are more likely related to short-term, post-Contact agriculture rather than traditional land use. No SIHP numbers were assigned.

5.3.4 Barrera 1985

Sometime prior to 1985, Chiniago, Inc. completed the pedestrian inspection of a large 586-acre parcel of land at Waikele. No historic properties were identified during the study; Barrera (1985) had predicted that any structural remains would have been destroyed by large scale commercial agriculture endeavors. The study concluded that development of the parcel may proceed without any further archaeological investigation (Barrera 1985).

5.3.5 Hammatt and Borthwick 1985

In 1985, CSH conducted an archaeological reconnaissance of a wetland parcel located between Leeward Community College and the northern point of Middle Loch, which overlays a portion of the current study area in Waiawa Ahupua'a. The purpose of the study was to locate and evaluate

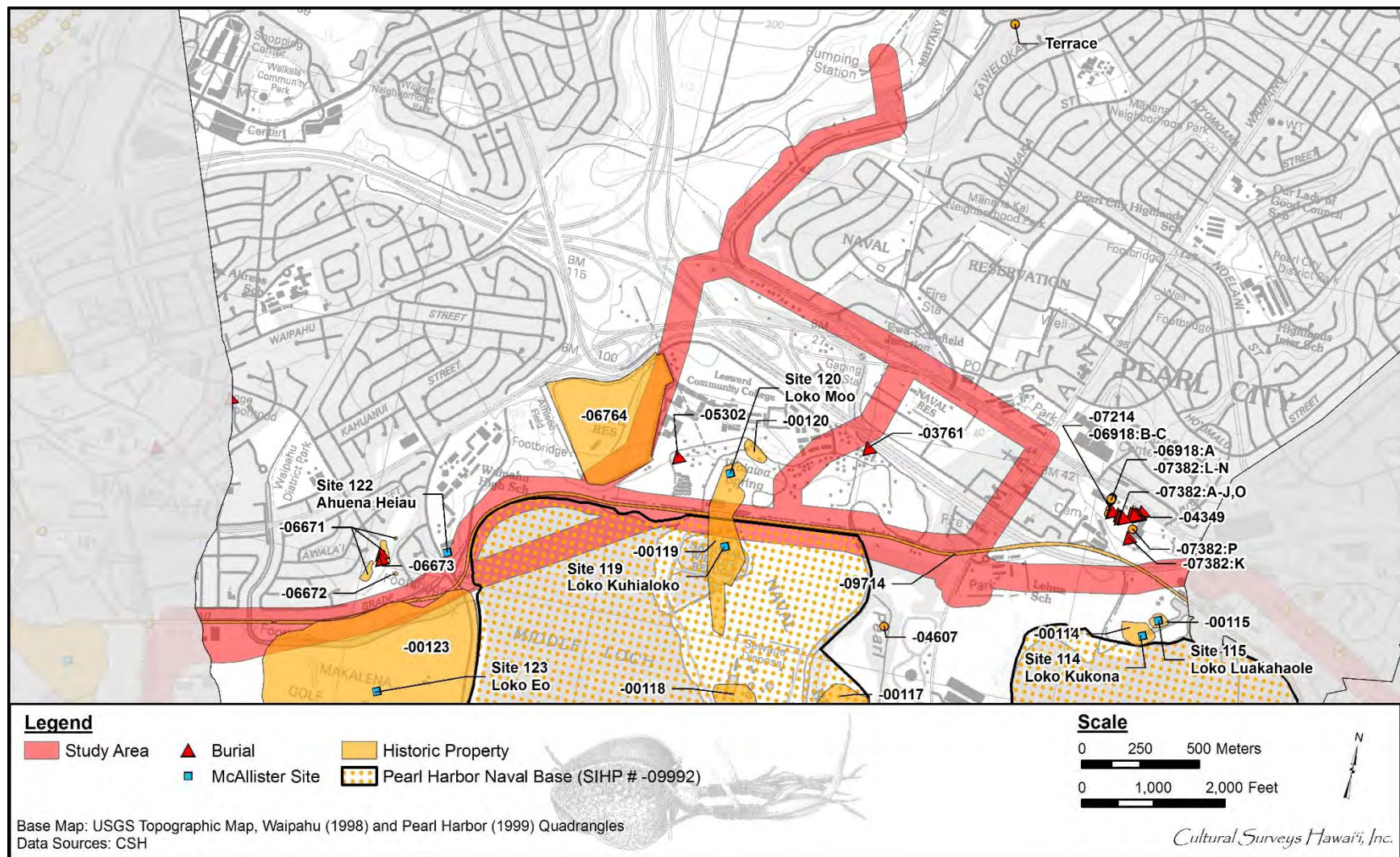


Figure 92. Previously identified historic properties in the vicinity of the central section of the study area from Waipi'o to Waimano Ahupua'a

Table 26. Previously identified historic properties in the vicinity of the central section of the study area from Waipi'o to Waimano Ahupua'a

SIHP # (50-80-)	Formal Type	Source	Comment
09-00114	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Kukona; remnants of 27-acre pond with coral and basalt wall
09-00115	Hawaiian fishpond	McAllister 1933	Loko Luakahaole; 1-acre pond filled in by 1933
09-00117	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Paauau; large pond filled in by 1933
09-00118	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Apala; small pond surrounded by wall
09-00119	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Kuhialoko; long narrow pond with wall on one of long sides
09-00123	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Eo; large pond with wall, surrounded on three sides by land
09-03761	Burial	Pietruszewsky and Mahoney 1988	Six to 18 post-Contact burials on south bank of Waiawa Stream
09-04349	Cemetery	Kaschko 1990, Yucha and McDermott 2017	Loch View B Cemetery; ca. 1900-1908, 14 coffin burials
09-04607	Alignment	Henry et al. 1993	Earthen berm alignment with unknown function
09-05302	Human burials	Chaffe and Anderson 1995, Jourdane 1995	Post-Contact burial cluster of at least six individuals
09-06671	Historic building	Perzinkski et al. 2004	Historic remnants of Brown estate
09-06672	Cultural layer	Perzinkski et al. 2004	Pre- and post-Contact layer
09-06673	Cultural layer	Perzinkski et al. 2004	Pre- and post-Contact layer with two Hawaiian burials
09-06764	Ewa Junction Navy Fuel Drum site	Rainalter et al. 2006	Post-Contact; no longer extant
09-06918:A	Concrete and basalt infrastructure	Groza et al. 2008	Remnant rock and mortar walls of WWII barracks dating to 1945
09-06918: B-C	Concrete and basalt infrastructure	Kaschko 1990	Feature B: rectangular landscaping rock; Feature C: concrete staircase

SIHP # (50-80-)	Formal Type	Source	Comment
09-07214	Human interment	Yucha and McDermott 2017	Concentration of at least three historic coffin burials
09-07382: A-P	Human interment area	Yucha and McDermott 2017	Pre- to post-Contact cultural use area containing eight human burials, three pit features, two <i>imu</i> , a charcoal lens, and a portion of Hale Mohalu driveway
12-09714	Railroad	Yucha et al. 2016	OR L ROW
13-09992	Historic Military District	Apple 1978	U.S. Naval Base, Pearl Harbor Historic District (NRHP #66000940)
McAllister 122 [No SIHP # assigned]	<i>Heiau</i>	McAllister 1933, Athens et al. 2000	Ahuena Heiau; no longer in existence
"Terrace"	Terrace	Bell et al. 2006	Likely historic, possibly older, stacked cobble soil retention feature

archaeological sites which would be impacted by proposed land-fill operations. Although a portion of their project area included the indicated location of a former Hawaiian fishpond called Loko Mo'ō, no historic properties were identified and Hammatt and Borthwick (1985) note the project area shows a severe degree of modern land modification.

5.3.6 Yent 1985

In 1985, the Department of Land and Natural Resources (DLNR), Division of State Parks, Outdoor Recreation, and Historic Sites (Yent 1985) conducted an archaeological reconnaissance and limited subsurface testing at the former Hale Mohalu Hospital in Pearl City. The purpose of the archaeological work was to define and evaluate archaeological resources on the property as part of an Environmental Assessment prior to the leasing of the property by DLNR. No historic properties were identified during the archaeological investigation. However, archival research indicated Land Commission Awards within the subject property, suggesting traditional Hawaiian agricultural use. It was recommended that if a construction project involving ground disturbance were proposed for the subject property, a more intensive archaeological subsurface testing program should be conducted prior to construction.

5.3.7 Bath 1988 (Pietrusewsky and Mahoney 1988)

In 1987, skeletal remains were encountered at a construction site adjacent to Leeward Community College. The remains were recovered by Joyce Bath (state O'ahu archaeologist) and transported to the University of Hawai'i Anthropology Laboratory for analysis. Pietrusewsky and Mahoney (1988) conclude the remains comprise an unusual assortment of secondarily deposited human bones which comprise between six and 18 individuals of infant to adult age. Red cloth and a clear glass disk were recovered in association with the burial remains, indicating the burials are likely post-Contact. The burials were designated as SIHP # 50-80-09-3761. This burial site was on

the east side of the central of three *mauka* (northern extending) corridors of the present study area (see Figure 92 and Table 26).

5.3.8 Folk 1990

In 1990, CSH conducted an archaeological reconnaissance of Waipahu Street from Amokii Street eastward to August Ahrens School, for the proposed widening of Waipahu Street. The study included a pedestrian survey intended to identify any archaeological surface sites and to determine the likelihood of encountering subsurface cultural remnants during the proposed project. The entire length of the project area was deemed to be culturally sensitive and archaeological monitoring was recommended for future groundwork in order to identify and locate any subsurface cultural remnants. Additionally, it was recommended that specific portions of curbstone and rock wall facing be preserved since they had been quarried by hand from the Lana'i Rock Quarry Company in the early 1900s (Folk 1990). No SIHP # was assigned during this project.

5.3.9 Kaschko 1990

In 1990, IARII conducted an archaeological subsurface survey on a parcel in Pearl City, immediately *makai* of Kamehameha Highway. Surface survey identified five intact graves with whole or partial headstones at the 'Ewa end of the property. Additionally, a number of broken headstones were observed piled in the *makai* and 'Ewa corner of the property. The majority of the headstones had Portuguese names with dates ranging from 1900 to 1908. Backhoe excavations and subsequent hand probing identified minimally seven to 12 burial pits containing wooden coffins within the property. All burials were left in place and the trenches were backfilled. Background research identified the parcel as the Loch View B Cemetery. It was noted that "headstones and grave outlines, etc. could have been disturbed during past construction work on Kamehameha Highway," and "one disturbed/disarticulated burial was encountered, the condition of which suggested the removal and reburial of the remains" (Kaschko (1990:3). This may indicate burials from the cemetery extend into the Kamehameha Highway ROW. The historic property is designated as SIHP # 50-80-09-4349.

5.3.10 Goodman and Nees 1991

The Applied Research Group (Bishop Museum) conducted an archaeological reconnaissance and inventory survey in 1990 for the Gentry Development Company which focused on a huge 3,600-acre parcel of land within Waiawa Ahupua'a. The parcel is bounded to the south by the H-2 Freeway and by Waihona Street to the east and is overlain by the current study area along Waihona Street. Archaeological reconnaissance included pedestrian survey where viable and subsurface testing targeted areas with potential for pre-Contact components. Numerous features and historic properties were identified in association with both pre- and post-Contact land use. Historic properties associated with post-Contact land use include irrigation complex components, agricultural infrastructure, cemeteries and burial sites, and military infrastructure. Pre-Contact historic properties include a complex of rock shelters, a petroglyph complex, mounds, terraces, and a portion of a trail pre-Contact trail. The identified historic properties are assigned as SIHP # 50-80-09-1469 through -1472 and SIHP # 50-80-09-2261 through -2273. Of note, Goodman and Nees (1991) postulate that based on the presence of the identified rock shelter and petroglyph complexes along the pre-Contact trail, it is possible a portion of the project area "may have been used as a corridor for traversing the central plain from the southern, coastal shores to the mauka population centers (Wahiawa and Waialua)" (Goodman and Nees 1991). A combination of

preservation and data recovery was recommended for the identified historic properties. The *mauka* (northernmost) portion of the present study area extends along the southeast side of this study area but none of the historic properties identified in this study are close to the present study area.

5.3.11 Henry et al. 1993

In December 1992, PHRI conducted an AIS for the Waiawa Floodplain Feasibility Study located in Mānana Ahupua'a, between the East and Middle Lochs of Pearl Harbor. This study area includes the portion of the current study area where the existing Pearl City WWPS, and alternative Pearl City WWPS numbers one and three are located. Fieldwork for the study included a surface survey and subsurface testing involving backhoe trenches, auger tests, and Livingston Core samples. The surface survey identified SIHP # 50-80-09-4607, which was interpreted as an earthen berm alignment of indeterminate function. SIHP # 50-80-09-4607 is approximately 250 m south of the present study area. The subsurface testing was primarily within wetland and swampy portions of their study area and modern disturbances were identified in five of the 16 backhoe trenches.

5.3.12 Chaffee and Anderson 1995, Jourdane 1995

In 1995, Scientific Consultant Services, Inc., was contracted to investigate and disinter human remains from the site of a pipeline project excavation on the Magoon Estate located approximately 150 m outside the current study area. The initial find was documented by Jourdane (1995) and included one concentration of skeletal remains in a highly disturbed context. A discreet coffin burial was identified nearby upon further investigation. The concentration of skeletal remains was determined to represent a minimum of five individuals, resulting in a total of at least six individuals. The burials included associated grave goods which placed the date of the burials at no earlier than 1917. The burials are designated as SIHP # 50-80-09-5302.

5.3.13 McGerty and Spear 1995

In 1995, Scientific Consultant Services completed an AIS (recorded as an archaeological assessment) for a Department of Housing and Community project. The project area consisted of 138.5 acres on two parcels bisected by Kamehameha Highway in the Mānana Pearl City Junction (TMKs: [1] 9-7-023 and 024). The upper parcel is bounded on the 'Ewa side by Hale Ola and Holiday City sub-divisions, and Mānana-Kai Park; on the *makai* side by Cane Haul Road; on the Koko Head side by Waimano Home Road and Kauhale Mānana sub-division; and on the *mauka* side by Kamehameha Highway. The southwestern parcel, which particularly concerns us here as it includes portions of the study area, is bounded on the *mauka* side by Kamehameha Highway; on the 'Ewa and Koko Head side by cleared lots; and on the *makai* side by land belonging to the University of Hawai'i. The background research indicated intensive post-Contact agricultural and military use of the project area. Thus, the potential for locating intact archaeological resources has been significantly decreased. No archaeological resources were encountered during this investigation.

5.3.14 Hammatt and Chiogioji 1998

In 1998, CSH conducted an archaeological reconnaissance survey and assessment of a portion of the H-1 Freeway from Hālawa to the H1-H2 interchange at Waiawa for proposed traffic improvements (Hammatt and Chiogioji 1998). Their survey area slightly overlaps the current study area in southeast Pearl City near where Kamehameha Highway and the H-1 (Queen Lili'uokalani

Freeway) cross. No archaeological sites had previously been recorded within any portion of the study area or its immediate vicinity, and no surface archaeological sites were observed during the reconnaissance survey of the lands adjacent to the highway study area corridor. It was noted that there are several buildings older than 50 years adjacent to the highway corridor at First and Second streets in Pearl City. Recommendations included consultation with the SHPD to ascertain if the buildings are of historical concern if future highway improvement activities will impact these structures. No further archaeological investigations were recommended for the area as it was determined that any prehistoric surface or subsurface archaeological remains are unlikely to be present due to urban development along the H-1 Freeway study area (Hammatt and Chiogioji 1998:20).

5.3.15 Rechtman and Henry 1998

In 1998, PHRI completed an archaeological reconnaissance survey at two discrete locations including the Red Hill Fuel Storage Area, *mauka* of Moanalua Freeway (far from the present study area), and the 'Ewa Junction Drum Filling and Fuel Storage Area, which is partially included within the western *mauka* (north-trending) corridor of the current study area. The 'Ewa Junction Drum Filling Area was located *makai* of Farrington Highway, *mauka* of Middle Loch, and immediately west of Leeward Community College, and was the proposed location for the 43.3-acre HHCTCP maintenance and storage facility. The project was undertaken in compliance with Section 110 of the National Historic Preservation Act (NHPA); "The 'Ewa Drum Filling and Fuel Storage Area received a 100% surface survey" (Rechtman and Henry 1998:6). No archaeological historic properties were identified within the project areas during the course of the fieldwork and it was concluded that "Due to the amount of prior disturbance and development at both of these facilities it is highly unlikely that any such resources, if they once existed, would have been preserved" (Rechtman and Henry 1998:ii). The study concluded, "NHPA Section 110 responsibilities with respect to the identification and evaluation of archaeological resources located within these facilities" had been fulfilled (Rechtman and Henry 1998). The 'Ewa Junction Drum Filling and Fuel Storage Area location was part of the Sroat et al. 2012 AIS study and is currently the location of the development of a HART Rail Operations Center. (This area was restricted and inaccessible during the current archaeological field inspection.)

5.3.16 Athens et al. 2000

As previously introduced in Section 5.1.5, IARII conducted field research designed to target 21 former fishponds around the Pearl Harbor area. The project aimed to create a chronological framework for fishpond construction using qualitative dating methods and Bayesian calibration. It was not possible to produce a chronology due to complications associated with methodology, however, Athens et al. (2000) offer insight into future endeavors with similar goals and the identification of fishpond sediment. They conclude from their results that many of the former fishponds were heavily disturbed by historical land use and fishpond sediments were only distinguishable in eight of the 21 targeted fishponds (Athens et al. 2000).

The Athens et al. (2000) study addresses four fishponds near the central portion of the present study area. These are summarized below numerically by SIHP number with a brief account of the work accomplished:

- SIHP # -114 Loko Kukona: No work undertaken
- SIHP # -115 Loko Luakahaole: No work undertaken
- SIHP # -117 Loko Pā'au'au: Two cores were recovered and six radiocarbon determinations were made. Major dating inversions were noted and “Therefore, the only possible conclusion is that the stratigraphic column of Loko Pā'au'au has been massively disturbed and likely consists of fill rather than naturally deposited sediments” (Athens et al. 2000:47).
- SIHP # -118 Loko Apala: No work undertaken
- SIHP # -119, Loko Kuhia (Kuhialoko): Two cores were recovered and nine radiocarbon determinations were made. There is an inconsistency in the dating results. Historic types of pollen (*Ambrosia*, *Prosopis*, and *Batis*) were present from 318 cm to the surface of the core, leading to the conclusion that “major historic disturbances have occurred in the core at least to this depth [318 cm]” (Athens et al. 2000:52).
- SIHP # -120, Loko Moko: No work undertaken
- SIHP # -123 Loko Eo: Four cores were recovered and 16 radiocarbon determinations were made. Unfortunately, “Between Layer IIa and VII [to an indicated depth of 669 cm] the dates show no stratigraphic consistency, suggesting that this part of the core has been disturbed and is likely fil.” (Athens et al. 2000:59). While there was consistency in dating from deeper layers of paleoenvironmental interest, these were all prior to human arrival.

5.3.17 Hammatt et al. 2000

In 2000, CSH conducted an AIS (recorded as an archaeological assessment) for a proposed bike path along Waiawa Road, adjacent to the southern property boundary of Leeward Community College in Waiawa. The AIS included background research and a pedestrian survey of the study area to identify potential surface sites. Background research indicated the former use of the area for traditional Hawaiian land cultivation followed by post-Contact rice farming, however, Hammatt et al. (2000) note that disturbances related to modern land use have probably eliminated any remnant sites. No surface historic properties were identified during the AIS. Archaeological monitoring was recommended for subsurface work related to bike path construction (Hammatt et al. 2000).

5.3.18 Mason Architects and Hawaii Army National Guard 2002

In 2001, Mason Architects and the cultural resources management staff of the Hawaii Army National Guard conducted an assessment of historic buildings at the Waiawa Unit Training Equipment Site located adjacent to the *mauka* (northernmost) extent of the current study area at its northern extent in Waiawa Gulch. Six buildings were evaluated including building numbers 13, 22, 25, 27, 28, and 65, all of which were constructed during World War II. All of the structures were assessed as meeting the NRHP Criterion C since they “embody the distinctive characteristics of a type, period, or method of construction” (Mason Architects and Hawaii Army National Guard 2002).

5.3.19 Sinoto 2002

Aki Sinoto Consulting conducted an AIS (recorded as an archaeological assessment) in 2002 for the proposed Wal-Mart store location in Pearl City near the Kamehameha Highway intersection with Acacia Road. The AIS included historical background research and a pedestrian survey of the 18.37-acre land parcel. Background research indicated the area has been highly affected by post-Contact sugarcane cultivation and military use, and no historic properties were identified during the pedestrian survey. Sinoto (2002) recommended that ground disturbance exceeding 1 m (3 ft) should be conducted under the supervision of an archaeological monitor.

5.3.20 Yoklavich 2003

In 2003, Mason Architects prepared a written historical and descriptive data document for the Former Navy Aviation Supply Depot Garage (Building No. 22) at Waiawa Gulch, which lies directly outside the current study area near its *mauka* (northernmost) extent in Waiawa Gulch. The document greatly details the structural components and architectural history of the building as well as the history of the complex it belongs to. Mason Architects and Hawaii Army National Guard (2002) previously assessed the World War II-era building as meeting the NRHP eligibility Criterion C.

5.3.21 Hammatt et al. 2004

In 2004, CSH conducted an archaeological assessment and cultural impact evaluation in support of the Waipahu Street Drainage Improvements project, near August Ahrens Elementary School in Waipahu. The study concluded the entire project area had been heavily modified by residential and agricultural development of the area and that any subsurface historic properties would have likely been destroyed. No historic properties were identified during the study and Hammatt et al. (2004) recommended no further work.

5.3.22 Perzinski et al. 2004

In 2004, CSH conducted an AIS of a 13-acre Queen Emma Foundation parcel located immediately north and slightly overlapping the current study area on the northeast side of Waipi'o Peninsula. Three historic properties were identified: SIHP #s 50-80-09-6671, the historical remnants of the Brown estate consisting of concrete and cinder block foundations; -6672, a subsurface cultural layer containing evidence of both pre- and post-Contact land use; and -6673, a pre- and post-Contact cultural layer containing two pre-Contact flexed human burials. Perzinski et al. (2004) recommended data recovery for SIHP # -6672, a burial treatment plan for SIHP # -6673, and no further work for SIHP # -6671 (Perzinski et al. 2004). None of these three historic properties were within the present study corridor per se.

5.3.23 Fong et al. 2005

CSH conducted an archaeological LRFI in 2005 for a 13.54-acre land parcel proposed for commercial development near the intersection of Kamehameha Highway and Acacia Street. At the time of this study, the parcel still contained structures affiliated with former U.S. Navy occupation of the property. Fong et al. (2005) note the project area had been intensively modified by grubbing and grading to create large, terraced foundation pads for individual warehouses. No historic properties were identified, and no further archaeological work was recommended.

5.3.24 Bell et al. 2006

In 2006, CSH conducted an archaeological field check and literature review for a rockfall remediation project along Waihona Street in Waiawa Ahupua'a. One historic property comprised of a small terrace was identified during the study. The terrace is constructed of unmodified cobbles stacked up against two large natural boulders to create a semi-circle, its function interpreted as a soil retaining wall. Bell et al. (2006) concluded the terrace was likely of the post-Contact era but possibly older. While quite modest in nature and import, this is the only previously identified historic property documented on the low elevation flat land significantly inland from the coast in the central portion of the present study area.

5.3.25 Perzinski et al. 2006

CSH completed data recovery in 2005 for a 9.95-acre portion of a Castle & Cooke Homes land parcel which was previously subject of an AIS (Perzinski et al. 2004). The parcel is located immediately north of the current study area inland of the east side of Waipi'o Peninsula. The parcel contains SIHP # 50-80-09-6671, the historical remnants of the Brown estate consisting of concrete and cinder block foundations; SIHP # -6672, a subsurface cultural layer containing evidence of both pre- and post-Contact land use; and SIHP # -6673, a pre- and post-Contact cultural layer containing two pre-Contact flexed human burials. The data recovery specifically addressed SIHP # -6672 and the disinterment of SIHP # -6673. SIHP # -6672 was further investigated through subsurface testing which produced charcoal and bivalve midden; the burials associated with SIHP # -6673 were disinterred and relocated to a parcel of land in South Hālawā. Perzinski et al. recommended archaeological monitoring for all future ground disturbance within the project area land parcel (Perzinski et al. 2006).

5.3.26 Rainalter et al. 2006

In 2006, CSH conducted an archaeological LRFI for the construction of a proposed Leeward Community College Second Access Road. The study area was bounded on the *mauka* side by the Middle Loch of Pearl Harbor, on the *makai* side by Farrington Highway, on the 'Ewa side by Waipi'o Point Access Road, and on the east side by Waiawa Stream (Rainalter et al. 2006). The Rainalter et al. 2006 study area overlaps the present study corridor. Two historic properties were identified within their study area: SIHP # 50-80-09-5302, a previously recorded burial site containing both coffin and pit burials (Chaffee and Anderson 1995, Jourdane 1995), located approximately 100 m north and east of the current study area; and SIHP # -6764, the 'Ewa Junction Navy Fuel Drum Site, a fuel storage facility designed to store automobile gasoline and aviation kerosene in underground storage tanks. The Rainalter et al. (2006) study included three proposed corridors that crossed through the former 'Ewa Junction Navy Fuel Drum Site. The study develops fairly detailed data on the 'Ewa Junction Navy Fuel Drum Site and, following consultation with the Navy, concludes, "based on this initial evaluation by the Navy, it is likely that the site would be considered eligible by the Navy for listing on the National Register . . ." The burial site, SIHP # -5302, is approximately 150 m north (outside) of the present study corridor. The east side of the westernmost *mauka* (northern) corridor of the present study area is partially within the former 'Ewa Junction Navy Fuel Drum Site, SIHP # -6764, but the import of this was resolved prior to the (presently ongoing) development as a HART Rail Operations Center.

5.3.27 Rasmussen and Tomonari-Tuggle 2006

In 2004, archaeological monitoring was conducted along the Waiiau Fuel Pipeline corridor from the HECO Barbers Point Tank Farm to the Waiiau Generating Station in the 'Ewa Moku (District) (previously introduced in Section 5.1.8).

Stratigraphy is reported from the northeast corner of the Makalena Golf Course and east to *makai* of Leeward Community College (Station 545+70 to Station 594+80).

The Waiiau Fuel Pipeline corridor monitoring south and southeast of Leeward Community College occurred in the direct vicinity of previously identified human burials (SIHP #s 50- 80-09-3761 and -5302) and the *mauka* (north) portions of the fishponds Loko Kuhialoko (SIHP # -0119) and Loko Mo'ō (SIHP # -0120). Despite being within close proximity to previously identified historic properties, it was determined that no significant archaeological finds had been identified during archaeological monitoring and that the observed stratigraphy within the project area consists of imported fills or naturally deposited sediments (Rasmussen and Tomonari-Tuggle 2006:75). Of note was the identification of

A bed of oyster shells is exposed in a natural escarpment, about 7 m high, on the north side of the trench [at Waipahu High School Station 552+00]. Macdonald and Abbott (1979:357) explain that the oyster shells were deposited during the Waimanalo sea stand and later exposed as the sea level changed. [Rasmussen and Tomonari-Tuggle 2006:55]

A similar exposure of a bed of naturally deposited oyster shells at Waipi'o Point Access Road at a depth of 150-200 cmbs was also noted (Rasmussen and Tomonari-Tuggle 2006:53).

5.3.28 McCurdy et al. 2007

In 2007, CSH conducted an archaeological LRFI for a proposed sewer line installation in the *makai* portion of Pearl City from the Pearl City WWPS east to Lehua Avenue and north to Kamehameha Highway, west along Kamehameha Highway to Waihona Street, and north along Waihona Street to the Waiawa WWPS and end of the proposed sewer line. The study consisted of historical background research and a pedestrian survey of the project area during which no historic properties were identified. McCurdy et al. (2007) state that an archaeological monitoring program may be required to address the potential of project-related excavations impacting subsurface cultural deposits.

5.3.29 Dye et al. 2008 (Waiawa Refuge Unit)

In 2008, T.S. Dye & Colleagues, Archaeologists, Inc., conducted an historic properties assessment for the Pearl Harbor National Wildlife Refuge: Waiawa, Honouliuli, and Kalaeloa units. The purpose of the assessment was to compile and synthesize the information about previously identified historic properties within the refuge units. Dye et al. (2008) concluded most of the landscape within the district of 'Ewa has been greatly impacted by the last 150 to 200 years of land use which was dominated by cattle ranching and large-scale commercial cultivation of cash crops. Due to this, few extant traditional Hawaiian surface structures remain, and none are within the assessed refuge units which are determined to have a low likelihood of significant cultural resources present (Dye et al. 2008).

5.3.30 Groza et al. 2008

In 2007, CSH (Groza et al. 2008) completed an AIS of the Hale Mohalu II project, located on a portion of the site of the former Hale Mohalu Hospital in Pearl City. Fieldwork consisted of a surface survey and the excavation of 24 backhoe trenches. One surface historic property, SIHP # 50-80-09-6918, was identified within the project area—the remains of a former World War II barracks built by the U.S. Navy in 1945. This barracks was used as a tuberculosis treatment annex at the end of World War II and leased a few years later by the Hawaiian Board of Health to treat Hansen's disease patients. The features associated with SIHP # -6918 include two freestanding walls at the property entrance, a rock and mortar wall around the base of a banyan tree, and concrete stairs.

The stratigraphy observed in the subject property generally consisted of thick fill deposits exhibiting extensive disturbance from prior development of the area. Of note were cultural deposits identified within former LCA boundaries. These deposits consisted of culturally enriched (via charcoal flecking) clay loam, indicative of wetland taro cultivation. Charcoal samples collected from the deposits yielded a radiocarbon date range of AD 1610-1690. No SIHP numbers were assigned to the agricultural sediments.

5.3.31 Jourdane and Dye 2008

In 2008, T.S. Dye & Colleagues, Archaeologists, Inc., produced an historic properties assessment for the proposed T-Mobile H-2 Interchange Cellular Site at 94-977 Lumipolu Street in Waipahu. The assessment was based on a field inspection conducted by Hawaii Environmental Consultants, LLC. Jourdane and Dye (2008) concluded no historic properties were present within the study area and that the undertaking would have no effect on historic properties.

5.3.32 Runyon and Hammatt 2008

In 2006, CSH conducted archaeological monitoring for the installation of residential utilities at a land parcel owned by Castle & Cooke Homes Hawaii, Inc. The land parcel overlaps the current study area corridor and is located adjacent to the Pearl Harbor Bike Path and the northwest boundary of the Ted Makalena Golf Course. Monitored excavations for the project reached depths up to 1 m (approximately 3 ft). Despite the identification of SIHP # 50-80-09-6671, the historical remnants of the Brown estate consisting of concrete and cinder block foundations; SIHP # 50-80-09-6672, a subsurface cultural layer containing evidence of both pre- and post-Contact land use; and SIHP # 50-80-09-6673, a pre- and post-Contact cultural layer containing two pre-Contact flexed human burials during the AIS for the project (Perzinski et al. 2004), no historic properties were identified during archaeological monitoring (Runyon and Hammatt 2008).

5.3.33 Tulchin and McDermott 2008

In 2008, CSH conducted an archaeological LRFI for the Ted Makalena Golf Course Improvements project, which encompasses approximately 150 acres within the northern portion of the Waipi'o Peninsula. No historic properties were identified during the field inspection and it was determined that the absence of historic properties can be attributed to extensive land modifications associated with historic sugar cultivation and military operations, as well as the modern golf course development observed throughout the project area. Background research for this project also suggests the entire project area likely contains 3- to 7-m thick deposits of fill (Tulchin and McDermott 2008).

5.3.34 Engineering-environmental Management 2009

Engineering-environmental Management, Inc., conducted a historic building survey and evaluation in 2009, which included ten Army National Guard facilities on O'ahu. The survey was intended to aid the Hawaii Army National Guard in complying with Sections 106 and 110 of the National Historic Preservation Act of 1966, as amended, and the requirements of Army Regulation 200-1. The survey included the three structures at the Waiawa National Guard Facility, which is adjacent to the northernmost extent of the current study area on the west side of Waiawa Gulch. Engineering-environmental Management, Inc., assessed the RC Organizational Storage (Building 13) and two Unit Training Equipment Site Military Vehicle Storage Buildings (Building 00025 and Building 00065), which were constructed between 1943 and 1945, as eligible for NRHP listing under Criterion A for their association "with the broad pattern of military storage expansion during World War II" and under Criterion C for "embodying distinctive characteristics of type and period of construction and as a significant grouping whose components lack individual distinction, but an overall distinguishable entity." It is also stated that the remaining World War II-era warehouses at Waiawa Gulch are also evaluated as eligible for NRHP listing under the same criteria (Engineering-environmental Management 2009).

5.3.35 Hammatt 2010

As previously introduced (in Section 5.1.13), in 2010, CSH completed an AIS for Construction Phase 1 and the western portion of Phase 2 of the HHCTCP, which runs *mauka* (north) of the current study area before intersecting it briefly in Waiawa and Mānana Ahupua'a. Pedestrian inspection of the Phase 2 portion of the survey area confirmed the entire survey area was previously disturbed by urban development. No surface cultural resources were identified. Test excavations targeted proposed transit stations with a focus on testing areas that are planned for subsurface disturbance (i.e., elevator shafts, subsurface utilities). Test excavations were also located at selected guideway column foundation locations along the proposed elevated rail line.

The stratigraphy described along Kamehameha Highway consisted of varying layers of fill overlying naturally deposited alluvial sediment, which was encountered at approximately 1.1 to 1.4 m below surface.

A focus of subsurface testing was the then-proposed Transit Maintenance and Storage Facility (the westernmost of the three present study corridors extending *mauka* traverses this parcel) and the Leeward Community College Station adjacent to the east. Nine test trenches were excavated at the Maintenance and Storage Facility and three test trenches were excavated at the Leeward Community College Station. The observed and documented stratigraphy within the Maintenance and Storage Facility consisted of varying layers of naturally deposited silt. In some instances limestone and basalt bedrock were encountered. The observed and documented stratigraphy within the LCC Station consisted of varying layers of imported fill associated with parking lot construction, overlying naturally deposited silt. No subsurface cultural resources were observed.

Another focus of subsurface testing was the Pearl Highlands Station and park-and-ride facility (located where the westernmost *mauka* corridor of the present study area meets the Kamehameha Highway portion of the present study area) where 15 test excavations were undertaken. In general, the stratigraphy at the Pearl Highlands Station consisted of varying layers of fill to depths in excess of 3.5 m. Fill events were determined to be associated with residential and agricultural

development. Natural alluvial sediments, which were expected along the margins of Waiawa Stream, were encountered beneath the extensive fill deposits in only three of the test excavations.

One historic property other than the previously discussed SIHP # 50-80-09-7751, comprised of a subsurface *lo'i* deposits (at the proposed Waipahu Transit Center location) was identified in the Hammatt 2010 study.

5.3.36 O'Hare et al. 2011

As previously introduced (Section 5.1.14), in 2010, CSH conducted an archaeological LRFI for the Honouliuli/Waipahu/Pearl City Wastewater Facilities from Honouliuli to Hālawā Ahupua'a. This study area runs roughly in alignment with the *makai* bike path portion of the central portion of the current study area. No historic properties were identified during the archaeological surface survey of the project area. Based on the intersection of the project area with locations likely to have been utilized for Hawaiian settlement due to proximity to a water source, O'Hare et al. 2011 recommended a combination of on-call monitoring, on-site monitoring, and AIS for different nodes throughout the project area (O'Hare et al. 2011).

5.3.37 Sroat et al. 2012

In 2011, CSH conducted an AIS of a 6.5-km (4.1-mile) section of the proposed Honolulu High-Capacity Transit Corridor Project (HTTCTCP) in Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a. Field methods included pedestrian survey, ground penetrating radar, and backhoe-assisted subsurface testing. This AIS study overlapped with approximately the eastern half of the Kamehameha Highway section of the central portion of the present project area. Stratigraphy from a couple of test excavations (E1 and E2) are germane to the east end of the central portion of the present study area.

Trench E1 was located along Kamehameha Highway on the east side of the Pu'u Momi Street intersection. The stratigraphy encountered in Trench E1 consisted of the asphalt road surface (Stratum Ia at 0–15 cmbs), basalt gravel base course (Stratum Ib to 40 cmbs), and gravelly clay loam fill (Stratum II to BOE at 149 cmbs.). Trench E2 located along Kamehameha Highway immediately north of Loch View B Cemetery was virtually identical (Sroat et al. 2012:92–99).

Only one historic property, SIHP # 50-80-09-7150, a subsurface cultural deposit (*lo'i* sediments) was identified in the Sroat et al. 2012 AIS and that was well to the east of the central portion of the present study area within Waiau Ahupua'a; this will be discussed further in the overview of that eastern portion of the present study area.

5.3.38 Thurman et al. 2012

In 2011, CSH conducted an archaeological reconnaissance survey of a 1,680-acre parcel of Kamehameha School Lands in the uplands of Waiawa Ahupua'a, which stretches from the H-2 Freeway in the west to Waiawa Gulch in the east. The purpose of the study was to explore the gulches, rock outcrops, and karst topographic areas, and to revisit previously recorded historic properties. Newly identified historic properties within the study area included CSH 1, a traditional Hawaiian petroglyph site consisting of three images; CSH 2, a possible rock shelter that requires additional investigation; and CSH 3, a traditional Hawaiian lithic quarry. Revisited historic properties include SIHP #s 50-80-09-1470, -1471, -1472, -2262, -2263, -2264, -2270, -2271, -2272, and -2273 which were initially identified during an archaeological reconnaissance and

inventory survey (Goodman and Nees 1991). Recommendations for the newly and previously identified historic properties range from preservation to further documentation (Thurman et al. 2012). None of the identified sites was near the present study area.

5.3.39 Yeates and Dye 2013

In 2011, T.S. Dye & Colleagues, Archaeologists, Inc., conducted an AIS (recorded as an archaeological assessment) for a proposed plaza at Pearl City Assisted Living Center in Waiawa Ahupua'a. The AIS consisted of a 100% pedestrian survey of the project area and the excavation of five test excavations. No historic properties were identified and Yeates and Dye (2013) concluded the entire project area had been greatly modified to include only fill material.

5.3.40 Blackwell and Barnes 2014

In 2014, HDR, Inc., conducted an historic building survey and evaluation of Army National Guard facilities adjacent to the northernmost portion of the present study area for the sake of compliance with Section 106 of the National Historic Preservation Act of 1966, as amended; the requirements of Army Regulation 200-1; Hawai'i Revised Statutes (HRS) §6E; and HAR §275–284. The survey included the Waiawa Gulch Unit Regional Training Site Maintenance and the former Training Equipment Site structures which are/were located adjacent to the current study area at its northern extent in Waiawa Gulch. The structures assessed were constructed in the 1960s, however, neither was assessed as eligible for listing on the NRHP or the HRHP (Blackwell and Barnes 2014).

5.3.41 Monahan 2015

In 2014, TCP Hawai'i, LLC conducted an AIS of a 1,395-acre Kamehameha Schools land parcel for a proposed solar farm development project. The study area is located north of the H-1 Freeway, east of the H-2 Freeway, and immediately west of the northernmost portion of the current study area along Waihona Street in Waiawa Ahupua'a. The study included a combination of targeted pedestrian inspection, systematic pedestrian survey, and targeted subsurface testing. Three historic properties, previously documented by Goodman and Nees (1991), were identified during the study as well as previously identified features associated with the historic properties. These historic properties include 1) SIHP # 50-80-09-2270, a network of post-Contact roads and railroad ROWs comprised of 28 features; 2) SIHP # -2273, a post-Contact irrigation system consisting of 25 features; and 3) SIHP # -2271, remnant plantation worker camps including two features. Recommendations pertaining to the historic properties included no further work for SIHP #s -2270 and -2271, and preservation for SIHP # -2273 (Monahan 2015). The historic properties discussed are well inland of the present study area.

5.3.42 Yucha et al. 2016

In 2014, CSH completed archaeological monitoring for the Pearl City Force Main project at four discrete locations near the inland border of Pearl City Peninsula along the OL&R ROW. All four locations fall within the current study area corridor and include study areas near Waiawa Stream and Waiawa Spring. Despite the study area being directly adjacent to two known historic properties, SIHP # 50-80-09-0019 (Loko Kuhialoko) and SIHP # 50-80-12-9714 (OR&L ROW), no historic properties were identified during the implemented monitoring program (Yucha et al. 2016).

5.3.43 Yucha and McDermott 2017

In 2013, CSH completed an archaeological monitoring program for the Hale Mohalu II project along Kamehameha Highway in Pearl City, Waimano Ahupua'a. The monitoring program resulted in the identification of three historic properties including SIHP #s 50-80-09-4349, -7214, and -7382. SIHP # -4349 consists of four inadvertently encountered post-Contact coffin burials that are components of what has previously been identified as the former Loch View B Cemetery. One burial yielded a half silver dollar dating to "1905," indicating the burial area was used at least until then. SIHP # -7214 is comprised of at least three inadvertently encountered post-Contact human burials and SIHP # -7382 consists of a pre- to post-Contact cultural layer with multiple traditional Hawaiian features and human burial components (Yucha and McDermott 2017).

5.3.44 Shideler and Hammatt 2018

In 2018, CSH conducted an LRFI at Leeward Community College in Waiawa Ahupua'a, for a proposed photovoltaic and energy storage project. The study included a pedestrian survey of the project area during which no historic properties or evidence of previous land use was visible at ground surface. No further archaeological work was recommended within the project area (Shideler and Hammatt 2018).

5.3.45 Yucha et al. 2018

CSH conducted an archaeological evaluation in 2018 for the Defense Emergency Siren Modernization Program at 14 discreet locations including Mānana Community Park, which is in the vicinity of the current study area within Mānana Ahupua'a. Based on the geographic location, known cultural history at this specific geographic location, absence of any indication of prior finds at this specific location, and indication of land alteration, no further archaeological work was recommended by Yucha et al. (2018) for the Mānana Community Park Siren location.

5.4 Summary of Previously Identified Historic Properties within the Central Portion of the Project Corridors

As defined for the purposes of this study, the central portion of the study corridor traverses (from west to east) SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District; SIHP # 50-80-09-123, Loko Eo fishpond; SIHP # 50-80-09-6764, the former Ewa Junction Navy Fuel Drum site; SIHP # 50-80-09-119, the Loko Kuhia (Kuhialoko); and SIHP # 50-80-12-9714, the former OR&L alignment.

SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District, is traversed in the central portion of the study area along Middle Loch and Pearl City Peninsula. A brief discussion on the National Historic Landmark and historic property can be found in Section 5.2.

SIHP # 50-80-09-6764 (Loko Eo) and SIHP # 50-80-12-9714 (Kuhialoko), have been previously documented but have yet to be identified in an archaeological context. Athens et al. (2000) made a significant effort to test Loko Eo and Loko Kuhia with problematic results. While this certainly does not rule out future testing efforts, it suggests they may not be fruitful. On the other hand, monitoring might produce data on the presence and nature of fishpond walls or phases of maintenance that may not have been readily available with the employed coring methodology previously used.

SIHP # 50-80-09-6764, the former Ewa Junction Navy Fuel Drum site, was at the time of the fieldwork for the present study, actively being redeveloped for a HART Rail Operations Center and is suggested to be a non-issue for the present project.

As previously noted, even though the portion of the SIHP # 50-80-12-9714 OR&L railroad ROW that skirts the north side of Pearl Harbor has largely been redeveloped into a bike path, and lies outside the portion on the NRHP, any modification of this site remnant is still a significant historic preservation issue.

5.5 Previous Archaeological Investigations in the Eastern Portion of the Study area from Waiau to Hālawā

Much of the lands in the vicinity of the Waiau to Hālawā section of the current study area were developed prior to the establishment of legislation requiring cultural resource management efforts to mitigate the impact of development on archaeological resources. As a result, there have been relatively few archaeological studies conducted in the vicinity of the current study area (Figure 93 and Table 27). These studies include archaeological inventory surveys, archaeological reconnaissance, osteological assessments, literature review and field inspections, and archaeological monitoring programs which are summarized in the text below in chronological order. Archaeological finds documented during these studies include post-Contact burials, pre- and post-Contact cultural layers, Hawaiian *loko* deposits, *lo'i* deposits, and historical infrastructure. In total, 21 archaeological sites have been documented in the vicinity of the Waiau to Hālawā section of the study area (most have been assigned a SIHP number); these are indicated on Figure 94 and described in Table 28.

5.5.1 Cluff 1970

An archaeological surface survey and investigation was undertaken by the Division of State Parks, Outdoor Recreation and Historic Sites, DLNR in 1969. The survey included a portion of the Hālawā interchange, less than 500 m northeast of the current study area, that had reportedly been the location of numerous graves and the remains of a *heiau* which had not been previously recorded or examined archaeologically. The surface survey revealed a possible site of a *heiau*, a stone house platform, several grave structures, and family burial plots. No SIHP numbers were assigned (Cluff 1970).

5.5.2 Barrera 1971

In 1971, the Bishop Museum (Barrera 1971) conducted an archaeological surface survey of the Aloha Stadium property in Hālawā. Numerous marked and unmarked graves were observed near the housing area adjacent to the proposed stadium site. It appears the author was likely referring to graves within the historic 'Aiea Cemetery, located immediately northwest of the Aloha Stadium property. No SIHP number was assigned to the historic cemetery. No additional archaeological resources were encountered during the investigation.

5.5.3 Yent and Ota 1981

In 1981, the DLNR Division of State Parks conducted an archaeological reconnaissance survey at Rainbow Bay State Park, along the 'Aiea Bay shoreline. No historic properties were identified, and extensive land disturbance was noted. The study did indicate the likely presence of subsurface

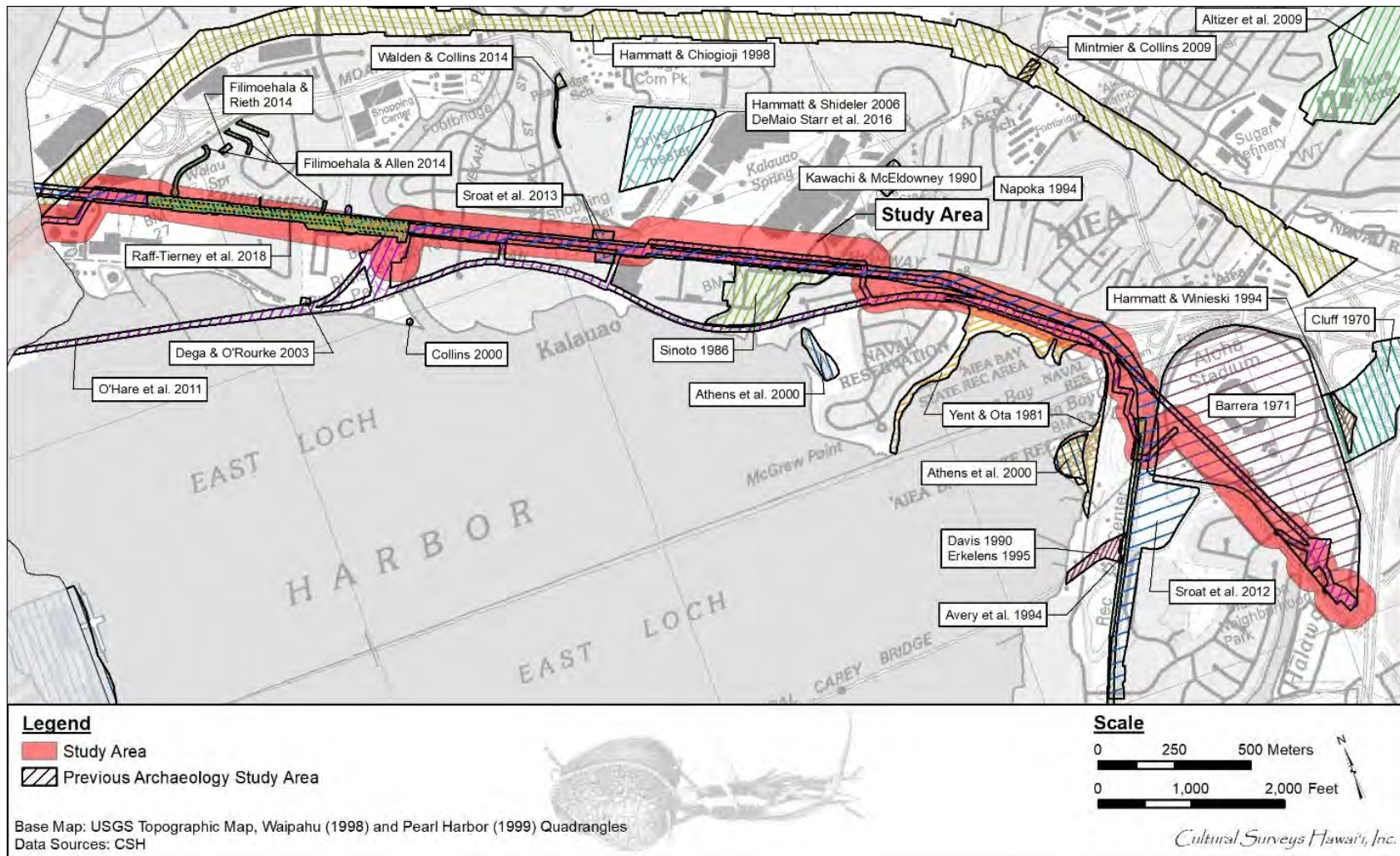


Figure 93. Previous archaeological investigations in the immediate vicinity of the study area from Waiau to Hālawā

Table 27. Previous archaeological investigations in the immediate vicinity of the study area from Waiau to Hālawā (listed chronologically)

Reference	Type of Study	Location	Results
Cluff 1970	AIS	Adjacent to H-1 freeway eastbound off-ramp exit for Aloha Stadium, Hālawā Ahupua'a	Identified possible <i>heiau</i> remnants, historical structural remnants, a coral and basalt stone wall, three irregular basalt stone mounds (possibly associated with burial/s), concrete enclosure in basalt paving stones (possibly associated with a burial), and three burial plots containing no less than 23 individuals; no SIHP #s assigned
Barrera 1971	Archaeological surface survey	Aloha Stadium, Hālawā Ahupua'a	No historic properties identified; noted graves in adjacent 'Aiea Cemetery
Yent and Ota 1981	Archaeological reconnaissance	Rainbow Bay State Park, Kalauao and 'Aiea Ahupua'a	No historic properties identified
Sinoto 1986	Archaeological surface survey	Pearl Promenade in Aiea, Kalauao Ahupua'a	One historic property identified: SIHP # 50-80-12-9714, OR&L Railroad ROW
Davis 1990	Archaeological field inspection	Terminal points of Admiral Carey Bridge, Hālawā Ahupua'a and Ford Island	No historic properties identified
Kawachi and McEldowney 1990	Osteological assessment	Kaonohi gauging station at intersection of Pali Momi and Moanalua Rd, Kalauao Ahupua'a	One historic property identified: SIHP # 50-80-09-3713, two historic coffin burials and a subsurface cultural layer containing charcoal lenses, and midden, and both traditional and historic artifacts; coffins disinterred and relocated to unknown location
Avery et al. 1994	Archaeological monitoring	Kamehameha Hwy from western boundary of Hālawā to Radford Dr, Hālawā Ahupua'a	No historic properties identified

Reference	Type of Study	Location	Results
Hammatt and Winieski 1994	Archaeological reconnaissance	Adjacent to H-1 freeway eastbound off-ramp exit for Aloha Stadium, Hālawā Ahupua'a	No historic properties identified
Napoka 1994	Field inspection	Intersection of Moanalua Rd and Nalopaka Place, 'Aiea Ahupua'a	One historic property identified: SIHP # 50-80-09-4892, Pōhaku o Ki'i
Erkelens 1995	Archaeological inventory surface	Ford Island Golf Park and Rainbow Marina, East Loch, Pearl Harbor, Hālawā Ahupua'a	No historic properties identified
Hammatt and Chiogioji 1998	Archaeological reconnaissance and assessment	H-1 Freeway, Waiawa to Hālawā Ahupua'a	No historic properties identified
Athens et al. 2000	Paleo-environmental study	Pearl Harbor Area	Study identified eight of 21 targeted Hawaiian fishponds and provided insight into future endeavors to construct a chronological framework for fishpond construction using qualitative dating techniques and Bayesian analysis
Collins 2000	Personal communication	Neal S. Blaisdell Park, Waimalu Ahupua'a	One historic property identified: SIHP # 50-80-12-6383, two previously disturbed human burials
Dega and O'Rourke 2003	Archaeological monitoring	Neal S. Blaisdell Park, Waimalu Ahupua'a	No historic properties identified
Hammatt and Shideler 2006	Archaeological LRFI	Northeast portion of city block bounded by Moanalua Rd to the northeast and Kaonohi St to the southeast, Kalauao Ahupua'a	No historic properties identified
CSH 2008	Archaeological technical report	HHCTCP	One historic property identified within current study area: 'Aiea Cemetery (not included on Fig. 50)
Altizer et al. 2009	Archaeological LRFI	'Aiea Intermediate School, 'Aiea Ahupua'a	No historic properties identified

Reference	Type of Study	Location	Results
Mintmier and Collins 2009	Archaeological assessment	H-1 freeway intersection with Ka'amilo St, Kalauao Ahupua'a	No historic properties identified
O'Hare et al. 2011	Archaeological LRFI	Project area roughly aligned with Kamehameha Hwy and Pearl Harbor shoreline until extending into <i>makai</i> portion of Honouliuli, Honouliuli to Hālawa Ahupua'a	No historic properties identified
Sroat et al. 2012	AIS	Phase 2 and western portion of Phase 3 of HHCTCP, Waiawa to Hālawa Ahupua'a	One historic property identified within Waiawa Ahupua'a portion: SIHP # 50-80-09-7150, subsurface <i>lo'i</i> deposit yielding radiocarbon date range of AD 1414-1480
Sroat et al. 2013	Supplementary AIS	Pearlridge Station of HHCTCP, Waimalu Ahupua'a	No additional historic properties identified (supplement of Sroat et al. 2012)
Filimoehala and Allen 2014	Archaeological monitoring	Kuleana Place, Kaulike Dr, and Kauhiau Place, Waiawa Ahupua'a	Three historic properties identified: SIHP # 50-80-09-7569, a pre-Contact charcoal deposit; SIHP # -7570, a fire feature; and SIHP # -7571, a post-Contact subsurface deposit with two fire or refuse features; one modern rock wall alignment identified in addition (no SIHP # assigned)
Filimoehala and Reith 2014	Archaeological assessment	North of Kamehameha Hwy near Waiawa Spring area, Waiawa Ahupua'a	No historic properties identified
Walden and Collins 2014	AIS	Northeast extent of Moanalua Loop, Waimalu Ahupua'a	One historic property identified: SIHP # 50-80-09-7567, comprised of two culverts (Features 1 and 2) constructed in the mid-1950s

Reference	Type of Study	Location	Results
Demaio Starr et al. 2016	AIS	Northeast portion of city block bounded by Moanalua Rd to the northeast and Kaonohi St to the southeast, Kalauao Ahupua'a	One historic property identified: SIHP # 50-80-09-7811, Kam Hi-Way Drive-In which includes original projection booth and concession stand
Raff-Tierney et al. 2018	Archaeological monitoring	Kamehameha Hwy alignment, at abutment of Waiiau and Waimalu Ahupua'a	Two historic properties identified: SIHP # 50-80-09-8144, a historical subsurface trash deposit, and SIHP # -7150, a previously identified subsurface <i>lo'i</i> deposit (see Sroat et al. 2012)

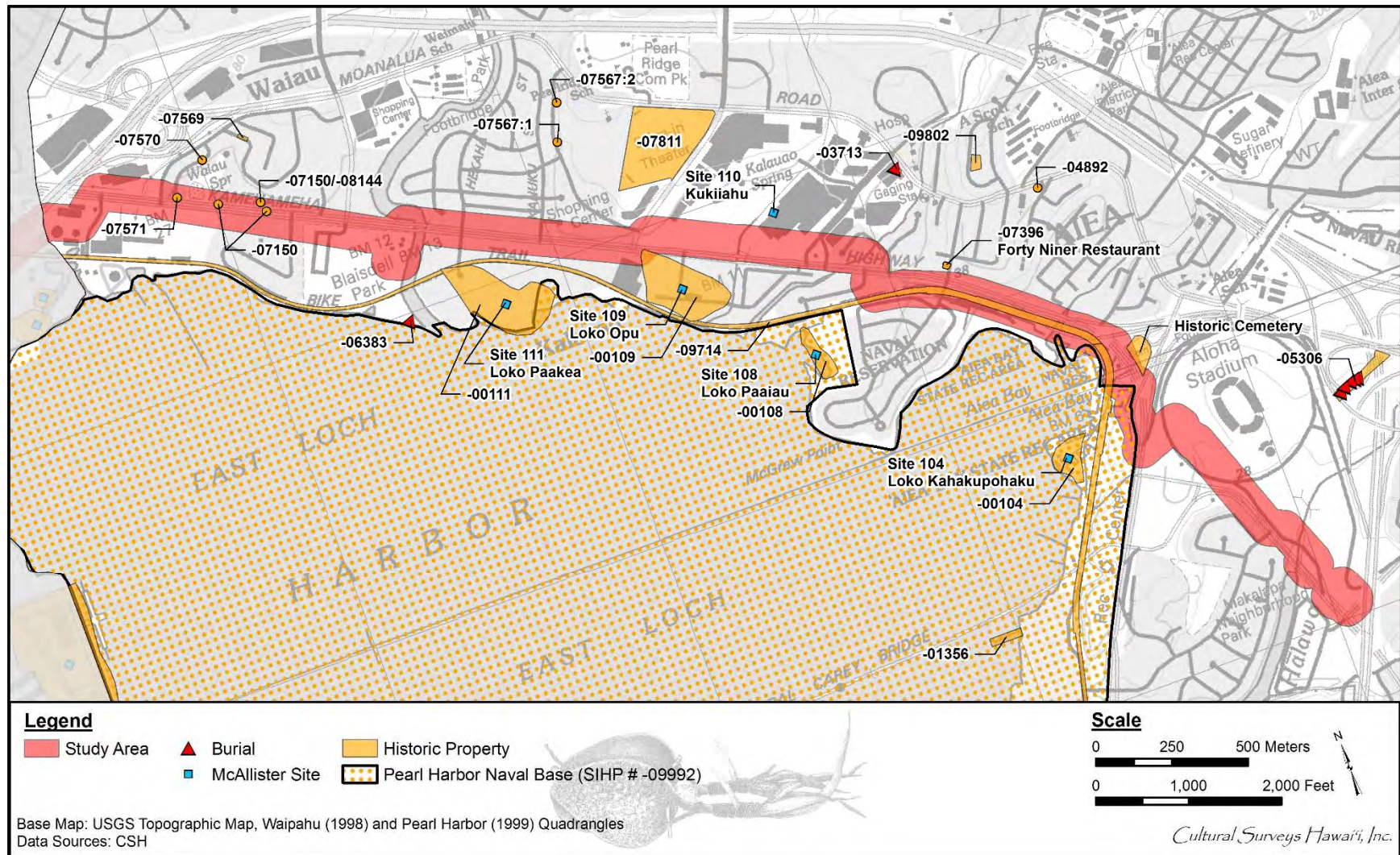


Figure 94. Previously identified historic properties in the immediate vicinity of the eastern section of the study area from Waiau to Hālawā

Table 28. Previously identified historic properties in the immediate vicinity of the eastern section of the study area from Waiiau to Hālawā

SIHP # (50-80-)	Formal Type	Source	Comment
09-00108	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Paaiāu; rectangular pond surrounded by land and wall on harbor side
09-00109	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Opu; 10.5-acre pond, partially filled in and surrounded by wall
09-00111	Hawaiian fishpond	McAllister 1933, Athens et al. 2000	Loko Paakea; 12-acre pond with 1,850 ft wall and adjoining smaller pond
09-03713	Burial	Kawachi and McEldowney 1990	Pre- to post-Contact cultural deposits and two historical coffin burials
09-04892	Storied stone (Pōhaku o Ki'i)	Napoka 1994	Rock associated with significant Hawaiian legend
09-05306	Human interment area	Cluff 1970	Three burial plots potentially containing 23 individuals and possible <i>heiau</i> remnants
09-07150	Subsurface cultural deposits	Sroat et al 2012, Raff-Tierney et al. 2018	<i>Lo'i</i> sediments yielding a radio-carbon date range in the 1400s
09-7396	Building	Cordes and Cordes 2012	Forty Niner Restaurant, constructed in 1947
09-07567: 1 & 2	Water control feature	Walden and Collins 2014	Two culverts constructed in the mid-1950s
09-07569	Cultural deposit	Filimoehala and Allen 2014	Pre-Contact charcoal deposit associated with traditional Hawaiian irrigation
09-07570	Fire feature	Filimoehala and Allen 2014	Presumed post-Contact
09-07571	Subsurface cultural deposit	Filimoehala and Allen 2014	Post-Contact deposit consisting of two fire or refuse features
09-07811	Kam Hi-Way Drive-In	Demaio-Starr et al. 2016	Mid-1900s drive-in cinema
09-08144	Subsurface trash deposit	Raff-Tierney et al. 2018	Trash deposit dating to the early to mid- twentieth century
09-09802	Historic residence	HRHP	Honolulu Plantation manager's residence constructed in 1926
12-06383	Burial	Collins 2000	Two previously disturbed human burials in secondary context

SIHP # (50-80-)	Formal Type	Source	Comment
12-09714	Railroad	Sinoto 1986	OR&L ROW
13-00104	Hawaiian fishpond	McAllister 1933 and Athens et al. 2000	Loko Kahakupōhaku; small pond of 3 acres with a semi-circular wall
13-01356	USS <i>Bowfin</i>	National Register of Historic Places	WWII-era U.S. submarine
13-09992	Historic Military District	Apple 1978	U.S. Naval Base, Pearl Harbor Historic District (NRHP #66000940)
McAllister 110 (no SIHP # assigned)	Traditional habitation	McAllister 1933	Kukiiahu; habitation place of chiefess Kalaimanua and setting for battle of Kukiiahu
Historic Cemetery	‘Aiea Cemetery	CSH 2008	Early to mid-1900s cemetery established by Honolulu Plantation Co.

cultural deposits associated with pre-Contact land use, specifically associated with aquaculture (i.e., fishponds) (Yent and Ota 1981).

5.5.1 Sinoto 1986

In 1986, the Bishop Museum (Sinoto 1986) conducted an archaeological surface survey for the Pearl Promenade project, near the Pearlridge Shopping Center. One historic property was identified: SIHP # 50-80-12-9714, the OR&L Railroad ROW. Background research indicated the area was traditionally utilized by Hawaiians for aquaculture (i.e., fishponds). However, surface survey revealed the entire area was filled in and graded, associated with historic and modern development. As the entire study area showed signs of extensive land alteration, no further cultural resource management work was recommended.

5.5.2 Davis 1990

IARII conducted an archaeological field inspection at the terminal points of the Admiral Carey Bridge that extends from the shore of Hālawa to Ford Island. No historic properties were identified at surface level within the project area; the area had been heavily developed. Background research for the project did, however, determine the former existence of multiple fishponds along the now buried shoreline near to the current study area (Davis 1990).

5.5.3 Kawachi and McEldowney 1990

In 1990, active construction in the Pearlridge-Pali Momi area at the Kaonohi gauging station, adjacent to Pali Momi Road and Moanalua Road, unearthed two previously undocumented coffin burials. Kawachi and McEldowney from the State of Hawai'i's Historic Preservation program inspected the area prior to disinterment of the burials and identified historical cultural deposits as well as indications of traditional land use such as shell midden and a stone adze. The Kaonohi (Pali Momi) prehistoric habitation site and historic burials are designated as SIHP # 50-80-09-3713 (Kawachi and McEldowney 1990).

5.5.4 Avery et al. 1994

From 1992 to 1993, Archaeological Consultants of Hawaii, Inc. (ACH) (Avery et al. 1994) monitored subsurface drilling associated with the installation of power line poles along Kamehameha Highway from Aloha Stadium to the Makalapa Gate of the Pearl Harbor Naval Base. No historic properties were identified during the archaeological monitoring. A paleoenvironmental analysis of alluvial sediments was also undertaken, indicating the possible existence of a lowland *Pritchardia* palm forest prior to Polynesian settlement.

5.5.5 Hammatt and Winieski 1994

In 1994, CSH conducted an archaeological reconnaissance survey at the proposed Hālawa Caprock non-potable well located adjacent to the H-1 Freeway on-ramp which serves as the *makai* exit for Aloha Stadium. The study concluded all evidence of early historic or pre-historic Hawaiian activity would have been eradicated by development of the project area in the late nineteenth century for commercial sugar cultivation. No historic properties were identified (Hammatt and Winieski 1994).

5.5.6 Napoka 1994

In 1994, the State of Hawai'i DLNR, State Historic Preservation Division, determined the cultural significance of a large boulder called Pōhaku o Ki'i at the intersection of Moanalua Road and Nalopaka Place in 'Aiea. The *pōhaku* (rock) is associated with traditional legendary accounts of the area and SHPD determined that they be consulted prior to any undertakings in the area which might affect the historic property. Pōhaku o Ki'i is designated as SIHP # 50-80-09-0492.

5.5.7 Erkelens 1995

IARII conducted an archaeological study for the proposed Ford Island Golf Park and Saratoga Boulevard relocation. The study area is located at the Ford Island Golf Park and the Rainbow Marina in the East Loch of Pearl Harbor. No historic properties were identified during the archaeological investigation and it was determined that the project area has likely been affected by previous historical ground disturbance. Therefore, no further archaeological mitigation measures were recommended (Erkelens 1995).

5.5.8 Hammatt and Chiogioji 1998

In 1998, CSH conducted an archaeological reconnaissance survey and assessment of a portion of the H-1 Freeway from Hālawa to the H1-H2 interchange at Waiawa for proposed traffic improvements (Hammatt and Chiogioji 1998). The survey area traverses approximately 60 m south of the current study area. No archaeological sites had previously been recorded within any portion of the study area or its immediate vicinity, and no surface archaeological sites were observed during the reconnaissance survey of the lands adjacent to the highway study area corridor. There are several buildings older than 50 years adjacent to the highway corridor at First and Second streets in Pearl City. Recommendations included consultation with the SHPD to ascertain if the buildings are of historical concern if future highway improvement activities will impact these structures. No further archaeological investigations were recommended for the area; it was determined that any prehistoric surface or subsurface archaeological remains are unlikely to be present due to urban development along the H-1 Freeway study area (Hammatt and Chiogioji 1998:20).

5.5.9 Athens et al. 2000

In 2005, IARII conducted field research designed to target 21 former fishponds around the Pearl Harbor area (as previously introduced in 0 and Section 5.3.16). The project aimed to create a chronological framework for fishpond construction using qualitative dating methods and Bayesian calibration. It was not possible to produce a chronology due to complications associated with methodology, however, Athens et al. (2000) offer insight into future endeavors with similar goals and the identification of fishpond sediment. Their results conclude that many of the former fishponds were heavily disturbed by historical land use and fishpond sediments were only distinguishable in eight of the 21 targeted fishponds (Athens et al. 2000).

- SIHP # -104 Loko Kahakupōhaku: “This is a small filled fishpond located along the east shoreline of East Loch. No field investigations were undertaken at this pond due to possible hazardous waste contamination of the overlying fill” (Athens et al. 2000:31). A photo is supplied.
- SIHP # -108 Loko Paaiau: “Loko Paaiau is a small fishpond located on the west side of McGrew Point at the northeast end of East Loch. This pond is one of the few in the Pearl Harbor area that is not covered by fill. There is about 1 m of standing water in the pond. The outer pond wall, except for its northeast section, appears mostly intact although overgrown with mangroves” (Athens et al. 2000:31). Two partial cores and one full core were taken, and 21 carbon dates were obtained. It was concluded that “fishpond sediments for one reason or another were not preserved at the coring location. Other locations, therefore, should be tested at Loko Paaiau for the presence of fishpond sediments” (Athens et al. 2000:33).
- SIHP # -109 Loko Opu, no work undertaken
- SIHP # -111, Loko Pa‘akea, no work undertaken

5.5.10 Collins 2000

In 2000, the partial remains of two individuals were inadvertently identified in the southeastern portion of Blaisdell Park. The remains were encountered within a disturbed context and may have been reburied after initial disturbance. A possible cultural layer was also identified in association with the human burials. “Collins 2000” refers to personal communications between Dega and/or O’Rourke and Sara Collins of the SHPD (Dega and O’Rourke 2000:19). The burials are designated as SIHP # 50-08-12-6383. We note in passing that additional human remains were found near Blaisdell Park on March 15, 2011 (Shikina 2011).

5.5.11 Dega and O’Rourke 2003

In 2003, Dega and O’Rourke conducted an archaeological investigation of environmental sampling at the Neal S. Blaisdell Park located approximately 100 m south of the current study area. Environmental testing occurred in the southwestern corner of Blaisdell Park at the location of the former Waiiau Drum Storage Facility and included shallow surface soil collection as well as the drilling of four wells to test groundwater. Though Dega and O’Rourke (2003) had hypothesized the area to have moderate to high probability for documenting historic properties, no cultural materials were identified during the study. It was also noted by the authors that areas of deep

subsurface investigation revealed stratigraphy consisting of natural sediments overlain by historic and modern fill deposits.

5.5.12 Hammatt and Shideler 2006

In 2006, Hammatt and Shideler from CSH conducted a LRFI for the Live Work Play 'Aiea project located within the Pearl Ridge area and bounded by Moanalua Road to the north and Ka'ono'hi Street to the southeast. They determined the project area was unlikely to have any significant subsurface cultural deposits. If there had been cultural materials in the past, they most likely were destroyed by decades of commercial sugarcane cultivation or the grading associated with the establishment of the Kamehameha Drive-In (Hammatt and Shideler 2006).

5.5.13 CSH 2008 (not depicted on Figure 93)

In 2008, CSH completed an archaeological technical report for the HHCTCP (CSH 2008). The report identified likely impacts to archaeological resources within the HHCTCP corridor. Within the Kamehameha Highway portion of the project corridor, the study identified and provided brief documentation of 'Aiea Cemetery, located on the *mauka* side of Kamehameha Highway, adjacent to the Aloha Stadium property.

Background research associated with an additional archaeological study (Sroat et al. 2012) indicated the cemetery was established by the Honolulu Plantation Company. The cemetery previously extended *makai* of Kamehameha Highway, but was bisected during highway construction. The burials in the *makai* portion of the cemetery were indicated to have been relocated to the *mauka* portion of the cemetery prior to highway construction.

5.5.14 Altizer et al. 2009

CSH completed an LRFI in 2009 for the 'Aiea Intermediate School Erosion Control project. The project area is located approximately 750 m northeast of current study area, bounded by 'Aiea Stream to the northeast and Ali'ipoe Street to the southeast. No historic properties were identified during the field inspection and the study determined there is little potential for intact cultural deposits within the project area (Altizer et al. 2009).

5.5.15 Mintmier and Collins 2009

Pacific Consulting Services, Inc. conducted an AIS (recorded as an archaeological assessment) in 2009 for the Freeway Management System replacement of a dynamic message sign at the intersection of the H-1 Freeway with Ka'milo Street. No historic properties were identified during the surface assessment but Mintmier and Collins (2009) conclude subsurface cultural deposits may be present since this area was traditionally and historically used for agriculture and settlement and was also a seat of power for many of O'ahu's royal leaders.

5.5.16 O'Hare et al. 2011

In 2010, CSH conducted an archaeological LRFI for the Honouliuli/Waipahu/Pearl City Wastewater Facilities from Honouliuli to Hālawa Ahupua'a. This project area runs roughly parallel on the *makai* side of the current study area, ranging from 0 to 500 m *makai* (south) of the current study area, before diverging near Aloha Stadium. No historic properties were identified during the archaeological surface survey of the project area. Based on the intersection of the project area with locations likely to have been utilized for Hawaiian settlement due to proximity to a water source,

O'Hare et al. 2011 recommended a combination of on-call monitoring, on-site monitoring, and archaeological inventory survey for different nodes throughout the project area (O'Hare et al. 2011).

5.5.17 Sroat et al. 2012

In 2011, CSH conducted an AIS of a 6.5-km (4.1-mile) section of the proposed HTTCTCP in Waiawa, Mānana, Waimano, Waiāu, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a. Field methods included pedestrian survey, ground penetrating radar, and backhoe-assisted subsurface testing. Twenty-two test excavations (E4 through E25) were conducted along Kamehameha Highway within the present project area corridor between Pu'u Poni Street on the west and Aloha Stadium on the east.

It is noted that the project area "is largely confined to the footprint of Kamehameha Highway" and that

Kamehameha Highway has long been a major utility corridor, including: fuel, gas, cable TV, electric, fiber optic, water, storm drains, and sewer lines. The installation of these numerous linear utility lines, extending parallel to the highway's long axis, has undoubtedly affected portions of the study area by increasing the disturbance of underlying natural sediments beneath the highway surface. [Sroat et al. 2012:90]

Hence, outside the highway corridor the stratigraphy could be significantly different.

Only one historic property was identified during this study, during a test excavation within Waiāu Ahupua'a just west of Blaisdell Park: SIHP # 50-80-09-7150, a subsurface cultural deposit (*lo'i* sediments) yielding a radiocarbon date range of AD 1414-1480. Sroat et al. (2012) evaluated the historic property as eligible for inclusion in the NRHP as well as HRHP under Criterion D. Four segments within the Section 2 construction were recommended for full-time on-site monitoring, including the area around SIHP # -7150. The remaining segments of the Section 2 project area were recommended for on-call monitoring with weekly spot checks (Sroat et al. 2012).

5.5.18 Sroat et al. 2013

In 2013, an additional inventory survey was conducted by CSH in association with Sroat et al. (2012), around the area of the Pearlridge Station, within Section 2 of the HTTCTCP. No additional historic properties were identified, and monitoring recommendations stated in the previous report were reiterated (Sroat et al. 2013).

5.5.19 Filimoehala and Allen 2014

In 2013, IARII conducted archaeological monitoring in support of the Waiāu Area Sewer Rehabilitation/Reconstruction project located adjacent and north of the current study area. Three historic properties were identified (SIHP #s 50-80-09-7569 through -7571), and one modern wall rock alignment was observed (no SIHP number assigned). SIHP # -7569 is a pre-Contact charcoal deposit associated with traditional Hawaiian irrigated cultivation. A native plant charcoal sample obtained from an associated deposit yielded a radiocarbon date with a bimodal distribution of AD 1518-1593 and 1618-1664. SIHP # -7570 is a fire feature (undated, presumed post-Contact), and SIHP # -7571 (located adjacent to the western end of the current study area) is a post-Contact subsurface deposit consisting of two fire or refuse features (Filimoehala and Allen 2014).

5.5.20 Filimoehala and Reith 2014

In 2014, IARII conducted an AIS (recorded as an archaeological assessment) of a 0.03-acre house lot located approximately 150 m northeast of the current study area. No historic properties were identified. However, one isolated mid-twentieth century bottle was observed within fill (Filimoehala and Reith 2014).

5.5.21 Walden and Collins 2014

In 2013, Pacific Consulting Services, Inc. conducted an AIS, approximately 500 m north of the current study area, along a steep embankment at the northeast extent of Moanalua Loop to facilitate proposed rockfall mitigation. One post-Contact historic property was identified; SIHP # 50-80-09-7567, which consists of two culverts (Features 1 and 2) constructed in the mid-1950s. The presence of a concrete chute drain constructed in 1966 was also noted. Since at the time of the report the structure was less than 50 years old, it did not qualify as a historic property and no SIHP number was assigned (Walden and Collins 2014).

5.5.22 Demaio Starr et al. 2016

CSH completed an AIS for the Live Work Play 'Aiea project located within the Pearl Ridge area and bounded by Moanalua Road to the north and Ka'onohi Street to the southeast (same as the Hammatt and Shideler 2006 project area). One historic property was identified and consisted of the Kam Hi-Way Drive-In property, which is designated as SIHP # 50-80-09-7811. The AIS lead to the SHPD determination that no further archaeological work was required for the project (Demaio Starr et al. 2016).

5.5.23 Raff-Tierney et al. 2018

Between 2014 and 2016, CSH conducted archaeological monitoring fieldwork for the Waimalu WWPS Force Main and Waiau Area Sewer Rehabilitation/Reconstruction project. This project area is located within the current study area, where Waiau and Waimalu Ahupua'a abut. Two historic properties were identified during monitoring including SIHP # 50-80-09-8144, a subsurface trash deposit identified in a fill deposit dating to the early to mid-twentieth century, and SIHP # -7150, a subsurface *lo'i* deposit which was previously identified by Sroat et al. (2012) (Raff-Tierney et al. 2018).

5.5.24 Honolulu Rapid Transit Project (H RTP) Archaeological Monitoring To Date

The Honolulu Rapid Transit Project (H RTP) to date has encountered human skeletal remains in two locations within 'Ewa District; both within the present study area (general location of the finds depicted on Figure 95). Human tibia shaft and fibula shaft (leg bone) fragments were identified (designated Burial Find 1) in previously disturbed fill sediments near the corner of 'Aiea Kai Place and Kamehameha Highway on December 4, 2014. Human skeletal remains (designated Burial Find 2 through 10) were identified in the Pearl Ridge Makai Station in August 2017. Treatment has moved forward in consultation with the SHPD and O'ahu Island Burial Council. The finalization of reporting is pending.

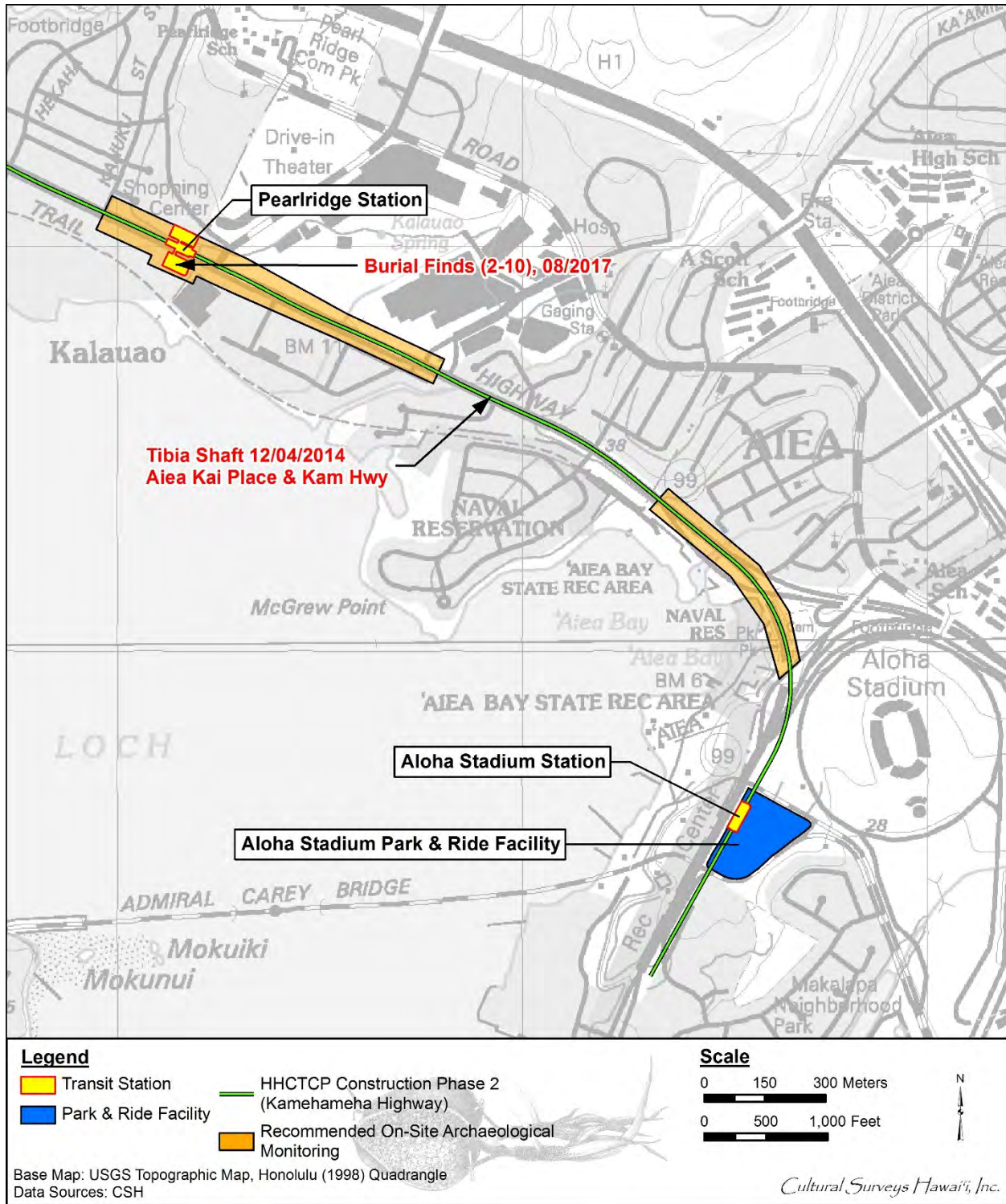


Figure 95. Portion of a 1998 Honolulu USGS topographic quadrangle showing locations of human skeletal remains identified in 'Ewa District during the HRTCP monitoring

5.6 Summary of Previously Identified Historic Properties within the Eastern Portion of the Study Corridor

The eastern portion of the study area is relatively free of previously identified historic properties. In the area just west of Blaisdell Park are features of two sites (SIHP #s 50-80-09-7150 and -7571). SIHP # -7150 identifies subsurface cultural deposits relating to *lo'i* sediments previously identified by Sroat et al. (2012) and Raff-Tierney et al. (2018). These sediments yielded a radio-carbon date range for ponded field taro cultivation in the 1400s. SIHP # -7571 identifies a subsurface post-Contact cultural deposit consisting of two fire or refuse features identified in the Filimoehala and Allen (2014) study.

Near Kalauao Spring stream, the south side of the study area is adjacent to the Loko Opu fishpond (SIHP # 50-80-09-109). We are not aware of any archaeological study at this fishpond since it was identified by McAllister in 1933.

SIHP # 50-80-13-9992, U.S. Naval Base, Pearl Harbor Historic District, is traversed in the eastern portion of the study area, west of the Aloha Stadium. A brief discussion on the National Historic Landmark and historic property can be found in Section 5.2.

The 'Aiea cemetery (no SIHP #) is adjacent to the north side of the project corridor just west of Aloha Stadium but because of the situating of this cemetery effectively up on a bluff it is thought not to be of concern for the present project.

Section 6 Community Consultation

6.1 Introduction

Throughout the course of this assessment, an effort was made to contact and consult with NHOs, agencies, and community members including descendants of the area, in order to identify individuals with cultural expertise and/or knowledge of the *ahupua'a* of Honouliuli. CSH initiated its outreach effort in July 2019 through letters, email, telephone calls, and in-person contact. Consultation for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement project is still ongoing.

6.2 Community Contact Letter

Letters (Figure 96 and Figure 97) along with a map and an aerial photograph of the project were mailed with the following text:

Cultural Surveys Hawai'i, Inc. (CSH) is conducting a cultural impact assessment (CIA) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities and is seeking your guidance and *mana'o*. The CIA is being conducted to help inform the Environmental Impact Statement (EIS) being prepared by the City and County of Honolulu Department of Environmental Services (ENV) to evaluate the potential impacts from the proposed improvements and upgrades to the existing East Interceptor System of the Honouliuli sewer basin. CSH is conducting the CIA under contract to AECOM, the City ENV's prime contractor for the EIS.

The City ENV's proposed action is to rehabilitate, upgrade, and/or expand the existing Honouliuli major sewer conveyance system (East Interceptor System) to accommodate flows through 2050. The affected area include areas with current wastewater flows to the Honouliuli Wastewater Treatment Plant (WWTP) as well as potential future flows from areas including but not limited to Hālawā, 'Aiea, Pearl City, Waipi'o, Waikele, Waipahu, 'Ewa, Kapolei, and Mililani. The East Interceptor System area includes the primary trunk system of gravity lines, pump stations, and force mains conveying flows from areas generally east (to Hālawā) and north (to Mililani) of the Honouliuli WWTP. The proposed action includes portions of coastal Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiāu, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a, 'Ewa District, O'ahu Island, TMK: [1] Zone 9, Sections 1, 4, 6 and 9, multiple plats.

For the purpose of the CIA, a general corridor width of 400-feet along the proposed activities and options will be used for the study area. The project area is depicted on a portion of the 1998 Waipahu and 1999 Pearl Harbor U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1 through Figure 4) and 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photographs (Figure 5 through Figure 8).

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Cultural Impact Assessment Outreach for the Honouliuli/Waipahu/Pearl City Wastewater Collection System Project

July 2019

Aloha,

Cultural Surveys Hawai'i, Inc. (CSH) is conducting a cultural impact assessment (CIA) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities and is seeking your guidance and *mana'o*. The CIA is being conducted to help inform the Environmental Impact Statement (EIS) being prepared by the City and County of Honolulu Department of Environmental Services (ENV) to evaluate the potential impacts from the proposed improvements and upgrades to the existing East Interceptor System of the Honouliuli sewer basin. CSH is conducting the CIA under contract to AECOM, the City ENV's prime contractor for the EIS.

The City ENV's proposed action is to rehabilitate, upgrade, and/or expand the existing Honouliuli major sewer conveyance system (East Interceptor System) to accommodate flows through 2050. The affected area include areas with current wastewater flows to the Honouliuli Wastewater Treatment Plant (WWTP) as well as potential future flows from areas including but not limited to Hālawā, 'Aiea, Pearl City, Waipi'o, Waikele, Waipahu, 'Ewa, Kapolei, and Mililani. The East Interceptor System area includes the primary trunk system of gravity lines, pump stations, and force mains conveying flows from areas generally east (to Hālawā) and north (to Mililani) of the Honouliuli WWTP. The proposed action includes portions of coastal Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiau, Waimalu, Kalauao, 'Aiea, and Hālawā Ahupua'a, 'Ewa District, O'ahu Island, TMK: [1] Zone 9, Sections 1, 4, 6 and 9, multiple plats.

For the purpose of the CIA, a general corridor width of 400-feet along the proposed activities and options will be used for the study area. The project area is depicted on a portion of the 1998 Waipahu and 1999 Pearl Harbor U.S. Geological Survey (USGS) 7.5-minute topographic quadrangles (Figure 1 through Figure 4) and 2016 ESRI Aerial Imagery and 2017 Hawaii Orthos aerial photographs (Figure 5 through Figure 8).

The purpose of this CIA is to gather information about the project area and its environs through research and interviews with individuals knowledgeable about this area in order to assess potential impacts to cultural resources, cultural practices, and beliefs as a result of the proposed project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

- **General history as well as present and past land use of the project area**
- **Knowledge of cultural sites which may be impacted by future development of the project area—for example, historic and archaeological sites, as well as burials**

Figure 96. Community consultation letter page one

HONOULIULI 176 – CIA for Honouliuli/Waipahu/Pearl City Wastewater Collection System
Project

Page 2

- Knowledge of traditional gathering practices in the project area, both past and ongoing
- Cultural associations of the project area, such as *mo'olelo* and traditional uses
- Any cultural significance of the project area in relation to the 'Ewa community (plantation and/or post-World War II history)
- Referrals of *kāpuna* or elders and *kama'āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands
- Any other cultural concerns the community might have related to Hawaiian, or the 'Ewa community's, cultural practices within or in the vicinity of the project area

In advance, we appreciate your assistance in our research effort. If you are interested in participating in this study, please contact Kellen Tanaka at ktanaka@culturalsurveys.com, or by phone at (808) 262-9972.

Mahalo mui loa,

Kellen Tanaka
Cultural Researcher

Figure 97. Community consultation letter page two

The purpose of this CIA is to gather information about the project area and its environs through research and interviews with individuals knowledgeable about this area in order to assess potential impacts to cultural resources, cultural practices, and beliefs as a result of the proposed project. We are seeking your *kōkua* and guidance regarding the following aspects of our study:

- General history as well as present and past land use of the project area
- Knowledge of cultural sites which may be impacted by future development of the project area—for example, historic and archaeological sites, as well as burials
- Knowledge of traditional gathering practices in the project area, both past and ongoing
- Cultural associations of the project area, such as *mo'olelo* and traditional uses
- Any cultural significance of the project area in relation to the 'Ewa community (plantation and/or post-World War II history)
- Referrals of *kūpuna* or elders and *kama'āina* who might be willing to share their cultural knowledge of the project area and the surrounding *ahupua'a* lands
- Any other cultural concerns the community might have related to Hawaiian, or the 'Ewa community's, cultural practices within or in the vicinity of the project area

In most cases, two or three attempts were made to contact individuals, organizations, and agencies. The results of the community consultation process are presented in Table 29.

6.3 Community Contact Table

Below in Table 29 are names, affiliations, dates of contact, and comments from NHOs, individuals, organizations, and agencies contacted for this project. Results are presented below in alphabetical order.

Table 29. Community contact table

Name	Affiliation	Comment
A'i, Howard Kaleihulumanu	<i>Kumu hula</i>	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
A'i, Olana	<i>Kumu hula</i>	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Agard, Kekuni		Mr. Agard replied via email 4 July 2019: <i>Much of what you're looking for regarding the culture for 'Ewa has been completed by Kamehameha Schools 'Ewa Region of Community Engagement and Resources and Nohopapa Hawai'i.</i> https://ksbe.edu/ewa/ <i>Scroll to the bottom of the page for a very detailed set of documents on many of the ahupua'a you're inquiring about.</i> CSH replied via email 9 July 2019: <i>Mahalo for your response and the information you provided. That website has a lot of useful information.</i>
Akaka, Keith Kalani	Kula Kaiapuni Hawaii o Waiau, Hawaiian language immersion educator, chanter and kumu hula	Letter and figures sent via USPS 3 July 2019 Mail returned
Akau, Roddy	Director of the Moanalua Culture Project; cultural practitioner and <i>kahu</i>	Letter and figures sent via email 3 July 2019
Alaka'i, Robert	Cultural practitioner	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Aquino, Henry J.C.	House District 38	Letter and figures sent via USPS 3 July 2019 Rep. Aquino replied via telephone 16 July 2019: Recommended contacting Iwalani Tseu
Balaz, Keahialaka	<i>Kama 'āina</i> of Waipio	Letter and figures sent via USPS 3 July 2019 Mail returned
Barbieto, Leda	Raised in Ewa Plantation (Banana / Varona Camp)	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Barbieto, Pio	Raised in Ewa Plantation (Banana / Varona Camp)	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Blanpied, Robyn	Executive Director, Friends of Pearl Harbor Historic Trail	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019

Name	Affiliation	Comment
Bond, John	Kanehili Cultural Hui	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Cabanilla, Rida	House District 41 Ewa Historical Society	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Caceres, Mana Kaleilani	OIBC Representative for 'Ewa; Cultural descendant	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019 Mr. Caceres replied via email 17 July 2019: <i>Mahalo for your email. I will look through the attached information and get back to you after we've had some time to review it. Mahalo once again.</i> CSH replied via email 18 July 2019: <i>Mahalo for your quick response. We look forward to hearing from you.</i>
Cachola, Romy M.	House District 30	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Cayan, Phyllis	Intake Specialist, SHPD	Letter and figures sent via email 3 July 2019
Ching, Arlene Seto	Former Branch Mgr., Aiea Public Library; current branch manager, Ewa Beach Elementary School Library	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Clark, William B.	Aiea Neighborhood Board	Letter and figures sent via USPS 3 July 2019
Cullen, Ty J.K.	Representative, House District 39	Letter and figures sent via USPS 3 July 2019 Letter and Figures sent via email 17 July 2019
DaMate, Leimana	Executive Director, DLNR-Aha Moku	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
De Santos, Kahulu	Cultural Advisor, Aulani, A Disney Resort and Spa	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Eaton, Ku'uwainani	Hoakalei Cultural Foundation	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Ewa Villages Non-Profit Development Corporation		Letter and figures sent via USPS 3 July 2019 Mail returned

Name	Affiliation	Comment
Farden, Hailama	President, Association of Hawaiian Civic Clubs	Letter and figures sent via USPS 3 July 2019 Mr. Farden replied via telephone 3 July 2019: Requested CSH follow up with him in a few weeks. CSH followed up with Mr. Farden via email 26 July 2019 CSH met with Mr. Farden 30 July 2019 Interview summary sent to Mr. Farden for review 27 Augusts 2019 Awaiting approval of summary
Ferreira, Kamakana	Project Planner for the OHA-HLID (Halawa Luluku Interpretive Development)	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Fevella, Kurt	Senatorial District 19	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Fujita, Mitsuko	<i>Kama'āina</i> of Waimalu	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Fukushima, Miles	<i>Kama'āina</i> , Pig hunter	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Funakoshi, E.	Pearl City Neighborhood Board	Mr. Funakoshi replied via email 4 July 2019: <i>where is the location of the wastewater facility?</i> CSH replied via email 9 July 2019: <i>Mahalo for your response. On the attached pdf, page 4 depicts the locations of the existing and alternative Waimalu and Halawa Wastewater Pump Stations (WWPS), page 5 depicts the existing and 3 alternative Pearl City WWPS, and page 6 the existing and 2 alternative Waipahu WWPS. There is no wastewater treatment facility directly associated with the project at this time.</i>
Gabbard, Mike	Senatorial District 20	Letter and figures sent via USPS 3 July 2019 Sen. Gabbard replied via email 3 July 2019: <i>Mahalo for reaching out. If you're not already doing it, my recommendation is to solicit this information at the area neighborhood boards.</i> CSH replied via email 9 July 2019: <i>Mahalo for your response and your recommendation. We have reached out to the neighborhood boards within the project area.</i>

Name	Affiliation	Comment
Hanohano, Anolani	Kānehili Hawaiian Homestead	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Hanohano, Piilani	Government Relations Coordinator, Kamehameha Schools – Community Relations and Communications Group, Government Relations	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Harimoto, Bree	Senatorial District 16	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Hasager, Ulla	Director of Civic Engagement, College of Social Sciences and Ethnic Studies at UH Mānoa; Ph.D. in Anthropology; affiliated with Malama Hālawa	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Higa, Jeffrey	Assistant Executive Director, Plantation Village	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Hilo, Regina	Burial Sites Specialist, SHPD	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Holt Takamine, Victoria	Executive Director, PA'I Foundation	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Huliauapa'a (Wahi Kūpuna Internship Program)	Non-profit organization providing education on Hawai'i's <i>wahi kūpuna</i> (ancestral places); conducted a field school at Waiawa in 2017	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Hussey, Sylvia	Interim CEO, OHA	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Inciong, Tane	<i>Kama'āina</i> of Waipio	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Jeremiah, Jason	Cultural Resources Sr. Manager, Kamehameha Schools Land Assets Division	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Johanson, Aaron Ling	House District 31	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019

Name	Affiliation	Comment
Joto, Lorelei	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kai, G. Umi	President, 'Aha Kāne	Letter and figures sent via USPS 3 July 2019 Mr. Kai replied via email 3 July 2019 : <i>No comments from me</i> <i>Have you checked with Shad Kane?</i> CSH replied via email 3 July 2019 : <i>Mahalo for your quick response. Yes, we have reached out to Shad Kane via email as well.</i>
Kaleikini, Ali'ikaua	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kaleikini, Hāloa	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kaleikini, Kala	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kaleikini, Mahiamoku	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kaleikini, Moehonua	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kaleikini, No'eau	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kaleikini, Paulette Ka'anohi	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Kaleikini, Tuahine	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kane, Shad	'Ewa Moku Representative, Aha Moku; Kalaeloa Heritage and Legacy Foundation	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Kamahele, Momi	Hawaiian Studies Department Leeward Community College	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Kanekoa, Mikiala	Hālau 'o Kaululaua'e	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Kamelamela, Jonah	<i>Kama'āina</i> of 'Aiea	Letter and figures sent via USPS 3 July 2019 Mail returned
Kauahi, Leatrice	OHA Employment and Housing Section	Letter and figures sent via USPS 3 July 2019 Mail returned

Name	Affiliation	Comment
Keala, Jalna	Association of Hawaiian Civic Clubs	Letter and figures sent via USPS 3 July 2019 Mail returned
Kehaulani, Bruce		Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Keko'olani, Terri	Hawaii Peace and Just Center	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Keli'inoi, Kalahikiola	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Keli'inoi, Kilinahe	Cultural descendant	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Kim, Donna Mercado	Senatorial District 14	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Kong, Sam Satoru	House District 33	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Kruse, Kehaulani	Outrigger Enterprises, Cultural Advisor	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Lee, Chew Hoy	Participant in Waiawa ethno-historic study	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Lee, Mike Kumukauoha	Kanehili Cultural Hui	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Lee, Richard H.S.	Participant in Waiawa ethno-historic study	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Lewis, Joseph Kūhiō	President, Kapolei Community Development Corporation	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Lidstone, Miki'ala	Executive Director, Ulu A'e Learning Center	Letter and figures sent via USPS 3 July 2019 Mail returned Letter and figures sent via email 17 July 2019
Lopez, Kealii	Imua Hawaii	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Lum, Kehaulani	Pelekikena, Ali'i Pauahi Hawaiian Civic Club	Letter and figures sent via USPS 3 July 2019 Mail returned Letter and figures sent via email 17 July 2019
Lyman, Melissa	Kalaeloa Heritage and Legacy Foundation, President	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Malama, Tesha	'Ewa Villages Association	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019

Name	Affiliation	Comment
Man, Gabriel	Moanalua Culture Project	Mr. Man responded on behalf of the Moanalua Culture Project via email 6 July 2019: <i>Mahalo Kellen for contacting us. I've forwarded your email to Kahu Roddy's personal email. He should respond to you next week sometime.</i> CSH replied via email 9 July 2019: <i>Mahalo for your response. We look forward to hearing from him.</i>
McDermott, Bob	House District 40	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
McKeague, Kawika	Cultural practitioner, Honouliuli historian and longtime resident	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Mills, Kimberly	DLNR, Planner	Letter and figures sent via USPS 3 July 2019 Ms. Mills replied via email 5 July 2019: <i>This request will be shared at the next Aiea Community Association meeting scheduled for July 15.</i> <i>You may wish to review our oral history book Aiea Yesterday Today Tomorrow for information also.</i> CSH replied via email 9 July 2019: <i>Mahalo for your response and for sharing our request with the Aiea Community Association. I look forward to reviewing the book you recommended.</i>
Moa, Kimberly		Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Nā Kūpuna a me Nā Kāko'ō o Hālawa (Malama Hālawa)	NHO; official steward for complex of sites under H-3 Freeway in Hālawa Valley	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Nahulu-Mahelona, Moani	Hawaiian Studies Department, Kapolei HS	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Nicholson, Dorrinda	<i>Kama'āina</i> of Pearl Harbor, <i>kupuna</i>	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019 Ms. Nicholson replied via email 20 July 2019: <i>Don't have any mana'o re this area you are studying.</i>
Nishihara, Clarence K.	Senatorial District 17	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019

Name	Affiliation	Comment
Paik, Linda Kaleo	Cultural practitioner/ Secretary/Treasurer for Koa Ike; Cultural Specialist; Former History and Culture, SHPD; 'Aha Wahine; Aha Moku Committee, Kona District, O'ahu	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Paishon, Jr., Frank	Raised in Tenney Village	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Patterson, Kaleo	Native Hawaiian Church; Pacific Justice & Reconciliation Center	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Pena, Uluwehi	<i>Kama'āina</i> of Aiea	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Poirier, Richard G.M.	Mililani/Waipio/Melemanu Neighborhood Board No. 25	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Puahala, Roth	President, Ke One O Kakuhihewa	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Ramos, R. Kelani	Pelekikena, Nā Lani 'Ēha Hawaiian Civic Club	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Ramos, Rodolfo	President, Ewa Villages Community Association; Chair of 'Ewa Task Force	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Robins, Jennifer	Former Bishop Museum archaeologist; worked on inventory survey for H-3 Freeway	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Rodenhurst, Roda	President, 'Ahahui Siwila Hawai'i O Kapolei (Kapolei Hawaiian Civic Club)	Letter and figures sent via USPS 3 July 2019 Mail returned
Serrao, Marleen Kau'i	Pelekikena, 'Ewa-Pu'uloa Hawaiian Civic Club	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Shibuya, Barbara	<i>Kama'āina</i> of 'Ewa, member of the Shibuya Dayanan Family	Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Silva, Adrian Nakea	Chariman, Hui Huliau Inc.	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019

Name	Affiliation	Comment
Solis, Ka'ahiki	SHPD, Cultural Historian (O'ahu)	Letter and figures sent via email 3 July 2019 CSH replied via email 9 July 2019: <i>Mahalo for your response.</i>
Suganuma, La'akea	President, Royal Hawaiian Academy of Traditional Arts and Nā Lei Ali'i Kawanākoā	Letter and figures sent via USPS 3 July 2019 Mr. Suganuma replied via email 3 July 2019: <i>Mahalo.</i> CSH replied via email 9 July 2019: <i>Mahalo for your response.</i>
Swinney, Shirley S.	Vice President, Kapolei Community Development Corporation; Hawaii Community Development Authority	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Tamamoto, Claire	President, Aiea Community Association	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Teale, Laulani	Cultural practitioner; affiliated with Malama Hālawā; connections with Hale o Papa	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Tseu, Iwalani	Referred by Rep. Henry Aquino	CSH reached out to Ms. Tseu via telephone 19 July 2019 Letter and figures sent via USPS and email 19 July 2019 CSH followed up with Ms. Tseu via email 23 August 2019
Tseu, Leighton		Letter and figures sent via email 3 July 2019 Letter and figures sent via email 17 July 2019
Tynanes, Mitchell	Ewa Neighborhood Board No. 23	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Veray, Larry	Pearl City Neighborhood Board No. 21	Letter and figures sent via email 3 July 2019 Mr. Veray replied via email 3 July 2019: <i>Please let us know where you may need assistance from our board members. I have info'ed them on this email just in case they have Kupuna who may have some important information to support your assessment. Thanks for reaching out to us.</i> CSH replied via email 9 July 2019: <i>Mahalo for your response and offer of assistance. We look forward to hearing from any kupuna with information regarding cultural resources associated with the district of 'Ewa.</i>

Name	Affiliation	Comment
Wong-Kalu, Hinaleimoana	OIBC Chair	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Woode Jr., Lawrence A.	Pelekikena, Hawaiian Civic Club of 'Ewa- Pu'uloa	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via USPS 17 July 2019
Woode, Napali	Native Hawaiian Economic Alliance	Letter and figures sent via USPS 3 July 2019 Mail returned Letter and figures sent via email 17 July 2019
Wond, Kanani	Vice President, Kaupe'a Homestead Association	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019
Yee, Christian	<i>Kama 'āina</i> , familiar with <i>wahi pana</i> and <i>mo'olelo</i>	Letter and figures sent via USPS 3 July 2019 Letter and figures sent via email 17 July 2019

Section 7 Traditional Cultural Practices

Timothy R. Pauketat succinctly describes the importance of traditions, especially in regards to the active manifestation of one's culture or aspects thereof. According to Pauketat,

People have always had traditions, practiced traditions, resisted traditions, or created traditions . . . Power, plurality, and human agency are all a part of how traditions come about. Traditions do not simply exist without people and their struggles involved every step of the way. [Pauketat 2001:1]

It is understood that traditional practices are developed within the group, in this case, within the Hawaiian culture. These traditions are meant to mark or represent aspects of Hawaiian culture that have been practiced since ancient times. As with most human constructs, traditions are evolving and prone to change resulting from multiple influences, including modernization as well as other cultures. It is well known that within Hawai'i, a "broader "local" multicultural perspective exists" (Kawelu 2015:3). While this "local" multicultural culture is deservedly celebrated, it must be noted that it has often come into contact with "traditional Hawaiian culture." This contact between cultures and traditions has undoubtedly resulted in numerous cultural entanglements. These cultural entanglements have prompted questions regarding the legitimacy of newly evolved traditional practices. The influences of "local" culture are well noted throughout this section, and understood to represent survivance or "the active sense of presence, the continuance of native stories, not a mere reaction, or a survivable name. Native survivance stories are renunciations of dominance, tragedy and victimry" (Vizenor 1999:vii). Acknowledgement of these "local" influences help to inform nuanced understandings of entanglement and of a "living [Hawaiian] contemporary culture" (Kawelu 2015:3). This section strives to articulate traditional Hawaiian cultural practices as were practiced within the *ahupua'a* in ancient times, and the aspects of these traditional practices that continue to be practiced today; however, this section also challenges "tropes of authenticity" (Cipolla 2013) and acknowledges the multicultural influences and entanglements that may "change" or "create" a tradition.

This section integrates information from Sections 3–6 in examining cultural resources and practices identified within or in proximity of the project area in the broader context of the encompassing 'Ewa landscape. Excerpts from interviews are incorporated throughout this section where applicable.

7.1 Traditional Settlement and Agricultural Patterns

Traditionally, the *moku* of 'Ewa was widely inhabited by pre-Contact populations, including the Hawaiian *ali'i*. This would be attributable to the plentiful marine and estuarine resources available at the coast, along with irrigated lowlands which were suitable for wetland taro cultivation including a rare taro called the *kāi o 'Ewa*, which was grown in mounds in marshy locations (Handy and Handy 1972:471). In addition to taro, breadfruit, coconuts, *wauke*, bananas, *olonā* and other plants were also grown in the interior. 'Ewa was also known as one of the best areas to grow gourds and was famous for its *māmaki*. Handy and Handy (1972:429) noted the "lower part of the valley sides were excellent for the cultivation of yams and bananas."

Handy and Handy (1972:429) also noted the *moku* of 'Ewa was famous for its 'awa which grew "farther inland." The *ahupua'a* of Hālawa was noted for also its 'awa (*Piper methysticum*)

(Fornander 1916:610). According to the *mo'olelo*, 'awa was introduced to O'ahu by high chief Mo'ikeha who brought the plant from Kaua'i and planted it in Hālawa (Fornander 1919f:5[3]:608). 'Awa became an important ritual offering, medicine, and beverage used for relaxation (Handy and Handy 1972:192–193). Another *mo'olelo* suggests that the *ahupua'a* of Waiawa was named for the 'awa plant. According to the *mo'olelo*, Maihea, a farmer living in the upland of Waiawa, prayed daily to the unknown gods with his offering of 'awa, taro greens, and sweet potatoes (Handy and Handy 1972:472).

7.2 Wahi Pana

'Ewa Moku contains a myriad of cultural sites or *wahi pana*, however, trails, resting places, plains, fishponds, and temples were of particular importance.

Trails were and continue to be valuable resources for Native Hawaiian culture and life ways. In the past, trails were well-used for travel within the *ahupua'a* between *mauka* and *makai* and laterally between *ahupua'a*. There were several pre-Contact/early historic trails across the *moku* of 'Ewa: a cross-*ahupua'a* trail which passed through 'Ewa connected Honolulu to Wai'anae. Branching off from this trail, a *mauka-makai* trail followed the boundary between Honouliuli and Hō'ae'ae to the Pōhākea Pass and to Wai'anae. A second branching *mauka-makai* trail that generally followed the path of Waikele Stream in Waikele *Ahupua'a* eventually crossed through the Kolekole Pass to Wahiawā and to Wai'alua District on the windward side of the island.

A number of resting places were located along the trails within the *moku* of 'Ewa. A small waterfall called Kahuawai (or Kahuewai) (water gourd container; Soehren 2009) was located along Kalauao Stream. 'Ī'ī (1959:95) noted the waterfall was once a favorite resting place for travelers, exclusively for *ali'i*. 'Ī'ī also mentioned two resting places in Hālawa for travelers, Napehā and Kauwamoa ('Ī'ī 1959:95). Napehā, which translates as “bend over breath” (Pukui et al. 1974:163), was said to have been named for the chief, Kūali'i, who stopped and bent over the pool to take a drink ('Ī'ī 1959:95). Sterling and Summers (1978:10) give the literal meaning of Napehā as “out of breath.” The pool was a resting place where people went diving. Kauwamoa was said to be a favorite diving spot of Pe'ape'a, son of Kamehamehanui of Maui ('Ī'ī 1959:95).

The 'Ewa coastal plain was also a place of spiritual significance as it was associated with the *ao kuenta*, the realm of homeless souls. According to Samuel Kamakau, there existed three spirit realms, the *ao kuenta*, *ao 'aumakua*, and *ke ao o milu*. Upon death, the spirit of the recently deceased was said to leave the body and then proceed toward a *leina* where they would leap into Pō, the world of the unseen (Handy and Pukui 1972:146). The spirit was guided to and over the *leina* and into Pō by their *'aumakua* (Handy and Pukui 1972:146), however, if the soul of the deceased had no place in the *'aumakua* realm, or was abandoned by an *'aumakua*, they were destined to wander the *wiliwili* grove of Kaupe'a until such time that they were rescued by their *'aumakua*. Fornander (1919b:6[2]:292) states that Pu'uokapolei may have been a *leina*, jumping off point associated with the wandering souls who roamed the plains of Kaupe'a and Kānehili, *makai* of the hill.

Pu'uokapolei was also known to be the home of Kamapua'a's grandmother, Kamaunuanoho, (Nakuina 1904:50). There was once a large rock shelter on the *makai* side said to have been the residence of Kamapua'a and his grandmother (McAllister 1933:108). After conquering the majority of O'ahu, Kamapua'a established his grandmother as queen (Pukui et al. 1974:203).

Another account (*Ka Loea Kālai'āina*, 13 January 1900 in Sterling and Summers 1978:34) stated that Kekele'aikū, the older brother of Kamapua'a, also lived on Pu'uokapolei.

The plain of Pukaua is also located near Pu'uokapolei. Two distinct *mo'olelo* are connected with this cultural site. The first of these two stories appeared in the 13 January 1900 publication of *Ka Loea Kālai'āina* and states that two old women with supernatural powers were heading to their home to Pukaua following an evening of fishing at the village of Kualaka'i. As the sun began to rise, the women hid to avoid being seen and their bodies turned to stone. The second *mo'olelo* involves Hi'iaka, and is spread across several daily publications of *Ka Hōkū o Hawai'i* from February 1927. According to the *mo'olelo*, the two women were *mo'o*. The women met Hi'iaka as she journeyed toward the 'Ewa coast. They were afraid that Hi'iaka would kill them, so they transformed into their lizard form and hid from Hi'iaka (*Ka Hōkū o Hawai'i*, 15 February 1927, translated in Maly 1997:19). This stone was known as "Pe'e-kāua," which translates to "we two hidden."

7.3 Loko I'a

The fact that there were so many fishponds in 'Ewa, more than any other district on O'ahu, indicates that agricultural and aquacultural intensification was a direct link to the chiefs who resided there and to the increasing needs of the population.

In Waipi'o Ahupua'a, there were several *loko* including Loko 'Ēo ("a filled container") and Loko Hanaloa ("long bay"), two of the largest. Waiawa Ahupua'a also had many fishponds; 12 are mentioned in mid-nineteenth century Māhele documents.

On the western coast of the Mānana Peninsula was a large fishpond called Loko Pā'au'au. The word *pā'au'au* translates as "bath enclosure" (Pukui et al. 1974:173). Pā'au'au was also the name of the 'ili in which the pond was located, and the name of the home of early resident John F. Colburn who had a home near the pond. Three other *loko i'a* (fishponds) are mentioned in Māhele documents; Hi'iakalalo, Kaloko'eli, and Mo'olau, were located in Mānana Ahupua'a.

Located in Waimano Ahupua'a, along the eastern shore of the Mānana Peninsula, Loko Welokā was a large fishpond with a small island in the center. Pukui and Elbert (1986:355) translate the word *welokā* as "thrashing, smiting, as a fishtail," which may also be a reference to the shark demigoddess associated with Waimano. Two other large fishponds, Loko Kūkona and Loko Luakaha'ole, were also located in Waimano Ahupua'a along the northern coast of Pearl Harbor.

Waiiau Ahupua'a had the smallest floodplain and the smallest offshore fisheries of all the *ahupua'a* of 'Ewa (Cordy 1996:5). Two fishery grounds in Waiiau Ahupua'a, Kai o Kalua'o'opu and Kai o Ka'akauwaihau, were named for their associated 'ili. A favorite bathing spot of the 'Ewa shark goddess, Ka'ahupāhua was at Puhikani in Waiiau (*Ke Au Hou*, 1910b, in Sterling and Summers 1978:16). The location of this spring or pond could not be found on any available maps.

In Waimalu Ahupua'a, Loko Pa'akea was a large fishpond located along the Pearl Harbor coast which was said to have been built by the chiefess, Kalaimanuia (McAllister 1933:103–104). Pukui et al. (1974:173) translate the word *pa'akea* as "coral bed, limestone." The fishponds of Loko Pā'aiau and Loko Opu in Kalauao are also credited with being built by Kala'imanuia. Māhele testimony mentions three other ponds located in Kalauao Ahupua'a, but they are not labeled on any available maps.

There were numerous fishponds located in Hālawā Ahupua'a including Loko Waiāho, also known as Queen Emma's Pond, and Loko Ke'oki which were both located near the mouth of the Pearl River near the nineteenth century village called Watertown. Loko Papiolua was located opposite the tip of Waipi'o Peninsula. Inland of Kūāhūa Island, in the bay now called the South East Loch, were Loko A Mano (Amana), Loko Pōhaku, Ola Loko, Wailolokai, and Wailolowai. Loko Kūnana and Loko Muliwai were located between the east side of the island and the Hālawā shore. Near the northeastern corner of the East Loch of Pearl Harbor were Loko Kahakupōhaku and Kealipaia.

7.4 Religious Practice

Several *heiau* were located within the *moku* of 'Ewa. Honouliuli Ahupua'a was the home to two known *heiau* located on Pu'u Ku'ua and on Pu'u o Kapolei, and two sites that could have possibly been *heiau* located at the foot of Pu'u Kanehoa, and at the foot of Mauna Kapu (McAllister 1933). Pu'u Ku'ua Heiau is located in Palikea, Honouliuli at the height of approximately 1,800 ft, overlooking both Honouliuli and Nānākuli. The *heiau* located on Pu'u o Kapolei had been destroyed by the time of McAllister's survey of the island in 1930. Each year, a ceremony commemorating the changing of the seasons is still observed in the beginning of May at Waikīkī and Honouliuli. Sam 'Ohukani'ōhi'a Gon III, Na Wa'a Lalani Kahuna O Pu'u Koholā, and the late Kumu Hula John Keola Lake's *hula hālau* perform *oli* and *hula* during the ceremony (Genz et al. 2012). The ceremony occurs at Pu'uokapolei Heiau which is oriented so that it views the setting of the sun behind Pu'ula'ila'i farther west, and maintains a line of sight extending eastward from Pu'ula'ila'i toward Papa'ena'ena Heiau located in Waikīkī.

In Waikēle, there were two *heiau*, Mokoula and Hapupu, located just north of the present Interstate H-1 Freeway. By the time of McAllister's survey, the two *heiau* had been completely destroyed. A *heiau* called Keakua'ōlelo was located in Pānakaūahi Gulch in Waipi'o. There was also once a *heiau* called Ahu'ena ("red hot heap") in the area between Farrington Highway and the coast, however, when Thrum listed it in 1907, he noted that only the foundations remained (Thrum 1907:46). Along the main coastal trail in Waipi'o were two *heiau*, Moa'ula and Heiau o 'Umi. McAllister noted that both were "covered" in cane, and provided no further information on their condition. John Papa 'Ī'ī was once the custodian of the idols in the *heiau*.

A *heiau* called Puoiki was located on the boundary point between Waiawa and Mānana Ahupua'a, the point of the ridge called Lae Pōhaku (McAllister 1933:105). According to McAllister, the ceremonies at this *heiau* were performed at the base of the knoll where the *heiau* was built. On the ridge between Waiawa and Waimalu gulches, McAllister (1933:105) also noted a *heiau* named Kolokukahau Heiau, but it had been destroyed before his survey in the 1930s.

Waimalu Ahupua'a was home to Naulu-a-Maihea Heiau which was associated with 'Ula-a-Maihea, a "famous prophet and seer" who resided in the *ahupua'a* of Waimalu (Fornander 1996:42). The *heiau*, which McAllister identified as Site 112, has been "destroyed" (Sterling and Summers 1978:14).

Located at the top of 'Aiea Heights Drive, Keaiwa Heiau was the once site of a training area for traditional healers and a medicinal herb garden.

Hālawā Ahupua'a was home to four *heiau* including Waipao Heiau, Waikahi Heiau, Hale of Papa Heiau, and Luakini Heiau. Waipao Heiau (McAllister Site 106) was a large religious structure

located “near the mouth of Kamananui Gulch” (McAllister 1933:103). Waikahi Heiau (McAllister Site 105) was located “on the flat area on the mountain side of the road where the two gulches of Halawa meet” (McAllister 1933:103). It was a *heiau* of *po‘o kanaka* class which was associated with human sacrifice. Waipao and Waikahi Heiau were both destroyed under sugarcane cultivation (Kleiger 1995:14). Located in North Hālawā Valley adjacent to the H-3 Interstate Freeway, the Hale o Papa was part of a large religious complex associated with a *luakini*, “a heiau of the highest class, a war temple, in which human sacrifices were offered” (Malo 1951:155). The Hale o Papa *heiau* was the *heiau* for the female deities. It is the female component of the *luakini*, where only chiefesses of the highest ranks were allowed to enter.

Section 8 Summary and Recommendations

CSH undertook this CIA at the request of AECOM, and on behalf of the City and County of Honolulu Department of Environmental Services. The research broadly covered the entire *moku* of 'Ewa, including the *ahupua'a* of Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiiau, Waimalu, Kalauao, 'Aiea, and Hālawa, including the current study area.

8.1 Results of Background Research

Background research for this study yielded the following results, presented in approximate chronological order:

1. The study area traverses through 11 of the 13 *ahupua'a* located in the *moku* of 'Ewa. They are (from west to east) Honouliuli, Waikele, Waipi'o, Waiawa, Mānana, Waimano, Waiiau, Waimalu, Kalauao, 'Aiea, and Hālawa Ahupua'a.
2. The 'Ewa District had more fishponds than any other district on O'ahu, indicating that agricultural and aquacultural intensification was a direct link to the chiefs who resided there and to the increasing needs of the population.
3. In traditional Hawaiian times, the areas of exposed coral (Pleistocene limestone) outcrop were undoubtedly more extensive. This Pleistocene limestone outcrop, where not covered by alluvium or stockpiled material, has characteristic dissolution "pit caves" (Myroie and Carew 1995), which are nearly universally, but erroneously, referred to as "sink holes" (Halliday 2005). According to McAllister (1933), holes and pits in the coral were generally accessed for water, while larger pits, often containing soil, were used for cultivation.
4. The *mo'olelo* of 'Ewa invoke the deep Hawaiian past. Some *mo'olelo* make connections with Kahiki, the traditional homeland of Hawaiians in central Polynesia. Most notably, the chief Kaha'i left from Kalaeloa (coastal area in Honouliuli Ahupua'a) for a trip to Kahiki, and on his return to the Hawaiian Islands, brought back the first breadfruit (Kamakau 1991b:110) and planted it near the waters of Pu'uloa (long hill), now known as Pearl Harbor (Beckwith 1940:97). In addition, several *mo'olelo* associate places in 'Ewa with the gods Kāne and Kanaloa, the pig god Kamapua'a, the Hina family, and with the sisters of the Hawaiian volcano goddess Pele, all of whom have strong connections with Kahiki (Kamakau 1991b:111; Pukui et al. 1974:200).
5. There were numerous *heiau* within the *moku* of 'Ewa. Archaeologist Gilbert McAllister reports on two known *heiau* in the *ahupua'a* of Honouliuli, as well as two other sites that could have possibly been *heiau*. These *heiau* were located on Pu'u Ku'ua, on Pu'u o Kapolei, at the foot of Pu'u Kanehoa, and at the foot of Mauna Kapu (McAllister 1933). There were two *heiau* in Waikele, Mokoula and Hapupu, both just north of the present Interstate H-1 Freeway. In Waipi'o, a *heiau* called Keakua'ōlelo was located in Pānakauahi Gulch. There was once a *heiau* in the area between Farrington Highway and the coast, called Ahu'ena ("red hot heap"). McAllister noted two *heiau*, Moa'ula and Heiau o 'Umi along the main coastal trail in Waipi'o. McAllister (1933:105) also recorded a *heiau* called Puoiki which was located on the point of the ridge called Lae Pōhaku, the boundary point between Waiawa and Mānana Ahupua'a. McAllister (1933:105) also noted a *heiau* on the

ridge between Waiau and Waimalu gulches named Kolokukahau Heiau. Naulu-a-Maihea Heiau is located within Waimalu Ahupua'a (Sterling and Summers 1978:14). Keaiwa Heiau is located at the top of 'Aiea Heights Drive (Sterling and Summers 1978:11). There were four *heiau* located in Hālawa Ahupua'a including Waipao Heiau, Waikahi Heiau, Hale of Papa Heiau, and Luakini Heiau (McAllister 1933).

6. There were several pre-Contact/early historic trails across 'Ewa: a cross-*ahupua'a* trail that crossed 'Ewa and connected Honolulu to Wai'anae; a *mauka-makai* trail that branched off from the first trail, and followed the boundary between Honouliuli and Hō'ae'ae to the Pōhākea Pass and to Wai'anae; and a second branching *mauka-makai* trail that generally followed the path of Waikele Stream in Waikele Ahupua'a. This trail eventually led through the Kolekole Pass to Wahiawā and to Wai'alua District on the windward side of the island. A *mauka-makai* (north-south) trail branched off the cross-*ahupua'a* trail into two offshoots which led to the coastal settlements of Kūalaka'i and One'ula.
7. Along the trails within the *moku* of 'Ewa were a number of places where travelers could stop and rest. Along the coastal trail connecting Honolulu to Wai'anae was a small waterfall called Kahuawai (or Kahuewai) (water gourd container; Soehren 2009) along Kalauao Stream, which 'Ī'ī (1959:95) stated was once a favorite resting place for travelers, exclusively for *ali'i*. Along the coastal trail connecting Honolulu to Wai'anae, 'Ī'ī (1959:95) mentioned two resting places in Hālawa for travelers, Napehā and Kauwamoa. Napehā was a pool and resting place where people went diving. The pool was said to have been named for the chief, Kūali'i, who stopped and bent over the pool to take a drink ('Ī'ī 1959:95). Kauwamoa was also a diving place where people liked to gather, said to be a favorite diving spot of Pe'ape'a, son of Kamehamehanui of Maui ('Ī'ī 1959:95).
8. The rich resources of Pu'uloa—the fisheries in the lochs, the shoreline fishponds, the numerous springs, and the irrigated lands along the streams—made 'Ewa a prize for competing chiefs. 'Ewa Moku was also a political center and home to many chiefs in its day. Oral accounts of *ali'i* recorded by Hawaiian historian Samuel Kamakau date back to at least the twelfth century. *Ali'i* associated with Honouliuli and greater 'Ewa Moku included Kākūhihewa, Keaunui, Lakona, Mā'ilikūkahi, and Kahahana.
9. Beginning with the time of Western Contact, however, Hawaiian populations were introduced to many virulent western diseases that began to decimate the native populations. Thus, four years following the 1832 census, the 'Ewa population had dropped to 3,423 (Schmitt 1973:9, 36), "a decrease of 592 in 4 years" (Ewa Station Reports 1836). Between 1848 and 1853, there was a series of epidemics of measles, influenza, and whooping cough that often wiped out whole villages.
10. As the demand for *kalo* (taro) declined and importation of Chinese laborers to the west coast of California and Hawai'i increased, a market for rice developed. *Lo'i* (irrigated taro patches) lands were ideal for growing rice, and as these lands lay in disuse and became more available, the Chinese farmers quickly purchased these lots. By the mid-1860s, much of the *lo'i* on O'ahu had been transformed into rice fields.
11. With the increasing foreign interests on O'ahu Island during the last half of the nineteenth century, an array of agricultural enterprises were attempted. In 1871, John Coney rented the lands of Honouliuli to James Dowsett and John Meek, who used the land for cattle

grazing. In 1877, James Campbell purchased most of Honouliuli Ahupua'a for a total of \$95,000.

12. By 1889, the Ewa Plantation Company was established and lands throughout Honouliuli were designated for sugarcane cultivation. Sugar production exploded with the successful drilling of an artesian well by James Campbell on the 'Ewa Plain. Campbell's first well was named Waianiani ("crystal waters") by the *kama'āina* of Honouliuli (Nellist 1925). By 1930, Ewa Plantation had drilled 70 artesian wells to irrigate cane lands; artesian wells provided fresh water to Honouliuli for nearly 60 years (Ho'okuleana 2014).
13. In 1897, B.F. Dillingham established the Oahu Sugar Company on 12,000 acres leased from the estates of John Papa 'Ī'ī, Bishop, and Robinson. The Oahu Sugar Company had over 900 field workers, composed of 44 Hawaiians, 473 Japanese, 399 Chinese, and 57 Portuguese. The first sugar crop was harvested in 1899, ushering in the sugar plantation era in Waipahu (Ohira 1997).
14. The eastern section of 'Ewa was largely developed by the Honolulu Plantation Company. Commercial sugarcane cultivation began in Waimalu and Hālawa in the 1850s, on the estate of Mr. J.R. Williams (Condé and Best 1973:327). The plantation was first known as the Honolulu Sugar Company.
15. The early twentieth century saw the lands of Honouliuli heavily utilized by both civilians and the U.S. military for transportation. The U.S. Government began acquiring the coastal lands of 'Ewa for development of a naval base at Pearl Harbor. In 1901, the U.S. Congress formally ratified annexation of the Territory of Hawaii, and the first 1,356.01 acres of Pearl Harbor land were transferred to U.S. ownership.
16. In 1909, the government appropriated the entire Waipi'o peninsula from the 'Ī'ī Estate for the Pearl Harbor Naval Station and Shipyard. Additional dredging to deepen and widen the channel was conducted in the 1920s.

8.2 Results of Community Consultations

CSH attempted to contact Hawaiian organizations, agencies, and community members as well as cultural and lineal descendants in order to identify individuals with cultural expertise and/or knowledge of the project area and vicinity. Community outreach letters were sent to 110 individuals or groups. Community consultation for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement project is still ongoing.

8.3 Impacts and Recommendations

Impacts and recommendations for the Honouliuli Waipahu Pearl City Wastewater Collection System Improvement project are pending on the results of the community consultation process.

1. Project construction workers and all other personnel involved in the construction and related activities of the project should be informed of the possibility of inadvertent cultural finds, including human remains. In the event that any potential historic properties are identified during construction activities, all activities will cease and the SHPD will be notified pursuant to HAR §13-280-3. In the event that *iwi kūpuna* are identified, all earth moving activities in the area will stop, the area will be cordoned off,

and the SHPD and Police Department will be notified pursuant to HAR §13-300-40. In addition, in the event of an inadvertent discovery of human remains, the completion of a burial treatment plan, in compliance with HAR §13-300 and HRS §6E-43, is recommended.

2. In the event that *iwi kūpuna* and/or cultural finds are encountered during construction, project proponents should consult with cultural and lineal descendants of the area to develop a reinterment plan and cultural preservation plan for proper cultural protocol, curation, and long-term maintenance.

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Appendix D: Acoustic Study

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**ACOUSTIC STUDY FOR THE
HONOULIULI / WAIPAHAU / PEARL CITY
WASTEWATER CONVEYANCE FACILITIES**

Prepared for:

AECOM

Prepared by:

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JULY 2019

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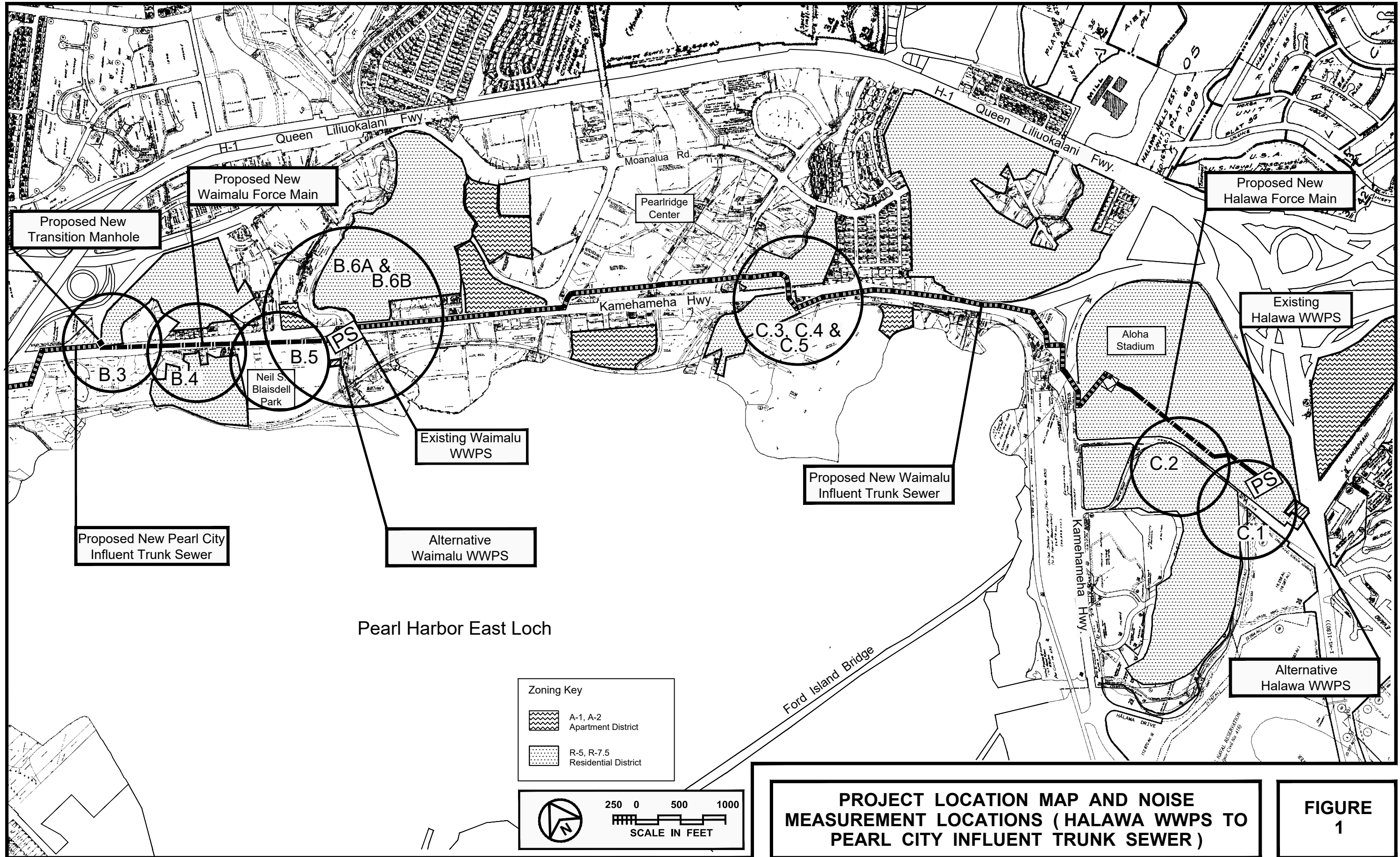
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CHAPTER I. SUMMARY

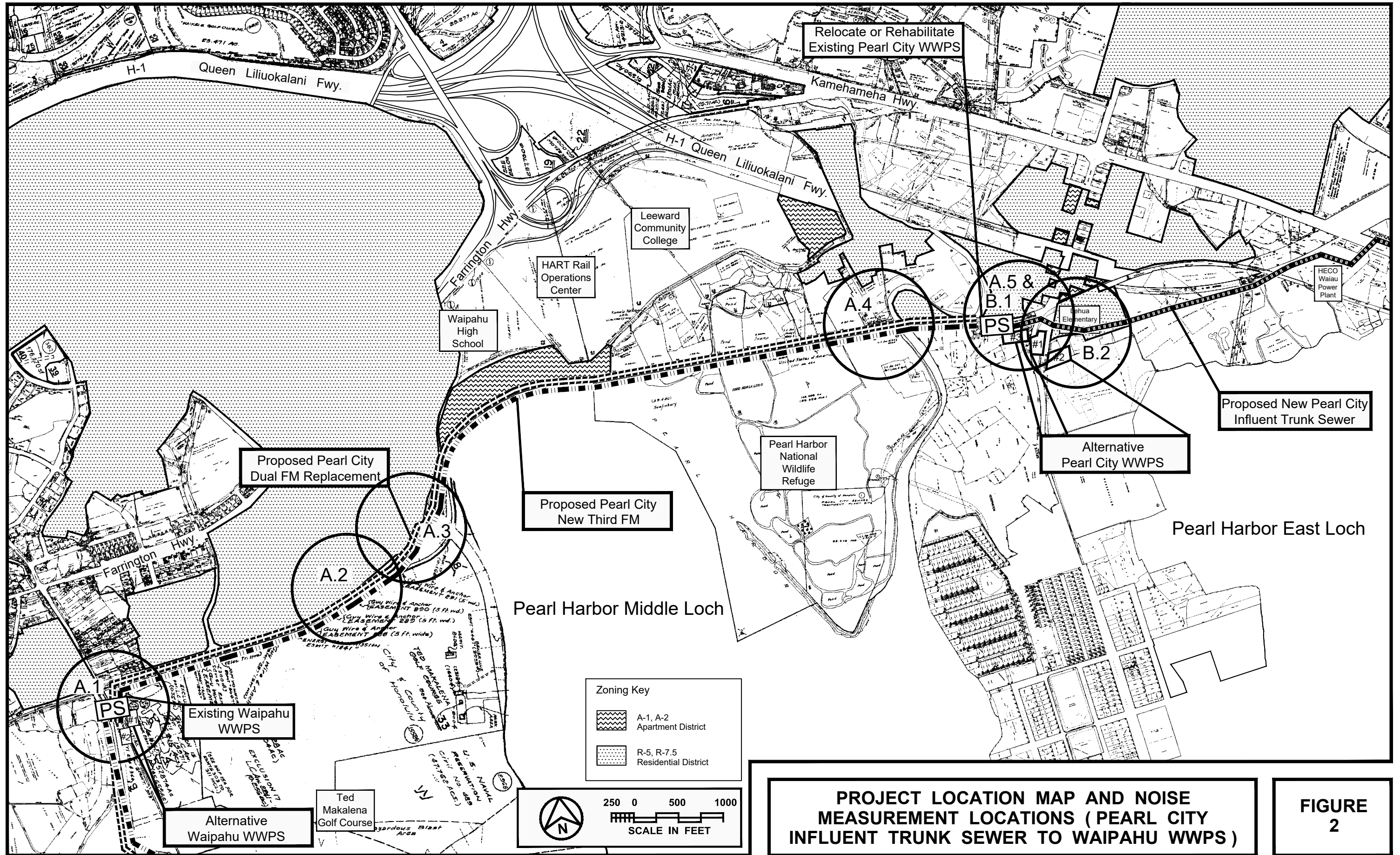
The potential construction noise levels associated with the Honouliuli / Waipahu / Pearl City Wastewater Conveyance Facilities Project involving improvements to the East Interceptor System of the Honouliuli sewer basin were evaluated for their potential impacts and their relationship to the current FHA/HUD noise standard and the Hawaii State Department of Health noise regulations. These improvements include work at Wastewater Pump Stations (WWPSs), along force mains, trunk sewers, and along gravity lines within the East Interceptor System which feed into the 84-inch, Honouliuli Wastewater Treatment Plant (WWTP) interceptor sewer line. Figures 1 through 6 depict the general locations of the conveyance system corridors, which include the conveyance system from Waiawa to Pearl City and Waipahu WWPSs. Construction noise associated with earthwork, building erection, open trench construction, microtunneling and other trenchless construction, and the 96-inch gravity sewer tunnel (GST) were evaluated. In addition, the potential construction noise levels and impacts associated with the tunnel access shaft construction and operations were evaluated. The potential impacts resulting from ground vibrations during tunneling operations were also evaluated.

Under the No-Tunnel option, possible noise impacts may occur primarily during the construction phase, during construction of the various gravity line, trunk sewer, force main, and wastewater pump station and storage facility improvements. It is expected that compliance with the State Department of Health (DOH) construction noise permit and variance requirements will be required, and that construction noise impacts would be minimized by the adherence to these DOH rules regarding construction noise. Following completion of the construction of the gravity line, trunk sewer, force main, GST, or pump station, and storage facility improvements, compliance with the State DOH property line noise limits for fixed machinery will also be required, and it is expected that the long term noise impacts associated with the improved pump station and storage facilities would be minimized by the adherence to the DOH rules regarding noise limits for fixed machinery. Additional noise mitigation measures during construction are recommended.

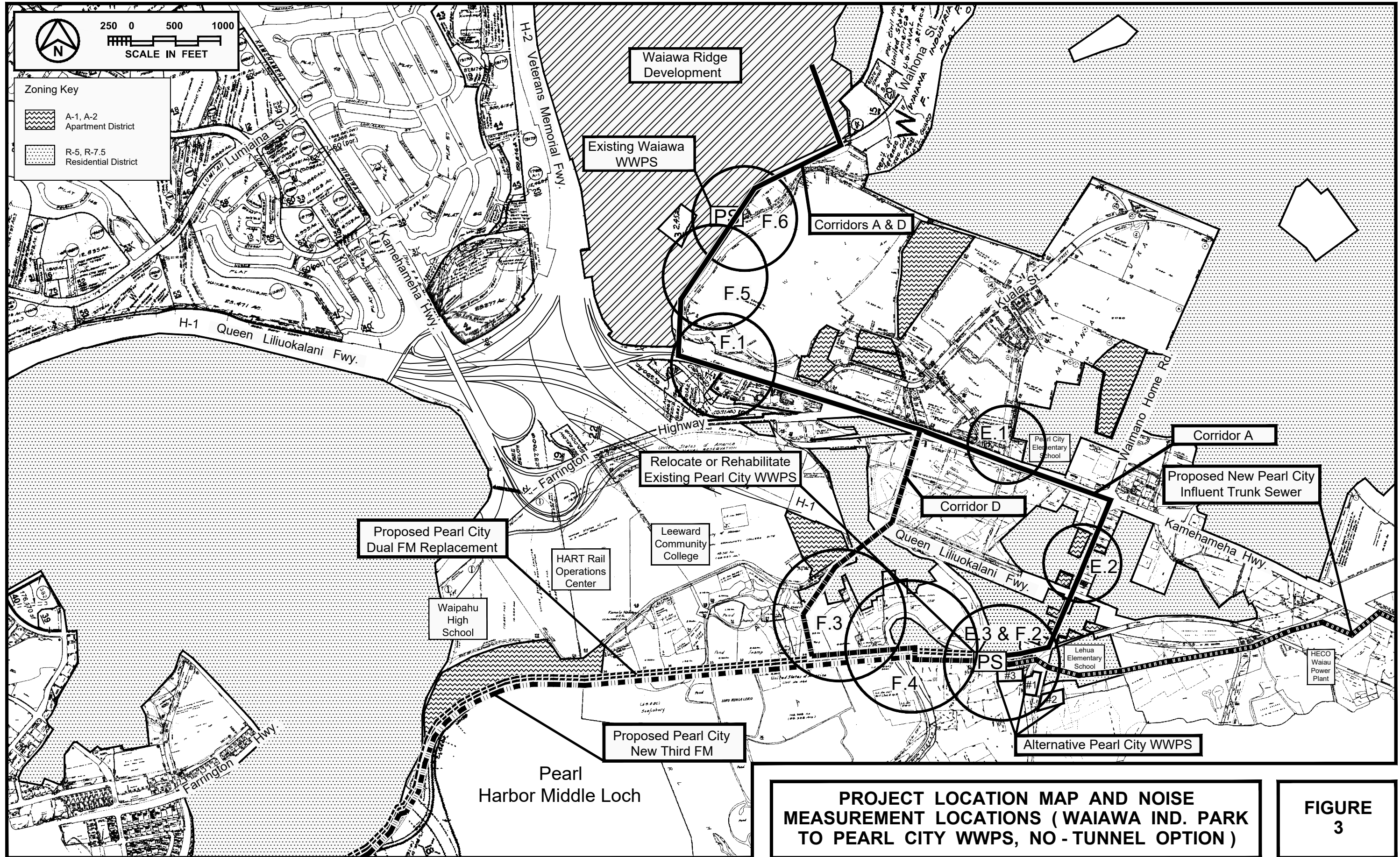
Under the Hybrid option, a 96-inch GST installed using a tunnel boring machine (TBM) or a 72-inch diameter pipe, installed using microtunneling between Pearl City WWPS and Waipahu WWPS would be implemented. The potential noise impacts during tunnel boring or microtunneling operations between the Pearl City WWPS and Waipahu WWPS are more dependent on where the tunnel access shafts or microtunneling pits are located, and where the shaft or pit excavation operations occur relative to structures above ground. That is because ventilation or diesel engine powered equipment, both fixed and mobile, will probably operate at the access shafts or pits during TBM or microtunneling operations. Under the GST option, the noise sources will be located at the Waipahu and Pearl City ends of the GST. Under the microtunneling option, the noise sources would be located at landside pits spaced along the gravity tunnel alignment. The need to transport large quantities of excavated



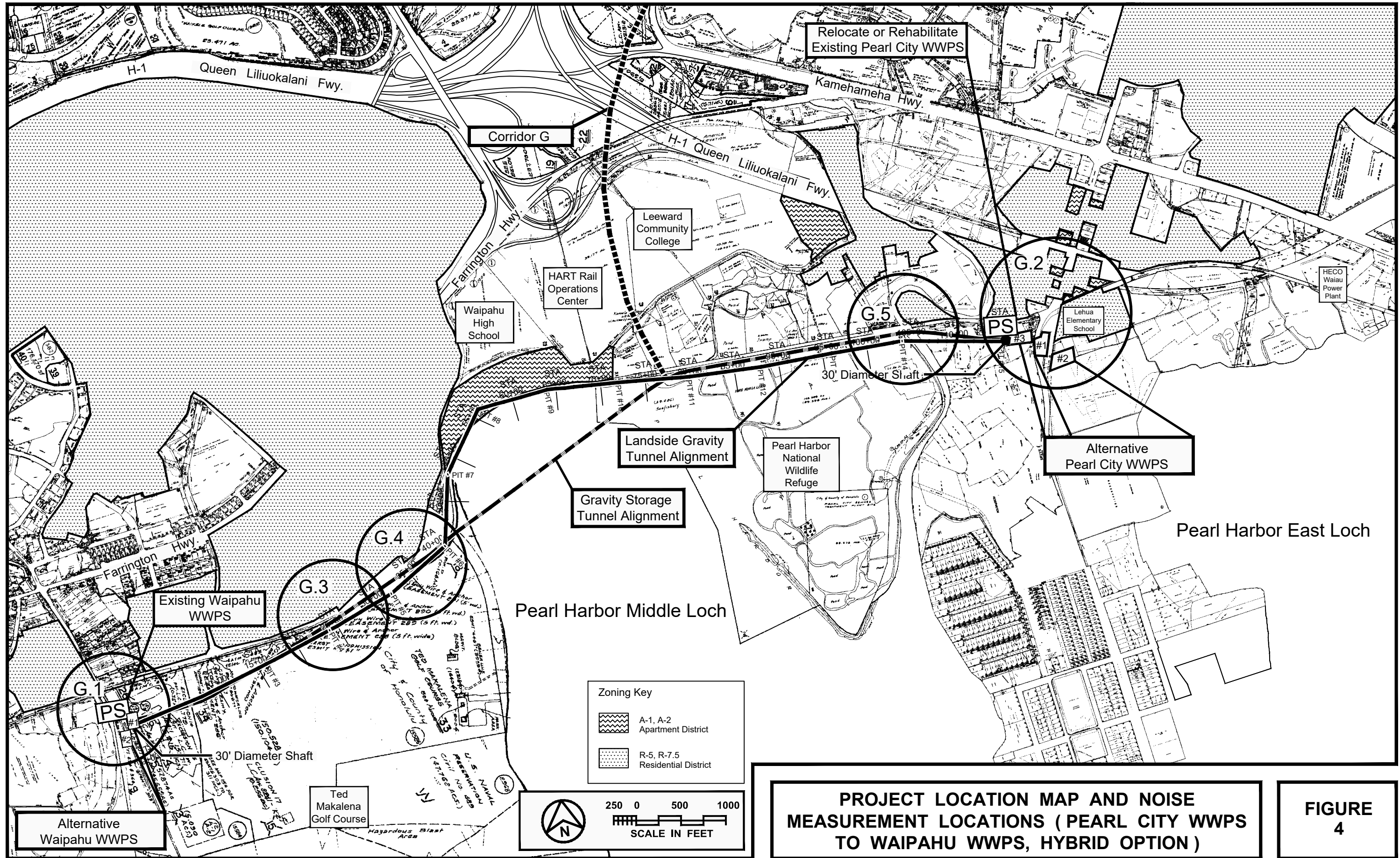
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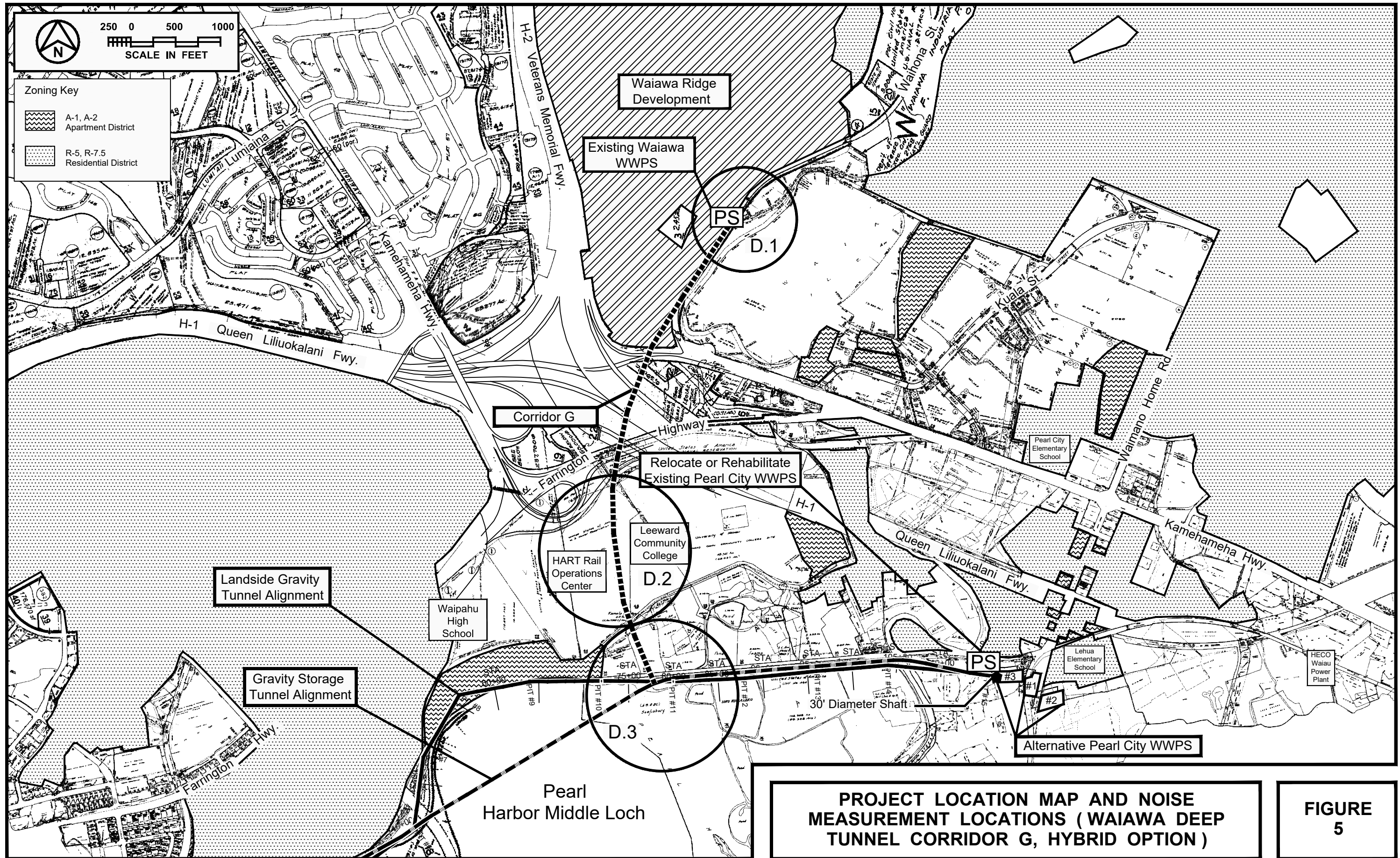
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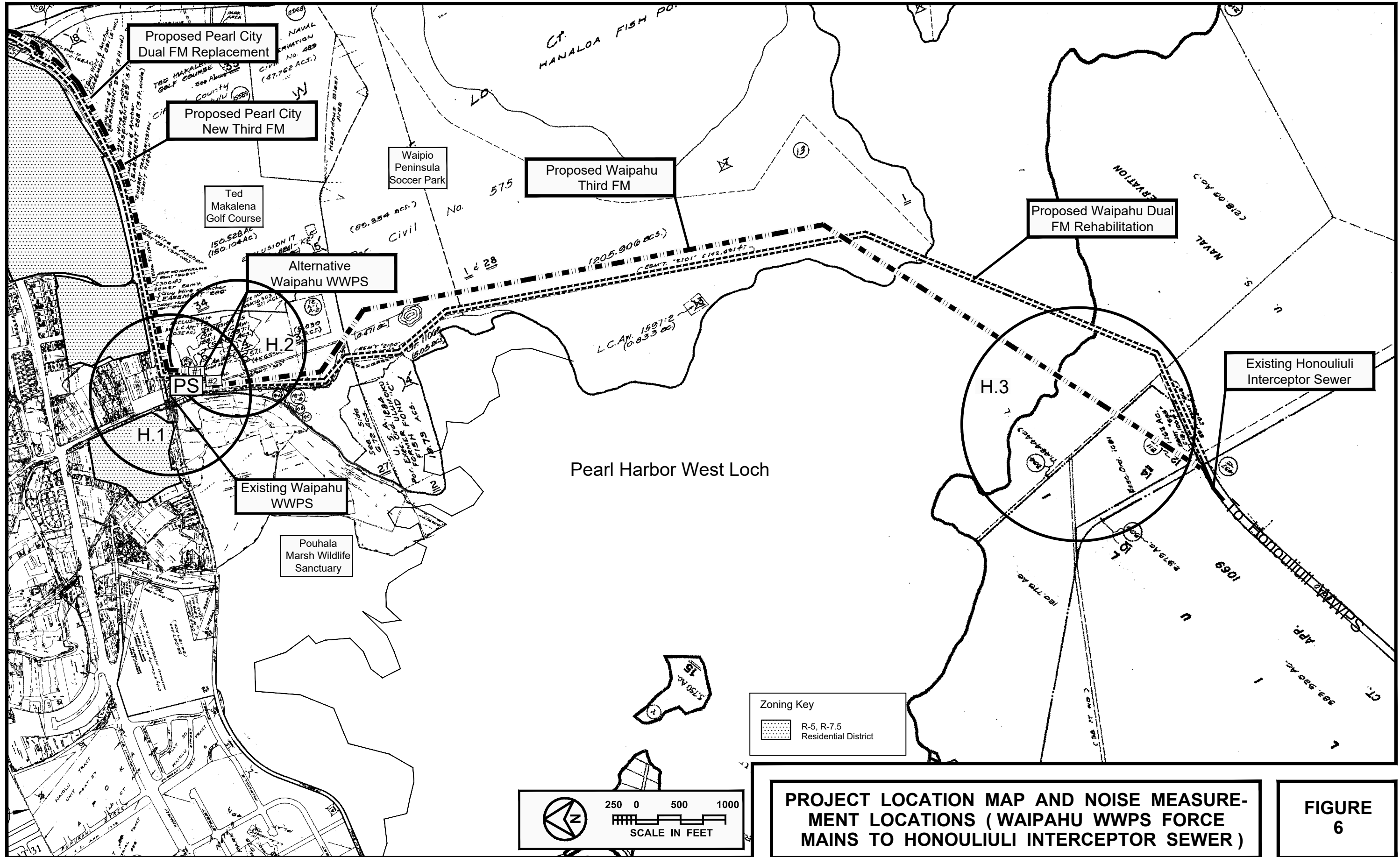
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PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS (WAIAWA DEEP TUNNEL CORRIDOR G, HYBRID OPTION)

FIGURE 5

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PROJECT LOCATION MAP AND NOISE MEASUREMENT LOCATIONS (WAIPAHU WWPS FORCE MAINS TO HONOULIULI INTERCEPTOR SEWER)

FIGURE 6

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materials from the Waipahu WWPS access shaft is also associated with the GST option, but potential noise impacts associated with the haul trucks remain to be evaluated if the GST option is selected for implementation. If the GST is not implemented but replaced with the 72-inch pipe installed using microtunneling techniques, potential noise impacts may occur at approximately 14 pits containing the microtunneling drive equipment.

The GST access shafts appear to have adequate setback distances from the closest noise sensitive receptors to not preclude their use due to very high risks of adverse noise and vibration impacts. Noise mitigation measures may still be required at the Waipahu access shaft if 24-hour operations are required during TBM operations.

As is the situation with all large construction projects, it will not be practical to reduce all construction noise to inaudible levels. It will not be feasible to eliminate all noise impacts during construction of the project. But because of the relatively long period of actual construction activities and the relatively low levels of background noise in the surrounding areas, special construction noise mitigation measures are recommended. These measures include: sound attenuation treatment of fixed machinery which operate continuously so as to limit their combined maximum noise levels to 65 dBA at the closest residences during the daytime and to 45 or 50 dBA at the closest residences during the nighttime; selection of the open trench alignments, and microtunneling/sliplining pit locations which maximize the distances to noise sensitive structures; requiring the use of broadband back-up alarms for vehicles which operate on the construction sites in place of the more commonly used high frequency, beeper back-up alarms; consideration of the use of HECO service drops if necessary to meet the project noise limits during the daytime or nighttime periods; and the use of monitoring during tunnel excavation and blasting operations so as to minimize risks of damage to structures and risks of causing adverse noise and vibration impacts during these operations. In addition, when very small buffer distances are available between the work areas and noise sensitive receptors, the advance disclosure of those schedules as well as coordination with affected parties in scheduling work is also recommended.

CHAPTER II. PURPOSE

The primary objective of this study was to describe the existing and potential noise environment in the environs of the Honouliuli / Waipahu / Pearl City Wastewater Conveyance Facilities project between Halawa WWPS and the Honouliuli Interceptor Sewer on the island of Oahu. This study was limited to evaluations of potential noise and vibration impacts during construction of the preferred No-Tunnel or Hybrid options available to the project. The potential noise impacts were examined at the preferred gravity storage tunnel (GST) access shaft locations, likely locations of microtunneling pits, and along the preferred alignments of the force main and trunk sewer corridors where the open trenching construction method will probably be used. A description of the potential construction equipment noise levels, existing background noise levels, and a description of the potential noise impacts at noise sensitive receptors in the immediate vicinity of the sewer conveyance alignments were included in the noise study objectives. Estimates of potential ground vibration levels associated with the tunneling operations between the Waiawa WWPS and the Pearl City to Waipahu GST connection, as well as between the Pearl City and Waipahu WWPSs were discussed. The potential vibration impacts during excavation of the gravity tunnels were evaluated at locations where the shorter distances were expected between the tunnels and existing noise sensitive receptors.

Recommendations for minimizing potential construction noise and vibration impacts were also to be provided as required.

CHAPTER III. NOISE DESCRIPTORS AND THEIR RELATIONSHIP TO LAND USE COMPATIBILITY

The noise descriptor currently used by federal agencies (such as FHA/HUD) to assess environmental noise is the Day-Night Average Sound Level (DNL). This descriptor incorporates a 24-hour average of instantaneous A-Weighted Sound Levels as read on a standard Sound Level Meter. By definition, the minimum averaging period for the DNL descriptor is 24 hours. Additionally, sound levels which occur during the nighttime hours of 10:00 PM to 7:00 AM are increased by 10 decibels (dB) prior to computing the 24-hour average by the DNL descriptor. A more complete list of noise descriptors is provided in Appendix B to this report.

Table 1, derived from Reference 1, presents current federal noise standards and acceptability criteria for residential land uses. Table 2, also extracted from Reference 1, presents the general effects of noise on people in residential use situations. Land use compatibility guidelines for various levels of environmental noise as measured by the DNL descriptor system are shown in Figure 7 (from Reference 2). As a general rule, noise levels of 55 DNL or less occur in rural areas, or in areas which are removed from high volume roadways. In urbanized areas which are shielded from high volume streets, DNL levels generally range from 55 to 65 DNL, and are usually controlled by motor vehicle traffic noise. Residences which front major roadways are generally exposed to levels of 65 DNL, and as high as 75 DNL when the roadway is a high speed freeway. In the project area along the project conveyance system alignments, traffic noise levels (as well as background noise levels) vary over a wide range between 50 to 70 DNL.

For purposes of determining noise acceptability for funding assistance from federal agencies (FHA/HUD and VA), an exterior noise level of 65 DNL or less is considered acceptable for residences. This standard is applied nationally (Reference 3), including Hawaii. Because of our open-living conditions, the predominant use of naturally ventilated dwellings, and the relatively low exterior-to-interior sound attenuation afforded by these naturally ventilated structures, an exterior noise level of 65 DNL does not eliminate all risks of noise impacts. Because of these factors, and as recommended in Reference 4, a lower level of 55 DNL is considered as the "Unconditionally Acceptable" (or "Near-Zero Risk") level of exterior noise. However, after considering the cost and feasibility of applying the lower level of 55 DNL, government agencies such as FHA/HUD and VA have selected 65 DNL as a more appropriate regulatory standard.

For commercial, industrial, and other non-noise sensitive land uses, exterior noise levels as high as 75 DNL are generally considered acceptable. Exceptions to this occur when naturally ventilated office and other commercial establishments are exposed to exterior levels which exceed 65 DNL.

On the island of Oahu, the State Department of Health (DOH) regulates noise from construction activities through the issuance of permits for allowing excessive

TABLE 1

**EXTERIOR NOISE EXPOSURE CLASSIFICATION
(RESIDENTIAL LAND USE)**

NOISE EXPOSURE CLASS	DAY-NIGHT SOUND LEVEL	EQUIVALENT SOUND LEVEL	FEDERAL (1) STANDARD
Minimal Exposure	Not Exceeding 55 DNL	Not Exceeding 55 Leq	Unconditionally Acceptable
Moderate Exposure	Above 55 DNL But Not Above 65 DNL	Above 55 Leq But Not Above 65 Leq	Acceptable(2)
Significant Exposure	Above 65 DNL But Not Above 75 DNL	Above 65 Leq But Not Above 75 Leq	Normally Unacceptable
Severe Exposure	Above 75 DNL	Above 75 Leq	Unacceptable

Notes: (1) Federal Housing Administration, Veterans Administration, Department of Defense, and Department of Transportation.

(2) FHWA uses the Leq instead of the Ldn descriptor. For planning purposes, both are equivalent if: (a) heavy trucks do not exceed 10 percent of total traffic flow in vehicles per 24 hours, and (b) traffic between 10:00 PM and 7:00 AM does not exceed 15 percent of average daily traffic flow in vehicles per 24 hours. The noise mitigation threshold used by FHWA for residences is 67 Leq.

TABLE 2
EFFECTS OF NOISE ON PEOPLE
(Residential Land Uses Only)

EFFECTS ¹	Hearing Loss	Speech Interference		Annoyance ²	Average Community ⁴ Reaction	General Community Attitude Towards Area
		Indoor	Outdoor			
DAY-NIGHT AVERAGE SOUND LEVEL IN DECIBELS	Qualitative Description	%Sentence Intelligibility	Distance In Meters for 95% Sentence Intelligibility	% of Population Highly Annoyed ³		
75 and above	May Begin to Occur	98%	0.5	37%	Very Severe	Noise is likely to be the most important of all adverse aspects of the community environment.
70	Will Not Likely Occur	99%	0.9	25%	Severe	Noise is one of the most important adverse aspects of the community environment.
65	Will Not Occur	100%	1.5	15%	Significant	Noise is one of the important adverse aspects of the community environment.
60	Will Not Occur	100%	2.0	9%	Moderate to	Noise may be considered an adverse aspect of the community environment.
55 and below	Will Not Occur	100%	3.5	4%	Slight	Noise considered no more important than various other environmental factors.

1. "Speech Interference" data are drawn from the following tables in EPA's "Levels Document": Table 3, Fig. D-1, Fig. D-2, Fig. D-3. All other data from National Academy of Science 1977 report "Guidelines for Preparing Environmental Impact Statements on Noise, Report of Working Group 69 on Evaluation of Environmental Impact of Noise."

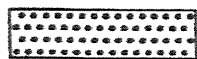
2. Depends on attitudes and other factors.

3. The percentages of people reporting annoyance to lesser extents are higher in each case. An unknown small percentage of people will report being "highly annoyed" even in the quietest surroundings. One reason is the difficulty all people have in intergrading annoyance over a very long time.

4. Attitudes or other non-acoustic factors can modify this. Noise at low levels can still be an important problem, particularly when it intrudes into a quiet environment.

NOTE: Research implicates noise as a factor producing stress-related health effects such as heart disease, high-blood pressure and stroke, ulcers and other digestive disorders. The relationships between noise and these effects, however, have not as yet been quantified.

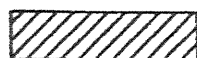
LAND USE	ADJUSTED YEARLY DAY-NIGHT AVERAGE SOUND LEVEL (DNL) IN DECIBELS				
	50	60	70	80	90
Residential – Single Family, Extensive Outdoor Use	Compatible	With Insulation per Section A.4			
Residential – Multiple Family, Moderate Outdoor Use	Compatible	With Insulation per Section A.4			
Residential – Multi-Story Limited Outdoor Use	Compatible	With Insulation per Section A.4	With Insulation per Section A.4		
Hotels, Motels Transient Lodging	Compatible	With Insulation per Section A.4	With Insulation per Section A.4		
School Classrooms, Libraries, Religious Facilities	Compatible	With Insulation per Section A.4	With Insulation per Section A.4		
Hospitals, Clinics, Nursing Homes, Health Related Facilities	Compatible	With Insulation per Section A.4	With Insulation per Section A.4		
Auditoriums, Concert Halls	Compatible	With Insulation per Section A.4			
Music Shells	With Insulation per Section A.4	With Insulation per Section A.4			
Sports Arenas, Outdoor Spectator Sports	Compatible	With Insulation per Section A.4			
Neighborhood Parks	Compatible	With Insulation per Section A.4			
Playgrounds, Golf courses, Riding Stables, Water Rec., Cemeteries	Compatible	With Insulation per Section A.4	With Insulation per Section A.4		
Office Buildings, Personal Services, Business and Professional	Compatible	With Insulation per Section A.4	With Insulation per Section A.4		
Commercial – Retail, Movie Theaters, Restaurants	Compatible	With Insulation per Section A.4	With Insulation per Section A.4		
Commercial – Wholesale, Some Retail, Ind., Mfg., Utilities	Compatible	With Insulation per Section A.4	With Insulation per Section A.4	With Insulation per Section A.4	
Livestock Farming, Animal Breeding	Compatible	With Insulation per Section A.4	With Insulation per Section A.4	With Insulation per Section A.4	
Agriculture (Except Livestock)	Compatible	With Insulation per Section A.4	With Insulation per Section A.4	With Insulation per Section A.4	With Insulation per Section A.4



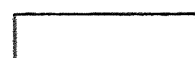
Compatible



Marginally Compatible



With Insulation per Section A.4



Incompatible

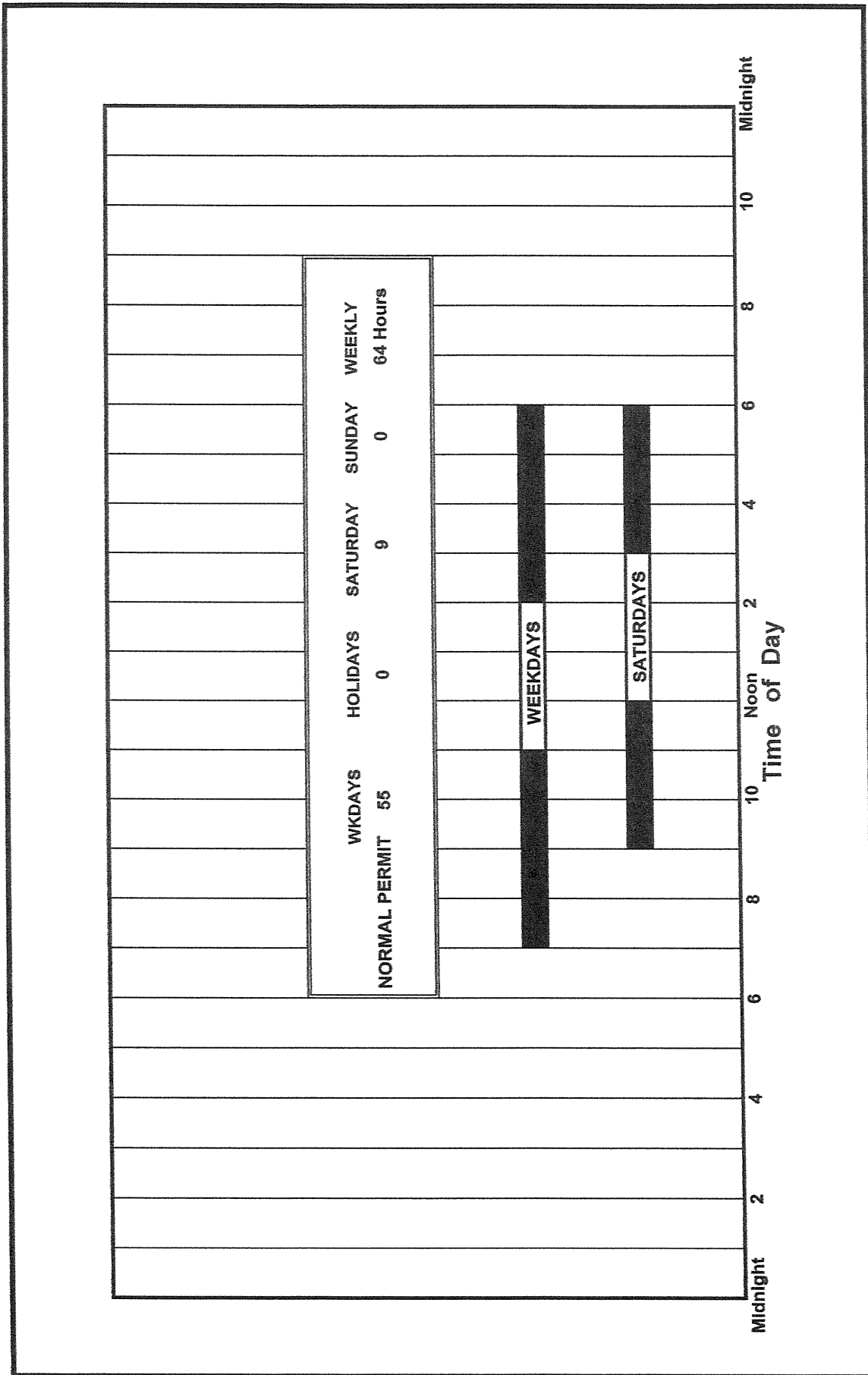
LAND USE COMPATIBILITY WITH YEARLY AVERAGE DAY-NIGHT AVERAGE SOUND LEVEL (DNL) AT A SITE FOR BUILDINGS AS COMMONLY CONSTRUCTED.
 (Source: American National Standards Institute S12.9-1998/Part 5)

FIGURE 7

noise during limited time periods. The limited time periods normally permitted are the daytime hours on weekdays and Saturdays, with noisy construction activities not permitted on Sundays and holidays (see Figure 8). State DOH noise regulations are expressed in maximum allowable property line noise limits rather than DNL (see Reference 5). Although they are not directly comparable to noise criteria expressed in DNL, State DOH noise limits for residential, commercial, and industrial lands equate to approximately 55, 60, and 76 DNL, respectively.

It should be noted that the noise compatibility guidelines and relationships to the DNL noise descriptor may not be applicable to impulsive noise sources such as sheet pile driving. The use of penalty factors (such as adding 10 dB to measured sound levels or the use of C-Weighting filters) have been proposed. However, the relationships between levels of impulsive noise sources and land use compatibility have not been as firmly established as have the relationships for nonimpulsive sources. The State DOH limits for impulsive sounds which exceed 120 impulses in any 20 minute period are 10 dB above the limits for non-impulsive sounds. If impulsive sounds do not exceed 120 impulses in any 20 minute time period, there are no regulatory limits on their sound levels under the State DOH regulations.

Where construction work is required during the evening or nighttime hours, or on Sundays or holidays, the granting of a noise variance is possible from the State DOH whenever the broader public interests are served by the variance. Examples of construction activities where noise variances have been granted for work during the nighttime, Sunday, or holiday periods are: highway repaving and reconstruction, work on bridges which cross over highways, sewer line rehabilitation, sewer manhole rehabilitation, water line rehabilitation, and electrical facility repairs and installation. In general, construction work is performed during the evening or nighttime hours, or on Sundays or holidays because of less traffic congestion during those periods, the economic impacts on property owners along the project corridor, or because of the need to perform certain types of specialized construction work (cured-in-place pipe lining, microtunneling, tunnel boring, or high voltage cable splicing) around-the-clock. At school buildings, which are not normally occupied during the night and which have large buffer distances to residences, nighttime work could be a beneficial noise mitigation measure.



**FIGURE
8**

**AVAILABLE WORK HOURS UNDER DOH PERMIT
PROCEDURES FOR CONSTRUCTION NOISE**

CHAPTER IV. GENERAL STUDY METHODOLOGY

References 6 through 8 were used to describe the various options for wastewater conveyance between the Halawa Wastewater Pump Station (WWPS) and the Honouliuli Interceptor Sewer. All options assumed use of the existing Honouliuli Interceptor Sewer for the final conveyance to the Honouliuli WWTP. The Hybrid conveyance option includes essentially all of the features of the No-Tunnel conveyance option, except for the substitution of either a 96-inch gravity storage tunnel (GST) or 72-inch landside gravity tunnel between the Pearl City and Waipahu WWPSs in place of force mains and storage facilities. Under the Hybrid option, a 46-inch deep gravity tunnel from Waiawa WWPS to the 96-inch or 72-inch gravity tunnels will be substituted for trunk sewers between Waiawa and Pearl City WWPSs. Under the Hybrid option, potential noise impacts should be isolated to the shafts and pits used for tunnel boring and microtunneling operations between Pearl City, Waipahu, and Waiawa WWPSs. Under the No-Tunnel option, noise impact differences from the Hybrid option will occur as a result of open trench and trenchless construction being used between Pearl City, Waipahu, and Waiawa WWPSs. Where the locations of tunnel shafts and microtunneling pits or manholes were identified, the associated construction noise sources were assumed to be at those identified locations. Where the locations of the pits or manholes were not established, it was assumed that they were located at the closest point of approach of the pipeline to the noise sensitive receptor, as was assumed for all trenchless construction. The use of sheet pile driving was assumed for both trenchless and open trench construction, with the locations of the activity being along the pipeline for open trench and at the shaft, pit, or manhole for trenchless construction.

Figures 1 through 6 show the alignments of the conveyance system from Halawa and Waiawa WWPSs to the Honouliuli Interceptor Sewer. Background noise level measurements were obtained at locations identified in Inset Figures A.1 through H.3, which are grouped in Appendix C. The background noise measurements were used to obtain estimates of the potential intrusiveness of the project construction noise levels at noise sensitive receptors closest to the project construction activities. Because construction activities are typically high but not normally continuous, the State DOH uses curfews rather than noise level limits when regulating noise during construction (see Reference 5). So, noise impacts resulting from construction activities can typically cause activity interference and disturbances during the daytime on weekdays and Saturdays, excluding holidays and Sundays. These noise impacts may be unavoidable, and mitigation measures can occur during the project planning purposes in selecting the project options which result in the least noise impacts, or during actual construction using the DOH's construction noise permit procedures and on-site sound attenuation measures during construction. This study identified the potential risks of adverse noise impacts for the various project options by comparing the potential construction noise levels to the daytime background noise levels at the noise sensitive receptor locations closest to the possible alignments of the conveyance piping or to the trenchless access shafts, pits, or manholes.

Because potential noise impacts during the nighttime, holiday, and Sunday periods are also possible for construction activities (microtunneling, CIPP, etc.) where continuous operation of noise sources may be required to reduce project costs or risks of equipment failures, or where potential traffic congestion impacts resulting from lane closures during the normal working hours are severe, nighttime background noise measurements should be obtained at noise sensitive receptor locations which are anticipated to be closest to the locations of the nighttime operating equipment. These nighttime background noise measurements should be used to determine the potential intrusiveness of nighttime construction work at these noise sensitive receptor locations. During the nighttime period, when most residents are asleep, there are increased risks of annoyance and sleep interference when construction occurs during the night. If the noise from construction activities does not exceed normal background noise levels, risks of adverse noise impacts from the construction activities will tend to be much lower than if the construction noise was much higher than the normal background noise levels. Where risks of adverse noise impacts were potentially high, the use of special noise mitigation measures (such as the construction of sound attenuating walls at the GST access shafts) were flagged as possibly being necessary to avoid denial by DOH of any requests for nighttime work.

Other potential noise and vibration impacts were also examined, such as those resulting from the use of blasting during excavation of the GST and deep tunnel shafts, and ground vibrations at receptors above and a short distances from the bored tunnel alignment. These potential noise and vibration impacts are primarily associated with the Hybrid option, and within the conveyance system between the Pearl City, Waipahu, and Waiawa WWPSs.

Existing daytime background noise levels were measured at twenty one noise sensitive receptor locations during the month of July 2019. The measurement locations are identified in Table 3 and their locations are shown in the indicated inset figures of Appendix C. The results of the background noise measurements were compared with calculations of predicted noise levels during construction activities which may occur at noise sensitive receptors in the vicinity of those measurement locations.

For this project, the State DOH noise limits of 55 dBA during the daytime (7:00 am to 10:00 pm) and 45 dBA during the nighttime (10:00 pm to 7:00 am) were also used as the minimum thresholds for evaluating potential noise impacts at single family residences. The State DOH noise limits of 60 dBA during the daytime (7:00 am to 10:00 pm) and 50 dBA during the nighttime (10:00 pm to 7:00 am) were used as the minimum thresholds for evaluating potential noise impacts at multifamily residences. These daytime and nighttime noise thresholds are consistent with the property line limits of Reference 5. It should be noted that these thresholds are being used only for the purposes of this study, since the State DOH typically applies these noise limits only to fixed machinery, and not to other mobile or portable noise sources which are used in construction, and which are regulated using the DOH construction noise permitting process.

**TABLE 3
DAYTIME BACKGROUND NOISE MEASUREMENT RESULTS**

LOCATION: HONOLULI/ WAIPAHI/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES
DATE: JULY 4-16, 2019

Start Time	End Time	LAm _{ax}	LA _{eq}	LA _{min}	LA ₅₀	LA ₁₀	Event Description
<u>LOCATION D1, 7/4/19 (See Inset Figure D.1 & F.6)</u>							
1540	1555	76.3	61.2	44.9	49.6	65.6	
1555	1610	76.1	59.3	44.8	50.6	60.8	
1610	1625	77.7	60.9	45.4	49.6	62.8	
1625	1640	74.8	58.7	43.6	49.0	60.7	
<u>LOCATION A1, 7/5/19 (See Inset Figure A.1 & H.1)</u>							
1135	1150	87.8	62.4	48.6	56.6	62.6	1145: Brake squeal
1150	1205	78.9	58.0	45.4	52.0	61.0	
1205	1220	74.9	57.6	42.9	52.5	61.3	
1220	1235	68.7	55.5	43.2	50.7	59.6	
<u>LOCATION A2, 7/5/19 (See Inset Figure A.2 & G.3)</u>							
1250	1305	67.5	50.1	36.9	45.9	52.2	
1305	1320	67.6	53.8	37.4	51.4	57.0	
1320	1335	80.2	56.9	37.9	46.2	54.4	1320: Moped
1335	1350	78.9	60.0	40.2	52.2	62.8	1338: Glass bottles
<u>LOCATION A3, 7/5/19 (See Inset Figure A.3 & G.4)</u>							
1420	1435	67.9	53.1	44.9	51.2	56.1	
1435	1450	72.9	56.3	44.6	52.0	57.7	1442: Helicopter
1450	1505	66.0	51.9	44.5	48.4	54.2	
1505	1520	64.8	54.3	44.4	52.6	57.4	
<u>LOCATION F4, 7/8/19 (See Inset Figure A.4, F.4, & G.5)</u>							
1044	1059	73.2	57.7	51.8	56.2	58.3	
1059	1114	71.0	57.2	51.9	56.0	57.7	
1114	1129	74.2	57.6	51.7	56.0	58.1	
1129	1144	72.7	58.4	54.0	56.5	58.7	
<u>LOCATION F3, 7/8/19 (See Inset Figure F.3)</u>							
1155	1210	71.6	60.0	56.3	59.3	61.2	
1210	1225	67.6	60.1	55.3	59.6	61.7	
1225	1240	75.2	61.0	56.8	60.6	62.2	
1240	1255	74.5	60.4	55.8	59.3	61.5	

TABLE 3 (CONTINUED)
DAYTIME BACKGROUND NOISE MEASUREMENT RESULTS

LOCATION: HONOLULU/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES
 DATE: JULY 4-16, 2019

Start Time	End Time	L _{Amax}	L _{Aeq}	L _{Amin}	LA50	LA10	Event Description
<u>LOCATION D2, 7/8/19 (See Inset Figure D.2)</u>							
1505	1520	71.4	57.3	48.0	54.1	60.1	
1520	1535	70.1	54.2	48.2	52.3	55.6	
1535	1550	66.8	51.3	46.8	50.0	52.7	
1550	1605	72.7	55.0	47.6	50.9	55.7	
<u>LOCATION E2, 7/9/19 (See Inset Figure E.2)</u>							
0806	0821	82.9	69.0	60.9	67.5	71.1	
0821	0836	93.6	71.4	60.3	66.6	71.7	0824: Motorcycle
0836	0851	79.7	68.2	61.6	66.8	70.6	
0851	0906	82.6	68.2	61.0	65.8	70.8	
<u>LOCATION F2, 7/9/19 (See Inset Figure E.3 & G.2)</u>							
0919	0934	68.4	59.8	54.9	59.3	61.5	
0934	0949	70.8	59.9	55.8	58.8	61.1	
0949	1004	73.8	60.6	53.6	59.1	61.8	
1004	1019	67.3	58.8	55.2	58.5	60.2	
<u>LOCATION B1, 7/9/19 (See Inset Figure A.5, B.1, E.3, & G.2)</u>							
1208	1223	74.6	61.4	56.8	60.6	62.6	
1223	1238	76.1	62.3	57.5	61.5	63.4	
1238	1253	74.0	63.3	58.0	61.9	65.0	
1253	1308	72.2	62.1	56.6	61.1	63.4	
<u>LOCATION B2, 7/9/19 (See Inset Figure B.2)</u>							
1324	1339	70.6	61.6	57.1	61.1	63.2	
1339	1354	70.7	62.0	57.9	61.5	63.8	
1354	1409	69.7	61.9	56.9	61.3	64.0	
1409	1424	69.5	61.9	56.5	61.3	64.1	
<u>LOCATION B3, 7/10/19 (See Inset Figure B.3)</u>							
0824	0839	86.1	60.4	50.0	55.9	60.8	0827: Artifact
0839	0854	67.5	57.9	51.1	56.4	60.5	
0854	0909	69.3	58.1	51.2	56.7	60.8	
0909	0924	72.5	59.2	52.2	57.3	61.8	

TABLE 3 (CONTINUED)
DAYTIME BACKGROUND NOISE MEASUREMENT RESULTS

LOCATION: HONOULIULI/ WAIPAHI/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES
 DATE: JULY 4-16, 2019

Start Time	End Time	LAm _{ax}	LA _{eq}	LA _{min}	LA ₅₀	LA ₁₀	Event Description
<u>LOCATION B4, 7/10/19 (See Inset Figure B.4)</u>							
0944	0959	67.6	55.9	50.8	54.1	58.8	
0959	1014	69.7	57.7	51.8	56.2	60.1	
1014	1029	78.0	59.2	51.1	55.5	60.9	1021: Heavy truck
1029	1044	68.0	55.3	47.6	52.8	58.1	
<u>LOCATION B5, 7/10/19 (See Inset Figure B.5)</u>							
1105	1120	64.9	56.0	50.2	55.4	57.9	
1120	1135	65.9	56.0	52.2	55.2	57.9	
1135	1150	65.3	55.6	52.9	55.2	57.2	
1150	1205	66.5	56.8	53.1	55.7	58.6	
<u>LOCATION B6, 7/11/19 (See Inset Figure B.6B)</u>							
0903	0918	80.9	61.3	49.4	53.4	62.2	0905: Barking dogs
0918	0933	66.3	52.6	47.5	50.8	54.4	
0933	0948	74.6	56.6	48.6	52.7	58.1	
0948	1003	76.3	55.7	48.1	52.5	57.7	
<u>LOCATION C5, 7/11/19 (See Inset Figure C.5)</u>							
1045	1100	69.5	58.4	49.6	57.1	61.6	
1100	1115	74.2	60.1	49.9	57.4	61.3	
1115	1130	65.7	58.1	50.0	57.0	61.1	
1130	1145	67.7	58.4	49.8	56.9	61.3	
<u>LOCATION C2, 7/11/19 (See Inset Figure C.4)</u>							
1157	1212	69.8	56.3	49.0	54.4	58.2	
1212	1227	64.8	55.6	48.3	54.4	58.2	
1227	1242	68.2	55.7	49.0	54.0	58.1	
1242	1257	66.2	56.0	49.9	54.9	58.2	
<u>LOCATION C3, 7/12/19 (See Inset Figure C.3)</u>							
0815	0830	66.9	54.3	46.6	53.4	56.8	
0830	0845	71.3	56.9	46.0	54.1	60.2	
0845	0900	64.2	55.0	47.3	53.9	57.4	
0900	0915	77.4	58.4	46.7	53.8	59.5	0903: Siren

TABLE 3 (CONTINUED)
DAYTIME BACKGROUND NOISE MEASUREMENT RESULTS

LOCATION: HONOULIULI/ WAIPAHU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES
 DATE: JULY 4-16, 2019

Start Time	End Time	LAm _{ax}	LA _{eq}	LAm _{in}	LA ₅₀	LA ₁₀	Event Description
<u>LOCATION C1, 7/12/19 (See Inset Figure C.1)</u>							
0940	0955	69.8	58.4	53.4	57.5	59.9	
0955	1010	74.6	59.9	52.8	57.7	61.9	
1010	1025	91.4	68.8	53.1	57.0	67.7	1012: Refuse truck
1025	1040	68.9	57.7	53.9	57.1	58.9	
<u>LOCATION C4, 7/12/19 (See Inset Figure C.2)</u>							
1108	1123	81.7	64.7	55.4	61.8	67.7	
1123	1138	80.2	64.4	55.6	62.2	66.7	
1138	1153	81.9	66.0	56.8	63.3	68.6	
1153	1208	79.4	64.9	55.7	62.1	67.5	
<u>LOCATION E1, 7/16/19 (See Inset Figure E.1)</u>							
1244	1259	73.7	62.1	54.0	60.2	65.1	
1259	1314	71.7	62.6	54.5	61.5	65.3	
1314	1329	75.5	62.5	54.3	61.3	64.9	
1329	1344	78.7	63.3	54.2	61.2	65.4	

- Notes:
- a. LA_{eq} = Average A-Weighted Sound Level (in dBA)
 - b. LAm_{ax} = Maximum A-Weighted Sound Level (in dBA)
 - c. LAm_{in} = Minimum A-Weighted Sound Level (in dBA)
 - d. LA₁₀ = A-Weighted Sound Level (in dBA) which was exceeded 10 percent of the time.
 - e. LA₅₀ = A-Weighted Sound Level (in dBA) which was exceeded 50 percent of the time.

In addition to the State DOH 60, 55, 50, and 45 dBA noise limits for single and multifamily residential uses, the FHA/HUD noise standard of 65 DNL was also used to evaluate potential noise impacts from mobile equipment. Also, during the daytime hours of 7:00 am to 10:00 pm, a 15-hour average noise level of 67 dBA from construction equipment should be within the FHA/HUD 65 DNL standard for noise sensitive receptors. The 65 DNL standard can also be met if an 8-hour average noise level of 69.7 dBA is not exceeded during a typical workday.

Recommendations for mitigating potential noise and vibration impacts were provided for construction activities during the normally permitted daytime construction period as well as for construction activities which would be required during the nighttime, holiday, or Sunday construction periods.

V. EXISTING ACOUSTICAL ENVIRONMENT

Existing background noise levels within the project environs are typically controlled by traffic noise at those receptor locations which are located near major roadways, and are typically controlled by the sounds of natural and human activities, distant traffic and local traffic, and aircraft at those receptor locations which are not located near major roadways. The natural sounds could include the sound of surf, birds, animals, insects, and foliage moving with the wind. The sounds of human activities could include lawn mowers, leaf blowers, music, home construction, and conversations. Background noise levels during the daytime tend to be higher with intermittent excursions to the 80 or 90 dBA level during intermittent noise events, while background noise levels during the nighttime tend to be lower and drop to levels below 40 dBA during the quietest periods at the quietest locations. Background noise levels along the coastline between Kapolei and Halawa tend to be lower than those in the developed inland areas, due to the presence of the major inland roadways (Salt Lake Boulevard, Lehua Avenue, Waipio Depot Street, Farrington Highway, Kamehameha Highway, and H-1 Freeway).

Table 3 presents the results of the daytime background noise measurements at Locations A1 to H3. The Inset Figures A.1 through H.3 (which are contained in Appendix C) depict the measurement locations and their relationships to existing noise sensitive receptors and the project sewer conveyances. At each measurement location, the hourly average background noise levels (LAeq) recorded at each location are shown in their inset figures, and 15-minute summaries of the recorded data are shown in Table 3. Appendix D contains the strip charts of the A-Weighted, background noise levels which were continuously recorded at the various measurement locations in July 2019. Except for Location E2, which was influenced by traffic noise from H-1 Freeway, the 24-hour noise levels at all other measurement locations were probably less than 65 DNL. Traffic noise levels tend to be highest at the first row of dwellings which front the roadway, and diminish at dwellings which are further removed from the roadway or which are shielded by the terrain and structures which block the visual line of sight between the dwelling and roadway vehicles. Because of the dominating influence of traffic noise on existing background noise levels near the major roadways, existing background noise levels in the project environs can range from 70+ DNL at locations near the major roadways, to less than 55 DNL at locations removed or shielded from the major roadways.

During the nighttime and early morning hours, background noise levels tend to be lowest due to the reductions in motor vehicle traffic along the roadways, and due to the diminished levels of human activities. Traffic noise levels tend to be highest during the daytime hours, increasing rapidly during the morning commuting period, remaining relatively constant during the daytime hours, increasing slightly during the afternoon commuting period, and decreasing during the evening and nighttime period to its lowest level at 3:30 to 4:30 am. Existing average background noise levels during the nighttime hours are typically 5 to 10 dBA lower than those during the daytime hours. Because of the lower levels of background noise at night, noise sources (such as construction

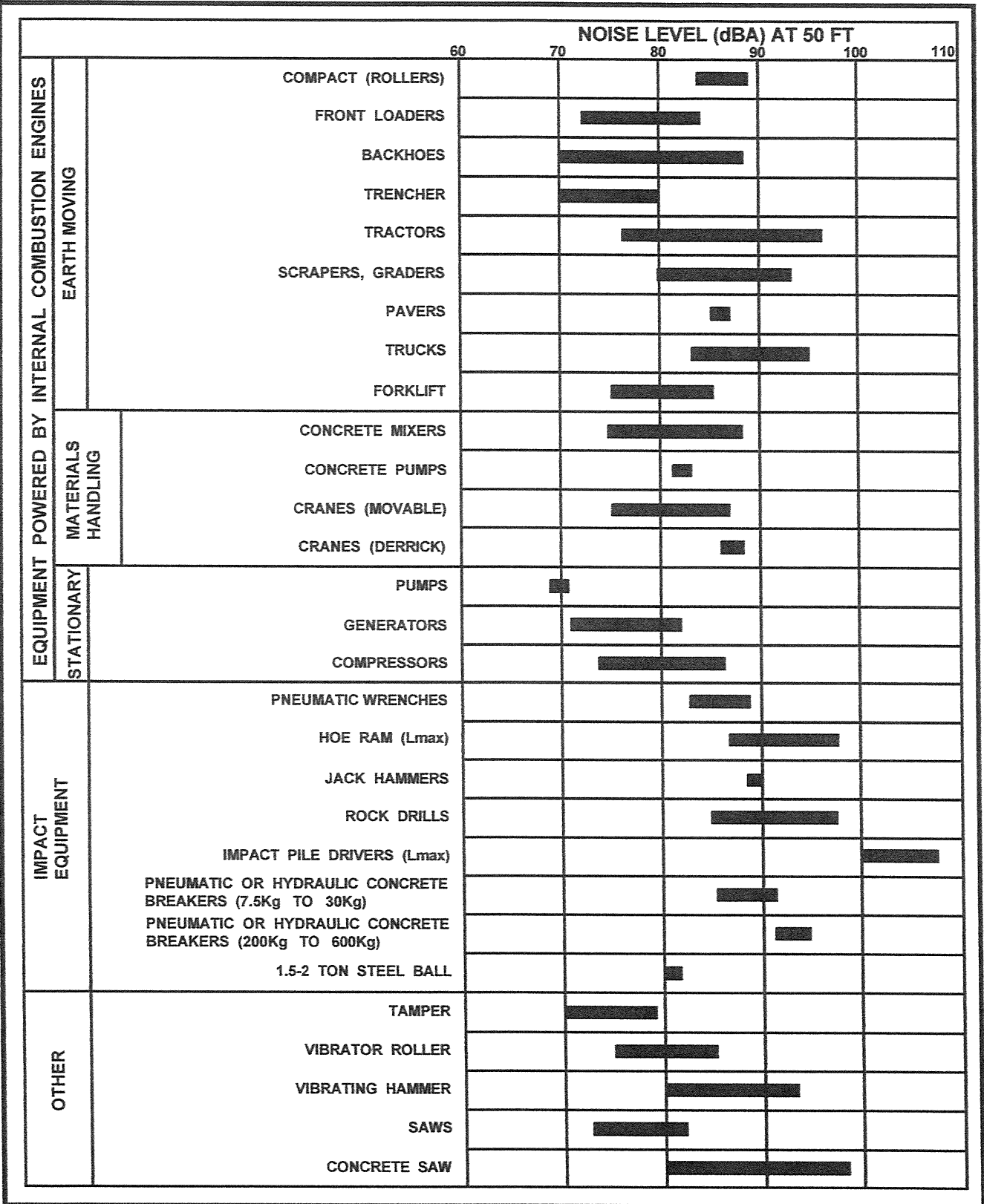
equipment) tend to be audible at longer distances during the quieter nighttime periods than during the noisier daytime periods.

Existing background noise levels in the areas which are removed from the major roadways are too low to mask the noise from typical construction activities, whether they involve open trenching or trenchless methods. So, as is typical in essentially all areas where construction activities occur, construction noise is typically audible, irrespective of the existing background noise levels. And in the project environs, where background noise levels in the quieter neighborhoods are more typical of rural rather than densely populated areas, construction activities will tend to be audible at longer distances from the locations of the construction equipment.

CHAPTER VI. DESCRIPTION OF POTENTIAL FUTURE NOISE LEVELS

NO-TUNNEL OPTION. The potential future noise levels associated with the construction of the sewer conveyance system between Halawa WWPS to the Honouliuli WWTP using conventional open trench as well as trenchless methods are essentially all associated with the activities which could occur during the construction of the force mains and trunk sewers. It was assumed that adverse noise impacts associated with new WWPS facilities will be mitigated during design of those facilities so as to comply with State DOH noise limits along the property lines of these wastewater facilities. Where trenchless methods (microtunneling, horizontal directional drilling, sliplining, CIPP, etc.) are used, some construction work above ground will also be required when excavating pits or in reconstruction of manholes. In addition, the trucking of spoils, fill material, and piping to and from the above ground work areas will also be required during construction of these No-Tunnel options.

Typical noise levels of construction equipment to be used in the No-Tunnel option are shown in Figure 9 and Table 4. The decrease in construction equipment noise with increasing distance from the noisier equipment is shown in Figure 10. The primary locations where these equipment noise sources may be operating are: at the various pump stations of the conveyance system, as well as anywhere along the force main and trunk sewer alignments shown in Figures 1 through 6. If open trench construction methods are used along a segment of the conveyance system, noisy construction equipment would operate along the entire segment of the conveyance system alignment, with the highest noise levels associated with sheet pile driving, excavators, vacuum trucks, and cranes. If trenchless construction methods are used along a segment of the conveyance system, noisy construction equipment would typically be localized and spaced apart at various access pits or manholes along the conveyance system alignment. The highest noise levels are expected to occur during excavation of the access pits or manholes, and should be similar to the highest noise levels associated with open trench construction. During operation of the microtunneling, sliplining, or CIPP equipment at the access pits or manholes, construction noise levels should be lower with cranes and vacuum trucks being the louder, intermittent, noise sources. The available setback distances between the closest residences and the construction equipment will vary with each conveyance system alignment, and relatively high noise levels during construction may be unavoidable, particularly during operations of mobile equipment such as sheet pile drivers, concrete saws, jackhammers, excavators, loaders, diesel trucks, backhoes, vacuum trucks, and cranes. These mobile equipment would typically be used during both open trench and trenchless construction, and tend to operate over shorter intervals of time rather than continuously. The equipment which tend to operate continuously, such as generators, pumps, slurry plant, ventilation fans, boiler trucks, air compressors, etc., are typically fixed at specific locations on the construction site, could be fitted with sound attenuation treatment (barriers, enclosures, silencers, etc.), and will typically have lower noise levels than those associated with the mobile construction equipment.



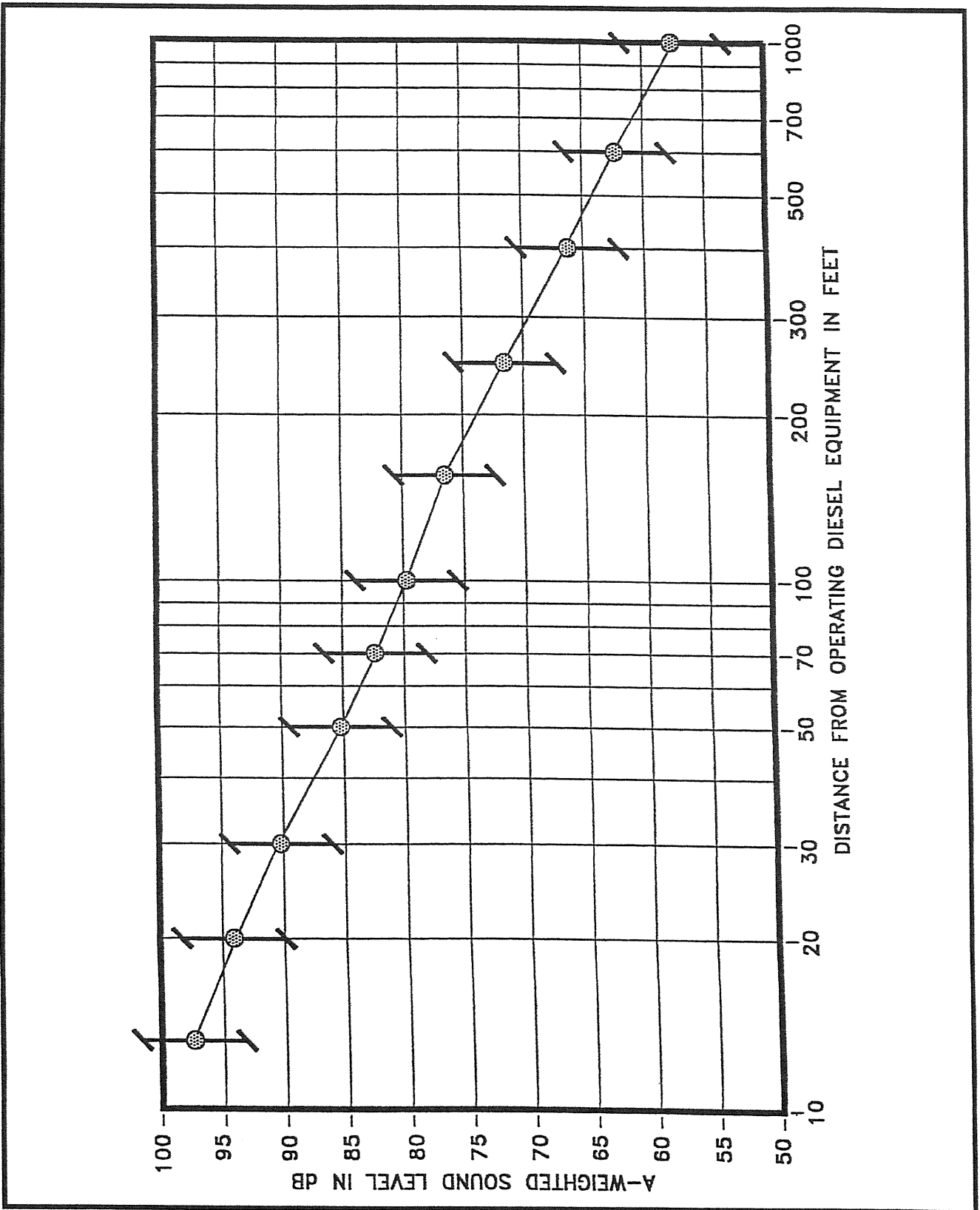
RANGES OF CONSTRUCTION EQUIPMENT NOISE LEVELS

FIGURE 9

TABLE 4

**RANGES OF A-WEIGHTED SOUND LEVELS OF
CONSTRUCTION EQUIPMENT AT 50 FOOT DISTANCE**

EQUIPMENT	SOUND LEVELS (dBA) (Minimum / Maximum)
Backhoe	72 / 85
Beeper Type Back Up Alarm	86 / 91
Broadband Back Up Alarm	86 / 89
Concrete Saw	86 / 96
25 Ton Crane	75 / 87
40 Ton KRUPP Crane	73 / 83
80 Ton KRUPP Crane (Quiet)	62 / 73
Excavator	70 / 90
Forklift / Loader	72 / 85
225 KW Generator	67
Sheet Pile Driving (Impact)	95 / 105
Sheet Pile Driving (Vibrator)	90 / 100
Trash Pump	70 / 80
Vacuum Truck	72 / 85
Ventilation Fan	70 / 70



ANTICIPATED RANGE OF CONSTRUCTION NOISE LEVELS VS. DISTANCE

FIGURE 10

Historically, the improvements to the sewer conveyance systems have utilized both the open trench and trenchless construction methods. Construction using both methods have typically occurred during the permitted daytime hours shown in Figure 4, and have occurred in all zoning districts (residential, commercial, industrial, etc.). Using the noise variance procedures of the State DOH, construction has also occurred during the nighttime, Sunday, and holiday periods when required due to potential impacts on traffic congestion, due to the necessity of 24-hour work periods, and due to the necessity of minimizing adverse noise impacts on adjacent daytime activities (schools, commercial, etc.). Potential noise impacts from these improvements to the sewer conveyance systems are site specific, and are typically short term. In general, the potential noise impacts from these types of projects have not been "show stoppers," and methods of construction and noise mitigation measures have been developed to allow these projects to proceed, even within the most noise sensitive residential areas. So while noise impacts during construction of the No-Tunnel option are possible, these noise impacts are temporary, and mitigation measures (use of work scheduling, use of quiet equipment, erection of sound barriers, use of sound enclosures, etc.) are available to address most of the potential noise impacts.

Between the Pearl City and Waipahu WWPSs under the Hybrid option, use of force mains using the sliplining or open trench construction methods would be replaced with the construction of either a 96-inch gravity storage tunnel (GST) between launch and retrieval shafts located at these two pump stations or a 72-inch landside gravity tunnel constructed using microtunneling (see Figure 4). The 96-inch gravity storage tunnel (GST) or 72" gravity tunnel would replace the 36-inch force mains between the Waipahu WWPS and the Pearl City WWPS planned under the No-Tunnel option. At other sections of the conveyance system between the Halawa WWPS and the Honouliuli Interceptor Sewer (with the exception of the Waiawa collection system), the selection of the Hybrid option would not change the potential construction noise impacts associated with the No-Tunnel option. So, in order to compare the potential differences in potential noise impacts between the No-Tunnel and Hybrid options, comparisons of the potential noise impacts associated with the candidate conveyance systems between the Waiawa, Pearl City, and Waipahu WWPSs (as shown in Figures 3 and 4) were used to compare the noise impacts between the No-Tunnel and Hybrid options.

Halawa WWPS to Waimalu WWPS (See Figure 1): The replacement of the Halawa WWPS and upgrade/replacement of the Waimalu WWPS are planned. Risks of adverse noise impacts following construction at the pump stations are considered to be low, since the closest noise sensitive residential receptors are over 250 feet from the pump stations and with high volume roadways (Salt Lake Boulevard and Kamehameha Highway) separating the pump stations from the noise sensitive residences. Open trench construction will probably be used to install a new 14" force main (FM) and 48" trunk sewer (TS) where shown in Figures 1, 2., B.6B, and C.1 through C.5. Table 5 summarizes the potential noise levels and impacts during construction at and between these two pump stations.

**TABLE 5
SUMMARY OF POTENTIAL NOISE LEVELS AT CLOSEST NOISE SENSITIVE RECEPTORS DURING CONSTRUCTION
NO-TUNNEL OPTION**

<u>PROJECT SEGMENT</u>	<u>SEWER LINES CONSTRUCTED</u>	<u>REFERENCE FIGURE, INSERT</u>	<u>RECEPTORS</u>	<u>DAYTIME BACKGROUND NOISE (dBA)</u>	<u>DISTANCE TO WWPS (FT)</u>	<u>DISTANCE TO SEWER (FT)</u>	<u>WWPS CONSTR. NOISE (dBA)</u>	<u>SEWER LINE CON- STR. NOISE (dBA)</u>
Halawa to Waimalu WWPSs	14" Force Main or 48" Trunk Sewer Between Halawa and Waimalu WWPSs	Figure 1, C.1	Ohialomi Pl. Residence	57.7 to 63.9	264	200	56 to 66	71 to 86
		Figure 1, C.2	Ohenana Lp.. Residence	64.4 to 65.0	N/A	60	N/A	82 to 97
		Figure 1, C.3	Honu Lp. Residence	54.3 to 56.5	N/A	60	N/A	82 to 97
		Figure 1, C.4	Aiea Kai Pl. Residence	55.6 to 55.9	N/A	10	N/A	98 to 113
		Figure 1, C.5	Kihale Pl. Residence	58.1 to 58.8	N/A	20	N/A	92 to 107
		Figure 1, B.6B	Pahemo Pl. Residence	52.6 to 57.7	304	136	54 to 64	75 to 90
Waimalu to Pearl City WWPS	30" Force Main or 48" Trunk Sewer Between Waimalu and Pearl City WWPSs	Figure 2, B.1	Hugh St. Residence	61.4 to 62.3	270	85	55 to 65	79 to 94
		Figure 2, B.2	Lehua Elem. School Bldg.	61.6 to 64.1	N/A	15	N/A	94 to 104
		Figure 1, B.3	Kuleana Pl. Residence	57.9 to 59.0	N/A	80	N/A	80 to 95
		Figure 1, B.4	Kaluamoi Dr. Residence	55.3 to 57.3	N/A	130	N/A	75 to 90
		Figure 1, B.5	500 ft. from Kamehameha Hwy C.L.	55.6 to 56.1	N/A	400	N/A	64 to 79
		Figure 1, B.6A	Kaahumanu St. Apartments	67.6 to 68.1	330	196	53 to 63	71 to 86
Waiawa Ind. Park to Pearl City WWPS	Corridor A: 48" Trunk Sewer	Figure 3, E.1	Pearl City Elem. School	62.9 to 63.5	N/A	44	N/A	85 to 100
		Figure 3, E.1	Luehu St. Residences	52.1 to 52.7	N/A	250	N/A	69 to 84
		Figure 3, E.2	Lehua Ave. Residences	68.2 to 69.2	N/A	64	N/A	82 to 97
		Figure 3, E.3	Hugh St. Residence	61.4 to 62.3	270	(Not Finalized)	55 to 65	(Not Finalized)
Waiawa Ind. Park to Pearl City WWPS	Corridors A & D: 48" Trunk Sewer Corridors A & D: 48" Trunk Sewer Corridor D: 48" Trunk Sewer Corridor D: 48" Trunk Sewer Corridor D: 48" Trunk Sewer Corridors A & D: 48" Trunk Sewer	Figure 3, F.6	Elm Dr. Residents	Est. 47 to 50	450	(See Inset F.5)	50 to 60	
		Figure 3, F.1	Elm Pl. Residence	Est. 49.5 to 50.1	N/A	380	N/A	65 to 80
		Figure 3, E.3	Hugh St. Residence	61.4 to 62.3	270	N/A	55 to 65	
		Figure 3, F.3	Waiawa Rd. Residence	60.0 to 60.4	N/A	(Not Finalized)	N/A	(Not Finalized)
		Figure 3, F.4	Bike Path Residence	57.2 to 57.8	N/A	(Not Finalized)		(Not Finalized)
		Figure 3, F.5	Elm Dr. Residents	Est. 47 to 50	N/A	270	N/A	68 to 83
Pearl City to Waipahu WWPS	Dual 36" Force Main & 3rd 36" Force Main	Figure 2, A.1	Waipahu Depot St. Residence	50.0 to 59.2	360	450	52 to 62	63 to 78
		Figure 2, A.2	Awamoku St. Residences	50.1 to 56.6	N/A	120	N/A	76 to 91
		Figure 2, A.3	Poailani Cir. Residences	51.9 to 54.2	N/A	132	N/A	75 to 90
		Figure 2, A.4	P.H. Bike Path Residences	57.2 to 57.8	N/A	140	N/A	75 to 90
		Figure 2, A.5	Hugh St. Residence	61.4 to 62.3	270	430	55 to 65	63 to 78
Waipahu WWPS to Honouliuli 84" Interceptor Sewer	Dual 36" Force Main & 3rd New Force Main	Figure 6, H.1	Waipahu Depot St. Residence	50.0 to 59.2	310	460	54 to 64	63 to 78
		Figure 6, H.2	Police Academy	45.0 to 54.2	250 (Alt. #2)	270	56 to 66 (Alt. #2)	68 to 83
		Figure 6, H.3	Abandoned Military Structure	43.6 to 46.2	N/A	80	N/A	80 to 95

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Waimalu WWPS to Pearl City WWPS (Figures 1 and 2): The upgrade/replacement of the pump stations at Waimalu and Pearl City WWPS are planned. Risks of adverse noise impacts following construction at the Waimalu WWPS are considered to be low, since the closest noise sensitive residential receptors are approximately 300 feet from the pump station and with high volume Kamehameha Highway separating that pump station from the noise sensitive residences. At the Pearl City WWPS, existing residences to the northeast are located at 200+ feet from that pump station, but background noise levels are relatively low at these residences. Trenchless construction will probably be used to install a new 30" force main (FM) and open trench construction is planned for the 48" trunk sewer (TS) where shown in Figures 1, 2, and B.1 through B.6A. Table 5 summarizes the potential noise levels and impacts during construction at and between these two pump stations.

Waiawa WWPS to Pearl City WWPS (Figure 3): Under the No-Tunnel option, a 42" trunk sewer is planned between Waiawa Industrial Park and the Pearl City WWPS, using open trench and microtunnel construction. One of two possible conveyance corridors (A or D) will be used if the No-Tunnel option is selected. Risks of adverse noise impacts during and following construction at the Waiawa WWPS are considered to be low, because the pump station is located in an industrial subdivision and since the closest noise sensitive receptors are over 400 feet from the pump station and located on a ridge in military housing units. At the Pearl City WWPS end of the trunk sewer alignments, potential noise impacts during construction of the 42" trunk sewer will be lower under Corridor A than under Corridor D (see Figures 3, E.1 through E.3, F.1, F.3 to F.6, and Table 5). Potential problems with the use of open trench construction along Corridors D and E are shown in Inset Figures E.3, F.3 and F.4, and have not been completely resolved. If Corridor D or E is selected, the use of trenchless construction instead of open trenching will be used where open trench conflicts are shown.

Pearl City WWPS to Waipahu WWPS (Figure 2): The upgrade/replacement of the pump stations at Waipahu and Pearl City WWPS are planned. Risks of adverse noise impacts following construction at the Waipahu WWPS are considered to be low, since the closest noise sensitive residential receptors are over 350 feet from the pump station. At the Pearl City WWPS, existing residences to the northeast are located at 250+ feet from that pump station, but background noise levels are relatively low at these residences. Sliplining will probably be used to rehabilitate two existing 36" force mains, and open trench construction will probably be used to add a third 36" force main alongside the existing two force mains. If deemed necessary, the two existing 36" force mains may be replaced in kind using open trench construction alongside the existing force main alignment where shown in Figures 2 and A.1 through A.5. Table 5 summarizes the potential noise levels and impacts during construction at and between these two pump stations.

Waipahu WWPS to Honouliuli Interceptor Sewer (Figure 6): The upgrade/rehabilitation of the Waipahu WWPS is planned. Risks of adverse noise impacts from

the WWPS are considered to be low. Two existing 36" Waipahu force mains are expected to be rehabilitated using sliplining, and a third 36" force main will be added where shown in Figures 6, and H.1 through H.3. Table 5 summarizes the potential noise levels and impacts during construction at the pump station and along the force mains.

HYBRID OPTION.

Pearl City WWPS to Waipahu WWPS (Figure 4). The potential future noise and vibration levels associated with the implementation of the 96-inch gravity storage tunnel (GST) option using a tunnel boring machine (TBM) are essentially all associated with the activities which could occur during the construction of the gravity tunnel. Although the trenchless method using a TBM primarily involve the construction of a tunnel under the lands between the Pearl City WWPS and Waipahu WWTP (see Figures 4 and 5), construction work above ground will also be required in excavating access shafts along the selected tunnel alignment. In addition, the trucking of spoils from the TBM launch shaft at Waipahu WWPS to disposal locations on Oahu will be required.

In constructing the 96-inch GST, a Tunnel Boring Machine (TBM) is expected to be launched from the Waipahu WWPS end of the tunnel following excavation of the access shaft. Other access shafts may also be constructed along the selected tunnel alignment to recover and relaunch the TBM toward its final destination at the Pearl City WWPS. The TBM may be powered by commercial electrical power, and will be supported with a material conveyor, ventilation fan, and materials handling equipment operating near the various access shafts. Figures 4, G.1, and G.2 depict the relationships of noise sensitive receptors to the GST launch and retrieval shafts, and Table 6 summarizes the potential noise levels and impacts during GST construction at and between the Waipahu and Pearl City pump stations.

At various locations along the tunnel alignment, a tunnel access shaft may be excavated using conventional methods, and the excavated materials will be trucked from these access shafts to disposal locations on Oahu. It is anticipated that construction operations will be limited to the normally permitted periods during construction of the access shafts and during recovery of the TBM.

Under the Hybrid option, a 72-inch landside gravity tunnel may be constructed using microtunneling techniques in place of the 96-inch GST where shown in Figure 4. The microtunneling pits of this landside gravity tunnel will generally have larger buffer distances to noise sensitive receptors than would the 36-inch Pearl City FM alignment under the No-Tunnel option. If this microtunneling option is selected, potential noise impacts would be localized in the vicinity of the 15 pits along the microtunneling alignment. The highest construction noise emission levels will probably occur during sheet pile driving, which will be localized at the 15 pits under the Hybrid landside gravity tunnel option, but would probably occur along the entire 36" FM under the No-Tunnel option. Figures 4, and G.1 through G.5 depict the relationships of noise sensitive receptors to the microtunneling alignment, and Table 6 summarizes the potential noise

**TABLE 6
SUMMARY OF POTENTIAL NOISE LEVELS AT CLOSEST NOISE SENSITIVE RECEPTORS DURING CONSTRUCTION
HYBRID OPTION**

<u>PROJECT SEGMENT</u>	<u>SEWER LINES CONSTRUCTED</u>	<u>REFERENCE FIGURE, INSERT</u>	<u>RECEPTORS</u>	<u>DAYTIME BACKGROUND NOISE (dBA)</u>	<u>DISTANCE TO WWPS (FT)</u>	<u>DISTANCE TO SEWER (FT)</u>	<u>WWPS CONSTR. NOISE (dBA)</u>	<u>SEWER LINE CON- STR. NOISE (dBA)</u>
Pearl City to Waipahu WWPS	96" Gravity Storage Tunnel (GST) 72" Landside Gravity Tunnel	Figure 4, G.1	Police Academy	45.0 to 54.2	250 (Alt. #2)	250 (To Shaft)	56 to 66	69 to 84
		Figure 4, G.2	Hugh St. Residence	61.4 to 62.3	N/A	300 (To Shaft)	N/A	67 to 82
		Figure 4, G.3	Residence @ Microtunnel Pit #4	50.1 to 56.6	N/A	150	N/A	74 to 89
		Figure 4, G.4	Residence @ Microtunnel Pit #5	51.9 to 54.2	N/A	145	N/A	74 to 89
		Figure 4, G.5	Residence @ Microtunnel Pit #14	57.2 to 57.8	N/A	170	N/A	73 to 88
Waiawa WWPS to GST or Landside Gravity Tunnel	46" Deep Gravity Tunnel	Figure 5, D.1	Elm Dr. Residents	Est. 47 to 50	450 (To Shaft)	N/A	N/A	63 to 78
		Figure 5, D.2	Leeward Com. Coll. (Closest Bldg)	48.3 to 51.9	N/A	140	N/A	N/A
		Figure 5, D.3	Farm Residences Near GST Shaft	47.3 to 50.9	540 (To Shaft)	N/A	N/A	61 to 76

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levels and impacts during microtunneling for the 72-inch landside gravity tunnel between the Waipahu and Pearl City WWPSs.

Waiawa WWPS to Conveyance Tunnel from Pearl City WWPS to Waipahu WWPS (Figures 4 and 5): Under the Hybrid option, a 48-inch gravity tunnel would be used instead of the 42-inch trunk sewer between the Waiawa and Pearl City WWPSs. Like the other tunneling construction methods, potential noise impacts would be localized in the vicinity of the access pits along the gravity tunnel alignment. The highest construction noise emission levels will probably occur during sheet pile driving, which will be localized at the access pits under the Hybrid's Waiawa Corridor G option. Figures 5, and D.1 through D.3 depict the relationships of noise sensitive receptors to the microtunneling alignment, and Table 6 summarizes the potential noise levels and impacts during construction of the 42-inch deep tunnel between Waiawa WWPS and the conveyance tunnel connection between Pearl City and Waipahu WWPSs.

CHAPTER VII. DISCUSSION OF PROJECT-RELATED NOISE IMPACTS AND POSSIBLE MITIGATION MEASURES

General Construction Noise. Audible construction noise will probably be unavoidable during the entire project construction period. The total time period for actual construction is estimated to span the period from 2022 through 2040, beginning with the work on the Waipahu and Pearl City conveyance systems and ending with the work on the Halawa conveyance systems. Construction noise levels and impacts are expected to be identical under the No-Tunnel and Hybrid options during construction of the conveyance systems between Halawa and Pearl City WWPS and between Waipahu WWPS and the existing Honouliuli Interceptor Sewer. The Hybrid option with the GST between Pearl City and Waipahu WWPSs is expected to produce the least noise impacts along the existing Pearl City to Waipahu WWPS conveyance corridor, as well as along the ultimate conveyance system corridor between Waiawa WWPS and the Pearl City area. With the GST and the use of Waiawa Corridor G, the higher noise impacts along the 72" gravity tunnel between Pearl City and Waipahu WWPSs under the Hybrid option would be avoided. Under the No-Tunnel option, the cumulative noise impacts along the existing Pearl City to Waipahu WWPSs corridor plus those along the Waiawa Corridor A or D would be the greatest of all options. The potentially high noise impacts along Waiawa Corridors A or D under the No-Tunnel option would be avoided under the Hybrid option.

Under both the No-Tunnel and Hybrid options, construction noise levels will probably be audible at the closest residences, and may Intermittently exceed existing daytime background noise levels by 10 to 45 dBA without sheet pile driving, and by possibly as much as 60 dBA with sheet pile driving. There are some locations where the sewer lines may pass within 20 feet of noise sensitive receptors (see Inset Figures B.2, C.4, and C.5), which could result in extremely high construction noise levels. Typical levels of construction noise inside naturally ventilated and air conditioned structures are approximately 10 and 20 dBA less, respectively, than the expected exterior noise levels at the closest residences to the various work areas.

Possible Noise Mitigation Measures for General Construction Sources. Mitigation of construction noise impacts is administered by the State Department of Health (DOH) through the issuance of Construction Noise Permits and through a curfew system, which limits noisy construction activities to normal work hours from Mondays through Saturdays, excluding holidays (see Reference 5). Figure 8 depicts the hours typically allowed for construction activities on weekdays and Saturdays under the DOH permit system. For construction work (such as sheet pile driving) which could generate very high noise levels at the closest residences, the DOH may include additional curfew restrictions on early morning and late afternoon work hours to further minimize risks of adverse construction noise impacts. The DOH construction noise permit system has been in use for a very long time, and has generally been successfully applied. This is partially due to the efforts of contractors to minimize adverse noise impacts, the temporary nature of the very noisy construction activities at any one location, and the use of scheduling and resident notifications of the anticipated noisy activities.

The relatively high noise levels during construction of the project are unavoidable, particularly at the relatively short setback distances to the closest residences. Mitigation of construction noise to inaudible levels will not be practical in all cases due to the intensity of construction noise sources (80 to 90+ dBA at 50 FT distance), and due to the exterior nature of the work (excavating, grading and earth and spoils moving, trenching, crane operations, hammering, etc.). The use of properly muffled construction equipment should be required on the job site. The anticipated noise levels during project construction activities are similar to other construction activities (exterior earthwork, open trenching, or building erection). Noise mitigation measures should be included in the various construction projects for the Honouliuli / Waipahu / Pearl City Wastewater Conveyance Facilities project. The following noise mitigation measures are recommended for inclusion within the project construction documents:

1. Provide sound attenuation treatments (walls, enclosures, or silencers) to reduce all steady, continuous noise sources (generators, pumps, blowers, etc.) which operate during the normally permitted daytime hours so that they do not exceed an 8-hour average value of 69 dBA at the closest residences. The use of solid 3/4" plywood panels instead of fabric dust screens at these closest residences could provide approximately 5 to 10 dBA of sound attenuation at the closest residences who are expected to experience the highest construction noise levels.

2. For fixed or stationary equipment (generators, pumps, blowers, etc.) which need to operate 24 hours per day, provide sound attenuation treatments (walls, enclosures, or silencers) to reduce their noise levels to the allowable State DOH nighttime limits of 45 or 50 dBA at the station boundaries which adjoin or face residences.

3. In some instances where the trunk sewer and force main lines are extremely close to noise sensitive structures (see Inset Figures B.2, C.4., and C.5 in Appendix C), consider the use of trenchless construction instead of open trenching. In situations where schools are involved, consider the use of off-hour scheduling of the work, and even nighttime work if large buffer distances are available to other noise sensitive receptors in the area.

3. Require the installation and use of broadband back-up alarms in place of beeper-type back-up alarms for all mobile equipment operating on the project work sites. The broadband alarms should be less audible at the longer distances, and should be less annoying at all distances from the mobile construction equipment. Use broadband alarms which automatically adjust the alarm sound level for differences in background noise level.

4. If prolonged periods of work are required during the non-permitted (or noise variance) hours, consider the use of HECO electrical service drops at the access pits or shafts in place of portable generators and engine driven equipment (pumps, lights, etc.). These service drops may also be used to meet the 69 dBA maximum daytime

level recommendation in Paragraph 1, and the 45 or 50 dBA nighttime level recommendation in Paragraph 2.

5. Maximize the separation distances between residences and the heavy truck routes to and from the construction sites which are used for materials delivery or spoils removal.

6. Include construction noise mitigation measures for the construction contractors as follows:

- Use of the quietest equipment that is readily available, particularly in respect to factory quieted portable generators, pumps, and compressors; and the use of properly muffled and enclosed heavy equipment and vehicles;
- The construction contractor should attempt to develop schedules of work within 50 feet of a residence which is mutually agreeable to all parties. This could allow residents to schedule their activities so as to avoid the anticipated construction periods of very high noise levels;
- The construction contractor should not schedule very noisy construction work which occurs simultaneously on more than one side of any residence within 50 feet of the work area. This will allow the resident to close the exterior windows and doors on the exposed side of the home while allowing for natural ventilation via the other sides of the home;
- Provide weekly schedules of the location, date, and time of the anticipated noisy construction activities to residences within 500 feet of the scheduled work areas;
- Provide the cell phone number of the job site supervisor, who is responsible for responding to residents' complaints regarding the construction activities;
- Require the construction contractor to maintain a date and time log of all noise complaints, which includes the name and address of the complainant and the remedial measures taken; and
- Require the construction contractor to report all noise complaints received within 1 working day of the receipt of the complaint to the Officer-In-Charge.

Blasting Operations. The potential impacts from blasting to break rock during excavation of the access shafts along the GST and Waiawa deep tunnel alignments have not been proposed but were evaluated. Distances from the tunnel access shaft to the closest residences could range between 270 to 550 feet. Blast induced ground and air vibrations have the potential to startle or annoy surrounding residents, and to also cause damage to structures. However, when properly controlled, blasting operations at

the proposed tunnel access shafts should not pose significant risks of damage or annoyance to neighboring buildings or residents.

Airborne Noise from Blasting. The air blasts associated with blasting are concussion type, low frequency vibrations, which are of relatively short duration (or impulsive) and generally described in terms of peak over pressure in psi, or in dBL. The dominant sources of the air blast are the Air Pressure Pulse, which is caused by the large displacement of the ground surface near the charge, and the Stemming Release Pulse, which is caused by gas pressure ejecting the stemming (fill) material from the hole bored for the explosive charge. The low frequency characteristic (usually referred to as bass sounds) of air blast noise tends to induce vibrations in structures (and subsequent complaint reactions) due to the low resonant frequency (10 to 25 Hz) of buildings. High frequency sounds of amplitudes equal to blast noise generally do not induce vibrations and cause physical damage to structures. Although the human ear has an opposite characteristic (i.e., the ear is less sensitive to low frequency sounds), structures which vibrate can produce secondary audible effects such as rattling sounds (of fixtures, doors, etc.), and effects which are sensitive to touch (or feelable). Sound levels at which these secondary effects occur vary with the weight (and probably stiffness) of the structure. In general, the inception point of sound induced vibration is difficult to establish, but may occur at levels as low as 80 dBL. These levels are significantly below the peak levels of 120 to 136 dBL which have been associated with low risk of damage to structures.

If blasting is used to break rock, the charge weights per delay will be adjusted so as to eliminate any risk of damage to nearby structures. The levels of air blast are anticipated to be well below the structural damage criteria for buildings, so risks of window glass breakage from the blasting at the proposed project are considered to be very low. Since complaints resulting from air blast noise levels may occur at levels considerably below those necessary to cause damage to structures (120 to 136 dBL), additional analyses were conducted to estimate the percent of the neighboring population which may be highly annoyed by blasting operations. At air blast noise levels of 119 dBL, and with no more than two blasts per day, the average noise exposure levels from blasting operations are predicted to be 47 Lcdn, which is analogous to 47 DNL except for the use of C-Weighting rather than A-Weighting filters. An exposure level of 47 Lcdn (or 47 DNL) is very low, and less than 2 percent of the population exposed to this level are expected to be highly annoyed (see Reference 9). For these reasons, risks of adverse airborne noise impacts from blasting operations of up to two blasts per day, and which are also controlled to avoid risks of damage to structures are considered to be very low.

Ground Vibration from Blasting. Ground vibrations, or seismic waves, are also generated during blasting operations, and are generally described in terms of peak particle velocity in inches per second. Most of the seismic energy remains trapped in the ground, but some energy is released as an over pressure pulse into the air (or Rock Pressure Pulse). In general, the ground vibrations as well as the airborne Rock Pressure Pulse are expected to be less intrusive than the Air Pressure and Stemming

Release Pulses. As an example, tunneling work along Dole Street on Oahu for a sewer project generated some initial air blast complaints from nearby residents during blasting of the surface entrance to the tunnel. However, once the entrance to the tunnel was formed and blasting was confined to tunneling underground, complaints stopped.

Predictions of peak over pressure or ground vibration levels vs. scaled distance from the blast are not precise, with initial uncertainties for a given location in the order of 20 to 30 dBL. For this reason, it is standard practice to employ seismograph monitoring of air and ground vibrations during blasting operations with a 3-axis geophone (for ground vibrations) and a microphone (for air vibrations).

The shorter separation distances between the potential blasting areas and surrounding noise sensitive neighbors range are relatively small and range from approximately 270 feet to approximately 550 feet. At these small separation distances between the blast areas and surrounding noise sensitive neighbors, charge weights may need to be limited to less than one pound of explosives per delay. At one pound of explosives per delay, the predicted vibration levels at 270 feet separation distance are in the order of 0.02 to 0.11 inches per second. These predicted levels of ground vibration are encroaching into the thresholds for structural or architectural damage to "ruins and ancient monuments," and may be feelable (see Table 7). In addition, these levels are not encroaching into the 0.35 inches per second threshold recommended to minimize adverse human responses to vibrations resulting from sporadic impulsive shock excitations (see Reference 10). Based on these predictions of vibration levels from blasting operations, it was concluded that risks of adverse impacts from ground vibrations can be very low, but the sizes of the charge weights per delay may need to be kept at relatively small values in order to minimize risks of damage to nearby structures.

Mitigation of Noise and Vibration Impacts from Blasting. Because blasts may be both feelable and audible in the surrounding communities, mitigation measures will probably be required to minimize risks of antagonizing nearby residents. These recommended mitigation measures are described as follows:

- Regularly monitor air blast and ground vibration levels simultaneously at the closest noise sensitive residence(s) or structure(s) during the blasting operations to develop the data base for the surrounding area.
- For initial blasts, prior to establishment of a data base of ground vibration and air blast levels vs. scaled distance, use the minimum practical charge weight (in equivalent pounds of TNT) per delay as well as the minimum practical number of delays (or bore holes).
- If practical, reduce maximum air blast levels to less than 110 dBL at the nearest noise sensitive residences in response to air blast complaints. Possible methods of accomplishing this are: reducing charge sizes; increasing delay intervals;

TABLE 7
SUMMARY OF BUILDING DAMAGE CRITERIA

PEAK GROUND VELOCITY (mm/sec)	PEAK GROUND VELOCITY (in/sec)	COMMENT
193.04	7.6	Major damage to buildings (mean of data).
137.72	5.4	Minor damage to buildings (mean of data).
101.16	4.0	'Engineer structures' safe from damage.
50.8	2.0	Safe from damage limit (probability of damage <5%). No structural damage.
33.02	1.3	Threshold of risk of 'architectural' damage for houses.
25.4	1.0	No data showing damage to structures for vibration <1 in./sec.
15.24	0.6	No risk of 'architectural' damage to normal buildings.
10.16	0.4	Threshold of damage in older homes.
5.08	0.2	Statistically significant percentage of structures may experience minor damage (including earthquake, nuclear event, and blast data for old and new structures). No 'architectural' damage.
3.81	0.5 to 0.15	Upper limits for ruins and ancient monuments.
1.0	0.04	Vertical vibration clearly perceptible to humans.
0.32	0.01	Vertical vibration just perceptible to humans.

Source: 'State - of - the - Art Review : Prediction and Control of Groundborne Noise and Vibration from Rail Transit Trains'; U.S. Department of Transportation; December 1983.

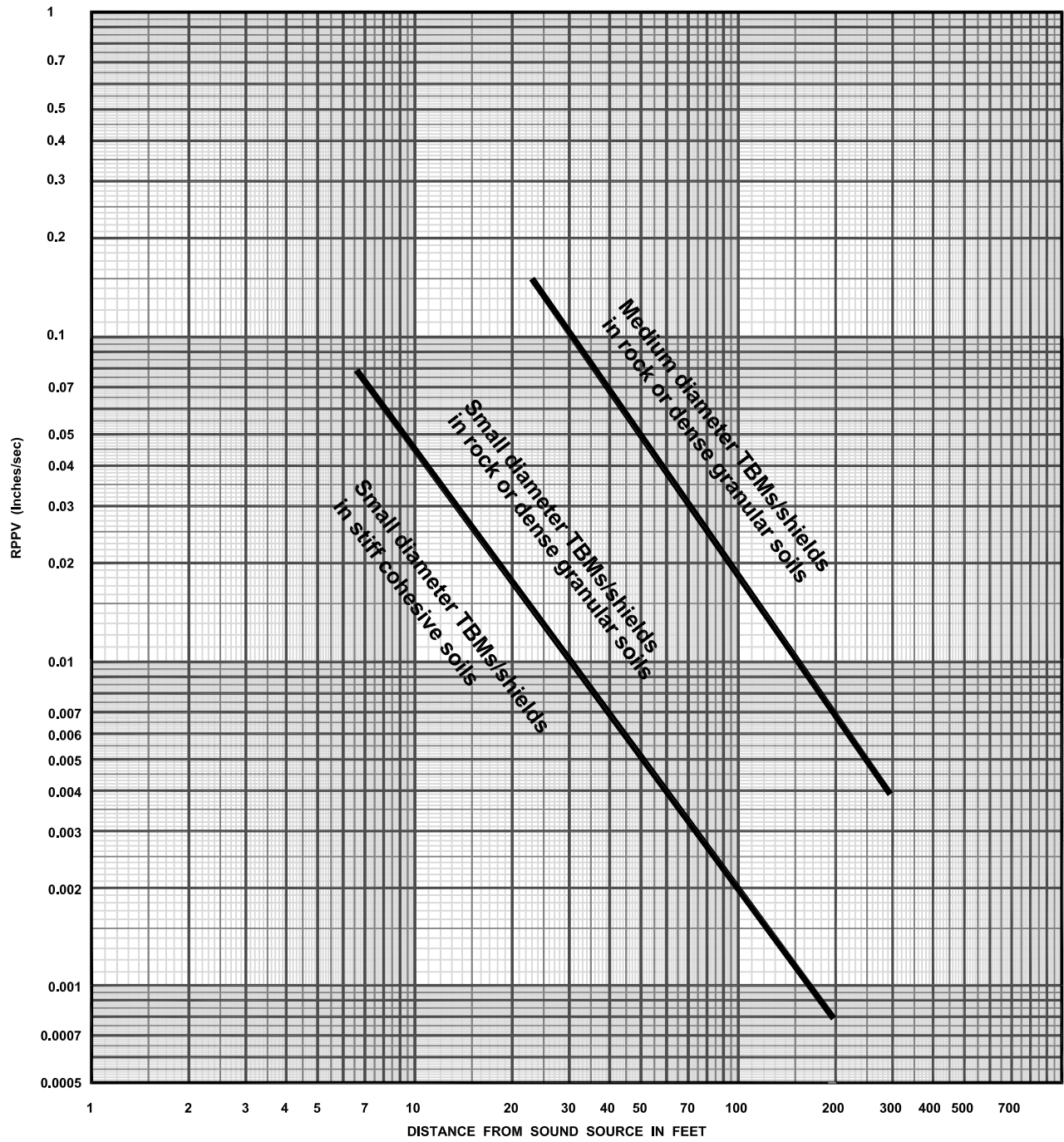
away from noise sensitive properties; trucking in high quality stemming material to minimize stemming blowouts; and filling (sandbagging) over the area to be blasted and the detonating chord.

- Schedule actual blasting during the warm periods of the day to minimize the possibility of thermal ducting and focusing of air blast noise at large distances from the blast. If possible, also schedule blasting during fixed time periods, so that the members of the community can also schedule their activities accordingly.
- The most conservative vibration criteria for damage to "ruins and ancient monuments" (see Table 7) is 0.15 inches per second. In order to address any resident's concerns regarding the possible aggravation of ground settlement problems by the proposed blasting operations, it is recommended that additional study of the effects of low level vibrations on ground settlement be conducted. An attempt should be made to correlate locally measured vibration data from blasting or pile driving (at vibration levels which equal or exceed 0.05 inches per second and for various soil conditions) with any reported settlement problems in nearby structures. The lack of any reported settlement problems in conjunction with a localized soils analysis for the area where the vibrations were measured should also be noted. The results of this additional study should then be used to select the applicable vibration criteria for areas with poor soil conditions.

Ground Vibration from Tunnel Boring Machine. Ground vibrations from the TBM may be feelable whenever the TBM is relatively close to inhabited buildings. Figure 11 was constructed using vibration data developed in Reference 11. In general, the greater the separation distance between the TBM and the receptor, the lower the ground vibration level during excavation of the gravity tunnel should be at the receptor. From the small diameter TBM, ground vibration levels should be at or less than 0.01 inches per second at 100 feet separation distance between the TBM and the receptor. From Table 7, a vibration level at or less than 0.01 inches per second should be barely perceptible to human beings. This "feelable" level of 0.01 inches per second is much lower than the 0.15 inches per second shown in Table 7 as the most conservative vibration level for potential damage to "ruins and ancient monuments". Also from Figure 11, in order to reach this higher level of 0.15 inches per second, the separation distance needs to be reduced to approximately 25 feet. All separation distances between the TBM and the structures closest to the GST should exceed 25 feet, so there should be a low risk of structural or architectural damage resulting from the vibrations of the TBM.

A deep tunnel boring machine, if used for the Waiawa 46" deep gravity tunnel, would be beyond 150 feet from buildings of the Leeward Community College (see Inset Figure D.2). The relatively low vibration levels (0.001 inches per second) at this distance should not be perceptible to humans as indicated in Table 7, and are well below the levels associated with risk of damage buildings. Because these levels are

Vibrations from small to medium sized TBMs/shields



VIBRATIONS FROM SMALL TO MEDIUM SIZED TBMS / SHIELDS

FIGURE 7

expected to be very low, mitigation measures should not be required during operations of the Waiawa deep tunnel boring machine in the vicinity of Leeward Community College. It should be noted that during the recently completed GST between Kaneohe Wastewater Pre-Treatment Facility and Kailua Regional Wastewater Treatment Plant, a much larger diameter TBM than the Waiawa deep tunnel boring machine was operated approximately 100 feet below the closest residence without incident. For these reasons, mitigation of vibration impacts under the Hybrid option should not be required.

A. REFERENCES

- (1) "Guidelines for Considering Noise in Land Use Planning and Control;" Federal Interagency Committee on Urban Noise; June 1980.
- (2) American National Standard, "Sound Level Descriptors for Determination of Compatible Land Use," ANSI S12.9-1998/ Part 5; Acoustical Society of America.
- (3) "Environmental Criteria and Standards, Noise Abatement and Control, 24 CFR, Part 51, Subpart B;" U.S. Department of Housing and Urban Development; July 12, 1979.
- (4) "Information on Levels of Environmental Noise Requisite to Protect the Public Health and Welfare with an Adequate Margin of Safety;" U.S. Environmental Protection Agency; EPA 550/9-74- 004; March 1974.
- (5) "Title 11, Administrative Rules, Chapter 46, Community Noise Control;" Hawaii State Department of Health; September 23, 1996.
- (6) "Honouliuli / Waipahu / Pearl City Wastewater Facilities Plan, Work Task 4 - Preliminary Engineering Report;" AECOM; August 2016.
- (7) "Honouliuli / Waipahu / Pearl City Wastewater Facilities Plan, Task 1 - Modeling Assistance for the Waiawa Master Plan;" Technical Memorandum Draft; AECOM, October 2017.
- (8) "Environmental Impact Statement Preparation Notice, Honouliuli / Waipahu / Pearl City Wastewater Conveyance Facilities;" AECOM Technical Services, Inc; March 2019.
- (9) "Method for Assessment of High-Energy Impulsive Sounds with Respect to Residential Communities;" American National Standard, ANSI S12.4; Acoustical Society of America.
- (10) "Guide to the Evaluation of Human Exposure to Vibration in Buildings;" American National Standard, ANSI S3.29-1983; Acoustical Society of America.
- (11) Flanagan, Richard F.; "Ground Vibration from TBMs and Shields;" Tunnels & Tunneling; October 1993.

APPENDIX B

EXCERPTS FROM EPA'S ACOUSTIC TERMINOLOGY GUIDE

Descriptor Symbol Usage

The recommended symbols for the commonly used acoustic descriptors based on A-weighting are contained in Table I. As most acoustic criteria and standards used by EPA are derived from the A-weighted sound level, almost all descriptor symbol usage guidance is contained in Table I.

Since acoustic nomenclature includes weighting networks other than "A" and measurements other than pressure, an expansion of Table I was developed (Table II). The group adopted the ANSI descriptor-symbol scheme which is structured into three stages. The first stage indicates that the descriptor is a level (i.e., based upon the logarithm of a ratio), the second stage indicates the type of quantity (power, pressure, or sound exposure), and the third stage indicates the weighting network (A, B, C, D, E.....). If no weighting network is specified, "A" weighting is understood. Exceptions are the A-weighted sound level and the A-weighted peak sound level which require that the "A" be specified. For convenience in those situations in which an A-weighted descriptor is being compared to that of another weighting, the alternative column in Table II permits the inclusion of the "A". For example, a report on blast noise might wish to contrast the LCdn with the LAdn.

Although not included in the tables, it is also recommended that "Lpn" and "LepN" be used as symbols for perceived noise levels and effective perceived noise levels, respectively.

It is recommended that in their initial use within a report, such terms be written in full, rather than abbreviated. An example of preferred usage is as follows:

The A-weighted sound level (LA) was measured before and after the installation of acoustical treatment. The measured LA values were 85 and 75 dB respectively.

Descriptor Nomenclature

With regard to energy averaging over time, the term "average" should be discouraged in favor of the term "equivalent". Hence, Leq, is designated the "equivalent sound level". For Ld, Ln, and Ldn, "equivalent" need not be stated since the concept of day, night, or day-night averaging is by definition understood. Therefore, the designations are "day sound level", "night sound level", and "day-night sound level", respectively.

The peak sound level is the logarithmic ratio of peak sound pressure to a reference pressure and not the maximum root mean square pressure. While the latter is the maximum sound pressure level, it is often incorrectly labelled peak. In that sound level meters have "peak" settings, this distinction is most important.

"Background ambient" should be used in lieu of "background", "ambient", "residual", or "indigenous" to describe the level characteristics of the general background noise due to the contribution of many unidentifiable noise sources near and far.

With regard to units, it is recommended that the unit decibel (abbreviated dB) be used without modification. Hence, DBA, PNdB, and EPNdB are not to be used. Examples of this preferred usage are: the Perceived Noise Level (Lpn was found to be 75 dB. Lpn = 75 dB). This decision was based upon the recommendation of the National Bureau of Standards, and the policies of ANSI and the Acoustical Society of America, all of which disallow any modification of bel except for prefixes indicating its multiples or submultiples (e.g., deci).

Noise Impact

In discussing noise impact, it is recommended that "Level Weighted Population" (LWP) replace "Equivalent Noise Impact" (ENI). The term "Relative Change of Impact" (RCI) shall be used for comparing the relative differences in LWP between two alternatives.

Further, when appropriate, "Noise Impact Index" (NII) and "Population Weighed Loss of Hearing" (PHL) shall be used consistent with CHABA Working Group 69 Report Guidelines for Preparing Environmental Impact Statements (1977).

APPENDIX B (CONTINUED)

TABLE I
A-WEIGHTED RECOMMENDED DESCRIPTOR LIST

<u>TERM</u>	<u>SYMBOL</u>
1. A-Weighted Sound Level	L_A
2. A-Weighted Sound Power Level	L_{WA}
3. Maximum A-Weighted Sound Level	L_{max}
4. Peak A-Weighted Sound Level	L_{Apk}
5. Level Exceeded x% of the Time	L_x
6. Equivalent Sound Level	L_{eq}
7. Equivalent Sound Level over Time (T) ⁽¹⁾	$L_{eq(T)}$
8. Day Sound Level	L_d
9. Night Sound Level	L_n
10. Day-Night Sound Level	L_{dn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$
12. Sound Exposure Level	L_{SE}

(1) Unless otherwise specified, time is in hours (e.g. the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified a $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine).

SOURCE: EPA ACOUSTIC TERMINOLOGY GUIDE, BNA 8-14-78,

APPENDIX B (CONTINUED)

TABLE II
RECOMMENDED DESCRIPTOR LIST

<u>TERM</u>	<u>A-WEIGHTING</u>	<u>ALTERNATIVE⁽¹⁾ A-WEIGHTING</u>	<u>OTHER⁽²⁾ WEIGHTING</u>	<u>UNWEIGHTED</u>
1. Sound (Pressure) ⁽³⁾ Level	L_A	L_{pA}	L_B, L_{pB}	L_p
2. Sound Power Level	L_{WA}		L_{WB}	L_W
3. Max. Sound Level	L_{max}	L_{Amax}	L_{Bmax}	L_{pmax}
4. Peak Sound (Pressure) Level	L_{Apk}		L_{Bpk}	L_{pk}
5. Level Exceeded x% of the Time	L_x	L_{Ax}	L_{Bx}	L_{px}
6. Equivalent Sound Level	L_{eq}	L_{Aeq}	L_{Beq}	L_{peq}
7. Equivalent Sound Level ⁽⁴⁾ Over Time(T)	$L_{eq(T)}$	$L_{Aeq(T)}$	$L_{Beq(T)}$	$L_{peq(T)}$
8. Day Sound Level	L_d	L_{Ad}	L_{Bd}	L_{pd}
9. Night Sound Level	L_n	L_{An}	L_{Bn}	L_{pn}
10. Day-Night Sound Level	L_{dn}	L_{Adn}	L_{Bdn}	L_{pdn}
11. Yearly Day-Night Sound Level	$L_{dn(Y)}$	$L_{Adn(Y)}$	$L_{Bdn(Y)}$	$L_{pdn(Y)}$
12. Sound Exposure Level	L_S	L_{SA}	L_{SB}	L_{Sp}
13. Energy Average Value Over (Non-Time Domain) Set of Observations	$L_{eq(e)}$	$L_{Aeq(e)}$	$L_{Beq(e)}$	$L_{peq(e)}$
14. Level Exceeded x% of the Total Set of (Non-Time Domain) Observations	$L_{x(e)}$	$L_{Ax(e)}$	$L_{Bx(e)}$	$L_{px(e)}$
15. Average L_x Value	L_x	L_{Ax}	L_{Bx}	L_{px}

(1) "Alternative" symbols may be used to assure clarity or consistency.

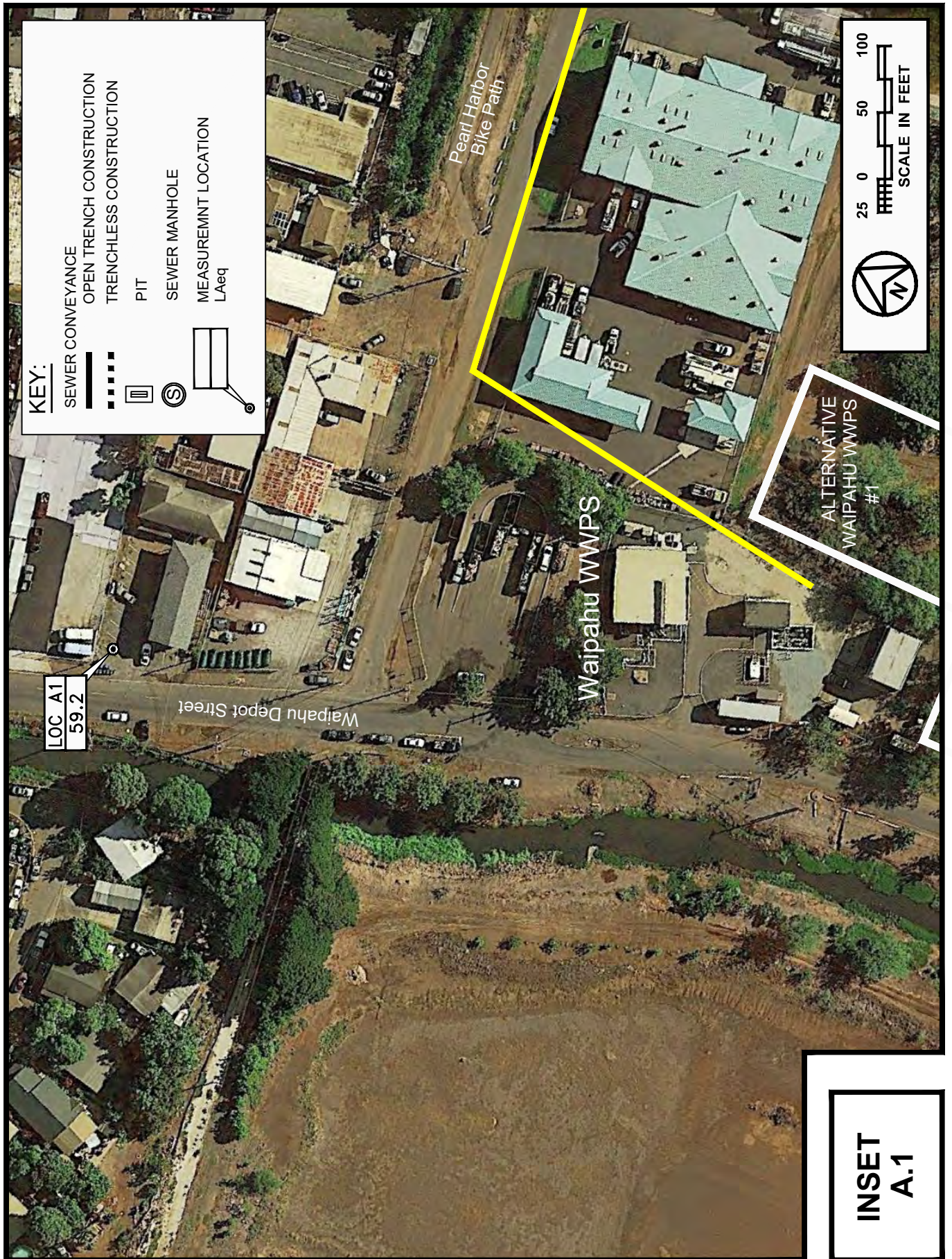
(2) Only B-weighting shown. Applies also to C,D,E,.....weighting.

(3) The term "pressure" is used only for the unweighted level.

(4) Unless otherwise specified, time is in hours (e.g., the hourly equivalent level is $L_{eq(1)}$). Time may be specified in non-quantitative terms (e.g., could be specified as $L_{eq(WASH)}$ to mean the washing cycle noise for a washing machine.

**APPENDIX C. INSET FIGURES ALONG SEWER CONVEYANCES SHOWN
IN FIGURES 1 THROUGH 6**

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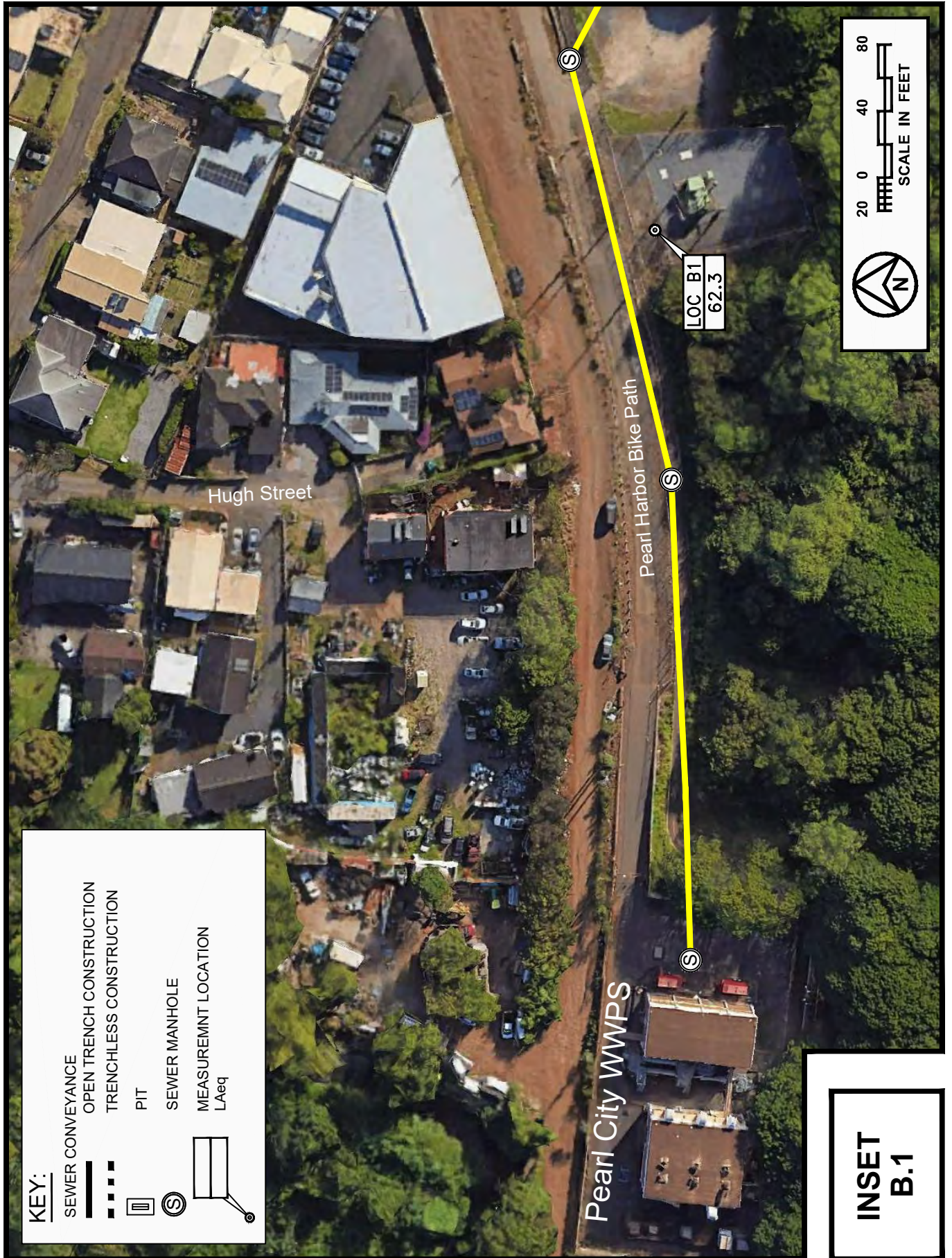


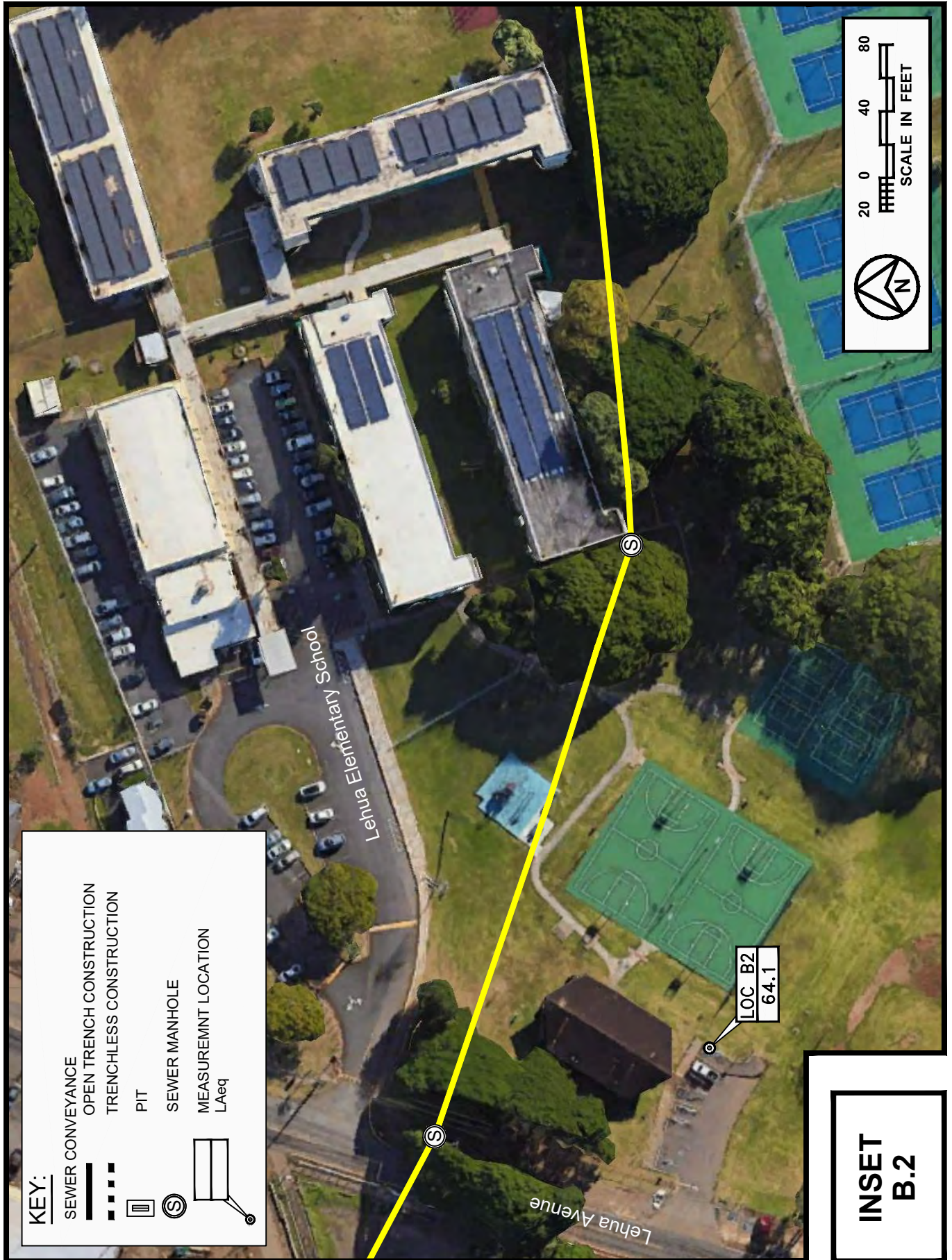














KEY:

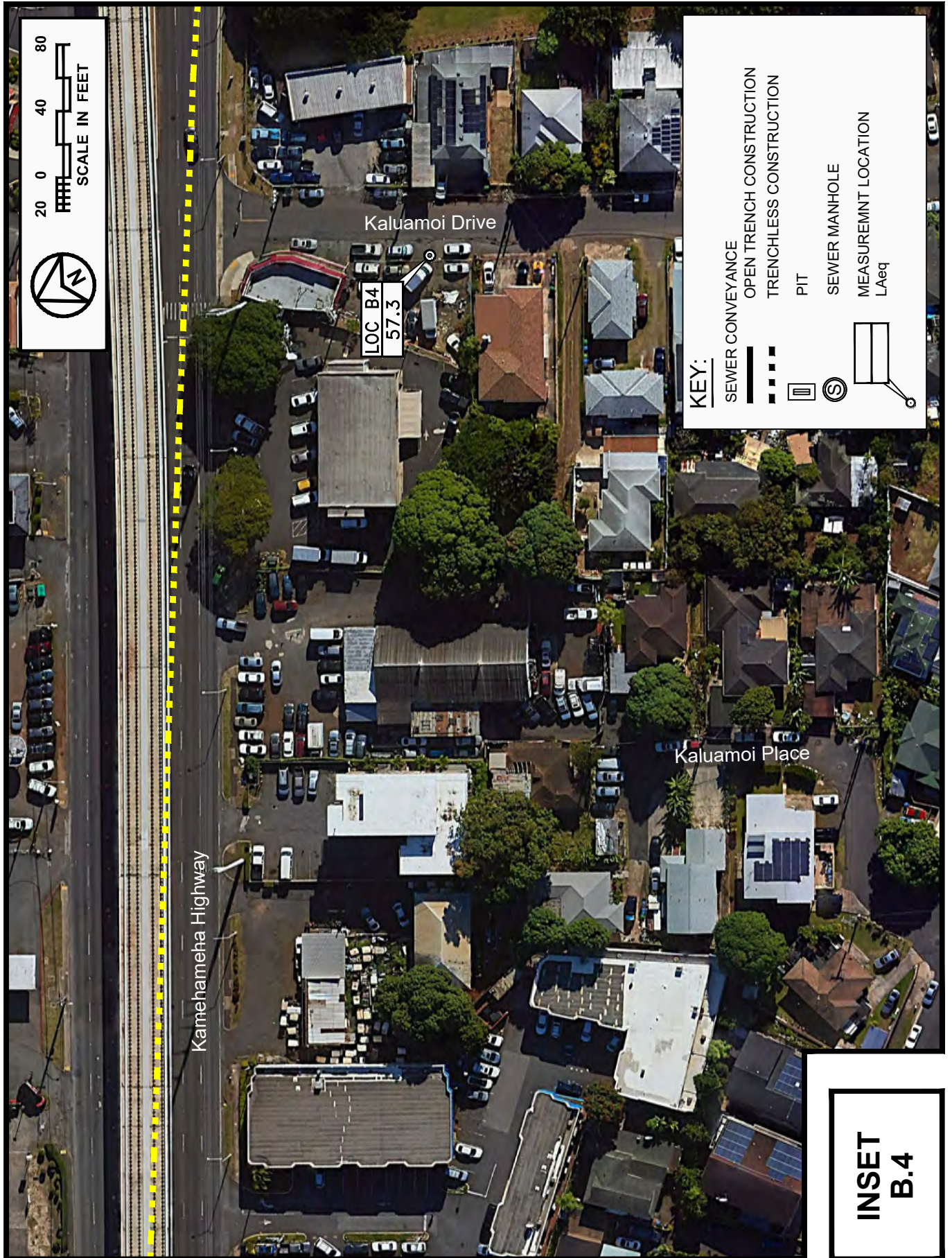
- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION
LAeq

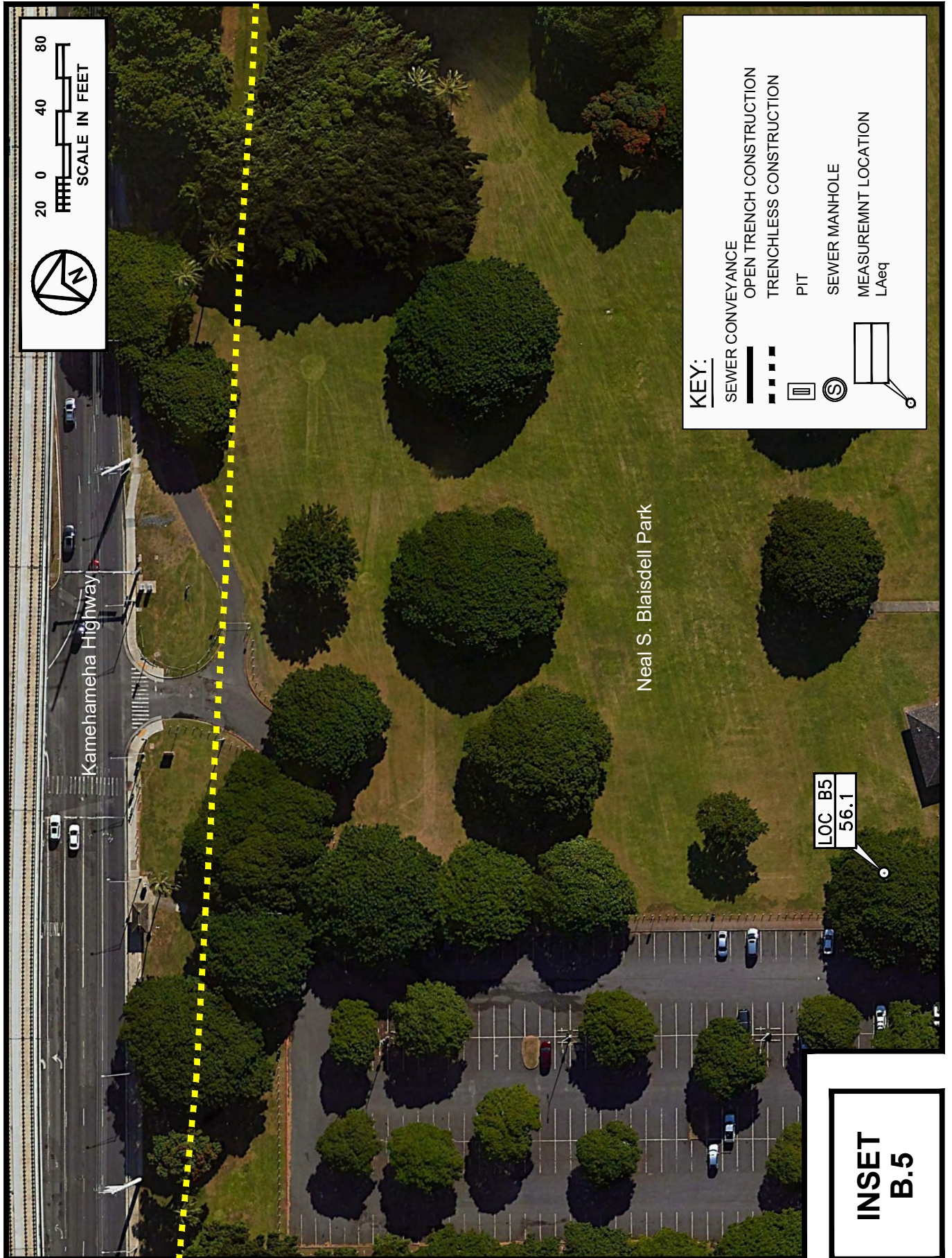
LOC B3
59.0

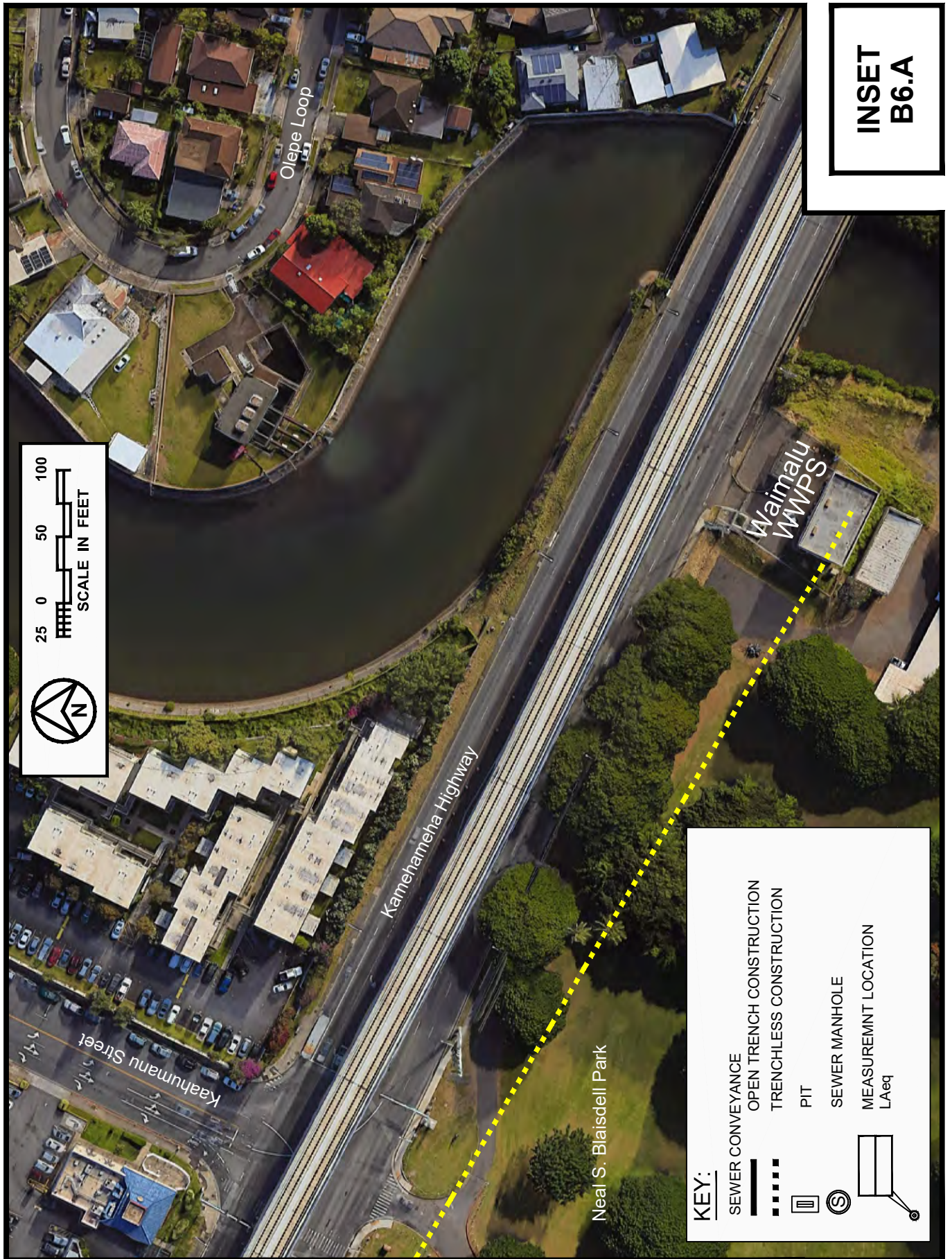
**INSET
B.3**

15 0 30 60
SCALE IN FEET

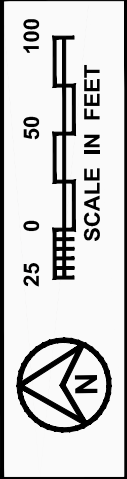
North Arrow







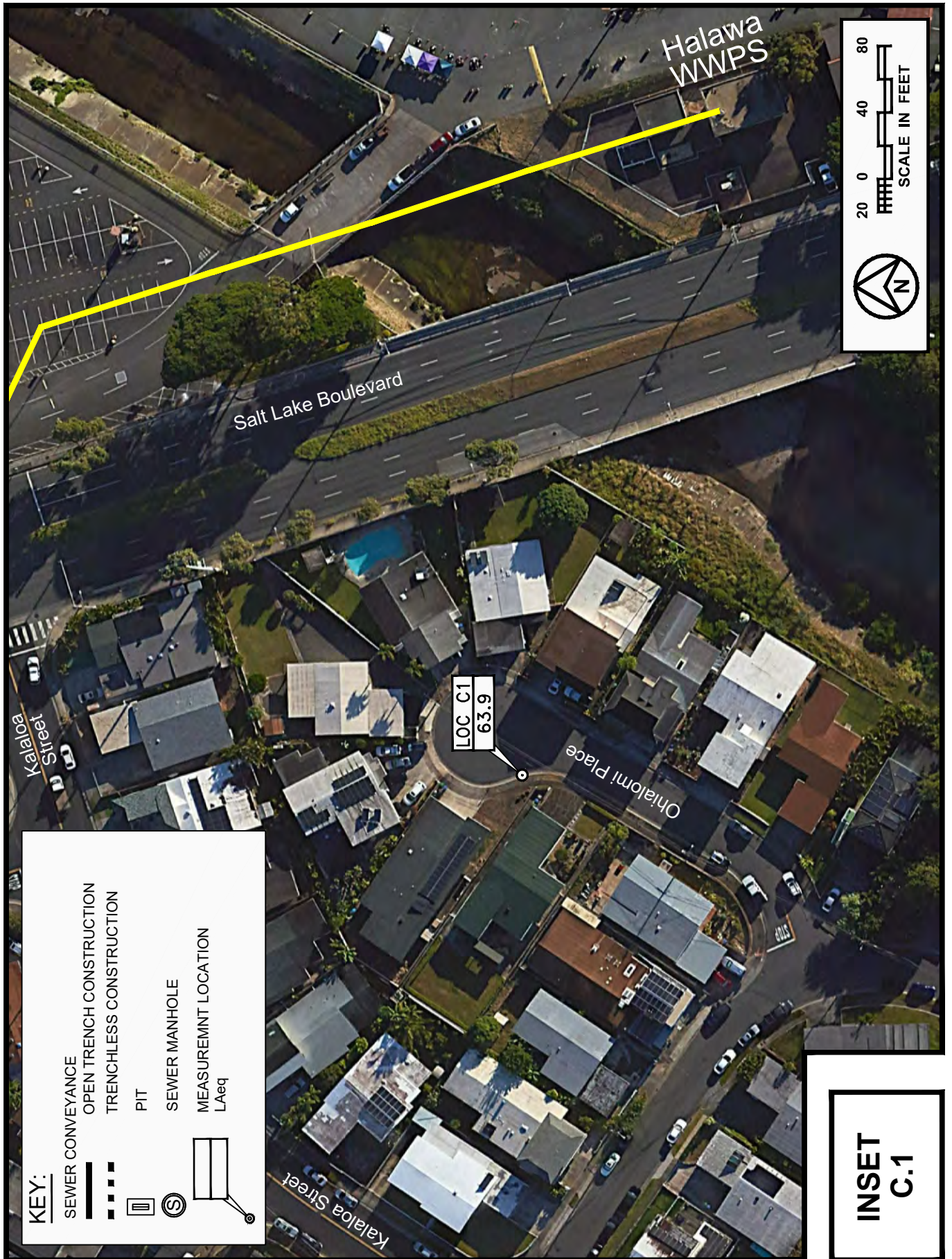
**INSET
B6.A**



KEY:

	SEWER CONVEYANCE
	OPEN TRENCH CONSTRUCTION
	TRENCHLESS CONSTRUCTION
	PIT
	SEWER MANHOLE
	MEASUREMENT LOCATION LAeq









KEY:

- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION
LAeq

**INSET
C.3**







Waiawa
WWPWS

KEY:

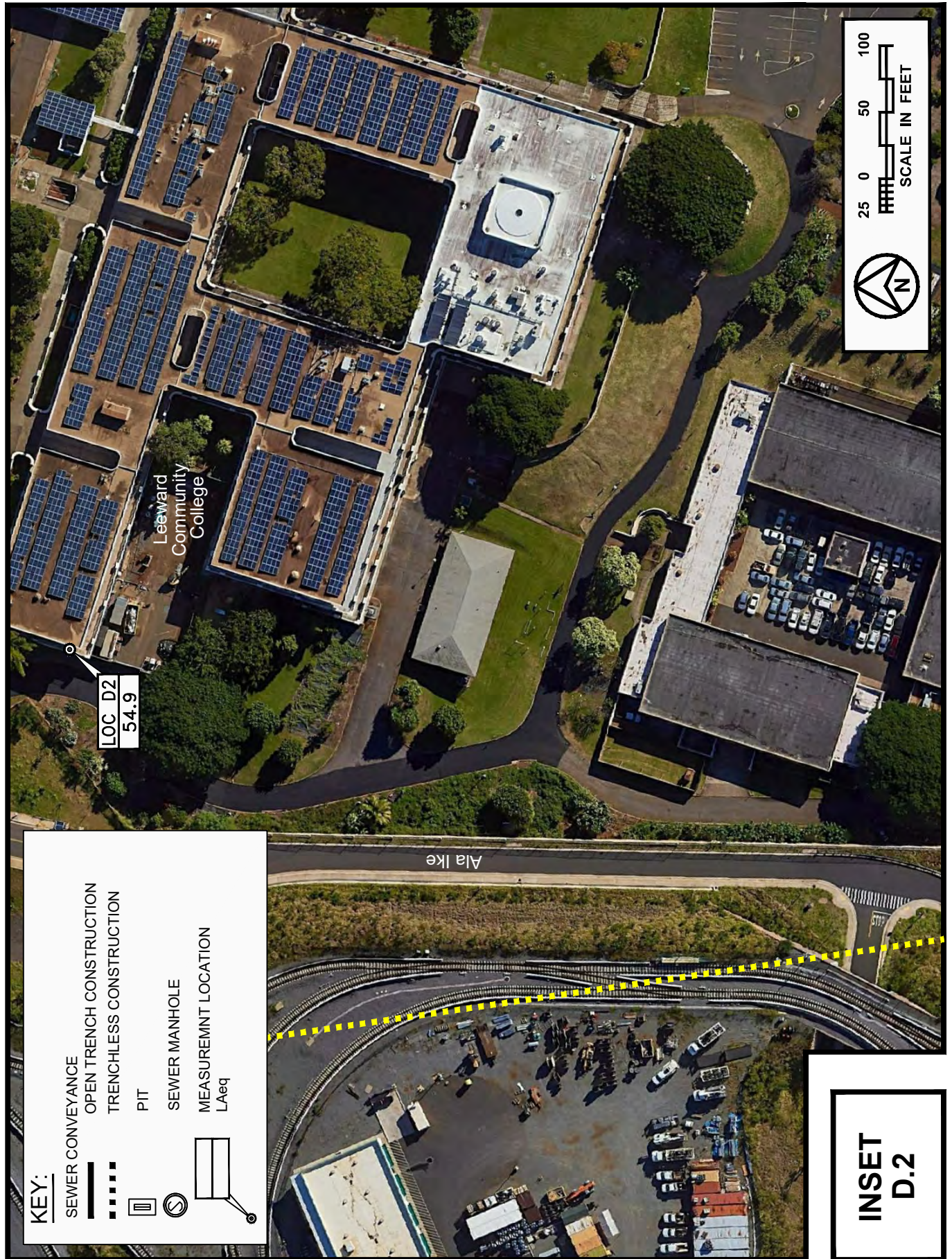
- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION
LAeq

LOC D1
60.2

25 0 50 100
SCALE IN FEET

N

INSET
D.1



KEY:

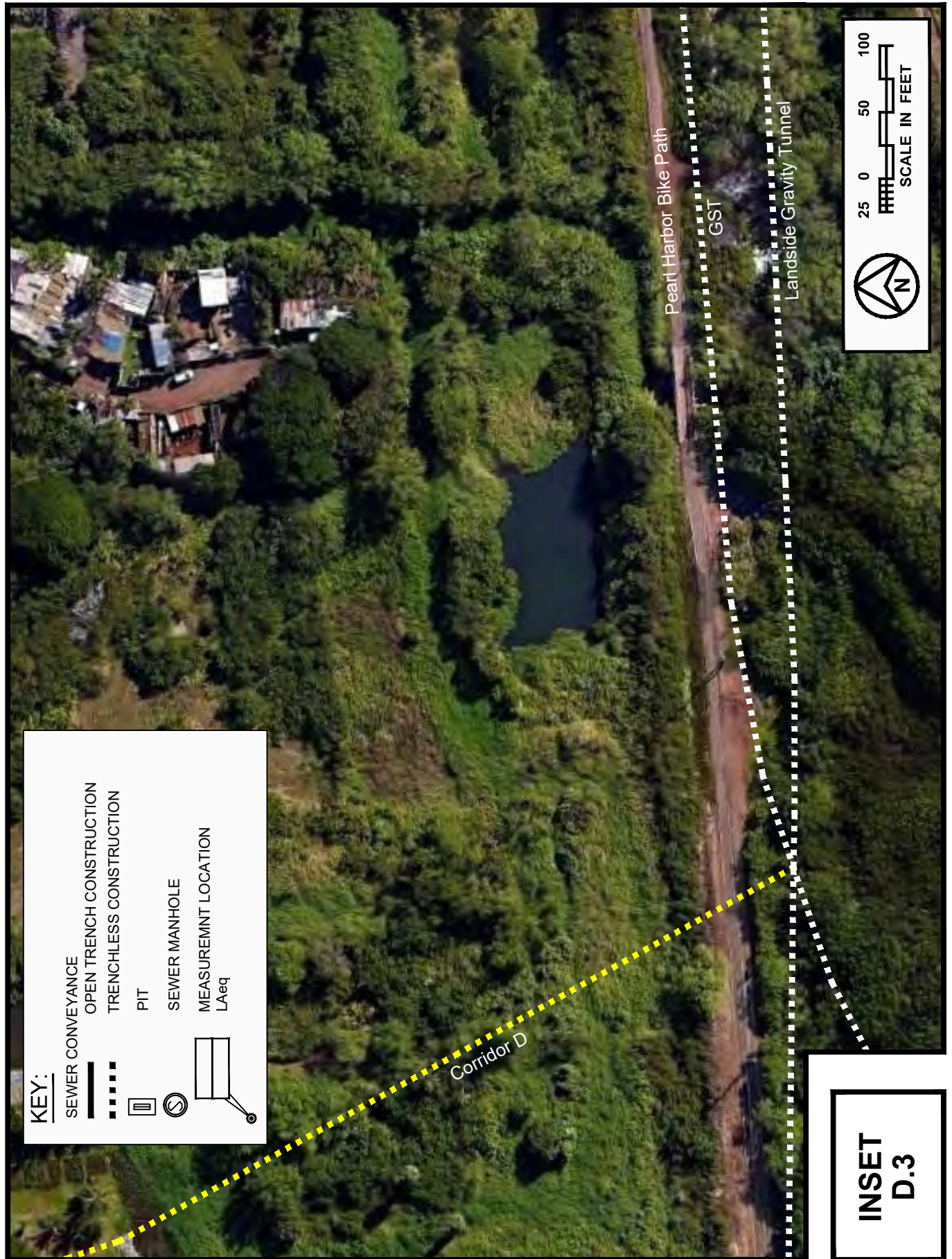
- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION
LAeq

LOC D2
54.9

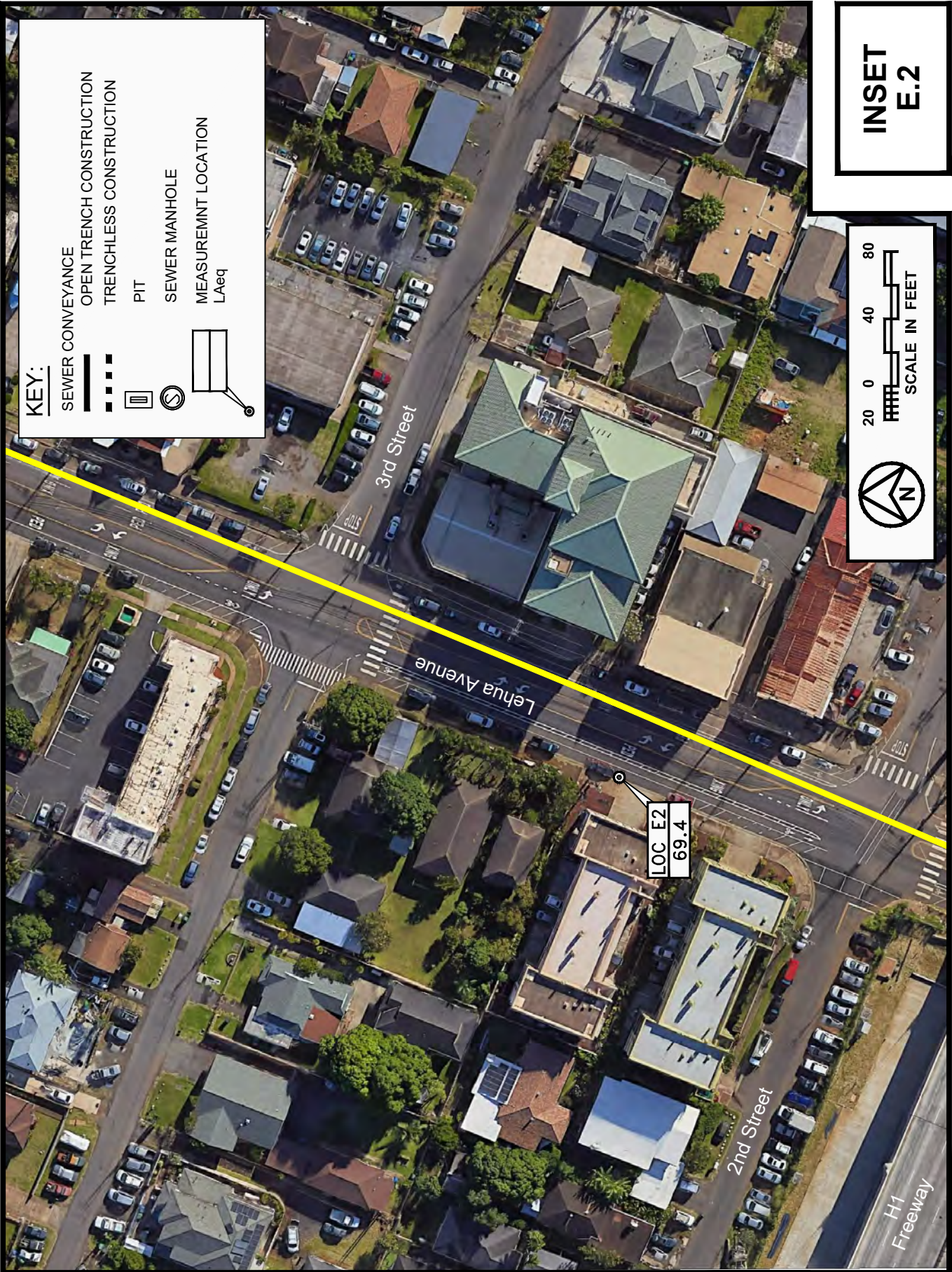
25 0 50 100
SCALE IN FEET

N

**INSET
D.2**









KEY:

- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION
LAeq

**INSET
E.3**



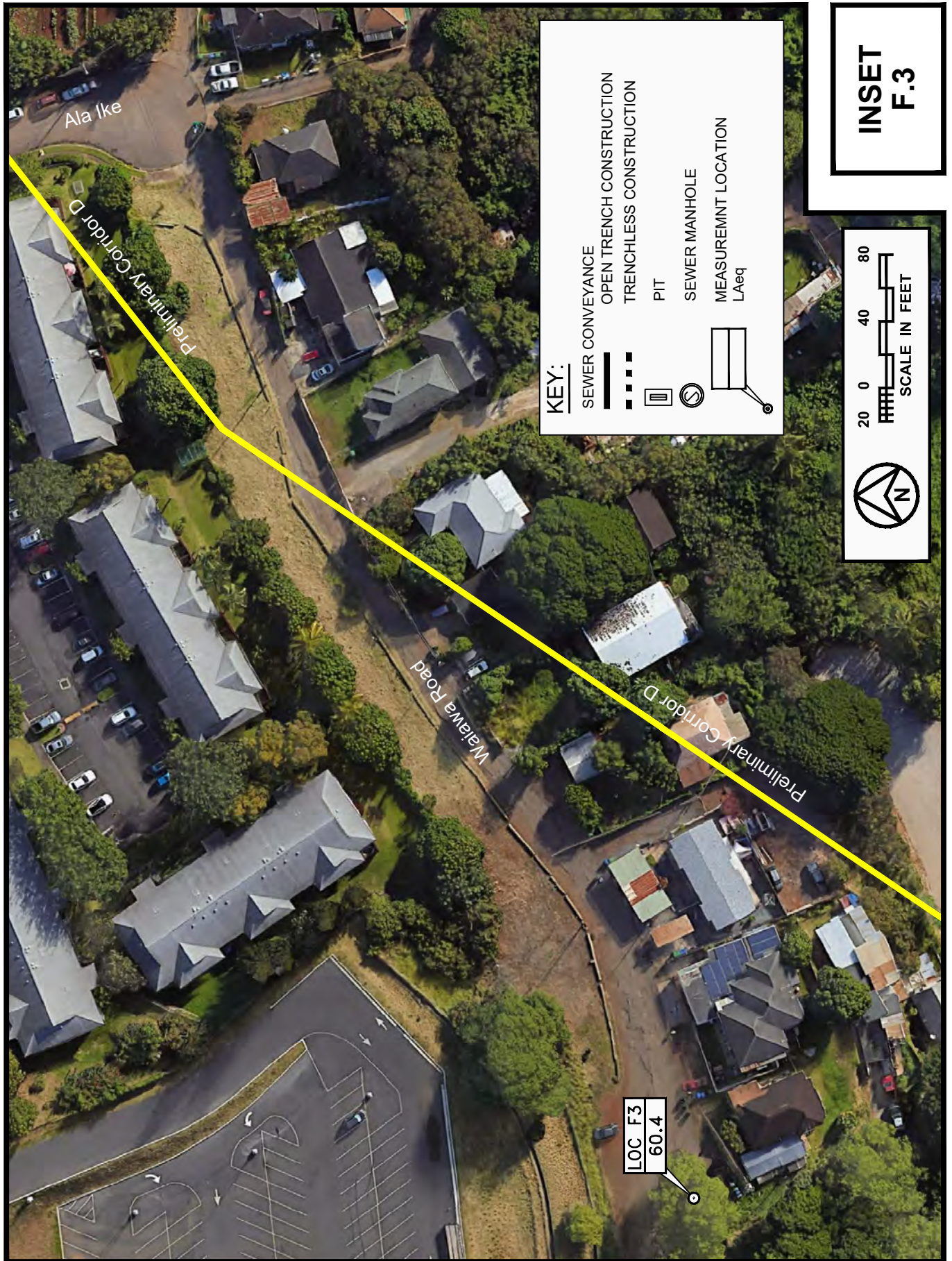
KEY:

- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION
LAeq

20 0 40 80
SCALE IN FEET

N

**INSET
F.1**





KEY:

- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION LAeq

LOC F4
57.8

Preliminary Corridor D

Preliminary Corridor D

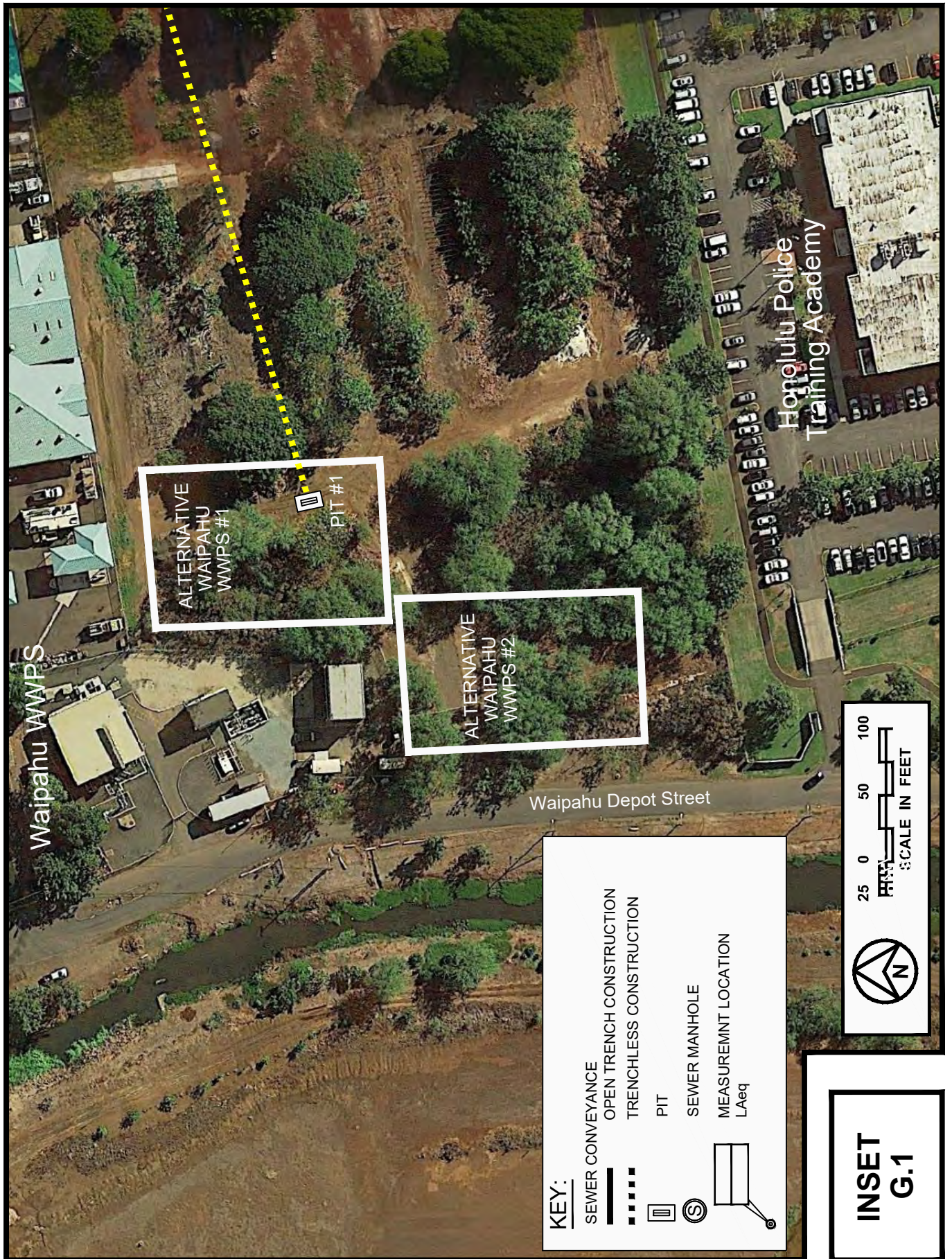
Pearl Harbor Bike Path



INSET
F.4





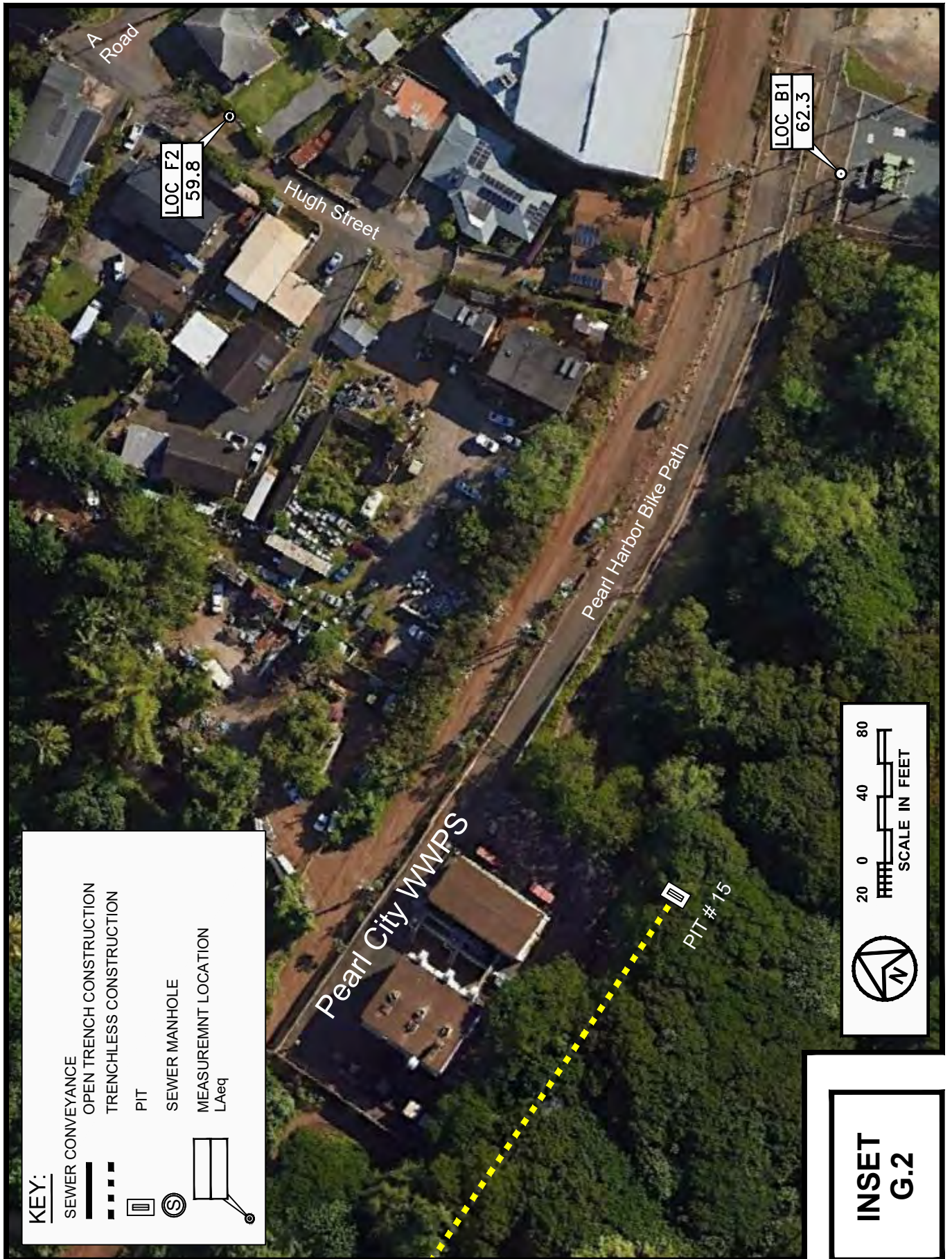


KEY:

- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION LAeq

25 0 50 100
 FT IN
 SCALE IN FEET

**INSET
G.1**



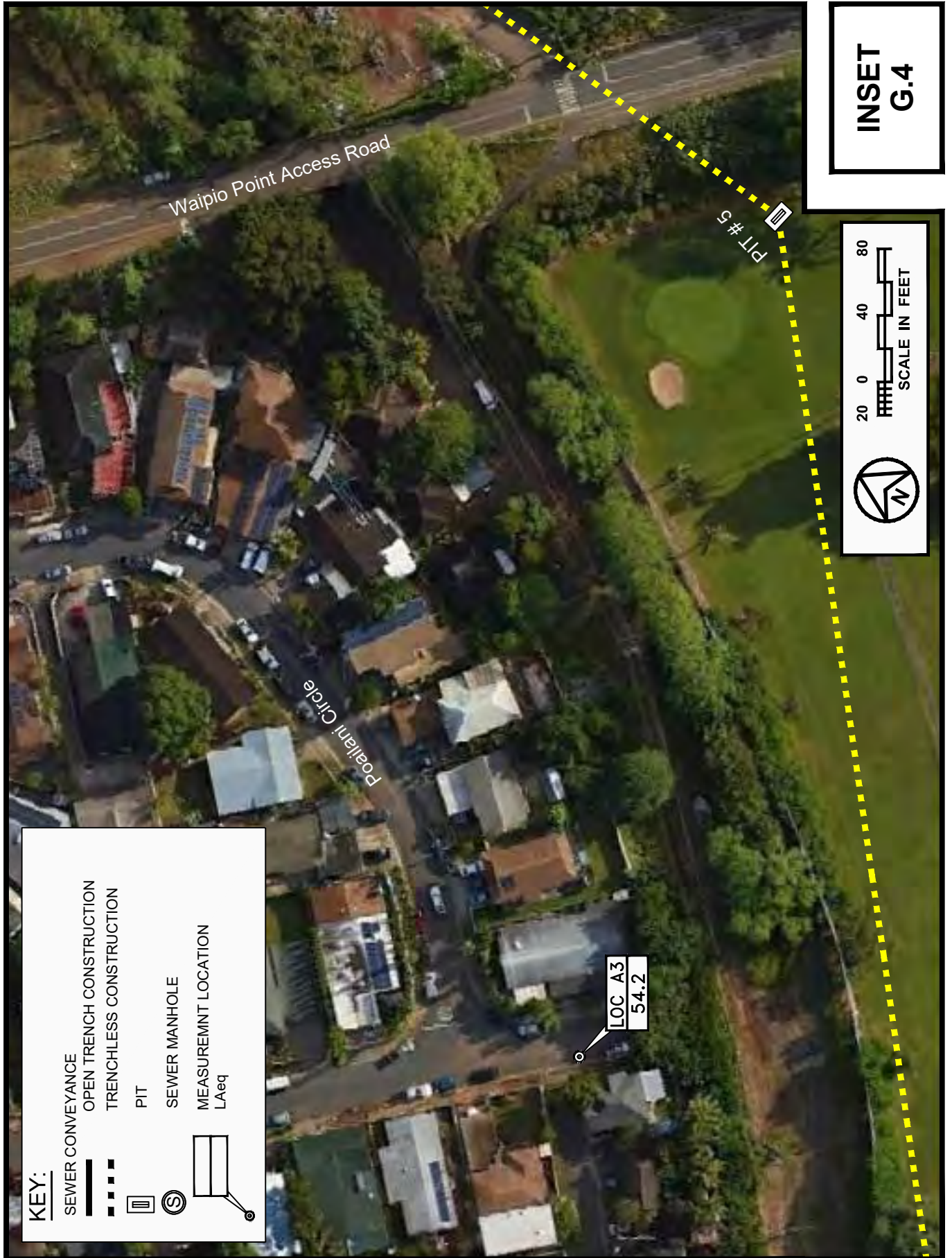
KEY:

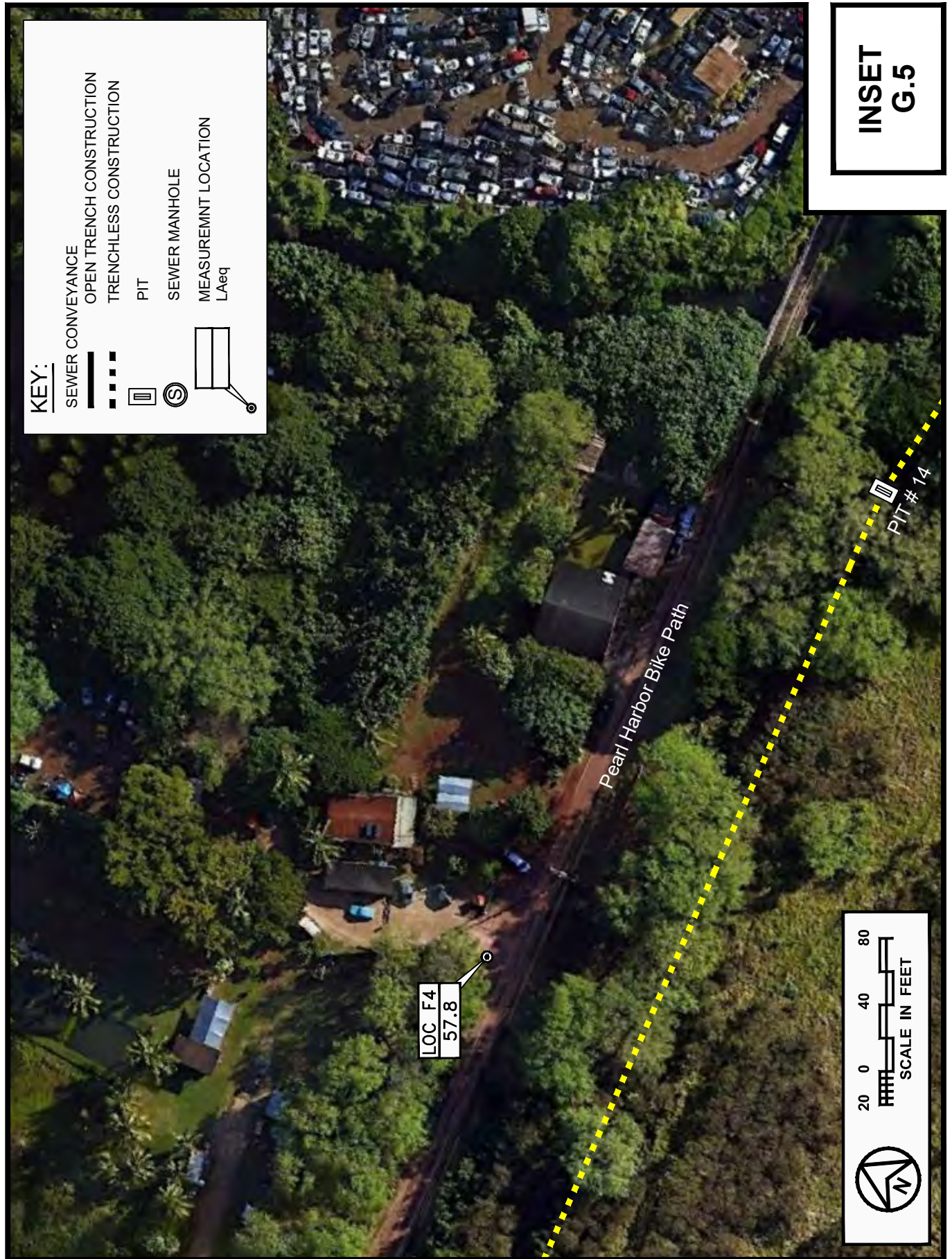
- SEWER CONVEYANCE
- OPEN TRENCH CONSTRUCTION
- TRENCHLESS CONSTRUCTION
- PIT
- SEWER MANHOLE
- MEASUREMENT LOCATION
LAeq

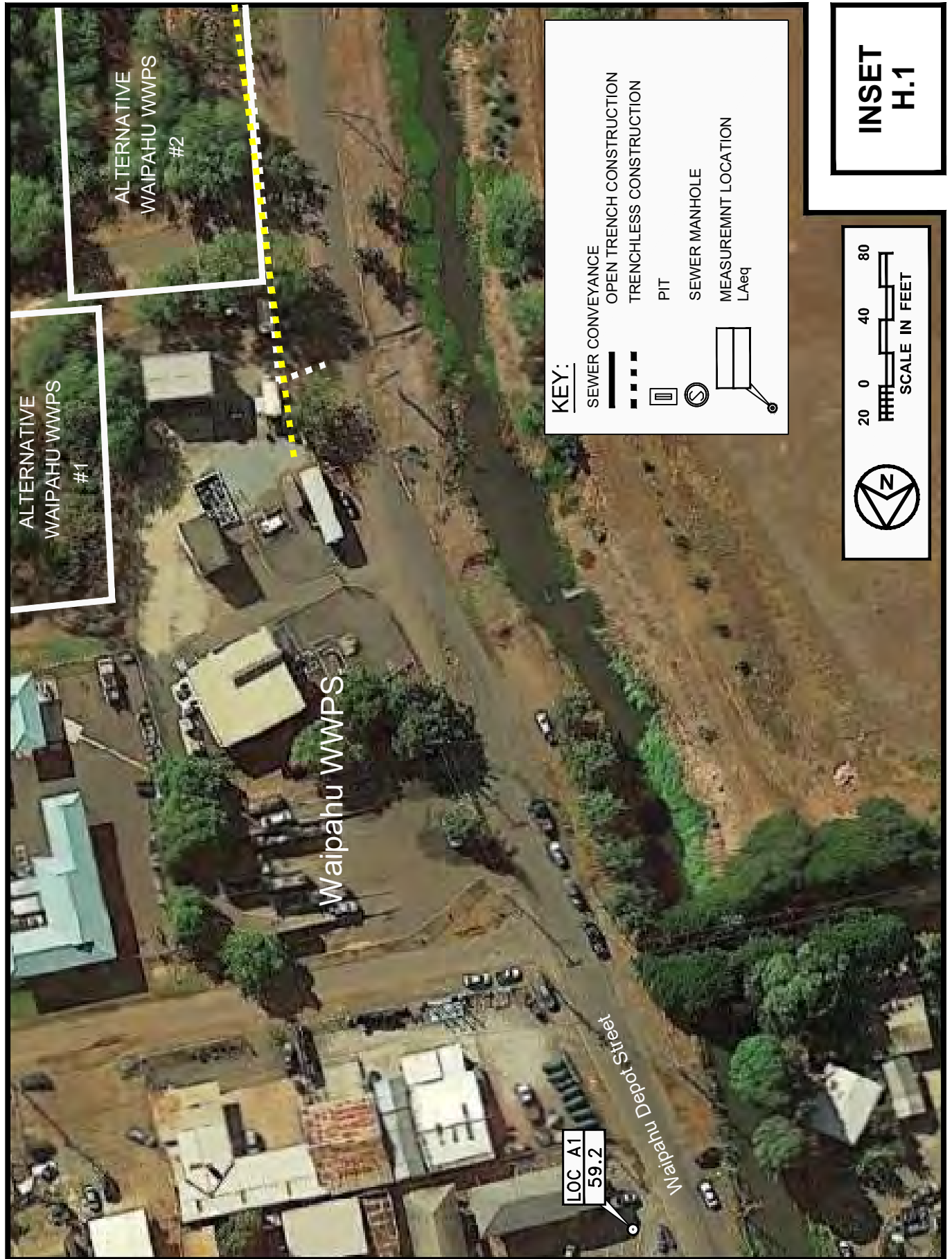
20 0 40 80
SCALE IN FEET

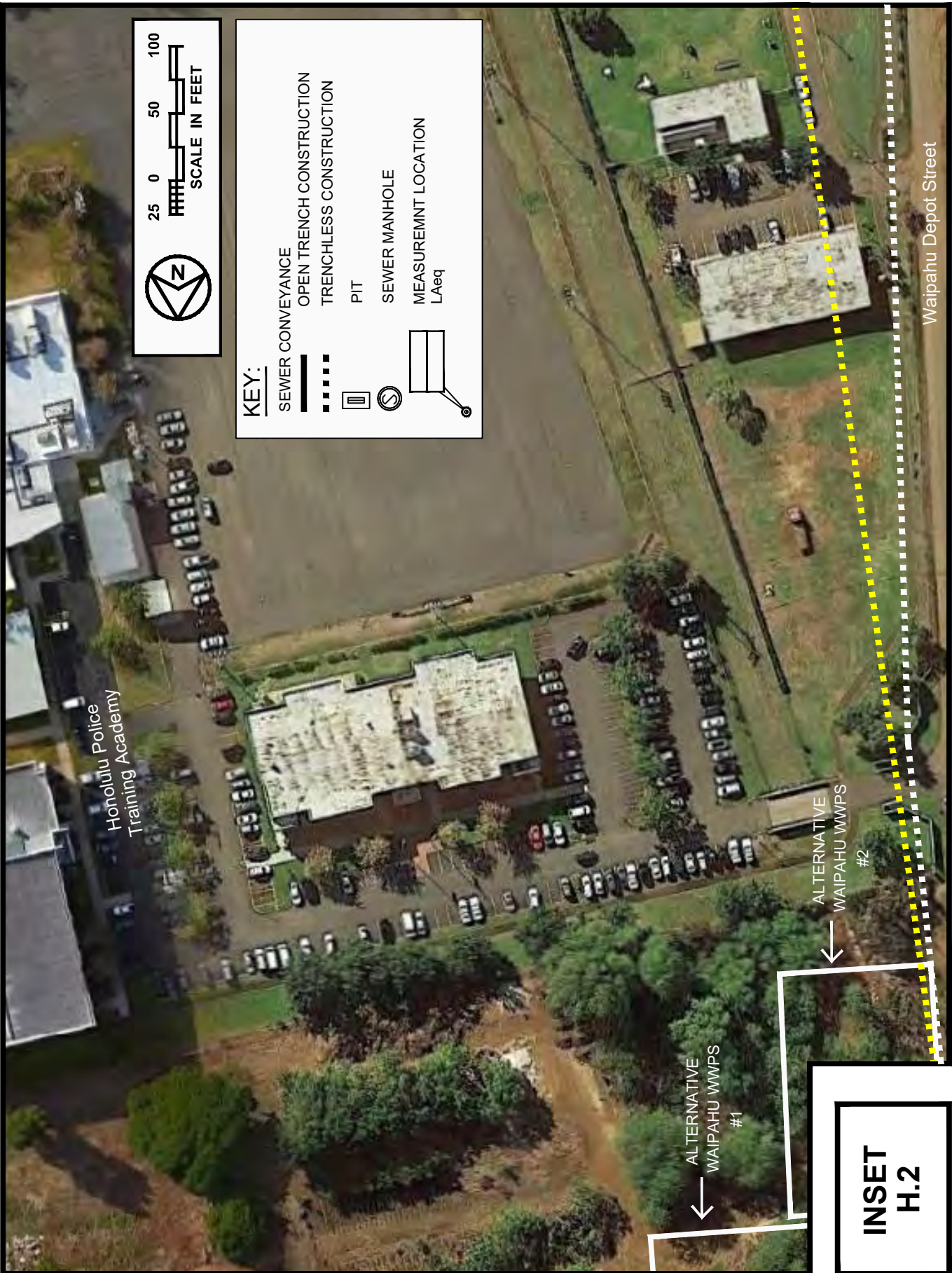
**INSET
G.2**

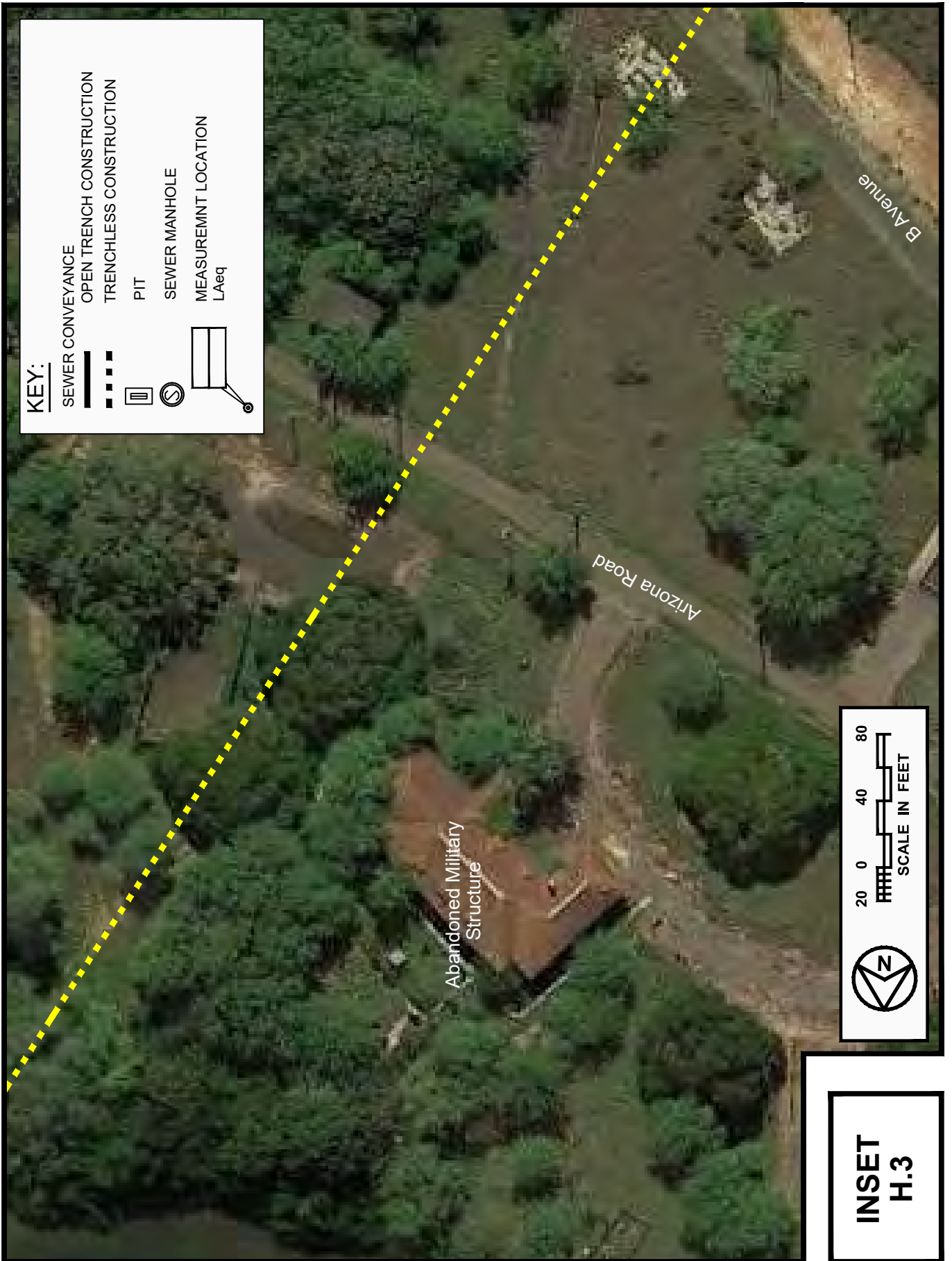










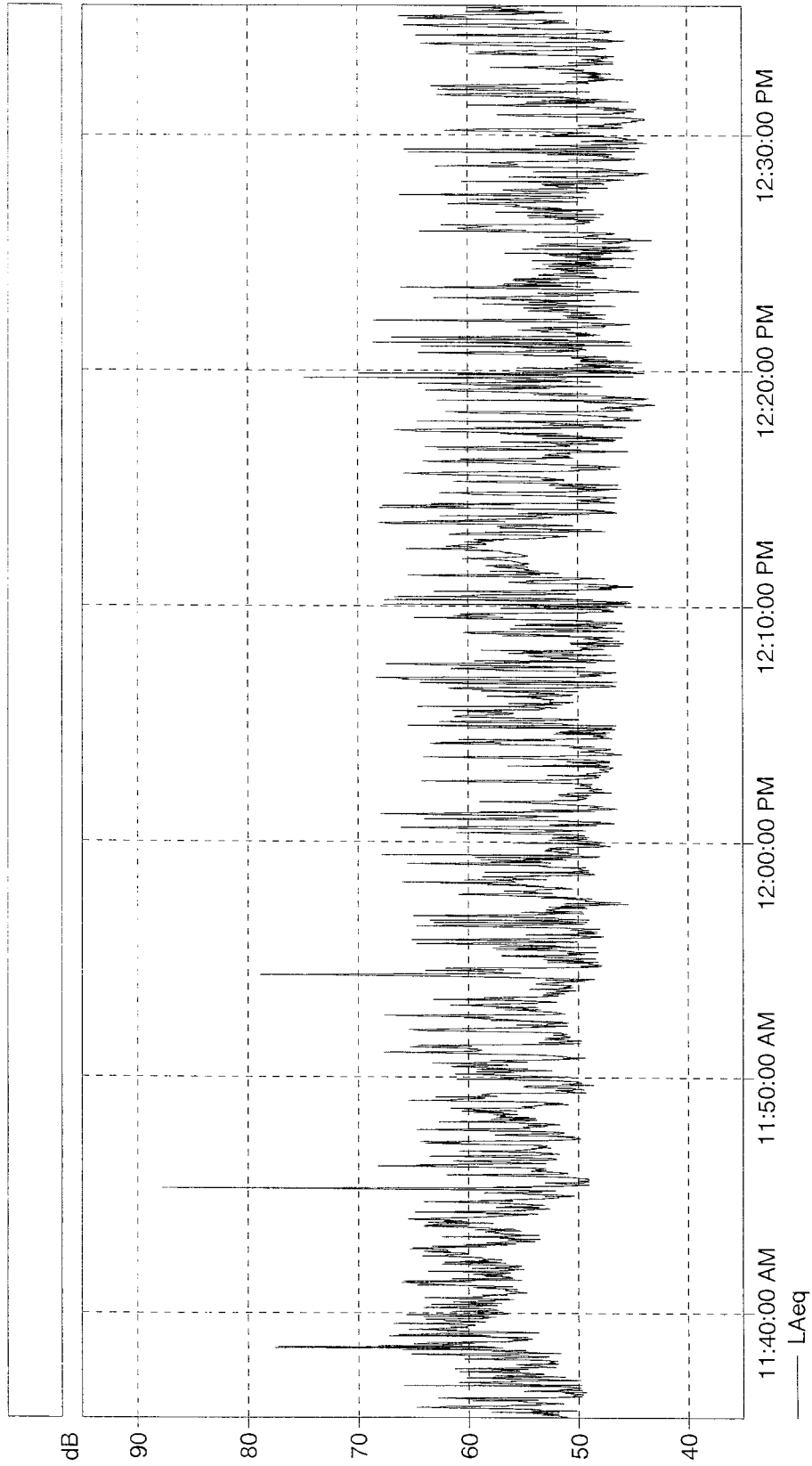


**APPENDIX D. STRIP CHART RECORDS OF BACKGROUND NOISE
MEASUREMENTS AT LOCATIONS A1 THROUGH H3**

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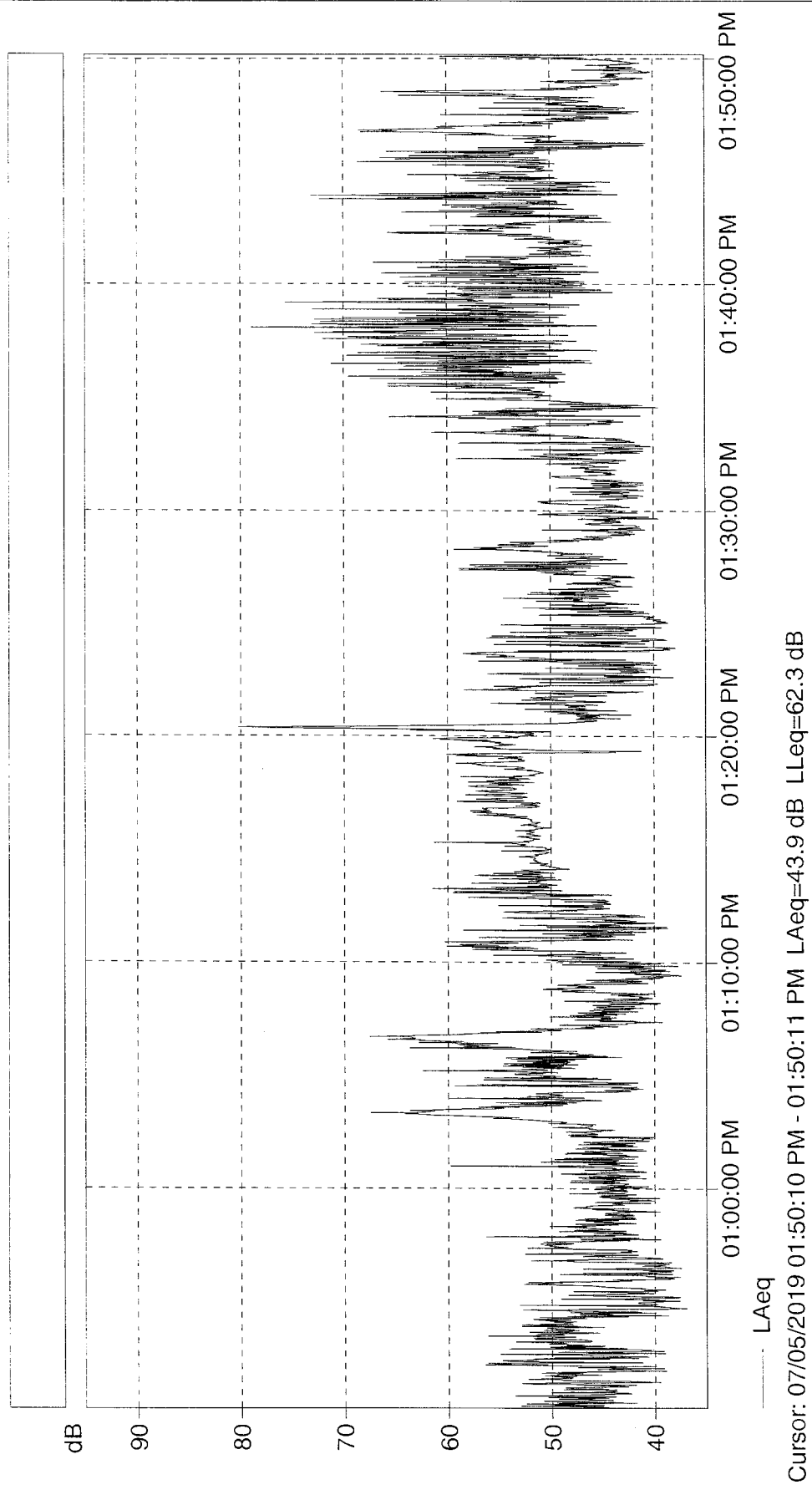
Loc A1 07-05-19



Cursor: 07/05/2019 12:35:30 PM - 12:35:31 PM LAeq=57.0 dB LLeq=71.7 dB



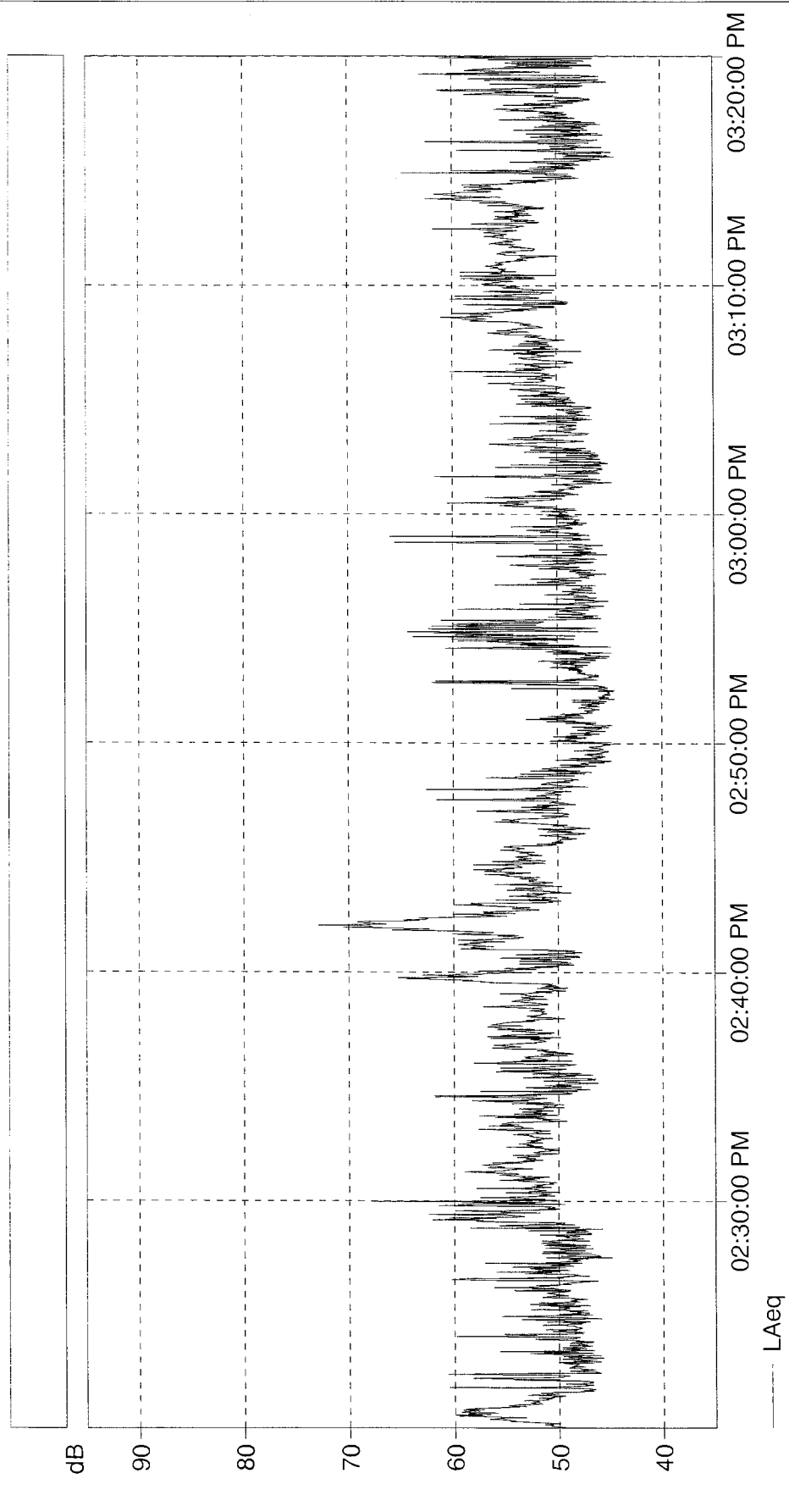
Loc A2 07-05-19



Cursor: 07/05/2019 01:50:10 PM - 01:50:11 PM LAeq=43.9 dB LLeq=62.3 dB



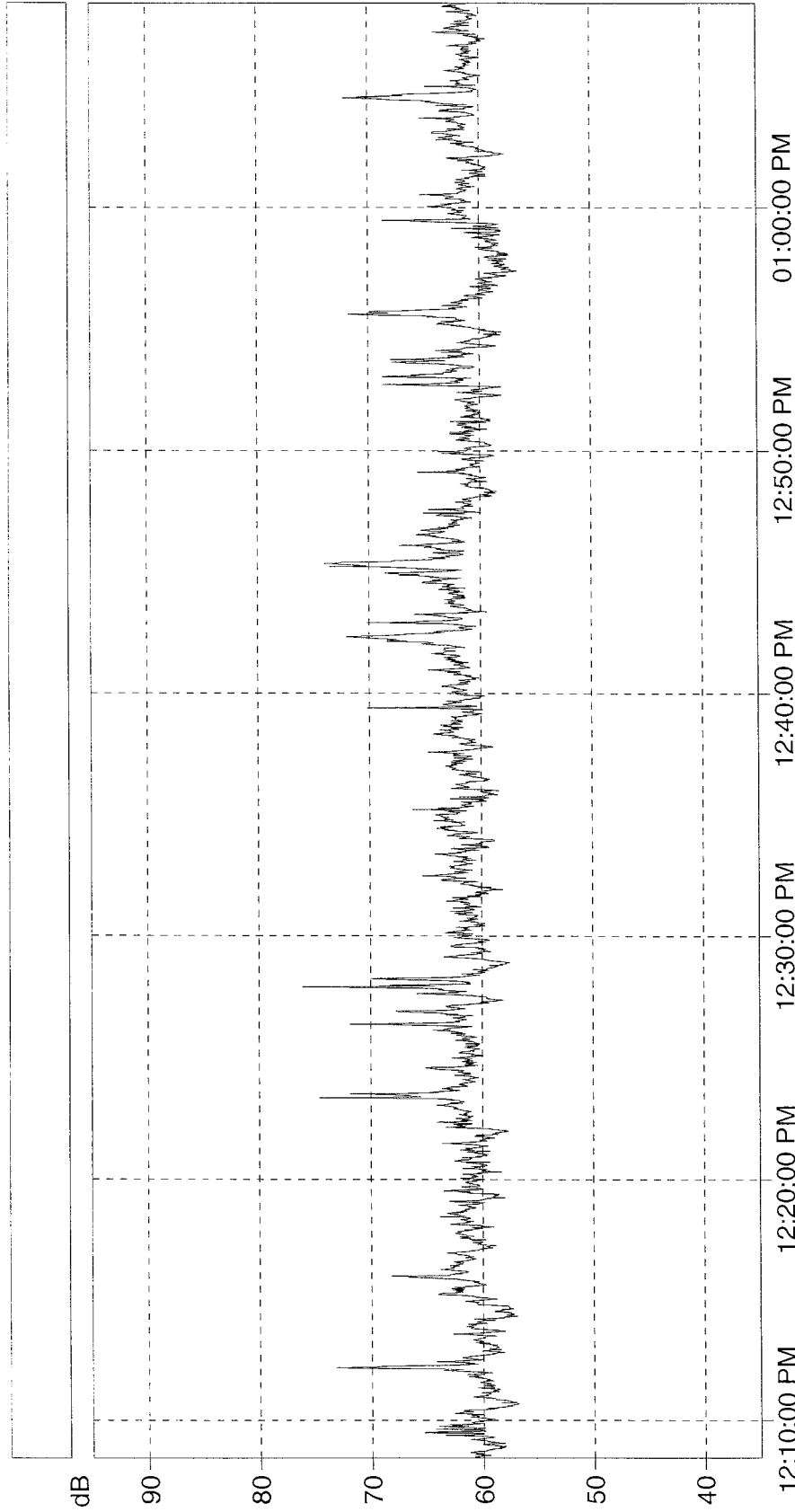
Loc A3 07-05-19



Cursor: 07/05/2019 03:20:01 PM - 03:20:02 PM LAeq=49.8 dB LLeq=63.1 dB



Loc B1 07-09-19

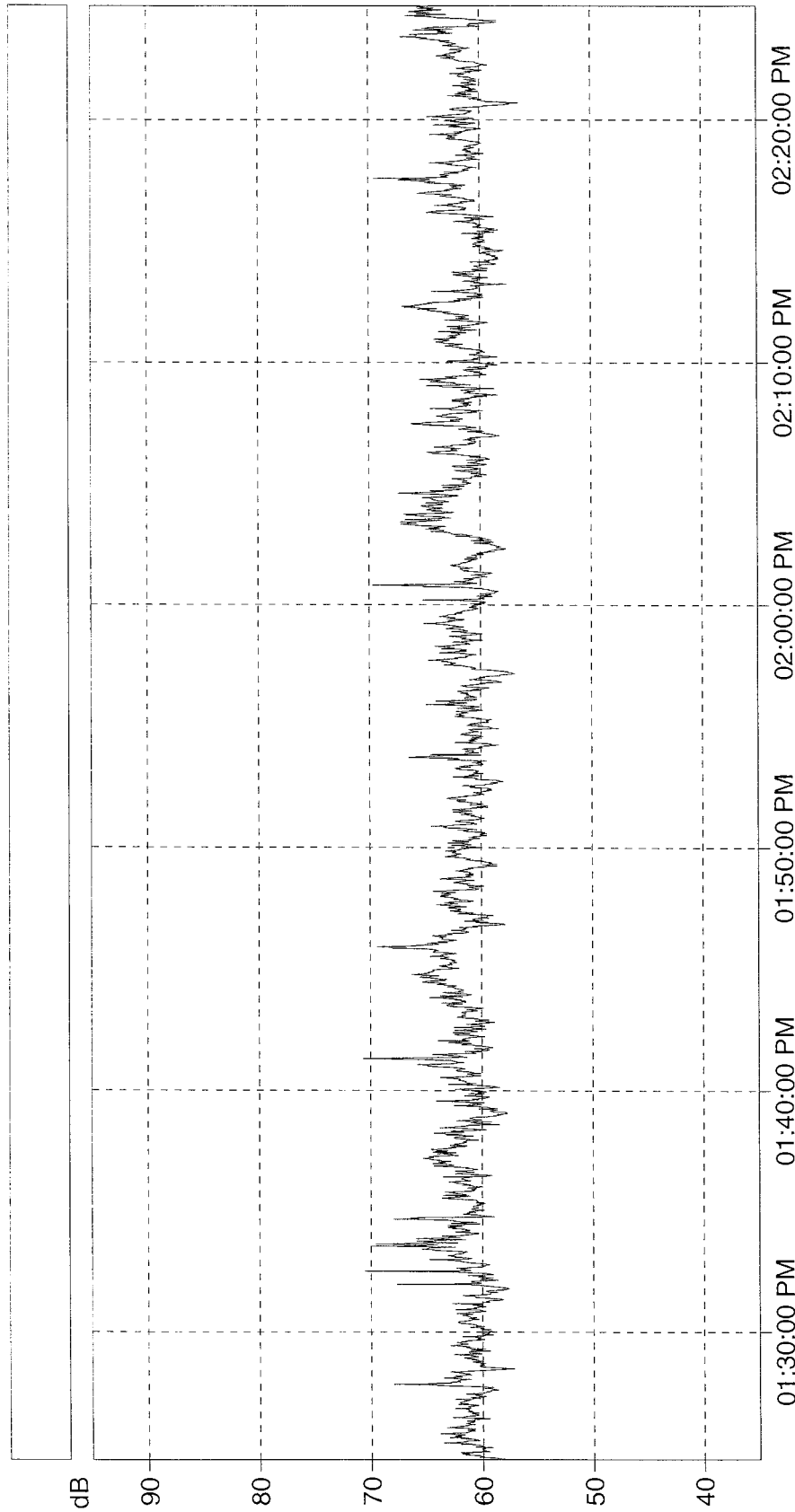


LAeq

Cursor: 07/09/2019 01:08:25 PM - 01:08:26 PM LAeq=61.8 dB LLeq=72.1 dB



Loc B2 07-09-19

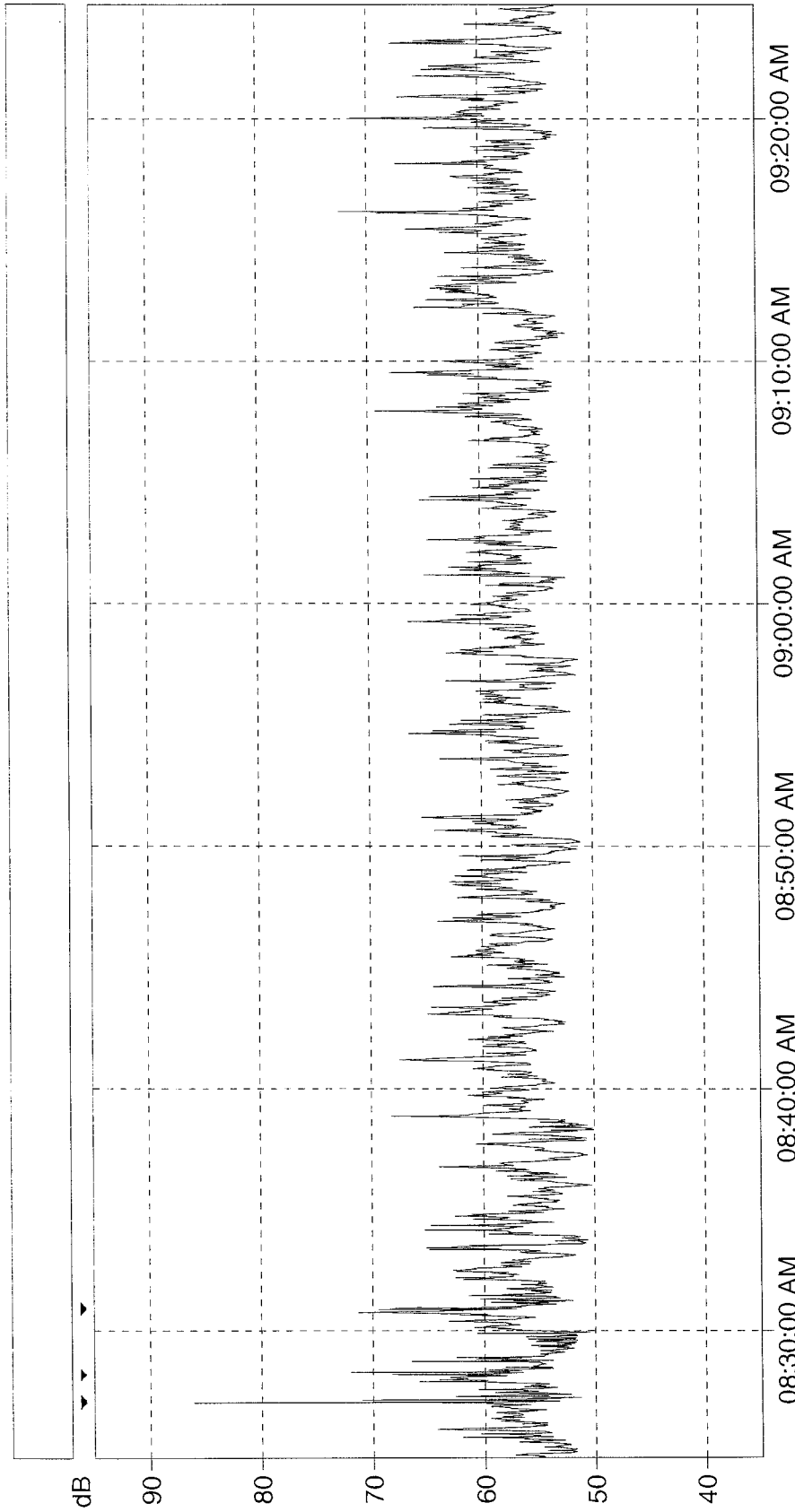


..... LAeq

Cursor: 07/09/2019 02:24:41 PM - 02:24:42 PM LAeq=64.1 dB LLeq=77.2 dB



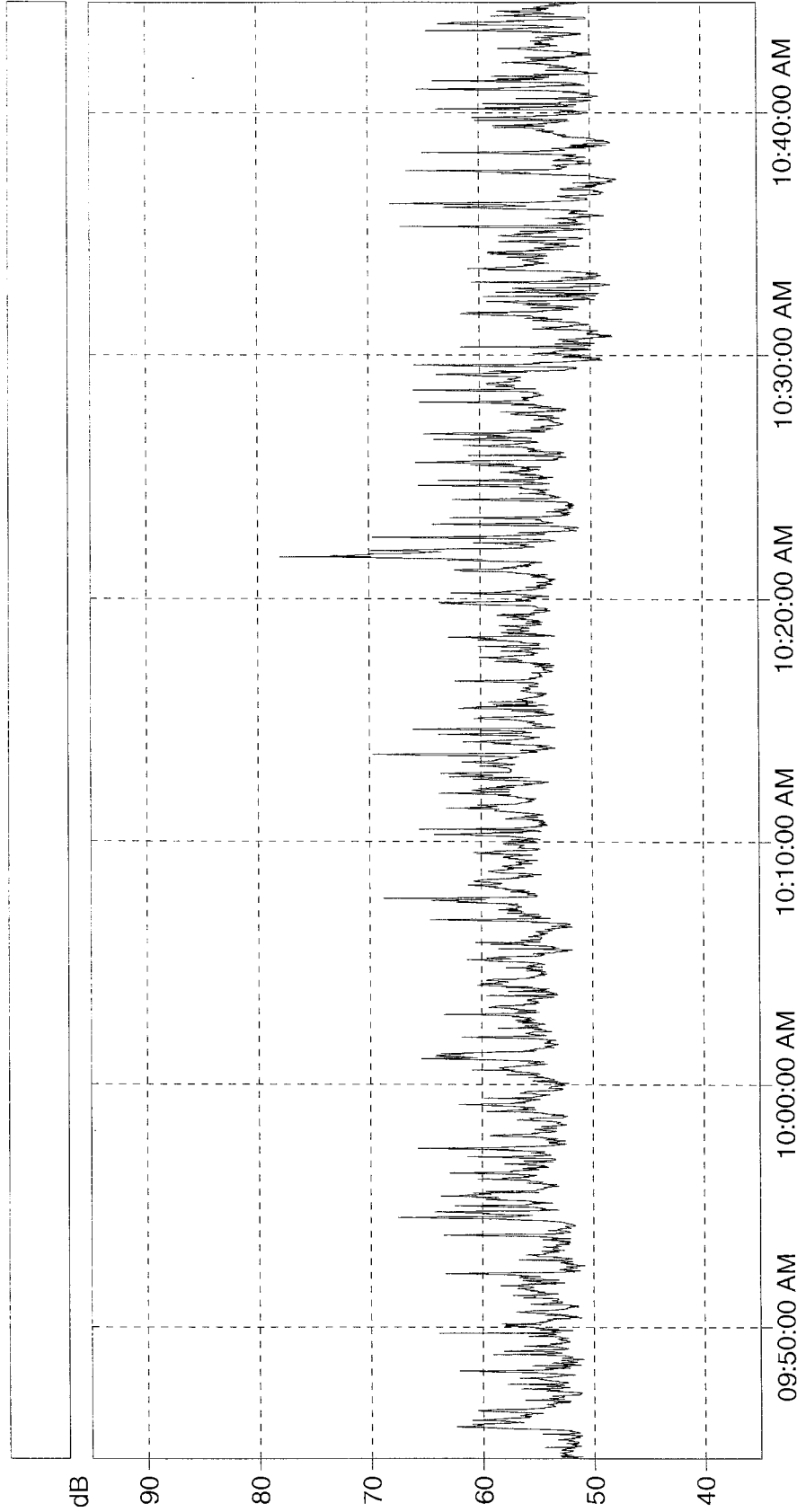
Loc B3 07-10-19



Cursor: 07/10/2019 09:24:42 AM - 09:24:43 AM LAeq=53.3 dB LLeq=71.4 dB



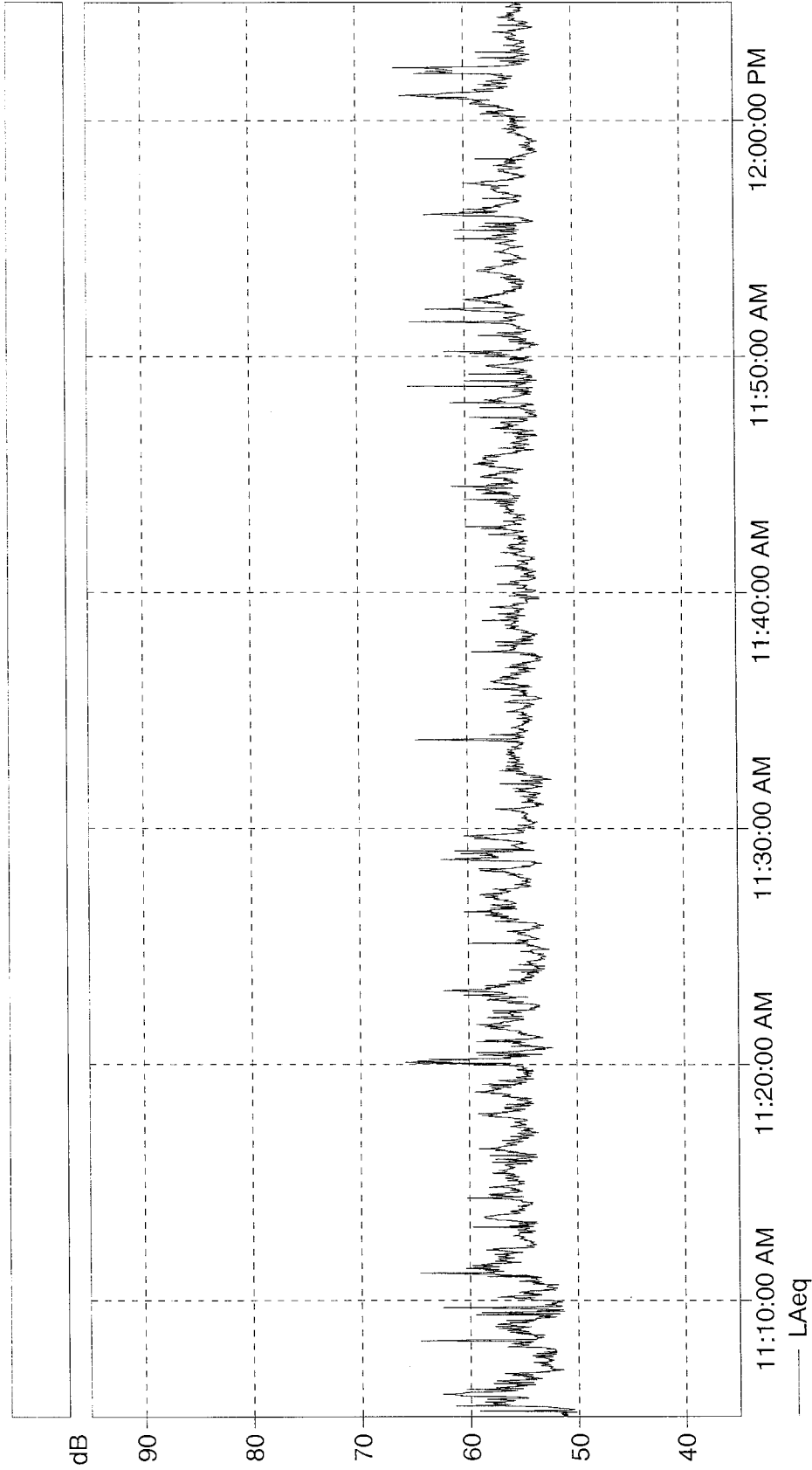
Loc B4 07-10-19



Cursor: 07/10/2019 10:44:32 AM - 10:44:33 AM LAeq=52.9 dB LLeq=66.2 dB
----- LAeq



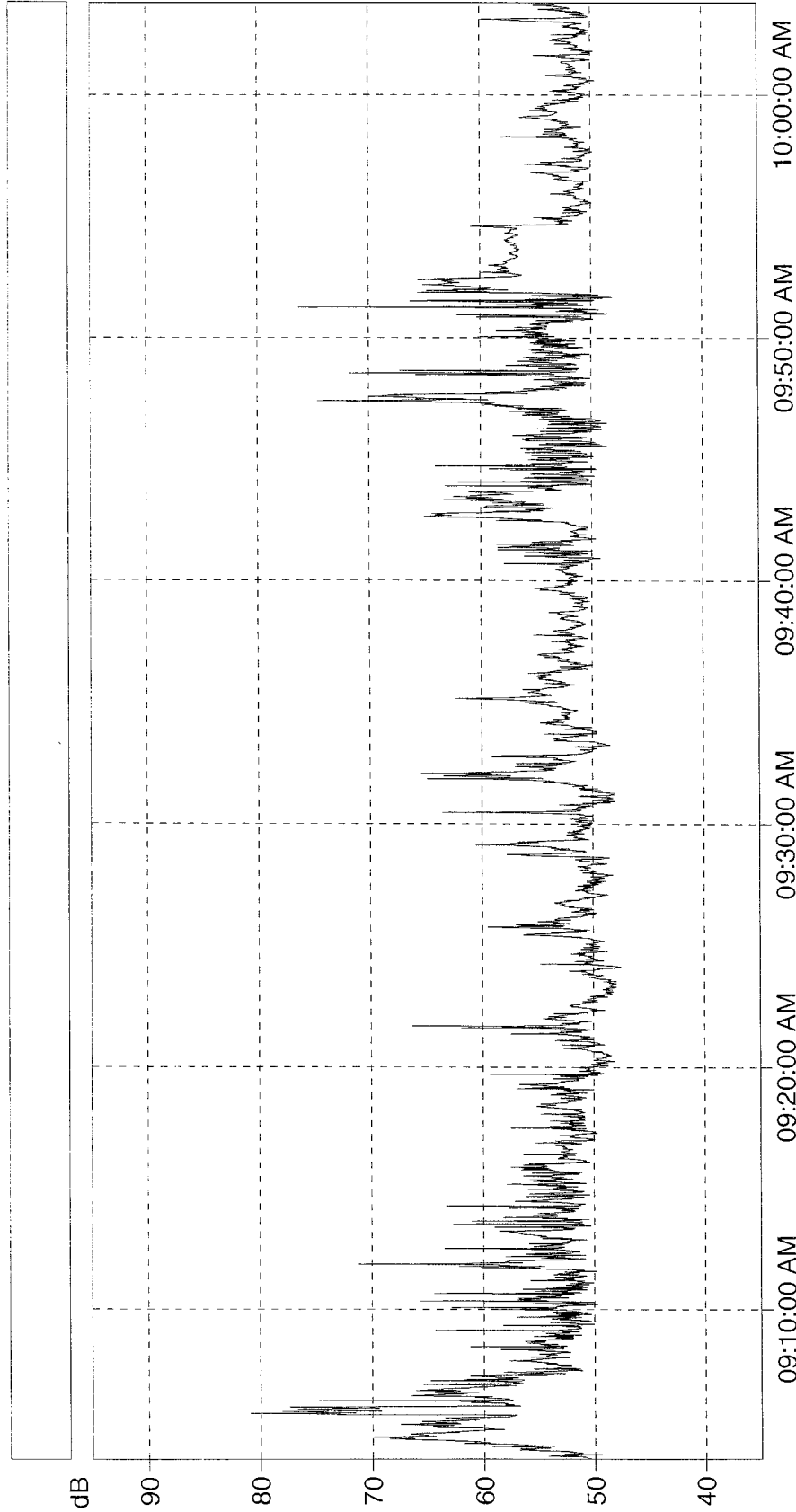
Loc B5 07-10-19



Cursor: 07/10/2019 12:05:01 PM - 12:05:02 PM LAeq=55.1 dB LLeq=73.4 dB



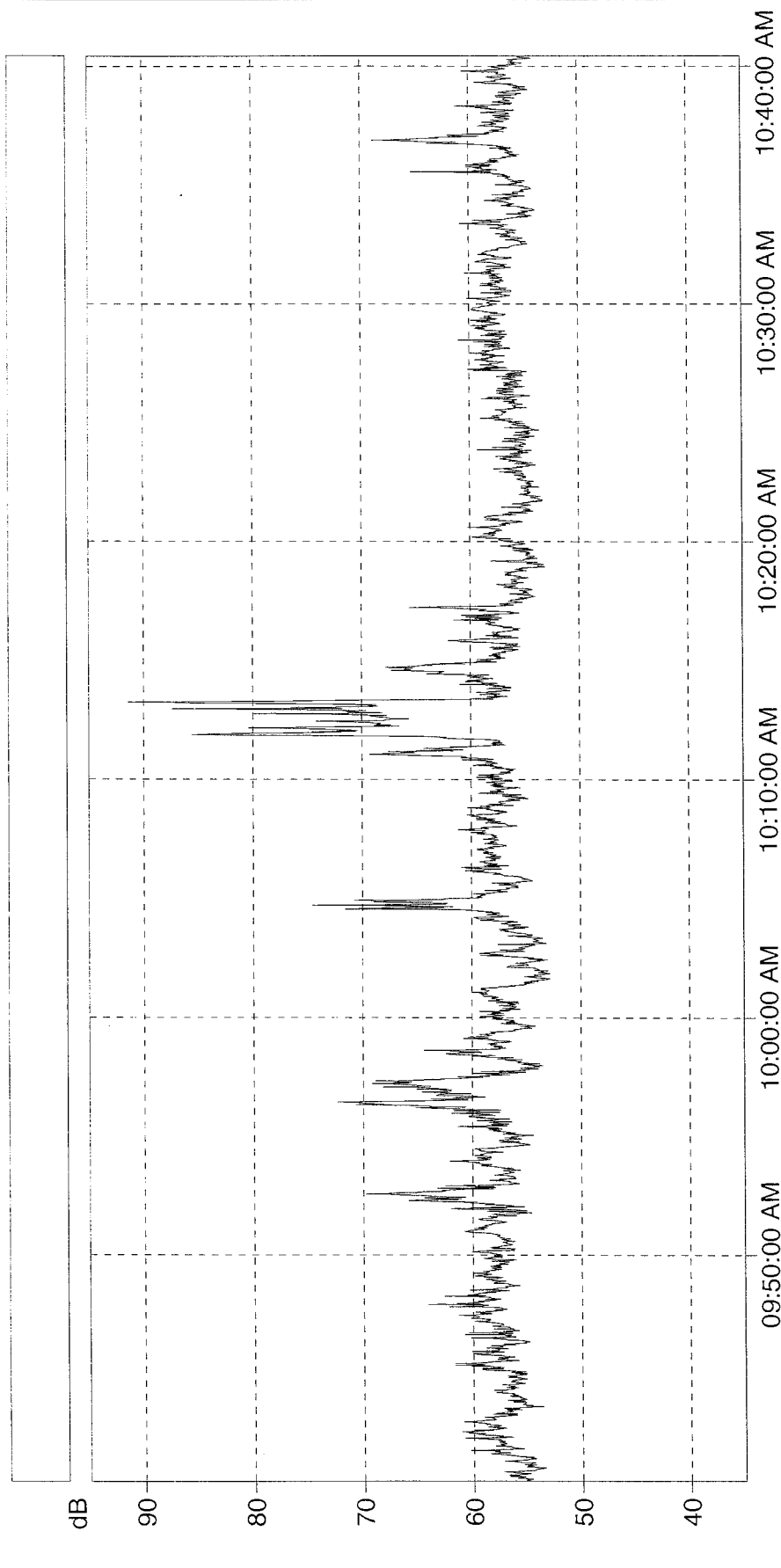
Loc B6 07-11-19



Cursor: 07/11/2019 10:03:46 AM - 10:03:47 AM LAeq=51.8 dB LLeq=67.7 dB



Loc C1 07-12-19

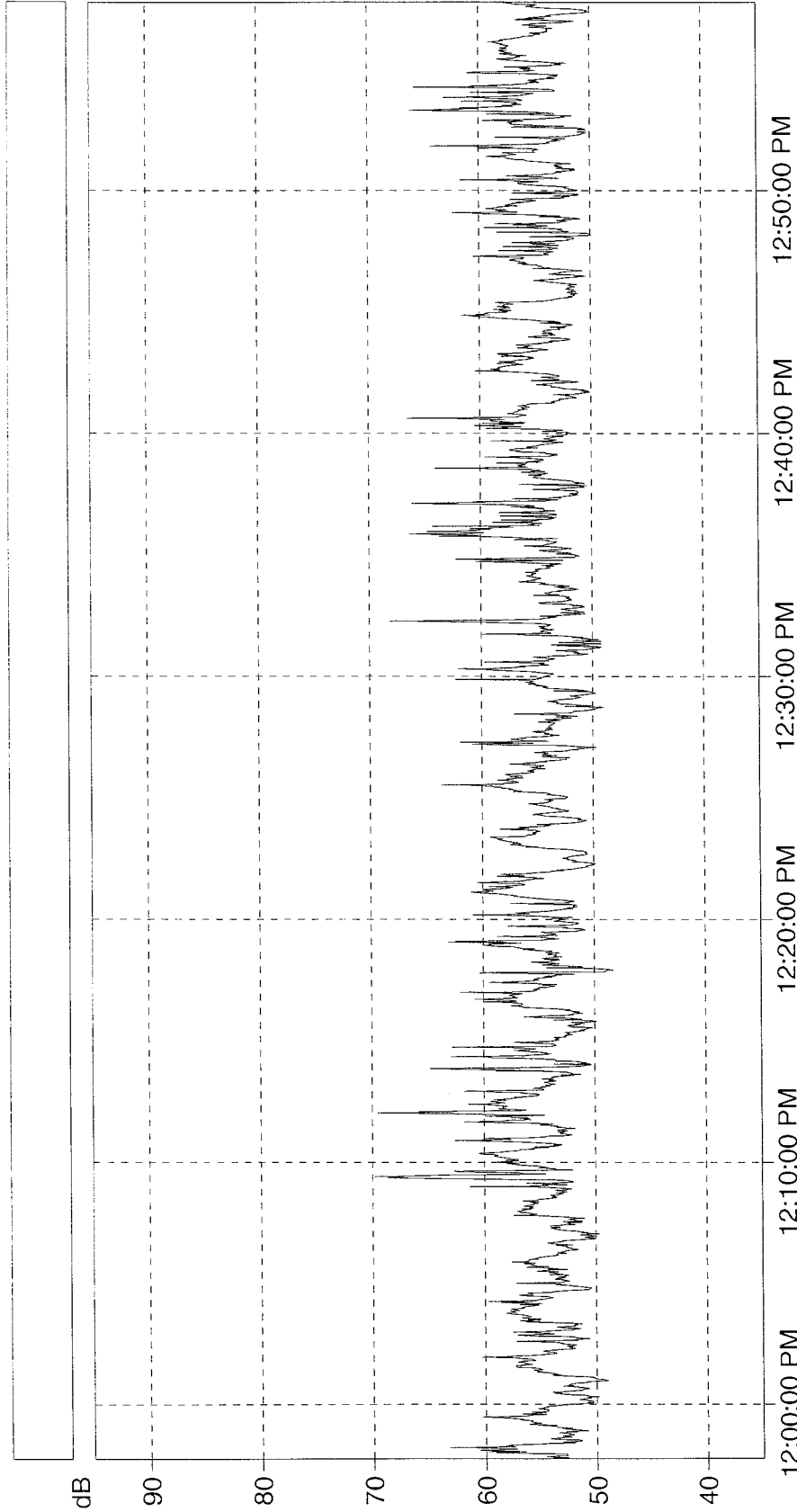


— LAeq

Cursor: 07/12/2019 10:40:25 AM - 10:40:26 AM LAeq=55.2 dB LLeq=80.5 dB



Loc C2 07-11-19

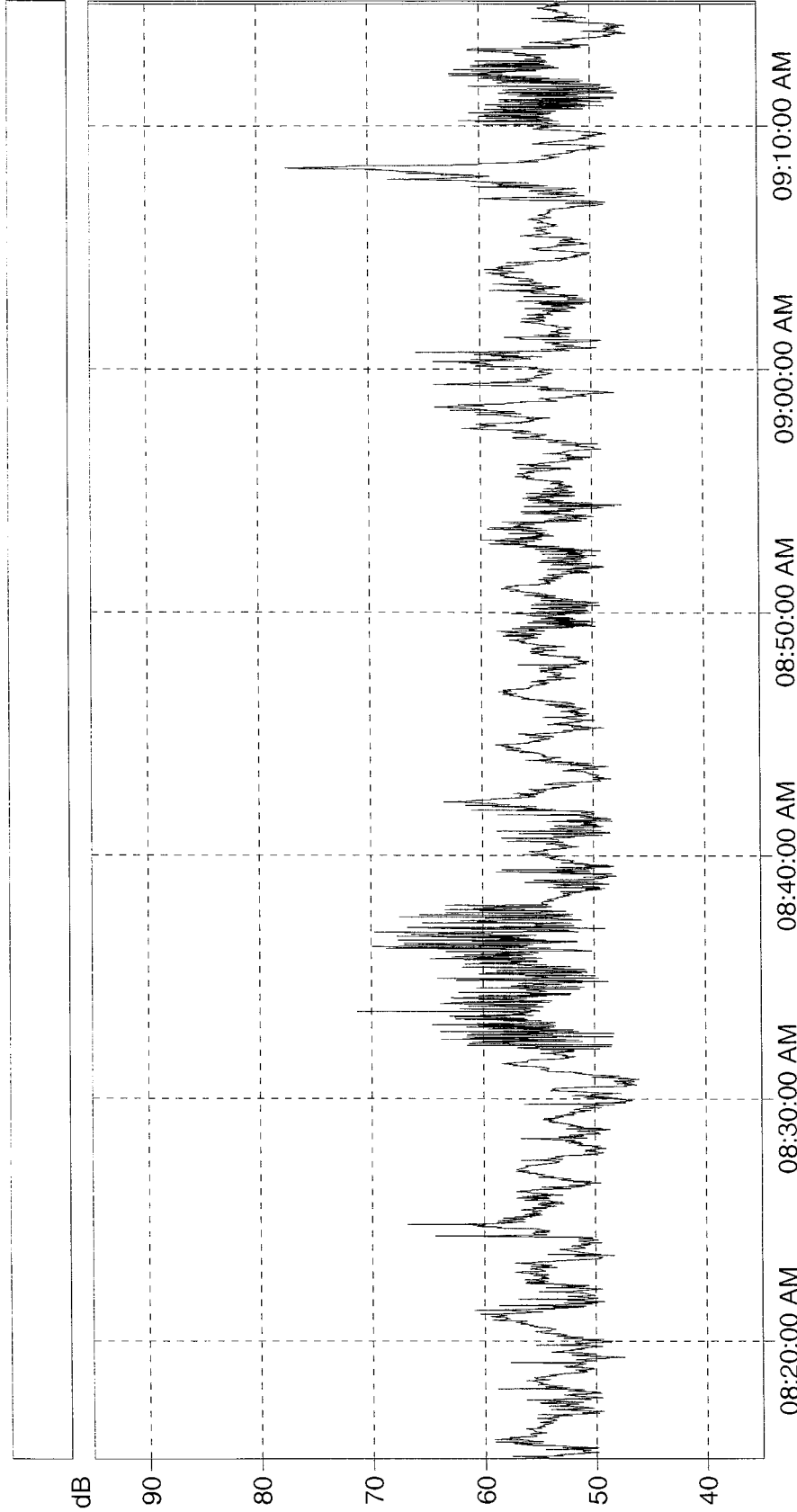


LAeq

Cursor: 07/11/2019 12:57:44 PM - 12:57:45 PM LAeq=57.3 dB LLeq=73.0 dB



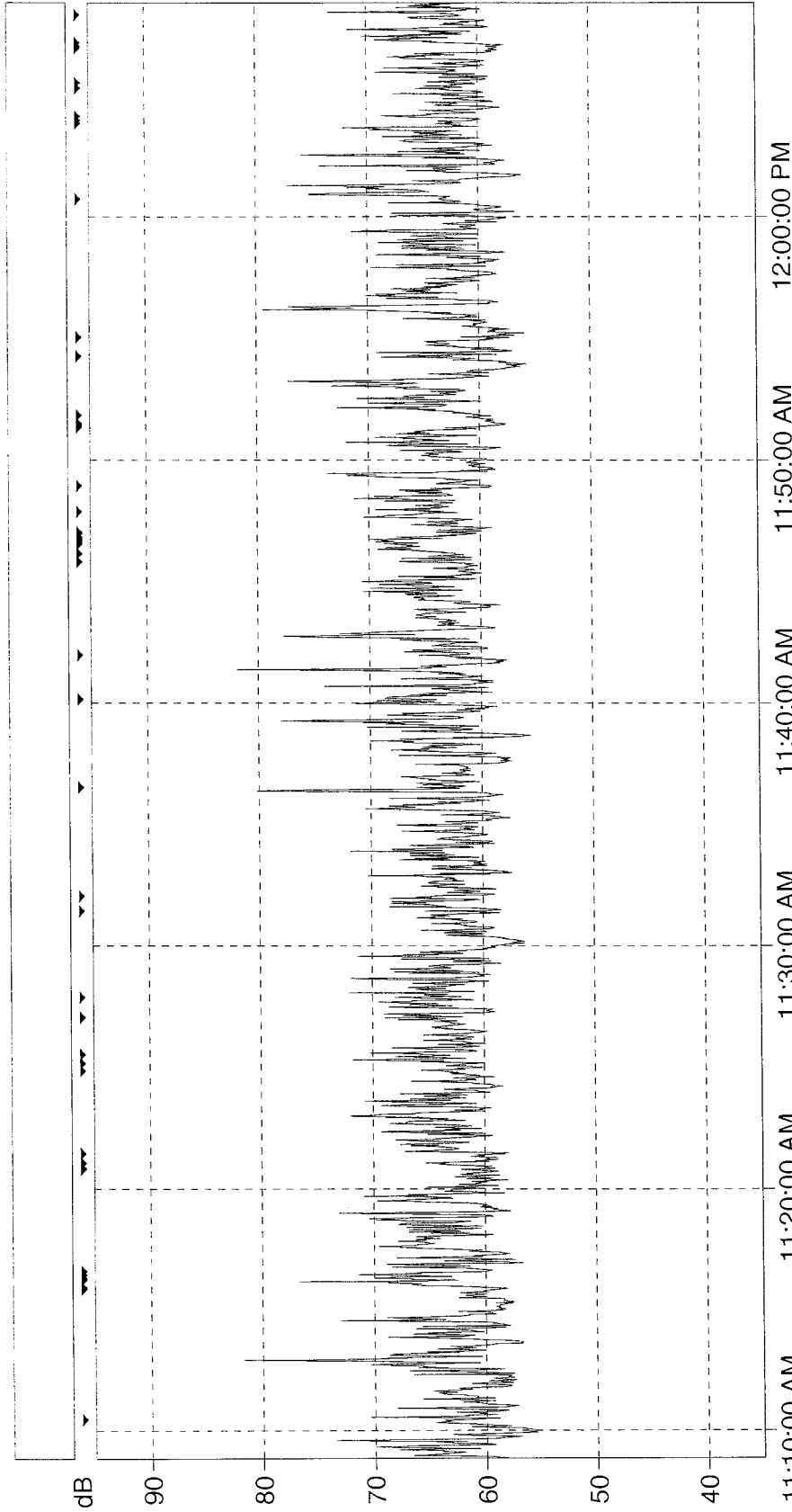
Loc C3 07-12-19



Cursor: 07/12/2019 09:15:00 AM - 09:15:01 AM LAeq=52.6 dB LLeq=68.5 dB



Loc C4 07-12-19



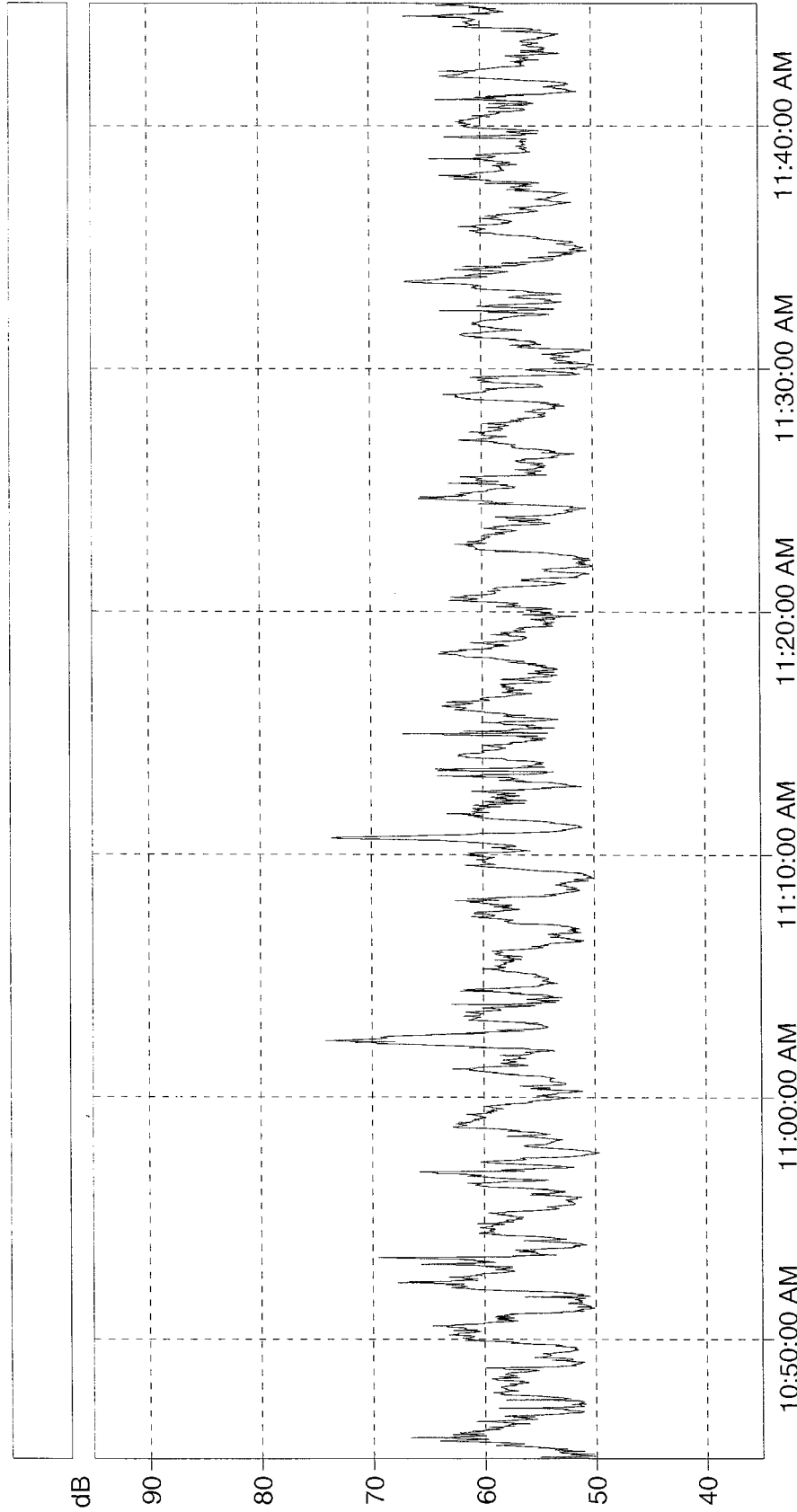
11:10:00 AM 11:20:00 AM 11:30:00 AM 11:40:00 AM 11:50:00 AM 12:00:00 PM

L Aeq

Cursor: 07/12/2019 12:08:49 PM - 12:08:50 PM L Aeq=66.5 dB L Leq=86.3 dB



Loc C5 07-11-19

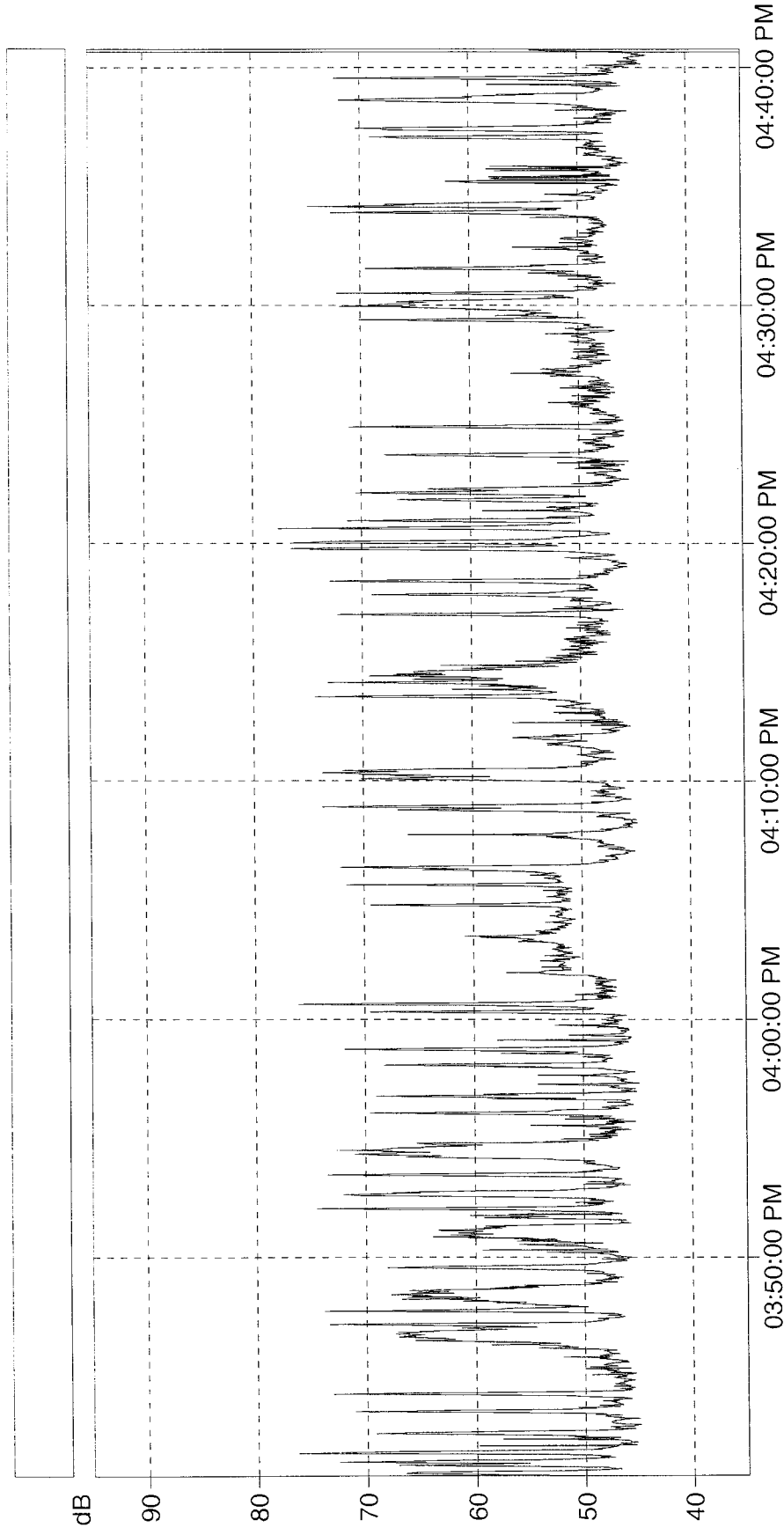


LAeq

Cursor: 07/11/2019 11:45:02 AM - 11:45:03 AM LAeq=67.7 dB LLeq=80.4 dB



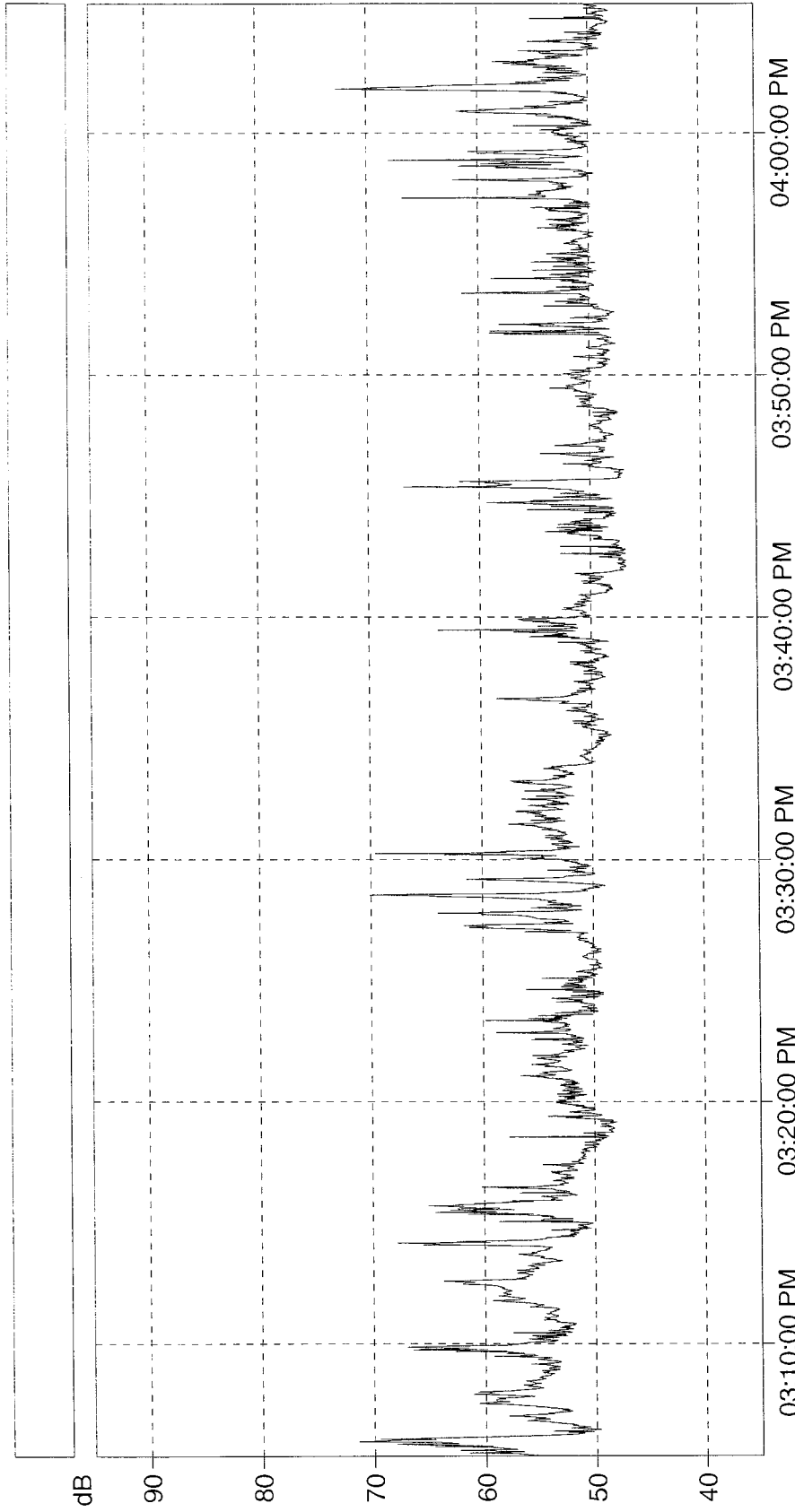
Loc D1 07-04-19



Cursor: 07/04/2019 04:40:38 PM - 04:40:39 PM LAeq=45.5 dB LLeq=59.3 dB



Loc D2 07-08-19

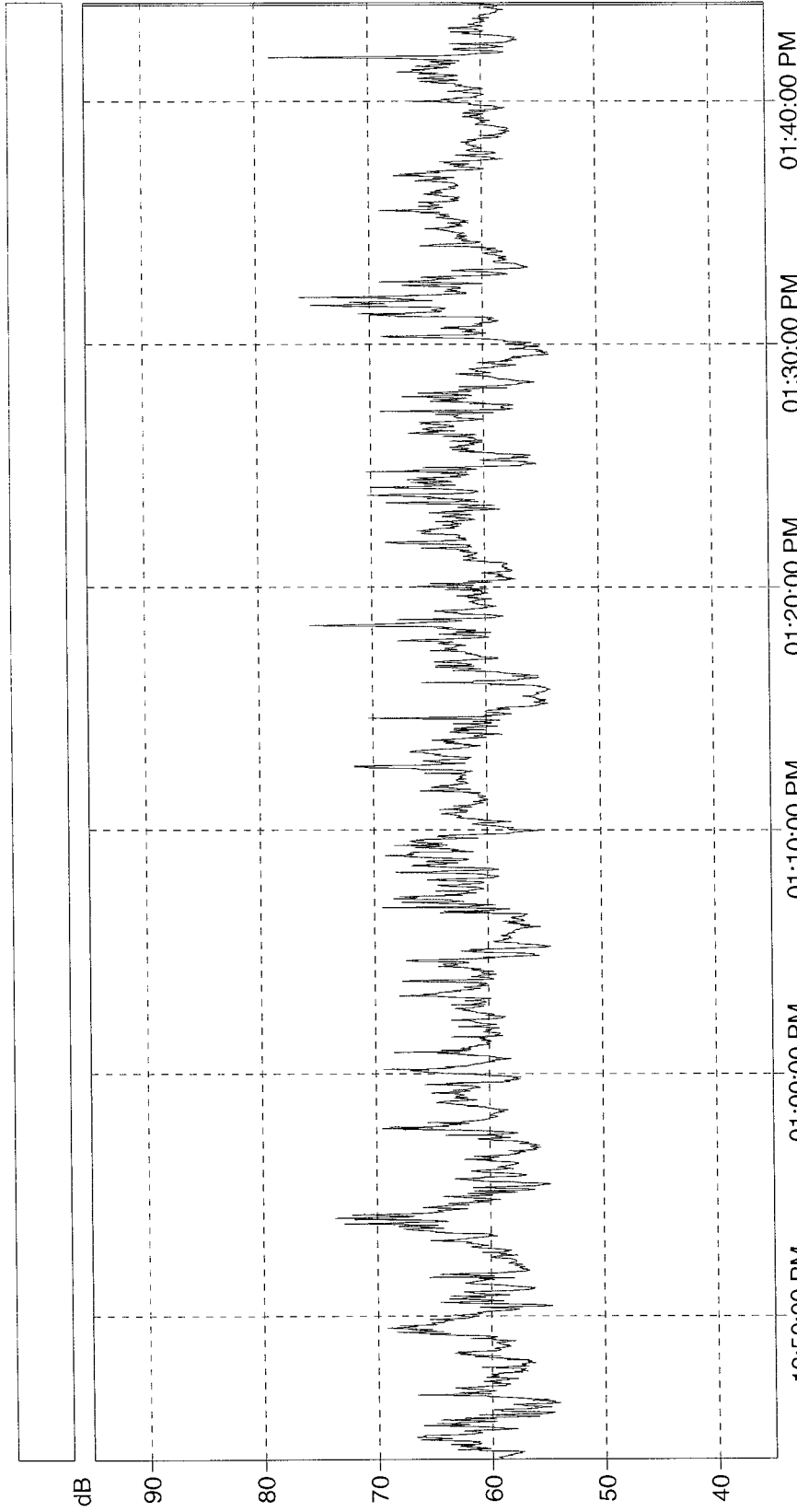


L_{Aeq}

Cursor: 07/08/2019 04:05:19 PM - 04:05:20 PM LAeq=50.9 dB LLeq=70.4 dB



Loc E1 07-16-19



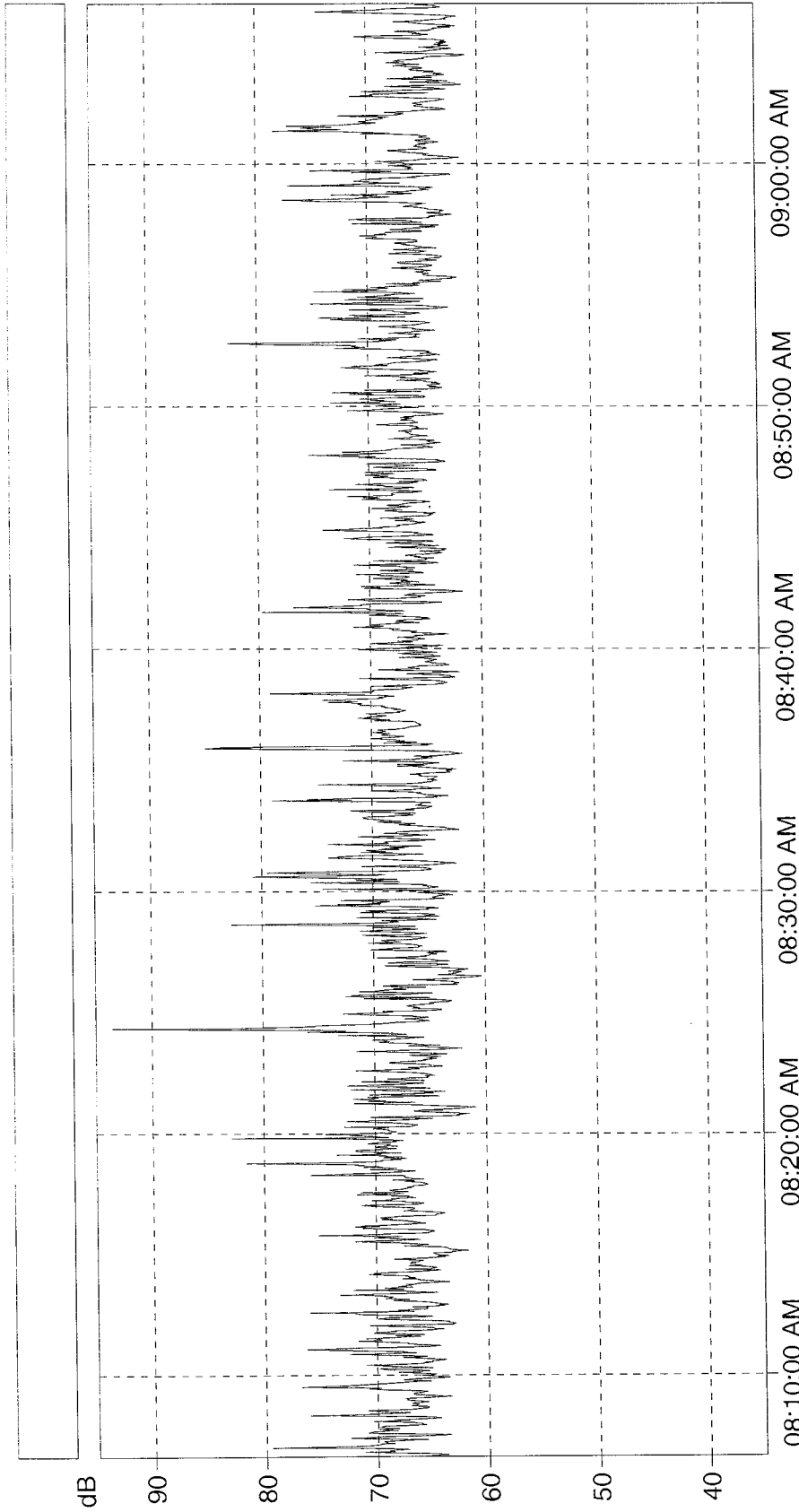
12:50:00 PM 01:00:00 PM 01:10:00 PM 01:20:00 PM 01:30:00 PM 01:40:00 PM

— LAeq

Cursor: 07/16/2019 01:43:57 PM - 01:43:58 PM LAeq=59.1 dB LLeq=82.7 dB



Loc E2 07-09-19

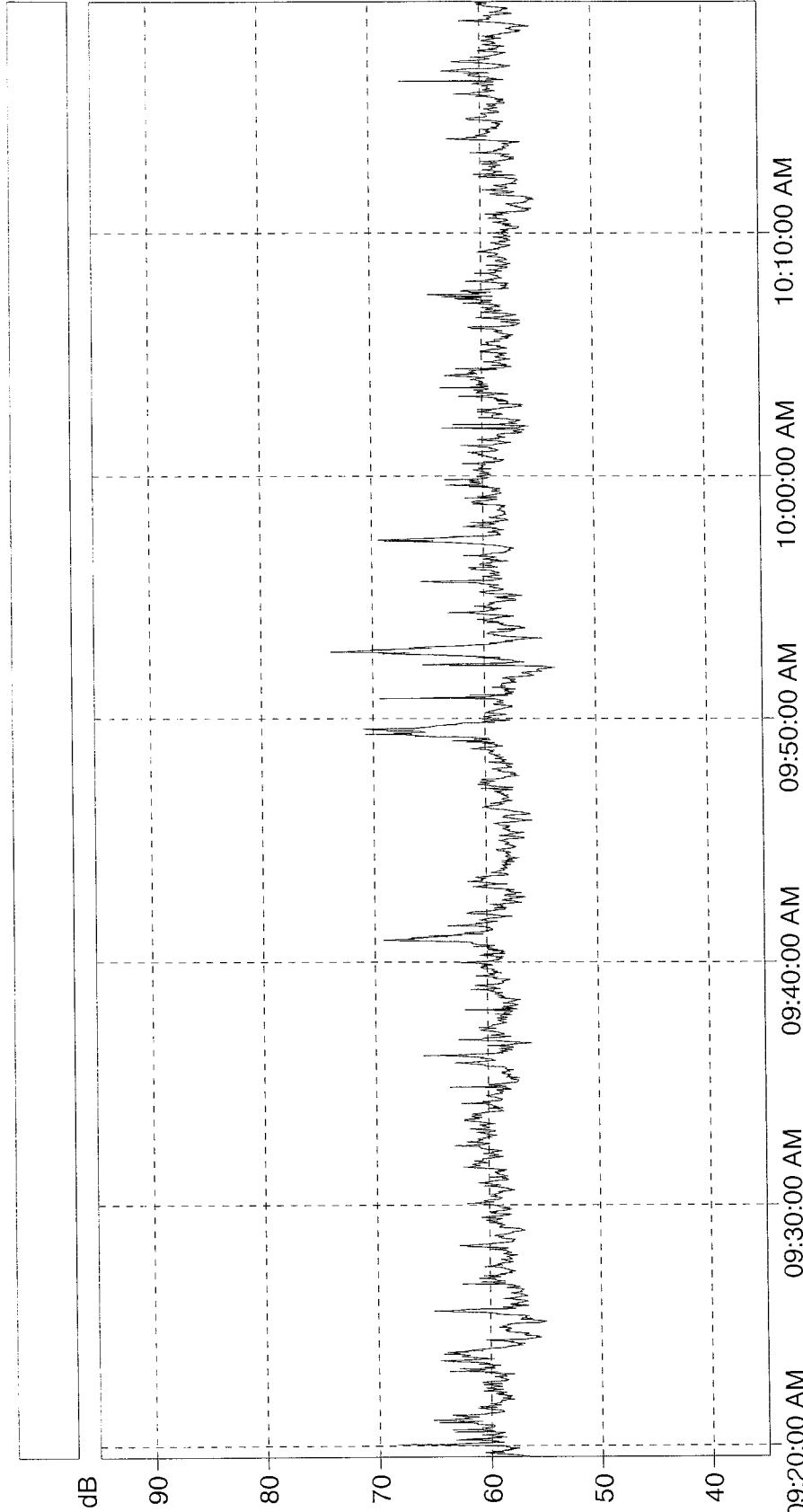


----- LAeq

Cursor: 07/09/2019 09:06:36 AM - 09:06:37 AM LAeq=63.2 dB LLeq=76.6 dB



Loc F2 07-09-19



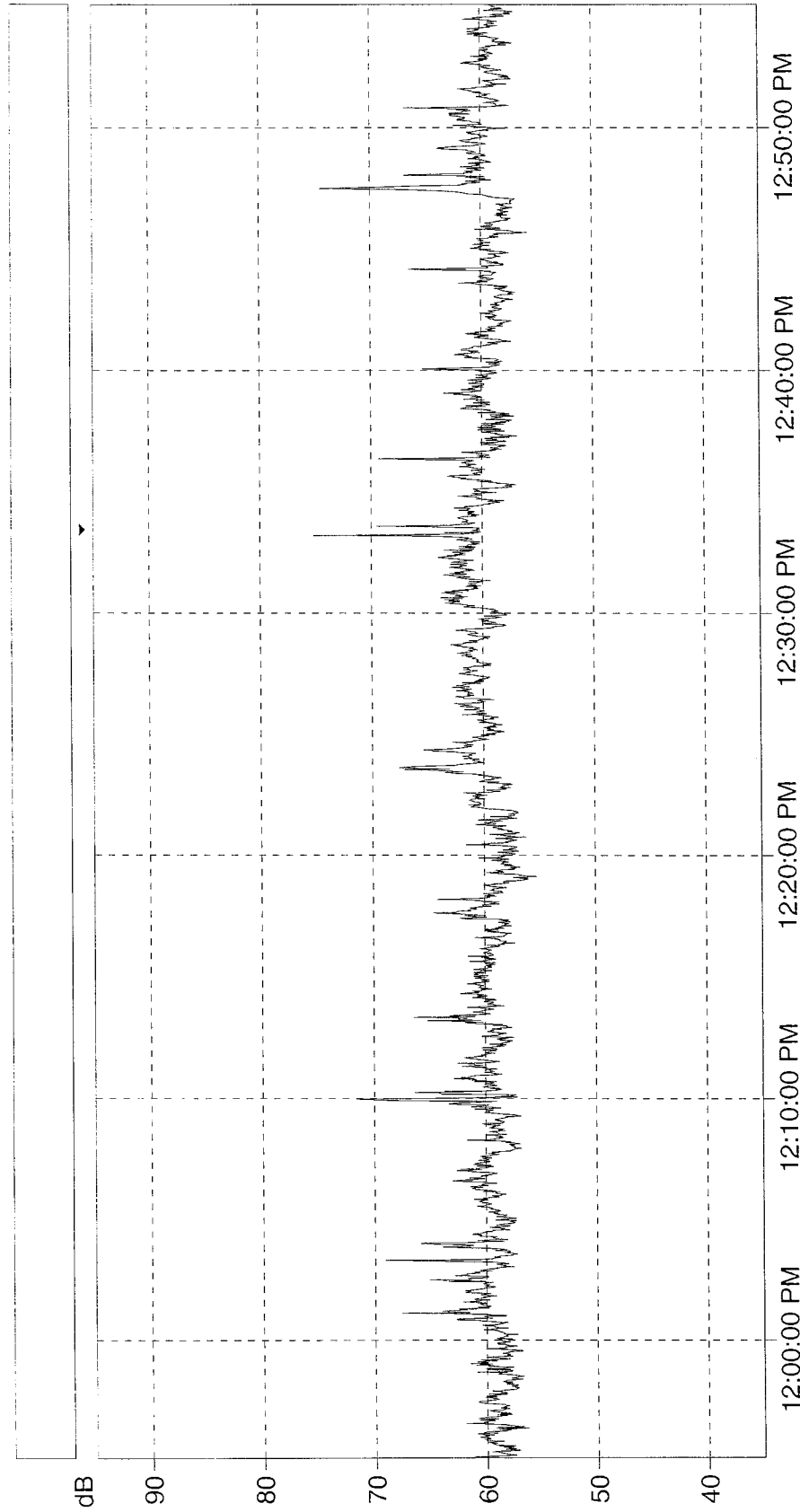
09:20:00 AM 09:30:00 AM 09:40:00 AM 09:50:00 AM 10:00:00 AM 10:10:00 AM

----- L_{Aeq}

Cursor: 07/09/2019 10:19:31 AM - 10:19:32 AM L_{Aeq}=58.6 dB L_{Leq}=73.9 dB



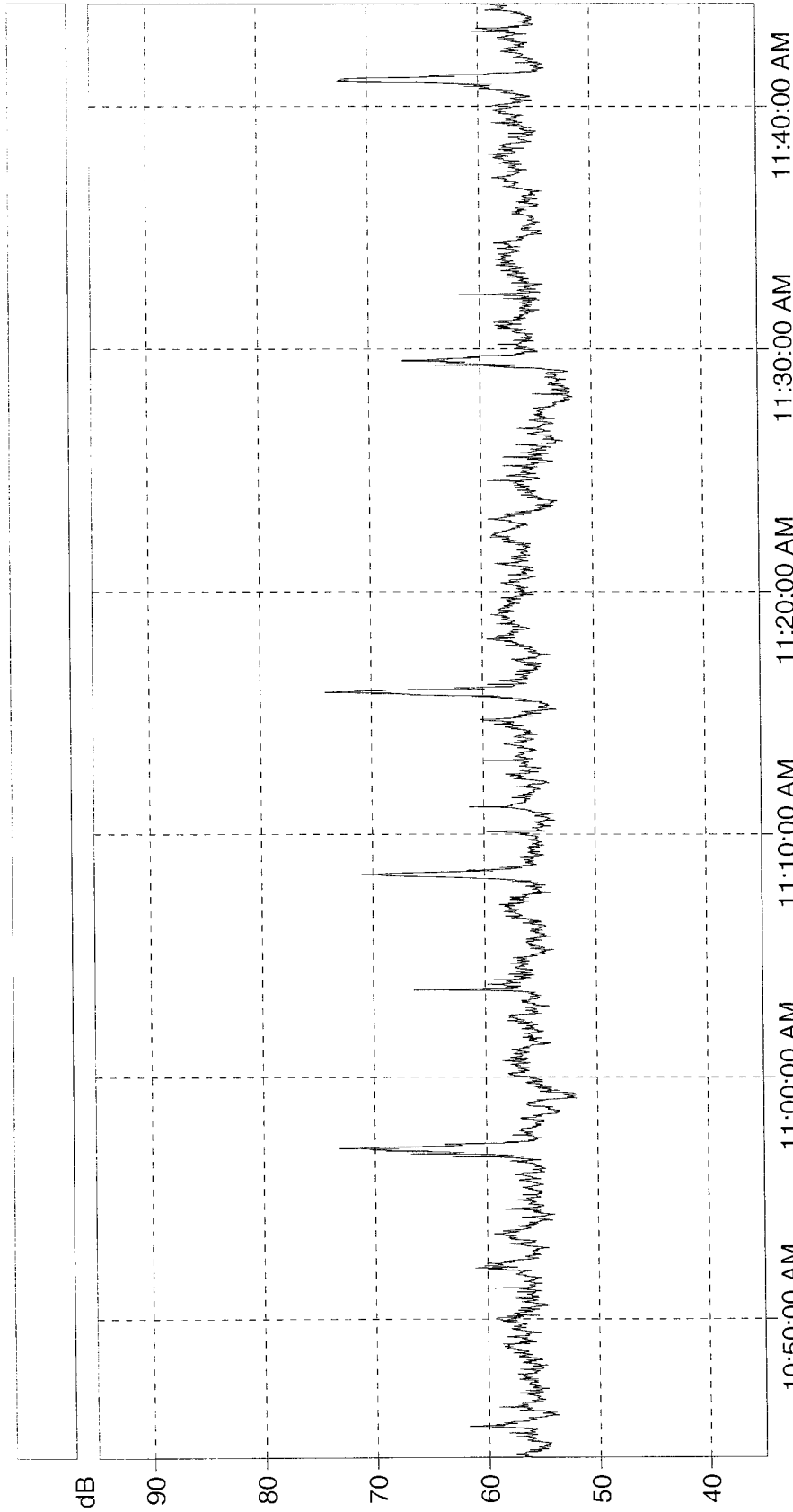
Loc F3 07-08-19



Cursor: 07/08/2019 12:55:05 PM - 12:55:06 PM LAeq=59.2 dB LLeq=78.3 dB



Loc F4 07-08-19



10:50:00 AM 11:00:00 AM 11:10:00 AM 11:20:00 AM 11:30:00 AM 11:40:00 AM

..... L Aeq

Cursor: 07/08/2019 11:44:14 AM - 11:44:15 AM LAeq=58.7 dB LLeq=73.9 dB

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Appendix E: Transportation Impact Analysis Report

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Honouliuli/Waipahū/Pearl City Wastewater Conveyance Facilities

Transportation Impact Assessment Report



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Transportation Impact Assessment Report

Honouliuli/Waipahū/Pearl City Wastewater Conveyance Facilities

Hālawā, 'Aiea, Pearl City, and Waipahū, Hawai'i

October 2019

Prepared for:

City & County of Honolulu
Department of Environmental Services
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Prepared by:

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Honolulu, Hawai'i 96813
(808) 521-5031

Project Reference: 60220849

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Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities
Transportation Impact Assessment Report

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1.0 INTRODUCTION

The City and County of Honolulu (CCH) Department of Environmental Services (ENV) is developing updates to its Honouliuli/Waipahū/Pearl City Wastewater Facilities Plan (Honouliuli Fac Plan) for the Honouliuli sewer basin. The study area for the Honouliuli Fac Plan includes the Honouliuli Wastewater Treatment Plant (WWTP) and its service area that ranges from 'Ewa to Hālawā. The purpose of the updates to the Honouliuli Fac Plan is to implement improvements to the existing wastewater collection system and treatment facilities to meet future flow demands and treatment requirements.

The Honouliuli sewer basin is the second largest sewer basin on O'ahu, and it serves approximately one-third of the island's population. The Honouliuli WWTP provides primary treatment to approximately 26 million gallons of wastewater per day. Figure 1 illustrates the extent of the Honouliuli sewer basin.

An Environmental Impact Statement (EIS) was prepared for proposed upgrades to the Honouliuli Wastewater Treatment Plant and immediate area collection system and published in April 2017.

This current effort involves preparation of an Environmental Impact Statement (EIS) for the Honouliuli Wastewater Conveyance Facilities. With the planning level of information currently available, the EIS evaluation is considered programmatic. This EIS identifies the potential impacts of several alternative projects being considered. As individual projects are programmed for implementation, individual supplemental EIS documents would be prepared, if necessary, that further refine the EIS for the specific projects.

The proposed conveyance projects described in the EIS for the Honouliuli Wastewater Conveyance Facilities include planned improvements to the East Interceptor System and development of a new system that would connect the Waiawa Area to the East Interceptor System.

The East Interceptor System is the primary trunk wastewater collection system in the Honouliuli sewer basin and is comprised of gravity lines, force mains, and wastewater pump stations (WWPSs). The existing East Interceptor is shown in Figure 2. The proposed improvements to the East Interceptor involve rehabilitation, replacement, or augmentation of existing conveyance facilities. Part of the East Interceptor has an alignment that generally runs along Kamehameha Highway between Salt Lake Boulevard near Aloha Stadium and the H1 Freeway Overpass in the Waimalu area. From there, the East Interceptor leaves Kamehameha Highway and proceeds to the Pearl City WWPS. From there to the West Loch area, two major system options are being studied: one utilizing primarily additional force mains generally along the alignment of the existing East Interceptor and the other utilizing a gravity sewer tunnel (GST).

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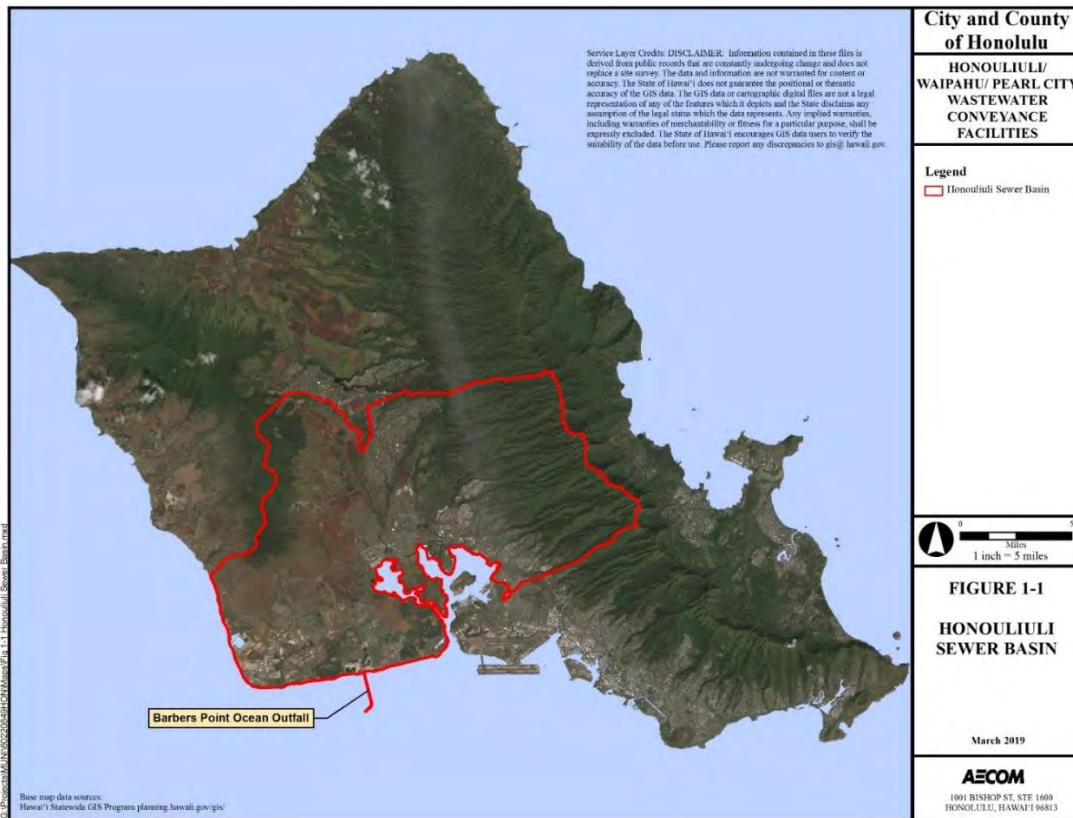


Figure 1 Honouliuli Sewer Basin

There are two alternative versions of the GST option: a deep gravity tunnel aligned directly through Pearl City Peninsula and Middle Loch and a microtunnel aligned along the existing force main.

The proposed Waiawa Area conveyance options are three alternative corridors that connect the Waiawa Area to the East Interceptor.

This Transportation Impact Assessment Report (TIAR) identifies transportation issues associated with the East Interceptor and Waiawa Area conveyance options assesses in the EIS. Most of the proposed facilities, once constructed, are anticipated to have minimal impact on transportation.

The primary transportation impacts associated with the proposed projects are anticipated to occur during construction. Accordingly, the TIAR focuses on the construction transportation impacts in a manner that identifies the system level transportation impact consequences of the proposed projects, thereby helping the decision-making process of project selection and prioritization. As specific projects are refined through design and programming, more detailed impact analyses could be performed as part of a supplemental EIS if appropriate.

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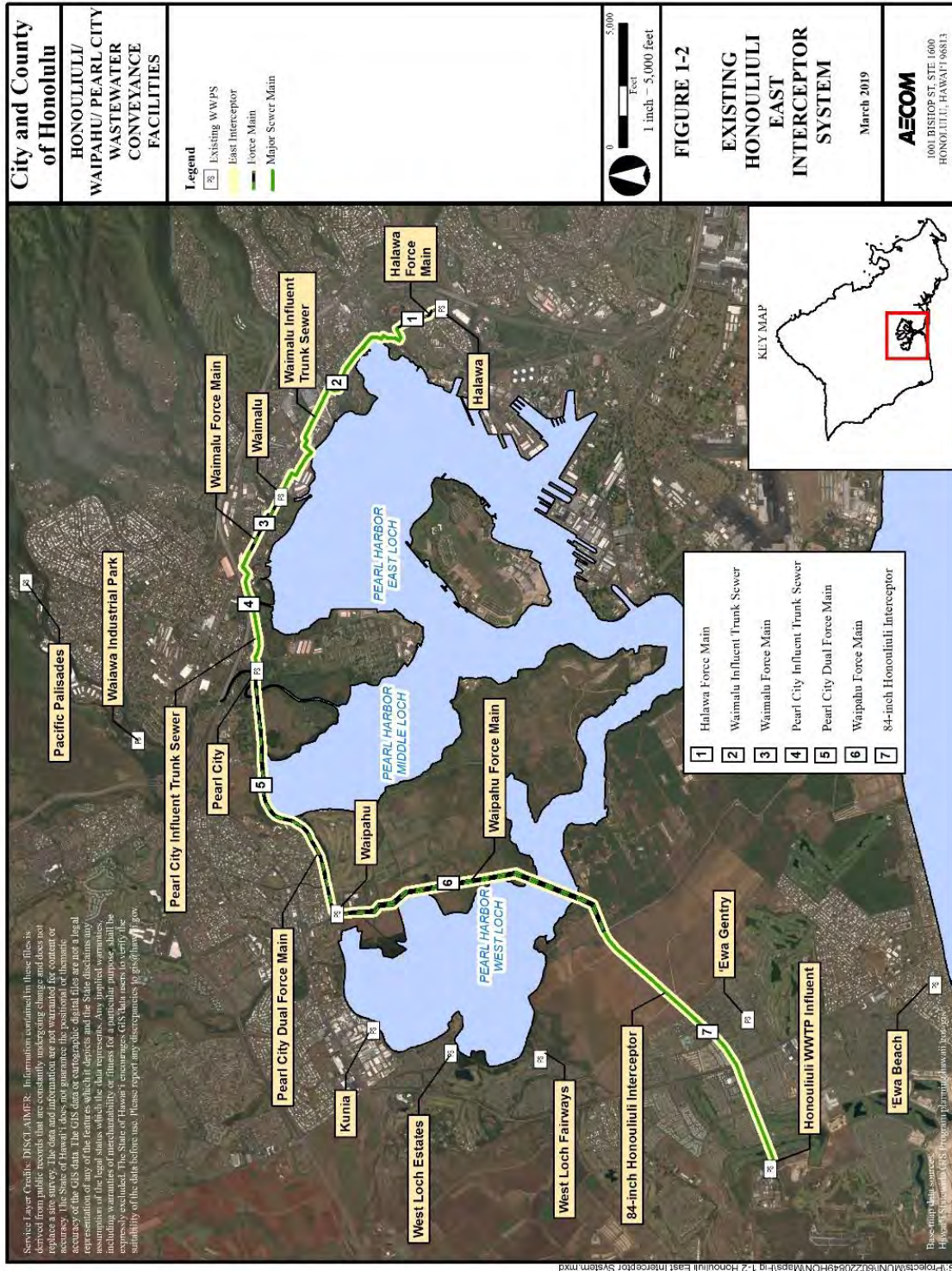


Figure 2 Existing Honouliuli East Interceptor System

2.0 EXISTING CONDITIONS

Existing conditions provide a base level in the physical and operational environment that the transportation impacts of the proposed East Interceptor and Waiawa Area conveyance options can be compared to.

2.1 Existing Roadways

2.1.1 Salt Lake Boulevard

Salt Lake Boulevard is a major arterial roadway with an 'Ewa-Koko Head orientation that runs through the Salt Lake and Hālawa areas between Pu'uloa Road and Kamehameha Highway. A segment of Salt Lake Boulevard between Kamehameha Highway and Kahuapa'ani Street has the potential to interact with proposed upgrades to the existing Hālawa WWPS and force mains that run along Salt Lake Boulevard from a point near its crossing of Hālawa Stream to Kamehameha Highway.

Near Kamehameha Highway, Salt Lake Boulevard separates into two roadways that intersect Kamehameha Highway at two different intersections. The Koko Head-bound leg intersects Kamehameha Highway opposite the roadway to the Ford Island Bridge. The 'Ewa-bound leg intersects Kamehameha Highway approximately 750 feet 'Ewa of the Ford Island road intersection at a three-legged "T"-intersection. The legs join at the Main Entrance to Aloha Stadium. The proposed East Interceptor conveyance options potentially would affect only the 'Ewa-bound leg of Salt Lake Boulevard.

Between the Main Entrance to Aloha Stadium and Kahuapa'ani Street, Salt Lake Boulevard is a six-lane, divided roadway with three lanes in each direction. There is a raised median, curb, and gutters, and attached sidewalks on both sides of the road. The 'Ewa-bound leg of Salt Lake Boulevard is four lanes wide with two lanes designated for left turns and two lanes designated for right turns at Kamehameha Highway.

The posted speed limit along the segment of Salt Lake Boulevard between Kahuapa'ani Street and Kamehameha Highway is 25 miles per hour (mph), and it is under the jurisdiction of CCH.

2.1.2 Kamehameha Highway

Kamehameha Highway is a major arterial roadway that traverses much of the island of O'ahu. The existing East Interceptor force main runs along Kamehameha Highway through the Hālawa and 'Aiea areas. From Salt Lake Boulevard to the 'Aiea interchange, Kamehameha Highway is an eight-lane, divided roadway with four lanes in each direction. Kamehameha Highway continues through the interchange as a four-lane, divided roadway, but becomes a six-lane, divided roadway between the interchange and Honomanu Street. Kamehameha Highway continues as a six-lane divided roadway through 'Aiea to a point just 'Ewa of Kuleana Road, where H1 Freeway crosses over it. Within this segment, Kamehameha Highway has a raised median, curb, and gutters, and

attached sidewalks along most of the roadway. Honolulu Authority for Rapid Transportation (HART) rail transit guideway columns are located in the median of Kamehameha Highway through the study area. The posted speed limit on Kamehameha Highway is 35 mph. Kamehameha Highway is under the jurisdiction of the State of Hawaii Department of Transportation (HDOT).

2.1.3 McGrew Loop

McGrew Loop is a local roadway in 'Aiea providing access to the McGrew Point military housing. It intersects Kamehameha Highway opposite Honomanu Street. The Pearl Harbor Bike Path crosses McGrew Loop, just makai of its intersection with Kamehameha Highway. The East Interceptor force main crosses McGrew Loop parallel to and near the bike path. At this point, McGrew Loop is a two-lane, undivided roadway with one lane in each direction. There are curb and gutters and attached sidewalks on both sides of the road. The road is under the jurisdiction of the Joint Base Pearl Harbor Hickam.

2.1.4 'Aiea Kai Place

'Aiea Kai Place is a local roadway in 'Aiea that leads into a residential community. It is a short road that is a mauka-makai road at its intersection with Kamehameha Highway but curves into an 'Ewa-Koko Head orientation makai of Kamehameha Highway. It is a two-lane, undivided road with one lane in each direction. There are gutters but no curbs or sidewalk. The posted speed limit is 25 mph, and the road is under the jurisdiction of CCH.

2.1.5 Lehua Avenue

Lehua Avenue is a local roadway that provides access and circulation to the Pearl City Peninsula. It intersects Kamehameha Highway opposite Waimano Home Road. The roadway has a mauka-makai orientation and is four-lane road with two lanes in each direction. Between Kamehameha Highway and 4th Street, it is a divided roadway with a raised median. Makai of 4th Street, Lehua Avenue is an undivided roadway. There are curbs and gutters and attached sidewalks between Kamehameha Highway and "A" Street. Makai of "A" Street, the presence of curb and gutter and sidewalks varies.

The Pearl Harbor Bike Path crosses Lehua Avenue just makai of A Road. The posted speed limit is 25 mph. The roadway is under the jurisdiction of CCH.

The Pearl City WWPS is located 'Ewa of Lehua Avenue adjacent to the Pearl Harbor Bike Path and existing and proposed force mains run adjacent to the Pearl Harbor Bike Path.

2.1.6 Waihona Street

Waihona Street is a mauka-makai roadway that provides access to the Pearl City Industrial Park. It is a two-lane, undivided roadway with one lane in each direction. There are curb and gutters and attached sidewalks on both sides of the road.

Waihona Street intersects Kamehameha Highway at a “T”-intersection. ‘Ewa of the intersection of Waihona Street and Kamehameha Highway, there are on-ramps to ‘Ewa-bound Interstate H1 Freeway and Wahiawa-bound Interstate H2 Freeway.

The existing Waiawa Industrial Park WWPS is located adjacent to Waihona Street on the ‘Ewa-side. The posted speed limit is 25 mph, and the road is under the jurisdiction of CCH.

2.1.7 Waipi’o Point Access Road

Waipi’o Point Access Road is local road in the Waipahū area. It has a mauka-makai orientation and is a two-lane, undivided roadway with one lane in each direction. East Interceptor conveyance options would cross Waipi’o Point Access Road near the Pearl Harbor Bike Path.

In this area, there are generally no curb and gutters. There are pedestrian paths and a buffered bicycle lane, beginning makai of the Pearl Harbor Bike Path. The posted speed limit in the area is 25 mph. The roadway is under the jurisdiction of Joint Base Pearl Harbor Hickam but administered by CCH.

2.1.8 Waipahū Depot Street

Waipahū Depot Street is a mauka-makai-oriented local roadway in Waipahū that runs from Waipahū Street in Waipahū town and continues makai of Farrington Highway to the vicinity of the Honolulu Police Academy.

The East Interceptor conveyance options would travel along Waipahū Depot Street makai of the Pearl Harbor Bike Path. The options would continue to the existing Waipahū WWPS located on the Koko Head side of the road, mauka of the Honolulu Police Training Academy. In this segment, Waipahū Depot Street is a two-lane, undivided roadway with one lane in each direction. There are no curb and gutter or sidewalks.

The Pearl Harbor Bike Path terminates at Waipahū Depot Street. The existing Oahu Railway & Land Company (OR&L) railroad right-of-way continues ‘Ewa of Waipahū Depot Street and plans call for the extension of the Pearl Harbor Bike Path on the railroad right-of-way. The posted speed limit is 25 mph. The roadway is under the jurisdiction of CCH.

2.2 Pedestrian & Bicycle Conditions

2.2.1 Pedestrian Facilities

Kamehameha Highway

There are East Interceptor conveyance option projects proposed along Kamehameha Highway between Salt Lake Boulevard and the area near Kuleana Road. Within this segment, there are attached sidewalks along at least one side of Kamehameha Highway. At Salt Lake Boulevard near Aloha Stadium, attached sidewalks are available on both sides of the roadway. As Kamehameha Highway passes through the 'Aiea interchange, an attached sidewalk is maintained on the makai side of the roadway, transitioning to an off-road path that rejoins Kamehameha Highway just prior to reaching Honomanu Street. 'Ewa of that point, there are generally attached sidewalks on both sides of Kamehameha Highway, although the quality of the sidewalks varies, especially toward Kuleana Road. There are relatively short segments of detached sidewalk interspersed within the attached sidewalks along this roadway segment.

Proposed Waiawa Area conveyance options could affect Kamehameha Highway between Waimano Home Road and Waihona Street. Within this segment, attached sidewalks are provided on both sides of Kamehameha Highway between Waimano Home Road and the Pearl Highlands Shopping Center. From there to Kuala Street, there is an attached sidewalk on the mauka side of Kamehameha Highway. Between Kuala Street and Waihona Road, there are no sidewalks on either side of Kamehameha Highway.

The intersections along Kamehameha Highway in 'Aiea and Pearl City all have existing crosswalks across most of its legs. Several intersections do not have a crosswalk across the 'Ewa-leg on Kamehameha Highway. These intersections include Acacia Road, Waimano Home Road/Lehua Avenue, Pu'u Momi Street, Pu'u Poni Street, Kaluamoi Drive, Ka'ahumanu Street, Kanuku Street, Kaonohi Street, Pali Momi Street, Honomanu Street, and Salt Lake Boulevard. A few other intersections do not have a crosswalk across the Koko Head-leg on Kamehameha Highway. This situation occurs at the Hekaha Street and Lipoa Place intersections.

Lehua Avenue

There are attached sidewalks along both sides of Lehua Avenue between Kamehameha Highway and 1st Street. Makai of 1st Street, there is an attached sidewalk on the Koko Head side of the road that continues until "A" Road. There are no sidewalks near where Lehua Avenue intersects with the Pearl Harbor Bike Path. At its intersection with Kamehameha Highway, there is a signalized crosswalk across its makai Lehua Avenue leg. There are crosswalks on all four legs of the Lehua Avenue intersections with 4th Street, 3rd Street, 2nd Street, and 1st Street.

Waihona Street

Attached sidewalks exist on both sides of Waihona Street. There are no crosswalks at its intersection with Kamehameha Highway or at any point along the street.

Waipi'o Point Access Road

There are no sidewalks in the area where the proposed projects would cross the Waipi'o Point Access Road. There is an unsignalized crosswalk across the road near where the Pearl Harbor Bike Path crosses Waipi'o Point Access Road.

Waipahū Depot Street

Along Waipahū Depot Street, there is attached sidewalk only adjacent to the Servco Auto Leeward Center on the Koko Head side of the road. There is a signalized crosswalk on the makai leg of its intersection with Kamehameha Highway.

2.3.2 Bicycle Facilities

Kamehameha Highway

There are no on-street bicycle facilities on Kamehameha Highway between Salt Lake Boulevard and Waihona Street.

Instead, bicycle traffic is directed to the Pearl Harbor Bike Path. The Pearl Harbor Bike Path generally parallels Kamehameha Highway and operates as a shared-use path, accommodating both bicycles and pedestrians. The Pearl Harbor Bike Path begins just 'Ewa of Aloha Stadium and is currently continuous from there to Waipahū Depot Street. The Pearl Harbor Bike Path is mostly located on the historic OR&L Railroad right-of-way.

The Hawai'i Bicycling League collected bi-directional bicycle volumes along the Pearl Harbor Bike Path at Neal S. Blaisdell Park in Pearl City in the Years 2016 and 2017. The league collected data over the span of three days in each of those years for two hours during the morning and afternoon weekday peak periods. The bicycle volumes at this location are shown in Table 1.

Lehua Avenue

There is an existing bicycle route between Kamehameha Highway and 3rd Street, which then transitions into buffered bicycle lanes from 3rd Street to the Pearl Harbor Bike Path.

Waipi'o Point Access Road

There is a shared-use path that begins makai of the Pearl Harbor Bike Path and continues until a point just makai of the driveway entrance to the Ted Makalena Golf Course.

Other Mauka-Makai Roads

Other mauka-makai roads are relatively low-volume roadways that are configured for bicycles to share the road with auto vehicles.

Table 1 Hawaii Bicycling League Bike Volumes on Pearl Harbor Bike Path

Year	Day 1		Day 2		Day 3	
	AM	PM	AM	PM	AM	PM
2016	26	54	21	40	21	42
2017	29	60	24	5	22	41

Notes: AM and PM counts were recorded over a 2-hour period:
 AM 7-9 AM, PM 4-6 PM. Volumes are bi-directional.

2016 counts taken on September 13, 14, and 15
 2017 counts taken on November 14, 15, and 16

Source: Hawaii Bicycling League

2.3 Transit Conditions

2.3.1 Bus Routes Influenced by Construction Zones

Kamehameha Highway would be affected during the construction of proposed East Interceptor and Waiawa Area conveyance options. Kamehameha Highway is utilized by several line-haul City bus routes. These include:

- Route A - City Express! - Waipahū – University of Hawai‘i;
- Route 11 - Alapa‘i Transit Center - Makalapa, Hālawa, ‘Aiea Heights;
- Route 20 - Waikīkī – Airport, Pearlridge;
- Route 40 - Honolulu – Mākaha;
- Route 42 – Waikīkī - ‘Ewa Beach;
- Route 51 - Honolulu – Wahiawa;
- Route 53 - Honolulu – Pacific Palisades.

Route A - City Express! University of Hawai‘i - Waipahū buses provide limited-stop transit service between the University of Hawai‘i at Mānoa and Waipahū. In the areas related to the Honouliuli Fac Plan, this route travels through Hālawa (Aloha Stadium), ‘Aiea (Pearlridge Center), Pearl City on Kamehameha Highway and through Waipahū along Farrington Highway to Kunia Road.

Route 11 - Alapa‘i Transit Center – Makalapa, Hālawa, ‘Aiea Heights provides service between downtown Honolulu and ‘Aiea. Its route only interacts with the Proposed Action

corridor for a short segment of Kamehameha Highway between Pali Momi Street and Kaonohi Street adjacent to Pearlridge Center.

Route 20 - Waikīkī – Pearlridge provides service between Waikīkī and Daniel K. Inouye International Airport with continuing service to Pearlridge Center. After the airport, it travels along Kamehameha Highway entering the Proposed Action corridor in Hālawā (Aloha Stadium) and continuing to Kaonohi Street adjacent to Pearlridge Center.

Route 40 - Honolulu – Mākaha provides local trunk service between Ala Moana Center and Mākaha. It passes through the Proposed Action corridor on Kamehameha Highway and on Farrington Highway.

Route 42 - Waikīkī - 'Ewa Beach provides local trunk service between Waikīkī and 'Ewa Beach. It passes through the Proposed Action corridor on Kamehameha Highway and Farrington Highway.

Route 51 - Honolulu – Wahiawa provides local trunk service between Ala Moana Center and Wahiawa. It travels through the Proposed Action corridor on Kamehameha Highway and a short segment of Farrington Highway before heading north to Wahiawa.

Route 53 - Honolulu – Pacific Palisades provides local trunk service between Ala Moana Center and Pacific Palisades. It travels through the Proposed Action corridor on Kamehameha Highway before turning mauka on Waimano Home Road in Pearl City.

Several circulator City bus routes also utilize segments of Kamehameha Highway:

- Route 32 - Kalihi – Pearlridge;
- Route 71 - Pearlridge – Newtown;
- Route 73 - Leeward Community College/Pearl City Peninsula;
- Route 74 - 'Aiea – Hālawā Heights.

Route 32 - Kalihi – Pearlridge provides circulator service between the Kalihi Transit Center and Pearlridge Center, serving the Mapunapuna, Salt Lake, and Aliamanu areas along the way. It enters the Proposed Action corridor on Salt Lake Boulevard and then travels along Kamehameha Highway to Kaonohi Street (Pearlridge Center0).

Route 71 - Pearlridge – Newtown provides circulator service between Pearlridge and Newtown communities. It traverses a short segment of the Proposed Action corridor on Kamehameha Highway between Kaonohi Street and Ka'ahumanu Street.

Route 73 - Pearl City Uplands-Leeward Community College/Pearl City Peninsula provides circulator service within the Pearl City between the mauka areas of Pearl City and alternatively Leeward Community College and Pearl City Peninsula. Proposed East Interceptor and Waiawa Area conveyance options would affect portions of Route 73 along Lehua Avenue and the segment of Kamehameha Highway/Farrington Highway between Waimano Home Road and Waiawa Road.

Route 74 - 'Aiea – Hālawā Heights provides circulator service between Hālawā Heights and 'Aiea Heights. The middle of the route traverses Kamehameha Highway between 'Aiea Interchange and Salt Lake Boulevard and Salt Lake Boulevard between Kamehameha Highway and Kahuapa'ani Street. This segment of the route coincides with roadway segments influenced by the proposed East Interceptor conveyance options.

2.3.2 City Bus Stops Located Within Potential Construction Zones

Salt Lake Boulevard

Between the location of the Hālawā WWPS and Kamehameha Highway, there are four bus stops: two in the direction toward Kamehameha Highway (Stop #2572 and Stop #2571) and two in the direction toward Kahuapa'ani Street (Stop #2959 and Stop #2960).

Kamehameha Highway

Between Salt Lake Boulevard and Waihona Street, there are numerous City bus stops:

'Ewa-bound direction

Existing bus stops are #479, #480, #481, #482, #483, #484, #485, #486, #487, #488, #489, #490, #491, and #492.

Koko Head-bound direction

Existing bus stops are #1695, #682, #683, #1419, #1420, #687, #688, #689, #690, #691, #692, #693, #694, and #695.

Lehua Avenue

There are two bus stops in the mauka-bound direction (Stop #2642 and Stop #2643) and two in the makai-bound direction (Stop #2634 and Stop #2635).

2.4 Traffic Conditions

2.4.1 Traffic Volumes

24-hour Traffic Volumes

Kamehameha Highway

The 24-hour traffic volumes on key roadways previously described were researched and/or collected. The 24-hour traffic volumes for the segments of Kamehameha Highway that are in the Proposed Action corridor were obtained from HDOT. The Traffic Station data is from the year 2017. In addition to the 2017 data, historic traffic volumes between the years 2012 and 2016 were also obtained from HDOT. The HDOT Traffic Station

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volumes are provided in Appendix A, which includes the data from years 2012 to 2017. For some years and some segments along Kamehameha Highway, only the total 24-hour volume is available.

Table 2 24-Hour Traffic Volumes along Kamehameha Highway

Segment Description	BMP	EMP	Year					
			2017	2016	2015	2014	2013	2012
Farrington Hwy to Acacia Rd	17.47	17.65	60891	60288	59691	59100	39658	39500
	17.65	18.02	60891	60288	59691	59100	43697	43697
	18.02	18.11	60891	60288	59691	59100	37795	38093
	18.11	18.25	60891	60288	59691	59100	63806	63806
Acacia Rd to Waimano Home Rd	18.25	18.54	61500	60891	60282	59455	59100	47900
Waimano Home Rd to Ka'ahumanu St	18.54	19.66	37670	37297	36924	36417	36200	33600
Ka'ahumanu St to Kaonohi St	19.66	20.25	44878	44434	43981	43212	42871	42700
Kalauao Stream Bridge - Kaonohi St to Off Ramp to Moanalua Freeway	20.25	21.03	38200	52339	51816	49300	53300	52300
Off-Ramp to Moanalua Freeway to Salt Lake Blvd	21.03	21.17	31500	31419	31108	30800	57000	41200
	21.17	21.44	31500	31419	31108	30800	51000	39054
	21.44	21.47	31500	31419	31108	30800	38749	39054
	21.47	21.51	31500	31419	31108	30800	50300	36389
	21.51	21.54	31500	31419	31108	30800	32400	35400
Notes: BMP = Begin Mile Post; EMP = Ending Milepost Source: State of Hawaii Office of Planning-Highway Performance Monitoring System								

As shown in Table 2, the 24-hour vehicular volume along Kamehameha Highway shows the impacts of the HART rail construction. These are evidenced by lower 24-hour volumes toward the Farrington Highway-Acacia Road counts in the 2012 to 2013 time frame, shifting to the Kalauao Stream Bridge area counts toward the 2017 time frame as the rail construction progresses in the Koko Head direction.

Figure 3 is a graph of the year 2013 traffic volumes on Kamehameha Highway at the Kalauao Stream Bridge (near Pearlridge Center). The graph depicts the traffic volumes as they vary over a 24-hour period. This location is typical of traffic on the segment of Kamehameha Highway that would interact with East Interceptor conveyance option projects and uses the year 2013 traffic volume which is more typical than the recent year 2017 traffic volumes that are influenced by rail construction. The double peak in the

'Ewa-bound direction during the afternoon peak period is the result of the Pearl Harbor shipyard ending its work shift earlier than the general commuter peak.

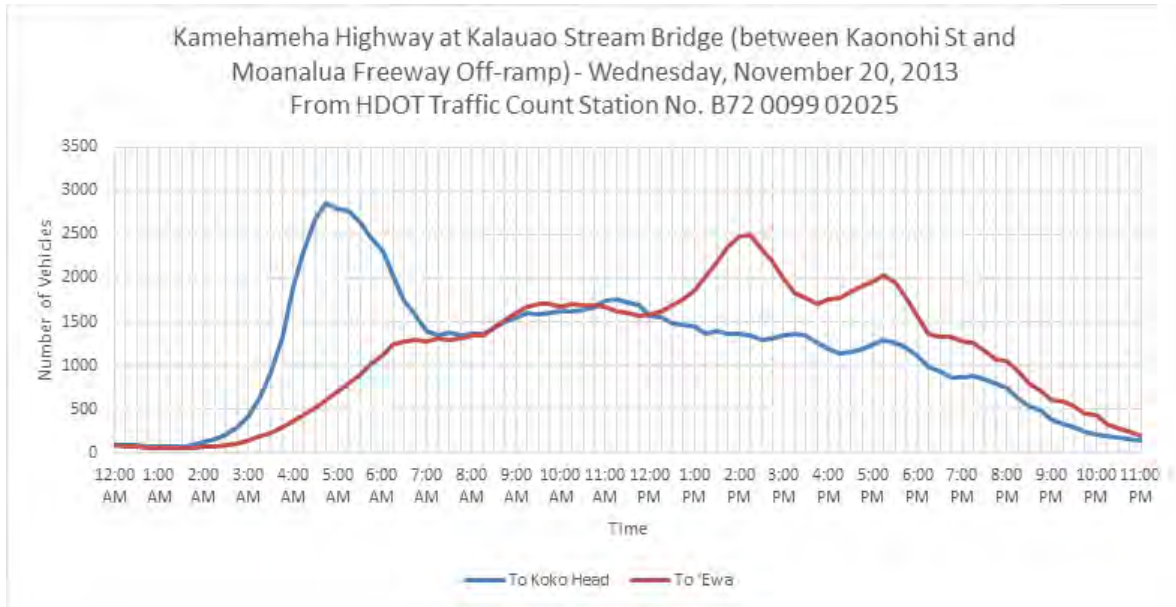


Figure 3 Kamehameha Hwy Traffic Volume at Kalauao Stream Bridge

Other Roadways

Automatic traffic recorder (ATR) traffic volume counts were conducted by AECOM to supplement the traffic volume data obtained from HDOT. These counts were primarily on the mauka-makai streets that intersect Kamehameha Highway and could potentially interact with the Proposed Action projects.

These ATR traffic volumes counts were conducted on Lehua Avenue, Waihona Street, Waipi'o Point Access Road, and Waipahū Depot Street.

The Lehua Avenue counts were conducted from Monday, June 17, 2019 to Wednesday, June 19, 2019. Traffic volumes along Waihona Street and Waipi'o Point Access Road were collected from Wednesday, June 19, 2019 to Friday, June 21, 2019. The traffic volumes on Waipahū Depot Street were collected from Wednesday, June 12, 2019 to Friday, June 14, 2019. Data summaries from these 24-hour counts are provided in Appendix B.

The 24-hour volume data from the ATR counts are also shown on the following figures below. These figures show a total hourly volume over the course of the 24-hour period. It illustrates when the morning and afternoon peak hours occur along each roadway. It also depicts the approximate traffic volumes during the off-peak periods.

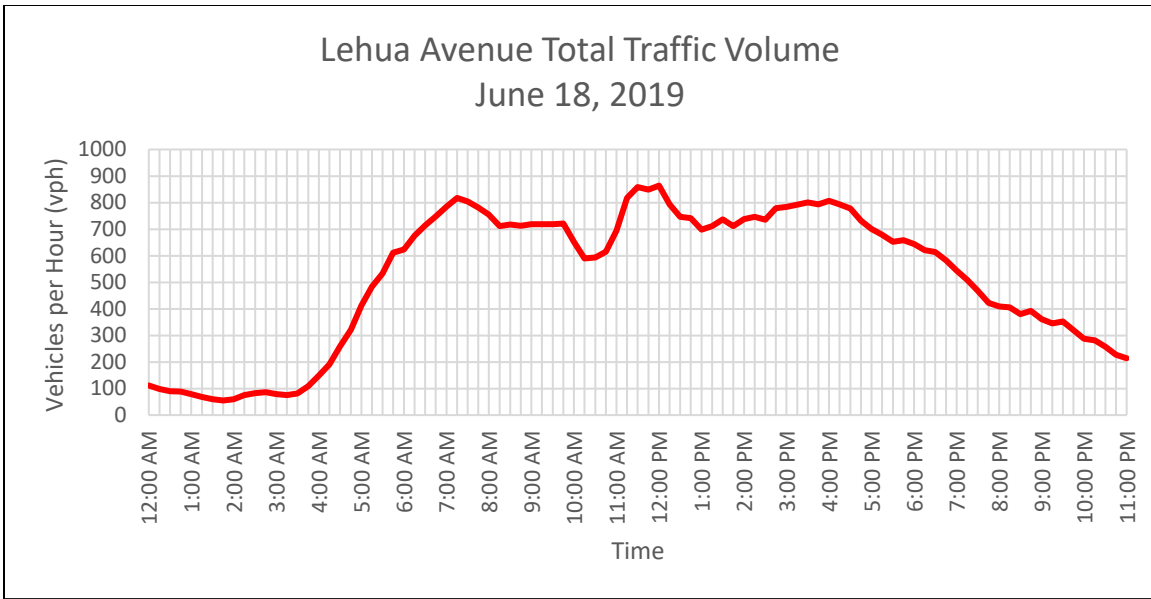


Figure 4 24-Hour Volume Along Lehua Avenue

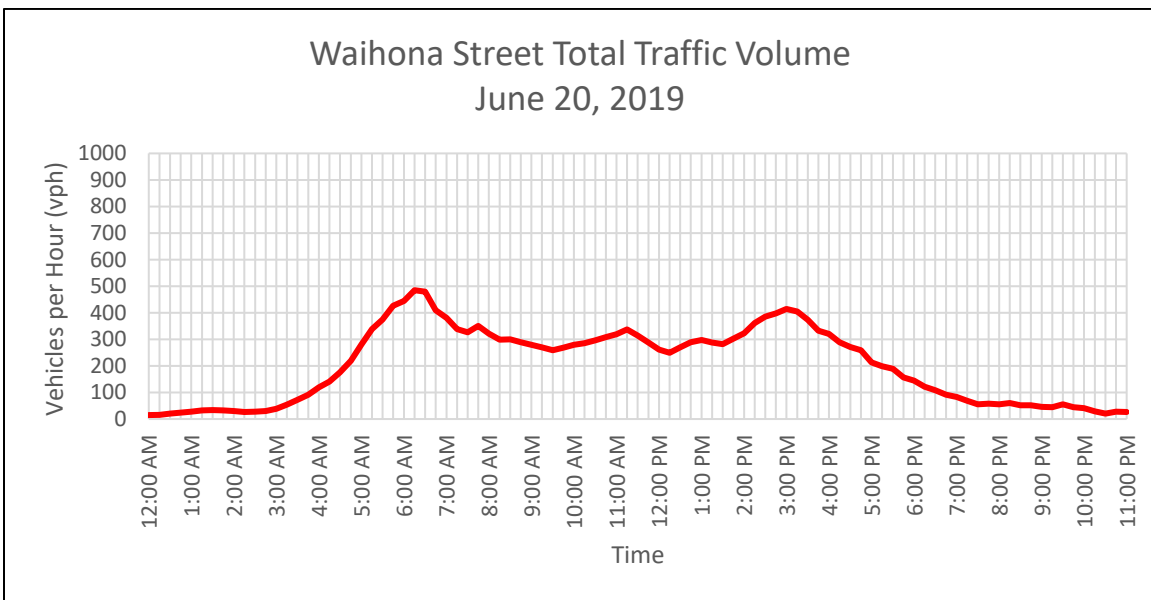


Figure 5 24-Hour Volume Along Waihona Street

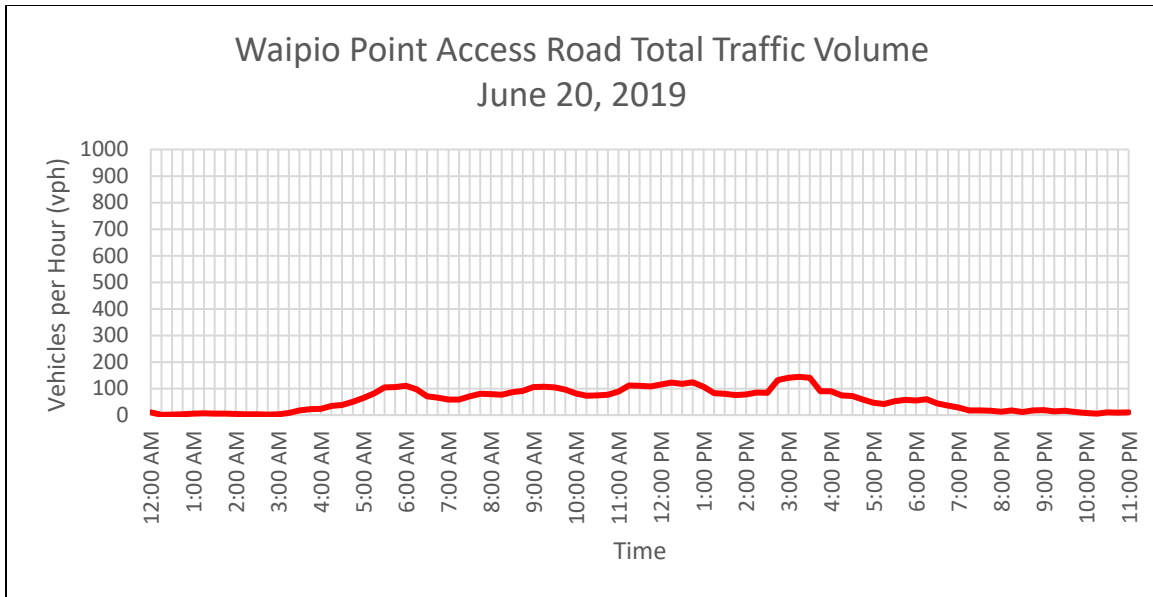


Figure 6 24-Hour Volume Along Waipi'o Point Access Road

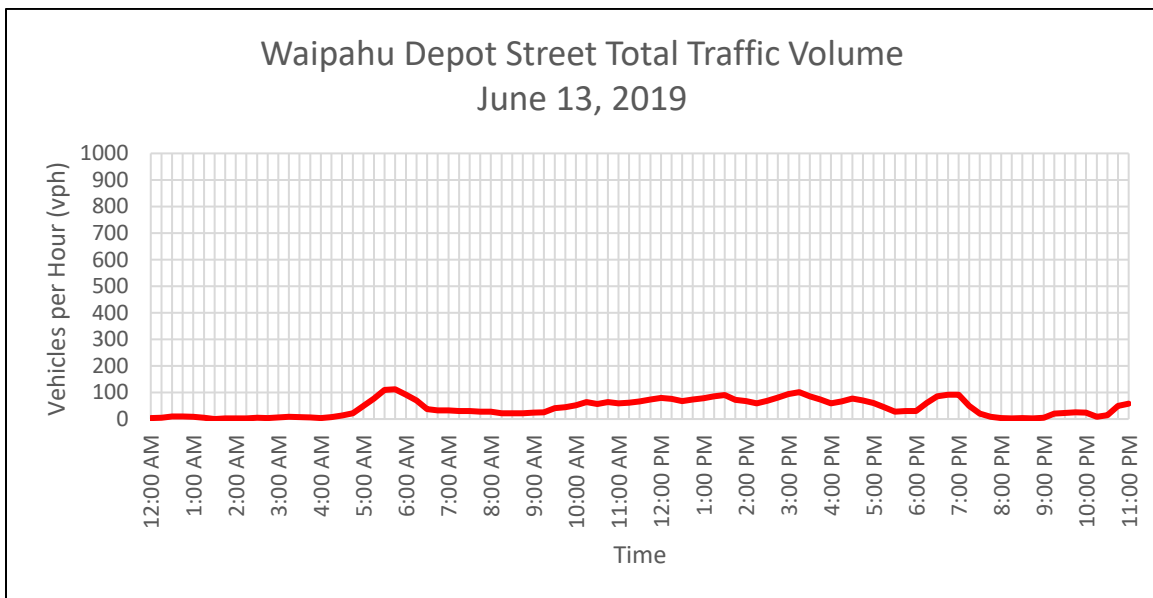


Figure 7 24-Hour Volume Along Waipahū Depot Street

Peak Period Intersection Turning Movement Volume Counts

There were two locations where intersection operations would potentially be helpful in identifying the need for potential alternative construction approaches:

- Kamehameha Highway/Waihona Street
- Kamehameha Highway/Salt Lake Boulevard

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At the Kamehameha Highway and Waihona Street intersection, turning movement counts were conducted between 6:00 AM to 8:00 AM (morning peak period) and 3:00 PM to 5:30 PM (afternoon peak period) on June 12, 2019.

At the Kamehameha Highway and Salt Lake Boulevard intersection, turning movement counts were conducted between 6:00 AM and 8:00 AM (morning peak period) and 3:15 PM and 5:30 PM (afternoon peak period) on June 13, 2019.

The vehicular count summary sheets for the Waihona Street and Salt Lake Boulevard intersections are provided in Appendix C.

Based on the counts at the Waihona Street intersection, the AM peak hour was found to occur from 6:30 AM to 7:30 AM and the PM peak hour was found to occur from 3:30 PM to 4:30 PM. At the Salt Lake Boulevard intersection, the AM peak hour was found to occur from 6:00 AM to 7:00 AM and the PM peak hour was found to occur from 4:00 PM to 5:00 PM. Figure 8 and Figure 9 illustrate the observed vehicular volumes at the two intersections during the peak hour periods.



Figure 8 Existing Year 2019 Weekday Commuter AM and PM Peak Hour Traffic Volumes at the Kamehameha Highway/Waihona Street Intersection

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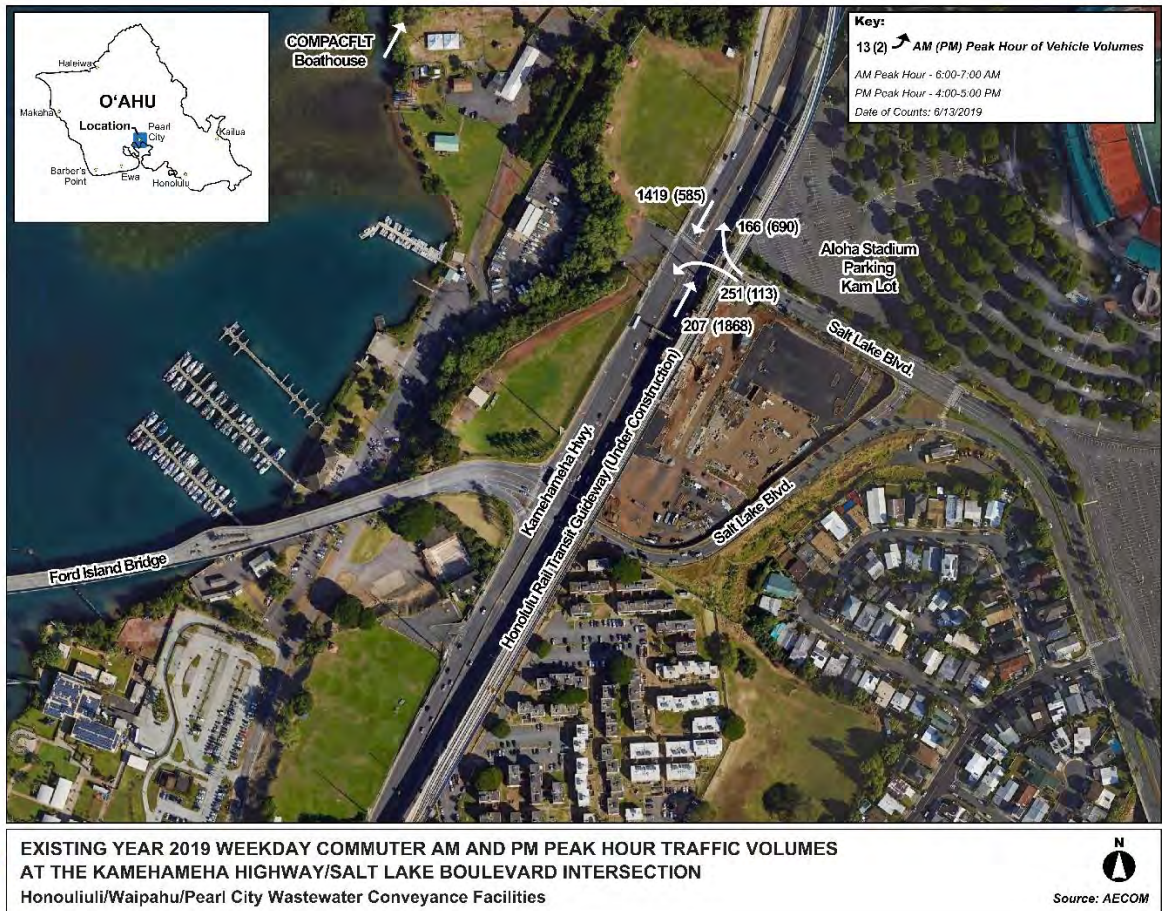


Figure 9 Existing Year 2019 Weekday Commuter AM and PM Peak Hour Traffic Volumes at the Kamehameha Highway/Salt Lake Boulevard Intersection

2.4.2 Existing Traffic Operations

Kamehameha Highway

Segment level of service (LOS) was used to characterize the overall level of congestion on Kamehameha Highway in the corridor that would interact with the proposed East Interceptor and Waiawa Area conveyance options. The LOS used for segments is a planning level index based on volume/capacity ratio and indicates which segments would be most sensitive to construction disruption by the Honouliuli Fac Plan projects.

The segment LOS was based on a composite of traffic volumes between years 2012 and 2017 to minimize the effects of the HART rail construction of the traffic volumes.

As shown in Figure 10, the most constrained segments are located in the 'Ewa end of the corridor near Acacia Road and toward the Koko Head end of the corridor in the vicinity of the Kalauao Stream Bridge (Pearlridge Center).

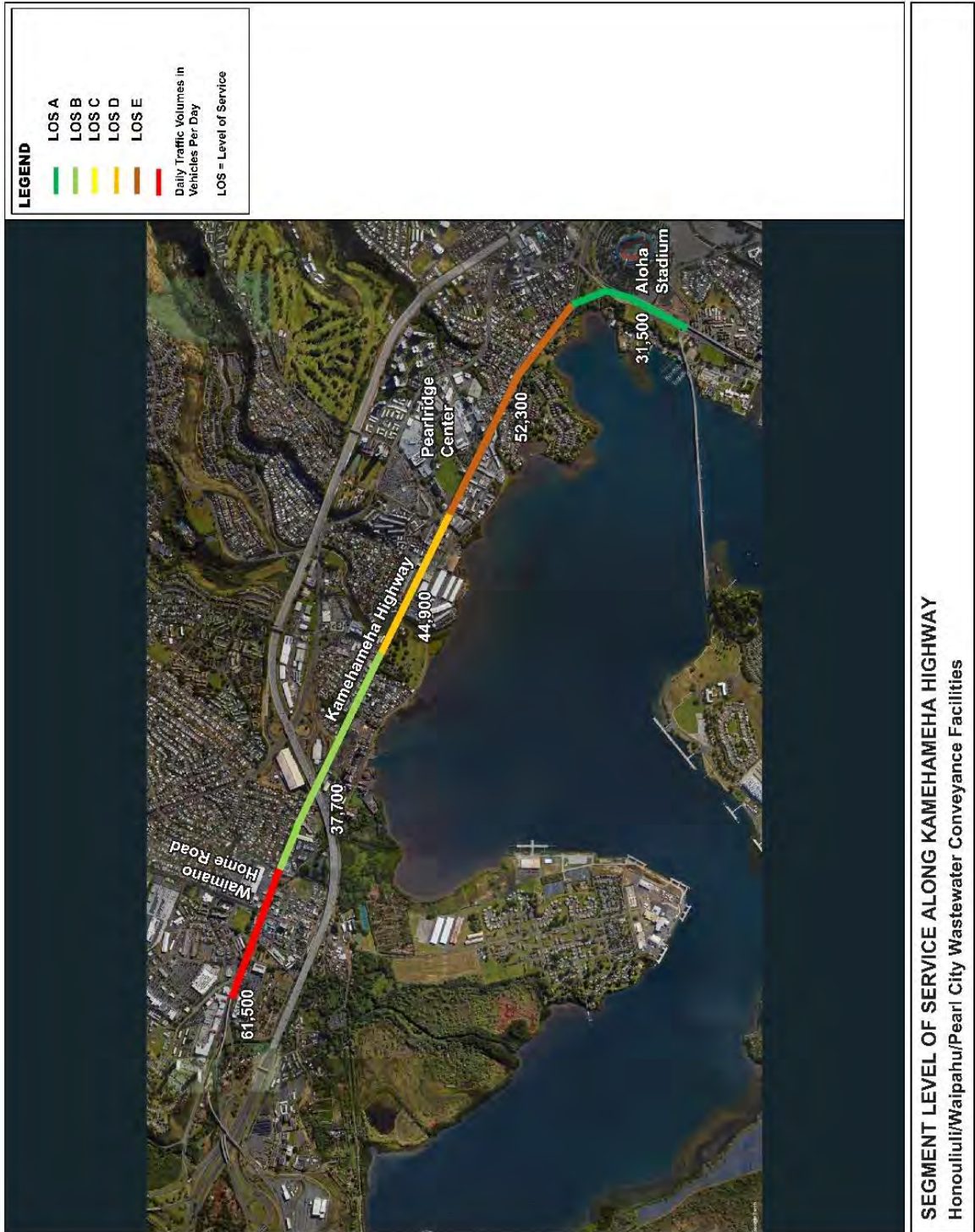


Figure 10 Existing Kamehameha Highway Segment LOS

Waihona and Salt Lake Boulevard Intersections

Table 3 summarizes the weekday AM and PM commuter peak hour operations at the intersections of Kamehameha Highway and Waihona Street and Kamehameha Highway and Salt Lake Boulevard.

The intersections were analyzed using the signalized (Salt Lake Boulevard) and unsignalized (Waihona Street) intersection capacity methods described in the 2010 Highway Capacity Manual (HCM) through the Synchro/Sim Traffic Software. Using these methods, the overall intersection delay and level of service (LOS) for the signalized intersection and the individual delay and LOS for the turning movements from Salt Lake Boulevard onto Kamehameha Highway were calculated.

LOS is an indicator of quality of service which is based on performance measures such as intersection delay. LOS A indicates relatively little delay while LOS F indicates significant vehicle delay, often resulting in vehicle queuing.

Table 3 Existing Weekday Peak Hour Intersection Operations

Intersection	AM Peak Hour		PM Peak Hour	
	Delay (sec/veh)	LOS	Delay (sec/veh)	LOS
Kamehameha Highway/Salt Lake Boulevard	12.3	B	32.8	C
Kamehameha Highway/Waihona Street*	20.1/11.4	C/B	742.1/43.3	F/E

Notes: Based on counts conducted on Wednesday, 6/12/19, and Thursday, 6/13/19
 AM Peak Hours: 6:00-7:00 AM (Salt Lake Boulevard), 6:30-7:30 AM (Waihona Street)
 PM Peak Hours: 4:00-5:00 PM (Salt Lake Boulevard), 3:30-4:30 PM (Waihona Street)

*Unsignalized level of service (LOS) is expressed for each key traffic movement:
 Left turn out of Waihona Street/Right turn out of Waihona Street

sec/veh = seconds per vehicle, LOS = Level of Service

As shown in Table 3, the Kamehameha Highway and Salt Lake Boulevard (‘Ewa-bound leg) intersection operates with LOS C or better during both peak hour periods. LOS C represents good quality of service for urban peak hour conditions.

The Kamehameha Highway and Waihona Street intersection operate well during the morning peak hour, with the turning movements from Waihona Street operating at a LOS

C or better, indicating minimal delay to vehicles turning out of Waihona Street onto Kamehameha Highway.

During the afternoon peak period, turning movements out of Waihona Street onto Kamehameha Highway currently operate at a LOS F and E, indicating significant delay. Field observations, however, do not corroborate the magnitude of delay indicated by the analysis algorithms. It could be possible that traffic signalization upstream of the Waihona intersection on Kamehameha Highway could be platooning traffic flow on Kamehameha Highway in a manner that provides periods where sufficient gaps in traffic flow allow vehicles exiting Waihona Street to do so without significant delay. Even so, the calculated LOS indicates that this intersection could be vulnerable to disruption by construction lane closures.

3.0 FUTURE CONDITIONS

The program of proposed improvements included in the Proposed Action would be implemented over time. As such, the existing conditions documented in the previous section of this report could change over the course of project implementation. This section of the report identifies the changes likely to occur within the areas that would interact with the proposed East Interceptor and Waiawa Area conveyance options.

3.1 Roadway Conditions

The roadway segments of Kamehameha Highway, Lehua Avenue, Waihona Street, Waipi'o Point Access Road, and Waipahū Depot Street potentially affected by construction of the proposed East Interceptor or Waiawa Area conveyance options are not expected to have significant changes to their existing roadway configurations.

Salt Lake Boulevard and its intersections with Kamehameha Highway has the potential to change significantly depending on future redevelopment plans for the Aloha Stadium property.

In the vicinity of the Kamehameha Highway and Waihona Street intersection, HART will construct the Waiawa Station which includes a parking garage and bus transit center. This could affect the configuration of Kamehameha Highway and the intersection at Waihona Street when this occurs.

3.2 Pedestrian and Bicycle Conditions

3.2.1 Pedestrian Facilities

Pedestrian facilities, such as sidewalks and crosswalks along most of the roadway facilities potentially affected by construction of the proposed East Interceptor and Waiawa Area conveyance options, are not expected to change significantly.

An exception would be the area near Aloha Stadium where redevelopment could result in significant changes depending on the configuration of plans for Aloha Stadium lands. Another area that could be significantly different in the future is the area near the future HART Waiawa Station near Waihona Street.

3.2.2 Bicycle Facilities

The [2019 Draft O'ahu Bike Plan Update](#) (Draft Bike Plan) prepared by CCH Department of Transportation Services proposes bicycle facility improvements within areas potentially affected by the proposed East Interceptor or Waiawa Area conveyance

options. The key existing bicycle facility in the area, the Pearl Harbor Bike Path, is planned to be extended 'Ewa of Waipahū Depot Street as the Leeward Bike Path. Another project identified in the Draft Bike Plan proposes the addition of bike lanes along Kamehameha Highway through the 'Aiea and Pearl City areas including the segment that includes the Waihona Street intersection. The Draft Bike Plan also includes a project that would extend the existing shared-use path on Waipi'o Point Access Road from the Pearl Harbor Bike Path mauka to Farrington Highway and makai from its current terminus at the Ted Makalena Golf Course driveway through the Waipi'o Soccer Complex to Waipahū Depot Street as the Waipi'o Park Path.

3.3 Transit Facilities

HART has projected full revenue operation of the rail system by Year 2025 and desired interim operation from East Kapolei to Aloha Stadium by Year 2020. Even the interim plan includes the segments of Kamehameha Highway that could experience construction impacts associated with the proposed East Interceptor and Waiawa Area conveyance options.

The rail transit guideway is located primarily in the median of Kamehameha Highway. The Hālawā (Aloha Stadium), Kalauao (Pearlridge), and Waiawa (Pearl Highlands) stations, are being constructed along Kamehameha Highway and will include TheBus and HandiVan service interfaces. The Hālawā and Waiawa stations will also include new bus transit centers. Existing bus stops along Kamehameha Highway and within the surrounding areas are also assumed to remain. Existing bus routes are planned to be modified to work cooperatively with rail service.

3.4 Traffic Conditions

A preliminary construction schedule was generated for the East Interceptor conveyance options in the EIS that approximate the construction timeframe for all the related projects to occur between the Year 2022 and 2040. The preliminary construction schedule for the Waiawa Area conveyance options is dependent on the planned development in the Waiawa area, the Transit-Oriented Development (TOD) around the HART Waiawa rail station, and the completion of the some of the downstream East Interceptor system improvements due to the increased wastewater flow.

The schedules for the proposed East Interceptor and Waiawa Area conveyance options are dependent on the pace of development within the Honouliuli sewer basin and the programming of funds. As such, there is not a definitive schedule for the implementation of the proposed conveyance projects.

Therefore, future traffic conditions were not projected for specific future time frames. Instead, the issues associated with potential future traffic conditions are identified. If development such as the proposed redevelopment of Aloha Stadium and the construction of the HART Waiawa Station dramatically affect the traffic conditions in their respective areas, analyses would be conducted to determine if the changes warrant other project-specific actions such as a supplemental EIS or specific studies.

3.4.1 Future Background Traffic Volumes

The East Interceptor and Waiawa Area conveyance options are shown in Figure 11. As shown, Kamehameha Highway between Salt Lake Boulevard and the H1 Freeway crossing in Waimalu and Kamehameha Highway between Waimano Home Road/Lehua Avenue and Waihona Street are two segments that have the potential for construction impacts. Mauka-makai-oriented roadways such McGrew Loop, Lehua Avenue, Waihona Street, Waipi'o Point Access Road, and Waipahū Depot Street also could experience construction impacts from proposed East Interceptor and Waiawa Area conveyance options.

As discussed in the previous chapter of this report, historic traffic volumes along Kamehameha Highway have been variable over the past seven years, mostly due to the effects of the HART rail construction. Generally, the base pattern in the magnitude of traffic volumes has been one of a stable level of traffic. This makes sense given that key segments of Kamehameha Highway are nearing or at capacity during peak periods of the day as illustrated in Figure 10. Once the HART rail construction is complete, there are no current plans to expand this part of Kamehameha Highway. Therefore, based on this historical traffic data, it is judged that future growth of traffic on Kamehameha Highway would be flat with relatively little growth in traffic.

In areas of redevelopment, such as Aloha Stadium and the HART Waiawa Rail Station, traffic volumes could change significantly from existing levels. This change would be dependent on the nature of the development implemented and would be identified and assessed through project-specific studies conducted in advance of the redevelopment.

3.5.2 Project-Generated Traffic Volumes

Once the selected East Interceptor and Waiawa Area conveyance options are implemented, almost negligible traffic would be generated by the proposed projects. The conveyance facilities would be underground and have no interaction with the transportation system. The pump stations would typically generate only occasional minimal vehicular traffic.

The primary traffic volumes generated by the proposed projects would occur during their construction. These would potentially be due to general construction vehicles and trucks designated to carry tunnel spoils (muck) from the construction sites to designated disposal areas. The number of construction vehicles and trucks needed would vary depending on the individual projects and type of work involved.

There are several permutations of the East Interceptor and Waiawa Area conveyance options that could constitute the ultimate selected action. The construction traffic generated by each permutation could vary significantly based on the options chosen. Therefore, it is recommended that specific analyses be conducted after the preferred options are chosen to identify the construction traffic volumes generated by the component projects.

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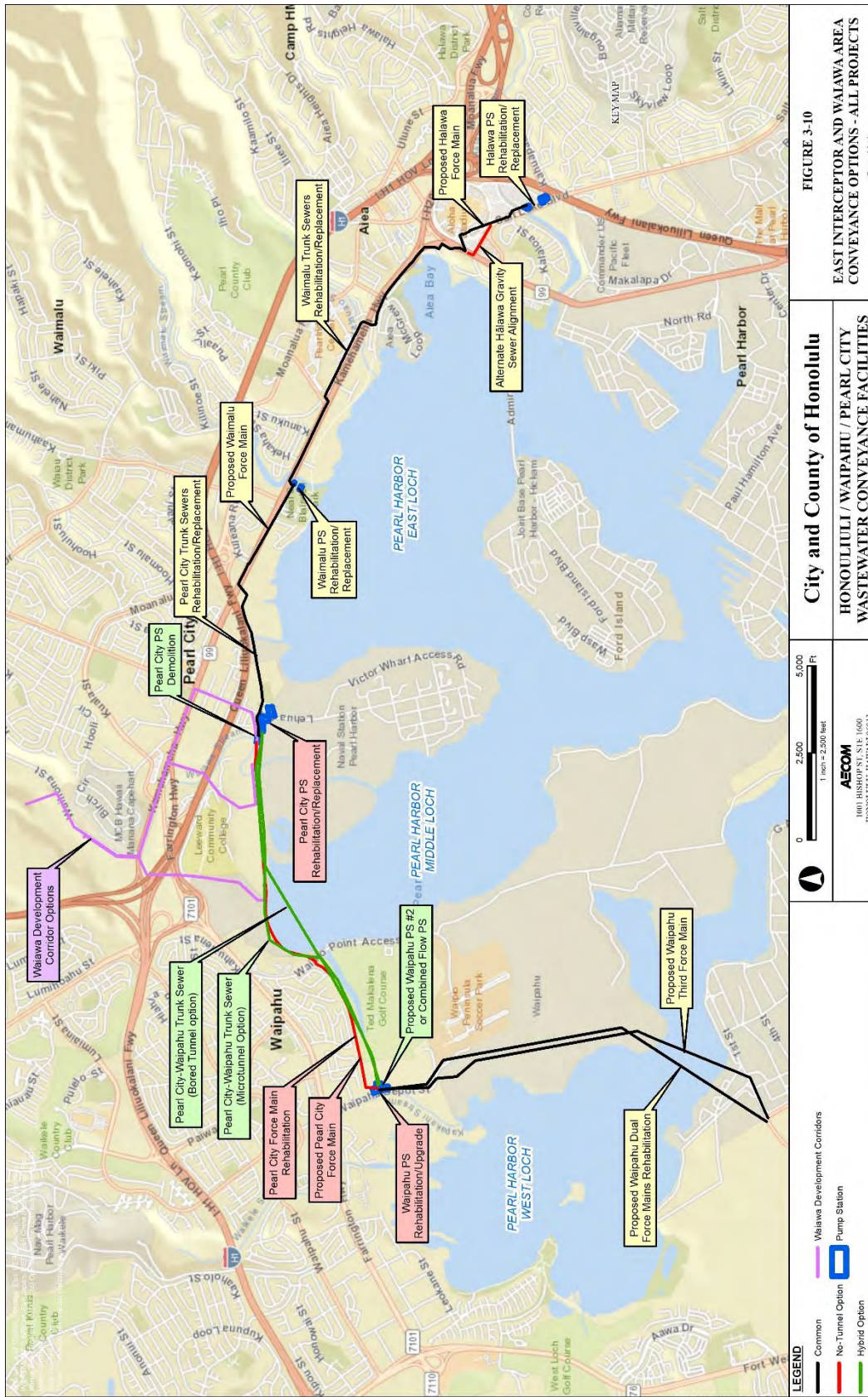


Figure 11: East Interceptor and Waiawa Area Conveyance Options – All Projects

4.0 PROPOSED ACTION AND OPTIONS

There are two major components of the Proposed Action:

- East Interceptor conveyance options;
- Waiawa Area conveyance options.

Each major component is comprised of multiple alternatives within different segments of the proposed projects. This leads to various potential permutations of the Proposed Action.

4.1 East Interceptor Conveyance Options

Options to rehabilitate, replace, and/or expand the existing East Interceptor System are grouped into two sets of projects for the purpose of this transportation assessment. The two sets of projects include:

- East Interceptor – Aloha Stadium to Pearl City Peninsula/Waipi'o Peninsula to 'Ewa;
- East Interceptor – Pearl City Peninsula to Waipi'o Peninsula.

4.1.1 East Interceptor – Aloha Stadium to Pearl City Peninsula/ Waipi'o Peninsula to 'Ewa

These segments of the proposed East Interceptor conveyance improvements include the following projects:

- Existing Hālawā WWPS – Rehabilitate or Replace.
- Proposed Hālawā Force Main;
- Waimalu Trunk Sewers – Rehabilitation/Replacement
- Existing Waimalu WWPS – Rehabilitate or Replace;
- Proposed Waimalu Force Main;
- Pearl City Trunk Sewers – Rehabilitation/Replacement;
- Proposed Third Waipahū Force Main;
- Existing Waipahū Dual Force Main Rehabilitation.

These projects are required updates to the East Interceptor System. There are options in terms of rehabilitation versus replacement for existing sewers and force mains. For both proposed new facilities and replacement of existing facilities, the method of construction is likely open-trench construction although microtunneling is an option if conditions warrant it. Figure 12 displays these East Interceptor projects.

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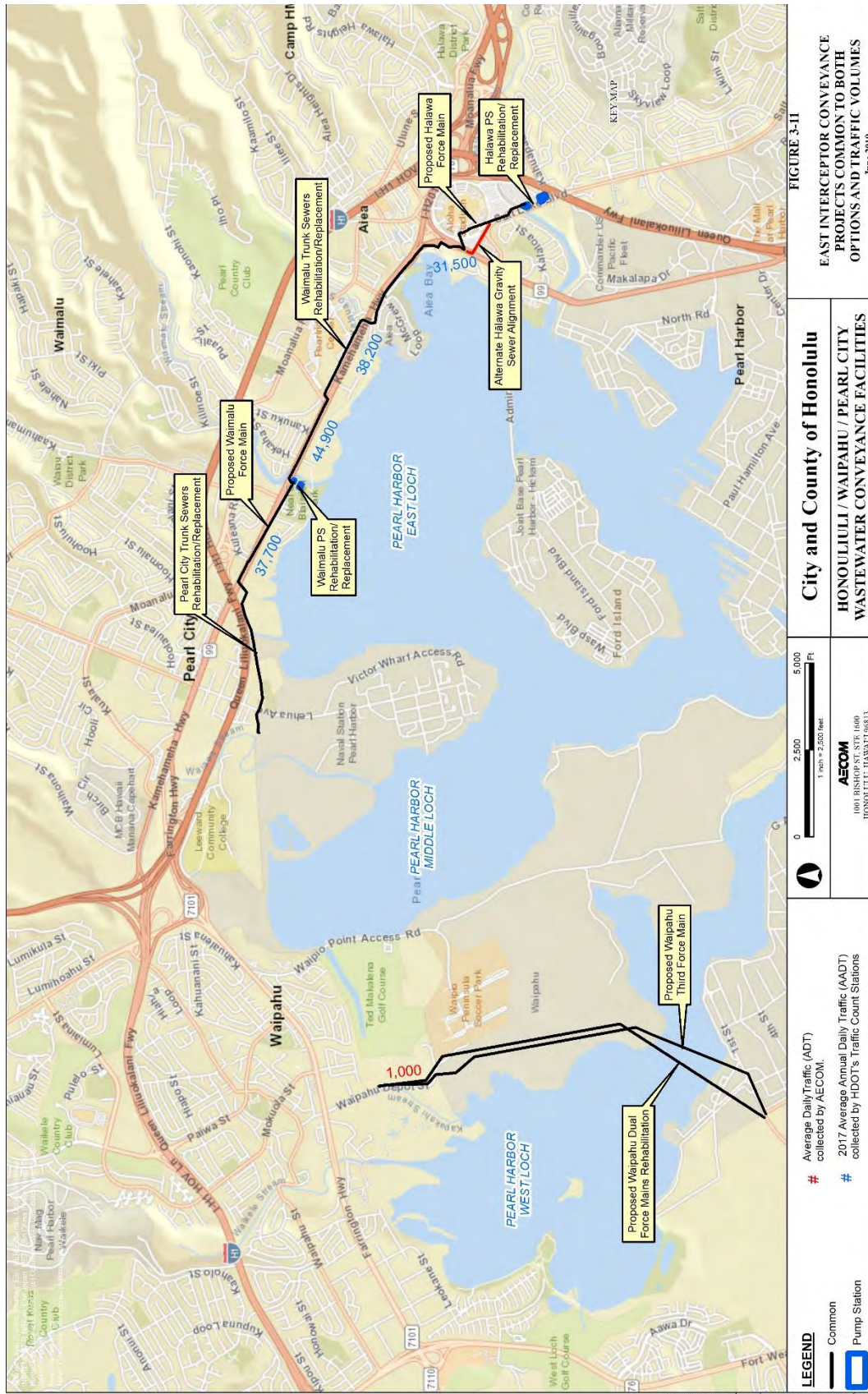


Figure 12 East Interceptor Conveyance Projects Common to Both Options and Traffic Volumes

4.1.1.1 Construction Transportation Impacts

Roadway Impacts

The projects illustrated in Figure 12 would affect Kamehameha Highway, Salt Lake Boulevard, Lehua Avenue, and Waipahū Depot Street. The likely construction method for these projects would be open trench installations.

The traffic volumes illustrated on Figure 12 show Kamehameha Highway with average vehicular volume exceeding 30,000 vehicles along segments affected by of the proposed East Interceptor conveyance options. In addition to being within or adjacent to Kamehameha Highway, the proposed options cross Kamehameha Highway at several points along its alignment. Given the level of traffic volumes and the probable need to close through traffic lanes on Kamehameha Highway, proposed East Interceptor projects would negatively impact traffic flow during construction.

Work on these projects would also impact traffic accessing the surrounding area. There are several shopping centers and other businesses along the alignments of the proposed East Interceptor conveyance options.

Traffic volumes are significantly less on Salt Lake Boulevard, Lehua Avenue, and Waipahū Depot Street, but traffic on these streets would experience delays as well.

The proposed Hālawa WWPS Force Main project would interact with Salt Lake Boulevard before entering the Aloha Stadium parking lot. In the existing Aloha Stadium configuration, the construction of the Hālawa Force Main could impact traffic on Salt Lake Boulevard and the parking for Aloha Stadium. There is also an alternate alignment consisting of a new gravity sewer that would continue along Salt Lake Boulevard and not enter the existing Aloha Stadium parking lot. Relocation of the Halawa WWPS FM would be done in coordination with the proposed redevelopment of the Aloha Stadium.

The Pearl City Trunk Sewers cross Lehua Avenue in the vicinity of the Pearl Harbor Bike Path. This crossing is near Lehua Elementary School and the Lehua Community Park. Lehua Avenue also provides the only access to the Pearl City Peninsula community. The construction method used for the crossing of Lehua Avenue would affect the traffic impacts of Lehua Avenue.

The Waipahū WWPS Force Main and Force Mains Rehabilitation projects are partially located along Waipahū Depot Street. The 24-hour average volume is approximately 1,000 vehicles as seen on Figure 12 while the hourly volume is displayed in Figure 4. Waipahū Depot Street is a low-volume roadway as the peak vehicular volumes are around 100 vehicles per hour (vph). Lane closures associated with the proposed projects should not have a large impact on traffic flow, but access needs to be maintained to the Honolulu Police Training Academy located makai of the Pearl Harbor Bike Path crossing.

Pedestrian and Bicycle Impacts

Construction of the proposed East Interceptor projects along Kamehameha Highway could impact pedestrian facilities such as sidewalks and crosswalks along the segment between Aloha Stadium and Waimalu in the vicinity of the H1 Freeway overpass. If future bike lane improvements on Kamehameha Highway proposed in the 2019 Draft O'ahu Bike Plan Update are implemented, coordination is needed to avoid significant disruption of the bike lanes.

Salt Lake Boulevard, Lehua Avenue, and Waipahū Depot Street could experience lesser impacts to pedestrian facilities as there are currently only sporadic pedestrian facilities provided.

Segments of the existing Waimalu and Pearl City Trunk Sewers align with or are adjacent to the Pearl Harbor Bike Path. This occurs at McGrew Loop, 'Aiea Kai Place, and between Waimalu and the Pearl City WWPS located 'Ewa of Lehua Avenue. Construction activity at these locations could impact the multi-use Pearl Harbor Bike Path. The severity of the impact would depend on the construction method used to implement the proposed Trunk Sewer improvements.

Transit Impacts

Table 4 identifies the existing City bus routes potentially affected by the proposed East Interceptor conveyance options. Most of the existing City bus routes identified would be affected by potential traffic congestion caused by lane closures on Kamehameha Highway to accommodate construction of new sewer mains or rehabilitation of existing sewer mains.

By year 2025, the HART rail system will begin full revenue service. The rail system travels through the Hālawā, 'Aiea, and Pearl City area on an elevated guideway with supports located in the median of Kamehameha Highway. Along the Aloha Stadium to Pearl City Peninsula segment there will be the Hālawā (Aloha Stadium) and Kalauao (Pearlridge) stations. It is assumed that the City bus routes will be modified to coordinate bus service with rail service. Although these modified City bus routes would likely be different from the existing bus routes shown in Table 4, the issues would be similar.

Proposed sewer main construction and rehabilitation along Kamehameha Highway associated with the rail system would likely require lane closures that would result in traffic congestion which would, in turn, affect both existing and future City bus routes along Kamehameha Highway.

Construction associated with the proposed projects could also affect bus stops on Kamehameha Highway and multimodal access to the HART rail stations. For the proposed East Interceptor Conveyance options, the HART rail station involved would be the Hālawā (Aloha Stadium) and the Kalauao (Pearlridge) stations.

Table 4 Existing City Bus Routes Affected-East Interceptor Conveyance Options

Option	Affected Existing City Bus Routes
East Interceptor Conveyance Options	A, 11, 20, 32, 40, 42, 51, 53*, 71**, 73, 74**
<p>Notes: * = Route impacted based on its weekday route ** = Peak Hour Routes</p>	

4.1.1.2 Operational Transportation Impacts

The operations for the East Interceptor conveyance options should not have major impacts on the existing traffic. Once the sewer pipes and WWPSs are implemented, there would be minimal vehicular traffic related to the projects. There may be some emergency repair and maintenance work that may impact the traffic conditions, but it would not be a regular activity.

4.1.2 East Interceptor – Pearl City Peninsula to Waipi’o Peninsula.

This segment of the proposed East Interceptor conveyance options includes a No-Tunnel option and a Hybrid option. The primary difference between the two options is the implementation of a Gravity Sewer Tunnel (GST) instead of force mains between the Pearl City and Waipahū WWPSs. The No-Tunnel option involves the expansion and rehabilitation/replacement of the existing force mains while the Hybrid option uses a GST.

Figure 13 shows the alignment for the No-Tunnel option. The No-Tunnel option maintains the existing Pearl City Force Main alignment between the Pearl City and Waipahū WWPSs, along the Pearl Harbor Bike Path. The likely construction method would be open-trench.

The projects related to the No-Tunnel option include:

- Existing Waipahū WWPS – Rehabilitation/Upgrade;
- Proposed Additional Pearl City Force Main;
- Existing Pearl City Force Mains Rehabilitation; and
- Existing Pearl City WWPS – Reconstruct/Replace.

Figure 14 displays the alignment for the Hybrid option. The Hybrid option involves the construction of a gravity sewer tunnel or the construction of a microtunnel gravity sewer line between the existing Pearl City WWPS and the Waipahū WWPS. Much of this option would also closely follow the existing Pearl Harbor Bike Path and involve creating several shaft locations to begin the drilling. The microtunnel alignment follows Pearl Harbor Bike Path while the deep tunnel has a similar alignment, but its center portion cuts through Pearl Harbor Middle Loch, decreasing the amount of the Pearl Harbor Bike Path used.

The projects related to the Hybrid option include the following:

- Pearl City – Waipahū Trunk Gravity Sewer Tunnel (microtunnel and deep tunnel options);
- Proposed Waipahū WWPS No. 2; and
- Existing Pearl City WWPS – Demolition.

4.1.2.1 Construction Transportation Impacts

Roadway Impacts

The No-Tunnel and Hybrid options would have minimal impact on the roadways. Primary roadway impacts would occur where the proposed East Interceptor project crosses Waipi'o Point Access Road and would depend on the construction method used.

Construction-related vehicles associated with the rehabilitation/replacement of the Pearl City and Waipahū WWPS may slightly impact traffic on Lehua Avenue and Waipahū Depot Street. The primary difference in construction traffic impacts between the No-Tunnel and Hybrid options is the additional truck traffic that would be generated by the Hybrid option to transport the tunnel spoils from the shaft sites to the designated disposal areas. The amount of truck traffic generated would vary depending on the configuration of the options. Additional traffic studies conducted when there is a better understanding of the configurations would provide more specific information.

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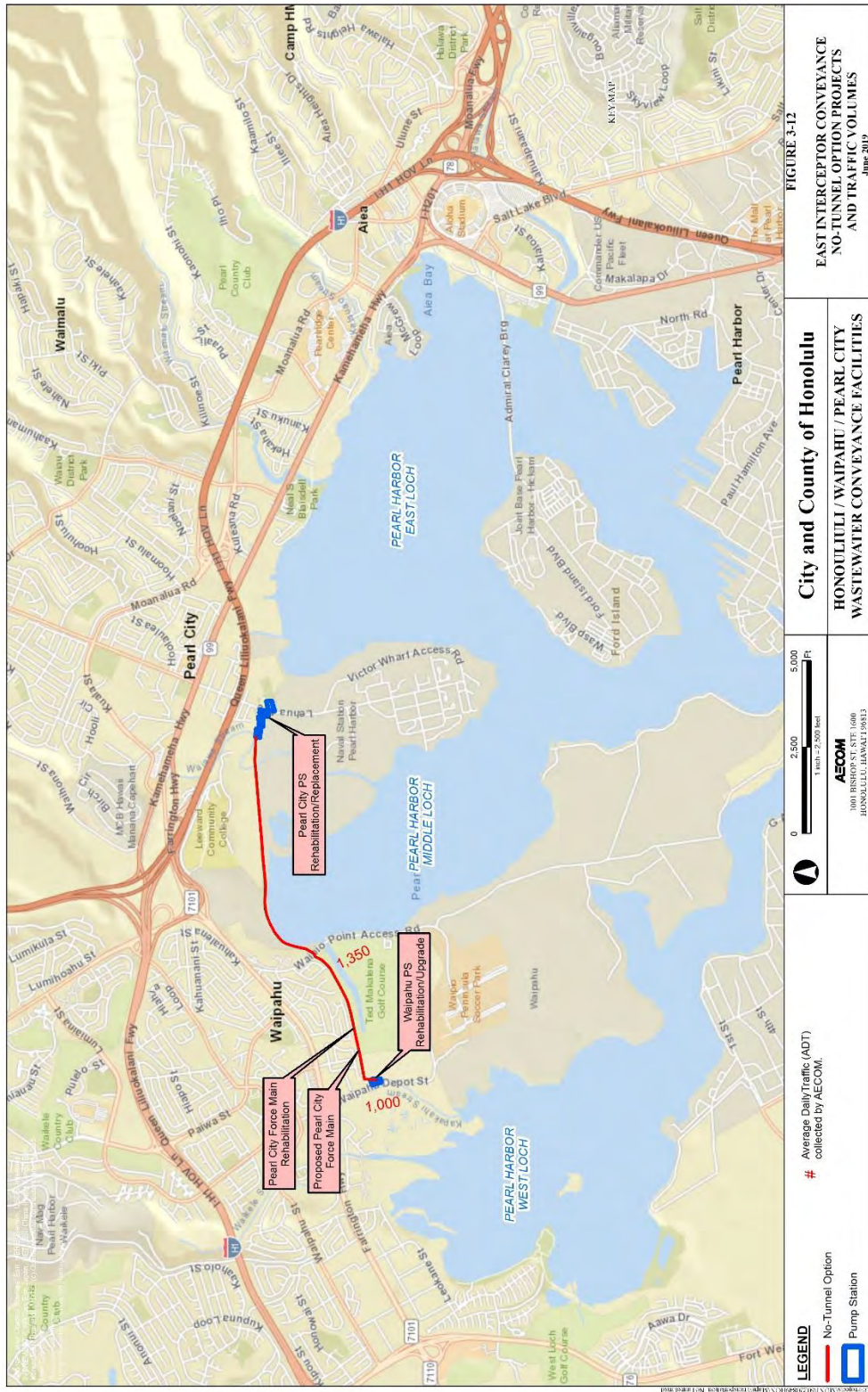


Figure 13 East Interceptor No-Tunnel Option Projects and Traffic Volumes

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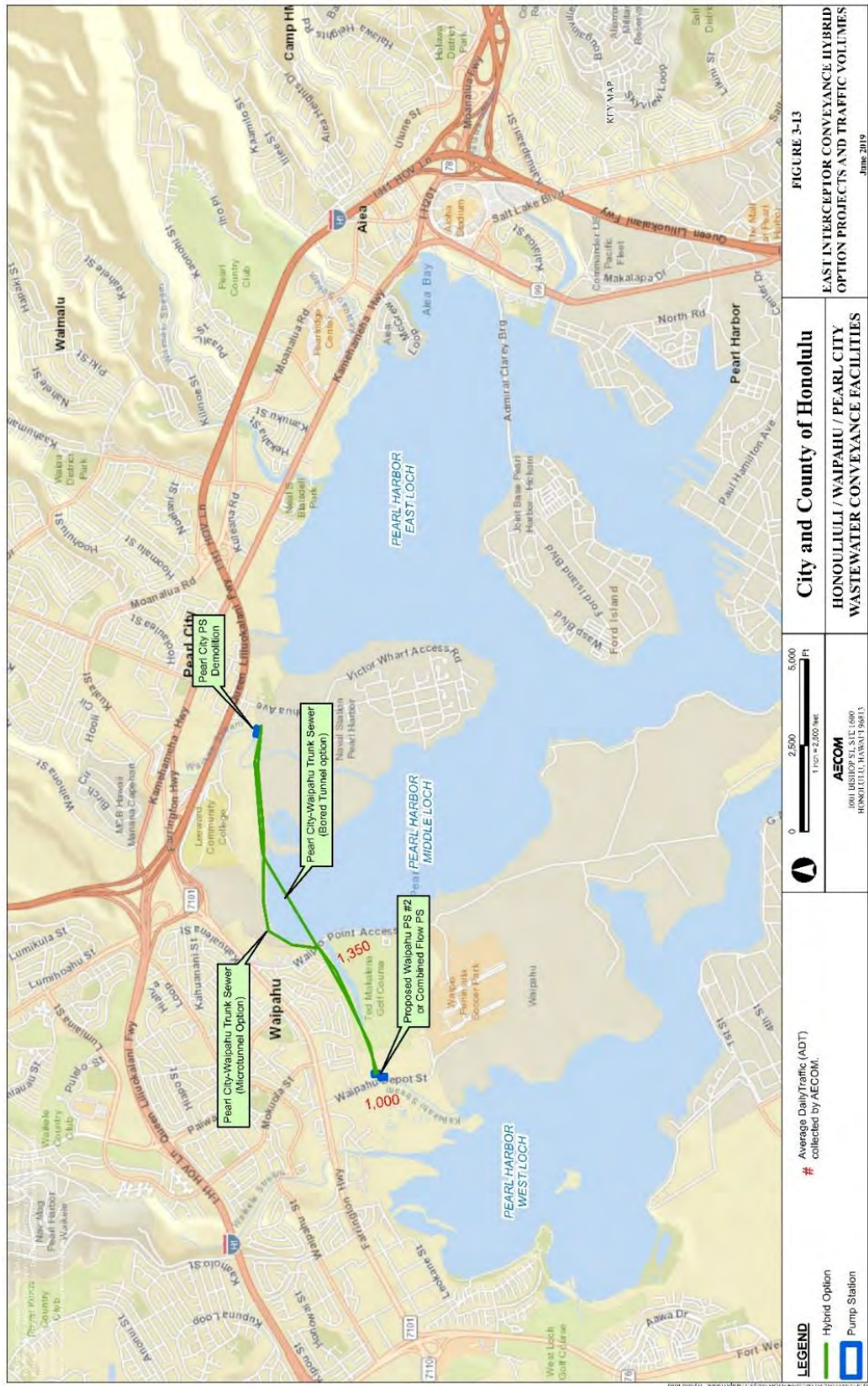


Figure 14 East Interceptor Hybrid Option Projects and Traffic Volumes

Pedestrian and Bicycle Impacts

Despite its name, the Pearl Harbor Bike Path is a multi-use path for both pedestrians and bicycles.

The No-Tunnel and Hybrid East Interceptor conveyance options have similar alignments for these segments, both generally following the Pearl Harbor Bike Path.

Of the two options, the No-Tunnel option would likely have a larger impact on the Pearl Harbor Bike Path, primarily because of the method of construction. The proposed Existing Pearl City Force Main Rehabilitation and Additional Pearl City Force Main would most likely involve open trench installation. The installation of mains using open trench construction would require closing significant portions of the Pearl Harbor Bike Path during construction. The proposed project is approximately 11,000 linear feet (LF) and while not all of it needs to be closed at the same time, closing one point essentially closes a large proportion of the entire segment due to lack of access to the path except at selected locations.

The hybrid option impacts the Pearl Harbor Bike Path less than the No-Tunnel option as the installation involves deep underground construction. There would still be a few areas along the bike path where the tunnel shaft sites would be located. The bicyclists and pedestrians using the path would still have to be detoured around these sites, but the detouring may be easier to accomplish than closing a long portion of the path.

If the bike lane projects on Kamehameha Highway identified in the [2019 Draft O'ahu Bike Plan Update](#) are implemented, bicyclists would have an alternative facility to closures of the Pearl Harbor Bicycle Path.

Transit Impacts

This segment of the proposed East Interceptor improvement project has very little interaction with the transit system during construction. The only transit route with direct potential interaction with the proposed projects is Route 73 - Pearl City Uplands-Leeward Community College/Pearl City Peninsula. Route 73 provides primarily AM and PM peak period transit service to Pearl City Peninsula using Lehua Avenue. Potential interactions could be construction impacts from the Pearl City WWPS or the tunnel pits needed to start the GST in the Hybrid options.

As in the roadway impacts, construction-related vehicular traffic has the potential to increase traffic congestion, thereby affecting transit schedules.

4.1.2.2 Operational Transportation Impacts

The operations for the East Interceptor conveyance options should not have major impacts on the existing traffic. Once the sewer mains/tunnels and WWPSs are constructed, there would be minimal vehicular traffic related to the proposed projects. There

may be some emergency repair and maintenance work that may impact the traffic conditions, but such activity would be infrequent events.

4.2 Waiawa Area Conveyance Options

The Waiawa Area conveyance options serve to tie in the wastewater flow from the future Waiawa Ridge development to the East Interceptor System. The Waiawa Area conveyance options comprise three alternative alignments to connect the Waiawa Industrial Park WWPS to the East Interceptor System:

- Corridor A;
- Corridor D; and
- Corridor G.

Figure 15 displays the Waiawa Area conveyance options.

Corridors A and D would likely be constructed using a combination of open trench and microtunneling methods. In areas where trenching is not feasible, and the depth of the pipe exceeds 25 feet, microtunneling is the preferred construction method. Corridor G is currently proposed as a deep tunnel that would connect from Waiawa Industrial Park to the proposed deep tunnel version of the Hybrid option of the proposed East Interceptor improvement project.

4.2.1 Construction Transportation Impacts

4.2.1.1 Roadway Impacts

All three of the options follow Waihona Street before the corridors diverge. Waihona Street has approximately 4,800 vehicles over the course of a 24-hour period. During the data collection process, it was also observed that during the afternoon peak period, there were instances of vehicles queueing along Waihona Street while waiting to turn out onto Kamehameha Highway. Additionally, the future implementation of the HART Waiawa Rail Station will increase traffic activity in the vicinity of the Kamehameha Highway/Waihona Street intersection. Construction related to the proposed Waiawa Area conveyance options would negatively impact traffic operations at this intersection without mitigative measures.

The common alignment for Corridors A and D is along Waihona Street, then along Kamehameha Highway. There is significant 24-hour traffic volume along this segment of Kamehameha Highway growing from approximately 23,000 vehicle per day near Waihona Street to approximately 61,500 vehicle per day at Acacia Road. This is a very busy segment of Kamehameha Highway and lane closures along this segment of Kamehameha Highway would have negative impacts on traffic operations.

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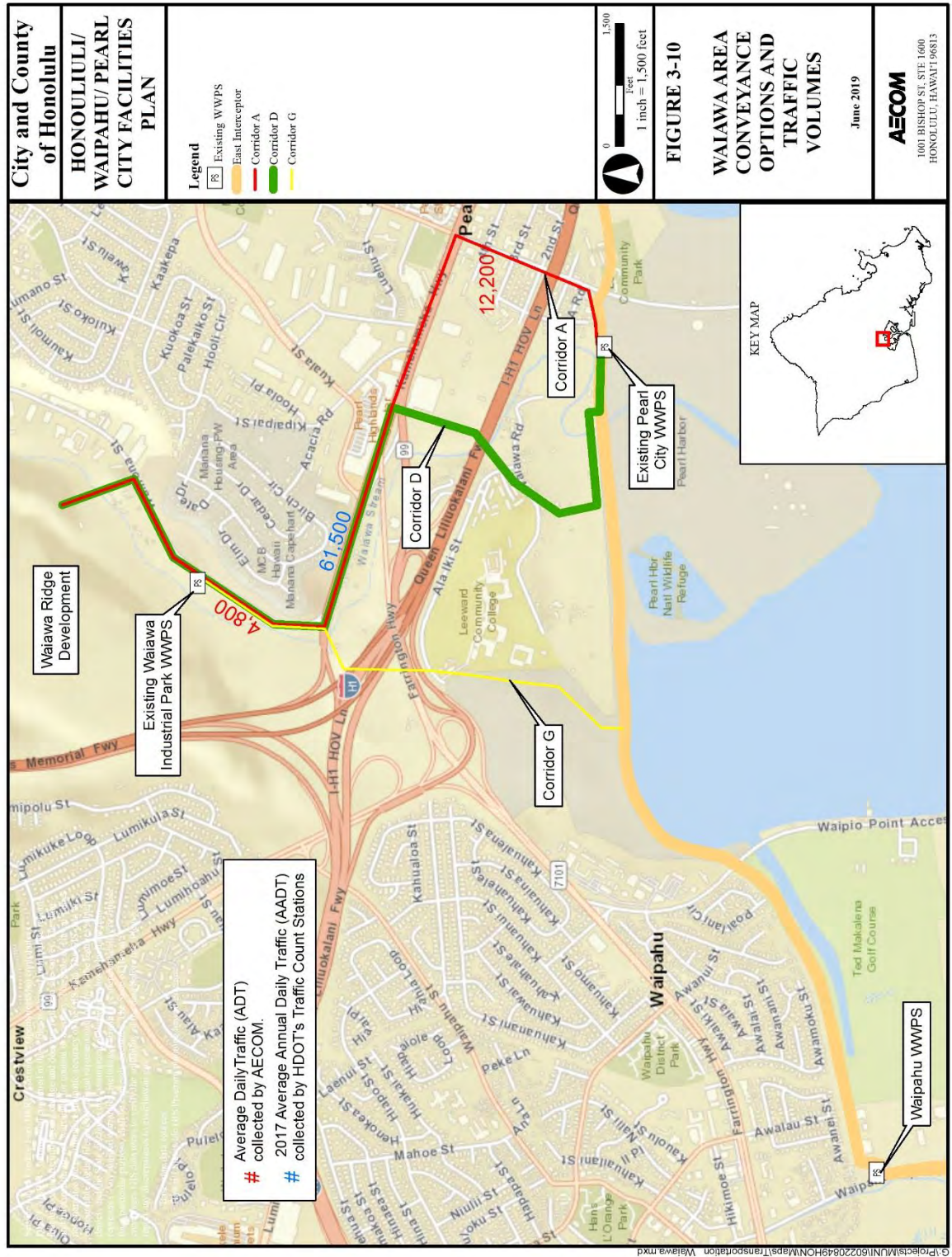


Figure 15 Waiawa Area Conveyance Options and Traffic Volumes

Corridors A and D differ in the extent of Kamehameha Highway affected. Corridor A continues along Kamehameha Highway to Lehua Avenue; whereas, Corridor D turns makai from Kamehameha Highway near the Kamehameha Highway/Farrington Highway merge onto an existing Navy water transmission easement. Corridor D then utilizes other public rights-of-ways and easements until it ties into the existing Pearl City WWPS or the proposed Pearl City-Waipahū Trunk Gravity Sewer tunnel.

Corridor A travels down Lehua Avenue to the Pearl Harbor Bike Path and then along the path to reach the Pearl City WWPS.

Lehua Avenue, just makai of its intersection with Kamehameha Highway and Waimano Home Road has a 24-hour volume of approximately 12,200 vehicles per day. Figure 5 illustrates the traffic volumes throughout the day on Lehua Avenue, showing a relatively high midday peak along with morning and afternoon peak periods. Between the hours of 5:00 AM and 5:00 PM, two-way hourly traffic volume along Lehua Avenue averages around 700 vph. Although this volume is significant for a four-lane collector roadway, the magnitudes of the traffic volumes suggest that lane closures would be feasible when done in a manner not to impact operations at the very busy Kamehameha Highway/Lehua Avenue/Waimano Home Road.

Corridor G follows along Waihona Street but then crosses Kamehameha Highway, the H-2 Freeway, the H-1 Freeway, and Farrington Highway before connecting to the proposed deep tunnel version of the Hybrid option of the proposed East Interceptor improvement project. Because of its particular configuration, Corridor G would be used only with the deep tunnel version of the East Interceptor conveyance Hybrid option. The deep tunnel boring method for Corridor G would avoid impacting the major roadways that it proposes to cross. This alignment also avoids affecting Kamehameha Highway like Corridor D and Kamehameha Highway and Lehua Avenue like Corridor A.

4.2.1.2 Pedestrian and Bicycle Impacts

Construction of the proposed Waiawa Area Corridors A and D along Kamehameha Highway could impact pedestrian facilities such as sidewalks and crosswalks along the segment between Waihona Street and Lehua Avenue. If future bike lane improvements on Kamehameha Highway proposed in the 2019 Draft O'ahu Bike Plan Update are implemented, coordination would be needed to avoid significant disruption of the future bike lanes. Corridor G may avoid these impacts due to its deep tunnel configuration.

The 2019 Draft O'ahu Bike Plan Update also identifies bicycle facility improvements on Waihona Street. As opposed to the Kamehameha Highway bike lane improvements which are designated Tier 1 (highest importance), the 2019 Draft O'ahu Bike Plan Update identifies the Waihona Street bicycle facility improvements as Tier 2, so time frame for implementation is likely farther away. Corridors A, D, and G all involve construction on Waihona Street and could have impacts on the Waihona Street bicycle facility improvements.

All three corridors could have potential impacts to the Pearl Harbor Bike Path depending on the construction methods used. Corridors A and D would traverse parts of the Pearl Harbor Bike Path to reach the Pearl City WWPS. Corridor G would connect to the deep tunnel associated with the East Interceptor Hybrid option. This connection would likely require some type of construction pit that could impinge on the Pearl Harbor Bike Path.

4.2.1.3 Transit Impacts

Table 5 identifies the existing City bus routes potentially affected by the proposed Waiawa Area conveyance options. Most of the existing City bus routes identified would be affected by potential traffic congestion caused by lane closures on Kamehameha Highway to accommodate construction of new sewer mains or rehabilitation of existing sewer mains. City bus route 73 also would experience potential impacts of sewer main construction on Lehua Avenue for proposed Waiawa Area Corridor A.

Table 5 Existing City Bus Routes Affected-Waiawa Area Conveyance Options

Option	Affected Existing City Bus Routes
Waiawa Area Corridor A	A, 40, 42, 51, 53*, 73
Waiawa Area Corridor D	A, 40, 42, 51, 53*, 73
Waiawa Area Corridor G	A, 40, 42, 51
<p>Notes: Corridors A and D are anticipated to use a combination of open trenches and microtunneling for the installation of pipes. Corridor G is anticipated to use deep tunnel boring for the installation of pipes.</p> <p>* = Route impacted based on its weekend route</p>	

Corridors A and D would affect Kamehameha Highway to differing extents, potentially increasing traffic congestion if roadway closures are required during construction. This traffic congestion would, in turn, affect bus transit operations on Kamehameha Highway. Additionally, construction activity on Kamehameha Highway could impact bus stops.

A major feature of the HART rail system that could interact with the Waiawa Area conveyance options is the HART Waiawa Rail Station. This rail station will incorporate a major park and ride garage and a bus transit center. The activity associated with the Waiawa Rail Station is expected to increase multimodal activity on Kamehameha Highway in the vicinity of Waihona Street.

Construction along Corridor A and Corridor D would occur along Kamehameha Highway. Potential lane closures associated with the construction along Corridors A and D could impact multimodal access to the Waiawa Rail Station.

Corridor G would avoid impacts at the roadway level by tunneling below the major roadways. The alignment crosses under the HART Waiawa Rail Station and the edge of the HART Rail Operations Center (ROC). Because it is a deep tunnel alignment, Corridor G is not expected to affect the ROC. Feasibility studies would need to be conducted to assure that the Corridor G deep tunnel alignment does not affect geotechnical support for the Waiawa Rail Station or the ROC.

4.2.2 Operational Transportation Impacts

The Waiawa Area conveyance options should not have major impacts on operational transportation conditions. Once the sewer mains/tunnels are constructed, there would be minimal vehicular traffic related to the proposed projects. There may be some emergency repair and maintenance work that may impact the traffic conditions, but such activity would be infrequent events.

5.0 SUMMARY AND RECOMMENDATIONS

5.1 Summary of Transportation Impacts

This transportation impact analysis report summarizes the results of evaluations conducted to identify potential transportation impacts of the Proposed Action assessed in the Honouliuli Wastewater Conveyance Facilities EIS. It was determined that there would be minimal operational transportation impacts once the Proposed Action implemented. Most of the potential transportation impacts would occur during the construction of the proposed East Interceptor conveyance options and Waiawa Area conveyance options.

5.1.1 Operational Transportation Impacts

The proposed East Interceptor and Waiawa Area conveyance options were found to have minimal operational transportation impacts. Once the sewer mains/tunnels and WWPSs are constructed, there would be only minor interaction between them and multimodal transportation. Most of the facilities are underground, and emergency repair and maintenance work that may impact transportation conditions are expected to infrequent events.

5.1.2 Construction Transportation Impacts

Construction transportation impacts of the proposed East Interceptor and Waiawa Area conveyance options were found to have the potential to affect the various transportation modes. These construction transportation impacts are temporary but identifying them helps to organize and sequence the proposed improvements in a manner that minimizes their disruption during construction.

Tables 6 and 7 summarize the construction transportation impacts of the proposed East Interceptor conveyance options and Waiawa Area conveyance options, respectively.

5.1.2.1 Roadway Impacts

The primary potential construction transportation impact would be lane closures on Kamehameha Highway to accommodate open trench construction or to accommodate the boring pits associated with microtunneling construction. Open trench construction would have the most severe construction impacts due to disruption along the entire length of the proposed conveyance line as opposed to the intermittent disruption due to microtunneling boring pits.

Kamehameha Highway is a six-lane, major arterial roadway for most of its length. Due to the relatively high traffic volumes documented in Chapter 2 of this report, lane closures during peak traffic periods would increase traffic congestion, resulting in delays to vehicles on Kamehameha Highway, including bus transit vehicles.

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Table 6 Summary of Construction Impacts - East Interceptor Conveyance Options

Proposed Options	Roadways	Pedestrian	Bicycle	Transit
East Interceptor-Aloha Stadium to Pearl City Peninsula & Waipi'o Peninsula to 'Ewa	Potential lane closures on Kamehameha Hwy, Salt Lake Blvd, Lehua Ave, and Waipahu Depot St. Access to adjacent properties. Aloha Stadium access & parking depending on redevelopment plans.	Disruption of Sidewalks and crosswalks along Kamehameha Hwy and Salt Lake Blvd. Pearl Harbor Bike Path segments disrupted by construction.	Pearl Harbor Bike Path possibly disrupted by construction. Future bike lanes on Kamehameha Hwy impacted by potential lane closures.	City bus routes on Kamehameha Hwy affected by potential lane closures. Potential bus stop and HART rail station multimodal access issues.
East Interceptor - Pearl City Peninsula to Waipi'o Peninsula-No-Tunnel Option	Waipi'o Point Access Rd crossing.	Pearl Harbor Bike Path would be disrupted during construction. Waipi'o Point Access Rd crossing	Pearl Harbor Bike Path between the Pearl City and Waipahu WWPS	The City bus routes not impacted.
East Interceptor - Pearl City Peninsula to Waipi'o Peninsula-Hybrid Option (Microtunnel)	Potential Waipi'o Point Access Rd crossing depending on construction method.	Pearl Harbor Bike Path would be disrupted during construction. Waipi'o Point Access Rd. crossing depending on construction method.	Pearl Harbor Bike Path between the Pearl City and Waipahu WWPS	The City bus routes not impacted.
East Interceptor - Pearl City Peninsula to Waipi'o Peninsula-Hybrid Option (Deep Tunnel)	Roadways not impacted by this option.	Pearl Harbor Bike Path would be partially impacted by tunnel boring pits.	Pearl Harbor Bike Path between the Pearl City and Waipahu WWPS partially impacted.	The City bus routes not impacted.

Notes:

- East Interceptor: Aloha Stadium to Pearl City WWPS and Pearl City WWPS to Waipahū WWPS No-Tunnel option would be likely be installed via open trench construction.
 - East Interceptor: Hybrid option GST would use either microtunneling or deep tunnel methods.
- WWPS = wastewater pump station, GST = gravity sewer tunnel

Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities
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Table 7 Summary of Construction Impacts - Waiawa Area Conveyance Options

Proposed Options	Roadway	Pedestrian	Bicycle	Transit
Waiawa Area - Corridor A	Traffic congestion on Kamehameha Hwy, Lehua Ave, and Waihona St. due to potential lane closures.	Sidewalks and crosswalks along Kamehameha Hwy, Lehua Ave, and Waihona St. Pearl Harbor Bike Path between the Pearl City WWPS and Lehua Ave.	Pearl Harbor Bike Path between the Pearl City WWPS and Lehua Ave. Future Kamehameha Hwy Bike Lanes	City bus route 73 on Lehua, Routes traveling on Kamehameha Hwy: Waimano Home Rd/Lehua Ave to Waihona St. Multimodal access to Waiawa Rail Station.
Waiawa Area - Corridor D	Traffic congestion on Kamehameha Hwy and Waihona St. due to potential lane closures.	Sidewalks and crosswalks along Kamehameha Hwy, Waihona St. Pearl Harbor Bike Path between the Pearl City WWPS and Corridor D.	Pearl Harbor Bike Path between the Pearl City WWPS and Corridor D. Future Kamehameha Hwy Bike Lanes	City bus routes traveling on Kamehameha Hwy: Pearl Highlands Center to Waihona St. Multimodal access to Waiawa Rail Station.
Waiawa Area - Corridor G	Traffic congestion on Waihona Street due to tunnel pit.	Pearl Harbor Bike Path possibly disrupted by connection to East Interceptor Deep Tunnel.	Pearl Harbor Bike Path possibly disrupted by connection to East Interceptor Deep Tunnel.	Need to check feasibility of tunneling under Waiawa Rail Station and ROC
<p>Notes:</p> <ul style="list-style-type: none"> - Waiawa Area Corridors A and D would be constructed using a combination of open trenches and microtunneling. - Waiawa Area Corridor G would be implemented using deep tunnel construction and would only be implemented with East Interceptor Hybrid option deep tunnel. <p>WWPS=wastewater pump station HART= Honolulu Authority for Rapid Transportation, ROC = Rail Operations Center</p>				

Areas on Kamehameha Highway potentially affected would be the segment from Salt Lake Boulevard to Waimalu near the H1 Freeway overpass for the East Interceptor conveyance options and the segment between Lehua Avenue and Waihona Street for the Waiawa Area conveyance options.

Potential construction impacts to Salt Lake Boulevard would depend on the outcome of current planning efforts to redevelop the Aloha Stadium site into a new Stadium and transit-oriented development uses. These efforts could result in a reconfiguration of the internal roadways and Salt Lake Boulevard.

The East Interceptor conveyance options construction has the potential to affect McGrew Loop, 'Aiea Kai Place, Lehua Avenue, Waipi'o Point Access Road, and Waipahū Depot Street as force main improvement projects cross these roadways. There are also potential East Interceptor impacts to Waipahū Depot Street as several improvement options are aligned within or adjacent to it makai of the Pearl Harbor Bike Path.

The Waiawa Area Corridor A has the potential to affect the Kamehameha Highway/Lehua Avenue/Waimano Home Road intersection and a segment of Lehua Avenue between Kamehameha Highway and the Pearl Harbor Bike Path depending on the construction technique used.

Construction associated with Corridors A and D of the Waiawa Area conveyance options could negatively impact future intersection operations at the intersection of Kamehameha Highway and Waihona Street depending on its configuration after the HART Waiawa Rail Station is constructed.

5.1.2.2 Pedestrian and Bicycle Impacts

Potential construction impacts could occur for pedestrian facilities such as sidewalks and crosswalks associated with Kamehameha Highway with the degree of impact depending on the construction method used. As mentioned previously, open trench construction would have the most severe impacts due to the length of the disruption.

The 2019 Draft O'ahu Bike Plan Update identifies planned updates to the bicycle network including the addition of bike lanes on Kamehameha Highway. Proposed East Interceptor and Waiawa Area improvement projects could impact these future Kamehameha Highway bicycle facilities depending on the construction method used.

The Pearl Harbor Bike Path is the pedestrian and bicycle facility with the highest potential for construction impacts. Despite its name, the Pearl Harbor Bike Path is a multi-use path for pedestrians and bicycles. Both the proposed East Interceptor and Waiawa Area improvement projects could affect the Pearl Harbor Bike Path.

In the case of the East Interceptor, a significant part of its alignment is either within or adjacent to the Pearl Harbor Bike Path. The segment between Aloha Stadium and Pearl

City WWPS interacts with the Pearl Harbor Bike Path for a short segment in the McGrew Loop area and a more extensive segment from Kamehameha Highway in the Waimalu area to the Pearl City WWPS. The construction impacts of the segment between the Pearl City WWPS and the Waipahū WWPS depends on whether the No-Tunnel or the Gravity Sewer Tunnel (GST) option is selected. Furthermore, the construction impacts of the GST option depends on whether the microtunneling or the deep tunnel version is selected. The GST - deep tunnel version has the potential for the least impact; whereas, the No-Tunnel option has the potential for the greatest construction impacts.

The Waiawa Area conveyance options could have construction impacts to the Pearl Harbor Bike Path depending on the way they connect to the East Interceptor.

Pedestrian and bicycle construction impacts could also occur to planned multi-use path improvements on Waipi'o Point Access Road identified in the [2019 Draft O'ahu Bike Plan Update](#). The construction impacts could occur where Pearl Harbor Bike Path crosses Waipi'o Point Access Road, depending on the specific alignment and construction method used for the East Interceptor.

5.1.2.3 Transit Impacts

Transportation impacts during construction of the East Interceptor conveyance options could also impact transit operations along Kamehameha Highway.

Traffic congestion due to lane closures would delay City buses as well as other vehicles. Construction impacts to sidewalks and crosswalks would impair access to bus stops and future HART rail stations located along Kamehameha Highway. The severity of the construction impacts would depend on the option and the construction method selected.

Construction associated with Corridors A and D of the Waiawa Area conveyance options could impact future intersection operations at the intersection of Kamehameha Highway and Waihona Street depending on its configuration after the HART Waiawa Rail Station is constructed. This impact could affect multimodal access to the HART Waiawa Rail Station.

Waiawa Area Corridor G is proposed to utilize deep tunnel construction between Pearl City Industrial Park and its connection to the East Interceptor GST deep tunnel version near the HART Maintenance and Operations Center (MOC). The Corridor G deep tunnel would pass under both the HART Waiawa Rail Station and the MOC. Studies need to verify that the Corridor G deep tunnel would not negatively impact the foundations of either HART facility.

5.2 Recommendations

The following recommendations identify issues that need to be examined as the Proposed Action project options go through design and programming for implementation. The recommendations are organized by the major project segments:

- East Interceptor – Aloha Stadium to Waimalu Area;
- East Interceptor – Waimalu Area to Pearl City WWPS;
- East Interceptor – Pearl City WWPS to Waipahū WWPS;
- East Interceptor – Waipahū WWPS to ‘Ewa;
- Waiawa Area conveyance options.

5.2.1 East Interceptor – Aloha Stadium to Waimalu Near H1 Freeway Overpass

5.2.1.1 Roadway Lane Closures

The largest portion of this segment travels within or adjacent to Kamehameha Highway from Aloha Stadium to Waimalu near the H1 Freeway Overpass. Work to rehabilitate or construct additional sewer mains along this segment would likely require roadway lane closures along Kamehameha Highway. Roadway lane closures are projected to be the major construction transportation impact for the East Interceptor segment between Aloha Stadium and the Pearl City WWPS. The alignments of two proposed projects within this segment, the Waimalu and Pearl City sewer improvements, generally run along Kamehameha Highway.

Other roadways with potential lane closures are Salt Lake Boulevard, McGrew Loop, ‘Aiea Kai Place, and Lehua Avenue. Most of these involve roadway crossings although Salt Lake Boulevard could involve a relatively short distance of lane closure. It is judged that most of these roadways could accommodate proposed East Interceptor project construction without experiencing a high-level of traffic congestion. The actual impact to Salt Lake Boulevard would be dependent on future redevelopment plans for the Aloha Stadium site.

The severity of the lane closures would depend on the construction method used. Open trench construction would affect the roadway along the entire length of the proposed improvement. Microtunneling would require areas to accommodate launching and recovery pits for the boring tool, but there is the potential that the pits could be located off the roadways, eliminating the need for lane closures. Even if it is necessary to locate the pit within the roadway, the lane closures would be intermittent and less extensive than with the open trench method.

Whatever method used, it is recommended that road closures be minimized as much as feasible during peak morning and afternoon commuter travel periods.

It is also recommended that a robust public information program be implemented, informing the public what locations would have road closures and the schedule of the

road closures. If possible, it would be desirable to include promotion of the businesses along Kamehameha Highway that could be affected by traffic congestion caused by project lane closures.

5.2.1.2 Other Roadway Issues

Because of the significant traffic demand on Kamehameha Highway during commuter peak periods, it is recommended to minimize construction vehicle traffic during these time periods.

5.2.1.3 Constrained Utility Corridor

There are many existing underground utilities within and adjacent to Kamehameha Highway. This constrained utility corridor may require modification of portions of the proposed alignments of the East Interceptor conveyance options.

Efforts to correctly identify the location of underground utilities before design begins would help avoid the need to revise designs during construction and incurring the costs that the resulting delay would cause.

5.2.1.4 Pedestrian Facilities Along Kamehameha Highway

Construction of the proposed East Interceptor projects could impact sidewalks and crosswalks on Kamehameha Highway. Throughout the construction process, pedestrian accessibility to adjacent properties and routes for pedestrians traveling through the construction areas need to be maintained.

5.2.1.5 Pearl Harbor Bike Path

Proposed projects in this segment of the East Interceptor could potentially impact a small segment of the multi-use Pearl Harbor Bike Path during construction. The alignment of the proposed Waimalu Trunk Sewer improvements closely parallel the Pearl Harbor Bike path in the vicinity of McGrew Loop and 'Aiea Kai Place.

It is recommended that if construction activities impact the Pearl Harbor Bike Path in this area, measures be implemented to provide a temporary alternative path for pedestrians and bicyclists.

5.2.1.6 Kamehameha Highway Bike Lanes

The [2019 Draft O'ahu Bike Plan Update](#) identifies plans to implement future bike lanes on Kamehameha Highway in the Pearl City-'Aiea area as a Tier 1 (high priority) project. If the bike lanes are implemented before the proposed projects on Kamehameha Highway begin construction, adequate notification should be incorporated into the public information program recommended in the roadway lane closure discussion. If feasible, it would also be desirable to stage the construction of the proposed East Interceptor projects so that construction on the Pearl Harbor Bike Path and on Kamehameha Highway do not occur concurrently. This would allow the two facilities to partially compensate for the other.

5.2.1.7 Transit on Kamehameha Highway

Construction and construction-related roadway lane closures on Kamehameha Highway could affect transit service in several ways:

- Traffic congestion due to construction lane closures would affect the operation of City buses that use Kamehameha Highway as part of their route;
- Construction could also disrupt bus stops and access to bus stops along Kamehameha Highway;
- Construction could disrupt multi-modal access to HART rail stations located within this segment of Kamehameha Highway (Hālawā Station-Aloha Stadium, Kalauao Station-Pearl Ridge).

As proposed East Interceptor projects are implemented, a high level of coordination between the project implementors and the appropriate transit agencies is recommended. This would enable the transit agencies to adjust existing and future bus routes that acknowledge construction constraints. Multimodal access needs to be maintained to the HART Transit Stations.

5.2.1.8 Aloha Stadium Site

Parts of the construction of the proposed Hālawā WWPS and Force Main projects pass through the parking lot of the existing Aloha Stadium site. This could result in temporary loss of parking.

Additionally, existing and proposed East Interceptor elements could be constraints to plans that the Hawaii Stadium Authority is currently working on for the redevelopment of the Aloha Stadium site.

It is recommended to coordinate closely with the Hawaii Stadium Authority on their redevelopment plans, so that both plans for Aloha Stadium redevelopment and proposed East Interceptor project may be implemented together efficiently.

As recommended in previous sections, a robust public information program needs to be implemented to allow the Stadium Authority and the public to understand how proposed East Interceptor projects would affect access and participation in events occurring on the Aloha Stadium site.

5.2.2 East Interceptor –Waimalu Near H1 Freeway Overpass to Pearl City WWPS

This segment of the East Interceptor is located mostly away from roadways. After leaving Kamehameha Highway, the alignments of the proposed East Interceptor conveyance options travel parallel to or within the Pearl Harbor Bike Path, crossing Lehua Avenue to the Pearl City WWPS.

5.2.2.1 Roadway Lane Closures

The only roadway affected by this segment of the East Interceptor is Lehua Avenue as the proposed projects cross it.

The crossing could require lane closure on Lehua Avenue depending on the construction method used. Crossing lane closures are generally not as disruptive as lane closures that are longitudinally-oriented to the roadway.

It is recommended to minimize disruption during the AM and PM commuter traffic peak periods and to be aware that there is a significant midday traffic peak that occurs on Lehua Avenue.

A robust public information program would be important in notifying users of Lehua Avenue of lane closures.

5.2.2.2 Other Roadway Issues

Since construction traffic generated within this segment would naturally flow into Kamehameha Highway and because there is significant traffic demand on Kamehameha Highway during commuter peak periods, it is recommended to minimize construction vehicle traffic during these time periods.

5.2.2.3 Pedestrian Facilities Along Lehua Avenue

The crossing of Lehua Avenue by proposed East Interceptor projects could impact sidewalks and crosswalks on Lehua Avenue. Throughout the construction process, pedestrian accessibility traveling through the construction areas need to be maintained.

5.2.2.4 Pearl Harbor Bike Path

Proposed projects in this segment of the East Interceptor could potentially have a significant temporary impact on the multi-use Pearl Harbor Bike Path during construction. The alignment of the proposed Pearl City Trunk Sewer improvements in this segment closely parallel or are within the Pearl Harbor Bike path.

The amount of closure would depend on the East Interceptor conveyance option selected. At Blaisdell Park, not far from this segment, a survey by the Hawaii Bicycling League found that by approximately 20-30 bicyclists during the morning peak period and approximately 40-60 bicyclists during the afternoon peak period utilize the Pearl Harbor Bike Path. Although data is not readily available, informal observations indicate that the Pearl Harbor Bike Path is also a popular jogging and walking path.

It is recommended that if construction activities impact the Pearl Harbor Bike Path in this area, measures be implemented to provide a temporary alternative path for pedestrians and bicyclists.

5.2.2.5 Transit Impacts

Because most of the proposed East Interceptor improvement projects are located off-road and only interact with Lehua Avenue, transit impacts are minimal.

Route 73 - Pearl City Uplands-Leeward Community College/Pearl City Peninsula is the only current bus route that would interact with the crossing of Lehua Avenue by the proposed East Interceptor projects during construction. This route is a circulator route as opposed to a trunk route, and construction activity associated with the Lehua Avenue crossing is not expected to significantly impact the route.

As proposed East Interceptor projects are implemented, coordination between the project implementors and the appropriate transit agencies is recommended. This would enable the transit agencies to adjust existing and future bus routes that acknowledge construction constraints.

5.2.3 East Interceptor –Pearl City WWPS to Waipahū WWPS

This segment of the proposed East Interceptor connects the existing Pearl City WWPS and the existing Waipahū WWPS. It has two major options:

- No-Tunnel option;
- Hybrid option.

The Hybrid option has two versions:

- Gravity sewer tunnel (GST);
- Microtunnel gravity sewer line.

The No-Tunnel option and the Hybrid option-Microtunnel alignments would closely follow the existing Pearl Harbor Bike Path. The No-Tunnel option would be open trench construction, while the Hybrid option-Microtunnel would involve creating several pits to launch and recover the microtunneling tool. The GST version of the Hybrid option involves a deep tunnel and would need fewer but larger pits at key locations to facilitate boring of the deep tunnel.

5.2.3.1 Roadway Issues

This segment of the East Interceptor does not interact with any roadways and does not require any lane closures.

Because of the construction traffic generated by construction within this segment would naturally flow into Kamehameha Highway and Farrington Highway and because there is significant traffic demand on both major roadway facilities during commuter peak periods, it is recommended to minimize construction vehicle traffic during these time periods.

5.2.2.3 Pearl Harbor Bike Path

This segment of the proposed East Interceptor could potentially have a significant temporary impact on the multi-use Pearl Harbor Bike Path during construction. The alignment of the proposed Pearl City Trunk Sewer improvements in this segment closely parallel or are within the Pearl Harbor Bike path.

The amount of closure would depend on the East Interceptor option selected. The No-Tunnel option is proposed to use open trench construction and could potentially disrupt the entire stretch of the Pearl Harbor Bike Path between the Pearl City WWPS and the Waipahū WWPS. The Hybrid option-Microtunnel version has the potential to be less disruptive because it would involve digging several pits to launch and receive the microtunneling tool instead of digging a continuous trench. The Hybrid option-GST version has the potential to be the least disruptive due to fewer (although larger) pits, interfering less with the Pearl Harbor Bike Path than the other two options.

At Blaisdell Park, not far from this segment, a survey by the Hawaii Bicycling League found that by approximately 20-30 bicyclists during the morning peak period and approximately 40-60 bicyclists during the afternoon peak period utilize the Pearl Harbor Bike Path. Although data is not readily available, informal observations indicate that the Pearl Harbor Bike Path is also a popular jogging and walking path.

Given the use of the Pearl Harbor Bike Path by both pedestrians and bicyclists, it is recommended that measures be implemented to provide a temporary alternative path for pedestrians and bicyclists appropriate to the amount of disruption of the Bike Path by a given option.

5.2.4 East Interceptor- Waipahū WWPS to 'Ewa

5.2.4.1 Roadway Issues

This segment mostly travels makai down the Waipi'o Peninsula and crosses West Loch to 'Ewa. Most of the alignment is not within any roadway.

There would be impacts to Waipahū Depot Street from the Waipahū WWPS to a point makai of the Honolulu Police Academy facility. Waipahū Depot Street is projected to be able to accommodate these impacts.

It is recommended to maintain access along Waipahū Depot Street to the Honolulu Police Academy facility during construction and to utilize the public information program to keep the facility informed on the schedule of construction and type of roadway closures to expect.

5.2.5 Waiawa Area Conveyance Options

There are three alignments evaluated for the proposed Waiawa Area conveyance options:

- Corridor A
- Corridor D
- Corridor G

Corridors A and D are gravity line sewers while Corridor G is a deep tunnel sewer.

5.2.5.1 Roadway Lane Closures

Corridors A and D would travel along Kamehameha Highway and lane closures likely would be needed to construct the lines. Corridor G utilizes a deep tunnel between Pearl City Industrial Park and its connection with the East Interceptor and completely avoids impacts to Kamehameha Highway.

Corridor D is the less impactful of the two options that travel along Kamehameha Highway in that it avoids the currently congested segment of Kamehameha Highway between Acacia Road and Waimano Home Road/Lehua Avenue intersection.

In addition to lane closures on Kamehameha Highway, Corridor A also would require lane closures on Lehua Avenue.

It is recommended that when road closures are required, disruption to traffic be minimized as much as feasible during peak morning and afternoon commuter travel periods.

It is also recommended that a robust public information program implemented, informing the public what locations would have road closures and the schedule of the road closures. If possible, it would be desirable to include promotion of the businesses along Kamehameha Highway that could be affected by traffic congestion caused by project lane closures.

5.2.5.2 Other Roadway Issues

Because of the significant traffic demand on Kamehameha Highway during commuter peak periods, it is recommended to minimize construction vehicle traffic during these time periods.

5.2.5.3 Pedestrian Facilities Along Kamehameha Highway

Construction of the proposed Corridor A and Corridor D could impact sidewalks and crosswalks on Kamehameha Highway. Throughout the construction process, pedestrian accessibility to adjacent properties and routes for pedestrians traveling through the construction areas need to be maintained.

5.2.5.4 Pearl Harbor Bike Path

The three corridor options affect the Pearl Harbor Bike Path in different ways. Corridor A impacts the Bike Path between Lehua Avenue and the Pearl City WWPS. Corridor D impacts the Bike Path between along the Bike Path between Leeward Community College and the Pearl City WWPS. Corridor G would need to connect to the GST version of the East Interceptor Hybrid option. This connection would likely require some type of construction pit that could impinge on the Pearl Harbor Bike Path.

It is recommended that if construction of the selected Waiawa Area conveyance option impacts the Pearl Harbor Bike Path in this area, measures be implemented to provide a temporary alternative path for pedestrians and bicyclists.

5.2.5.5 Kamehameha Highway Bike Lanes

The 2019 Draft O'ahu Bike Plan Update identifies plans to implement future bike lanes on Kamehameha Highway in the Pearl City-'Aiea area as a Tier 1 (high priority) project. If the bike lanes are implemented before construction of the selected Waiawa Area conveyance option begins and either Corridor A or Corridor D are selected, notification should be incorporated into a public information program.

5.2.5.6 Transit Issues

Construction and construction-related roadway lane closures on Kamehameha Highway could affect transit service in several ways:

- Traffic congestion due to construction lane closures would affect the operation of City buses that use Kamehameha Highway as part of their route;
- Construction could also disrupt bus stops and access to bus stops along Kamehameha Highway;
- Construction could disrupt multi-modal access to the HART Waiawa rail station located in the vicinity of Waihona Street.

As the selected Waiawa Area conveyance option is implemented, a high level of coordination between the project implementors and the appropriate transit agencies is recommended. This would enable the transit agencies to adjust existing and future bus routes that acknowledge construction constraints. Multimodal access needs to be maintained to the Hart Waiawa rail station.

As seen in Figure 15, Waiawa Area Corridor G crosses Kamehameha Highway and continues along the boundary of the future Waiawa rail station, which also includes a new transit center and park and ride facility. The Park and Ride facility is anticipated to be completed and in operation by the Year 2025. Corridor G continues makai and passes along the edge of the HART Rail Operations Center (ROC). If this corridor is selected, it is recommended that there is coordination with HART to assure that the deep tunneling would not disrupt the foundations associated with the HART Waiawa rail station or the HART ROC.

6.0 REFERENCES

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Appendix A

**State of Hawaii Office of Planning Highway Performance Monitoring System GIS
Database Traffic Volumes and HDOT 24-hour Traffic Count Data**

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Honolulu/Waipahu/Pearl City Wastewater Conveyance Facilities																								
HPMSYear	State_Code	CountyCode	County	Island	Route_ID	BMP	EMP	AADT	AADTStn	AADTSU	AADTCU	Mileage	FunSystem	FunSysDesc	FacType	FacTypeDes	Maintain	MaintName	Owner	OwnerName	ThruLanes	UrbanCode	UrbanDesc	Shape_Leng
Year 2012																								
2012	15	3	Honolulu	Oahu	99	17.47	17.65	39500		1003	478	0.18	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	39889	Urban - Honolulu	280.4019
2012	15	3	Honolulu	Oahu	99	17.65	18.02	43697		1110	529	0.37	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	39889	Urban - Honolulu	576.137
2012	15	3	Honolulu	Oahu	99	18.02	18.11	38093		968	461	0.09	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	39889	Urban - Honolulu	140.468
2012	15	3	Honolulu	Oahu	99	18.11	18.25	63806		1621	772	0.14	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	219.3028
2012	15	3	Honolulu	Oahu	99	18.25	18.54	47900		623	201	0.29	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	454.4126
2012	15	3	Honolulu	Oahu	99	18.54	19.66	33600		706	487	1.12	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	1761.182
2012	15	3	Honolulu	Oahu	99	19.66	20.25	42700		555	179	0.59	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	928.7743
2012	15	3	Honolulu	Oahu	99	20.25	21.03	52300		1112	660	0.78	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	1231.066
2012	15	3	Honolulu	Oahu	99	21.03	21.17	41200		536	173	0.14	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	39889	Urban - Honolulu	223.7034
2012	15	3	Honolulu	Oahu	99	21.17	21.44	39054		508	164	0.27	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	39889	Urban - Honolulu	443.8296
2012	15	3	Honolulu	Oahu	99	21.44	21.47	39054		508	164	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	39889	Urban - Honolulu	49.03605
2012	15	3	Honolulu	Oahu	99	21.47	21.51	36389		473	153	0.04	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	7	39889	Urban - Honolulu	65.37075
2012	15	3	Honolulu	Oahu	99	21.51	21.54	35400		460	149	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	8	39889	Urban - Honolulu	49.03171
Year 2013																								
2013	15	3	Honolulu	Oahu	99	17.36	17.47	47981		0	0	0.11	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	39889	Urban - Honolulu	172.4961
2013	15	3	Honolulu	Oahu	99	17.47	17.65	39658		0	0	0.18	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	39889	Urban - Honolulu	280.5173
2013	15	3	Honolulu	Oahu	99	17.65	18.02	43697		0	0	0.37	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	39889	Urban - Honolulu	576.3851
2013	15	3	Honolulu	Oahu	99	18.02	18.11	37795		0	0	0.09	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	39889	Urban - Honolulu	140.5569
2013	15	3	Honolulu	Oahu	99	18.11	18.25	63806		0	0	0.14	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	219.4084
2013	15	3	Honolulu	Oahu	99	18.25	18.54	59100		0	0	0.29	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	454.6065
2013	15	3	Honolulu	Oahu	99	18.54	19.66	36200		713	417	1.12	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	1761.982
2013	15	3	Honolulu	Oahu	99	19.66	20.25	42871		0	0	0.59	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	929.285
2013	15	3	Honolulu	Oahu	99	20.25	21.03	53300		2035	884	0.78	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	39889	Urban - Honolulu	1231.819
2013	15	3	Honolulu	Oahu	99	21.03	21.17	57000		0	0	0.14	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	39889	Urban - Honolulu	223.8585
2013	15	3	Honolulu	Oahu	99	21.17	21.44	51000		0	0	0.27	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	39889	Urban - Honolulu	444.2052
2013	15	3	Honolulu	Oahu	99	21.44	21.47	38749		0	0	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	39889	Urban - Honolulu	49.06067
2013	15	3	Honolulu	Oahu	99	21.47	21.51	50300		0	0	0.04	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	7	39889	Urban - Honolulu	65.41439
2013	15	3	Honolulu	Oahu	99	21.51	21.54	32400		0	0	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	8	39889	Urban - Honolulu	49.06073

AECOM

Source: Data Submitted to State of Hawaii Office of Planning - Highway Performance Monitoring System

July 2019

Honolulu/Waipahu/Pearl City Wastewater Conveyance Facilities																								
HPMSYear	State_Code	CountyCode	County	Island	Route_ID	BMP	EMP	AADT	AADTStn	AADTSU	AADTCU	Mileage	FunSystem	FunSysDesc	FacType	FacTypeDes	Maintain	MaintName	Owner	OwnerName	ThruLanes	UrbanCode	UrbanDesc	Shape_Leng
Year 2014																								
2014	15	3	Honolulu	Oahu	99	17.47	17.65	59100		774	365	0.18	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	280.5173
2014	15	3	Honolulu	Oahu	99	17.65	18.02	59100		843	453	0.37	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	89770	Urban - Honolulu	576.3851
2014	15	3	Honolulu	Oahu	99	18.02	18.11	59100		859	475	0.09	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	140.5569
2014	15	3	Honolulu	Oahu	99	18.11	18.25	59100		885	508	0.14	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	219.4084
2014	15	3	Honolulu	Oahu	99	18.25	18.54	59455		945	581	0.29	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	454.6065
2014	15	3	Honolulu	Oahu	99	18.54	19.66	36417		706	521	1.12	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	1761.982
2014	15	3	Honolulu	Oahu	99	19.66	20.25	43212		1236	685	0.59	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	929.285
2014	15	3	Honolulu	Oahu	99	20.25	21.03	49300		1864	858	0.78	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	1231.819
2014	15	3	Honolulu	Oahu	99	21.03	21.17	30800		1164	536	0.14	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	223.8585
2014	15	3	Honolulu	Oahu	99	21.17	21.44	30800		1164	536	0.27	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	89770	Urban - Honolulu	444.2052
2014	15	3	Honolulu	Oahu	99	21.44	21.47	30800		1164	536	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	49.06067
2014	15	3	Honolulu	Oahu	99	21.47	21.51	30800		1164	536	0.04	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	7	89770	Urban - Honolulu	65.41439
2014	15	3	Honolulu	Oahu	99	21.51	21.54	30800		1164	536	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	8	89770	Urban - Honolulu	49.06073
2014	15	3	Honolulu	Oahu	99	21.54	21.66	27464		1038	478	0.12	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	7	89770	Urban - Honolulu	196.2367
Year 2015																								
2015	15	3	Honolulu	Oahu	99	17.47	17.65	59691	vpd	1054	359	0.18	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	280.5173
2015	15	3	Honolulu	Oahu	99	17.65	18.02	59691	vpd	1054	359	0.37	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	89770	Urban - Honolulu	576.3851
2015	15	3	Honolulu	Oahu	99	18.02	18.11	59691	vpd	1054	359	0.09	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	140.5569
2015	15	3	Honolulu	Oahu	99	18.11	18.25	59691	vpd	1054	359	0.14	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	219.4084
2015	15	3	Honolulu	Oahu	99	18.25	18.54	60282	vpd	1064	363	0.29	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	454.6065
2015	15	3	Honolulu	Oahu	99	18.54	19.66	36924	vpd	719	526	1.12	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	1761.982
2015	15	3	Honolulu	Oahu	99	19.66	20.25	43981	vpd	856	297	0.59	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	929.285
2015	15	3	Honolulu	Oahu	99	20.25	21.03	51816	vpd	2034	933	0.78	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	1231.819
2015	15	3	Honolulu	Oahu	99	21.03	21.17	31108	vpd	827	331	0.14	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	223.8585
2015	15	3	Honolulu	Oahu	99	21.17	21.44	31108	vpd	827	331	0.27	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	89770	Urban - Honolulu	444.2052
2015	15	3	Honolulu	Oahu	99	21.44	21.47	31108	vpd	827	331	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	49.06067
2015	15	3	Honolulu	Oahu	99	21.47	21.51	31108	vpd	827	331	0.04	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	7	89770	Urban - Honolulu	65.41439
2015	15	3	Honolulu	Oahu	99	21.51	21.54	31108	vpd	827	331	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	8	89770	Urban - Honolulu	49.06073

AECOM

Source: Data Submitted to State of Hawaii Office of Planning - Highway Performance Monitoring System

July 2019

Honolulu/Waipahu/Pearl City Wastewater Conveyance Facilities																								
HPMSYear	State_Code	CountyCode	County	Island	Route_ID	BMP	EMP	AADT	AADTStn	AADTSU	AADTCU	Mileage	FunSystem	FunSysDesc	FacType	FacTypeDes	Maintain	MaintName	Owner	OwnerName	ThruLanes	UrbanCode	UrbanDesc	Shape_Leng
Year 2016																								
2016	15	3	Honolulu	Oahu	99	17.47	17.65	60288	B72009901747	2062	1561	0.18	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	290.5315
2016	15	3	Honolulu	Oahu	99	17.65	18.02	60288	B72009901747	2062	1561	0.37	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	89770	Urban - Honolulu	597.1719
2016	15	3	Honolulu	Oahu	99	18.02	18.11	60288	B72009901747	2062	1561	0.09	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	145.3199
2016	15	3	Honolulu	Oahu	99	18.11	18.25	60288	B72009901747	2062	1561	0.14	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	226.0692
2016	15	3	Honolulu	Oahu	99	18.25	18.54	60891	B72009901825	2082	1577	0.29	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	468.0798
2016	15	3	Honolulu	Oahu	99	18.54	19.66	37297	B72009901854	1276	966	1.12	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	1807.817
2016	15	3	Honolulu	Oahu	99	19.66	20.25	44434	B72009901966	1520	1151	0.59	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	952.4651
2016	15	3	Honolulu	Oahu	99	20.25	21.03	52339	P72000000006	1790	1356	0.78	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	1259.077
2016	15	3	Honolulu	Oahu	99	21.03	21.17	31419	B72009902154	1075	814	0.14	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	225.969
2016	15	3	Honolulu	Oahu	99	21.17	21.44	31419	B72009902154	1075	814	0.27	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	89770	Urban - Honolulu	435.7991
2016	15	3	Honolulu	Oahu	99	21.44	21.47	31419	B72009902154	1075	814	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	48.43173
2016	15	3	Honolulu	Oahu	99	21.47	21.51	31419	B72009902154	1075	814	0.04	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	7	89770	Urban - Honolulu	64.57573
2016	15	3	Honolulu	Oahu	99	21.51	21.54	31419	B72009902154	1075	814	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	8	89770	Urban - Honolulu	48.43177
Year 2017																								
2017	15	3	Honolulu	Oahu	99	17.47	17.65	60891	B72009901747	714	526	0.18	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	289.4686
2017	15	3	Honolulu	Oahu	99	17.65	18.02	60891	B72009901747	714	526	0.37	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	89770	Urban - Honolulu	595.2306
2017	15	3	Honolulu	Oahu	99	18.02	18.11	60891	B72009901747	714	526	0.09	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	144.6881
2017	15	3	Honolulu	Oahu	99	18.11	18.25	60891	B72009901747	714	526	0.14	2	Principal Arterial-Other Freeways Expressways	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	225.257
2017	15	3	Honolulu	Oahu	99	18.25	18.54	61500	B72009901825	714	526	0.29	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	466.3669
2017	15	3	Honolulu	Oahu	99	18.54	19.66	37670	B72009901854	714	526	1.12	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	1801.508
2017	15	3	Honolulu	Oahu	99	19.66	20.25	44878	B72009901966	1295	718	0.59	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	949.0334
2017	15	3	Honolulu	Oahu	99	20.25	21.03	38200	B72009902090	2032	935	0.78	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	6	89770	Urban - Honolulu	1254.503
2017	15	3	Honolulu	Oahu	99	21.03	21.17	31500	902103; B72009	2032	935	0.14	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	225.2215
2017	15	3	Honolulu	Oahu	99	21.17	21.44	31500	902103; B72009	2032	935	0.27	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	4	89770	Urban - Honolulu	434.2593
2017	15	3	Honolulu	Oahu	99	21.44	21.47	31500	902103; B72009	2032	935	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	5	89770	Urban - Honolulu	48.2823
2017	15	3	Honolulu	Oahu	99	21.47	21.51	31500	902103; B72009	2032	935	0.04	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	7	89770	Urban - Honolulu	64.35091
2017	15	3	Honolulu	Oahu	99	21.51	21.54	31500	902103; B72009	2032	935	0.03	3	Principal Arterial-Other	2	Two-Way Roadway	1	State Hwy Agency	1	State Hwy Agency	8	89770	Urban - Honolulu	48.26317

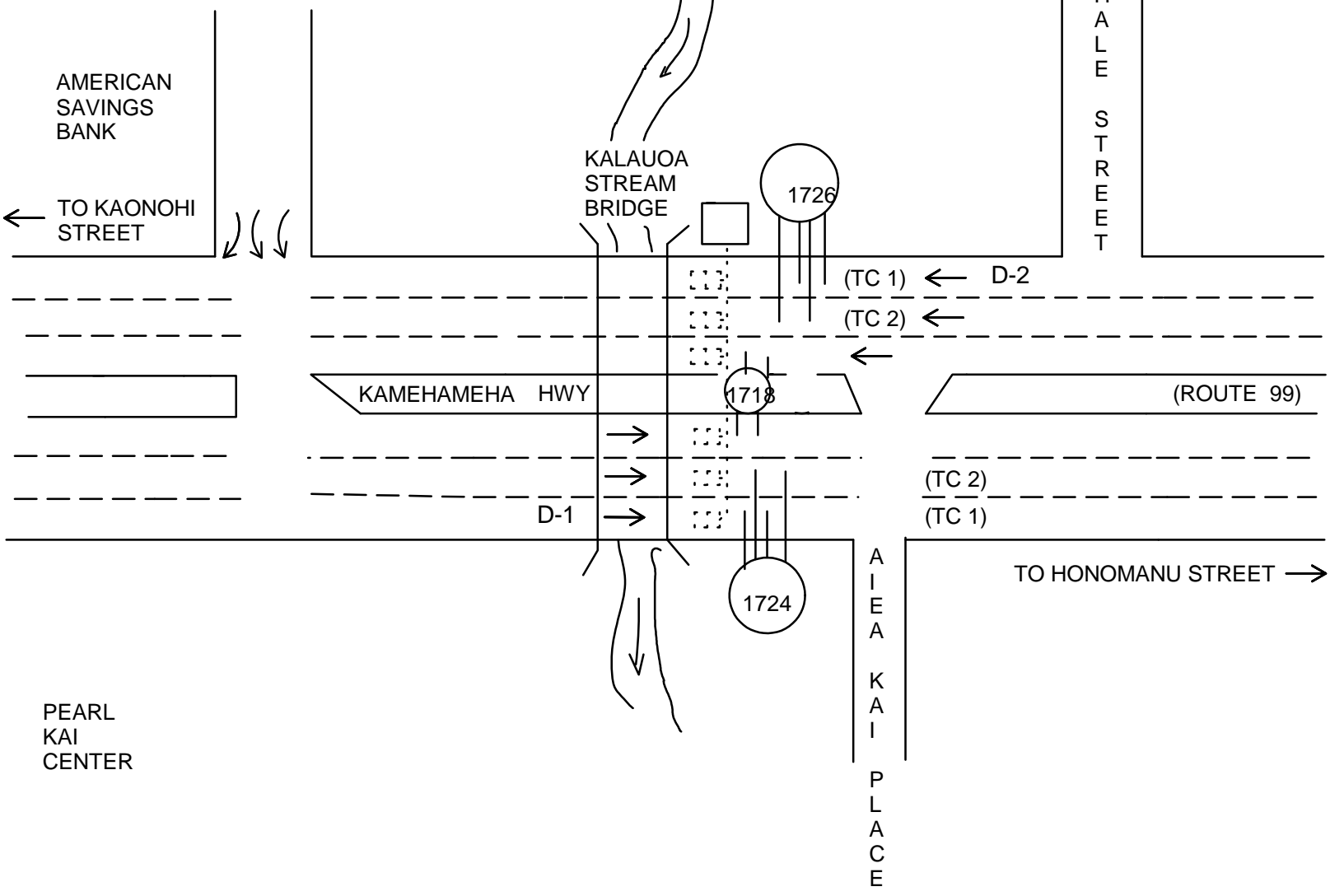
AECOM

Source: Data Submitted to State of Hawaii Office of Planning - Highway Performance Monitoring System

July 2019



ISLAND: OAHU
 AREA: AIEA



Station Location:			
Kamehameha Highway at Kalauao Stream Bridge			
Station Mileage:	20.68	GPS Coord (Latitude):	21.380174 N
		GPS Coord (Longitude):	157.939026 W
Begin Survey (Date/Time):	11-18-13 0000	End Survey (Date/Time):	11-21-13 0000
Survey Method:	LOOP HOSE OTHER	Survey Type:	VOL CLASS SPEED OTHER
Survey Crew:	CA, CO, LT, RG	Module No.:	

HPMS DATA							
Segment Description:							
KAMEHAMEHA HIGHWAY AT KALAUAO STREAM BRIDGE - KAONOHI ST TO OFF RAMP TO MOANALUA FREEWAY							
Segment Begin LRS	20.25	Segment End LRS	21.03	Length	0.78		
Facility Name	Juris	Func Class	Area Type	Route		D-1 = Direction to End of Route	
				No.	Mile	D-2 = Direction to Beginning of Route	
KAMEHAMEHA HIGHWAY	S	14	4	99	20.68	D-1	TO PEARL HARBOR I. C.
						D-2	TO JOSEPH P. LEONG HWY

Sketch By: COII Date: 1/25/2012 SLD: 2003

Run Date: 2014/06/02

Hawaii Department of Transportation
Highways Division **Highways Planning Survey Section**

2013 Program Count - Summary

Site ID: B72009902025

Functional Class: URBAN:PRINCIPAL ARTERIAL - OTHER

Location: Kamehameha Hwy at Kalauao Stream Bridge

Town: Oahu

Count Type: CLASS

DIR 1: +MP

DIR 2: -MP

Final AADT: 50800

Counter Type: Tube

Route No: 99

TIME-AM	DIR 1	DIR 2	TOTAL	TIME-AM	DIR 1	DIR 2	TOTAL	TIME-PM	DIR 1	DIR 2	TOTAL	TIME-PM	DIR 1	DIR 2	TOTAL
DATE : 11/19/2013															
12:00-12:15	21	29	50	06:00-06:15	592	198	790	12:00-12:15	362	340	702	06:00-06:15	276	562	838
12:15-12:30	21	39	60	06:15-06:30	638	246	884	12:15-12:30	398	364	762	06:15-06:30	306	367	673
12:30-12:45	17	23	40	06:30-06:45	562	304	866	12:30-12:45	385	339	724	06:30-06:45	314	350	664
12:45-01:00	23	20	43	06:45-07:00	548	325	873	12:45-01:00	376	375	751	06:45-07:00	255	334	589
01:00-01:15	30	20	50	07:00-07:15	424	305	729	01:00-01:15	340	375	715	07:00-07:15	220	288	508
01:15-01:30	18	21	39	07:15-07:30	400	329	729	01:15-01:30	383	408	791	07:15-07:30	230	344	574
01:30-01:45	21	17	38	07:30-07:45	383	295	678	01:30-01:45	352	474	826	07:30-07:45	230	322	552
01:45-02:00	14	12	26	07:45-08:00	376	394	770	01:45-02:00	375	499	874	07:45-08:00	202	329	531
02:00-02:15	21	12	33	08:00-08:15	340	471	811	02:00-02:15	328	522	850	08:00-08:15	214	297	511
02:15-02:30	22	12	34	08:15-08:30	322	317	639	02:15-02:30	370	643	1013	08:15-08:30	193	297	490
02:30-02:45	35	13	48	08:30-08:45	299	343	642	02:30-02:45	379	604	983	08:30-08:45	157	243	400
02:45-03:00	48	24	72	08:45-09:00	324	392	716	02:45-03:00	331	619	950	08:45-09:00	151	264	415
03:00-03:15	48	28	76	09:00-09:15	340	342	682	03:00-03:15	360	614	974	09:00-09:15	118	189	307
03:15-03:30	69	26	95	09:15-09:30	359	357	716	03:15-03:30	339	624	963	09:15-09:30	94	193	287
03:30-03:45	131	40	171	09:30-09:45	374	350	724	03:30-03:45	331	502	833	09:30-09:45	66	131	197
03:45-04:00	148	44	192	09:45-10:00	374	373	747	03:45-04:00	331	475	806	09:45-10:00	56	116	172
04:00-04:15	238	47	285	10:00-10:15	328	366	694	04:00-04:15	309	381	690	10:00-10:15	71	115	186
04:15-04:30	368	52	420	10:15-10:30	376	424	800	04:15-04:30	280	314	594	10:15-10:30	66	108	174
04:30-04:45	576	69	645	10:30-10:45	377	375	752	04:30-04:45	312	385	697	10:30-10:45	56	104	160
04:45-05:00	766	90	856	10:45-11:00	393	388	781	04:45-05:00	256	552	808	10:45-11:00	45	79	124
05:00-05:15	817	109	926	11:00-11:15	411	352	763	05:00-05:15	274	647	921	11:00-11:15	36	79	115
05:15-05:30	767	131	898	11:15-11:30	406	410	816	05:15-05:30	294	579	873	11:15-11:30	36	66	102
05:30-05:45	738	166	904	11:30-11:45	390	335	725	05:30-05:45	308	615	923	11:30-11:45	25	44	69
05:45-06:00	745	197	942	11:45-12:00	382	345	727	05:45-06:00	317	601	918	11:45-12:00	31	44	75

AM COMMUTER PERIOD (05:00-09:00)	DIR 1	DIR 2	PM COMMUTER PERIOD (15:00-19:00)	DIR 1	DIR 2
TWO DIRECTIONAL PEAK			TWO DIRECTIONAL PEAK		
AM - PEAK HR TIME			PM - PEAK HR TIME		
05:00 AM to 06:00 AM			05:00 PM to 06:00 PM		
AM - PEAK HR VOLUME	3067	603	PM - PEAK HR VOLUME	1193	2442
AM - K FACTOR (%)			PM - K FACTOR (%)		6.78
AM - D (%)	83.57	16.43	PM - D (%)	32.82	67.18
DIRECTIONAL PEAK			DIRECTIONAL PEAK		
AM - PEAK HR TIME			PM - PEAK HR TIME		
05:00 AM to 06:00 AM			07:45 AM to 08:45 AM		
AM - PEAK HR VOLUME	3067	1525	PM - PEAK HR VOLUME	1361	2442

AM PERIOD (00:00-12:00)	PM PERIOD (12:00-24:00)
TWO DIRECTIONAL PEAK	
AM - PEAK HR TIME	
05:00 AM to 06:00 AM	
AM - PEAK HR VOLUME	PM - PEAK HR TIME
3067	02:15 PM to 03:15 PM
603	PM - PEAK HR VOLUME
3670	1440
6.84	2480
83.57	7.31
16.43	100.00
100.00	36.73
	63.27
	100.00

NON-COMMUTER PERIOD (09:00-15:00)	6-HR, 12-HR, 24-HR PERIODS	DIR 1	DIR 2	Total
TWO DIRECTIONAL PEAK		AM 6-HR PERIOD (06:00-12:00)		
PEAK HR TIME		9,718		
02:00 PM to 03:00 PM		8,336		
PEAK HR VOLUME	1408	2388	3796	18,054
DIRECTIONAL PEAK		AM 12-HR PERIOD (00:00-12:00)		
PEAK HR TIME		15,420		
10:45 AM to 11:45 AM		9,577		
PEAK HR VOLUME	1600	2388		24,997
		PM 6-HR PERIOD (12:00-18:00)		
		8,090		
		11,851		
		19,941		
		PM 12-HR PERIOD (12:00-24:00)		
		11,538		
		17,116		
		28,654		
		24 HOUR PERIOD		
		26,958		
		26,693		
		53,651		
		D (%)		
		50.25		
		49.75		
		100.00		

Run Date: 2014/06/02

Hawaii Department of Transportation
Highways Division
Highways Planning Survey Section

Vehicle Classification Data Summary
2013

Site ID: B72009902025

Route No: 99

Date From: 2013/11/19 0:00

Town: Oahu

Direction: +MP

Date To: 2013/11/20 23:45

Location: Kamehameha Hwy at Kalauao Stream Bridge

Functional Classification: 14 URBAN:PRINCIPAL ARTERIAL - OTHER
REPORT TOTALS - 48 HOURS RECORDED

	VOLUME	%	NUMBER OF AXLES
Cycles	280	0.26%	559
PC	86367	80.34%	172734
2A-4T	14926	13.88%	29852

LIGHT VEHICLE TOTALS	101572	94.48%	203145
HEAVY VEHICLES			
Bus	2249	2.09%	5623
SINGLE UNIT TRUCK			
2A-6T	1663	1.55%	3326
3A-SU	140	0.13%	420
4A-SU	17	0.02%	68
SINGLE-TRAILER TRUCKS			
4A-ST	1566	1.46%	6264
5A-ST	202	0.19%	1010
6A-ST	9	0.01%	54
MULTI-TRAILER TRUCKS			
5A-MT	56	0.05%	280
6A-MT	2	0.00%	12
7A-MT	32	0.03%	224

HEAVY VEHICLE TOTALS	5936	5.52%	17281
CLASSIFIED VEHICLES TOTALS	107509 (A)	100.00%	220425 (B)
UNCLASSIFIED VEHICLES TOTALS	-3	-0.00%	

AXLE
CORRECTION
FACTOR (A/C) = 0.975

ROADTUBE
EQUIVALENT(B/2) = 110213 (C)

PEAK HOUR VOLUME : 3829 2013/11/20 14:00	PEAK HOUR TRUCK VOLUME	% TOTAL PEAK HOUR VOLUME	24 HOUR TRUCK VOLUME	AADT	% OF AADT	HPMS K-FACTOR (PEAK/AADT) (ITEM 66)
SINGLE UNIT TRUCKS (TYPE 4-7)	119	(65A-1) 3.11%	2034	50800	(65A-2) 4.00%	7.54%
COMBINATION (TYPE 8-13)	47	(65B-1) 1.23%	933		(65B-2) 1.84%	7.54%

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Appendix B

Automatic Traffic Recorder Traffic Count Worksheets

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MetroCount Traffic Executive Vehicle Counts

Datasets:

Site: **[Waipahu Depot Street]** Waipahu Depot Street between PHBP and Police Training Academy
(Toward Farrington Hwy)
June 12, 2019

Attribute: June 12, 2019

Direction: **7 - North bound A>B**, South bound B>A. **Lane:** 0

Survey Duration: 11:18 Wednesday, June 12, 2019 => 13:37 Friday, June 14, 2019,

Zone:

File: Waipahu Depot Street 0 2019-06-14 1338.EC0 (Regular)

Identifier: R186JWT5 MC56-L5 [MC55] (c)Microcom 19Oct04

Algorithm: Factory default axle (v5.02)

Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **12:00 Wednesday, June 12, 2019 => 12:00 Friday, June 14, 2019 (2)**

Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13

Speed range: 5 - 100 mph.

Direction: **AB** , Lane = 0-16

Separation: Headway > 0 sec, Span 0 - 300 ft

Name: Default Profile

Scheme: Vehicle classification (Scheme F3)

Units: Non metric (ft, mi, ft/s, mph, lb, ton)

In profile: Vehicles = 889 / 2041 (43.56%)

MetroCount Traffic Executive Vehicle Counts

Datasets:

Site: [Waipahu Depot Street] Waipahu Depot Street between PHBP and Police Training Academy
Attribute: June 12, 2019
Direction: 7 - North bound A>B, **South bound B>A. Lane:** 0
Survey Duration: 11:18 Wednesday, June 12, 2019 => 13:37 Friday, June 14, 2019,
Zone:
File: Waipahu Depot Street 0 2019-06-14 1338.EC0 (Regular)
Identifier: R186JWT5 MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **12:00 Wednesday, June 12, 2019 => 12:00 Friday, June 14, 2019 (2)**
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range: 5 - 100 mph.
Direction: **BA** , Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 300 ft
Name: Default Profile
Scheme: Vehicle classification (Scheme F3)
Units: Non metric (ft, mi, ft/s, mph, lb, ton)
In profile: Vehicles = 1117 / 2041 (54.73%)

MetroCount Traffic Executive Vehicle Counts

Datasets:

Site: [Lehua Avenue] NB Lehua Avenue between Kamehameha Hwy and 4th St
Attribute: June 17, 2019
Direction: 5 - South bound A>B, **North bound B>A. Lane:** 0
Survey Duration: 10:17 Monday, June 17, 2019 => 10:40 Wednesday, June 19, 2019,
Zone:
File: NB Lehua Avenue 0 2019-06-19 1041.EC0 (Regular)
Identifier: R186JWT5 MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **12:00 Monday, June 17, 2019 => 10:00 Wednesday, June 19, 2019 (1.91667)**
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range: 5 - 100 mph.
Direction: **BA** , Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 300 ft
Name: Default Profile
Scheme: Vehicle classification (Scheme F3)
Units: Non metric (ft, mi, ft/s, mph, lb, ton)
In profile: Vehicles = 11056 / 12172 (90.83%)

MetroCount Traffic Executive Vehicle Counts

Datasets:

Site: [Lehua Ave] Lehua Ave SB btw Kamehameha Hwy and 4th St
Attribute: June 17, 2019
Direction: 7 - North bound A>B, South bound B>A. **Lane:** 0
Survey Duration: 10:21 Monday, June 17, 2019 => 10:30 Wednesday, June 19, 2019,
Zone:
File: SB Lehua Ave 0 2019-06-19 1030.EC0 (Regular)
Identifier: R090852E MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 11:00 Monday, June 17, 2019 => 9:00 Wednesday, June 19, 2019 (1.91667)
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range: 5 - 100 mph.
Direction: BA , Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 300 ft
Name: Default Profile
Scheme: Vehicle classification (Scheme F3)
Units: Non metric (ft, mi, ft/s, mph, lb, ton)
In profile: Vehicles = 11474 / 12034 (95.35%)

MetroCount Traffic Executive Vehicle Counts

Datasets:

Site: [Waihona Street] Waihona Street along Straight Segment after Kamehameha Hwy
Attribute: June 19, 2019
Direction: 5 - South bound A>B, **North bound B>A. Lane:** 0
Survey Duration: 11:17 Wednesday, June 19, 2019 => 12:06 Friday, June 21, 2019,
Zone:
File: Waihona Street 0 2019-06-21 1207.EC0 (Regular)
Identifier: R186JWT5 MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **12:00 Wednesday, June 19, 2019 => 10:00 Friday, June 21, 2019 (1.91667)**
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range: 5 - 100 mph.
Direction: **BA** , Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 300 ft
Name: Default Profile
Scheme: Vehicle classification (Scheme F3)
Units: Non metric (ft, mi, ft/s, mph, lb, ton)
In profile: Vehicles = 4409 / 9401 (46.90%)

MetroCount Traffic Executive Vehicle Counts

Datasets:

Site: [Waihona Street] Waihona Street along Straight Segment after Kamehameha Hwy
Attribute: June 19, 2019
Direction: 5 - South bound A>B, North bound B>A. Lane: 0
Survey Duration: 11:17 Wednesday, June 19, 2019 => 12:06 Friday, June 21, 2019,
Zone:
File: Waihona Street 0 2019-06-21 1207.EC0 (Regular)
Identifier: R186JWT5 MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 12:00 Wednesday, June 19, 2019 => 9:00 Friday, June 21, 2019 (1.875)
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range: 5 - 100 mph.
Direction: AB , Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 300 ft
Name: Default Profile
Scheme: Vehicle classification (Scheme F3)
Units: Non metric (ft, mi, ft/s, mph, lb, ton)
In profile: Vehicles = 4397 / 9401 (46.77%)

MetroCount Traffic Executive Vehicle Counts

Datasets:

Site: [Waipio Point Access Road] Waipio Point Access Road between two bridges
Attribute: June 19, 2019
Direction: 5 - South bound A>B, **North bound B>A. Lane:** 0
Survey Duration: 12:07 Wednesday, June 19, 2019 => 12:13 Friday, June 21, 2019,
Zone:
File: Waipio Point Access Road 0 2019-06-21 1214.EC0 (Regular)
Identifier: R090852E MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: **13:00 Wednesday, June 19, 2019 => 10:00 Friday, June 21, 2019 (1.875)**
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range: 5 - 100 mph.
Direction: **BA** , Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 300 ft
Name: Default Profile
Scheme: Vehicle classification (Scheme F3)
Units: Non metric (ft, mi, ft/s, mph, lb, ton)
In profile: Vehicles = 1277 / 2586 (49.38%)

MetroCount Traffic Executive Vehicle Counts

Datasets:

Site: [Wapio Point Access Road] Wapio Point Access Road between two bridges
Attribute: June 19, 2019
Direction: 5 - South bound A>B, North bound B>A. Lane: 0
Survey Duration: 12:07 Wednesday, June 19, 2019 => 12:13 Friday, June 21, 2019,
Zone:
File: Wapio Point Access Road 0 2019-06-21 1214.EC0 (Regular)
Identifier: R090852E MC56-L5 [MC55] (c)Microcom 19Oct04
Algorithm: Factory default axle (v5.02)
Data type: Axle sensors - Paired (Class/Speed/Count)

Profile:

Filter time: 13:00 Wednesday, June 19, 2019 => 10:00 Friday, June 21, 2019 (1.875)
Included classes: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13
Speed range: 5 - 100 mph.
Direction: AB , Lane = 0-16
Separation: Headway > 0 sec, Span 0 - 300 ft
Name: Default Profile
Scheme: Vehicle classification (Scheme F3)
Units: Non metric (ft, mi, ft/s, mph, lb, ton)
In profile: Vehicles = 1194 / 2586 (46.17%)

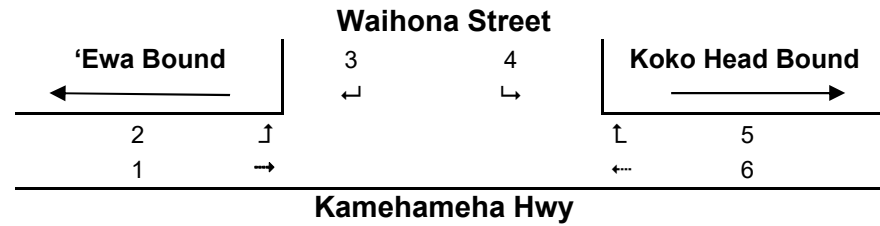
Appendix C

Turning Movement Traffic Count Worksheets

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HONOULIULI TRANSPORTATION ANALYSIS VEHICLE TURNING MOVEMENT FORM

LOCATION: Kamehameha Highway and Waihona Street
DATE: 6/12/2019
TIME: 6:00-8:00a
WEATHER: Clear
RECORDER: JY

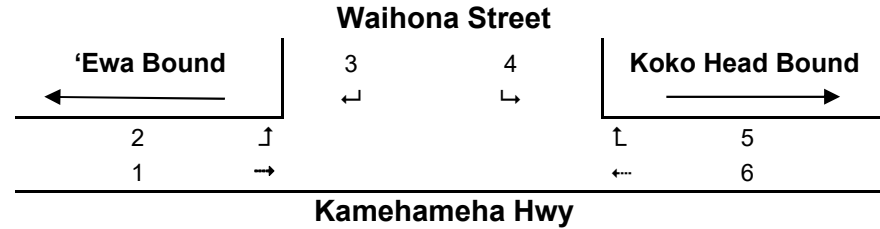


TIME PERIOD	MOVEMENT NUMBER					
	1	2	3	4	5	6
6:00-6:15a	0	0	6	19	75	133
6:15-6:30a	0	0	18	39	58	118
6:30-6:45a	0	0	13	23	91	183
6:45-7:00a	0	0	15	30	98	144
7:00-7:15a	0	0	9	25	69	156
7:15-7:30a	0	0	22	23	67	207
7:30-7:45a	0	0	11	26	42	199
7:45-8:00a	0	0	10	20	62	199
Peak Hour: 6:30-7:30a			59	101	325	690

Notes:

HONOULIULI TRANSPORTATION ANALYSIS VEHICLE TURNING MOVEMENT FORM

LOCATION: Kamehameha Highway and Waihona Street
DATE: 6/12/2019
TIME: 3:00-5:30p
WEATHER: Clear
RECORDER: JY

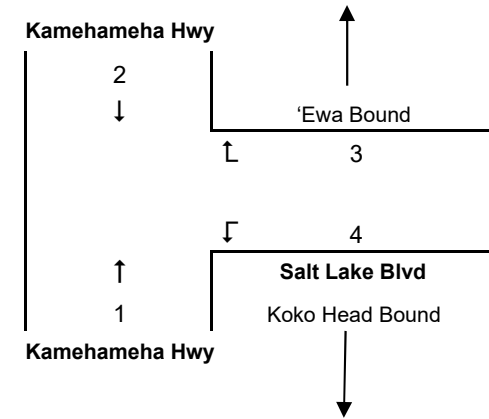


TIME PERIOD	MOVEMENT NUMBER					
	1	2	3	4	5	6
3:00-3:15p	0	0	31	32	46	342
3:15-3:30p	0	0	36	22	53	391
3:30-3:45p	0	0	34	35	20	447
3:45-4:00p	0	0	36	27	35	422
4:00-4:15p	0	0	50	30	25	416
4:15-4:30p	0	0	40	35	18	470
4:30-4:45p	0	0	43	32	29	431
4:45-5:00p	0	0	28	24	13	446
5:00-5:15p	0	0	32	21	19	427
5:15-5:30p	0	0	30	23	9	388
Peak Hour 3:30-4:30p	0	0	160	127	98	1755

Notes: Queueing on Waihona Street during the peak hour

HONOULIULI TRANSPORTATION ANALYSIS VEHICLE TURNING MOVEMENT FORM

LOCATION: Kamehameha Highway and Salt Lake Boulevard
DATE: 6/13/2019
TIME: 6:00-8:00a
WEATHER: Clear
RECORDER: JY



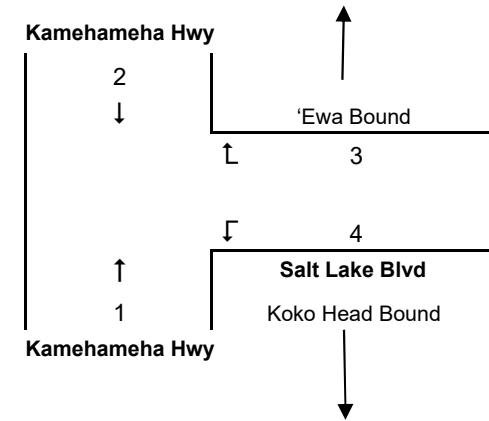
TIME PERIOD	MOVEMENT NUMBER			
	1	2	3	4
6:00-6:15a	44	434	36	73
6:15-6:30a	51	354	38	62
6:30-6:45a	60	354	42	68
6:45-7:00a	52	277	50	48
7:00-7:15a	62	243	57	85
7:15-7:30a	61	208	54	73
7:30-7:45a	44	249	59	95
7:45-8:00a	70	239	93	78
Peak Hour: 6:00-7:00a	207	1419	166	251

587
 505
 524
 427 2043
 447 1903
 396 1794
 447 1717
 480 1770

Notes: In the first couple periods, vehicles turning left from Salt Lake Blvd sometimes could not turn onto Kamehameha Hwy due to the queue
 The left-turn lane also could not always clear the queue in those instances
 Peak may have occurred a bit earlier than from 6-7a
 Cycle length of the traffic signal varied. After 8 am, I timed a 110 sec, 140 sec (twice), and 125 sec (twice)
 Approximately 4 seconds for the amber

HONOULIULI TRANSPORTATION ANALYSIS VEHICLE TURNING MOVEMENT FORM

LOCATION: Kamehameha Highway and Salt Lake Boulevard
DATE: 6/13/2019
TIME: 3:15-5:30p
WEATHER: Clear
RECORDER: JY



TIME PERIOD	MOVEMENT NUMBER			
	1	2	3	4
3:15-3:30p	438	150	152	40
3:30-3:45p	436	131	132	34
3:45-4:00p	489	141	126	36
4:00-4:15p	435	136	175	23
4:15-4:30p	503	139	161	34
4:30-4:45p	498	159	156	18
4:45-5:00p	432	151	198	38
5:00-5:15p	422	121	151	37
5:15-5:30p	296	123	121	25
Peak Hour 4:00-5:00p	1868	585	690	113

Notes: Observed cycle lengths include 250 sec, 110 sec (observed twice), and 155 sec.
 Direction 1 did not start its green phase along with Direction 2. It held its red phase for 15-25 sec. longer than Direction 2 (from field measurements)

Appendix D
Intersection Level of Service Definitions

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Highway Capacity Manual 2010

Signalized intersection level of service (LOS) is defined in terms of a weighted average control delay for the entire intersection. Control delay quantifies the increase in travel time that a vehicle experiences due to the traffic signal control as well as provides a surrogate measure for driver discomfort and fuel consumption. Signalized intersection LOS is stated in terms of average control delay per vehicle (in seconds) during a specified time period (e.g., weekday PM peak hour). Control delay is a complex measure based on many variables, including signal phasing and coordination (i.e., progression of movements through the intersection and along the corridor), signal cycle length, and traffic volumes with respect to intersection capacity and resulting queues. Table 1 summarizes the LOS criteria for signalized intersections, as described in the *Highway Capacity Manual 2010* (Transportation Research Board, 2010).

Table 1. Level of Service Criteria for Signalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)	General Description
A	≤10	Free Flow
B	>10 – 20	Stable Flow (slight delays)
C	>20 – 35	Stable flow (acceptable delays)
D	>35 – 55	Approaching unstable flow (tolerable delay, occasionally wait through more than one signal cycle before proceeding)
E	>55 – 80	Unstable flow (intolerable delay)
F ¹	>80	Forced flow (congested and queues fail to clear)

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

1. If the volume-to-capacity (v/c) ratio for a lane group exceeds 1.0 LOS F is assigned to the individual lane group. LOS for overall approach or intersection is determined solely by the control delay.

Unsignalized intersection LOS criteria can be further reduced into three intersection types: all-way stop, two-way stop, and roundabout control. All-way stop and roundabout control intersection LOS is expressed in terms of the weighted average control delay of the overall intersection or by approach. Two-way stop-controlled intersection LOS is defined in terms of the average control delay for each minor-street movement (or shared movement) as well as major-street left-turns. This approach is because major-street through vehicles are assumed to experience zero delay, a weighted average of all movements results in very low overall average delay, and this calculated low delay could mask deficiencies of minor movements. Table 2 shows LOS criteria for unsignalized intersections.

Table 2. Level of Service Criteria for Unsignalized Intersections

Level of Service	Average Control Delay (seconds/vehicle)
A	0 – 10
B	>10 – 15
C	>15 – 25
D	>25 – 35
E	>35 – 50
F ¹	>50

Source: *Highway Capacity Manual 2010*, Transportation Research Board, 2010.

1. If the volume-to-capacity (v/c) ratio exceeds 1.0, LOS F is assigned an individual lane group for all unsignalized intersections, or minor street approach at two-way stop-controlled intersections. Overall intersection LOS is determined solely by control delay.

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Appendix E

Intersection Operations Analysis – Synchro Worksheets

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HCM 2010 TWSC
 3: Kamehameha Highway & Waihona Street

07/03/2019

Intersection

Int Delay, s/veh 3.2

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑	↗	↘	↗
Traffic Vol, veh/h	0	0	690	325	101	59
Future Vol, veh/h	0	0	690	325	101	59
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	Free	-	Yield
Storage Length	-	-	-	300	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	750	353	110	64

Major/Minor

	Major1	Major2	Minor2		
Conflicting Flow All	-	0	-	0	750 375
Stage 1	-	-	-	-	750 -
Stage 2	-	-	-	-	0 -
Critical Hdwy	-	-	-	-	6.84 6.94
Critical Hdwy Stg 1	-	-	-	-	5.84 -
Critical Hdwy Stg 2	-	-	-	-	5.84 -
Follow-up Hdwy	-	-	-	-	3.52 3.32
Pot Cap-1 Maneuver	0	-	-	0	347 623
Stage 1	0	-	-	0	427 -
Stage 2	0	-	-	0	- -
Platoon blocked, %	-	-	-	-	- -
Mov Cap-1 Maneuver	-	-	-	-	347 623
Mov Cap-2 Maneuver	-	-	-	-	347 -
Stage 1	-	-	-	-	427 -
Stage 2	-	-	-	-	- -

Approach

	EB	WB	SB
HCM Control Delay, s	0	0	16.9
HCM LOS			C

Minor Lane/Major Mvmt

	EBT	WBT	SBLn1	SBLn2
Capacity (veh/h)	-	-	347	623
HCM Lane V/C Ratio	-	-	0.316	0.103
HCM Control Delay (s)	-	-	20.1	11.4
HCM Lane LOS	-	-	C	B
HCM 95th %tile Q(veh)	-	-	1.3	0.3

HCM 2010 TWSC
 3: Kamehameha Highway & Waihona Street

07/03/2019

Intersection

Int Delay, s/veh 49.5

Movement	EBL	EBT	WBT	WBR	SBL	SBR
Lane Configurations		↑↑	↑↑	↗	↘	↗
Traffic Vol, veh/h	0	0	1755	98	127	160
Future Vol, veh/h	0	0	1755	98	127	160
Conflicting Peds, #/hr	0	0	0	0	0	0
Sign Control	Free	Free	Free	Free	Stop	Stop
RT Channelized	-	None	-	Free	-	Yield
Storage Length	-	-	-	300	0	0
Veh in Median Storage, #	-	0	0	-	0	-
Grade, %	-	0	0	-	0	-
Peak Hour Factor	92	92	92	92	92	92
Heavy Vehicles, %	2	2	2	2	2	2
Mvmt Flow	0	0	1908	107	138	174

Major/Minor

	Major1	Major2	Minor2		
Conflicting Flow All	-	0	-	0	1908 954
Stage 1	-	-	-	-	1908 -
Stage 2	-	-	-	-	0 -
Critical Hdwy	-	-	-	-	6.84 6.94
Critical Hdwy Stg 1	-	-	-	-	5.84 -
Critical Hdwy Stg 2	-	-	-	-	5.84 -
Follow-up Hdwy	-	-	-	-	3.52 3.32
Pot Cap-1 Maneuver	0	-	-	0	~ 60 259
Stage 1	0	-	-	0	~ 102 -
Stage 2	0	-	-	0	- -
Platoon blocked, %	-	-	-	-	- -
Mov Cap-1 Maneuver	-	-	-	-	~ 60 259
Mov Cap-2 Maneuver	-	-	-	-	~ 60 -
Stage 1	-	-	-	-	~ 102 -
Stage 2	-	-	-	-	- -

Approach

	EB	WB	SB
HCM Control Delay, s	0	0	\$ 352.5
HCM LOS			F

Minor Lane/Major Mvmt







	EBT	WBT	SBLn1	SBLn2
Capacity (veh/h)	-	-	60	259
HCM Lane V/C Ratio	-	-	2.301	0.671
HCM Control Delay (s)	-	-	\$ 742.1	43.3
HCM Lane LOS	-	-	F	E
HCM 95th %tile Q(veh)	-	-	13.6	4.4

Notes

~: Volume exceeds capacity \$: Delay exceeds 300s +: Computation Not Defined *: All major volume in platoon







HCM 2010 Signalized Intersection Summary
 3: Kamehameha Highway & Salt Lake Boulevard

07/03/2019

								
Movement	EBL	EBT	WBT	WBR	SBL	SBR		
Lane Configurations		↑↑↑	↑↑↑		↔↔	↔↔		
Traffic Volume (veh/h)	0	1419	207	0	251	166		
Future Volume (veh/h)	0	1419	207	0	251	166		
Number	7	4	8	18	1	16		
Initial Q (Qb), veh	0	0	0	0	0	0		
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00		
Adj Sat Flow, veh/h/ln	0	1863	1863	0	1863	1863		
Adj Flow Rate, veh/h	0	1542	225	0	273	180		
Adj No. of Lanes	0	4	3	0	2	2		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Percent Heavy Veh, %	0	2	2	0	2	2		
Cap, veh/h	0	3225	2559	0	1221	989		
Arrive On Green	0.00	0.50	0.50	0.00	0.35	0.35		
Sat Flow, veh/h	0	6929	5421	0	3442	2787		
Grp Volume(v), veh/h	0	1542	225	0	273	180		
Grp Sat Flow(s),veh/h/ln	0	1602	1695	0	1721	1393		
Q Serve(g_s), s	0.0	11.1	1.6	0.0	3.9	3.1		
Cycle Q Clear(g_c), s	0.0	11.1	1.6	0.0	3.9	3.1		
Prop In Lane	0.00			0.00	1.00	1.00		
Lane Grp Cap(c), veh/h	0	3225	2559	0	1221	989		
V/C Ratio(X)	0.00	0.48	0.09	0.00	0.22	0.18		
Avail Cap(c_a), veh/h	0	8185	4691	0	1221	989		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	0.00	1.00	1.00	0.00	1.00	1.00		
Uniform Delay (d), s/veh	0.0	11.4	9.1	0.0	15.9	15.7		
Incr Delay (d2), s/veh	0.0	0.1	0.0	0.0	0.4	0.4		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	0.0	4.8	0.8	0.0	1.9	2.9		
LnGrp Delay(d),s/veh	0.0	11.6	9.1	0.0	16.4	16.1		
LnGrp LOS		B	A		B	B		
Approach Vol, veh/h		1542	225		453			
Approach Delay, s/veh		11.6	9.1		16.2			
Approach LOS		B	A		B			
Timer	1	2	3	4	5	6	7	8
Assigned Phs				4		6		8
Phs Duration (G+Y+Rc), s				40.5		30.0		40.5
Change Period (Y+Rc), s				5.0		5.0		5.0
Max Green Setting (Gmax), s				90.0		25.0		65.0
Max Q Clear Time (g_c+I1), s				13.1		5.9		3.6
Green Ext Time (p_c), s				22.4		1.6		21.3
Intersection Summary								
HCM 2010 Ctrl Delay			12.3					
HCM 2010 LOS			B					
Notes								
User approved pedestrian interval to be less than phase max green.								

HCM 2010 Signalized Intersection Summary
 3: Kamehameha Highway & Salt Lake Boulevard

07/03/2019

								
Movement	EBL	EBT	WBT	WBR	SBL	SBR		
Lane Configurations		↑↑↑	↑↑↑		↔↔	↔↔		
Traffic Volume (veh/h)	0	585	1868	0	113	690		
Future Volume (veh/h)	0	585	1868	0	113	690		
Number	7	4	8	18	1	16		
Initial Q (Qb), veh	0	0	0	0	0	0		
Ped-Bike Adj(A_pbT)	1.00			1.00	1.00	1.00		
Parking Bus, Adj	1.00	1.00	1.00	1.00	1.00	1.00		
Adj Sat Flow, veh/h/ln	0	1863	1863	0	1863	1863		
Adj Flow Rate, veh/h	0	636	2030	0	123	750		
Adj No. of Lanes	0	4	3	0	2	2		
Peak Hour Factor	0.92	0.92	0.92	0.92	0.92	0.92		
Percent Heavy Veh, %	0	2	2	0	2	2		
Cap, veh/h	0	4274	3392	0	818	663		
Arrive On Green	0.00	0.67	0.67	0.00	0.24	0.24		
Sat Flow, veh/h	0	6929	5421	0	3442	2787		
Grp Volume(v), veh/h	0	636	2030	0	123	750		
Grp Sat Flow(s),veh/h/ln	0	1602	1695	0	1721	1393		
Q Serve(g_s), s	0.0	3.9	23.3	0.0	3.0	25.0		
Cycle Q Clear(g_c), s	0.0	3.9	23.3	0.0	3.0	25.0		
Prop In Lane	0.00			0.00	1.00	1.00		
Lane Grp Cap(c), veh/h	0	4274	3392	0	818	663		
V/C Ratio(X)	0.00	0.15	0.60	0.00	0.15	1.13		
Avail Cap(c_a), veh/h	0	7314	4692	0	818	663		
HCM Platoon Ratio	1.00	1.00	1.00	1.00	1.00	1.00		
Upstream Filter(I)	0.00	1.00	1.00	0.00	1.00	1.00		
Uniform Delay (d), s/veh	0.0	6.5	9.7	0.0	31.7	40.1		
Incr Delay (d2), s/veh	0.0	0.0	0.2	0.0	0.4	77.2		
Initial Q Delay(d3),s/veh	0.0	0.0	0.0	0.0	0.0	0.0		
%ile BackOfQ(50%),veh/ln	0.0	1.7	10.8	0.0	1.5	24.1		
LnGrp Delay(d),s/veh	0.0	6.5	9.9	0.0	32.1	117.3		
LnGrp LOS		A	A		C	F		
Approach Vol, veh/h		636	2030		873			
Approach Delay, s/veh		6.5	9.9		105.3			
Approach LOS		A	A		F			
Timer	1	2	3	4	5	6	7	8
Assigned Phs				4		6		8
Phs Duration (G+Y+Rc), s				75.1		30.0		75.1
Change Period (Y+Rc), s				5.0		5.0		5.0
Max Green Setting (Gmax), s				120.0		25.0		97.0
Max Q Clear Time (g_c+I1), s				5.9		27.0		25.3
Green Ext Time (p_c), s				56.9		0.0		44.9
Intersection Summary								
HCM 2010 Ctrl Delay			32.8					
HCM 2010 LOS			C					

Appendix F: Economic and Fiscal Impacts

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APPENDIX F

ECONOMIC AND FISCAL IMPACTS

This report analyzes the potential economic and fiscal impacts of the proposed upgrading and/or expanding of the existing East Interceptor System in the Honouliuli sewer basin. The analysis estimates the economic impacts of the Proposed Action, which cover expenditures and sales, employment, and payroll, and the fiscal impacts of the action on revenues of the State of Hawaii. The impacts from the Proposed Action would occur both in the construction period and on an annual basis during operations.

F.1 METHODOLOGY

Construction period impacts are estimated using Proposed Actioned construction costs, and annual operations impacts are estimated using Proposed Actioned operations costs. In this analysis, these costs are transformed into economic and fiscal impacts by multiplying the costs or spending by multipliers from the 2012 Hawaii inter-county input-output (I-O) model updated by the Department of Business, Economic Development, and Tourism (DBEDT) in 2016 (DBEDT, 2016a), as well as the 2012 Hawaii state I-O model updated by DBEDT in 2016 (DBEDT, 2016b). The Hawaii state I-O model measures how money flows through the state through purchases and sales (inputs and outputs) that businesses and households make. It measures what comes in, through purchases that businesses and households make that come from outside of the state, or imports; and what goes out, through sales and services, or exports. The inter-county I-O model measures how money flows among various economic sectors within each county and between counties.

Economic and fiscal impacts were evaluated for both the initial change in the economy as a result of the Proposed Action – in other words, the new money spent by the action and the new people employed – as well as the impacts of those changes on the overall economy of the City and County of Honolulu. New spending from Proposed Action construction and operations would create sales for businesses, new employment (jobs), and earnings (wages). The new spending would ripple through the economy, creating direct (or initial), indirect (or successive), and induced effects. In the context of the Proposed Action, these are characterized as follows:

- Direct effects measure the volume of economic activity initially produced by constructing and operating the Proposed Action.
- Indirect effects measure the economic activity produced by the purchases of inputs from local industries necessary to construct and operate the Proposed Action.

- Induced effects measure the economic activity produced by the construction spending by households that results from changes in earnings through the direct and indirect effects of the Proposed Action.

I-O model multipliers are used to enable a fairly accurate analysis without difficult and costly survey taking. While the advantages outweigh the disadvantages, it is important to understand the following limitations of using any multipliers:

- One assumption is the accuracy of the data used. To perform the analysis, assumptions are used as a best guess of construction costs and future spending.
- Another assumption is that there are no supply constraints. For example, if operation of the Proposed Action creates a greater need for energy, the price of energy could go up. However, for the analysis, there is no adjustment for this potential cost increase.
- Use of I-O model multipliers also assumes that all businesses of the same type conduct business the same way, using a certain number of employees and a certain amount of raw materials to produce sales. In reality, some companies may have ways to use fewer employees or raw materials.
- Finally, there is no way of knowing exactly when an effect will occur. If a purchase is made, for example, in 2019 or in 2030, that does not mean that effects would occur in the same year. An effect may not occur for several years or may be spread over several years. In most cases, however, it is reasonable to assume that the greatest effect will occur in the year after money is spent.

F.2 ECONOMIC AND FISCAL IMPACTS OF CONSTRUCTION

The Proposed Action would construct replacement wastewater pump stations and force mains, and new force mains and trunk sewers to increase the capacity and rehabilitate the existing conveyance system from Hālawā to the Honouliuli Wastewater Treatment Plant. The construction expenditures would result in one-time increases in economic output, employment, and earnings, and one-time increases in fiscal revenues of the state. The economic impacts of Proposed Action construction would include the impact of expenditures on construction materials, and on earnings of construction workers and professional service providers during the construction period. Construction costs were used to estimate economic and fiscal impacts during the construction period.

The estimated construction period is 19 years for the East Interceptor No-Tunnel option and 16 years for the Hybrid option (AECOM 2019). The construction periods for the Waiawa Area conveyance options are not known at this time; however, it is expected that construction of the conveyance system to serve the proposed Waiawa Ridge development would occur during construction work on the East Interceptor System.

The Proposed Action would cost an estimated \$784 million to \$888 million to complete, depending on the East Interceptor and Waiawa Area options constructed (AECOM 2016b, 2018). These estimates are inclusive of the costs of rehabilitating

or upgrading the East Interceptor Conveyance System and the costs of constructing a new Waiawa Area Conveyance System. The estimates include both hard and soft costs. Hard costs comprise the construction materials and construction labor, while soft costs comprise engineering, commissioning, legal, and fiscal expenses not directly involved in the construction. Engineering, commissioning, legal, and fiscal costs were estimated to be 20 percent of the hard costs (AECOM 2014b), or approximately 16.7 percent of the total construction costs. **Table E-1** shows the estimated hard costs, soft costs, and total costs of constructing the Proposed Action.

Table E-1. Construction Costs

		Cost	
		%	\$
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor A</i>			
Hard Costs	Heavy and Civil Engineering Construction	83.3	653,398,333
Soft Costs	Architectural and Engineering Services	16.7	130,679,667
Total Construction Costs		100.0	784,078,000
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor D</i>			
Hard Costs	Heavy and Civil Engineering Construction	83.3	656,005,000
Soft Costs	Architectural and Engineering Services	16.7	131,201,000
Total Construction Costs		100.0	787,206,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor A</i>			
Hard Costs	Heavy and Civil Engineering Construction	83.3	732,350,000
Soft Costs	Architectural and Engineering Services	16.7	146,470,000
Total Construction Costs		100.0	878,820,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor D</i>			
Hard Costs	Heavy and Civil Engineering Construction	83.3	734,868,333
Soft Costs	Architectural and Engineering Services	16.7	146,973,667
Total Construction Costs		100.0	881,842,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor G</i>			
Hard Costs	Heavy and Civil Engineering Construction	83.3	739,905,000
Soft Costs	Architectural and Engineering Services	16.7	147,981,000
Total Construction Costs		100.0	887,886,000

Source: AECOM 2016b, 2018.

For the East Interceptor options, the hard costs shown in **Table E-1** are in 2016 dollars and were inflated to the estimated mid-point of construction: 2031 for the No-Tunnel option and 2030 for the Hybrid option. The hard costs for the Waiawa Area conveyance options are in 2018 dollars. As it is expected that construction of the conveyance system to serve the proposed Waiawa Ridge development would occur during construction work on the East Interceptor System, the hard costs for the Waiawa Area conveyance options were inflated to the estimated mid-points of construction for the East Interceptor options.

Multipliers for heavy and civil engineering construction were applied to hard costs; whereas, multipliers for architectural and engineering services were applied to the soft costs. **Table E-2** shows the resulting economic and fiscal impacts. If the East Interceptor No-Tunnel option is constructed along with any of the Waiawa Area options, on a one-time basis, Proposed Action construction would have an estimated total economic impact of approximately \$1.7 billion in output, supporting a total of approximately 9,800 jobs, earnings of \$550 million, and fiscal revenues of \$110 million. Construction of the East Interceptor Hybrid option would have a higher economic and fiscal impact, with an estimated total economic impact of \$1.9 billion in output, supporting a total of approximately 11,000 jobs, earnings of \$610 million to \$620 million, and fiscal revenues of \$120 million.

The employment values are expected to be overestimates, as the employment multipliers tend to decrease over time due to increases in worker productivity and inflation (DBEDT 2016b). The state taxes in the 2012 I-O model predominantly comprise general excise and use tax, and individual income tax, which together account for about 79 percent of total state taxes, as well as 11 other categories of taxes that represent lesser portions of the tax revenues of the state.

Construction expenditures and therefore the resulting effects actually would vary from year to year. However, for the East Interceptor Hybrid option with Waiawa Area Corridor G, the combination of options with the highest impact, the estimated total economic impact translates to an average annual economic impact of about \$120 million, which would support approximately 690 jobs, earnings of \$40 million, and fiscal revenues of \$7.8 million per year. Providing each job or employee represents one household and assuming the current average household size of 3.06 people in Honolulu County (United States Census Bureau [USCB], 2019), direct, indirect, and induced jobs provided by Proposed Action construction would support approximately 2,110 residents on average during Proposed Action construction.

Table E-2. One-Time Economic and Fiscal Impacts of Construction

	Output	Earnings	Employment	State Tax
	Million \$	Million \$	Jobs	Million \$
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor A</i>				
Direct/Indirect Impact				
Hard Construction Costs	974	327	5,162	69
Soft Construction Costs	186	82	1,085	15
Total	1,159	409	6,246	83
Induced Impact				
Hard Construction Costs	412	111	2,810	21
Soft Construction Costs	103	27	706	5
Total	515	139	3,515	26
Total Impact				
Hard Construction Costs	1,385	438	7,971	90
Soft Construction Costs	289	110	1,790	20
Total	1,674	548	9,762	110
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor D</i>				
Direct/Indirect Impact				
Hard Construction Costs	977	328	5,182	69
Soft Construction Costs	186	83	1,089	15
Total	1,164	411	6,271	84
Induced Impact				
Hard Construction Costs	413	112	2,821	21
Soft Construction Costs	104	28	708	5
Total	517	139	3,529	26
Total Impact				
Hard Construction Costs	1,391	440	8,003	90
Soft Construction Costs	290	110	1,797	20
Total	1,681	550	9,801	110

**Table E-2. One-Time Economic and Fiscal Impacts of Construction
(continued)**

	Output	Earnings	Employment	State Tax
	Million \$	Million \$	Jobs	Million \$
<i>East Interceptor Hybrid Option with Waiawa Area Corridor A</i>				
Direct/Indirect Impact				
Hard Construction Costs	1,091	366	5,786	77
Soft Construction Costs	208	92	1,216	16
Total	1,299	458	7,001	93
Induced Impact				
Hard Construction Costs	461	124	3,149	23
Soft Construction Costs	116	31	791	6
Total	577	155	3,940	29
Total Impact				
Hard Construction Costs	1,553	491	8,935	100
Soft Construction Costs	324	123	2,007	22
Total	1,876	614	10,941	123
<i>East Interceptor Hybrid Option with Waiawa Area Corridor D</i>				
Direct/Indirect Impact				
Hard Construction Costs	1,095	367	5,805	77
Soft Construction Costs	209	93	1,220	16
Total	1,304	460	7,025	94
Induced Impact				
Hard Construction Costs	463	125	3,160	24
Soft Construction Costs	116	31	794	6
Total	579	156	3,954	30
Total Impact				
Hard Construction Costs	1,558	492	8,965	101
Soft Construction Costs	325	123	2,014	22
Total	1,883	616	10,979	123

Table E-2. One-Time Economic and Fiscal Impacts of Construction (continued)

	Output	Earnings	Employment	State Tax
	Million \$	Million \$	Jobs	Million \$
<i>East Interceptor Hybrid Option with Waiawa Area Corridor G</i>				
Direct/Indirect Impact				
Hard Construction Costs	1,102	370	5,845	78
Soft Construction Costs	210	93	1,228	17
Total	1,313	463	7,073	94
Induced Impact				
Hard Construction Costs	466	126	3,182	24
Soft Construction Costs	117	31	799	6
Total	583	157	3,981	30
Total Impact				
Hard Construction Costs	1,569	496	9,027	101
Soft Construction Costs	327	124	2,027	23
Total	1,896	620	11,054	124

F.3 ECONOMIC AND FISCAL IMPACTS OF OPERATIONS

With operation of the Proposed Action, no increase in ENV personnel is anticipated. However, annual expenditures from operations of the Proposed Action would result in ongoing increases in economic output, employment, and earnings, and ongoing increases in fiscal revenues. Operations costs were used to estimate economic and fiscal impacts during the operation of the rehabilitated, upgraded, and/or expanded East Interceptor Conveyance System. The annual operating expenditures for the conveyance system improvements are estimated to range between approximately \$1.4 million and \$1.6 million, depending on the East Interceptor and Waiawa Area options constructed (2016a). This spending comprises expenditures in the utilities industry, inclusive of sewer treatment facilities, and the applicable multipliers were used. **Table E-3** shows the resulting economic and fiscal impacts.

If the East Interceptor No-Tunnel option is constructed along with any of the Waiawa Area options, on an ongoing basis, pump station, force main, and trunk sewer operation related to improving the East Interceptor System would result in an estimated annual impact of \$2.4 million in output, supporting an estimated 7 jobs, earnings of \$0.3 million, and fiscal revenues of approximately \$86,000. Operation of the East Interceptor Hybrid option would have a higher economic and fiscal impact, with an estimated annual economic impact of \$2.6 million in output,

supporting an estimated 8 jobs, earnings of \$0.3 million, and fiscal revenues of approximately \$93,000. Providing each job represents one household and assuming the current average household size of 3.06 people in Honolulu County (USCB 2019b, B25010, Average Household Size of Occupied Housing Units by Tenure, 2013-2017 American Community Survey 5-Year Estimates), direct, indirect, and induced jobs provided by these operations would support approximately 20 residents on average.

Table E-3. Ongoing Economic and Fiscal Impacts of Operations

	Output	Earnings	Employment	State Tax
	Million \$	Million \$	Jobs	\$
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor A</i>				
Direct/Indirect Impact	2.1	0.2	5	70,000
Induced Impact	0.3	0.1	2	16,000
Total Annual Impact	2.4	0.3	7	86,000
<i>East Interceptor No-Tunnel Option with Waiawa Area Corridor D</i>				
Direct/Indirect Impact	2.1	0.2	5	70,000
Induced Impact	0.3	0.1	2	16,000
Total Annual Impact	2.4	0.3	7	86,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor A</i>				
Direct/Indirect Impact	2.3	0.3	6	75,000
Induced Impact	0.3	0.1	2	17,000
Total Annual Impact	2.6	0.3	8	93,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor D</i>				
Direct/Indirect Impact	2.3	0.3	6	75,000
Induced Impact	0.3	0.1	2	17,000
Total Annual Impact	2.6	0.3	8	93,000
<i>East Interceptor Hybrid Option with Waiawa Area Corridor G</i>				
Direct/Indirect Impact	2.3	0.3	6	75,000
Induced Impact	0.3	0.1	2	17,000
Total Annual Impact	2.6	0.3	8	92,000

REFERENCES

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- AECOM Technical Services. 2016b. Work Task 4 - Preliminary Engineering Report, Honouliuli/Waipahu/Pearl City Wastewater Facilities Plan. Honolulu: AECOM, August 2016 Final. Electronic.
- AECOM Technical Services. 2018. Task 1 - Waiawa Master Plan - Modeling Assistance, Honouliuli/Waipahu/Pearl City Wastewater Facilities Plan. Honolulu: AECOM, November 2018 Final Technical Memorandum. Electronic.
- AECOM Technical Services. 2019. Environmental Impact Statement Preparation Notice, Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities. Honolulu: AECOM, March 2019. Electronic.
- Department of Business, Economic Development, and Tourism (DBEDT). 2016a. The 2012 Hawaii Inter-County Input-Output Study. DBEDT Research and Economic Analysis Division. Honolulu: DBEDT, Revised Aug. 2016. Electronic.
- Department of Business, Economic Development, and Tourism (DBEDT). 2016b. The Hawaii State Input-Output Study: 2012 Benchmark Report. DBEDT Research and Economic Analysis Division. Honolulu: DBEDT, Revised Aug. 2016. Electronic.
- United States Census Bureau (USCB). 2019. Average Household Size of Occupied Housing Units by Tenure. American FactFinder, 2013-2017 American Community Survey 5-Year Estimates, Table B25010. <http://factfinder2.census.gov/faces/nav/jsf/pages/index.xhtml>. 13 May 2019 (date viewed).

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Appendix G: EISPN Comment and Response Letters

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FEDERAL

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United States Department of the Interior



FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai'i 96850

In Reply Refer To:
01EPIF00-2019-TA-0313

May 22, 2019

Ms. Lori M.K. Kahikina, P.E.
City and County of Honolulu
Department of Environmental Services
1000 Uluohia Street, Suite 308
Kapolei, Hawai'i 96707

Subject: Response to your Request for Technical Assistance Regarding the Environmental Impact Statement Preparation Notice for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Dear Ms. Kahikina,

Thank you for your recent correspondence requesting technical assistance on species biology, habitat, or life requisite requirements. The Pacific Islands Fish and Wildlife Office (PIFWO) of the U.S. Fish and Wildlife Service (Service) appreciates your efforts to avoid or minimize effects to protected species associated with your proposed actions. We provide the following information for your consideration under the authorities of the Endangered Species Act (ESA) of 1973 (16 U.S.C. 1531 *et seq.*), as amended.

Due to significant workload constraints, PIFWO is currently unable to specifically address your information request. The table below lists the protected species most likely to be encountered by projects implemented within the Hawaiian Islands. Based on your project location and description, we have noted the species most likely to occur within the vicinity of the project area, in the '**Occurs In or Near Project Area**' column. Please note this list is not comprehensive and should only be used for general guidance. We have added to the PIFWO website, located at <https://www.fws.gov/pacificislands/promo.cfm?id=177175840> recommended conservation measures intended to avoid or minimize adverse effects to these federally protected species and best management practices to minimize and avoid sedimentation and erosion impacts to water quality.

If you are representing a federal action agency, please use the official species list on our web-site for your section 7 consultation. You can find out if your project occurs in or near designated critical habitat here: <https://ecos.fws.gov/ipac/>.

Under section 7 of the ESA, it is the Federal agency's (or their non-Federal designee) responsibility to make the determination of whether or not the proposed project "may affect" federally listed species or designated critical habitat. A "may affect, not likely to adversely

affect” determination is appropriate when effects to federally listed species are expected to be discountable (*i.e.*, unlikely to occur), insignificant (minimal in size), or completely beneficial. This conclusion requires written concurrence from the Service. If a “may affect, likely to adversely affect” determination is made, then the Federal agency must initiate formal consultation with the Service. Projects that are determined to have “no effect” on federally listed species and/or critical habitat do not require additional coordination or consultation.

Implementing the avoidance, minimization, or conservation measures for the species that may occur in your project area will normally enable you to make a “may affect, not likely to adversely affect” determination for your project. If it is determined that the proposed project may affect federally listed species, we recommend you contact our office early in the planning process so that we may assist you with the ESA compliance. If the proposed project is funded, authorized, or permitted by a Federal agency, then that agency should consult with us pursuant to section 7(a)(2) of the ESA. If no Federal agency is involved with the proposed project, the applicant should apply for an incidental take permit under section 10(a)(1)(B) of the ESA. A section 10 permit application must include a habitat conservation plan that identifies the effects of the action on listed species and their habitats, and defines measures to minimize and mitigate those adverse effects.

We appreciate your efforts to conserve endangered species. We regret that we cannot provide you with more specific protected species information for your project site. If you have questions that are not answered by the information on our website, you can contact PIFWO at (808) 792-9400 and ask to speak to the lead biologist for the island where your project is located.

Sincerely,

**Aaron
Nadig**

Digitally signed by
Aaron Nadig
Date: 2019.05.22
07:45:52 -10'00'

Island Team Manager
Pacific Islands Fish and Wildlife Office

cc: Mr. Paul Christiansen, Ms. Lesley Matsumoto

The table below lists the protected species most likely to be encountered by projects implemented within the Hawaiian Islands. For your guidance, we've marked species that may occur in the vicinity of your project, this list is not comprehensive and should only be used for general guidance.

<u>Scientific Name</u>	<u>Common Name / Hawaiian Name</u>	<u>Federal Status</u>	<u>May Occur In Project Area</u>
Mammals			
<i>Lasiurus cinereus semotus</i>	Hawaiian hoary bat/ 'ōpe'ape'a	E	<input checked="" type="checkbox"/>
Reptiles			
<i>Chelonia mydas</i>	Green sea turtle/honu - Central North Pacific DPS	T	<input checked="" type="checkbox"/>
<i>Erectmochelys imbricata</i>	Hawksbill sea turtle/ Honu 'ea	E	<input type="checkbox"/>
Birds			
<i>Anas wyvilliana</i>	Hawaiian duck/ koloa	E	<input type="checkbox"/>
<i>Branta sandvicensis</i>	Hawaiian goose/ nēnē	E	<input type="checkbox"/>
<i>Fulica alai</i>	Hawaiian coot/ 'alae kea	E	<input checked="" type="checkbox"/>
<i>Gallinula galeata sandvicensis</i>	Hawaiian gallinule/ 'alae 'ula	E	<input checked="" type="checkbox"/>
<i>Himantopus mexicanus knudseni</i>	Hawaiian stilt/ Ae'o	E	<input checked="" type="checkbox"/>
<i>Oceanodroma castro</i>	Band-rumped storm-petrel/ 'akē'akē	E	<input checked="" type="checkbox"/>
<i>Pterodroma sandwichensis</i>	Hawaiian petrel/ 'ua'u	E	<input checked="" type="checkbox"/>
<i>Puffinus auricularis newelli</i>	Newell's shearwater/ 'a'o	T	<input checked="" type="checkbox"/>
<i>Ardenna pacificus</i>	Wedge-tailed Shearwater/ 'ua'u kani	MBTA	<input type="checkbox"/>
<i>Gygis alba</i>	White Tern/ manu-o-kū	MBTA	<input type="checkbox"/>
<i>Chasiempis ibidis</i>	O'ahu 'elepaio	E	<input checked="" type="checkbox"/>
Invertebrates			
<i>Achatinella</i> spp.	O'ahu tree snails	E	<input checked="" type="checkbox"/>
<i>Megalagrion pacificum</i>	Pacific Hawaiian Damselfly	E	<input type="checkbox"/>
<i>M. xanthomelas</i>	Orangeblack Hawaiian Damselfly	E	<input type="checkbox"/>
<i>M. nigrohamatum nigrolineatum</i>	Blackline Hawaiian Damselfly	E	<input type="checkbox"/>

Plants				
<u>Scientific Name</u>	<u>Common Name or Hawaiian Name</u>	<u>Federal Status</u>	<u>Locations</u>	<u>May Occur In Project Area</u>
<i>Abutilon menziesii</i>	Ko'oloa'ula	E	O, L, M, H	<input checked="" type="checkbox"/>
<i>Achyranthes splendens</i> var. <i>rotundata</i>	'Ewa hinahina	E	O	<input checked="" type="checkbox"/>
<i>Bonamia menziesii</i>	No common name	E	K, O, L, M, H	<input type="checkbox"/>
<i>Canavalia pubescens</i>	'Āwikiwiki	E	Ni, K, L, M	<input type="checkbox"/>
<i>Colubrina oppositifolia</i>	Kauila	E	O, M, H	<input type="checkbox"/>
<i>Cyperus trachysanthos</i>	Pu'uka'a	E	K, O	<input type="checkbox"/>
<i>Gouania hillebrandii</i>	No common name	E	Mo, M	<input type="checkbox"/>
<i>Hibiscus brackenridgei</i>	Ma'o hau hele	E	O, Mo, L, M, H	<input type="checkbox"/>
<i>Ischaemum byrone</i>	Hilo ischaemum	E	K, O, Mo, M, H	<input type="checkbox"/>
<i>Isodendron pyriformium</i>	Wahine noho kula	E	O, H	<input type="checkbox"/>
<i>Marsilea villosa</i>	'Ihi'ihī	E	Ni, O, Mo	<input type="checkbox"/>
<i>Mezoneuron kawaiense</i>	Uhiuhi	E	O, H	<input type="checkbox"/>
<i>Nothoestrum breviflorum</i>	'Aiea	E	H	<input type="checkbox"/>
<i>Panicum fauriei</i> var. <i>carteri</i>	Carter's panicgrass	E	Molokini Islet (O), Mo	<input type="checkbox"/>
<i>Panicum niuhauense</i>	Lau'ehu	E	K	<input type="checkbox"/>
<i>Peucedanum sandwicense</i>	Makou	E	K, O, Mo, M	<input type="checkbox"/>
<i>Pleomele (Chrysodracon)</i> <i>hawaiiensis</i>	Halapepe	E	H	<input type="checkbox"/>
<i>Portulaca sclerocarpa</i>	'Ihi	E	L, H	<input type="checkbox"/>
<i>Portulaca villosa</i>	'Ihi	E	Le, Ka, Ni, O, Mo, M, L, H, Nihoa	<input type="checkbox"/>
<i>Pritchardia affinis</i> (<i>maideniana</i>)	Loulu	E	H	<input type="checkbox"/>
<i>Pseudognaphalium</i> <i>sandwicense</i> var. <i>molokaiense</i>	'Ena'ena	E	Mo, M	<input type="checkbox"/>
<i>Scaevola coriacea</i>	Dwarf naupaka	E	Mo, M	<input type="checkbox"/>
<i>Schenkia (Centaurium)</i> <i>sebaeoides</i>	'Āwiwi	E	K, O, Mo, L, M	<input type="checkbox"/>
<i>Sesbania tomentosa</i>	'Ōhai	E	Ni, Ka, K, O, Mo, M, L, H, Necker, Nihoa	<input checked="" type="checkbox"/>
<i>Tetramolopium rockii</i>	No common name	T	Mo	<input type="checkbox"/>
<i>Vigna o-wahuensis</i>	No common name	E	Mo, M, L, H, Ka	<input type="checkbox"/>

Location key: O=O'ahu, K=Kaua'i, M=Maui, H=Hawai'i Island, L=Lāna'i, Mo=Moloka'i, Ka=Kaho'olawe, Ni=Ni'ihau, Le=Lehua

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-060

September 17, 2019

Mr. Aaron Nadig, Island Team Manager
United States Department of the Interior
Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawai'i 96850

Dear Mr. Nadig:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter dated May 22, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN.

We appreciate the information provided on protected species that may be encountered on our project site. The Draft Environmental Impact Statement (DEIS) will evaluate potential impacts to these protected species and outline conservation measures to minimize any effects. Consultation and/or coordination will be initiated as appropriate. Also, the future projects will include best management practices to minimize and avoid sedimentation and erosion impacts to water quality.

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the DEIS. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,

Lori M.K. Kahikina, P.E.
Director

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STATE OF HAWAI'I

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From: Vitale, Charles [<mailto:charles.vitale@hawaii.gov>]
Sent: Thursday, May 30, 2019 10:19 AM
To: Christiansen, Paul <p.christiansen@honolulu.gov>
Cc: lesley.matsumoto@aecom.com; Chan, Scott L <scott.l.chan@hawaii.gov>; Andrews, Ryan G <ryan.g.andrews@hawaii.gov>; Kinimaka, Chris <chris.kinimaka@hawaii.gov>; DePonte, David C <david.c.deponte@hawaii.gov>
Subject: Comments on EIS for Honouliuli/Waipahu/Pearl City WW Conveyance Facilities

Dear Mr. Christiansen:

As a Potentially Interested Party, Aloha Stadium received a letter, dated 3 May 2019 notifying us of the subject EIS. We have reviewed it and have attached comments.

Regards, Charlie

*Charles Vitale, PE
Stadium Engineer
Aloha Stadium
PO Box 30666
Honolulu, HI 96820-0666
808-483-2762 (o)
808-483-2823 (f)
808-373-0434 (m)*

Sec./Table/Figure	Item description	comment
Section 2.1.1.7/Table 2.4	Halawa WWPS Force Main (new) 2036-2038	May have to be relocated/replaced sooner due to Stadium construction and/or ancillary development.
Section 2.1.1.8/Table 2.4/Figure 2-5	Halawa WWPS Reconstruction/Replace 2037-2040	Relocation option shows it in the LHPL. We should be against this as it takes away valuable development land. Leave where It is, or maybe exchange land with City and have it relocated under H-1.
Section 5.2.2	Development plans	General description of what they are including. Would prefer that they actual state they included Halawa Area TOD development Plan.
Figure 5-2	Zoning Map	Currently show AS in R-5 zoning. Should note that CCH on verge of changing to BMX-3
Section 7	Consultants	HIC-TOD not listed under state entities.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

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MAYOR



LORI M.K. KAHIKINA, P.E.
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TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-061

September 17, 2019

Mr. Charles Vitale, P.E., Stadium Engineer
State of Hawai'i
Aloha Stadium
P.O. Box 30666
Honolulu, Hawai'i 96820-0666

Dear Mr. Vitale:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your email dated May 30, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments:

1. Regarding the Halawa Force Main, the construction schedule included in the EISPN is preliminary and will likely change as the project goes through the planning phase and the schedule is refined. Also, the force main relocation may be part of the State's redevelopment of the Aloha Stadium area.
2. If relocation of the Halawa Wastewater Pump Station (WWPS) is determined to be the preferred option, the project will be done in coordination of the State's redevelopment of the area. The Draft Environmental Impact Statement (DEIS) will include mention of Aloha Stadium's concerns regarding potential locations for the WWPS.
3. The DEIS will evaluate the proposed action in the context of the relevant development plans, including the Halawa Area Transit Oriented Development Plan.
4. The DEIS will reference the proposed zoning change, and the zoning figure will be annotated to indicate proposed zoning changes that are likely to occur.

Mr. Charles Vitale, P.E.
September 17, 2019
Page 2

5. The Hawai'i Interagency Council for Transit-Oriented Development will be added to the list of organizations consulted in the DEIS and will receive future notifications regarding this proposed action.

We appreciate your participation in the EISPN review process. Your email and this response will be included in the DEIS. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,



Lori M.K. Kahikina, P.E.
Director

DAVID Y. IGE
GOVERNOR OF HAWAII

DEPARTMENT OF
ENVIRONMENTAL SVCS



19 MAY 13 P2:35

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M. KALEO MANUEL
DEPUTY DIRECTOR

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT
P. O. BOX 621
HONOLULU, HAWAII 96809

May 9, 2019

REF: RFD.5104.3

TO: Ms. Lori Kahikina, P.E., Director
Department of Environmental Services

FROM: M. Kaleo Manuel, Deputy Director *M. Manuel*
Commission on Water Resource Management

SUBJECT: Availability of Environmental Impact Statement Preparation Notice Honouliuli/Waipahu/Pearl City
Wastewater Conveyance Facilities

FILE NO.: RFD.5104.3
TMK NO.: Zone 9 Section 1 through 4 and 6 through 9 (multiple properties)

Thank you for the opportunity to review the subject document. The Commission on Water Resource Management (CWRM) is the agency responsible for administering the State Water Code (Code). Under the Code, all waters of the State are held in trust for the benefit of the citizens of the State, therefore all water use is subject to legally protected water rights. CWRM strongly promotes the efficient use of Hawaii's water resources through conservation measures and appropriate resource management. For more information, please refer to the State Water Code, Chapter 174C, Hawaii Revised Statutes, and Hawaii Administrative Rules, Chapters 13-167 to 13-171. These documents are available via the Internet at <http://dlnr.hawaii.gov/cwrm>.

Our comments related to water resources are checked off below.

- 1. We recommend coordination with the county to incorporate this project into the county's Water Use and Development Plan. Please contact the respective Planning Department and/or Department of Water Supply for further information.
- 2. We recommend coordination with the Engineering Division of the State Department of Land and Natural Resources to incorporate this project into the State Water Projects Plan.
- 3. We recommend coordination with the Hawaii Department of Agriculture (HDOA) to incorporate the reclassification of agricultural zoned land and the redistribution of agricultural resources into the State's Agricultural Water Use and Development Plan (AWUDP). Please contact the HDOA for more information.
- 4. We recommend that water efficient fixtures be installed and water efficient practices implemented throughout the development to reduce the increased demand on the area's freshwater resources. Reducing the water usage of a home or building may earn credit towards Leadership in Energy and Environmental Design (LEED) certification. More information on LEED certification is available at <http://www.usgbc.org/leed>. A listing of fixtures certified by the EAP as having high water efficiency can be found at <http://www.epa.gov/watersense>.
- 5. We recommend the use of best management practices (BMP) for stormwater management to minimize the impact of the project to the existing area's hydrology while maintaining on-site infiltration and preventing polluted runoff from storm events. Stormwater management BMPs may earn credit toward LEED certification. More information on stormwater BMPs can be found at <http://planning.hawaii.gov/czm/initiatives/low-impact-development/>
- 6. We recommend the use of alternative water sources, wherever practicable.
- 7. We recommend participating in the Hawaii Green Business Program, that assists and recognizes businesses that strive to operate in an environmentally and socially responsible manner. The program description can be found online at <http://energy.hawaii.gov/green-business-program>.
- 8. We recommend adopting landscape irrigation conservation best management practices endorsed by the Landscape Industry Council of Hawaii. These practices can be found online at

http://www.hawaiiscape.com/wp-content/uploads/2013/04/LICH_Irrigation_Conservation_BMPs.pdf.

- 9. There may be the potential for ground or surface water degradation/contamination and recommend that approvals for this project be conditioned upon a review by the State Department of Health and the developer's acceptance of any resulting requirements related to water quality.
- 10. The proposed water supply source for the project is located in a designated water management area, and a Water Use Permit is required prior to use of water. The Water Use Permit may be conditioned on the requirement to use dual line water supply systems for new industrial and commercial developments.
- 11. A Well Construction Permit(s) is (are) are required before the commencement of any well construction work.
- 12. A Pump Installation Permit(s) is (are) required before ground water is developed as a source of supply for the project.
- 13. There is (are) well(s) located on or adjacent to this project. If wells are not planned to be used and will be affected by any new construction, they must be properly abandoned and sealed. A permit for well abandonment must be obtained.
- 14. Ground-water withdrawals from this project may affect streamflows, which may require an instream flow standard amendment.
- 15. A Stream Channel Alteration Permit(s) is (are) required before any alteration can be made to the bed and/or banks of a steam channel.
- 16. A Stream Diversion Works Permit(s) is (are) required before any stream diversion works is constructed or altered.
- 17. A Petition to Amend the Interim Instream Flow Standard is required for any new or expanded diversion(s) of surface water.
- 18. The planned source of water for this project has not been identified in this report. Therefore, we cannot determine what permits or petitions are required from our office, or whether there are potential impacts to water resources.
- OTHER: Descriptions of groundwater aquifer sectors and systems should refer to them as "areas" for clarity and the source documentation for figure 3-5 from the Office of State Planning 2010 should reference the "Commission on Water Resource Management, 2008 Water Resource Protection Plan, Hawaii Water Plan"

If you have any questions, please contact W. Roy Hardy of the Commission staff at 587-0225.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-062

September 17, 2019

Mr. Kaleo Manuel, Deputy Director
State of Hawai'i
Department of Land and Natural Resources
Commission on Water Resource Management
P.O. Box 621
Honolulu, HI 96809

Dear Mr. Manuel:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter dated May 9, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN.

As requested, groundwater aquifers will be referenced as "areas" rather than "sectors and systems" in the Draft Environmental Impact Statement (DEIS). Also, the reference for Figure 3-5 Aquifer will be changed to "Commission on Water Resource Management, 2008 Water Resource Protection Plan, Hawai'i Water Plan".

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the DEIS. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,

Lori M.K. Kahikina, P.E.
Director

DAVID Y. IGE
GOVERNOR OF
HAWAII



DEPARTMENT OF
ENVIRONMENTAL SVCS

JUN -4 P2 50

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

REF:OCCL:TM

Correspondence: OA 19-179

Director Lori M.K. Kahikina, P.E.
Department of Environmental Services
City & County of Honolulu
1000 Uluohia St., Suite 308
Kapolei, HI 96707

JUN - 3 2019

ATTN: Paul Christiansen

SUBJECT: Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Dear Ms. Kahikina:

The Office of Conservation and Coastal Lands has reviewed the Environmental Impact Statement Preparation Notice (EISPN) for the subject matter. Your department is proposing to improve, rehabilitate and/or upgrade the existing wastewater collection system through the noted areas to the Honouliuli Wastewater Treatment Plant to accommodate wastewater flows projected through 2050.

According to the EISPN, a portion of the new conveyance facilities will be located within or adjacent to land within a conservation district near the Waipahu Wastewater Pump Station (WWPS). The EISPN incorrectly identifies the Conservation District rules as HAR Title 15, Chapter 15-24 and states: "A portion of the Hybrid option would be located within a 'protective' subzone. If necessary, a temporary variance may be requested for the proposed work."

The rules and regulations of the Conservation District are known as the Hawai'i Administrative Rules (HAR) Chapter 13-5. It is unclear why a temporary variance would be requested as HAR, §13-5-36 (b) states that a temporary variance cannot be for more than 1 year and shall not be extended.

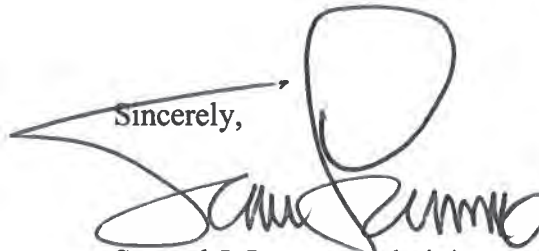
The OCCL is assuming the proposed alternatives may involve horizontal directional drilling under submerged land makai of the shoreline for the Proposed Waipahu Third FM on Fig. 2.1 and the Deep Tunnel Alignment on Figure 2-8 within Pearl Harbor, in addition to potential work near the Waipahu WWPS. In this particular area, submerged land makai of the shoreline lie within the Resource subzone of the Conservation District and as previously stated near the Waipahu WWPS, the Pouhala Marsh area lies within the Protective subzone of the Conservation District.

The potentially proposed work within the Conservation District is an identified land use pursuant to HAR, §13-5-22 P-6 PUBLIC PURPOSE USES (D-1) Not for profit land uses undertaken in support of a public service by an agency of the county, state, or federal government, or by an independent non-governmental entity, except that an independent non-governmental regulated public utility may be considered to be engaged in a public purpose use. Examples of public purpose uses may include but are not limited to public roads, marinas, harbors, airports, trails, water systems and other utilities, energy generation from renewable sources, communication systems, flood or erosion control projects, recreational facilities, community centers, and other public purpose uses, intended to benefit the public in accordance with public policy and the purpose of the conservation district. To allow, modify or deny the proposed use would be at the discretion of the Board of Land and Natural Resources. Therefore, this would require a Board permit.

The OCCL requests that consistent labels be utilized throughout the draft EIS document. For example, is the Waipahu Third FM on Fig. 2-1 the same as the Waipahu WWPS Force Main (new)? Also, Fig. 2-1, Waipio Depot St. should be Waipahu Depot Road.

Should you have any questions regarding this correspondence, contact Tiger Mills of our Office at (808) 587-0382.

Sincerely,

A handwritten signature in black ink, appearing to read 'Samuel J. Lemmo', written over a large, stylized circular flourish.

Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

C: ODLO
CITY-DPP
AECOM

-Via email to: Lesley.Matsumoto@aecom.com

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-050

September 17, 2019

Mr. Samuel J. Lemmo, Administrator
State of Hawai'i
Department of Land and Natural Resources
Office of Conservation and Coastal Lands
Post Office Box 621
Honolulu, Hawai'i 96809

Dear Mr. Lemmo:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter dated June 3, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments:

1. The Draft Environmental Impact Statement (DEIS) will include a reference to the Conservation District rules in Hawai'i Administrative Rules Chapter 13-5.
2. A permit will be requested, if applicable, depending on the final locations of the proposed work.
3. Consistent labeling will be applied in the DEIS. The Waipahu Third Force Main on Fig. 2-1 is the same as the Waipahu WWPS Force Main (New).
4. City geographic information system and tax records indicate that the name of Waipahu Depot Street is correct. We are aware that Waipahu Depot Road is occasionally used; however, the DEIS will identify this street as Waipahu Depot Street.

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the DEIS.

Mr. Samuel J. Lemmo
September 17, 2019
Page 2

Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,



Lori M.K. Kahikina, P.E.
Director

DAVID Y. IGE
GOVERNOR



CRAIG K. HIRAI
EXECUTIVE DIRECTOR

19 MAY 17 12:26

STATE OF HAWAII
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM
HAWAII HOUSING FINANCE AND DEVELOPMENT CORPORATION

677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

IN REPLY REFER TO:
19:DEV/067

May 14, 2019

City and County of Honolulu
Department of Environmental Services
1000 Ulu'ohia Street, Suite 308
Kapolei, Hawaii 96707

Attention: Paul Christiansen

Dear Mr. Christiansen:

SUBJECT: Environmental Impact Statement Preparation Notice for the
Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for providing the Hawaii Housing Finance and Development Corporation with the opportunity to review the subject EIS Preparation Notice. The HHFDC supports the proposed wastewater facility improvements as they will provide new conveyance infrastructure to serve planned development, including Transit Oriented Development, in the Honouliuli Wastewater Treatment Plant's tributary area. We are hopeful that this will create opportunities for the HHFDC to work with Developers to increase the stock of affordable housing for Hawaii's households.

Additionally, we request that this project assess the adequacy of wastewater infrastructure serving the Villages of Kapolei. As you may be aware, insufficiency of wastewater infrastructure is inhibiting development of HHFDC's land assets for affordable housing in this area.

Should you have any questions, please call Deepak Neupane, P.E., AIA, Development Branch Chief at 587-0527.

Sincerely,

A handwritten signature in blue ink, appearing to read "Craig K. Hirai", is positioned above the typed name and title.

Craig K. Hirai
Executive Director

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-053

September 17, 2019

Mr. Craig K. Hirai, Executive Director
State of Hawai'i
Department of Business, Economic Development and Tourism
Hawai'i Housing Finance and Development Corporation
677 Queen Street, Suite 300
Honolulu, Hawai'i 96813

Dear Mr. Hirai:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter dated May 14, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. This EISPN focuses on proposed improvements and upgrades to the existing East Interceptor System of the Honouliuli sewer basin, and we acknowledge your comment that the proposed wastewater conveyance infrastructure will help to provide needed service to planned development, including Transit Oriented Development, in the project area.

The Villages of Kapolei area is served by trunk sewers to the west of the Honouliuli Wastewater Treatment Plant, and therefore outside of the scope of this EISPN. Our department is available to discuss concerns with the Villages of Kapolei wastewater infrastructure with you separately.

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the Draft Environmental Impact Statement. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Lori M.K. Kahikina".

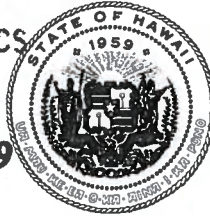
Lori M.K. Kahikina, P.E.
Director

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DAVID Y. IGE
GOVERNOR OF HAWAII



DEPARTMENT OF
ENVIRONMENTAL SVCS



79 JUN 10 P4 09

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE
1151 PUNCHBOWL STREET, ROOM 325
HONOLULU, HAWAII 96813

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

M. KALEO MANUEL
DEPUTY DIRECTOR - WATER

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

19700

Ms. Lori Kahikina, Director
City and County of Honolulu
Department of Environmental Services
1000 Ulu'ohia Street, Suite 308
Kapolei, HI 96707

ATTN: Paul Christiansen

Dear Ms. Kahikina:

The Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) has received your announcement of availability of the Environmental Impact Statement Preparation Notice for the proposed Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities improvements in the Honouliuli sewer basin throughout 'Ewa and Central O'ahu, Hawai'i, TMK Zone 9 Sections 1, 2, 3, 4, 6, 7, 8, and 9. Proposed work would include replacing wastewater pump stations and force mains and installing new force mains and trunk sewers on the existing and planned conveyance corridors in the East Interceptor System.

The State listed Hawaiian Hoary Bat or 'Ōpe'ape'a (*Lasiurus cinereus semotus*) has the potential to occur in the vicinity of the project area and may roost in nearby trees. If any site clearing is required this should be timed to avoid disturbance during the bat birthing and pup rearing season (June 1 through September 15). If this cannot be avoided, woody plants greater than 15 feet (4.6 meters) tall should not be disturbed, removed, or trimmed without consulting DOFAW.

We note that artificial lighting can adversely impact seabirds that may pass through the area at night by causing disorientation. This disorientation can result in collision with manmade artifacts or grounding of birds. For nighttime lighting that might be required, DOFAW recommends that all lights be fully shielded to minimize impacts. Nighttime work that requires outdoor lighting should be avoided during the seabird fledging season from September 15 through December 15. This is the period when young seabirds take their maiden voyage to the open sea.

State listed waterbirds such as the Hawaiian Duck (*Anas wyvilliana*), Hawaiian Stilt (*Himantopus mexicanus knudseni*), Hawaiian Coot (*Fulica alai*), and Hawaiian Common Gallinule (*Gallinula chloropus sandvicensis*) have the potential to occur in the vicinity of the proposed project sites. DOFAW recommends pre-assessment of any waterbirds present at the project sites prior to work. It is against State law to harm or harass these species. If any of these species are present during construction activities, then all activities within 100 feet (30 meters) should cease, and the bird should not be approached. Work may continue after the bird leaves the

area of its own accord. If a nest is discovered at any point, please contact the DOFAW Office at (808) 587-0166.

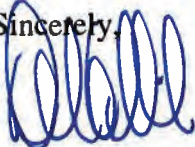
DOFAW recommends using native plant species for any soil stabilizing or replanting efforts upon completion that are appropriate for the area (i.e. climate conditions are suitable for the plants to thrive, historically occurred there, etc.). Please do not plant invasive species. DOFAW recommends consulting the Hawai'i-Pacific Weed Risk Assessment website to determine the potential invasiveness of plants proposed for use in the project (<https://sites.google.com/site/weedriskassessment/home>).

The State endangered White Tern (*Gygis alba*) has been known to nest in the vicinity of the project from the Pearl City Dual Force Main to the Halawa Force Main. If tree trimming or removal is planned, DOFAW strongly recommends surveying for the presence of White Terns prior to any action that could disturb the trees. White Tern pairs lay their single egg in a branch fork with no nest. The eggs and chicks can be easily dislodged by construction equipment that nudges the trees. If a nest is discovered, please notify DOFAW staff for assistance.

The State endangered Hawaiian Short-eared Owl or Pueo (*Asio flammeus sandwichensis*) has the potential to occur in the project vicinity site on the 'Ewa Plain from the Honouliuli Wastewater Treatment Plant Influent to West Loch. Pueo are a crepuscular species, most active during dawn and dusk twilights. DOFAW recommends twilight pre-construction surveys by a qualified biologist prior to clearing vegetation. If Pueo nests are present, a buffer zone should be established in which no clearing occurs until nesting ceases, and DOFAW staff should be notified.

We request the inclusion of DOFAW in the list of consulted agencies in the Draft Environmental Impact Statement to ensure appropriate consideration is given to endangered and threatened species listed under the State of Hawaii endangered species law, codified in Chapter 195D, Hawaii Revised Statutes (HRS). While all species listed as endangered or threatened under the Federal Endangered Species Act of 1973 are listed by the State of Hawaii under HRS 195D, the State and Federal laws are separate and some differences exist between the regulations. For example, the Pueo and White Tern are listed as endangered under HRS 195D on O'ahu only, but these species are not listed under the Federal ESA.

We appreciate your efforts to work with our office for the conservation of our native species. Should the scope of the project change significantly, or should it become apparent that threatened or endangered species may be impacted, please contact our staff as soon as possible. If you have any questions, please contact Jim Cogswell, Wildlife Program Manager at (808) 587-4187 or James.M.Cogswell@hawaii.gov.

Sincerely,


DAVID G. SMITH
Administrator

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-057

September 17, 2019

Mr. David G. Smith, Administrator
State of Hawai'i
Department of Land and Natural Resources
Division of Forestry and Wildlife
1151 Punchbowl Street, Room 325
Honolulu, Hawai'i 96813

Dear Mr. Smith:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter received on June 10, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments:

1. The Draft Environmental Impact Statement (DEIS) will include potential impacts to threatened or endangered species and outline conservation measures to minimize any impact to these species.
2. Site clearing and tree-cutting will be timed to avoid disturbance during the endangered Hawaiian Hoary Bat birthing and pup rearing season (June 1 through September 15). If this cannot be avoided, we will consult with the Division of Forestry and Wildlife (DOFAW).
3. Night construction will be avoided during the seabird fledging period (September 15 through December 15), and lights will be fully shielded to prevent impact. If this cannot be avoided, we will consult with DOFAW.
4. A pre-assessment of state-listed waterbirds present at project sites will be conducted prior to starting work. If any state-listed waterbirds are present during construction activities, all activities within 100 feet of the bird(s) will cease until the bird leaves. If a nest is discovered, we will notify DOFAW.

Mr. David G. Smith
September 17, 2019
Page 2

5. As much as practicable native plant species will be used for replanting, and no invasive species will be planted.
6. A survey for endangered White Terns will be conducted prior to tree trimming or removal. If a nest is discovered, we will notify DOFAW.
7. A twilight pre-construction survey will be conducted by a qualified biologist for Pueo prior to clearing vegetation in the 'Ewa Plain area. If Pueo nests are present, a buffer zone where no clearing occurs will be established and we will notify DOFAW.
8. DOFAW will be included in the list of consulted agencies in the DEIS.

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the DEIS. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,



Lori M.K. Kahikina, P.E.
Director

DAVID Y. IGE
GOVERNOR



STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHEOWL STREET
HONOLULU, HAWAII 96813-5097

JADE T. BUTAY
DIRECTOR

Deputy Directors
LYNN A.S. ARAKI-REGAN
DEREK J. CHOW
ROSS M. HIGASHI
EDWIN H. SNIFFEN

IN REPLY REFER TO:
DIR 0461
STP 8.2686

June 14, 2019

Ms. Lori M.K. Kahikina, P.E.
Director
City and County of Honolulu
Department of Environmental Services
1000 Uluohia Street, Suite 308
Kapolei, Oahu, Hawaii 96707
Attention: Paul Christiansen

Dear Ms. Kahikina:

Subject: Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities
Environmental Impact Statement Preparation Notice (EISPN)
Oahu, Hawaii
TMK: (1) Zone 9, Sections 1 through 4 and 6 through 9 (multiple properties)

The State Department of Transportation (DOT) understands the Department of Environmental Services (ENV) proposes improvements to the East Interceptor System and a proposed new sewer conveyance system from the Waiawa area to the Honouliuli Wastewater Treatment Plant. DOT's comments are as follows:

Harbors Division (DOT-HAR)

The EISPN notes that approval will be needed from DOT-HAR for work within the State Energy Corridor. The Draft Environmental Impact Statement (DEIS) should describe any proposed work and address potential impacts that work may have on facilities located within the corridor. DOT-HAR recommends that ENV consult with the corridor's tenants - Hawaiian Electric Company, Hawaii GAS, and Par Hawaii. The DEIS should also coordinate with DOT-HAR to acquire approval to conduct work within the State Energy Corridor.

Highways Division

A Transportation Assessment (TA) or a Traffic Impact Analysis Report (TIAR) should be prepared by a traffic engineer licensed in the State of Hawaii and should be included in the DEIS. The TA or the TIAR should be coordinated with the Oahu Regional Transportation Plan 2040 (approved by the Oahu Metropolitan Planning Organization) to ensure there would not be any impacts to State facilities or its Right-of-Way.

Airports Division (DOT-AIR)

1. Sections of the wastewater conveyance project will be located within five miles from the Daniel K. Inouye International Airport and the Kalaeloa Airport. Although the EISPN states that there will be no impacts to wildlife from the project, ENV shall ensure that the project does not attract wildlife that may create a potential safety hazard to flights.

Federal Aviation Administration (FAA) Advisory Circular 150/5200-33B Hazardous Wildlife Attractants on or Near Airports provides specific details regarding drainage management and related mitigation to address wildlife concerns near airports.

2. The City and County of Honolulu, Planning Commission issued Special Use Permit Number 2017/SUP in October of 2017 for the expansion of the Honouliuli Wastewater Treatment Plant. Condition 10 of the permit required ENV to enter into an aviation and wildlife management agreement with DOT-AIR.

DOT-AIR reminds ENV that a draft aviation easement, pursuant to condition 10 of SUP No. 2017/SP-2 was submitted to ENV for review and agreement in November 2018. Please provide an update of ENV's action regarding this matter.

If there are any questions, please contact Mr. Blayne Nikaido of the DOT Statewide Transportation Planning Office at (808) 831-7979 or by email at blayne.h.nikaido@hawaii.gov.

Sincerely,



JADE T. BUTAY
Director of Transportation

c: Lesley Matsumoto, AECOM Technical Services, Inc.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-067

September 17, 2019

Jade T. Butay, Director of Transportation
State of Hawai'i
Department of Transportation
869 Punchbowl Street
Honolulu, Hawai'i 96813-5097

Dear Mr. Butay:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter dated June 14, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments:

1. The Draft Environmental Impact Statement (DEIS) will describe proposed work and potential impacts to facilities within the State Energy Corridor. Hawaiian Electric Company, Hawai'i Gas, and Par Hawai'i will be included in the DEIS distribution list.
2. ENV will coordinate with the Hawai'i Department of Transportation's Harbors Division for work within the State Energy Corridor to obtain necessary approvals as projects progress to the planning, design, and construction phases.
3. A Traffic Impact Analysis Report (TIAR) will be prepared for the programmatic DEIS. Traffic planning associated with the projects will be coordinated with the Oahu Regional Transportation Plan 2040.
4. The DEIS will address any potential for attraction of wildlife that may create increased safety hazards to aviation due to the projects.
5. The City and County of Honolulu, Department of Environmental Services (ENV) acknowledges the condition for a Memorandum of Agreement (MOA) in the October 6, 2017 Special Use Permit (SUP), and a draft

Mr. Jade Butay
September 17, 2019
Page 2

avigation easement is currently under review by ENV. The Honouliuli Wastewater Treatment Plant properties subject to the SUP requirement are different than the properties affected by the actions proposed in this EISPN. ENV will continue to address the SUP requirements outside the scope of the DEIS.

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the DEIS. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,



Lori M.K. Katikina, P.E.
Director

DAVID Y. IGE
GOVERNOR OF HAWAII



SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE
MANAGEMENT

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

LD 786

July 5, 2019

City and County of Honolulu
Department of Environmental Services
Attn: Mr. Paul Christiansen
1000 Ulu'ohia Street, Suite 308
Kapolei, Hawaii 96707

via email: p.christiansen@honolulu.gov

Dear Mr. Christiansen:

SUBJECT: Availability of EIS Preparation Notice, Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities located at Honouliuli/Waipahu/ Pearl City, Island of Oahu; TMK Zone 9 Sections 1 through 4, and 6 through 9 (multiple properties)

Thank you for the opportunity to review and comment on the subject matter. The Land Division of the Department of Land and Natural Resources (DLNR) distributed or made available a copy of your request pertaining to the subject matter to DLNR's Divisions for their review and comments.

At this time, enclosed are comments from the (a) Engineering Division and (b) Land Division – Oahu District on the subject matter. Should you have any questions, please feel free to contact Barbara Lee at (808) 587-0453 or by email at barbara.j.lee@hawaii.gov. Thank you.

Sincerely,

A handwritten signature in black ink, appearing to read "Russell Y. Tsuji".

Russell Y. Tsuji
Land Administrator

Enclosure(s)

cc: AECOM Technical Services, Inc. (w/copies)
Attn: Ms. Lesley Matsumoto (via email: lesley.matsumoto@aecom.com)
Central Files

DAVID Y. IGE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 13, 2019

LD 786

MEMORANDUM

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE
MANAGEMENT
RECEIVED
LAND DIVISION
JUN 24 AM 11:43
DEPT. OF LAND &
NATURAL RESOURCES
STATE OF HAWAII

19 JUN 19 PM 02:32 ENGINEERING

TO:

DLNR Agencies:

- Div. of Aquatic Resources
- Div. of Boating & Ocean Recreation
- Engineering Division
- Div. of Forestry & Wildlife
- Div. of State Parks
- Commission on Water Resource Management
- Office of Conservation & Coastal Lands
- Land Division – Oahu District
- Historic Preservation

FROM

FROM:

Russell Y. Tsuji, Land Administrator

SUBJECT:

Availability of EIS Preparation Notice, Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

LOCATION:

Honouliuli/Waipahu/Pearl City, Island of Oahu; TMK Zone 9 Sections 1 through 4, and 6 through 9 (multiple properties)

APPLICANT:

Department of Environmental Services, City and County of Honolulu

Transmitted for your review and comment is information on the above-referenced project. The notice of availability of the EISPN has been published in OEQC's official publication, The Environmental Notice (TEN), on May 08, 2019. This issue of the TEN and a link to the Draft SEIS can be found at:

[http://oeqc2.doh.hawaii.gov/The Environmental Notice/2019-05-08-TEN.pdf](http://oeqc2.doh.hawaii.gov/The%20Environmental%20Notice/2019-05-08-TEN.pdf)

Although the public comment period has passed, we have been asked to submit any comments as soon as possible. Therefore, please submit comments by **July 02, 2019**. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Barbara Lee at 587-0453 or by email at barbara.j.lee@hawaii.gov with copy to darlene.k.nakamura@hawaii.gov. Thank you.

- () We have no objections.
- () We have no comments.
- (✓) Comments are attached.

Signed:

Carty S. Chang, Chief Engineer

Attachments

Cc: Central Files

Print Name:

Date:

6/24/19

**DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION**

LD/Russell Y. Tsuji

**Ref: Availability of EIS Preparation Notice, Honouliuli/Waipahu/Pearl City
Wastewater Conveyance Facilities**

Location: Honouliuli/Waipahu/Pearl City, Island of Oahu

TMK(s): Zone 9 Sections 1 through 4, and 6 through 9 (multiple properties)

**Applicant: Department of Environmental Services, City and County of
Honolulu**

COMMENTS


The rules and regulations of the National Flood Insurance Program (NFIP), Title 44 of the Code of Federal Regulations (44CFR), are in effect when development falls within a Special Flood Hazard Area (high risk areas). State projects are required to comply with 44CFR regulations as stipulated in Section 60.12. Be advised that 44CFR reflects the minimum standards as set forth by the NFIP. Local community flood ordinances may stipulate higher standards that can be more restrictive and would take precedence over the minimum NFIP standards.

The owner of the project property and/or their representative is responsible to research the Flood Hazard Zone designation for the project. Flood Hazard Zones are designated on FEMA's Flood Insurance Rate Maps (FIRM), which can be viewed on our Flood Hazard Assessment Tool (FHAT) (<http://gis.hawaiiinfip.org/FHAT>).

If there are questions regarding the local flood ordinances, please contact the applicable County NFIP coordinating agency below:

- Oahu: City and County of Honolulu, Department of Planning and Permitting (808) 768-8098.
- Hawaii Island: County of Hawaii, Department of Public Works (808) 961-8327.
- Maui/Molokai/Lanai County of Maui, Department of Planning (808) 270-7253.
- Kauai: County of Kauai, Department of Public Works (808) 241-4846.

Signed: _____


CARTY S. CHANG, CHIEF ENGINEER

Date: _____

9/24/19



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
LAND DIVISION

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

June 13, 2019

LD 786

MEMORANDUM

TO:

DLNR Agencies:

- Div. of Aquatic Resources
- Div. of Boating & Ocean Recreation
- Engineering Division
- Div. of Forestry & Wildlife
- Div. of State Parks
- Commission on Water Resource Management
- Office of Conservation & Coastal Lands
- Land Division – Oahu District
- Historic Preservation

FROM:

Russell Y. Tsuji, Land Administrator *RT*

SUBJECT:

Availability of EIS Preparation Notice, Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

LOCATION:

Honouliuli/Waipahu/Pearl City, Island of Oahu; TMK Zone 9 Sections 1 through 4, and 6 through 9 (multiple properties)

APPLICANT:

Department of Environmental Services, City and County of Honolulu

Transmitted for your review and comment is information on the above-referenced project. The notice of availability of the EISPN has been published in OEQC's official publication, The Environmental Notice (TEN), on May 08, 2019. This issue of the TEN and a link to the Draft SEIS can be found at:

[http://oeqc2.doh.hawaii.gov/The Environmental Notice/2019-05-08-TEN.pdf](http://oeqc2.doh.hawaii.gov/The%20Environmental%20Notice/2019-05-08-TEN.pdf)

Although the public comment period has passed, we have been asked to submit any comments as soon as possible. Therefore, please submit comments by **July 02, 2019**. If no response is received by this date, we will assume your agency has no comments. If you have any questions about this request, please contact Barbara Lee at 587-0453 or by email at barbara.j.lee@hawaii.gov with copy to darlene.k.nakamura@hawaii.gov. Thank you.

Any improvements on State Lands will require disposition from the Board of Land and Natural Resources.

- () We have no objections.
- () We have no comments.
- (x) Comments as noted to the side in italics.

Signed:

Patti E. Miyashiro

Attachments

Print Name:

Patti E. Miyashiro

Cc: Central Files

Date:

June 20, 2019

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-068

September 17, 2019

Russell Y. Tsuji, Land Administrator
State of Hawai'i
Department of Land and Natural Resources
Land Division
Post Office Box 621
Honolulu, Hawai'i 96809

Dear Mr. Tsuji:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter dated July 5, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments:

1. The Flood Hazard Zone designations will be identified in the Draft Environmental Impact Statement (DEIS). If development falls in a Special Flood Hazard Area, the City and County of Honolulu, Department of Environmental Services (ENV) will comply with all applicable federal, state, and local requirements.
2. ENV will coordinate with the Hawai'i State Board of Land and Natural Resources as needed for any proposed improvements on State land.

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the DEIS. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,

A handwritten signature in black ink, appearing to read "Lori M.K. Kahikina", is written over a circular stamp that partially overlaps the signature.

Lori M.K. Kahikina, P.E.
Director

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CITY AND COUNTY OF HONOLULU

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BOARD OF WATER SUPPLY DEPARTMENT OF ENVIRONMENTAL SVCS

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com



19 AUG 19 P2:45

August 14, 2019

KIRK CALDWELL, MAYOR

BRYAN P. ANDAYA, Chair
KAPUA SPROAT, Vice Chair
KAY C. MATSUI
RAY C. SOON
MAX J. SWORD

ROSS S. SASAMURA, Ex-Officio
JADE T. BUTAY, Ex-Officio

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

ELLEN E. KITAMURA, P.E.
Deputy Manager and Chief Engineer *EW*

Mr. Paul Christiansen
City and County of Honolulu
Department of Environmental Services
1000 Uluohia Street, Suite 308
Kapolei, Hawaii 96707

Dear Mr. Christiansen:

Subject: Your Letter Dated May 3, 2019 Requesting Comments on the Environmental Impact Statement Preparation Notice for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities Project

Thank you for the opportunity to comment on the proposed wastewater conveyance facilities project.

The existing water system is adequate to accommodate the water demands and off-site fire protection to the following projects: Waipahu Wastewater Pump Station (WWPS) Force Main (New), Waipahu WWPS Force Mains Rehabilitation, Pearl City Trunk Sewers – Rehabilitation/Replacement, Waimalu WWPS Force Main (New), Waimalu WWPS Reconstruct/Replacement, Waimalu Trunk Sewers – Rehabilitation/Replacement, Halawa WWPS Force Main (New), Halawa WWPS – Reconstruct/Replace, Pearl City – Waipahu Trunk Sewer, Waipahu WWPS No. 2, Pearl City WWPS Demolition (Alternative Pearl City WWPS #1 and #2), and Corridors A, D, and G. However, please be advised that this information is based upon current data, and therefore, the Board of Water Supply (BWS) reserves the right to change any position or information stated herein up until the final approval of the building permit application. The final decision on the availability of water will be confirmed when the building permit application is submitted for approval.

When water is made available, the applicant will be required to pay our Water System Facilities Charges for resource development, transmission and daily storage.

The existing water system cannot provide adequate fire protection to accommodate the proposed Alternative Pearl City WWPS #3 option for the Pearl City WWPS Demolition project. The BWS Water System Standards (WSS) require a fire hydrant to be located fronting wastewater developments per BWS Water System Standards. The nearest fire hydrant, fire hydrant L-00376, is located approximately 223 feet from the property. Therefore, the developer will be required to install the necessary water system improvements to provide adequate fire protection in accordance with our WSS. The construction drawings should be submitted to BWS for approval.

Mr. Paul Christiansen
August 14, 2019
Page 2

The construction schedule should be coordinated to minimize impact to the water system.

The proposed project is subject to BWS Cross-Connection Control and Backflow Prevention requirements prior to the issuance of the Building Permit Applications.

The on-site fire protection requirements should be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

If you have any questions, please contact Marc Chun, Head of our Water Resources Division at 748-5906

Very truly yours,



ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

cc: Lesley Matsumoto, AECOM Technical Services, Inc.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO:
PRO 19-076

September 17, 2019

MEMORANDUM

TO: Ernest Y.W. Lau, P.E., Manager and Chief Engineer
Board of Water Supply

FROM:  Lori M.K. Kahikina, P.E.
Director

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter dated August 14, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments:

1. We acknowledge your comments regarding the availability of water for our projects and the requirement to pay applicable Water System Facilities charges. We understand that a final decision on water availability will be made when the building permit application is submitted.
2. We acknowledge the requirement for fire hydrant location relative to our proposed Alternative Pearl City Wastewater Pump Station #3. This will be addressed should this pump station project enter the planning and design phase.
3. Our construction schedule will be coordinated to minimize impact to the water system.
4. We understand that our projects will be subject to Board of Water Supply Cross-Connection Control and Backflow Prevention requirements.
5. Our on-site fire protection requirements will be coordinated with the Fire Prevention Bureau of the Honolulu Fire Department.

Ernest Y.K. Lau, P.E.
September 17, 2019
Page 2

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the Draft Environmental Impact Statement. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 768-8000 • FAX: (808) 768-6041
DEPT. WEB SITE: www.honolulu.gov • CITY WEB SITE: www.honolulu.gov

79 MAY 22 P3:15

KIRK CALDWELL
MAYOR



KATHY K. SOKUGAWA
ACTING DIRECTOR

TIMOTHY F. T. HIU
DEPUTY DIRECTOR

EUGENE H. TAKAHASHI
DEPUTY DIRECTOR

May 20, 2019

2019/ELOG-870(SA)

MEMORANDUM

TO: Lori M. K. Kahikina, P.E., Director
Department of Environmental Services

FROM: *For:* Kathy K. Sokugawa, Acting Director *ek*
Department of Planning and Permitting

SUBJECT: Request for Comments on Environmental Impact Statement
Preparation Notice for Honouliuli/Waipahu/Pearl City
Wastewater Conveyance Facilities

This responds to your letter, received on May 6, 2019, requesting comments on the Environmental Impact Statement Preparation Notice (EISPN) for the above Project. Our comments are as follows:

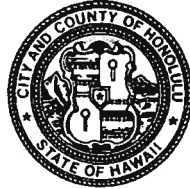
- Please list all required City permits
- The Draft EIS should discuss how the Project meets the policies and goals of both the General Plan and the Sustainable Communities Plans (Ewa, Central Oahu, and Primary Urban Center Development Plans).
- Clearly delineate and discuss which portions of the Project are within the Shoreline Setback Area based on the Certified Shoreline Survey.
- Discuss which portions of the Project are within the Special Management Area (SMA). If the total valuation of the Project will be valued at over \$500,000, an SMA Use Permit will be required.

Should you have any further questions, please contact Sarah Afong, of our staff, at 768-8026.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR


ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO:
PRO 19-051

September 17, 2019

MEMORANDUM

TO: Kathy K. Sokugawa, Acting Director
Department of Planning and Permitting

FROM:  Lori M.K. Kahikina, P.E.
Director

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your memorandum dated May 20, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments:

1. The Draft Environmental Impact Statement (DEIS) will include a list of any anticipated City permits that may be required.
2. The DEIS will evaluate the proposed action in the context of the relevant land use and development plans.
3. A Certified Shoreline Survey is not being conducted at this time given the preliminary nature of the projects, multiple options under consideration, and uncertain construction timeframes. However, a general discussion of portions of the project potentially located within the Shoreline Setback Area will be included in the DEIS. It is anticipated that as individual projects are developed, and design details become available, those projects will prepare separate project-specific Hawaii Revised Statutes Chapter 343 documents as appropriate.
4. The DEIS will include a section that discusses portions of the project located within the Special Management Area (SMA) and associated permit requirements. It is anticipated that as individual projects are developed, those projects will apply for SMA use permits as appropriate.

Kathy K. Sokugawa
September 17, 2019
Page 2

We appreciate your participation in the EISPN review process. Your memorandum and this response will be included in the DEIS. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

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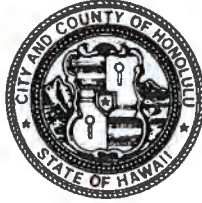
DEPARTMENT OF PARKS & RECREATION
CITY AND COUNTY OF HONOLULU

DEPARTMENT OF
ENVIRONMENTAL SVCS

1000 Uluohia Street, Suite 309, Kapolei, Hawaii 96707
Phone: (808) 768-3003 • Fax: (808) 768-3053
Website: www.honolulu.gov

19 MAY 21 P2 53

KIRK CALDWELL
MAYOR



MICHELE K. NEKOTA
DIRECTOR

JEANNE C. ISHIKAWA
DEPUTY DIRECTOR

May 16, 2019

MEMORANDUM

TO: Lori M.K. Kahikina, P.E., Director
Department of Environmental Services

ATTN: Paul Christiansen, Civil Engineer V

FROM: Michele K. Nekota 
Director

SUBJECT: Availability of Environmental Impact Statement Preparation Notice
Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

The Department of Parks and Recreation reviewed the subject Environmental Impact Statement Preparation Notice published on May 8, 2019 by the Department of Health, Office of Environmental Quality Control and has no comment at this time.

Should you have any questions, please contact John Reid, Planner at 768-3017.

MKN:jr
(771393)

cc: AECOM Technical Services, Inc

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO:
PRO 19-052

September 17, 2019

MEMORANDUM

TO: Michele K. Nekota, Director
Department of Parks and Recreation

FROM:  Lori M.K. Kahikina, P.E.
Director

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your memorandum dated May 16, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We understand you have no comments at this time.

We appreciate your participation in the EISPN review process. Your memorandum and this response will be included in the Draft Environmental Impact Statement. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU
801 SOUTH BERETANIA STREET · HONOLULU, HAWAII 96813
TELEPHONE: (808) 529-3111 · INTERNET: WWW.HONOLULU.PHILIPINES.POLICE.HI
DEPARTMENT OF ENVIRONMENTAL SVCS

KIRK CALDWELL
MAYOR



19 MAY 29 AIO :03

SUSAN BALLARD
CHIEF

JOHN D. MCCARTHY
JONATHAN GREMS
DEPUTY CHIEFS

OUR REFERENCE EO-TS

May 22, 2019

MEMORANDUM

TO: Lori M.K. Kahikina, P.E., Director
Department of Environmental Services

ATTENTION: Paul Christiansen, Civil Engineer, Capital Improvement Project Program and
Planning

FROM: Allan T. Nagata, Assistant Chief, Support Services Bureau

SUBJECT: Environmental Impact Statement for the Proposed Honouliuli/Waipahu/
Pearl City Wastewater Conveyance Facilities Improvements

This is in response to your agency's memorandum of May 3, 2019, requesting comments on the subject project.

Based on the information provided, this project should have no impact on the operations or services of the Honolulu Police Department (HPD) at this time. However, we would like to request a point of contact be provided should the need arise for the HPD to gain access to the project area for any legitimate law enforcement purpose.

If there are any questions, please call Major Rade Vanic of District 3 (Pearl City) at 723-8803.

A handwritten signature in black ink, appearing to read "Allan T. Nagata".

Allan T. Nagata
Assistant Chief
Support Services Bureau

cc: Lesley Matsumoto
AECOM Technical Services, Inc.

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO:
PRO 19-054

September 17, 2019

MEMORANDUM

TO: Allan T. Nagata, Assistant Chief
Honolulu Police Department

FROM: Lori M.K. Kahikina, P.E.
Director

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice
(EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance
Facilities

Thank you for your memorandum dated May 22, 2019, regarding the Honouliuli/
Waipahu/Pearl City Wastewater Conveyance Facilities EISPN.

In response to your request for a point of contact should the need arise for the
Honolulu Police Department to access the project area for law enforcement purposes,
please call 768-7272. This number is continuously staffed for emergencies or other
issues related to the Department of Environmental Services' wastewater system.

We appreciate your participation in the EISPN review process. Your letter
and this response will be included in the Draft Environmental Impact Statement. Should
you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470
or by email at p.christiansen@honolulu.gov.



HONOLULU AUTHORITY for RAPID TRANSPORTATION

19 JUN 10 P3 04

May 31, 2019

Andrew S. Robbins
EXECUTIVE DIRECTOR AND CEO

Krishniah N. Murthy
SENIOR ADVISOR

BOARD OF DIRECTORS

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CHAIR

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VICE CHAIR

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Jade Butay
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Kamani Kuala'au
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Tobias Martyn
Glenn M. Nohara
Ember Shinn
Kathy Sokugawa
Hovt H. Zia

MEMORANDUM

TO: LORI M.K. KAHIKINA, DIRECTOR
DEPARTMENT OF ENVIRONMENTAL SERVICES (ENV)

ATTN: PAUL CHRISTIANSEN

FROM: ANDREW S. ROBBINS, EXECUTIVE DIRECTOR AND CEO
HONOLULU AUTHORITY FOR RAPID TRANSPORTATION

SUBJECT: ENVIRONMENTAL IMPACT STATEMENT (EIS) PREPARATION NOTICE
HONOULIULI/WAIPAHAU/PEARL CITY WASTEWATER CONVEYANCE FACILITIES

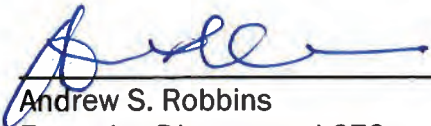
Thank you for the opportunity to comment on the EIS Preparation Notice for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities.

The Honolulu Authority for Rapid Transportation (HART) is currently building stations and relocating utilities along Kamehameha Highway through Pearl City and Aiea for the Honolulu Rail Transit Project. As part of this project, HART will be relocating the HECO 138-kV overhead power line along Kamehameha Highway between the Waiau Power Plant and Aloha Stadium. This relocation could involve a combination of overhead and underground alignments, and could end up in close proximity to the proposed Pearl City Influent Trunk Sewer, Waimalu Force Main, Waimalu Influent Trunk Sewer, and/or other facilities. HART intends to complete construction of this facility by 2025 and requests further coordination regarding potential alignments and planned construction phasing, in order to optimize overall project delivery for the City. HART also requests that the EIS include studies to ensure that the construction of the wastewater conveyance facilities will not affect the rail guideway and station foundations or other utility relocation work which has been undertaken.

Finally, it appears that Corridor G of the proposed Waiawa gravity sewer would run under HART property along the edge of the Rail Operations Center. If this corridor is selected, HART requests further coordination with its Safety and Security team as well as the Department of Transportation Services regarding impacts to rail operations.

Lori M.K. Kahikina, Director
Page 2
May 31, 2019

Please contact Mr. Frank Kosich, HART Director of Design and Construction, at frank.kosich@honolulu.gov or 768-6191 or Mr. In-Tae Lee, HART Deputy Director of Engineering and Design, at ilee@honolulu.gov or 768-6198 for further coordination. HART looks forward to working with ENV on this project.



Andrew S. Robbins
Executive Director and CEO

cc: In-Tae Lee, HART Deputy Director of Engineering and Design
Frank Kosich, HART Director of Design and Construction

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO:
PRO 19-055

September 17, 2019

MEMORANDUM

TO: Andrew S. Robbins, Executive Director and CEO
Honolulu Authority for Rapid Transportation

FROM: Lori M.K. Kahikina, P.E.
Director

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your memorandum dated May 31, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments:

1. We acknowledge that the Honolulu Authority for Rapid Transportation (HART) has significant planned construction and operations in the eastern portion of the area described in the EISPN.
2. The Department of Environmental Services (ENV) will coordinate with HART as needed. ENV's construction of the projects east of Pearl City will likely occur after HART's planned 2025 construction completion date.
3. The EISPN includes preliminary alignment corridors and facility locations. The Environmental Impact Statement (EIS) will not include a study of potential impact to the rail guideway and station foundations; however, any potential impact to the rail facilities will be considered during the planning and design phases of individual projects.
4. If Corridor G becomes a preferred alignment for conveyance facilities, coordination and construction constraints will be addressed in the planning and design phases for this specific project, including coordination with HART's Safety and Security team and the Department of Transportation Services.

Andrew S. Robbins
September 17, 2019
Page 2

We appreciate your participation in the EISPN review process. Your memorandum and this response will be included in the Draft Environmental Impact Statement. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

DEPARTMENT OF DESIGN AND CONSTRUCTION
CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET, 11TH FLOOR
HONOLULU, HAWAII 96813
Phone: (808) 768-8480 • Fax: (808) 768-4567
Web site: www.honolulu.gov

KIRK CALDWELL
MAYOR



ROBERT J. KRONING, P.E.
DIRECTOR

MARK YONAMINE, P.E.
DEPUTY DIRECTOR

June 4, 2019

City & County of Honolulu
Department of Environmental Services
1000 Uluohia Street, Suite 308
Kapolei, Hawaii 96707

Attn: Paul Christiansen

Dear Mr. Christiansen:

Subject: Environmental Impact Statement Preparation Notice
Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for the opportunity to review and comment on the EISPN. Our Facilities Division has some comments which are attached.

Should you have any questions, please contact Clifford Lau, Chief of our Facilities Division at 768-8483.

Sincerely,

A handwritten signature in black ink, appearing to read "R. J. Kroning".

Robert J. Kroning, P.E.
Director

RJK: cf (771481)

Attachment

cc: AECOM Technical Services, Inc. – Lesley Matsumoto

3.13.2.2 POTENTIAL IMPACTS

State Department of Education and the individual schools in the area would be consulted to coordinate work in the vicinity from inception to construction if all parties concur with the project. During construction, there may be additional noise and traffic at or near the schools. Construction related impacts would be short term and are not anticipated to have any significant impacts. No operational effects to schools are anticipated, other than periodic inspection and/or maintenance of proposed wastewater management facilities located on or near school property.

3.13.3 Parks and Recreational Areas

3.13.3.1 EXISTING SETTING

There are numerous parks and recreational areas in the vicinity of the project area. Only Lehua Community Park, Pacheco Neighborhood Park, Neal S. Blaisdell Park, Waipi'o Peninsula Sports Complex, 'Aiea Bay State Recreation Area, Pearl Harbor Bike Path, and Ted Makalena Golf Course are expected to be directly affected by at least one of the options (Figure 3-12). One project objective is to avoid impairment of public use of the existing parks or to replace in-kind taking of park land. This will be the planning and design objective to the maximum extent feasible. Any unavoidable impacts will be reviewed in consultation with the Department of Parks and Recreation for acceptability before proceeding further.

Should take out Lehua Community Prk from site of new station as that option would have major impact to that small park.

3.13.3.2 POTENTIAL IMPACTS

The State DLNR Division of State Parks and CCH Department of Parks and Recreation would be consulted to coordinate work in the vicinity of potentially affected park land. During construction, there may be additional noise and traffic at or near the parks and recreational areas. No operational long-term impacts to park land are anticipated, other than periodic inspection and/or maintenance of adjacent proposed facilities.

3.14 LAND OWNERSHIP

3.14.1 Existing Setting

The project area is located in TMK Zone 9 Sections 1 through 4 and 6 through 9, and spans multiple properties. Figure 3-13 shows government land ownership within and adjacent to the existing system utilities and the proposed project including State, State Department of Hawaiian Home Lands (DHHL), County, and Federal lands.

3.14.2 Potential Impacts

Regardless of the selected option, the majority of the proposed construction would be along or near existing roadway easements and utility corridors associated with the East Interceptor. However, construction of the proposed Waiawa conveyance corridors may require new permanent easements. In addition, temporary easements and right-of entry will most likely be required throughout the project.

City and County of Honolulu

HONOULULI/ WAIPAHAU/ PEARL CITY WASTEWATER CONVEYANCE FACILITIES

Legend

- PS Existing WWPS
- WWPS Boundary
- Wetlands
- 100-yr Flood Zone
- Major Landowners
- Others
- City and County Honolulu
- Federal
- State of Hawai'i
- Tax Map Key Parcel Boundary

Recommend that this site not be considered. The area shown would have a major impact on this small community park.



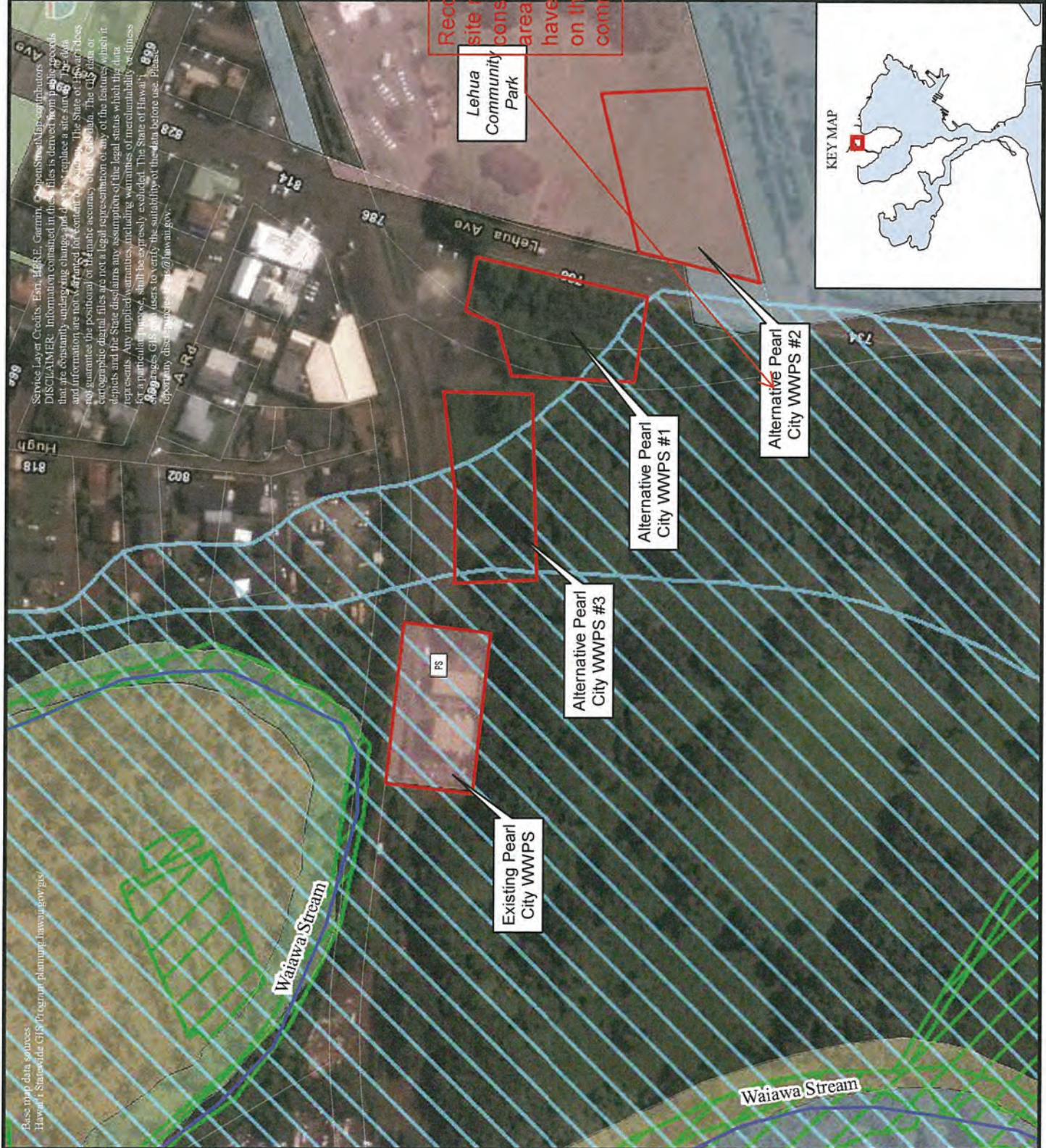
FIGURE 2-7

PEARL CITY WWPS - RECONSTRUCT/ REPLACE

March 2019

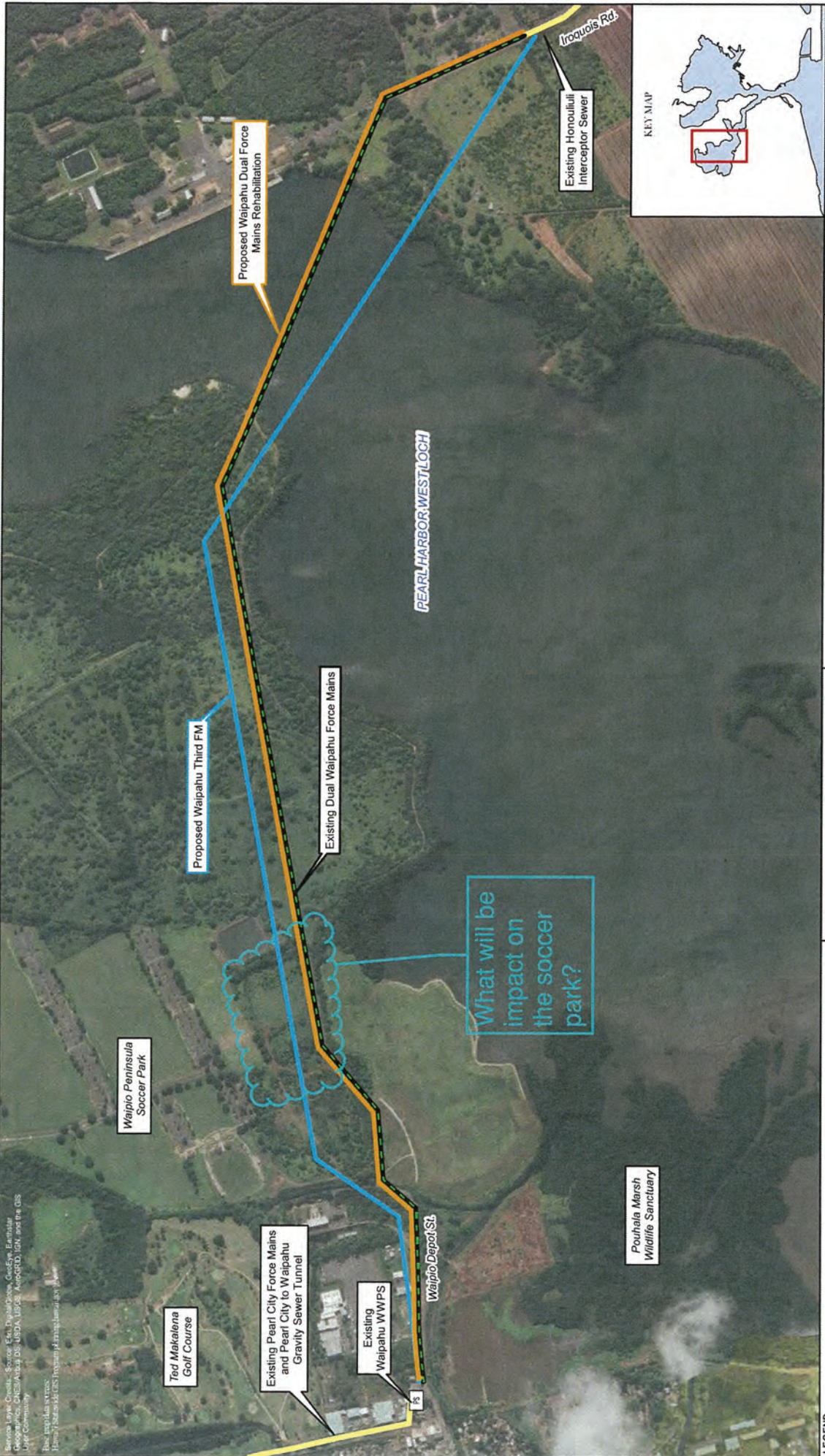
AECOM

1001 BISHOP ST, STE 1600
HONOLULU, HAWAII 96813



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Base map data sources:
Hawaii's Statewide GIS Program planning.hawaii.gov/gis/



Source: Esri, DeLorme, GeoEye, "DigitalGlobe", GeoEye, Earthstar, GeoWorld, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
 Base: Esri/DeLorme, GeoEye, "DigitalGlobe", GeoEye, Earthstar, GeoWorld, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community



AECOM
 1001 BISHOP ST., STE. 1600
 HONOLULU, HAWAII 96813

City and County of Honolulu
HONOLULU / WAIPAHU / PEARL CITY
WASTEWATER CONVEYANCE FACILITIES

FIGURE 2-1
WAIPAHU NEW FM AND EXISTING
FM REHABILITATION
 March 2019

- LEGEND**
- Existing East Interceptor
 - Existing WWPS
 - Existing Waipahu Dual Force Mains
 - Existing Waipahu Third Force Main
 - Proposed Waipahu Dual Force Main Replacement or Rehabilitation

DEPARTMENT OF ENVIRONMENTAL SERVICES
CITY AND COUNTY OF HONOLULU

1000 ULUOHIA STREET, SUITE 308, KAPOLEI, HAWAII 96707
TELEPHONE: (808) 768-3486 • FAX: (808) 768-3487 • WEBSITE: <http://envhonolulu.org>

KIRK CALDWELL
MAYOR



LORI M.K. KAHIKINA, P.E.
DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO:
PRO 19-058

September 17, 2019

MEMORANDUM

TO: Robert J. Kroning, P.E., Director
Department of Design and Construction

FROM:  Lori M.K. Kahikina, P.E.
Director

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your letter dated June 4, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN. We offer the following responses to your comments;

1. The proposed Waipahu Force Main work is not anticipated to directly impact the Waipio Peninsula Soccer Park. The currently undeveloped western portion of the property has been identified as a potential contractor staging area. If it is determined that this area is needed for staging, we will coordinate with the Department of Design and Construction and other affected parties to avoid conflicts regarding the use of the site.
2. The Alternative Pearl City Wastewater Pump Station (WWPS) #2 location in Lehua Community Park is not preferred and would only be considered as a possible option if the Hybrid conveyance option is not selected and it is determined that the Pearl City WWPS must be relocated outside of the 100-year flood zone.

We appreciate your participation in the EISPN review process. Your letter and this response will be included in the Draft Environmental Impact Statement. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

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NONGOVERNMENTAL ORGANIZATIONS AND GENERAL PUBLIC

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From: [Christiansen, Paul](#)
To: [Weieneth, Aaron](#); [Matsumoto, Lesley](#); [Loui, Rae](#)
Cc: [Pobuk, Jack](#); [Christiansen, Paul](#)
Subject: FW: Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities - Request to Hawaiian Electric for review and comment
Date: Friday, May 31, 2019 5:47:42 PM

Aloha Aaron,

Please see below.

Paul Christiansen, PE

Civil Engineer
Department of Environmental Services
CIP Program and Planning
City and County of Honolulu
(808) 768-3470

From: Liu, Rouen [mailto:rouen.liu@hawaiianelectric.com]
Sent: Friday, May 31, 2019 11:31 AM
To: Christiansen, Paul <p.christiansen@honolulu.gov>; lesley.Matsumoto@aecom.com
Cc: Uehira, Terrene <terrene.uehira@hawaiianelectric.com>; Kuwaye, Kristen <kristen.kuwaye@hawaiianelectric.com>
Subject: Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities - Request to Hawaiian Electric for review and comment

Dear Mr. Christiansen and Ms. Matsumoto,
Thank you for the opportunity to comment on the subject project. Hawaiian Electric Company has no objection to the project. Should Hawaiian Electric have existing easements and/or facilities on the subject property or within the rights of way, we will need continued access for maintenance of our facilities.

There are existing Hawaiian Electric fiber facilities along the proposed project area route:

Fiber Link: Waiau - Ewa Nui
Fiber Link: Waiau – CIP
Fiber Link: Waiau – Makalapa
Fiber Link: Ford Island – Makalapa

We appreciate your efforts to keep us apprised of the subject project in the planning process. As the proposed Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities project comes to fruition, please continue to keep us informed so we may evaluate any potential impacts to our fiber or other facilities.
Should there be any questions, please contact me at 543-7245.
Thank you,

Rouen Liu
Permit Engineer
Hawaiian Electric Company

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DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-059

September 17, 2019

Mr. Rouen Liu, Permit Engineer
Hawaiian Electric Company
P.O. Box 2750
Honolulu, Hawai'i 96840

Dear Mr. Liu:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your email dated May 31, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN.

We acknowledge your comments regarding the existing Hawaiian Electric Company (HECO) facilities in our project area, including HECO's need to have access to these facilities for maintenance purposes.

The Draft Environmental Impact Statement (DEIS) will include a discussion of the existing HECO facilities. As individual projects enter the planning and design phases we will keep HECO informed and acknowledge that potential impacts and possible mitigation measures may need to be evaluated.

We appreciate your participation in the EISPN review process. Your email and this response will be included in the DEIS. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,

Lori M.K. Kahikina, P.E.
Director

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From: steve.vendt hawaiianrailway.com [<mailto:steve.vendt@hawaiianrailway.com>]

Sent: Friday, May 17, 2019 9:40 AM

To: Christiansen, Paul <p.christiansen@honolulu.gov>; Matsumoto, Lesley <Lesley.Matsumoto@aecom.com>

Subject: Honouliuli Wastewater Facilities

Aloha,

The Hawaiian Railway Society is opposed to any new crossings of the Historic Railway listed on the National Register of Historic Places. Adding crossings off Renton Rd is just a convenience crossing. There are crossings already in place a few blocks away.

Mahalo,

Steven Vendt
Operations Manager
Hawaiian Railway
808-681-5461

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CITY AND COUNTY OF HONOLULU

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DIRECTOR

TIMOTHY A. HOUGHTON
DEPUTY DIRECTOR

ROSS S. TANIMOTO, P.E.
DEPUTY DIRECTOR

IN REPLY REFER TO
PRO 19-056

September 17, 2019

Mr. Steven Vendt, Operations Manager
Hawaiian Railway Society
91-1001 Renton Road
'Ewa Beach, Hawai'i 96706

Dear Mr. Vendt:

SUBJECT: Comments on the Environmental Impact Statement Preparation Notice (EISPN) for the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities

Thank you for your email dated May 17, 2019, regarding the Honouliuli/Waipahu/Pearl City Wastewater Conveyance Facilities EISPN.

This EISPN focuses on proposed improvements and upgrades to the existing East Interceptor System of the Honouliuli sewer basin. Improvements to the Honouliuli Wastewater Treatment Plant (WWTP) and nearby vicinity are outside the scope of this EISPN document. However, our Department is available to discuss your concerns related to the Honouliuli WWTP separately.

We appreciate your participation in the EISPN review process. Your email and this response will be included in the Draft Environmental Impact Statement. Should you have any questions, please contact Paul Christiansen, Civil Engineer, at 768-3470 or by email at p.christiansen@honolulu.gov.

Sincerely,

Lori M.K. Kahikina, P.E.
Director