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.honoluludpp.org • CITY WEB SITE: www.honolulu.gov

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AUG 23 2020

KIRK CALDWELL
MAYOR

KATHY K. SOKUGAWA
ACTING DIRECTOR

TIMOTHY F. T. HIU
DEPUTY DIRECTOR

EUGENE H. TAKAHASHI
DEPUTY DIRECTOR

August 14, 2020

2020/ED-5(CK)

Mr. Keith Kawaoka, Acting Director
State of Hawaii
Department of Health
Office of Environmental Quality Control
235 South Beretania Street, Room 702
Honolulu, Hawaii 96813

Dear Mr. Kawaoka:

SUBJECT:	Chapter 25, Revised Ordinances of Honolulu Draft Environmental Assessment (DEA)
Project:	Pat's at Punaluu - Replacement Wastewater Treatment System
Applicant:	Pat's at Punaluu - Association of Apartment Owners (AOAO)
Agent:	Environmental Science International (Stephanie Davis)
Location:	53-567 Kamehameha Highway - Hauula
Tax Map Key:	5-3-008: 002

With this letter, the Department of Planning and Permitting (DPP) hereby transmits the DEA and anticipated Finding of No Significant Impact (FONSI) for the Pat's at Punaluu Replacement Wastewater Treatment System Project, located at 53-567 Kamehameha Highway in Hauula (Tax Map Key 5-3-008: 002), Oahu, for publication in the August 23, 2020, edition of *The Environmental Notice*.

We have uploaded an electronic copy of this letter, the publication form, and the DEA to your online submittal site.

21-034

Should you have any questions, please contact Christi Keller, of our Zoning Regulations and Permits Branch, at 768-8087 or by email at c.keller@honolulu.gov.

Very truly yours,

for Kathy K. Sokugawa
Acting Director

APPLICANT
PUBLICATION FORM

Project Name:	Pat's at Punaluu Wastewater Treatment System Replacement
Project Short Name:	Pat's at Punaluu Replacement WWTP
HRS §343-5 Trigger(s):	HRS 343-5(a)(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; Project requires an SMA Use Permit under Ch 25, ROH.
Island(s):	Oahu
Judicial District(s):	Koolauloa
TMK(s):	(1) 5-3-008: 002
Permit(s)/Approval(s):	SMA Use, Underground Injection Control, Discharge, Building/Grading, Tank Installation
Approving Agency:	City and County of Honolulu, Department of Planning and Permitting
Contact Name, Email, Telephone, Address	Christi Keller c.keller@honolulu.gov (808) 768-8087 650 South King Street, 7th Floor Honolulu, Hawaii 96813
Applicant:	Association of Apartment Owners at Pat's at Punaluu
Contact Name, Email, Telephone, Address	Allen DeLaney-Kolby, President/Communications Committee Chair allen.delaney-kolby@patsatpunaluu.com (763) 218-4802 53-567 Kamehameha Hwy Hauula, HawaiiI 96717
Consultant:	Environmental Science International, Inc.
Contact Name, Email, Telephone, Address	Stephanie Davis sdavis@esciencei.com (808) 261-0740 ext. 142 354 Uluniu Street, Suite 304 Kailua, Hawaii 96734

Status (select one)	**Submittal Requirements**
_X__ DEA-AFNSI	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
____ FEA-FONSI	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the approving agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the approving agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the approving agency, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the approving agency, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.

___ FEIS Acceptance Determination	The approving agency simultaneously transmits to both the OEQC and the applicant a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
____ FEIS Statutory Acceptance	The approving agency simultaneously transmits to both the OEQC and the applicant a notice that it did not make a timely determination on the acceptance or nonacceptance of the applicant's FEIS under Section 343-5(c), HRS, and therefore the applicant's FEIS is deemed accepted as a matter of law.
____ Supplemental EIS Determination	The approving agency simultaneously transmits its notice to both the applicant and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.
____ Withdrawal	Identify the specific document(s) to withdraw and explain in the project summary section.
____ Other	Contact the OEQC if your action is not one of the above items.

Project Summary

The Project consists of replacement of the existing, non-functioning wastewater treatment system for the Pat's at Punaluu Condominiums (Project). The existing wastewater treatment system was installed in the 1970s and is in need of replacement due to deterioration, inability to adequately treat onsite wastewater, and potential for public health and beach and marine ecosystem hazards should the system stop functioning or spill over. The replacement wastewater treatment system will consist of a new, above-ground wastewater treatment plant (WWTP) that will be connected to the existing injection wells disposal system. The proposed WWTP will consist of the existing wet well/lift station/trash tank, a new primary treatment tank/system that includes an integrated clarifier tank and sludge holding tank, and the existing multiple injection well disposal system. The new WWTP system components will all be constructed in the western, mauka parking lot area of the Project site.

Reasons Supporting Determination

Potential short-term construction-related impacts relating to water quality, biological and marine resources, soils and cultural resources are anticipated to be reduced to a level of less than significant through compliance with existing regulatory standards, implementation of Best Management Practices, and implementation of mitigation measures as identified in the Draft EA. Upon implementation, the Project is anticipated to result in a long-term, beneficial effects on water quality, marine resources, and soils, as as the existing deteriorating condition of the site's wastewater treatment system will be corrected.

Draft
ENVIRONMENTAL ASSESSMENT

Pat's at Punalu'u Wastewater Treatment System Replacement
53-567 Kamehameha Highway
Hauula, Oahu, Hawaii

TMK No. (1) 5-3-008:002

Environmental Science International, Inc.
354 Uluniu Street, Suite 304
Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

Draft
ENVIRONMENTAL ASSESSMENT

Pat's at Punalu'u Wastewater Treatment System Replacement
53-567 Kamehameha Highway
Hauula, Oahu, Hawaii

TMK No. (1) 5-3-008:002

Prepared for:

AOAO at Pat's at Punalu'u
53-567 Kamehameha Hwy
Hauula, HI 96717

Prepared by:

Environmental Science International, Inc.
354 Uluniu Street, Suite 304
Kailua, Hawaii 96734

Project No. 119029

July 27, 2020

PROJECT SUMMARY

Project Name:	**Pat's at Punalu'u Condominium Wastewater Treatment System Replacement**
Applicant/Fee Owner:	**Association of Apartment Owners [AOAO] at Pat's at Punalu'u** **Point of Contact: Allen DeLaney-Kolby** **President/Communications Committee Chair** **53-567 Kamehameha Hwy** **Hauula, HI 96717** **(763) 218-4802**
Approving Agency:	**City and County of Honolulu** **Department of Planning and Permitting** **650 South King Street, 7th Floor** **Honolulu, Hawaii 96813**
Tax Map Key Parcels and Roads Potentially Affected:	**5-3-008:002 (Pat's at Punalu'u Condominium), 2.908 acres** **Kamehameha Highway**
State Land Use District:	**Urban District**
Existing County Zoning:	**A-2 Medium Density Apartment**
City Development Plan:	**Koolau Loa Sustainable Communities Plan**
Special Designation:	**Special Management Area [SMA]**
Anticipated Determination:	**Finding of No Significant Impact [FONSI]**

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EXECUTIVE SUMMARY

This EA was prepared on behalf of the AOAO at Pat's at Punalu'u for replacement of the wastewater treatment system at the Pat's at Punalu'u Condominium, referred to as the Property. The Property is located at 53-567 Kamehameha Highway in Hauula, Hawaii. The Property is identified as TMK No. (1) 5-3-008:002. The proposed project consists of replacing the existing wastewater treatment system with a new WWTP that will be connected to the existing injection wells disposal system. The purpose of the EA is to determine whether or not the project has the potential to cause significant environmental impacts. The EA was conducted in accordance with the requirements of the Hawaii EIS Law (HRS Chapter 343 and HAR Chapter 11-200.1).

The applicant for construction of the WWTP is the AOAO at Pat's at Punalu'u. The approving agency for the proposed activity is the City and County of Honolulu Department of Planning and Permitting Land Use Permits Division, which is responsible for administering the Land Use Ordinance and other regulations pertaining to land use within the City. The EA is necessary because the project is within the SMA and requires an SMA Use Permit. In accordance with ROH Chapter 25, an EA and FONSI are required prior to applying for the SMA Use Permit.

The Property is zoned as *Urban* by the State and as *A-2 Medium Density Apartment* by the County, and is located within a rural, mixed-use area in the Koolauloa District of Oahu. The area is developed with condominiums, single-family residences, small businesses, and agricultural farms. The Property is approximately 900 feet northeast of and below the UIC line, at a surface elevation of approximately 7 feet amsl. The Property is adjacent to the Pacific Ocean on its eastern boundary. Locally, the topographic surface gradient is relatively flat.

For wastewater treatment, Pat's at Punalu'u currently utilizes a system consisting of a 1,200-gallon wet well/trash tank for preliminary treatment, an aerobic treatment unit (54,627-gallon tank), clarifier, and chlorine contact tank. Treated effluent is then discharged into one (1) primary/active injection well, and eight (8) backup wells, by gravity. The existing wastewater treatment system was installed in the 1970s and is in need of replacement due to deterioration.

The proposed WWTP will consist of the following:

- Existing Wet Well/Lift Station/Trash Tank
- New Primary Treatment Tank/System (MSFBS)
    - Integrated Clarifier Tank
    - Integrated Sludge Holding Tank
- Existing Multiple Injection Well Disposal System
    - One (1) Primary Deep Injection Well (IW9)
    - Two (2) Backup Deep Injection Wells (IW5 and IW1) that are capable of 100% Redundancy

The new WWTP system components will all be constructed in the western parking lot area of Pat's at Punalu'u. The system was designed based on the total amount of wastewater currently generated by

Pat's at Punalu'u residents. The new WWTP is designed to treat 32,000 gpd. The existing permitted injection wells will be used for effluent disposal.

Most of the impacts for the proposed project are expected to be short-term and related to construction activities, such as storm water, noise, dust, and traffic. Efforts to minimize such impacts will be taken to the extent practicable. Long-term impacts are improved environmental conditions related to upgraded wastewater treatment, including a reduction in wastewater overflows.

Findings and Conclusions

Based on the analysis of information in this EA, it has been determined that the proposed WWTP will have no significant impacts to the natural, built, or social environment. The results of the EA were compared with the significance criteria established by the State under HRS 343 (HAR Chapter 11-200.1-13). It is concluded that the construction and operation of the proposed WWTP do not meet any of the thirteen criteria. By not meeting these criteria, it is appropriate that the proposed project be issued a FONSI and that an EIS not be required.

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APPENDICES

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LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
amsl	above mean sea level
AOAO	Association of Apartment Owners
BFE	base flood elevation
bgs	below ground surface
BOD	biochemical oxygen demand
BMP	Best Management Practice
CRM	Cement rubble masonry
CWB	Clean Water Branch
CZM	Coastal Zone Management
dBA	A-weighted decibel
DLNR	Department of Land and Natural Resources
DOH	State of Hawaii Department of Health
DPP	Department of Planning and Permitting
EA	Environmental Assessment
EIS	Environmental Impact Statement
ESI	Environmental Science International, Inc.
°F	degrees Fahrenheit
FONSI	Finding of No Significant Impact
GIS	Geographic Information System
gpd	gallons per day
HAR	Hawaii Administrative Rules
HECO	Hawaiian Electric Company
HRS	Hawaii Revised Statutes
KLSCP	Koolau Loa Sustainable Communities Plan
LUO	Land Use Ordinance
mg/L	milligram per liter
MSFBS	Multi-Stage Fixed Biofilm System
NEPA	National Environmental Policy Act
NOVO	Notice and Finding of Violation and Order
NPDES	National Pollutant Discharge Elimination System
OEQC	Office of Environmental Quality Control
ROH	Revised Ordinances of Honolulu
SAAQS	State Ambient Air Quality Standards
SCS	Scientific Consultant Services, Inc.
SDWB	Safe Drinking Water Branch
SHPD	State Historic Preservation Division
SMA	Special Management Area
TMK	Tax Map Key
TSS	total suspended solids
UIC	Underground Injection Control
USACE	U.S. Army Corp of Engineers
USFWS	U.S. Fish and Wildlife Service

Acronym	Definition
WWTP	wastewater treatment plant

SECTION 1 INTRODUCTION

This report describes the Environmental Assessment [EA] performed by Environmental Science International, Inc. [ESI], on behalf of the Association of Apartment Owners [AOAO] at Pat's at Punalu'u for replacement of the wastewater treatment system at the Pat's at Punalu'u Condominium, which is located at 53-567 Kamehameha Highway in Hauula, Hawaii, hereinafter referred to as the "Property" (Figure 1). The Property is owned by Pat's at Punalu'u and is identified by the City and County of Honolulu Property Assessment Division as Tax Map Key [TMK] No. (1) 5-3-008:002 (Figure 2). It is located on land zoned as *Urba*n by the State of Hawaii (Office of Planning, 2018) (Figure 3a). Under the City and County of Honolulu's Land Use Ordinance [LUO], the Property is zoned as *A-2 Medium Density Apartment* (Figure 3b).

1.1 PURPOSE

This assessment was undertaken to determine whether the project has the potential to cause significant environmental impacts. The assessment was conducted in accordance with the requirements of the Hawaii Environmental Impact Statement [EIS] Law, which are contained in Hawaii Revised Statutes [HRS] Chapter 343 (HRS 343; State of Hawaii Department of Health [DOH], 1974a) and in Hawaii Administrative Rules [HAR] Title 11, Chapter 200.1 (HAR 11-200.1; DOH, 2019b).

1.2 GENERAL INFORMATION

The replacement project consists of demolishing and removing the existing wastewater treatment system and constructing a new wastewater treatment plant [WWTP] that will be connected to the existing injection wells disposal system. The approving agency for the proposed activity is the City and County of Honolulu Department of Planning and Permitting [DPP] Land Use Permits Division, which is responsible for administering the LUO and other regulations pertaining to land use within the City. The EA is necessary because the project is located within the Special Management Area [SMA] and requires an SMA Use Permit. An EA and Finding of No Significant Impact [FONSI] are required prior to applying for the SMA Use Permit.

1.3 PROPERTY DESCRIPTION

Pat's at Punalu'u is a residential condominium building containing 160 living units. The building was built in 1974 and includes nine floors. The building is centrally located within the Property and is surrounded by an asphalt paved parking lot on the western side, and a lawn and pool on the eastern side (Figure 4). There are small landscaped areas throughout the Property. Photographs depicting the current site conditions are provided in Appendix A.

The Property occupies 2.908 acres of land on the windward side of Oahu, and it lies within the SMA (Figure 4). The Property is bordered by residential property to the north, the Pacific Ocean to the east, Hanohano Hale condominium to the south, and Kamehameha Highway to the west (Figures 2 and 3). Agricultural land is located to the west across Kamehameha Highway. A site plan depicting the layout of the Property is provided in Figures 5a and 5b.

1.4 PROPERTY LOCATION AND SETTING

The Property is located on a portion of land previously identified as Papaakoko Beach Lots. Later, the lots were consolidated and the Property now is identified as TMK First Taxation Division, Zone 5, Section 3, Plat 008, Parcel 002. It is located at latitude 21°35'25.9"N, longitude 157°53'24.8"W.

The Property is located within a rural, mixed-use area in the Koolauloa District of Oahu. The area is developed with condominiums, single-family residences, small businesses, and agricultural farms. The Property is approximately 900 feet northeast of and below the underground injection control [UIC] line, on the east coast of Oahu, at a surface elevation of approximately 7 feet above mean sea level [amsl] (Figure 6). The Property is adjacent to the Pacific Ocean on its eastern boundary. Locally, the topographic surface gradient is relatively flat.

The Property is located in flood hazard area Zone AE (Office of Planning, 2018) (Figure 10). This area is subject to inundation by the 1% annual chance flood event. Mandatory flood insurance purchase applies in this zone. More information on the flood hazard zone is provided in Section 4.6.2.2.

1.5 PROJECT BACKGROUND

For wastewater treatment, Pat's at Punalu‘u currently utilizes a system consisting of a 1,200-gallon wet well/trash tank for preliminary treatment, an aerobic treatment unit (54,627-gallon tank), clarifier, and chlorine contact tank. The system was installed in the 1970s and is in need of replacement due to deterioration. Pat's at Punalu‘u initiated this project to evaluate various alternatives to upgrade/replace its existing wastewater treatment system. The recommendation is to replace the existing wastewater treatment system with a new WWTP and use the existing injection wells disposal system. As the system currently exists, it is in violation of the DOH Wastewater Branch's regulations.

1.6 DESCRIPTION OF EXISTING FACILITY

According to the DOH Wastewater Branch records, Pat's at Punalu‘u generates 32,000 gallons per day [gpd] of average daily flow of domestic wastewater by residents of the Property.

The facility's wastewater is collected by an existing 6-foot diameter wet well (1,200 gallons) equipped with dual submersible lift pumps. The wet well functions as a trash tank for preliminary treatment of the wastewater influent before it is pumped through the existing treatment system (aerobic treatment unit, clarifier, and chlorine contact tank). Treated, chlorinated effluent is then discharged into the one primary/active injection well by gravity. The effluent disposal system also includes eight backup injection wells. The existing wastewater treatment system and injection wells are along the Property's western parking lot (Figures 5a and 5b).

The nine existing injection wells were permitted through the DOH Safe Drinking Water Branch [SDWB] UIC Program, Permit No. UO-1342. Effluent data shows that treated effluent from the existing wastewater treatment system complies with UIC permit effluent standards (< 60 milligrams per liter [mg/L] biochemical oxygen demand [BOD] and total suspended solids [TSS]).

In August 2017, the DOH Wastewater Branch issued an Informal Notice of Violation to the Pat's at Punalu'u AOAO for a wastewater spill from the northeast injection well. A field citation was issued in June 2018 after a DOH field inspection noted wastewater overflowing from injection well IW3 and spilling onto the ground. In September 2018, DOH conducted an inspection and noted that wastewater was overflowing from injection well IW3 and flowing in the parking lot towards the north entrance driveway of the Property. A Notice and Finding of Violation and Order [NOVO] was issued to the Pat's at Punalu'u AOAO on November 2, 2018 for this wastewater spill violation. The NOVO requires design, permitting, and installation of a new WWTP.

1.7 AGENCIES CONTACTED DURING THE PRE-CONSULTATION PROCESS

Pre-consultation letters were mailed to the following agencies in April 2020 to request initial comments on the proposed project:

City and County of Honolulu

- DPP
- Board of Water Supply*
- Department of Environmental Services
- Office of Climate Change, Sustainability and Resiliency
- Honolulu Fire Department*
- Honolulu Police Department*
- Department of Emergency Management
- Department of Transportation Services*
- Council Member Heidi Tsuneyoshi - Honolulu City Council District 2
- Office of the Mayor

State of Hawaii

- DOH, Environmental Management Division
  - o Clean Water Branch
  - o Safe Drinking Water Branch
  - o Wastewater Branch*
- Department of Land and Natural Resources
  - o Division of Aquatic Resources*
  - o Engineering Division*
  - o Land Division*
  - o Division of Forestry and Wildlife
  - o Office of Conservation and Coastal Lands
  - o State Historic Preservation Division [SHPD]
  - o Commission on Water Resources Management
- Office of Hawaiian Affairs
- Office of Planning
- Department of Transportation, Highways Division*

Federal Agencies

- United States Fish and Wildlife Service [USFWS]
- U.S. Army Corps of Engineers
- National Marine Fisheries Service (NOAA Fisheries)

Community Organizations

- Koolauloa Neighborhood Board No. 28

Responses were received from the agencies marked with an asterisk (*). Copies of the pre-consultation letters and agency responses (for those agencies that responded) are included in Appendix E. Comments received from the agencies were either addressed during preparation of the Draft EA or will be addressed during the design and permitting phases of the project. Copies of the Draft EA will be distributed to the same agencies and organizations listed above to provide an opportunity for their review and comment. A copy will also be provided to the Kahuku Library for public review and comment. Additional copies will be distributed to other agencies and organizations if requested.

SECTION 2 PROPOSED PROJECT DESCRIPTION

The proposed WWTP will consist of the following:

- Existing Wet Well/Lift Station/Trash Tank
- New Primary Treatment Tank/System (Multi-Stage Fixed Biofilm System [MSFBS])
    - Integrated Clarifier Tank
    - Integrated Sludge Holding Tank
- Existing Multiple Injection Well Disposal System
    - One (1) Primary Deep Injection Well (IW9)
    - Two (2) Backup Deep Injection Wells (IW5 and IW1) capable of 100% Redundancy

The new WWTP system components will all be constructed in the landscaped area west of the parking lot of Pat's at Punalu'u, as shown in Figures 5a and 5b. The system was designed based on the total amount of wastewater generated by Pat's at Punalu'u residents. The system will be designed to accommodate a design maximum daily flow of 32,000 gpd and 480 gallons of sludge produced a day from the main condominium building. The wastewater computations are provided in the *Basis of Design and Engineering Report* included as Appendix B.

The existing 6-foot diameter wet well/lift station, equipped with dual submersible lift pumps, will function as a trash tank for preliminary treatment of wastewater influent. This trash tank will be able to separate inorganics and solids from the process flow. Residential wastewater from the lift station will then be pumped to the MSFBS for secondary treatment. The lift station will use two stainless steel (one primary and one standby) solids handling/grinder wastewater pumps to direct incoming flow into the MSFBS treatment unit. The discharge side of the lift station will contain a magnetic flow meter to monitor daily flows. A pressure transducer and standby mechanical float switches will monitor the wet well levels. The pump controls will be in the WWTP fence area. In the event of a high-level alarm, the lift station control panel will send a phone message to the WWTP operator and site management personnel.

The secondary treatment component of the WWTP will be an Aquarius brand MSFBS, which will be installed aboveground inside an epoxy-coated steel tank integrated with a sludge tank and clarifier. The MSFBS will be enclosed by a 10 to 12-foot tall chain-link fence or freestanding cement rubble masonry [CRM] wall to prevent unauthorized access. The MSFBS is an attached-growth process that incorporates textile media to grow biofilm that is fixed in the biological treatment basins. Bacteria are attached to the media making the system robust to handle shock loading, and solids are allowed to settle towards the bottom of the tank. The treatment basin is divided into stages to create a series of specific living environments for various microbial populations. The beginning treatment stages perform the majority of the BOD and ammonia removal in the process, and the remaining stages operate to minimize sludge production. A food chain is created by growing higher life forms in the later stages that consume the lower life forms grown in the initial stages, resulting in biological sludge minimization. The textile media is arranged vertically on stainless steel media racks. These racks are custom designed for each application. Fine bubble diffused aeration grids are attached to the bottom of the media racks for ease of installation in a package system. The diffused aeration system is critical

to the performance of the Fixed Biofilm System as it provides oxygen to the biomass, mixing within the treatment stages, and scouring of the biofilm for controlling growth.

Four (two primary and two standby) blowers will be connected to the system to provide oxygen for the biological activity required by the process. The blowers will be housed in a utility enclosure adjacent to a new emergency generator. The initial required start-up time for the biological activity is approximately two weeks. The WWTP system features two 18-inch diameter observation ports and two, 6-inch diameter access ports to pump out sludge. The blowers will run continuously, but use variable speed drives to ensure efficient use of energy. The variable speed drives will power the blowers based on the level of dissolved oxygen in the treatment system. A dissolved oxygen sensor will be installed in the system to provide the readings. Dissolved oxygen levels of at least 2 mg/L will be maintained regardless of the flow or strength of the wastewater. All the controls will be located inside the utility enclosure. The process parameters and process mass balance are provided in the *Basis of Design and Engineering Report* included as Appendix B. Manufacturer's literature for the MSFBS is provided as an attachment in Appendix B.

Intermittent wastewater effluent from the MSFBS gets discharged to the three (3) permitted injection wells (Class V, Subclass AB). The existing injection well IW9 will provide a 100% primary effluent disposal system, while the other two backup injection wells (IW5 and IW1) will provide the 100% redundancy. Treated effluent flow from the MSFBS can be redirected between the injection wells via 4-inch valves.

Water conservation improvements, such as installation of low flow shower heads and low flush toilets in several units, have already been initiated by the Pat's at Punalu'u AOAO. These conservation improvements will continue to be implemented in the remaining units in conjunction with the proposed WWTP.

2.1 ELECTRICAL SUPPLY

The electrical components of the new WWTP will be connected to a proposed on-site, 208-volt three phase electrical circuit, which will be serviced by Hawaiian Electric Company [HECO] through a branch circuit from the Property's building circuit. A copy of the Draft EA will be provided to HECO for review/comment. Coordination with HECO regarding the proposed servicing of the proposed electrical circuit will occur during the building permit plan review by DPP. A diesel generator or equivalent equipment will provide emergency power from a separate fuel tank to the WWTP blowers and existing Wet Well/Lift Station.

2.2 WASTEWATER DISPOSAL AND SAMPLING

Based on a design maximum daily flow of 32,000 gpd and an estimated 480 gallons of sludge produced a day, the sludge holding tank of 5,890 gallons of total volume can retain 12.3 days of sludge for the WWTP with a sludge concentration of 1%. Local pump companies will be contracted to extract and haul away sludge from the sludge holding tank to the nearest wastewater treatment plant. A recurring 10-day sludge pumping schedule will be adopted based on the tank's 12.3-day sludge retention time.

There will be one (1) primary injection well (IW9), and two (2) backup wells (IW5 and IW1). All three wells will be connected to the WWTP and all can be controlled using plug valves. Treatment system operators and technicians can easily test the effluent by taking wastewater samples via an access point included in all the injection wells. Per HAR Chapter 11-62 requirement (DOH, 2016a), each injection well should be designed to handle the peak flow. The primary injection well is designed to accommodate the peak flow of 32,000 gpd. The two backup wells are designed to provide 100% backup disposal. A 100% redundancy is required by HAR Chapter 11-62 (DOH, 2016a).

2.3 ESTIMATED COST AND TIMING PHASE OF CONSTRUCTION

The estimated cost for the proposed WWTP is $1.8 million, including professional services. The source of funding for the project will be exclusively provided through loans obtained by the Pat's at Punalu'u AOAO. The proposed project will take approximately 6 to 12 months after completion of the EA and receipt of the SMA Use Permit and all agency approvals.

2.4 ALTERNATIVES TO THE PROPOSED PROJECT

2.4.1 No Action

The "no action" alternative would consist of leaving the existing wastewater treatment system as is. However, as described in Section 1.6, the existing system is deteriorating, which could lead to a risk of future wastewater spills. Additionally, the DOH Wastewater Branch requires that the wastewater treatment system be upgraded. Impacts may include fines from the DOH, lawsuits generated by the community, and detrimental effects on environmental and public health. Considering the age of the existing wastewater treatment system and the potential for future wastewater spills, this is not a feasible option.

2.4.2 Postponed Action

The "postponed action" alternative would consist of postponing replacement of the existing wastewater treatment system until a future date. As with the "no action" alternative, this would increase the risk of future wastewater spills and resulting environmental and public health problems. The DOH Wastewater Branch requires that the wastewater treatment system be upgraded in accordance with the NOVO. Postponing construction of the project could result in fines from the DOH; therefore, this is not a feasible option.

2.4.3 Alternative Wastewater Treatment Systems

The following two alternative, available wastewater treatment systems were evaluated and a comparative analysis was performed prior to the selection of the proposed WWTP. For comparison purposes, the estimated cost for the proposed Aquarius brand wastewater treatment system is $499,100.

1. Smith & Loveless FAST® fixed-film, aerobic wastewater treatment system (fixed bed biological reactor). The system consists of an above grade pre-engineered, factory-built packaged treatment plant, approximately 40 feet long by 8 feet wide by 9 feet high. The FAST® media creates a high surface area-to-volume ratio, which, combined with internal settling zones, maintains contestant bacterial growth during low-flow and peak usage. Cost is estimated at >$550,000. Although this system is similar to the proposed Aquarius brand wastewater treatment system, the treatment with the Aquarius was considered to be better and more modernized. The Aquarius system includes a larger sludge holding basin, while the Smith & Loveless system doesn't have extended sludge holding. The Smith & Loveless system is approximately 12 feet longer, which would occupy more space within the landscaped buffer and create more of a visual obstruction. Therefore, this system was not selected.

2. World Water Works Moving Bed Biofilm Reactor (MBBR™) fixed-film, aerobic wastewater treatment system. The MBBR™ system consists of a tank with submerged, but freely moving, specially designed bio-media, an aeration manifold providing both dissolved oxygen and mixing, and a sieve to retain the bio-media in the tank. A sludge holding tank can be added downstream of the MBBR™ tank. Cost of system with the addition of a sludge holding tank is estimated at $685,628. Although this system is similar to the proposed Aquarius brand wastewater treatment system, the fixed biofilm treatment with the Aquarius was considered to be better. The MBBR™ system also has a significantly higher cost. Therefore, this system was not selected.

2.4.4 Alternative Onsite Location

The southern end of the Property was considered as an alternate onsite location for placement of the proposed WWTP. However, this location was not optimal since it is further from existing injection well IW9, which is the primary and better operating well.

2.4.5 Alternative Offsite Location

An alternative offsite location for the proposed WWTP was also considered. The adjacent property on the mauka side of Kamehameha Highway is undeveloped. However, Pat's at Punalu'u does not own this property and an easement from the property owner in favor of Pat's at Punalu'u would be required. In addition, an easement crossing Kamehameha Highway would be required from the State Department of Transportation. In addition, utilizing the existing, developed site results in a smaller footprint, lower energy use, and reduced disturbance due to construction activities offsite.

SECTION 3 PLANS, PERMITS, POLICIES, AND CONTROLS

The proposed project is in compliance with required government and community plans, permits, policies, and controls. These are described below.

3.1 ENVIRONMENTAL POLICIES, PLANS, PERMITS, AND CONTROLS

3.1.1 Environmental Review Policy

The requirements for performing an EA are contained within the Hawaii EIS Law, which is set forth in HRS 343 (DOH, 1974a) and HAR Chapter 11-200.1 (DOH, 2019b). According to HRS 343, the purpose of the Hawaii EIS Law is to establish a system of environmental review to ensure that environmental concerns are considered in decisions made by the State of Hawaii. The intent of the law was to implement the requirements under the federal National Environmental Policy Act [NEPA].

The Hawaii EIS Law is administered and regulated by the State of Hawaii Office of Environmental Quality Control [OEQC]. The OEQC oversees the implementation of these regulations in order to assess the environmental, social, and economic consequences of a proposed development project prior to allowing construction to begin. The Hawaii EIS Law ensures the public the right to participate in planning projects that may affect their communities. The OEQC has issued guidelines for the environmental review process (OEQC, 2012).

Nine types of actions trigger the environmental review process under the Hawaii EIS Law. The proposed WWTP is subject to an environmental review under HRS Section 343-5(a)(9)(A): Propose any wastewater treatment unit, except an individual wastewater system or a wastewater treatment unit serving fewer that fifty single-family dwellings or the equivalent." In addition, development within the SMA is subject to the regulations of Chapter 25, Revised Ordinances of Honolulu [ROH], related to the SMA. In accordance with Section 25-3.3(c)(1), "any proposed development within the special management area requiring a special management area use permit shall be subject to an assessment by the agency in accordance with the procedural steps set forth in HRS Chapter 343" (City and County of Honolulu, 2018a). The project is a wastewater treatment unit and also requires an SMA Use Permit; therefore, the project is subject to the requirements of the Hawaii EIS Law.

3.1.2 Project Consistency with City and County of Honolulu Department of Planning and Permitting Land Use Ordinance

The following discussion includes an analysis of the proposed project consistency with the applicable City and County of Honolulu LUO included in Chapter 21, ROH: *Land Use Ordinance*.

Article 3: Establishment of Zoning Districts and Zoning District Regulations

Section 21-3.80 of the ROH establishes the purpose and intent of the Residential Districts. The Property is zoned for A-2: medium density apartment use. According to ROH 21-3.80(c), "[t]he intent of the A-2 medium density apartment district is to provide areas for medium density and multifamily dwellings. It is intended primarily for concentrated urban areas where public services are centrally located and infrastructure capacities are adequate" (City and County of Honolulu, 2018a). The

proposed WWTP upgrades would not affect the existing residential unit density or land use at the Property, or within the surrounding area. Therefore, the proposed project would be consistent with ROH Section 21-3.80(c).

Section 21-3.80-1 of the ROH establishes apartment district uses and development standards. Table 21-3.3 establishes the apartment development standards. The proposed project would not include any changes to the existing lot area, lot width or depth, and would not include any changes to the existing yard sizes. The project would not include additional improvements that would result in a total building area greater than the maximum allowed building area for A-2 zoning included in Table 21-3.3 (40 percent of zoning lot). The proposed project would not exceed the allowable height, height setbacks, or maximum floor area ratio (FAR) density established for A-2 zoning. Figure 5a shows how the proposed development components would comply with the provisions of the ROH Section 21-3 standards.

Article 4. General Development Standards

The proposed project would comply with applicable sections of ROH 21-4: General Development Standards. The proposed project components are planned to be sited within the Property parking lot/landscaping area, and would not encroach into yard or street setbacks, or conflict with any landscaping requirements. All proposed structures would comply with the maximum height allowed under A-2 zoning. Figure 5a shows how the proposed development components would comply with the provisions of the ROH Section 21-4 standards.

Articles 5 through 8 of the ROH are not applicable to the proposed project.

Article 9. Special District Regulations

The Property is located in the SMA and flood hazard area Zone AE. This area is subject to inundation by the 1% annual chance flood event. Mandatory flood insurance purchase applies in this zone. More information on the flood hazard zone is provided in Section 4.6.2.2. The permit application for the proposed project improvements would be submitted to DPP and reviewed for compliance with the flood hazard areas ordinance in accordance with ROH 21-9.10: Developments in Flood Hazard Areas.

3.1.3 Special Management Area

The SMA is administered and regulated by the City and County of Honolulu DPP. The requirements and regulations can be found in HRS 205A and Chapter 25, ROH. The purpose of these requirements is to regulate development along shorelines to avoid permanent losses of valuable resources and to ensure that access to publicly owned and publicly used beaches, recreational areas, and natural reserves is provided. As noted above, projects within the SMA must undergo the procedural steps set forth in HRS 343 prior to an SMA Use Permit being issued.

Pat's at Punalu'u AOAO is in the process of preparing an SMA major permit application for the proposed WWTP described in Section 2. The permit application will be submitted following acceptance of the Final EA and issuance of a FONSI.

3.1.3.1 Special Requirements Applicable to Shoreline Lots

Construction or activity on land within the shoreline area is subject to the regulations of Chapter 23, ROH, related to Shoreline Setbacks. In accordance with Section 23-1.2(b), "it is the specific purpose of this chapter to establish standards and to authorize the department of land utilization to adopt rules pursuant to HRS Chapter 91, which generally prohibit within the shoreline area any construction or activity which may adversely affect beach processes, public access along the shoreline, or shoreline open space" (City and County of Honolulu, 2018a). The Property is subject to a 60-foot shoreline setback as a result of the approval of Subdivision File No. 2015/SUB-132. The shoreline setback waiver line established by Chapter 23, ROH is defined as 75 feet inland from the presumed shoreline. The WWTP system will be approximately 165 feet from the shoreline (see Figures 5a and 5b). The project is not within 75 feet of the presumed shoreline and therefore meets the shoreline setback requirements.

In accordance with ROH Section 25-6.3(a), "All exterior lighting on a shoreline lot shall be shielded to reduce the possibility that seabirds and other marine life forms may become disoriented and harmed by the lighting. Shielded exterior lighting shall be implemented both during and after any construction work on a shoreline lot. Any wall-mounted exterior lighting on buildings on a shoreline lot shall be shielded by wall directors or other acceptable shielding, and all shielding shall be specified on building permit plans. Artificial light from exterior lighting fixtures, including, but not necessarily limited to floodlights, uplights, or spotlights used for decorative or aesthetic purposes on a shoreline lot shall be prohibited if the light directly illuminates or is directed to project across property boundaries toward the shoreline and/or ocean waters, except as may otherwise be permitted by HRS Section 205A-71(b)" (City and County of Honolulu, 2018a). The project may include small lights around the catwalk of the WWTP for safety purposes. All exterior lighting associated with the project will be shielded and will be indicated on building permit plans. No artificial light will be directed to travel across the property boundary toward the shoreline and ocean waters.

In accordance with ROH Section 25-6.3(b), "All landscaped areas, landscaping, and irrigation on or for any shoreline lot shall be contained and maintained within the property boundaries of the shoreline lot of origin, and shall under no circumstances extend: (1) seaward of the shoreline as depicted on the current shoreline survey for the shoreline lot; or, in the event there is no current shoreline survey for the lot, seaward of the presumed shoreline; and (2) into any adjoining beach access right-of-way, public or private" (City and County of Honolulu, 2018a). The project does not include landscaping near the shoreline or a beach access right-of-way.

3.1.4 Water Pollution Control

Water pollution control requirements and regulations governing the Property are administered and regulated by the DOH Clean Water Branch [CWB]. The requirements and regulations are contained in HAR Chapters 11-54 and 11-55 (DOH, 2014b, 2019a). The purpose of these regulations is to prevent the discharge of contaminated water into the navigable waters of the United States or adjoining shorelines.

The Property and the planned construction activities meet the State's *Antidegradation Policy* (HAR Section 11-54-1.1), which states that "existing uses and the level of water quality necessary to protect the existing uses shall be maintained and protected." By "existing uses," the policy refers to the existing uses of the receiving State water. In addition, the Property and the planned construction activities comply with the State's water quality standards (HAR Chapter 11-54), and the planned construction activities will not adversely impact water quality. The project does not require a Section 401 Water Quality Certification (Title 40 CFR §122.2; HAR Chapter 11-54).

In addition to State water pollution control requirements and regulations, the City and County of Honolulu Rules Relating to Water Quality apply to all Development and Land Disturbing Activities within the City and County of Honolulu and establish minimum requirements for the selection, design, implementation and maintenance of Best Management Practices [BMPs] to protect the Municipal Separate Storm Sewer System and Receiving Waters from Pollutants that are associated with land disturbance, surface hardening, and land use activities. The pollutants of concern addressed by these Rules include, but are not limited to, sediment, nutrients, trash, pathogens, pesticides, oil, grease, hazardous waste, toxic waste, metals, and organic compounds (City and County of Honolulu, 2018b).

The project will comply with the prevailing Rules Relating to Water Quality. Appropriate BMPs will be used during construction of the WWTP to prevent the discharge of the aforementioned pollutants of concern into coastal waters. Specific mitigation measures to prevent pollution and protect water quality are discussed in Section 4.2.2. The project site is not connected to the City's Municipal Separate Storm Sewer System.

3.1.4.1 Water Quality

Water quality in the State of Hawaii is under the oversight of the DOH CWB. According to the CWB (http://health.hawaii.gov/cwb), its mission is as follows.

> "The mission of the CWB is to protect the public health of residents and tourists who recreate in and on Hawaii's coastal and inland water resources, and to also protect and restore inland and coastal waters for marine life and wildlife. The mission is to be accomplished through statewide coastal water surveillance and watershed-based environmental management through a combination of permit issuance, monitoring, enforcement, sponsorship of polluted runoff control projects, and public education."

The objectives of the CWB are as follows.

1. Control point source discharges by issuing the appropriate National Pollutant Discharge Elimination System [NPDES] permits to maintain the designated uses of State receiving waters.

2. Ensure that permitted activities under Section 404 of the Clean Water Act will not adversely impact the designated uses of the State receiving waters.

3. Identify impaired water bodies and restore them to their designated uses.

4. Ensure expeditious compliance with the State water pollution rules.

5. Control polluted runoff through public and private partnerships.
6. Improve water quality in priority watersheds.

7. Develop appropriate Water Quality Standards.

The CWB is particularly concerned with the beneficial uses of State waters. Some examples include the capturing and re-use of storm water runoff so that (1) important groundwater resources can be replenished, rather than having storm water discharge directly to the ocean, and (2) landscaping and crops can be irrigated, rather than using potable water resources for irrigation. Other examples include the re-use of greywater and the protection of coastal waters from contamination caused by non-point source runoff.

Construction of the proposed project will be in accordance with State and Federal water quality regulations. The proposed project will not cause an increase in runoff quantities. The injection wells associated with the proposed project are already permitted by the DOH SDWB (see Section 3.1.3.3).

3.1.4.2 Storm Water Associated With Construction Activity

The project will not disturb more than an acre of land and, therefore, does not require an NPDES permit for discharges of storm water associated with construction activity.

3.1.4.3 Drinking Water Sources

The protection of Hawaii's drinking water sources is under the oversight of the DOH SDWB. According to the SDWB (http://health.hawaii.gov/sdwb), its mission is as follows.

> "The mission of the SDWB is to safeguard public health by protecting Hawaii's drinking water sources (surface water and groundwater) from contamination and assure that owners and operators of public water systems provide safe drinking water to the community. This mission is accomplished through the administration of the Safe Drinking Water Program, UIC Program, Groundwater Protection Program, and the Drinking Water State Revolving Fund."

The UIC program serves to protect the quality of Hawaii's underground sources of drinking water from chemical, physical, radioactive, and biological contamination that could originate from injection well activity. Underground injection wells are wells used for injecting water or other fluids into a groundwater aquifer. HAR Chapter 11-23 (DOH, 1992) provides conditions governing the location, construction, and operation of injection wells so that injected fluids do not migrate and pollute underground sources of drinking water.

The Property is located below (makai of) the UIC line, indicating that the underlying aquifer is not considered a drinking water source. Approval from the SDWB's UIC program was obtained for installation and operation of the nine existing injection wells associated with the proposed project (UIC permit No. UO-1342).

3.1.5 Wastewater System

Wastewater system requirements and regulations are administered and regulated by the DOH Wastewater Branch. The requirements and regulations can be found in HAR Chapter 11-62 (DOH, 2016a). The purpose of these regulations is to ensure that the use and disposal of wastewater and wastewater sludge do not contaminate or pollute valuable water resources, do not give rise to public nuisance, and do not become a hazard or potential hazard to public health, safety, and welfare. The proposed WWTP design plans and specifications must be reviewed and approved by the DOH Wastewater Branch prior to construction and must conform to applicable provisions of HAR Chapter 11-62.

3.1.6 Air Quality Standards

Air quality standards are administered and regulated by the DOH Clean Air Branch. The requirements and rules can be found in HAR Chapters 11-59 (DOH, 2001) and 11-60.1 (DOH, 2014a). The purpose of these standards is to protect public health and welfare and to prevent significant deterioration of air quality.

The proposed project is not anticipated to be a significant source of air pollution. Construction and operation of the WWTP will be required to comply with all applicable air quality standards. The potential impacts to air quality are addressed in Section 4.4.

3.1.7 Coastal Zone Management

The purpose of the Hawaii Coastal Zone Management [CZM] Program (HRS 205A; Office of Planning, 1977) is to provide for the effective management, beneficial use, protection, and development of the coastal zone. The CZM area encompasses all lands of the State and the offshore area out to the limit of the State's police power and management authority. The CZM Program's objectives and policies include recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, development management, public participation, beach protection, and marine resources.

The Property is within the CZM area and the proposed project conforms to CZM Program objectives and policies, as it will not have any significant impacts or conflict with the resources and activities associated with the CZM program, as described below.

3.1.7.1 Recreational Resources

The proposed project will not generate additional demands on existing public parks or beaches. It will not restrict access to or adversely affect the existing coastal recreational resources or their uses by the public. Thus, the proposed WWTP is not in conflict with the State's objective of providing coastal recreational opportunities that are accessible to the public. The potential impacts to recreational resources are addressed in Section 5.5.

3.1.7.2 Historic Resources

The proposed project is not located in an area where there are man-made or natural historic resources. Thus, the proposed WWTP is not in conflict with the State's objective of protecting, preserving, and restoring historic and prehistoric resources that are significant in Hawaiian and American history and culture. The potential impacts to historical and cultural resources are addressed in Section 5.3.

3.1.7.3 Scenic and Open Space Resources

The proposed project is located along the coastline where there are intermittent open views to the ocean. The proposed WWTP may interrupt the intermittent visual continuity and rural character of the area; however, there is not an open view to the ocean at the project location due to the presence of the existing Pat's at Punalu‘u buildings. The proposed WWTP is not in conflict with the State's objective of protecting, preserving, restoring, or improving the quality of coastal scenic and open space resources. The potential impacts to visual and aesthetic appeal and mitigation measures are addressed in Section 5.4.

3.1.7.4 Coastal Ecosystems

The proposed project is not located in an area where there are sensitive coastal ecosystems that could be threatened. Operation of the proposed WWTP will mitigate future potential spills of wastewater that could possibly reach the adjacent coastal waters. Thus, the proposed WWTP is not in conflict with the State's objective of protecting valuable coastal ecosystems from disruption and minimizing adverse impacts to coastal ecosystems. The potential impacts to coastal ecosystems are addressed in Section 4.3.

3.1.7.5 Economic Uses

The proposed project is not located in an area where there are economic uses that could be threatened. Thus, the proposed WWTP is not in conflict with the State's objective of providing public or private facilities and improvements important to the State's economy in suitable locations. Land use and economic issues are addressed in Sections 5.1 and 5.2.

3.1.7.6 Coastal Hazards

The proposed project is located in an area where there are coastal hazards and it potentially could be threatened by tsunamis or by potential hazards related to climate change, such as sea level rise. The proposed WWTP is unlikely to be threatened by storm waves, flooding, erosion, subsidence, or pollution from coastal sources. The proposed WWTP is not in conflict with the State's objective of reducing the hazards to life and property posed by tsunami, storm waves, stream flooding, erosion, subsidence, and pollution. The potential impacts posed by coastal hazards, including sea level rise, are addressed in Section 4.6.

3.1.7.7 Managing Development

The proposed project is located in an area where there is little ongoing development. The proposed WWTP is not a significant coastal development and is not in conflict with the State's objective of improving the development review process, communication, and public participation in the management of coastal resources and hazards.

3.1.7.8 Public Participation

State and City permits and approvals required by the proposed project include provisions for public participation and ensure protection of coastal resources. The public will be provided the opportunity to participate in the review of the Draft EA and provide comments. Thus, the proposed WWTP is not in conflict with the State's objective of stimulating public awareness, education, and participation in coastal management. A list of the recipients who will be provided a copy of the Draft EA is provided in Section 1.7.

3.1.7.9 Beach Protection

The proposed project will not adversely impact beaches for public use and recreation. Thus, the proposed WWTP is not in conflict with the State's objective of protecting beaches for public use and recreation. The potential impacts to coastal waters and recreational resources are addressed in Sections 4.2 and 5.5.

3.1.7.10 Marine Resources

The proposed project is not anticipated to affect marine resources. The long-term impacts of the proposed project will be beneficial to near shore water quality and marine habitat. Thus, the proposed WWTP is not in conflict with the State's objective of promoting the protection, use, and development of marine and coastal resources to ensure their sustainability. The potential impacts to these resources are addressed in Sections 4.2 and 4.3.

3.1.8 State Environmental Policy

The State Environmental Policy was developed to establish a policy that will encourage productive and enjoyable harmony between people and their environment, promote efforts to prevent or eliminate damage to the environment and the biosphere, stimulate the health and welfare of humanity, and enrich the understanding of the ecological systems and natural resources important to the people of Hawaii (HRS 344; DOH, 1974b). One of the mandates of the policy is to conserve natural resources so that natural resources, such as land, water, mineral, visual, and air, are protected by controlling pollution, by preserving or augmenting natural resources, and by safeguarding the State's natural environmental characteristics.

The proposed project does not conflict with the State Environmental Policy. The proposed replacement of the existing wastewater treatment system will provide better protection of the natural resources and is anticipated to positively impact land, air, and water quality by mitigating potential

pollution due to wastewater spills. The environmental resources identified in the area and the potential impacts to these resources are addressed in Section 4.

3.1.9 Flood Hazard Areas

Because the proposed project is located in a flood hazard area (Zone AE), it is subject to the provisions of Chapter 21A, ROH (Flood Hazard Areas), which imposes restrictions on construction in areas subject to flood hazards in order to protect life and property and reduce public costs for flood control, rescue, and relief efforts. The project will comply with the applicable provisions and development standards of Chapter 21A, ROH. Specific mitigation measures to minimize damage from flood hazards are discussed in Section 4.6.2.3.

3.2 SOCIAL AND ECONOMIC POLICIES, PLANS, AND CONTROLS

3.2.1 Hawaii State Plan

The Hawaii State Plan, which is set forth in the *Hawaii State Planning Act* (HRS 226; Office of Planning, 1978), is a comprehensive, long-term plan that identifies the goals, objectives, policies, and priorities for the State. It provides guidelines for growth, development, and the allocation of State resources. The plan contains diverse policies and objectives on topics of State interest, including the population, the economy (e.g., agriculture, the visitor industry), the physical environment (e.g., natural resources, historic resources, quality of the environment), facility systems (e.g., solid and liquid wastes, water, energy), socio-cultural advancement (e.g., housing, health, culture), and sustainability.

The proposed project is consistent with the goals, objectives, policies, and priority guidelines listed in the Hawaii State Plan, and directly supports multiple objectives and policies of the Plan by decreasing the risk of wastewater spills and protecting environmental resources. The most relevant sections of the Hawaii State Plan in relationship to the proposed project include the following: land-based, shoreline, and marine resources (HRS 226-11); land, air, and water quality (HRS 226-13); and facility systems – solid and liquid wastes (HRS 226-15). These sections are described below.

3.2.1.1 Land-Based, Shoreline, and Marine Resources

The proposed project is not in conflict with the State's two objectives.

1. Prudent use of Hawaii's land-based, shoreline, and marine resources.

2. Effective protection of Hawaii's unique and fragile environmental resources.

The proposed project will have no long-term negative impact on land-based, shoreline, or marine resources. No unique and fragile environmental resources have been identified in the area. The potential impacts to these resources are addressed in Section 4.

3.2.1.2 Land, Air, and Water Quality

The proposed project is not in conflict with the State's two objectives.

1. Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.

2. Greater public awareness and appreciation of Hawaii's environmental resources.

The proposed project will have no negative impact on land, air, or water resources. The potential impacts to these resources are addressed in Section 4.

3.2.1.3 Facility Systems - Solid and Liquid Wastes

The proposed project is not in conflict with the State's two 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.

The proposed project will replace the existing wastewater treatment system to provide improved treatment and disposal of solid and liquid wastes.

3.2.2 Hawaii State Land Use Controls and City and County of Honolulu Zoning Regulations

Land in the State of Hawaii is divided into the following four classifications: (1) urban, (2) agriculture, (3) rural, and (4) conservation. The project location is designated as an urban district. The urban district generally includes lands characterized by "city-like" concentrations of people, structures and services. This district also includes vacant areas for future development. Generally, lot sizes and uses permitted in the district area are established by the respective county through ordinances or rules. The City and County of Honolulu zoning designation for the project location is *A-2 Medium Density Apartment*. According to the City and County of Honolulu LUO (Chapter 21, ROH), the intent of the A-2 medium density apartment district is to provide areas for medium density, multifamily dwellings. It is intended primarily for concentrated urban areas where public services are centrally located and infrastructure capacities are adequate. The proposed project is consistent with the prescribed land use classification and zoning regulations for the area.

3.2.3 Oahu General Plan

The Oahu General Plan (City and County of Honolulu, 2017) is a comprehensive statement of objectives and policies that outline the long-range aspirations of Oahu's residents and the strategies to achieve them. It is the first tier of and lays the foundation for a comprehensive planning process that addresses physical, social, cultural, economic, and environmental concerns affecting the City and County of Honolulu. The plan is in the process of being updated and the proposed revised plan was prepared in December 2017, submitted for review by the Planning Commission in February 2018, and

transmitted from the Planning Commission to the City Council on April 20, 2018. The Proposed Revised Plan includes continued focus on critical issues such as regional population, economic health, and affordable housing, while also addressing concerns such as climate change, sea level rise, and sustainability.

The General Plan and its update seek to protect and enhance Oahu's natural beauty and environmental attributes by mitigating against the degradation of these assets. In addition, the objectives and policies for utility planning and development emphasize the need for environmentally sound waste disposal systems. The proposed project is consistent with the objectives of the General Plan and it will support the policy of increasing the use of environmentally sound waste disposal systems.

3.3 KOOLAU LOA SUSTAINABLE COMMUNITIES PLAN

Oahu is divided into eight geographic planning areas and each area has developed a Development Plan or Sustainable Communities Plan that has been adopted by City Council ordinance. The Koolau Loa Sustainable Communities Plan [KLSCP] dated October 1999 and updated in December 2012 (City and County of Honolulu, 2012) presents the vision for the long-range future of the Koolau Loa region, which is to preserve the region's rural character and its natural, cultural, scenic, and agricultural resources. The KLSCP designates the project area as "Low Density Apartment" land use. No new Low Density Apartment areas are recommended. The project area is also within the Community Growth Boundary, which was established to define, protect, and contain communities in areas that the General Plan designates "rural" and that exhibit the physical characteristics of rural lifestyles, as well as preserves the areas outside the boundary for agriculture, other resource, or open space values (City and County of Honolulu, 2012).

Based on the KLSCP, land use policies for existing and new residential communities that are applicable to the proposed project include:

- Respect and help preserve the natural setting of the Koolau Loa region by requiring development in residential areas to be sensitive to physical constraints and have minimal impact on the area's rural character.
- Adopt zoning, subdivision and related project design regulations which foster a rural character in new residential developments and improvements to existing residential areas.

The guidelines of the KLSCP allow for the pockets of existing apartments in Punalu‘u and Turtle Bay, and place more emphasis on the single-family homes in rural residential areas. Guidelines for the Low Density Apartment developments include:

- Limit building heights to three stories or 40 feet, including roof form, with heights above 40 feet allowed only when warranted due to the required flood elevation, steep slope of the site, or the desire to protect important natural features. Gabled or similar roof forms should be used to reflect a primarily rural residential design character.

- Employ building form and orientation, location of entries and landscape screening, etc., to maintain the existing residential scale and provide greater privacy and individual identity for housing units.
- Ensure compatibility of building scale, roof form and the quality of materials with those of adjacent low-density residential areas.

Overall, the proposed WWTP is consistent with the KLSCP's general policies and guidelines regarding land use. The proposed WWTP will have minimal impact on the area's rural character because it will be located adjacent to a current parking lot, in an area that already has two existing multi-story apartment buildings. The proposed WWTP is designed to have a height of approximately 14 feet above the level of the parking lot (concrete slab on grade plus tank height), which is well below the building height limit of 40 feet. Chain-link fencing with privacy slats or a CRM wall will be used to screen the WWTP from public view.

The KLSCP establishes policies and guidelines for infrastructure, including wastewater treatment. Koolau Loa is primarily served by individual wastewater treatment systems. The specific policies that are applicable to the proposed project include:

- Encourage coordination between public agencies and private land owners in addressing the adequacy of wastewater treatment systems within the region.
- Support alternative technologies for wastewater treatment that reflect the community's values and rural character.
- Provide collection systems, where practical, to eliminate individual cesspools, and to protect aquifers, streams, estuaries and nearshore waters from contamination.

The specific guidelines that are applicable to the project include:

- Identify appropriate areas and technologies for future wastewater facilities that maintain the rural character and are proportionate to future population projections.
- Establish and maintain a sufficient separation between wastewater treatment plants and any nearby urban uses to avoid significant adverse odor impacts, and provide sufficient screening which substantially block views of such plants from developed areas, parks and public rights-of-way.

The proposed WWTP is consistent with the KLSCP's general policies and guidelines regarding wastewater treatment. The current wastewater treatment system is aged and deteriorating and is in need of replacement. The proposed WWTP uses newer technologies and will provide better wastewater treatment, and will reduce the risk of wastewater spills to nearshore waters. As stated above, fencing or a CRM wall will be used to screen the WWTP from public view.

Additionally, the KLSCP includes guidelines for shoreline areas and states that existing makai (seaward) view openings along the coastal highway (Kamehameha Highway) shall be maintained and to avoid the placement of any obstructions (except where necessary for safety reasons). The proposed WWTP will not obstruct any existing view openings towards the ocean. In addition, the

treatment of household wastewater can be regarded as a safety issue particularly as it has the potential to affect human and environmental health if not managed properly.

3.4 BUILDING, GRADING, AND FIRE PERMITS

Prior to construction of the replacement WWTP at the Property, the necessary permits will be obtained from the appropriate State of Hawaii and City and County of Honolulu Agencies.

DOH, SDWB:

- *UIC Permit* No. UO-1342 has previously been issued for the installation and operation of the nine existing injection wells.

DOH, Wastewater Branch:

- Review of *Basis of Design and Engineering Report and Plan Set for Wastewater Treatment Works Replacement* for the design and construction of the wastewater treatment system.

Department of Transportation, Highways Division:

- *Discharge Permit* for potential generation of construction runoff that will impact the State Highway drainage system.

City and County of Honolulu, Honolulu City Council:

- *SMA Use Permit* for the construction of the wastewater treatment system. The project location is within the SMA area, which extends inland from and along the shoreline. It is the most sensitive area of the coastal zone.

City and County of Honolulu, DPP:

- *Building/Grading Permit* for the construction of the wastewater treatment system (includes review by HECO and BWS).

City and County of Honolulu Fire Department:

- *Tank Installation Permit* for the diesel tank associated with the emergency backup generator.

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SECTION 4 PHYSICAL ENVIRONMENT AND POTENTIAL IMPACTS

Wastewater treatment facilities potentially can have negative impacts on the physical environment in which they are constructed and operated and on the surrounding area. One of the principle objectives of an EA is to assess whether such impacts could be significant. The areas of potential concern that have been identified regarding the construction and operation of the WWTP are as follows: (1) land impacts, (2) water impacts, (3) biological impacts, (4) air quality impacts, and (5) noise impacts. In addition, potential impacts related to climate change should be evaluated.

4.1 POTENTIAL LAND IMPACTS

4.1.1 Existing Topographic and Geological Conditions

The Property is located on a relatively flat coastal plain, at a surface elevation of approximately 7 feet amsl. There is no significant elevation change across the Property. No unique topographical features are located on the Property.

Oahu consists of the eroded remnants of three shield volcanoes, Kaena, Waianae, and Koolau. Kaena is the oldest of the three volcanoes and it was predominantly submarine (Sinton et al., 2014). The Property is located along the coastline on the eastern side of the Koolau volcanic shield. Lavas erupted during the shield-building phase of the volcano belong to the *Koolau Volcanic Series* (Stearns and Vaksvik, 1935). Following formation of the Koolau shield, a long period of volcanic quiescence occurred, during which the shield was deeply eroded. Following this erosional period, eruptive activity resumed. Lavas and pyroclastic material erupted during this period belong to the *Honolulu Volcanic Series* (Stearns and Vaksvik, 1935).

The principal lithologic unit underlying the Property consists of Holocene surficial beach deposits (Sherrod et al., 2007). These deposits consist of sand and gravel worked by surf into unconsolidated strand-line deposits along the coastline; chiefly cream-colored and calcareous in composition, derived from comminuted coral, shells, and foraminifera. They also contain minor sandstone, known in Hawai‘i as beach rock and typically form deposits parallel to the coast, in contrast to alluvium, that extends up drainages perpendicular to the coast.

The soil in the area of the Property belongs to the *Jaucas Series*, specifically *Jaucas sand,* which consists of excessively drained, calcareous soils that occur as narrow strips on coastal plains adjacent to the ocean. These soils developed in wind- and water-deposited sand from coral and seashells. They are nearly level to strongly sloping (Foote et al., 1972).

The Land Study Bureau (LSB) of the University of Hawaii prepared an inventory and evaluation of the State's land resources during the 1960s and 1970s. The Bureau grouped undeveloped lands in the State into homogeneous units of land types; described their condition and environment; rated the land on its overall quality in terms of agricultural productivity; appraised its performance for selected alternative crops; and delineated the various land types and groupings based on soil properties and productive capabilities. From these criteria, overall ratings of A through E were created; with A having the overall highest soil productivity rating and E having the lowest (University of Hawaii, 1972). The

Property was omitted from the LSB study since it was already developed at the time of the study. Therefore, the Property does not contain any listed LSB rated soils. There are Type B rated LSB soils across Kamehameha Highway, well inland of the Property. The proposed project would not result in any disturbance to these or any other LSB rated soils (Office of Planning, 2018)

Injection well IW9 was recently drilled at the Property in October 2018, and added to the existing injection well system. The borehole was drilled to 85 feet below ground surface [bgs]. The subsurface soil consisted of medium- to coarse-grained silty sand from 2 to 60 feet bgs. Coral and shell fragments were noted throughout. Fine-grained silty sand with coral fragments was observed from 60 to 70 feet bgs. Silty clay was observed from 70 to 85 feet bgs. Groundwater was encountered at 4.3 feet bgs (INTERA, Inc., 2018). The *Injection Well Installation and Testing Report* is proved in Appendix D.

No site soil contamination has been identified other than what is being monitored by DOH UIC Branch. A Phase I Environmental Site Assessment is not warranted for the project since there is no reason to suspect hazardous substances listed under the Comprehensive Environmental Response, Compensation, and Liability Act.

4.1.2 Potential Topographic and Geological Impacts and Mitigation

Based on the site geology and soils observed during drilling of injection well IW9, the soils and geology of the site are suitable for the proposed project

Figure 5b shows the permanent and temporary work areas where soil disturbance will occur, as well as the area of the existing system to be demolished. The only area of subsurface excavation will be trenching to install piping for the new sewer force main and to connect the backup disposal wells. The temporary work area will be backfilled and repaved at the completion of work. Clean soil will be imported to backfill the area of the existing system following demolition. The project will not increase impervious surfaces, but will reduce the impervious area by removing the existing system. The project does not include offsite export of soil.

Less than significant short-term impacts to ground topography and soils are anticipated from the proposed project. Minor short-term excavation and grading will be required during construction of the WWTP. *The City and County of Honolulu Stormwater Construction Best Management Practice Manual* will be followed during construction, in addition to the provisions of the grading permit that will need to be obtained. Adherence to these regulatory guidelines, which would include protecting exposed soils from runoff through the use of filter socks, silt and dust fences, tarping soil stockpiles, and other appropriate BMPs, would mitigate potential impacts of soil erosion and fugitive dust during grading or excavation.

Future operation of the proposed WWTP will mitigate future potential spills of wastewater to the soils of the Property. There would be no long-term adverse impacts to site soils, topography or geological resources from the proposed WWTP upgrades.

4.1.3 Existing Storm Water Conditions

The area of the proposed WWTP is currently a landscaped area and paved parking lot. Storm water runs off the Property via surface sheet flow and infiltrates into the surrounding grassy areas. There are no storm drains located in the parking lot.

4.1.4 Potential Storm Water Impacts and Mitigation

Less than significant short-term impacts from storm water runoff are anticipated during construction. BMPs will be used during construction of the WWTP to prevent soil generated by construction activities from discharging beyond the project site as storm water runoff. Upon completion of construction activities, the area surrounding the WWTP will be restored to its previous condition (e.g., grass or parking lot).

There will be no impact to long-term storm water runoff quantities at the Property or the surrounding area compared to existing conditions due to the proposed project. All areas disturbed during construction will be landscaped with vegetation or covered with concrete or asphalt in accordance with the building permits. The project will not increase impervious surfaces, but will reduce the impervious area by removing the aboveground portion of the existing system, as shown in Figure 5b, which has a significantly larger footprint than the aboveground components of the proposed system. No parking spaces will be lost and the proposed project will comply with the landscaping requirement of a minimum five-foot landscape strip adjacent to any adjoining street right-of-way (Section 21-4, ROH). There will be no changes to existing surface water drainage patterns.

4.2 POTENTIAL WATER IMPACTS

Waters of potential concern in the area of the Property include (1) shallow groundwater, (2) coastal waters, and (3) deep, basal, drinking water. Of these, shallow groundwater and the coastal waters adjacent to the Property are the principal concerns.

4.2.1 Existing Hydrogeological Conditions

Groundwater in Hawaii exists in two principal types of aquifers. The first and most important type, in terms of drinking water resources, is the basal aquifer. The basal aquifer exists as a lens of fresh water floating on and displacing seawater within the pore spaces, fractures, and voids of the basalt that forms the underlying mass of each Hawaiian island. In parts of Oahu, including the area of the Property, groundwater in the basal aquifer is confined by the overlying caprock and is under pressure. Water that flows freely to the surface from wells that tap the basal aquifer is referred to as *artesian*.

The second type of aquifer is the caprock aquifer, which consists of various kinds of unconfined and semi-confined groundwater. The nearly impermeable sediments that form the caprock separate the caprock aquifer from the basal aquifer. The impermeable nature of these materials and the artesian nature of the basal aquifer severely restrict the downward migration of groundwater from the upper caprock aquifer.

Groundwater in the area of the Property is part of a basal aquifer within the *Koolauloa Aquifer System* of the *Windward Aquifer Sector* (Mink and Lau, 1990). The upper aquifer is classified as an unconfined aquifer that occurs in sedimentary nonvolcanic lithology. It is currently used and is ecologically important, but is not used as a drinking water source. It is highly vulnerable to contamination, is irreplaceable, and has low salinity. The lower aquifer is classified as a confined aquifer that occurs in flank lavas. It is currently used and is ecologically important, but is not used as a drinking water source. It has low vulnerability to contamination, is irreplaceable, and has low salinity.

Based on well logs for deeper wells installed nearby, the caprock extends to 150 feet bgs (SSFM Engineers, Inc., 1993). Therefore, it is assumed that the basal drinking water aquifer in the area of the Property occurs at a depth of 150 feet or greater. The direction of groundwater flow in the area is most likely to the north-northeast, towards the Pacific Ocean. Shallow groundwater at the Property is tidally influenced owing to its proximity to the ocean.

The nearest drinking water supply well is approximately 0.2 miles northwest and crossgradient of the Property, and there are no water wells of any kind downgradient (Figure 6). Based on the distance and direction to the nearest drinking water supply wells and the depth to the basal (drinking water) aquifer, it is unlikely that contaminants originating at the Property have impacted or could impact drinking water sources.

The coastal waters adjacent to the Property are classified as Class A, which precludes any discharge which has not received the best degree of treatment or control compatible with the criteria established for this class. The specific criteria applicable to marine waters are included in HAR Chapter 11-54 (DOH, 2014b).

4.2.2 Potential Hydrogeological Impacts and Mitigation

The proposed WWTP is anticipated to have no adverse impacts on shallow groundwater or the basal (drinking water) aquifer. There will likely be beneficial water quality impacts since the new WWTP will retain and treat wastewater more effectively compared to the existing treatment system. The proposed WWTP will provide improved treatment of solid and liquid wastes. The effluent that will be disposed in the injection wells must meet the requirements of HAR Chapter 11-62, “Wastewater Systems” (DOH, 2016a).

The proposed WWTP is anticipated to have no adverse impacts on coastal waters. The proposed project will not cause an increase in runoff quantities. Construction and operation of the WWTP will be conducted in accordance with the State’s water quality standards (HAR Chapter 11-54). During construction, barriers (e.g., sediment fences, silt screens, bags, or environmental filter socks) will be used as needed to limit sediment and land-based sources of pollution from discharging into the coastal waters. Operation of the proposed WWTP will mitigate future potential spills of wastewater that could possibly reach the adjacent coastal waters. Based on communication with the DOH Clean Water Branch, a NPDES permit will not be required for the disposal of treated wastewater via the injection wells. Due to the oxygen supplied for the biological process within the treatment system, complete nitrification is anticipated based on the system design. The long-term impacts of the proposed project will be beneficial to near shore water quality and marine habitat.

4.3 POTENTIAL BIOLOGICAL IMPACTS

There are numerous recognized ecosystems in Hawaii. Because so many Hawaiian species are highly specialized, populations are small and many of Hawaii's plants and animals are listed as threatened or endangered species by the USFWS. For the purposes of this EA, the following three biological communities of potential concern in the area of the Property have been identified: (1) floral, (2) faunal, and (3) marine.

4.3.1 Existing Biological Conditions

4.3.1.1 Floral (Plant Communities)

The project site is situated within a coastline residential area of Hauula. The Property was entirely graded during its development in the mid-1970s. There are no native rare or endangered floral species found on the Property; therefore, the proposed project will not adversely affect endangered or threatened plant species. The State of Hawaii Geographic Information System [GIS] "threatened and endangered plants map" and "critical habitat map" show little to no threatened and endangered species are currently found within the Property (Office of Planning, 2018).

The USFWS Critical Habitat for Threatened and Endangered Species online GIS map was also reviewed. No critical habitats were present at or surrounding the Property (USFWS, 2020a). The USFWS Wetlands Inventory Mapper was also reviewed in order to determine if wetland species habitats may be present at or surrounding the Property. No inland wetlands were identified within the vicinity of the Property. An Estuarine and Marine Wetland was identified along the shoreline at the makai (northeast) Property border (USFWS, 2020b). Protected marine species associated with this area are discussed below.

4.3.1.2 Faunal (Animal Communities)

Wildlife in the area of the Property is limited to mammals and birds which have adapted to the urban environment. Species commonly found in coastal environments on the Windward side of the island include feral cats, rats, house mice, and Indian mongoose. Birds common to the Property include the common mynah, Red-crested Cardinal, Northern Cardinal, Java Sparrow, Spotted Dove, Zebra Dove, and Japanese White-eye. The State of Hawaii GIS critical habitat map shows no Federal or State listed or candidate threatened or endangered animal species currently within the Property (Office of Planning, 2018).

According to the Final EA prepared for the Hauula Well Replacement (Shimabukuro, Endo & Yoshizaki, Inc., 2016), the USFWS noted that federal data indicate a federally endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) may forage and roost in the vicinity. The Hauula Well Replacement project is located approximately 2.1 miles from the Property. However, there is no known habitat for the Hawaiian hoary bat on the Property and the size of the Property is insignificant relative to the bat's range.

For the Final EA prepared for the Hanohano Hale Wastewater Treatment System Replacement (located at the adjacent property) (ESI, 2019), the USFWS provided a list of protected species that may occur in the vicinity of the Property. In addition to the Hawaiian hoary bat, the USFWS noted that the federally endangered band-rumped storm-petrel (*Oceanodroma castro*) and Hawaiian petrel (*Pterodroma sandwichensis*), and federally threatened green sea turtle (*Chelonia mydas*) and Newells shearwater (*Puffinus auricularis newelli*) may occur in the vicinity of the Property. The USFWS letter for the project on the adjacent property is included in Appendix E.

4.3.1.3 Marine (Ocean Floral and Faunal Communities)

The offshore area of the Property is characterized by expansive coral reefs. According to the State GIS benthic habitat map, just offshore, the benthic waters consist of unconsolidated channel sediment and a large 50-90% turf algae zone offshore. No live coral reefs are present in the shallow reef flat. The reef flats are classified as “Pavement.” Live corals in the coastal areas fronting the Property are not documented until approximately 0.25 miles offshore (Office of Planning, 2018) (Figure 7).

Due to the Property’s location adjacent to the Pacific Ocean, some threatened or endangered marine species may be intermittently present in the vicinity of the Property, including the federally threatened green sea turtle (*Chelonia mydas*).

According to the Kaluanui Stream Bridge Replacement Job EA (Nagamine Okawa Engineers Inc., 2018), which included an Essential Fish Habitat assessment, no federally protected species were observed during the surveys offshore of the project area. Three state and federally-listed (endangered or threatened) marine species — green sea turtle (*Chelonia mydas*), hawksbill sea turtle (*Eretmochelys imbricata*), and monk seal (*Neomonachus schauinslandi*) — may occur in the general vicinity, considering the distribution and occurrences of these species throughout the Islands.

4.3.2 Potential Biological Impacts and Mitigation

There would be a less than significant impact to biological resources from the proposed project. None of the plants within the Property are known to be Federal or State threatened or endangered or candidate species. Since the Property is developed and mostly paved or covered by buildings, there is no known habitat for the Hawaiian hoary bat, protected seabird species, the hawksbill sea turtle, green sea turtle, or monk seal. The following mitigation measures will be implemented to minimize potential impacts to biological resources:

1) Construction activities will be limited to daylight hours to avoid the use of construction work lights which may attract and disorient migrating seabirds and sea turtles. The project may include small lights around the catwalk of the WWTP for safety purposes. All exterior lighting associated with the project will be shielded (per Section 25-6.3(a), ROH). No artificial light will be directed to travel across the property boundary toward the shoreline and ocean waters (per Section 25-6.3(a), ROH). These mitigation measures will be implemented to avoid potential impacts to migrating seabirds and sea turtles.

2) During construction, barriers (e.g., sediment fences, silt screens, bags, or environmental socks) will be used as needed to limit sediment and land-based sources of pollution from

discharging into coastal waters and impacting marine habitats and sea turtles or monk seals (in accordance with the State's water quality standards [HAR Chapter 11-54] and City and County of Honolulu Rules Relating to Water Quality).

3) To protect Hawaiian hoary bats or birds that may use the trees on the Property for roosting, (a) avoid trimming or removal of trees taller than 15 feet between June 1 and September 15 (Hawaiian hoary bat's pupping season), when juvenile Hawaiian hoary bat that are not yet capable of flying may be roosting in the trees, and (b) restrict working at night under bright lights to avoid attracting insects that bats and birds feed on.
4) If there is any leak or spill of wastewater during replacement of the wastewater treatment system, it will be reported promptly to the Department of Land and Natural Resources [DLNR] Division of Aquatic Resources for assessment of the impact to the freshwater and marine habitats.

With these mitigation measures in place, the construction of the proposed WWTP is expected to result in no significant adverse impacts to existing plant species or native wildlife species or their habitat.

During operation of the proposed WWTP, the treated wastewater effluent will be discharged to the onsite injection wells disposal system. The primary disposal well (IW9) is located approximately 165 feet from the shoreline. Although there may be a concern that nutrients in the effluent could potentially impact marine wildlife species if the groundwater potentially mixes with seawater, the wastewater treatment process is anticipated to significantly reduce nitrogen and phosphorus levels in the effluent. Due to the oxygen supplied for the biological process within the treatment system, complete nitrification is anticipated based on the system design. With proper operation of the treatment system, no significant impact to marine wildlife species is anticipated. Based on communication with the DOH Clean Water Branch, a NPDES permit will not be required for the disposal of treated wastewater via the injection wells.

4.4 POTENTIAL AIR QUALITY IMPACTS

Air pollution is caused by many different man-made and natural sources. To determine if emissions generated at the Property would adversely affect air quality conditions, potential air quality impacts were evaluated in accordance with national and state air quality standards.

4.4.1 Existing Air Quality Conditions

The DOH Clean Air Branch has established the State Ambient Air Quality Standards [SAAQS]. The DOH Clean Air Branch regularly samples ambient air quality at monitoring stations throughout the State, and annually publishes this information. On Oahu, there are four monitoring stations. The closest station to the Property that measures multiple parameters is located in Kapolei in the Kapolei Business Park. This station measures sulfur dioxide, carbon monoxide, nitrogen dioxide, lead, ozone, and particulate matter.

Air quality in the State of Hawaii continues to be one of the best in the nation, and criteria pollutant levels remain well below SAAQS. According to the *Annual Summary 2015 Hawaii Air Quality Data,* air

quality monitoring data compiled by the DOH indicates that the established air quality standards for all monitored parameters are consistently met throughout the State and on the island of Oahu (DOH, 2016b).

Present air quality in the vicinity of the Property is primarily affected by emissions from motor vehicles and residential and agricultural sources. Air quality data from the nearest monitoring stations suggest that all National and State air quality standards are currently being met, although occasional exceedances of the more stringent State standards for carbon monoxide may occur near congested roadway intersections.

4.4.2 Potential Air Quality Impacts and Mitigation

Impacts on air quality are anticipated to be less than significant and short-term. Installation of the proposed WWTP may require machinery that generates dust, and emissions from construction equipment and vehicles may impact air quality in the immediate area. The prevailing northeasterly tradewinds are expected to disperse emissions and prevent elevated concentrations.

The short-term effects on air quality during construction will be mitigated by compliance with the DOH rules on air pollution. Fugitive dust emission will be controlled by implementing BMPs, such as watering active work areas, keeping adjacent paved roads clean, covering open-bodied trucks, and limiting the area to be disturbed at any given time.

Long-term operation and maintenance of the WWTP is not expected to have any adverse impacts on air quality. The pumps and blowers associated with the WWTP are electric-powered and will not discharge air pollutants. There isn't a strong quantitative way to measure odors from any activated sludge plant. The process will be strictly aerobic, covered, and contain no zones where denitrification should occur. The likelihood of anything going septic and producing foul odors is very low as long as the plant is operated properly. Any well operated wastewater plant will have a faint lingering earthy scent, which would reasonably be expected for the proposed WWTP, but the proposed treatment system should not produce any strong odors.

4.5 POTENTIAL NOISE IMPACTS

Noise pollution can result from construction activities and heavy equipment operation. To determine if noise generated at the Property would adversely affect noise quality in the area, potential noise impacts were evaluated in accordance with state noise control standards of HAR Chapter 11-46 (DOH, 1996).

The maximum permissible sound level for areas zoned as residential is 55 A-weighted decibels [dBA] during the daytime (7 am to 10 pm) and 45 dBA during the nighttime (10 pm to 7 am) (DOH, 1996). The maximum permissible sound level can be exceeded for short periods but not for more than ten percent of the time within any twenty minute period. The maximum permissible sound level for impulsive noise is 10 dBA above the maximum permissible sound level. Backup alarm devices on vehicles are exempt from the maximum permissible sound levels, where such devices are required by the Occupational Safety and Health Administration (DOH, 1996).

4.5.1 Existing Noise Conditions

Currently, noise levels in the vicinity of the Property are low, as land uses in the area are primarily residential. Sources of ambient noise are vehicular traffic, ocean waves, and periodic activity of the Pat's at Punalu'u Condominium occupants.

4.5.2 Potential Noise Impacts and Mitigation

There will be less than significant short-term intermittent noise impacts generated during construction of the WWTP. However, noise levels are not expected to adversely affect residents at or near the project site. All work is anticipated to be done during the daytime hours, between 7:00 am and 6:00 pm. Construction activities must comply with the provisions of HAR Chapter 11-46, "Community Noise Control" (DOH, 1996). The contractor will be required to obtain a noise permit if the noise levels from construction activities are expected to exceed 55 dBA.

Blowers and pumps will be utilized during long-term operation of the WWTP and may generate low levels of noise. However, the noise from this system is not anticipated to exceed the maximum permissible sound levels. The noise generating equipment (i.e., blowers and pumps) will be housed in a utility enclosure constructed adjacent to the emergency generator. The blowers will be installed inside the room with individual sound enclosures to reduce the noise level. Therefore, there would be less than significant long-term noise impacts from the proposed project.

Operation of the emergency generator is exempt from the rules of HAR Chapter 11-46.

4.6 CLIMATOLOGICAL CONDITIONS AND IMPACTS

4.6.1 Existing Climatological Conditions

Climatological conditions in the area of the Property consist of warm to moderate temperatures and moderate to heavy rainfall. The Property is on the Windward side of Oahu, which has prevailing northeasterly trade winds. The average annual precipitation in the area is approximately 60 inches, occurring mainly between November and April (Giambelluca et al., 2014). The adjusted mean pan evaporation rate is approximately 60 inches (DLNR, 1985). Average temperatures range from the low to high 70s (degrees Fahrenheit [ºF]) (Giambelluca et al., 2014).

4.6.2 Potential Impacts Related to Climate Change

The potential impacts of climate change on Hawaii's infrastructure and natural environment have become a significant concern. As a reflection of this concern, the December 2017 update to the Oahu General Plan (City and County of Honolulu, 2017) included new policies that emphasize the need to recognize and prepare for long-term impacts of climate change. The General Plan now also contains an objective on climate change and sea level rise. It calls for all public and private organizations to prepare for the future problems caused by rises in sea level, rises in groundwater levels, and more frequent and severe storms, shifts in local rainfall patterns, and higher urban temperatures. The

Climate Change Adaptation Policy Guidelines of the Hawaii State Planning Act, HRS §226-109, support planning and preparing for future disruptions and dislocations due to climate change.

Two principal concerns have been identified that pose a potential hazard to the Property. First, a significant sea level rise due to climate change could impact coastal structures, infrastructure, and properties. Second, changing weather patterns in the Pacific Ocean could result in localized increased precipitation severity and flooding. Although not directly related to climate change, tsunami hazards and impacts are included below.

4.6.2.1 Sea Level Rise

Planning for sea level rise is challenging due to changing variables including some which are unknown variables. In December 2013, the U.S. Army Corp of Engineers [USACE] issued Engineering Regulation 1100-2-8162 titled "*Incorporating Sea level Changes in Civil Works Programs*", which provided the "guidance for incorporating the direct and indirect physical effects of projected future sea level change across the project life cycle in managing, planning, engineering, designing, constructing, operating, and maintaining USACE projects and systems of projects". The guidance provided by the regulation can also be used in assessing the potential sea level rise which may be experienced at the Property.

Potential sea level rise at the Property has been predicted using the on-line Sea Level Change Calculator provided by USACE. The graph in Figure 8 shows the potential sea level rise from year 2000 to 2100 at the Mokuoloe mean sea level gauge located approximately 12.6 miles southeast from the Property. The graph shows the relative sea level rise which can be expected under differing prediction scenarios as determined by U.S. Department of Commerce National Ocean Service Center for Operational Oceanographic Products and Service (National Oceanic and Atmospheric Administration et. al., 2017). Included in the graph is the elevation of the proposed WWTP location.

According to USACE Sea Level Change Calculator, the proposed WWTP may be impacted by significant sea level rise by year 2080. The graph and table in Figure 8 illustrate that under the extreme climate change scenario, sea level rise could inundate the WWTP unless effective mitigative measures are implemented at the Property. A 7-foot sea level rise equal to the WWTP elevation may occur by year 2080; however, this is beyond the expected lifetime of the WWTP. The anticipated operational lifespan of the system/equipment is as follows: 1) Aquarius brand system (blowers, membrane diffusers, tank and media) has a typical life of 20 years; 2) emergency generator has a typical 20 year lifespan/warranty; 3) lift station tanks have a typical life of 40-50 years; and 4) pumps typically need to be replaced at 10-15 years.

Additionally, the *Hawaii Sea Level Rise Vulnerability and Adaptation Report* indicates that recent observations and predictions suggest that a 3.2-foot sea level rise could occur as early as year 2060 under more recently published highest-end scenarios (Hawaii Climate Change Mitigation and Adaptation Commission, 2017). According to the Hawaii Sea Level Rise Viewer, a 3.2-foot sea level rise would not impact the portion of the Property where the proposed WWTP will be located (Figure 9) (Pacific Islands Ocean Observing System at the University of Hawaii School of Ocean and Earth Science and Technology, 2018). Similarly, according to the City and County of Honolulu, Climate

Ready Oahu Web Explorer (City and County of Honolulu, 2020), a 3.2-foot sea level rise would only impact the area surrounding the Property. The rate of change for the shoreline affecting the Property is projected to have no land loss impact on the Property until a scenario of 6 feet sea level rise.

4.6.2.2 Flooding and Tsunami Hazards

According to the State GIS flood hazard zones map, the Property is located in flood hazard area Zone AE (Figure 10), which is defined as an area subject to inundation by the 1% annual chance flood event, or the 100-year flood, in any given year which exceeds the defined base flood elevation [BFE] (Office of Planning, 2018). The WWTP will be located in Zone AE with a BFE of 10 feet amsl.

Tsunamis and inundations of the low lying coastal areas are natural phenomena that occur infrequently in Hawaii. The location of the Islands in the Pacific Ocean exposes them to waves generated from geologic activity of the Pacific Ring of Fire. The Property is located in the County's Tsunami inundation evacuation zone, and has experienced several major flood events due to tsunamis resulting in flood waters over the BFE, and up to 12 feet deep.

According to sea level rise predictions, there is potential for a 3.2-foot sea level rise by 2060 and a 7-foot sea level rise by 2080 at the Property. The increase in sea level elevation and the potential for increase in monsoonal weather patterns brought by climate change will increase the chance of inundation by floodwaters at the Property.

According to the NOAA National Storm Surge Hazards Map (NOAA, 2020), under a scenario of a 3.2-foot sea level rise, the Property could be at risk of storm surges at low category hurricanes. In scenarios of larger category storms, the storm surges around the Property may reach as high as 6 feet above ground.

4.6.2.3 Flood, Tsunami, and Sea Level Rise Impacts and Mitigation

The WWTP will be designed to withstand tsunami inundations as well as floods from inland. The WWTP will be designed, located, and constructed to minimize or eliminate flood damage, impairment, and/or contamination during and subsequent to flooding by the regulatory flood. The aboveground tank housing the treatment system below the BFE will be constructed of epoxy-coated steel and will be watertight with walls impermeable to the passage of water. In addition, structural components will have the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy due to the regulatory flood. The pumps and blower panels will be protected from potential flooding by having them installed in a weatherproof housing. By incorporating these project design features there would be less than significant impacts from flooding, tsunami, and sea level rise. The proposed WWTP improvements would result in beneficial impacts compared to existing conditions since the WWTP components would be more resilient to flood waters from land and sea.

Currently, the impacts of minor flooding events are minimal; however, the impacts of a major tsunami at the Property could be significant. The chance of impacts will increase with the increase in sea level rise and climate change. The combination of sea level rise compounded by increased precipitation associated with climate change will increase the chances of major flooding events at the Property.

Major flooding could cause an overflow of the effluent disposal system (i.e., injection wells), which would result in a potential spill of treated wastewater to the Pat's at Punalu‘u parking lot, Kamehameha Highway, and/or adjacent coastal waters. To reduce the threat of flooding or sea level rise impacts to the injection wells, the following mitigation measures can be implemented as necessitated:

1) The effluent can be pumped directly to a temporary holding tank or removed using a pumping service.
2) Temporary or permanent flood barriers can be added around the wells.

These mitigation measures would reduce the flooding impacts to the injection wells to less than significant.

By the year 2080, if the WWTP is still in operation, measures will be taken to protect the WWTP from rising sea water, or the WWTP will be decommissioned or relocated to a new location inland away from the coastline. Conditions of the UIC permit require annual inspection, testing, and monitoring of the injection wells to evaluate their performance and prevent injection well failures. These observations will be used to determine if sea level rise is compromising the performance of the injection well system.

If sea level rise impacts the performance of the treatment system components or the injection well system, all applicable regulations in place at the time will be followed. If it is determined that the WWTP should be decommissioned, it will be decommissioned in accordance with DOH Wastewater Branch regulations

SECTION 5 SOCIAL ENVIRONMENT AND POTENTIAL IMPACTS

5.1 LAND USE

5.1.1 Existing Land Use

The Property and surrounding land to the north and south are zoned as *Urban,* and the surrounding land to the west is zoned as *Agricultural* under State Land Use designations (Figure 3a). The City and County of Honolulu DPP zoning designates the Property as *A-2 Medium Density Apartment* (Figure 3b) and the KLSCP designates the project area as *low density apartment* land use (City and County of Honolulu, 2012).

The Property is occupied by Pat's at Punalu'u, a residential condominium surrounded by an asphalt paved parking lot. The area surrounding the Property is occupied by residential properties to the north, the Pacific Ocean to the east, Hanohano Hale condominium complex to the south, and Kamehameha Highway to the west (Figure 2). Agricultural land is located across Kamehameha Highway to the west.

The general area surrounding the Property is developed with condominiums, single-family residences, small businesses, and agricultural farms. Based on available planning documents, the Property and surrounding area will continue to be used for residential and agricultural purposes for the foreseeable future.

5.1.2 Potential Land Use Issues

The Property and surrounding area is zoned for urban, residential, and agricultural uses, and its current and future use are consistent with the types of land use at surrounding properties. The Property has not had a significant impact on existing land use in the area. The proposed project does not involve changes to the Property's principal operations/land use and therefore, is not expected to have any impact to land use.

The proposed project will be located in a landscaped area and will not affect any of the Property's parking stalls. The aboveground WWTP and concrete slab will be located a minimum of 10 feet from the property boundary (Figure 5a), in accordance with the 10-foot front yard requirement as set in LUO Section 21-3.80-1.

5.2 SOCIAL AND ECONOMIC ISSUES

5.2.1 Existing Social and Economic Conditions

The project site is located in Hauula, Oahu in Census tract 102.01. In 2010, the Census tract had a residential population of approximately 5,882, which was approximately 0.6% of Oahu's total population. The Hauula population in this Census tract is similar in age to the overall age of the Oahu population as a whole. The racial mix of the area is comprised of proportionately more Native Hawaiians and Pacific Islanders, and fewer Asians than the island as a whole. The median household

income in 2010 was $66,500, and approximately 43.8% of Hauula's population lives below the poverty level. The areas near the Property consist primarily of condominium and single family homes along Kamehameha Highway and large agricultural lands in mauka areas. Hauula's small commercial area is located about 1.6 miles to the north, and Punalu‘u's small commercial area is located about 0.8 miles to the south.

5.2.2 Potential Social and Economic Impacts

The proposed project is anticipated to have no adverse impacts to socio-economic resources. The project will not result in an increase of dwelling units or the population of the Hauula area. Construction of the WWTP will generate short-term economic benefits through expenditures for construction materials and employment of workers.

5.3 HISTORIC, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

5.3.1 Existing Historic, Archaeological, and Cultural Resources

An archaeological assessment of the adjacent property to the south, Hanohano Hale condominium, was previously conducted by Scientific Consultant Services, Inc. [SCS] for the *Final EA for the Wastewater Treatment System at the Hanohano Hale Condominium*, prepared in 1993 (SSFM Engineers, Inc., 1993). The archaeological assessment found that the only known archaeological site in the vicinity is situated in the southern parking lot of the Pat's at Punalu‘u Condominium (State Site No. 50-80-06-3970). This site was recorded by Bath & Smith in 1988. Beneath the modern asphalt driveway, Bath and Smith identified one human burial and a subsurface cultural layer. The site consisted of a truncated dark humic sandy cultural layer identified below several layers of fill material under the asphalt parking lot. Several posthole and pit features were also noted. A copy of the SCS archaeological assessment is included in Appendix F.

An *Archaeological Monitoring Report* was prepared by SCS in 2010 for the greywater system installation project on the north side of the adjacent Hanohano Hale condominium building (SCS, 2010). During manual excavation for the project, human remains were encountered by construction personnel. Based on a field inspection conducted by Cultural Surveys Hawaii that confirmed the remains to be of native Hawaiian ancestry, the SHPD initiated an Archaeological Monitoring program for the remainder of work on the project. SCS archaeologists monitored all remaining excavations and during the work. Ten burial features consisting of 12 human burials were documented on the north side of the Hanohano Hale Condominium building in natural beach sand deposits that occur below the fill-soils (State Site No. 50-80-06-7120). Under the criteria established for the Hawaii State Register of Historic Places, SCS determined that the burial site is culturally significant as a pre-Contact Hawaiian burial ground and as a traditional cultural place for fishing, farming and habitation. A copy of the SCS archaeological monitoring report is included in Appendix F.

An *Archaeological Inventory Survey* was conducted in 2017 by Garcia and Associates in support of demolition and eventual new construction in the southern portion of the Pat's at Punalu‘u Condominium property (Garcia and Associates, 2017) . Excavation of 14 test trenches produced wide-spread evidence of previously-recorded State Site No. 50-80-06-3970 (mentioned above), a

truncated pre-Contact Hawaiian cultural deposit. A copy of the Garcia and Associates archaeological inventory survey is included in Appendix F (Figure 7 [pg. 12] of the appended survey shows the location of State Site Nos. 50-80-06-3970 and 50-80-06-7120).

The Hawaii Register of Historic Places (State of Hawaii State Historic Preservation, 2020) provides general areas of historical and cultural significance in the Koolauloa region, but the project site is not within these areas.

5.3.2 Potential Impacts to Historic, Archaeological, and Cultural Resources

The proposed project is not expected to result in adverse impacts to historical, archaeological, or cultural resources since the project is being constructed in a landscaped area and a parking lot (Figure 5b). The new WWTP system components will all be constructed aboveground, and the existing wet well/lift station and effluent disposal system (i.e., injection wells) are already in an area that has had extensive ground disturbance. The only area of subsurface excavation will be trenching to install piping for the new sewer force main and to connect the backup disposal wells, which are shown on Figures 5a and 5b. The trenches will be approximately 3 feet wide, with the deepest excavation to approximately 4 feet bgs at the connection to backup injection wells IW5 and IW1. Due to the limited subsurface excavation associated with the project, excavation activities are not anticipated to disturb any archaeological or cultural features. The existing wastewater treatment system located on the western side of the Property will be demolished and removed, but this is an area that was previously disturbed when the system was installed.

Although no adverse impacts are anticipated, since human burials and a subsurface cultural layer have been identified on the Pat's at Punalu'u property south of the proposed project location, there is the potential that similar cultural features or human burials might be encountered during the limited excavation activities. The following mitigation measures will be implemented:

1) An Archaeological Inventory Survey or Archaeological Monitoring will be conducted, as directed by the SHPD, as a mitigation measure to identify and protect archaeological or cultural resources.
2) All work will be coordinated with and approved by the SHPD prior to starting excavation activities, to ensure that proper procedures are followed to protect archaeological or cultural resources.
3) If any archaeological or cultural resources, or burials, are inadvertently discovered during excavation, all construction work will be ceased immediately and subsequent work shall proceed only upon an archaeological clearance from the SHPD.

With these mitigation measures, any potential impacts to archaeological or cultural resources will be minimized.

5.4 VISUAL AND AESTHETIC APPEAL

5.4.1 Existing Visual and Aesthetic Appeal

Pat's at Punalu'u is located along the coastline. Trees and landscaping border the west side of the existing parking lot along Kamehameha Highway. In the immediate area of the proposed WWTP there is not an open view to the ocean due to the presence of the existing Pat's at Punalu'u buildings.

5.4.2 Potential Impacts to the Visual and Aesthetic Appeal

The proposed WWTP is designed to have a height of approximately 14 feet above the level of the parking lot (concrete slab on grade plus tank height). The current height limitation for areas zoned as *A-2 Medium Density Apartment*, which includes the Property, is 40 feet (City and County of Honolulu LUO). The proposed WWTP is well within the A-2 zone height limitation (Figure 5a).

The dimensions of the proposed WWTP are approximately 12 feet wide by 28.5 feet long. The WWTP will be enclosed by a 10 to 12-foot high chain-link fence with privacy slats or a CRM wall to screen the WWTP from public view. A utility enclosure will be located southeast of the WWTP, adjacent to a new backup generator. The proposed location of the WWTP will not hinder existing views of the coastline from Kamehameha Highway and fencing or a wall around the WWTP will maintain the visual and aesthetic appeal of the rural area. Appropriate landscaping, such as trees or bushes, may be added to visually shield the new facility from Kamehameha Highway. Therefore, the proposed project improvements would result in less than significant impacts to visual and aesthetic resources.

5.5 RECREATIONAL ACTIVITIES AND AREAS

5.5.1 Existing Recreational Activities and Areas

The Property is located in Hauula, more than 0.8 miles north of Punalu'u Beach Park and approximately 0.7 miles south of Kaluanui Beach right-of-way.

5.5.2 Potential Impacts to Recreational Activities and Areas

Because of the distance to public beaches and parks, the proposed project will have no adverse impact on current recreational activities during the construction period, or during the long-term operation of the WWTP.

SECTION 6 INFRASTRUCTURE AND POTENTIAL IMPACTS

The Property has the potential to impact the following two public services: (1) transportation and (2) utilities. Owing to the location of the Property and the nature of its operations, it is not expected that other public services will be affected.

6.1 TRAFFIC AND ROADS

6.1.1 Existing Transportation Infrastructure

Kamehameha Highway is the main roadway serving the Hauula area. Primary vehicle access to the Property is from Kamehameha Highway. There are two driveways, one at the southwestern side of the Property and one at the northwestern side of the Property. The proposed WWTP is located adjacent to the northwestern driveway (Figures 5a and 5b).

Bus service is provided to the Property by routes along Kamehameha Highway, including Routes 60 and 88A. Generally, smooth traffic flow is characteristic along this coastal highway. Traffic is typically busiest during weekday commuter periods and weekend afternoons.

6.1.2 Potential Impacts to Traffic and Roads and Mitigation

All construction activities associated with the proposed WWTP will take place within the Property boundaries. No work will be performed within the State Right-of-Way. Construction activities will not alter public roadways or affect bus service or bike/pedestrian access to the State Right-of-Way. There will be no modifications to site access/egress on Kamehameha Highway. While the project is not expected to have significant traffic impacts, traffic on and adjacent to the Property may be impacted on a short-term basis during transportation of construction equipment and supplies to the project site. Construction vehicles will add to the traffic on the roadways during these short periods. The following mitigation measures are recommended for optimal traffic conditions during construction:

- Construction activities and construction materials should be located and stored away from vehicular traffic. Sight lines for drivers on the roadway should be carefully maintained.
- Trucks delivering construction materials should be scheduled on weekdays during times of non-peak commuter periods (8:30 AM to 3:30 PM).

With these mitigation measures in place, the project would result in less than significant impacts to traffic and roads.

6.2 UTILITIES

6.2.1 Existing Utilities in the Area

6.2.1.1 Electrical Supply

Electrical power is provided to the Property by HECO overhead service lines along Kamehameha Highway and a HECO-owned transformer located on the western side of the Property.

The electrical components of the proposed WWTP will be connected to the onsite 208 volts 3-phase electrical lines, through a branch circuit from the Pat's at Punalu‘u building circuit. In the event of a commercial power outage, the new emergency generator will be linked to an automatic transfer switch so that essential loads will automatically transfer to emergency power.

6.2.1.2 Water Supply

Potable water is provided to the Property by the Honolulu Board of Water Supply water line on Kamehameha Highway. Daily water usage consists of domestic uses for the condominium residents and landscape irrigation. Fire suppression water supply is also provided on the Property.

6.2.2 Potential Impacts to Utilities in the Area

The proposed project is not anticipated to require any offsite improvements. Utility service, such as potable water and electricity, to the surrounding area will not be affected. However, onsite utilities may be affected during construction activities. Additional electricity needed for operation of the proposed WWTP will be supplied by the onsite transformer. Therefore, there would be short-term less than significant impacts to utilities from the proposed project.

SECTION 7 DETERMINATION

Based on the analysis of information in this EA, it has been determined that the proposed Pat's at Punalu'u WWTP project will not have significant negative impacts to the natural, built, or social environment. Therefore, it is anticipated that a FONSI will be issued and an EIS will not be required.

7.1 FINDINGS AND REASONS SUPPORTING THE DETERMINATION

The potential effects of the proposed project were evaluated based on the thirteen *significance criteria* identified in HAR Title 11, Chapter 200.1-13. All phases and expected consequences of the proposed project have been evaluated, including potential primary, secondary, short-term, long-term, and cumulative impacts. Table 7.1 summarizes the significance criteria and the evaluation of the potential effects of the project.

It is concluded that the proposed project does not meet any of the thirteen criteria. By not meeting these criteria, it is appropriate that the proposed project be issued a FONSI and that an EIS not be required.

Table 7.1
Evaluation of Significance Criteria
Pat's at Punalu'u WWTP
Draft Environmental Assessment

No.	Significance Criterion	Yes	No	Reason for Determination
1	Irrevocably commits a natural, cultural, or historic resource?	☐	☑	The project is not expected to irrevocably commit any natural, cultural, or historic resource. The proposed WWTP will be installed in an area that has been previously disturbed by residential development and is currently a landscaped area and parking lot. There are no known significant cultural or historic resources in the project area and recommendations by the SHPD will be followed to protect cultural or historic resources.
2	Curtails the range of beneficial uses of the environment?	☐	☑	The project will not permanently curtail the beneficial uses of the environment. The proposed WWTP conforms to the land use designation for the Property and will be located within the existing property boundary of the Pat's at Punalu'u condominium.
3	Conflicts with the State's environmental policies or long-term environmental goals established by law?	☐	☑	The project will be in conformance with the State's environmental policies and goals established by law. The proposed WWTP will provide better treatment of Pat's at Punalu'u's wastewater and will accommodate present day flows. This is anticipated to reduce the risk of future wastewater spills.
4	Has a substantial adverse effect on the economic welfare, social welfare, or cultural practices of the community and State?	☐	☑	The project is not anticipated to have any adverse effects on the economic and social welfare or cultural practices of the community or state. Rather, it will benefit the residents of Pat's at Punalu'u by providing an improved wastewater treatment system.
5	Has a substantial adverse effect on public health?	☐	☑	The project is not anticipated to have any adverse effects on public health. Rather, it will have a positive impact on public health by improving treatment of wastewater and reducing the risk of future wastewater spills.
6	Involves adverse secondary impacts, such as population changes or effects on public facilities?	☐	☑	The project is not anticipated to result in adverse secondary impacts. The project is designed only to accommodate present day wastewater flows at the Pat's at Punalu'u condominium, and to reduce the risk of future wastewater spills.
7	Involves a substantial degradation of environmental quality?	☐	☑	The project is not anticipated to degrade environmental quality; it is anticipated to protect environmental quality by providing upgraded wastewater treatment. The project is intended to replace the existing wastewater treatment system to accommodate present day flows in order to reduce the risk of future wastewater spills.

No.	Significance Criterion	Yes	No	Reason for Determination
8	Is individually limited but cumulatively has substantial adverse effect upon the environment or involves a commitment for larger actions?	☐	☑	The project is not anticipated to result in a significant cumulative negative impact on the environment. The project site has already been developed and any adverse impacts related to the proposed project will primarily be limited within the property boundary. Due to the rural nature of the general area, other significant development projects are not anticipated. Therefore, the incremental effects of the proposed project combined with the effects of other past, present, and reasonably foreseeable future actions are not cumulatively considerable. The project does not involve a commitment for larger actions. In fact, it will replace Pat's at Punalu'u's existing wastewater treatment system, which will help reduce the need for additional actions.
9	Has a substantial adverse effect on a rare, threatened, or endangered species, or its habitat?	☐	☑	The project is not anticipated to adversely affect any rare, threatened, or endangered species or habitat. There are no known significant biological resources or habitats in the project area.
10	Has a substantial adverse effect on air or water quality or ambient noise levels?	☐	☑	The project is not anticipated to adversely affect long term air quality, water quality, or ambient noise levels. The project may temporarily affect air, water, or noise quality during construction, but BMPs will be implemented to minimize any impacts.
11	Has a substantial adverse effect on or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, sea level rise exposure area, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters?	☐	☑	The project is located within the SMA and appropriate permits will be obtained for the SMA. The proposed WWTP is located within the 100-year flood hazard area and in the County's Tsunami inundation evacuation zone. The WWTP will be designed, located, and constructed to minimize or eliminate flood damage, impairment, and/or contamination during and subsequent to flooding by the regulatory flood. In addition, structural components will have the capability of resisting hydrostatic and hydrodynamic loads and effects of buoyancy due to the regulatory flood or a tsunami. BMPs will be used during construction to minimize any impacts on coastal waters. The project is not located within the sea level rise exposure area.
12	Has a substantial adverse effect on scenic vistas and view planes, during day or night, identified in county or state plans or studies?	☐	☑	Although the project is located along the coastline, the dimensions of the proposed WWTP are approximately 12 feet wide by 28.5 feet long, with a height of approximately 14 feet above the level of the parking lot. Fencing or a wall will be used around the WWTP to maintain the visual and aesthetic appeal of the rural area. The proposed WWTP will not interfere with open views to the ocean.
13	Requires substantial energy consumption or emits substantial greenhouse gases?	☐	☑	The project will not require substantial energy consumption. A slight increase in energy use will result from the proposed WWTP and will be accommodated by the existing HECO power supply on the Property. The project will not emit substantial greenhouse gases.

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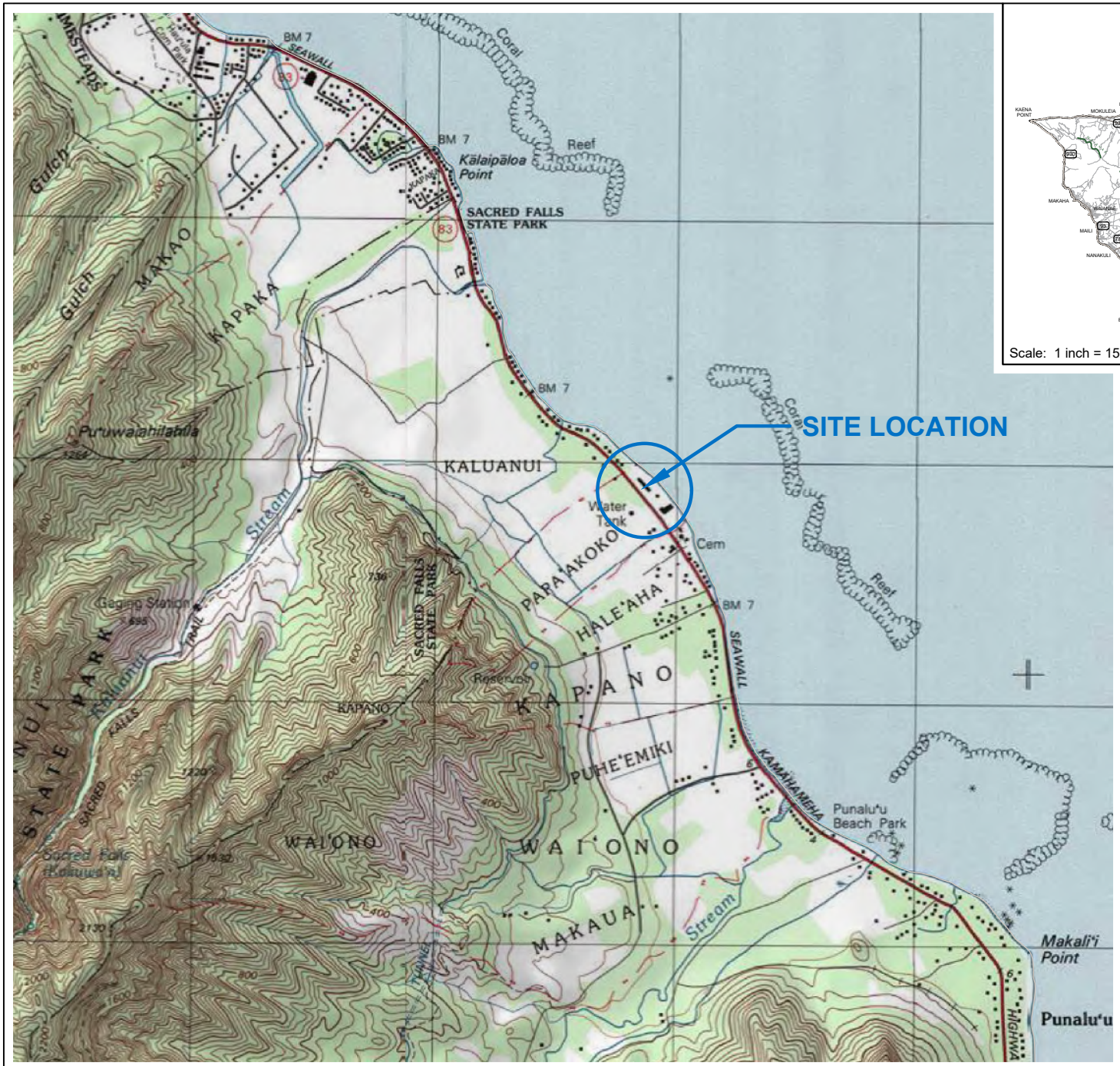
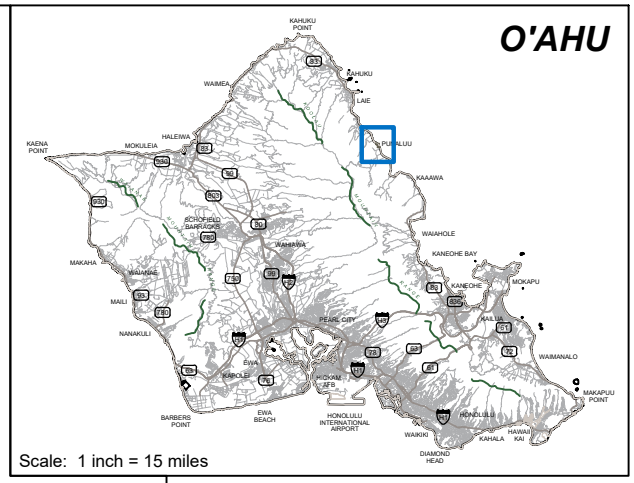
FIGURES





NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

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TOPO! Version 4.5.0

NORTH

GRAPHIC SCALE

2,000 0 2,000

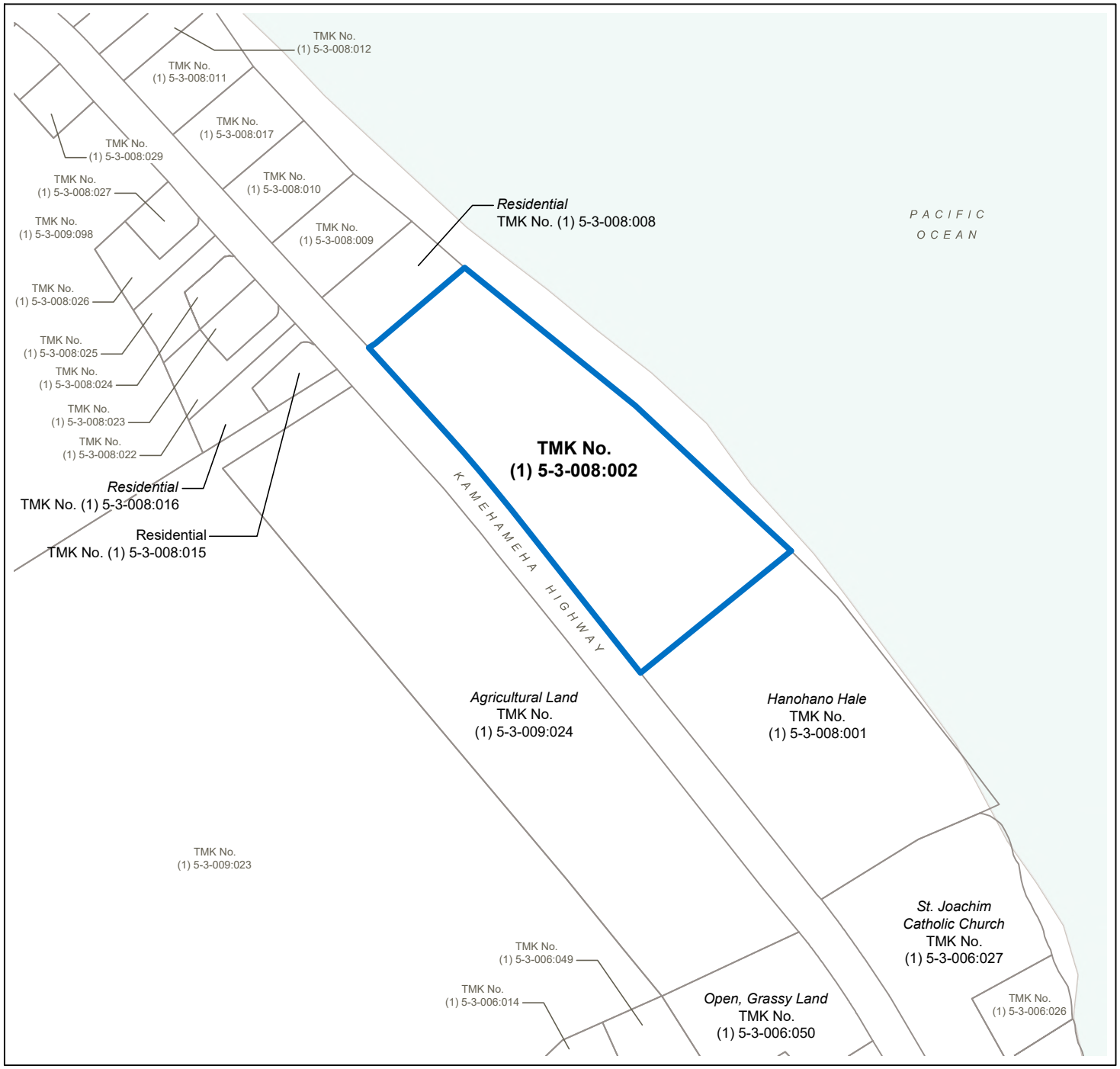
Scale in Feet

FIGURE 1

REGIONAL LOCATION & TOPOGRAPHIC MAP

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

Pat's at Punalu'u
TMK No. (1) 5-3-008:002

TMK Boundary

NOTES

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SOURCES

http://planning.hawaii.gov/gis. March 2017.

NORTH

GRAPHIC SCALE

200 0 200

Scale in Feet

FIGURE 2

TAX MAP

[TMK No. (1) 5-3-008:002]

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL

LEGEND

- Pat's at Punalu'u TMK No. (1) 5-3-008:002
- Perennial Stream
- Non-perennial Stream

STATE LAND USE DISTRICT BOUNDARY CODE

- Agricultural
- Conservation
- Urban

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

Aerial Map, 21°35'22.3"N 157°53'21.6"W. Google Earth. March 27,2018.

http://planning.hawaii.gov/gis. March 2018.

NORTH

GRAPHIC SCALE

800 0 800

Scale in Feet

FIGURE 3a

STATE LAND USE MAP

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL

LEGEND

- Pat's at Punalu'u TMK No. (1) 5-3-008:002
- Perennial Stream
- Non-perennial Stream

CITY & COUNTY OF HONOLULU
LAND USE ORDINANCE [LUO] ZONING CODE

- A-2, Medium-density Apartment District
- AG-2, Restricted Agriculture District
- B-1, Neighborhood Business District
- P-1, Restricted Preservation District
- P-2, General Preservation District
- R-5, Residential District

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

Aerial Map, 21°35'22.3"N 157°53'21.6"W. Google Earth. March 27,2018.

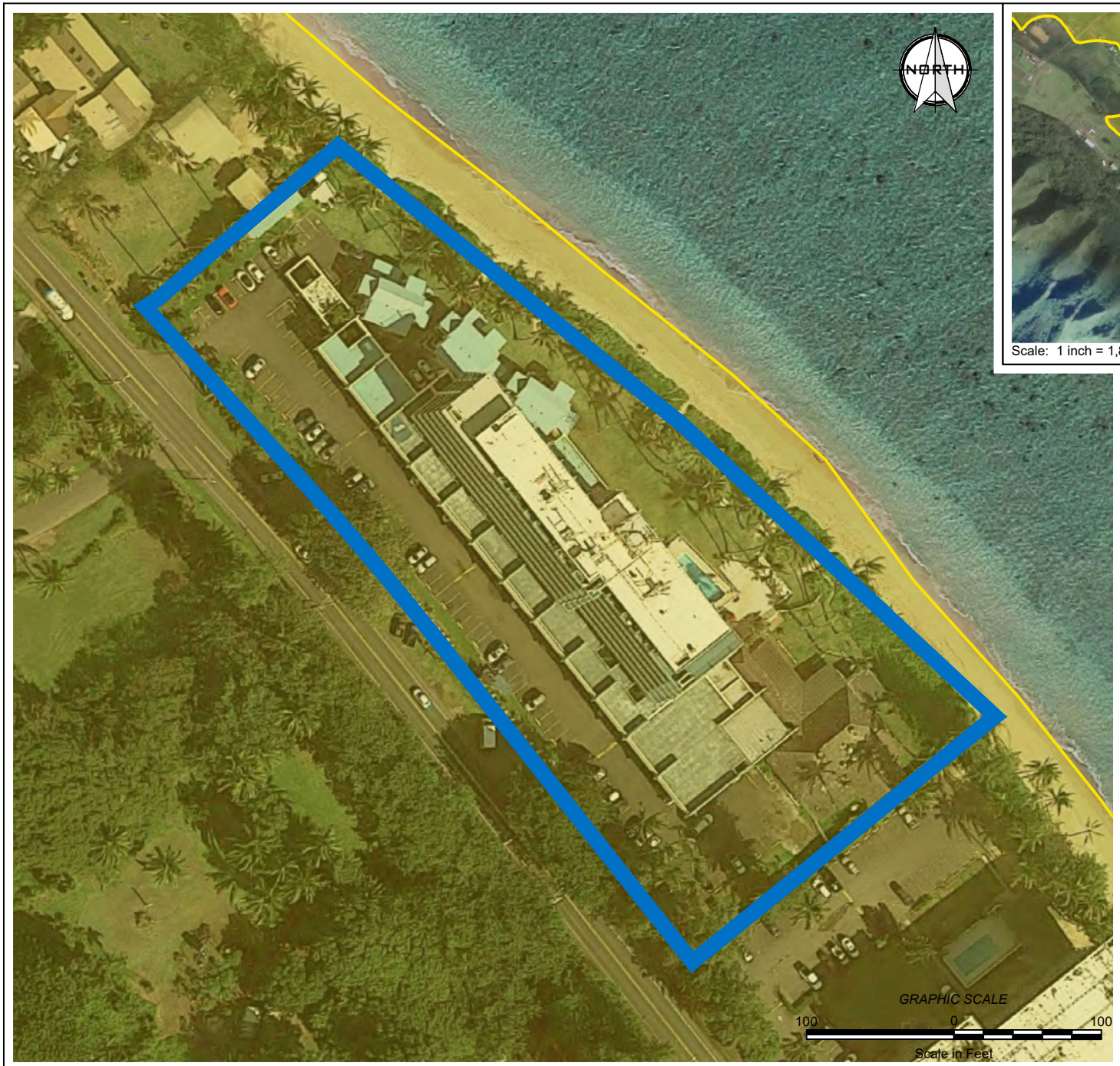
http://planning.hawaii.gov/gis. March 2018.

FIGURE 3b

CITY & COUNTY OF HONOLULU LUO ZONING MAP

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-549 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:001

ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

Pat's at Punalu'u
TMK No. (1) 5-3-008:002

Special Management Area Boundary

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

Aerial Map, 21°35'22.3"N 157°53'21.6"W. Google Earth. March 27,2018.

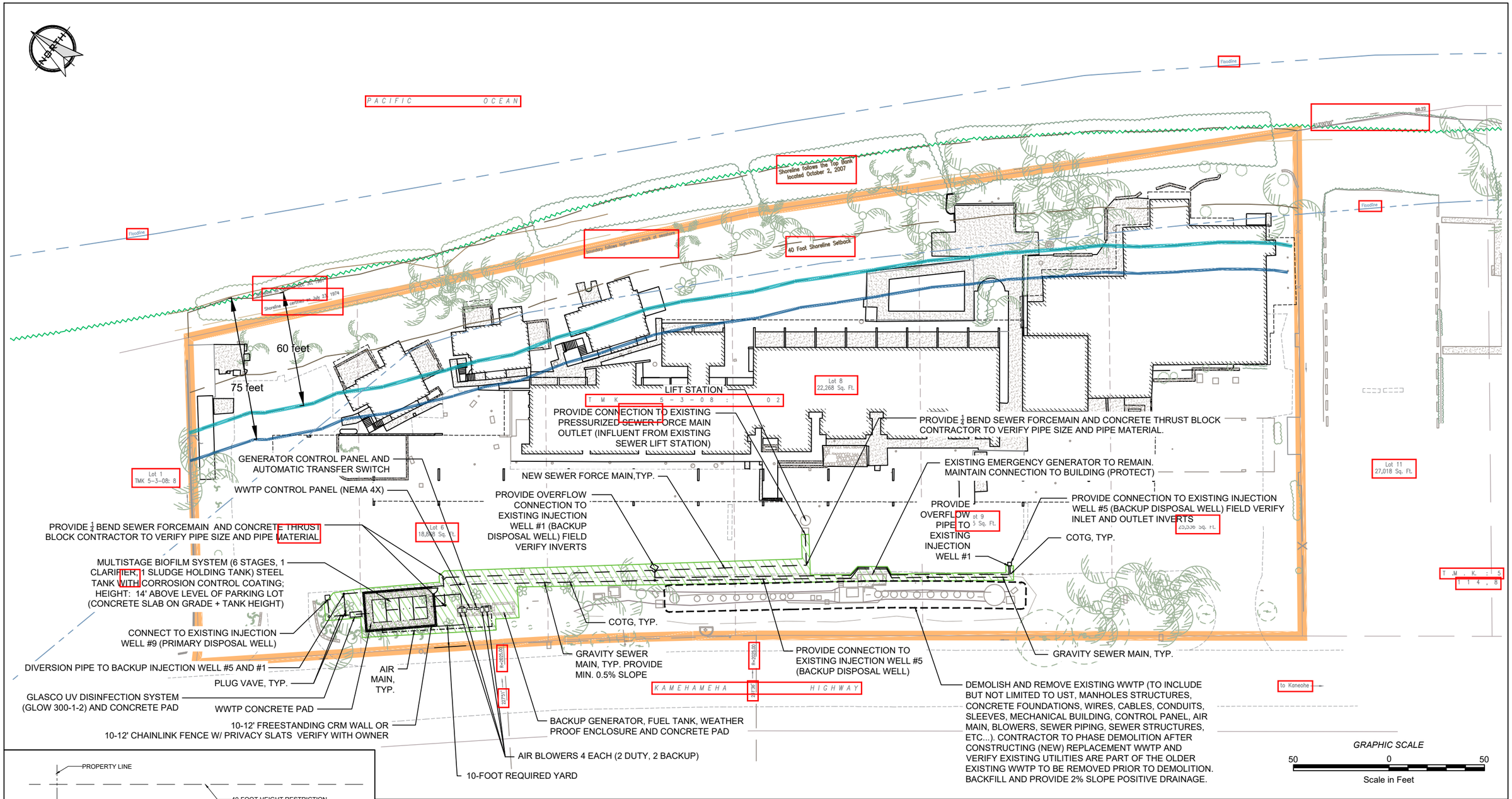
http://planning.hawaii.gov/gis. March 2018.

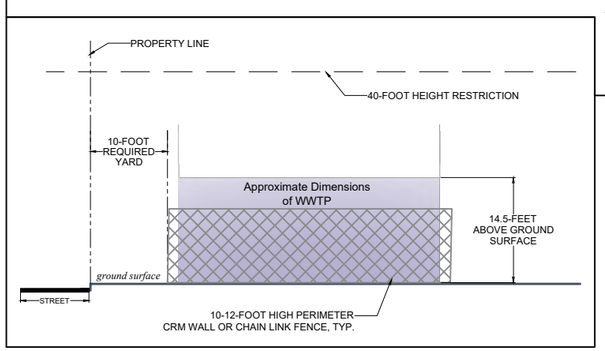
FIGURE 4

SITE LOCATION

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL





LEGEND

- Property Boundary
- Building
- Concrete
- 60-foot Shoreline Setback Line
- 75-foot Presumed Shoreline Setback Waiver Line
- Vegetation Line (2005-2008)
- Area of New WWTP System
- Injection Well of Existing System

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

C-1 General Site Plan-North, Pat's at Punalu'u WWTP Replacement. Laulea Engineering, LLC., 2019

C-1 General Site Plan-South, Pat's at Punalu'u WWTP Replacement. Laulea Engineering, LLC., 2019

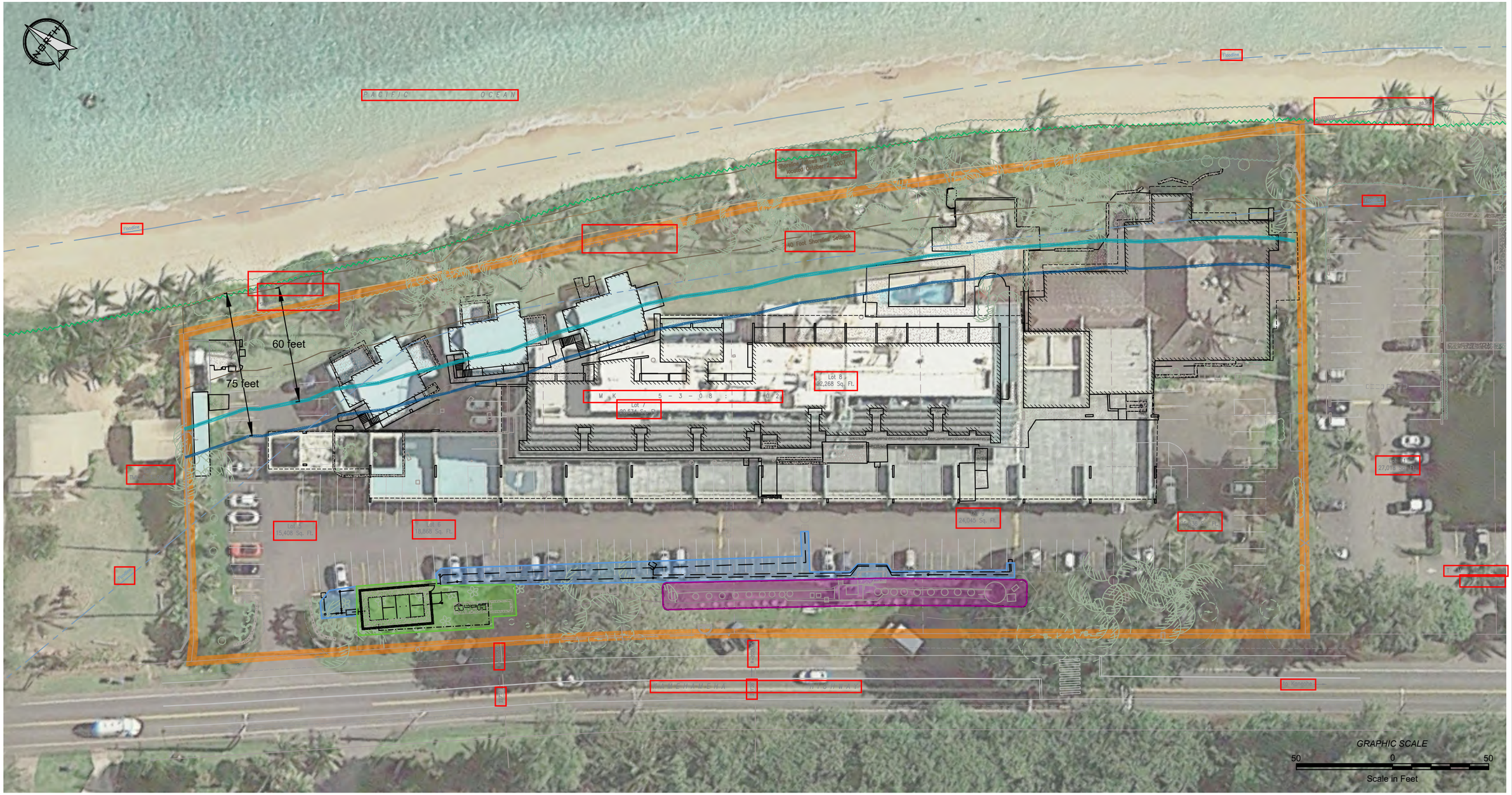
http://planning.hawaii.gov/gis, 2019

FIGURE 5a

SITE PLAN

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- Property Boundary
- Building
- Concrete
- 60-foot Shoreline Setback Line
- 75-foot Presumed Shoreline Setback Waiver Line
- Vegetation Line (2005-2008)
- ☐ Injection Well of Existing System
- 🟩 Area of New WWTP System
- 🟦 Area of Temporary Work Areas
- 🟪 Existing System to be Demolished

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

C-1 General Site Plan-North, Pat's at Punalu'u WWTP Replacement. Laulea Engineering, LLC., 2019

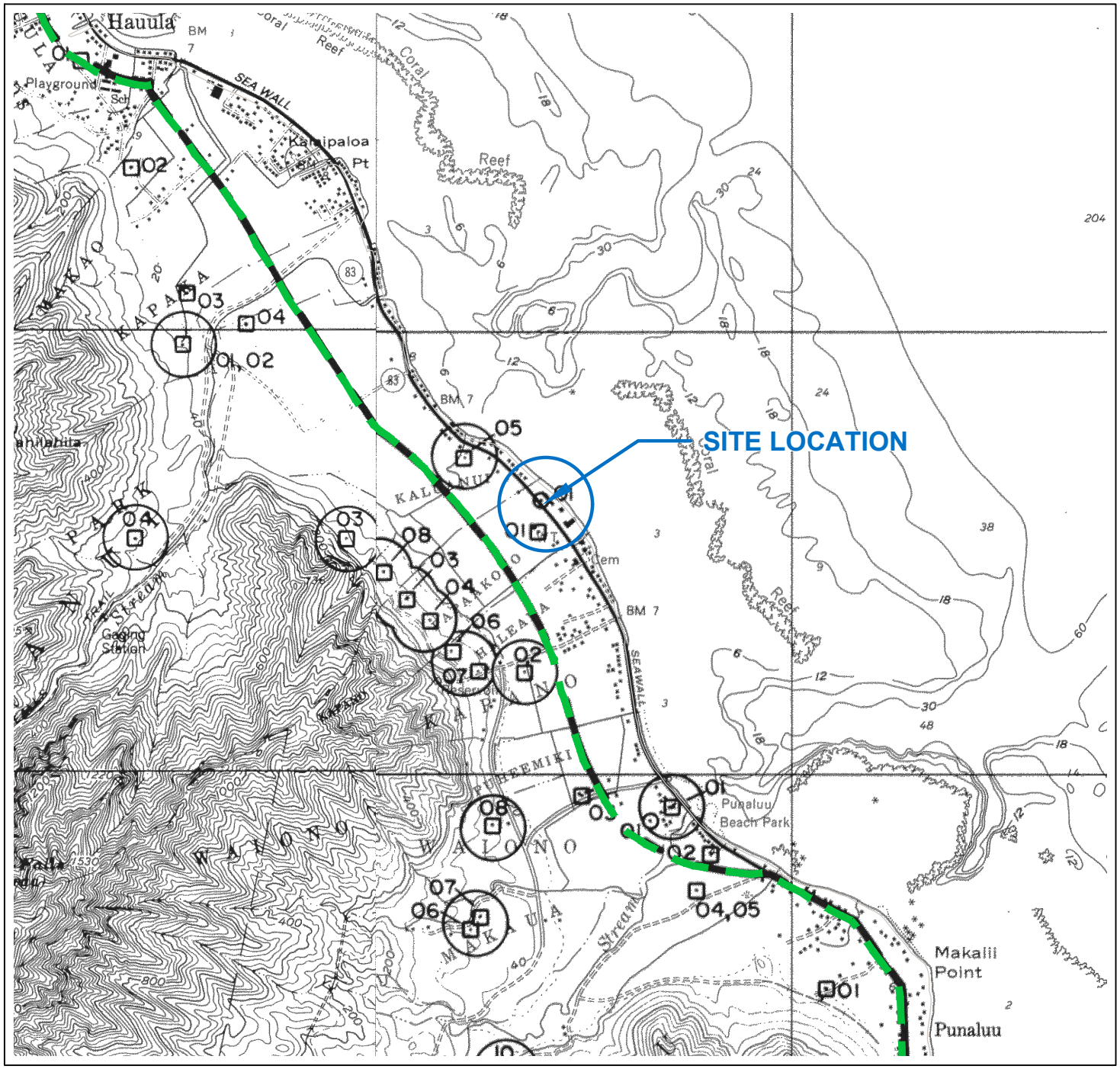
C-1 General Site Plan-South, Pat's at Punalu'u WWTP Replacement. Laulea Engineering, LLC., 2019

http://planning.hawaii.gov/gis, 2019

FIGURE 5b
SITE PLAN & AERIAL MAP

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- UNDERGROUND INJECTION CONTROL [UIC] LINE
- DRINKING WATER WELL
- INJECTION WELL
- OTHER WELL

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

http://planning.hawaii.gov/gis. November 2017

O-7 Kahuku, 08 Hauula & O-11 Kahana, Hawaii, State of Hawaii, Department of Health, Underground Injection Control Program, Effective - July 6, 1984, U.S. Department of the Interior Geological Survey, 1983.

NORTH

GRAPHIC SCALE

2,000 0 2,000

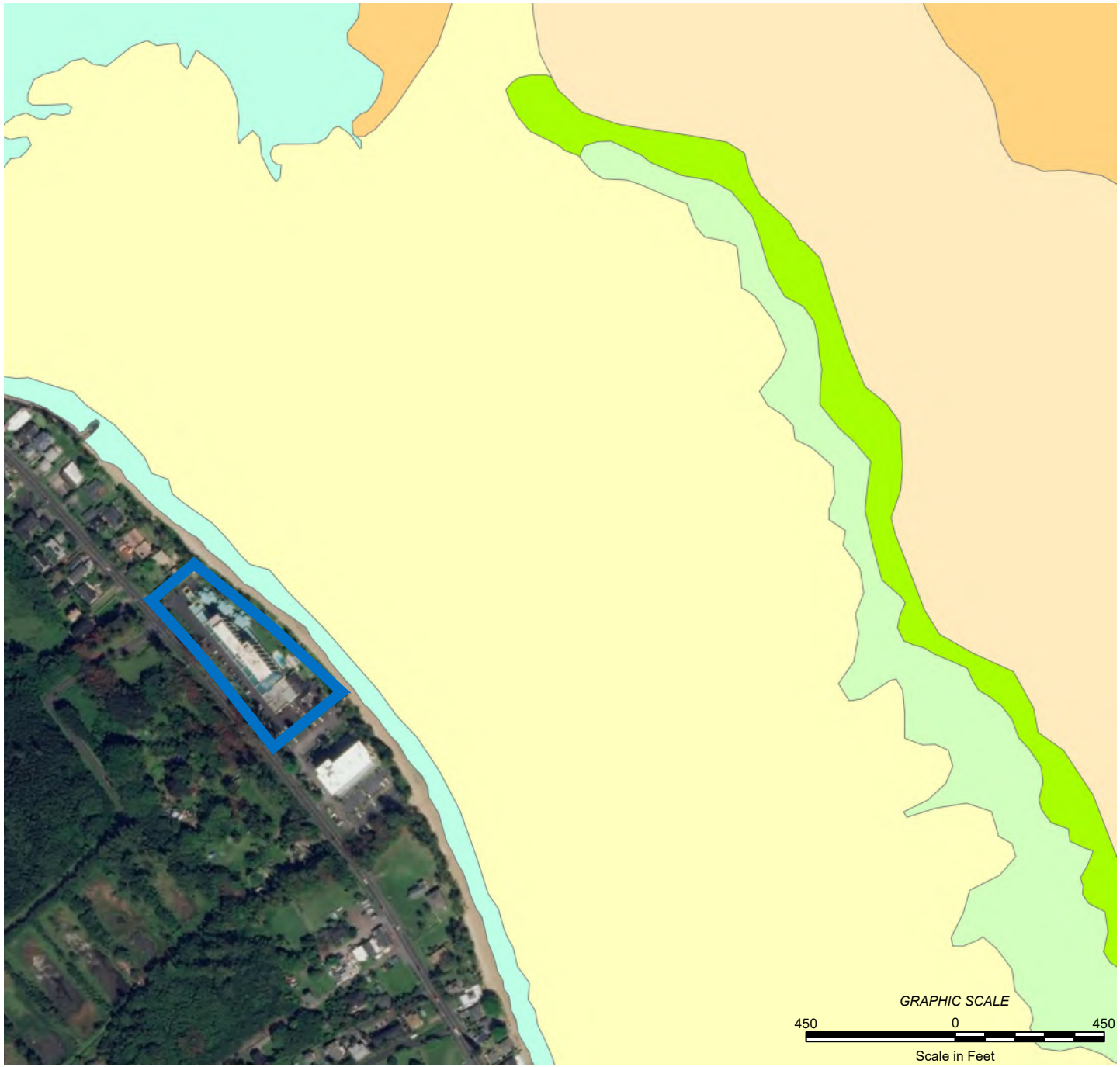
Scale in Feet

FIGURE 6

UIC LINE & WELL LOCATION MAP

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL



LEGEND

- Pat's at Punalu'u TMK No. (1) 5-3-008:002
- Channel, Uncolonized 90%-100%
- Fore Reef, Coral 10%-<50%
- Fore Reef, Coralline Agae 10%-<50%
- Reef Crest, Coralline Algae 10%-<50%
- Reef Crest, Turf 50%-<90%
- Reef Flat, Turf 50%-<90%

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

Aerial Map, 21°35'22.3"N 157°53'21.6"W. Google Earth. March 27,2018.

http://planning.hawaii.gov/gis. March 2018.

ESRI ArcGIS Pro version 2.1.0

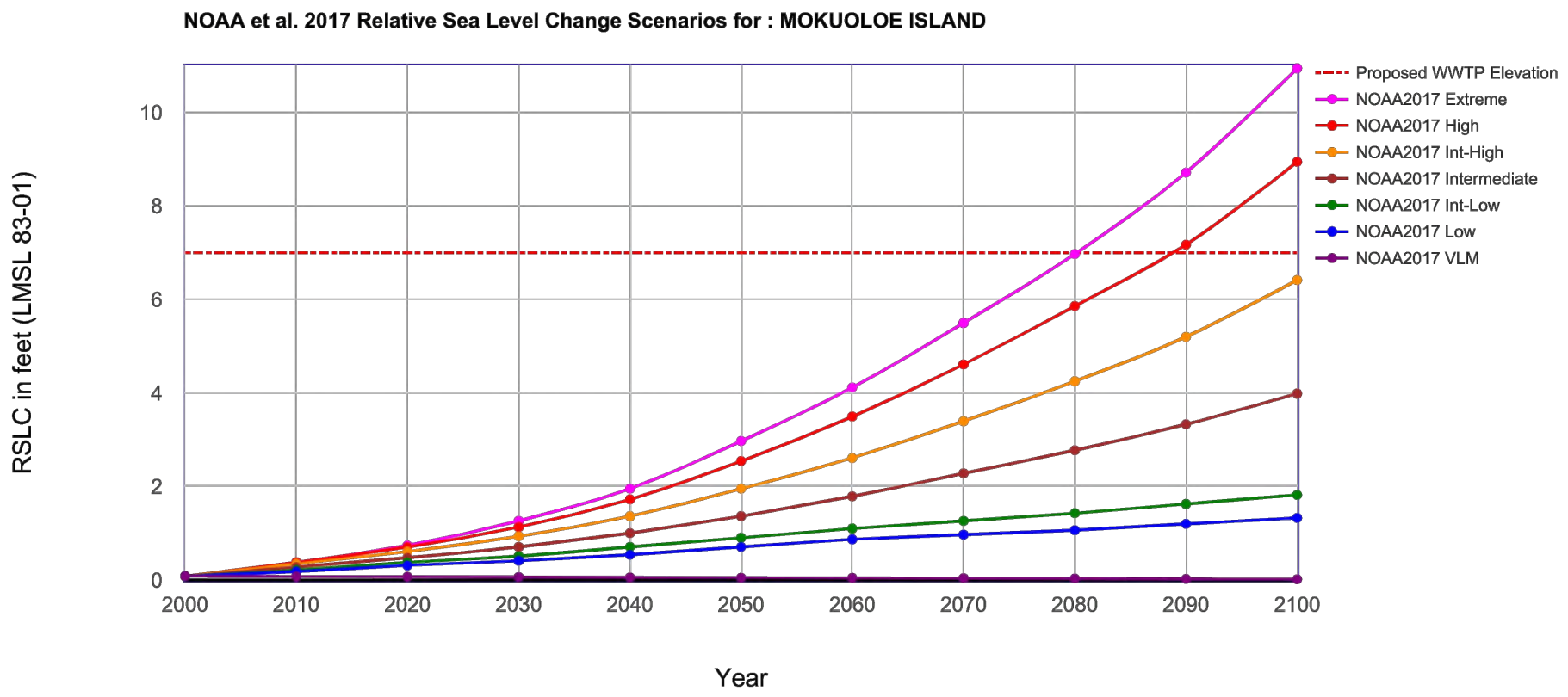
NORTH

FIGURE 7

BENTHIC MAP

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL



PAT'S AT PUNALU'U
Scenarios for MOKUOLOE ISLAND
NOAA2017 VLM: -0.00066 feet/yr
All values are expressed in feet

Year	NOAA2017 VLM	NOAA2017 Low	NOAA2017 Int-Low	NOAA2017 Intermediate	NOAA2017 Int-High	NOAA2017 High	NOAA2017 Extreme
2000	0.08	0.08	0.08	0.08	0.08	0.08	0.08
2010	0.08	0.18	0.22	0.28	0.35	0.38	0.38
2020	0.07	0.31	0.38	0.48	0.61	0.71	0.74
2030	0.06	0.41	0.51	0.71	0.94	1.13	1.27
2040	0.06	0.54	0.71	1.00	1.36	1.72	1.95
2050	0.05	0.71	0.90	1.36	1.95	2.54	2.97
2060	0.04	0.87	1.10	1.79	2.61	3.50	4.12
2070	0.04	0.97	1.27	2.28	3.40	4.61	5.50
2080	0.03	1.07	1.43	2.77	4.25	5.86	6.97
2090	0.02	1.20	1.63	3.33	5.20	7.17	8.71
2100	0.02	1.33	1.82	3.99	6.42	8.94	10.94

SOURCES: NOAA et. al. 2017

USACE Sea Level Change Curve Calculator (2017.55), http://www.corpsclimate.us/ccaceslcurves.cfm

NOTES:

1. Mokuoloe Island is a permanent service for mean sea level [MSL] station.
2. LMSL 83-01 is the local mean sea level from 1993 to 2001 which adjusts the MSL datum by 0.084 feet.
3. RSLC = Relative Sea Level Change
   VLM = Vertical Land Movement (feet/year)

FIGURE 8

RELATIVE SEA LEVEL CHANGE SCENARIOS FOR MOKUOLOE ISLAND

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL

LEGEND

Pat's at Punalu'u
TMK No. (1) 5-3-008:002

Sea Level Rise Exposure Area - 3.2 Feet Scenario

NOTES

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SOURCES

Aerial Map, 21°35'22.3"N 157°53'21.6"W. Google Earth. March 27,2018.

http://planning.hawaii.gov/gis. 2018.

NORTH

GRAPHIC SCALE

450 0 450

Scale in Feet

FIGURE 9

SEA LEVEL RISE EXPOSURE MAP

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL

LEGEND

Pat's at Punalu'u
TMK No. (1) 5-3-008:002

SPECIAL FLOOD HAZARD AREA

Special Flood Hazard Areas [SFHA] are defined as the area that will be inundated by the flood event having a 1% chance of being equaled or exceeded in any given year. The 1% annual chance flood is also referred to as the base flood or 100-year flood.

AE - Area subject to inundation by the 1%-annual-chance flood event for which Base Flood Elevations [BFEs] have been determined.

D - Area of undetermined but possible flood hazard.

VE - Area inundated by 1%-annual-chance flood with Velocity Hazard (wave action) for which BFEs have been determined.

X - Area of moderate risk within the 0.2%-annual-chance flooding.

X - Area of minimal flood hazard determined to be outside the 0.1%- and 0.2%-annual-chance floodplains.

NOTES

The accuracy of this document is limited to the quality and scale of the source information. This document is not a legal representation of an engineered survey.

SOURCES

Aerial Map, 21°35'22.3"N 157°53'21.6"W. Google Earth. March 27,2018.

http://planning.hawaii.gov/gis. March 2018.

FIGURE 10

FLOOD HAZARD MAP

ENVIRONMENTAL ASSESSMENT
Wastewater Treatment System Replacement
53-567 Kamehameha Hwy, Hauula, Hawaii
TMK No. (1) 5-3-008:002

ENVIRONMENTAL SCIENCE INTERNATIONAL

APPENDIX A

Site Photographs

Photo 1: Entrance to Property from Kamehameha Highway, facing north.

Photo 2: View of Property, including parking lot and landscape buffer, facing north.

Photo 3: View of Property and proposed location of WWTP, facing south.

Photo 4: View of proposed location of WWTP and existing injection well No. 9, facing north.

esi	Appendix A – Site Photographs	Photos 1 - 4
	Pat's at Punalu'u WWTP	Hauula, Hawaii
	Draft Environmental Assessment	Project No. 119029

Photo 5: View of proposed location of WWTP in landscaped area, facing north.

Photo 6: View of injection well No. 9, facing northwest.

Photo 7: View of injection well No. 5, facing north.

Photo 8: View of Property, including parking lot, facing north.

esi	Appendix A – Site Photographs	Photos 5 - 8
	Pat's at Punalu'u WWTP	Hauula, Hawaii
	Draft Environmental Assessment	Project No. 119029

Photo 9: View of existing wet well/lift station, facing north.

Photo 10: View of existing wastewater treatment system, facing north.

Photo 11: View of onsite HECO-owned transformer, facing northwest.

Photo 12: View of Property adjacent to Kamehameha Highway, facing south.

Photo 13: View of east side of Property adjacent to the ocean, facing south.

Photo 14: Coastline adjacent to Property, facing south.

Photo 15: View of east side of Property adjacent to the ocean, facing south.

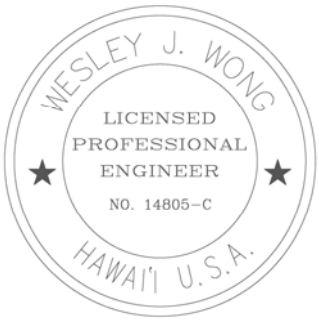
Photo 16: View of pool on southeast side of Property, facing south.

APPENDIX B

Basis of Design and Engineering Report

WASTEWATER TREATMENT SYSTEM
PAT'S AT PUNALUU
53-567 KAMEHAMEHA HWY, HAUULA, HI 96717
TMK: (1) 5-3-008:002

Basis of Design and Engineering Report
(DRAFT: 12/6/2019)



THIS WORK WAS PREPARED BY ME
OR UNDER MY SUPERVISION

EXP DATE : APRIL 30, 2020

Prepared For:
AOAO at Pat's at Punalu'u
53-567 Kamehameha Hwy
Hauula, HI 96717

Prepared By:

LAULEA
ENGINEERING, LLC
P.O. BOX 907
Kailua, HI 96734
December 6, 2019

TABLE OF CONTENTS

Acronyms, Abbreviations, and Definitions

ATU	Aerobic Treatment Unit
BOD5	Biochemical Oxygen Demand, 5-day
CBT™	Cyclic Biological Treatment ™
COD	Chemical Oxygen Demand
COTG	Clean-Out to Grade
DLIR	State of Hawaiʻi Department of Labor and Industrial Relations
DOH WWB	State of Hawaiʻi Department of Health Wastewater Branch
DOH SDWB	State of Hawaiʻi Department of Health Safe Drinking Water Branch
EPA	United States Environmental Protection Agency
F/M	Food to microorganism ratio
FOG	Fats, Oils, and/or Grease
ft^2	Square foot or square feet
GI	Grease Interceptor
gpd	Gallon per day
HAR 11-62	Hawaiʻi Administrative Rules Title 11 Chapter 62
HIOSH	Hawaiʻi Occupational Safety and Health
MSFBS	MultiStage Fixed Biofilm System
OKT	Old Koloa Town
L	Liter
LCC	Large Capacity Cesspool
lb	Pounds
mg	Milligrams
mpi	Minutes per inch
MSL	Mean Sea Level
OSHA	Occupational Safety and Health Administration
Owner	Subject property owner, which may be Owner(s), Trustee(s), Executor(s), etc.
pH	Potential of hydrogen; quantitative measure of the acidity or alkalinity of a solution
PL	Pre-Loader
TMK	Tax Map Key
WWTW	Wastewater Treatment Works

1. PROJECT BACKGROUND

The project involves property with the following information:

Tax Map Keys ("TMK"): (1) 5-3-008:002
Project Address: 53-567 Kamehameha Hwy, Hauula, HI 96717
Total Land Area: 2.9077 acres
Property Class: Condo Master

Pats at Punaluu is situated in Honolulu on the north coast of the island of Oahu. It contains 160 bedroom units with direct sources of wastewater. All wastewater is disposed of by means of existing injection wells after receiving treatment. The existing modified injection well #5 will act as the primary disposal units and the other injection wells acts as back-up and overflow disposal wells.

2. DESIGN CRITERIA

The daily design flow is calculated in the table below:

Tenant	Units	GPD/bedroom	Total GPD
Condominium Bedroom Units*	160	200	32,000

*See as-builts for basis of design

Based on the table above a design flow of 32,000 gpd was calculated. The owners of Pats at Punaluu have decided to purchase a wastewater treatment system to have a peak flow capacity of 43,000 gpd for a factor of safety. Influent BOD5 and TSS concentrations are assumed at 300 mg/l, while legal effluent limitations for disposal are set at 30 mg/l [HAR 11-62-26(b)(1)(D) & HAR 11-62-26(b)(2)(D)].

3. GENERAL WASTEWATER TREATMENT SYSTEM DESCRIPTION

The proposed wastewater treatment system will consist of the following:

- Existing Wet Well/Lift Station/Trash Tank
- Primary Treatment Tank/System (MSFBS)
  - Integrated Clarifier Tank
  - Integrated Sludge Holding Tank
- Multiple Injection Well Disposal System (One (1) Primary and Multiple (8) Backup Wells that add up to 100% Redundancy)

3.1 Existing Wet Well/Lift Station/Trash tank

The existing 6' diameter wet well (1,200 gallons) acts as a trash tank for preliminary treatment of the wastewater influent. The wet well is equipped with dual submersible lift pumps that operate at 3 phase 208 volts power from a branch circuit from the existing wastewater treatment plant electrical power.

3.2 Treatment System: Aquarius Nebula Multi Stage Fixed BioFilm System

The Aquarius treatment system does meet the requirements of the DOH-WWB HAR 11-62, Subchapter 2 WWTW. Effluent from the Aquarius will be treated to a maximum of 30 mg/L in BOD5 concentration and 30 mg/L in Suspended Solids.

The Aquarius system will use a 20,000 gallon 28.5' length by 12' wide by 12' height above ground epoxy coated steel tank which includes a sludge tank and clarifier integrated within the tank.

The Aquarius brand MultiStage Fixed Biofilm System (MSFBS) is an attached growth process that incorporates textile media to grow biofilm that is fixed in the biological treatment basins. The treatment basin is divided into stages to create a series of specific living environments for the microbiology. The beginning treatment stages perform the majority of the biochemical oxygen demand (BOD5) and ammonia removal in the process and the remaining stages operate to minimize sludge production. A food chain is created by growing higher life forms in the later stages that consume the lower life forms grown in the initial stages resulting in biological sludge minimization.

The textile media is arranged vertically on stainless steel media racks. These racks are custom designed for each application. Fine bubble diffused aeration grids are attached to the bottom of the media racks for ease of installation in a package system. The diffused aeration system is critical to the performance of the MSFBS as it provides oxygen to the biomass, mixing within the treatment stages, and scouring of the biofilm for controlling growth.

3.3 Utility Enclosure

A utility enclosure will be constructed adjacent to the emergency generator. The utility enclosure will house the primary/standby blowers and the WWTW control panels. The utility enclosure will be a non-occupied structure. Per the HAR, Title 11, Chapter 46, Community Noise Control Document, a 45 dBA noise level is to be met at the property line. The noise generating equipment (i.e., blowers and pumps) will therefore all be housed in the utility enclosure. The blowers will be installed inside the room with individual sound enclosures to reduce the noise level.

A metal chain link fence approximately 6 feet high and/or wall, with a locking access door will be constructed around the perimeter of the WWTW tanks to limit public access.

3.4 Sludge Holding Tank

The existing wet well/ trash tank will be able to separate inorganics as well as solids from the process flow. It is recommended that the wet well and sludge holding tank, mentioned in the below paragraph, are pumped on recurring schedules.

The Aquarius WWTW can include a sludge holding tank at the end of the multi-stage process to store the sludge holding capacity to a two week retention time. Fine bubble aeration will be used to aerate the sludge tank. Close monitoring of the clarifier capacity will be necessary for the first few months. After a few months of monitoring the operator will be able to give accurate time estimates to when the clarifier and wet well need to be pumped.

4. PROCESS PARAMETERS

The new wastewater treatment system design BOD5 and TSS loading is based on reasonable loading for residential sewage. As a measure of safety, the 1,200 gallon wet well/ trash tank is assumed to perform negligible treatment. This assumption was made to ensure that the treatment system will be able to handle the maximum loading. The wastewater will be of residential strength and is expected to contain relatively low levels of fat, oils and grease due to the nature of the wastewater sources (residential).

WWTW Design Daily Flow	=	32,000 gallons/day
Design Influent BOD5 Concentration	=	300 mg/L
Design Influent TSS Concentration	=	300 mg/L
Design Grease (after wetwell)	=	40 mg/L
Wetwell/Trash Tank diameter	=	6 feet
Total Tank Length	=	Approx. 28.5 feet (18.5'+3.5'+6.3')
Treatment System Length	=	18.5 feet
Tank Dimensions	=	12' x 28.5' SS tank
Tank Operating Volume	=	20,000 gallons
Sludge Generation Rate	=	0.5 lb TSS/lb BOD
Daily Sludge Generation	=	40 lbs/day
Daily Sludge Generation Volume	=	480 gallons/day (Primary)
Clarifier Tank Length	=	3.5 feet
Sludge Holding Tank Length	=	6.3 feet
Sludge Holding Capacity	=	5,890.5 gallons
Sludge Retention Time	=	12.3 days
Treated Effluent BOD5 Concentration	=	30 mg/L
Treated Effluent TSS Concentration	=	30 mg/L

4.1. Process Mass Balance

Design Flow = 32,000 gpd

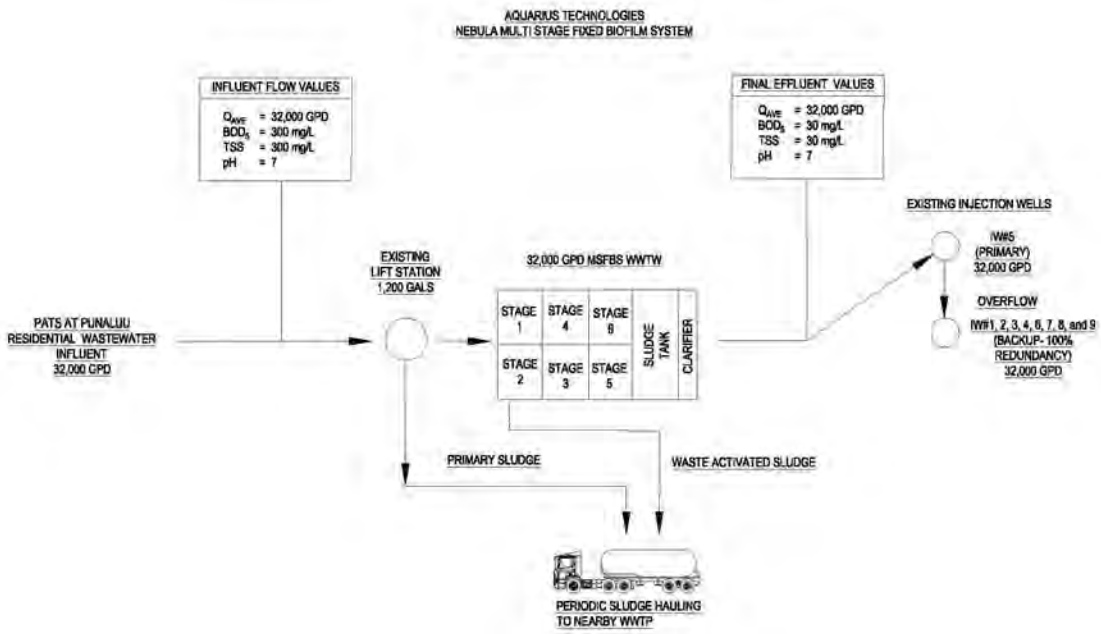


Figure 4.1- Process Flow Diagram (Hydraulic Loading and Organic Capacities Shown)

The wet well/trash tank is assumed to perform negligible treatment.
Total after MSFBS:

% BOD5 Reduction from WWTW = 97.5%
% TSS Reduction from WWTW = 97.5%

5. ELECTRICAL AND EMERGENCY POWER

Electrical service will be provided by Hawaiian Electric Company (HECO) through a branch circuit from the Pat's at Punalu'u building circuit. The electrical components of the new WWTW will be connected to the proposed on-site 208 volts 3-phase electrical lines.

Emergency power will be provided by a diesel generator or equivalent equipment. The new generator will draw its fuel from a separate fuel tank. The new generator will provide backup power to the WWTW blowers, and existing Wet Well/Lift Station.

6. EXISTING WASTEWATER EFFLUENT DISPOSAL AND SAMPLING

Pats at Punalu'u, located on the shore in Punalu'u near Hau'ula, contains nine (9) permitted class V, Subclass AB Injection wells designated as Injection Wells 1-9, that receive intermittent wastewater effluent, treated by the wastewater treatment plant, from the main condominium building. The site is used entirely for residential purposes.

The existing injection well #5 will provide a 100% primary effluent disposal system and the other 8 remaining injections wells will provide the 100% redundancy. Treated effluent flow from the new treatment system can be redirected between the wells using 4" valves. The treatment system operator can also take treated effluent samples from this effluent box feeding the effluent pumps. Per HAR 11-62 requirement, the existing injection wells are able to handle the peak flow. All wells will be connected to the MSFBS and all can be controlled using plug valves. The existing injection wells all have access ports that allow technicians to conduct sampling and testing of the effluent.

7. SCUM, FOG AND SLUDGE MANAGEMENT PLAN

Sludge, scum, FOG, and rubbish from the Wet Well/Lift Station and Aquarius WWTW will be vacuumed and trucked to nearby disposal facilities on a bi-weekly schedule.

Based on the 32,000 gpd flow and an estimated 480 gallons of sludge produced a day, a sludge holding tank of 5,890 gallons of total volume is designed to be able to retain 12.3 days of sludge for the WWTW with a sludge concentration of 1%. However, a more conservative sludge-pumping schedule will be issued to be able to monitor the sludge production in the early stages after WWTW startup.

Pat's at Punalu'u will contract local pump companies to extract and haul away sludge from the sludge holding tank to the closest wastewater treatment plant based on the 12.3-day retention availability. A 10-day sludge pump schedule will be adopted to begin.

8. CONTROLS AND INSTRUMENTATION

The MSFBS supplier shall furnish a control system. The system shall include local control stations, motor starters, control switches, relays, and pilot lights. Control Panels shall be free standing, NEMA 4 enclosures. The panels shall be UL approved. Mounting pad and stand shall be the responsibility of the Installing Contractor. Motor starters shall be 120/208V/3Ph/60Hz power shall be provided.

See Attachment 11.3 Aquarius Technologies: Nebula Multistage Biofilm System Drawings for additional details and a Controls & Instrumentation diagram.

9. OPERATIONS AND MAINTENANCE

Four (4) O&M manuals and one (1) electronic O&M manual shall be furnished during start-up. The manuals shall include installation, operation and maintenance instructions for all equipment provided. For WWTW startup, field personnel from Aquarius will perform a functional check of each item furnished and start-up of the process. During this time, the field representative will provide operation training, which shall include familiarization with the MSFBS process, and review of the O&M manuals. The MSFBS supplier to assist with the process start-up will provide one (1) two-month supply of microorganisms for seeding the plant.

10. REFERENCES

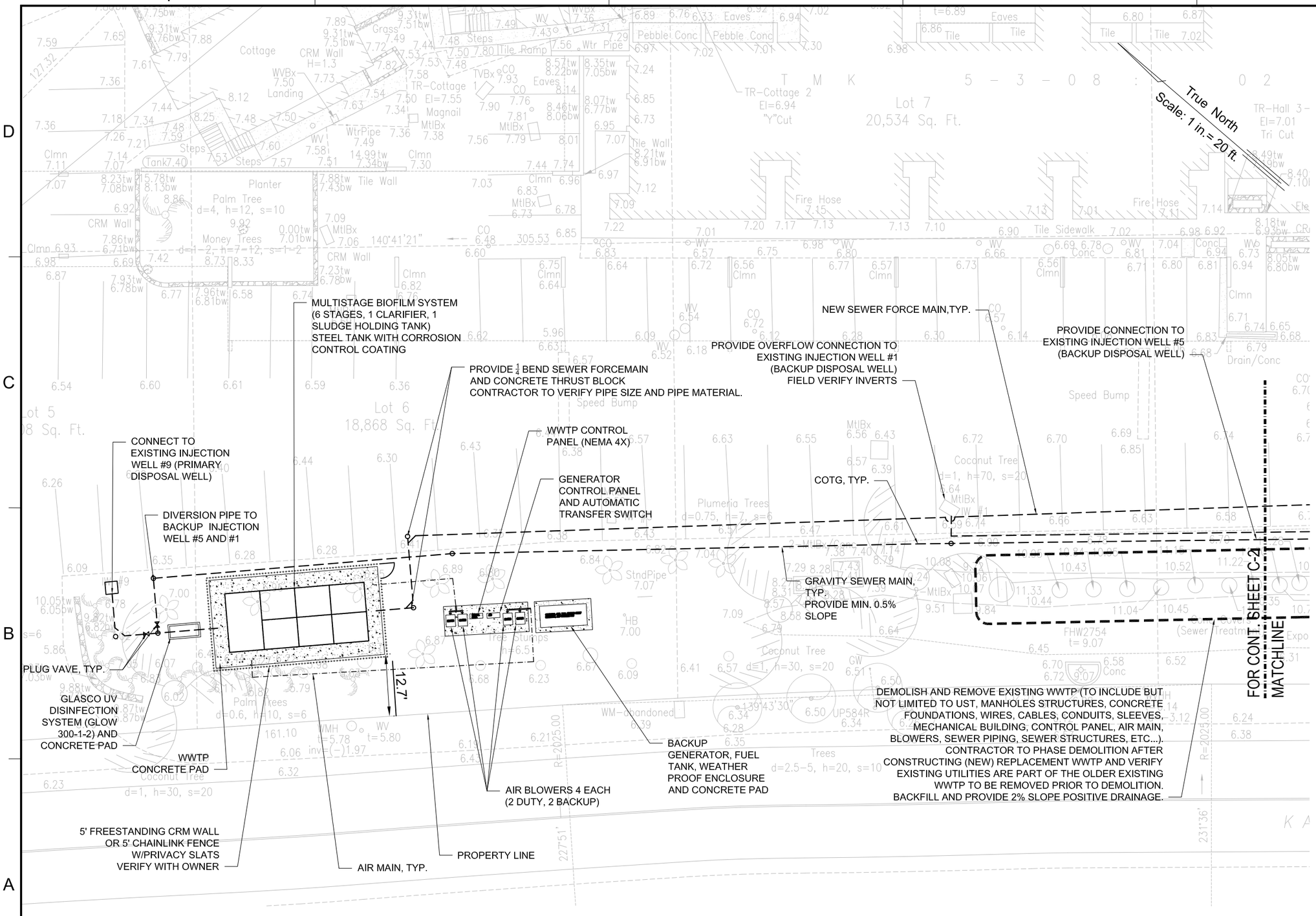
"Hawaiʻi Administrative Rules", Department of Health, Chapter 62 of Title 11, Wastewater Systems, State of Hawaiʻi, dated March 21, 2016 (hereafter called "HAR 11-62").

"Onsite Wastewater Treatment Systems Manual", Office of Water, Office of Research and Development, U.S. Environmental Protection Agency, dated February 2002 (hereafter called "EPA OWTSM").

County of Kauaʻi Real Property Assessment & Collection Divisions. (2011) "http://qpublic9.qpublic.net/qpmap4/map.php?county=hi_Kauaʻi&layers=parcels+esriBaseMap&mapmode"

11 ATTACHMENTS

11.1 General Layout Plan



GENERAL SITE PLAN- NORTH

20' 0 20' 40'

GRAPHIC SCALE

HORIZONTAL: 1" = 20'

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC

LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealc.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE — EXP. DATE APRIL 30, 2020

PAT'S AT PUNALU'U WWTW REPLACEMENT
53-567 KAMEHAMEHA HWY
HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: GENERAL SITE PLAN

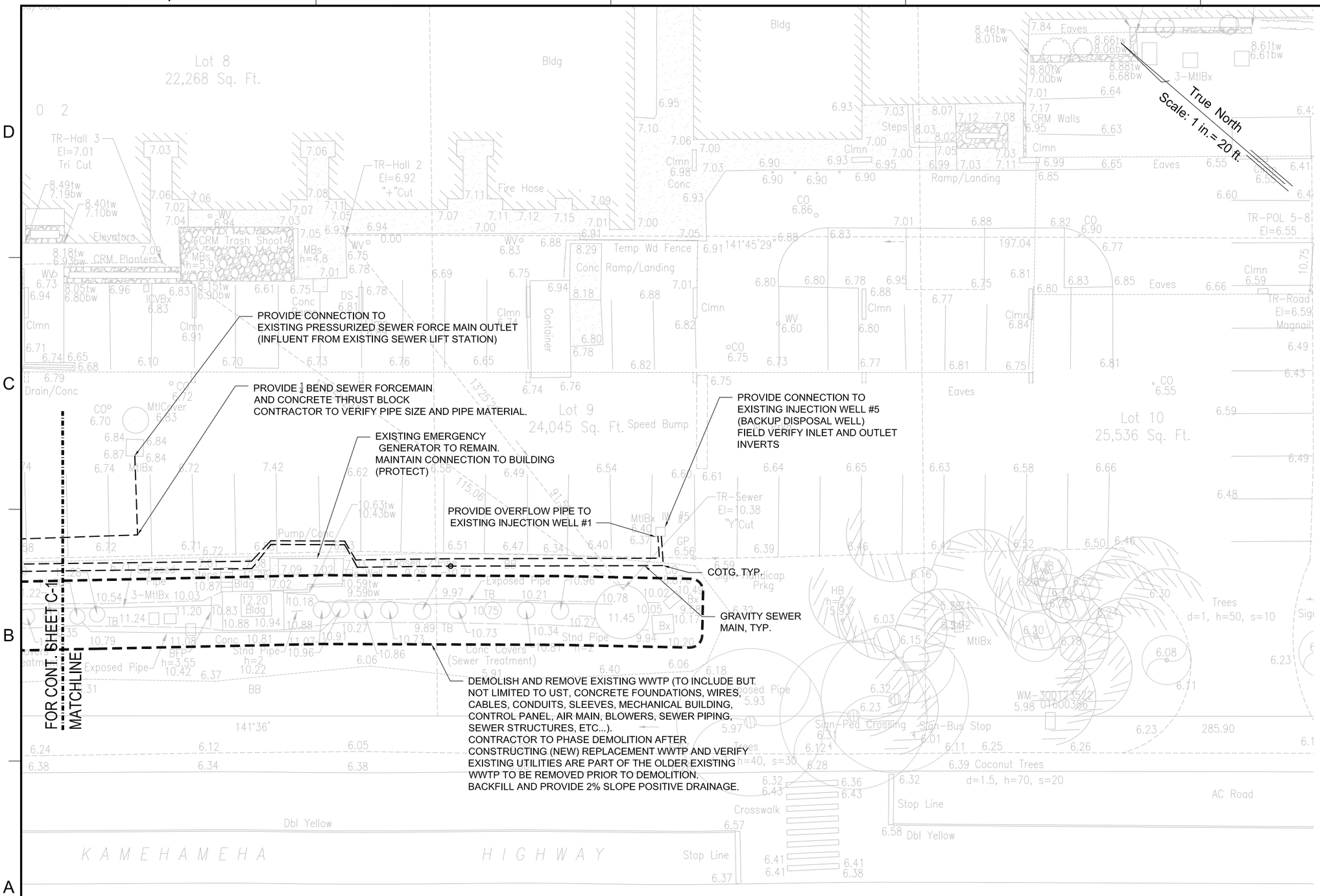
www.laulealc.com

SCALE: 1" = 30'

PROJECT NO.

C-1

60% SUBMITTAL MARCH 2020
NOT FOR CONSTRUCTION



GENERAL SITE PLAN- SOUTH

20' 0 20' 40'

GRAPHIC SCALE

HORIZONTAL: 1" = 20'

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC

LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealc.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE — APRIL 30, 2020 EXP. DATE

PAT'S AT PUNALU'U WWTW REPLACEMENT
53-567 KAMEHAMEHA HWY
HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: GENERAL SITE PLAN

www.laulealc.com

SCALE: 1" = 30'

PROJECT NO.

C-2

60% SUBMITTAL MARCH 2020
NOT FOR CONSTRUCTION

11.2 Aquarius Technologies: Nebula Multistage Biofilm System Preliminary Design/Equipment Summary

Consists of the following:

- Design/Equipment Summary
    - Estimated lead time
    - Budget Pricing (Cost only for materials/equipment, construction/installation not included)
- Aquarius Process Design Summary
- Aquarius Fine Bubble Aeration Design
- Aquarius Sludge Holding Tank Aeration Design
- Aquarius Preliminary Drawing
- Brochure

NEBULA™ MULTISTAGE BIOFILM SYSTEM

PRELIMINARY DESIGN / EQUIPMENT SUMMARY

Pat's at Punalu'u WWTP

Oahu, HI

Aquarius Project Number

6563-19

November 20, 2019

NEBULA™ MULTISTAGE BIOFILM SYSTEM EQUIPMENT SUMMARY

Project Name:	Pat's at Punalu'u WWTP	**Date:**	November 20, 2019
Project Location:	Oahu, HI	**Project No:**	6563-19

The **Equipment Summary** is an integral part of the **Process Design Summary** for the referenced project.

Aquarius Technologies, LLC (Aquarius) is submitting the following proposal and attachments for the supply of a Nebula™ MultiStage Biofilm System to meet the referenced specification sections as specified unless otherwise noted.

The following equipment will be provided for installation by the Installing Contractor:

Nebula™ MultiStage Biofilm System

Painted Steel Tank		
Qty	Unit	Description
1	Ea.	Design and furnish a painted steel Nebula Biofilm Treatment System.
		The tank shall be 28.5 ft long by 12 ft wide by 12 ft high including process tank and clarification (settler) tank, sludge storage tank, and stage walls and wall ports.
		Influent, and effluent connection are included.
		The tank shall be epoxy coated steel.
		The tank shall be covered with walkable and removable grating for UV protection of the biofilm media and access.
		Handrails and kickplates will be provided around the periphery of the tank.

Biofilm Media Racks		
Qty	Unit	Description
6	Ea.	Media racks shall be designed to support the media within the rack and allow for separation of each sheet. Racks shall be 304 SS with lifting lugs and 304 SS hardware.
		Geotextile media sheets attached to mounting bars and hardware for field installation are included.
		Media rack covers are included.
		Media racks shall be installed prior to shipment of the tank.
		Anchors if required shall be 316 SS.

Quantaer™ Fine Bubble Aeration System		
Qty	Unit	Description
1	Lot.	An isolation valve shall be supplied loose for each aeration stage for installation in the aeration piping (By Others).
		Aeration grids shall include 304 SS dropleg, PVC aeration manifold, and PVC diffuser holders and air distribution piping.

		EPDM (low pressure) membrane diffusers 9 in diameter with integral O-ring are included.
		Diffusers shall be attached to the media rack and shall be installed prior to shipment.

Nebula Aeration Blowers

Rotary Lobe Blower Package		
Qty	Unit	Description
2	Ea.	Blowers shall be capable of a peak airflow of 106 scfm at 4.83 psig.
		7.5 HP motor, TEFC, 230/460/3Ph/60Hz. Motors shall be VFD ready.
		Blowers shall ship fully assembled and finish painted.
1	Lot	Spare parts consisting of (2) air filters.

Clarification / Settler

Settler		
Qty	Unit	Description
1	Lot.	Settler basin components including slide gate, stilling baffle wall, effluent trough and weir assembly

Solids Holding Tank Aeration Blowers

Rotary Lobe Blower Package		
Qty	Unit	Description
2	Ea.	Blowers shall be capable of an airflow range of 19 scfm at 4.79 psig.
		2 HP motor, TEFC, 230/460/3Ph/60Hz. Motors shall be VFD ready.
		Blowers shall ship fully assembled and finish painted.
		Sound enclosures constructed of Aluminum.
1	Lot	Spare parts consisting of (2) air filters.

Controls / Instrumentation

Master Control Panel		
Qty	Unit	Description
1	Ea.	NEMA 4X 460V/3Ph/60Hz panel including PLC, VFDs for the process blowers, VFDs for the digester blower, and HOA lights and switches
		Master control panel shipped loose for mounting and installation by Others.

Instrumentation		
Qty	Unit	Description
1	Ea.	Dissolved Oxygen Probe

Blower/Controls Shared Enclosure

Master Control Panel		
Qty	Unit	Description
1	Ea.	Sound enclosure capable of housing all 4 blowers and control panel.
		Sound enclosure shall be rated for 55 dB(A).
		Sound enclosure shall be manufactured of powder coated steel.

Start Up Supervision, Operation & Maintenance Manuals, Freight

Start Up		
Qty	Unit	Description
4	Days	Installation and start up supervision
2	Trips	
		Additional startup supervision can be provided at $950/day plus travel and living expenses.

O&M Manuals		
Qty	Unit	Description
1	Lot	Operation & Maintenance Manuals

Freight		
Qty	Unit	Description
1	Lot	FOB Saukville, WI freight Prepay and Add

PROPOSAL DOES NOT INCLUDE

- All items not specifically noted above shall be “BY OTHERS”.
- Installation site work including unloading, handling, storage and field installation of equipment.
- Concrete Tank equipment pads for blowers / control panels if required
- Painted Steel Tank influent, effluent (sludge) piping to and from the tank
- Air piping from blower discharge to aeration piping at tank
- Drop pipe valves, gaskets, bolts and nuts for connecting drop pipes to the air main
- Pressure gages, pipe taps for field performance testing.
- Interconnecting wiring and conduit for all controls and electrical components
- Interconnecting piping from aerobic digester telescoping valve to aeration basin if required
- Sampling and laboratory testing to demonstrate performance
- Bonding, tariffs, permits, taxes or liquidated damages
- Operational, structural, wind or seismic calculations
- Custom designed products, controls or system integration

PRICING NOTES

- Budget pricing is based on January 2018 Steel Costs. At this time and due to the instability of the effects of the 9404 Aluminum and 9405 Steel Imports Proclamations effective March 23, 2018, firm pricing for these materials cannot be provided.

- Section 301 China Tariff implementation if enacted will be subject to the same terms and conditions as those outlined for aluminum and steel.

Project Schedule

Submittals		
Qty	Unit	Description
4-8	Weeks	Engineering Submittal Transmittal: After Order Acceptance

Release to Manufacturer		
Qty	Unit	Description
2	Weeks	Submittals Approved: After Submittal Transmittal

Shipment		
Qty	Unit	Description
14-16	Weeks	After Approval of Submittals and Release to Manufacturer

ATTACHMENTS

- Aquarius Preliminary Design Summary
- Aquarius Fine Bubble Aeration Design
- Aquarius Sludge Holding Tank Aeration Design
- Aquarius Preliminary Drawing
- Brochure

Pricing

The price for the equipment described above, **FOB Factory** is listed below

ITEM	PRICE (US$)
1. Nebula MultiStage Biofilm System	$ 478,050
2. Equipment Startup	$ 21,050
3. Freight	**Not Included in Total Price**
TOTAL BUDGET PRICING	**$ 499,100**

An estimated freight cost of **$55,000** for shipment of equipment to the jobsite is provided for reference. Freight costs are provided for budgetary purposes. Actual freight costs will be charged at time of shipment. Shipments shall be F.O.B. Jobsite, freight prepaid and add.

Closing and Contacts

Thank you for your consideration of Aquarius for the subject project. Should you have any questions, please contact us or our local representative listed below.

Sincerely,

Ian Arndt
Process Engineer
P: 262.284.0131
iarndt@aquariustechnologies.com

NEBULA™ MULTISTAGE BIOFILM SYSTEM PRELIMINARY DESIGN

Project Name:	Pat's at Punalu'u WWTP	**Date:**	November 20, 2019
Project Location	Oahu, HI	**Project No:**	6563-19

Design Notes

The **Process Design Summary** is an integral part of the **Equipment Summary** for the referenced project. Aquarius Technologies utilizes Customer Data and industry standard design assumptions to assure a comprehensive solution is developed and delivered. Please refer to the following Design Notes for assumptions and Basis of Design.

Pre-Treatment Process

Screening
▪ A coarse bar screen and grit removal is recommended prior to the fine screen
▪ A minimum mechanical fine screen with 2 mm openings and provisions for collection of screened materials is required if the wastewater to the Nebula Treatment System contains material that could potentially obstruct the biofilm media. (Washing of screenings provides usable organic material and minimizes odors.) (By Others)
pH Adjustment
▪ Neutralization is recommended/required prior to the Nebula Treatment System if the pH is less than or greater 6.5 – 8.5 for significant durations.
Fats, Oils, and Grease
▪ Fats, Oils, and Grease removal is required prior to the Nebula Treatment System for flows containing greater than 40 mg/L of FOG.
Other Miscellaneous Notes
▪ Elevated concentrations of Hydrogen Sulfide can be detrimental to both civil and mechanical structures. If anaerobic conditions exist in the collection system, elimination of Hydrogen Sulfide prior to treatment is required.

Influent

Flow
▪ The maximum flow, unless otherwise stated is assumed to be a hydraulic maximum and does not represent an additional organic load.

Process Design

Organic Loading
▪ The loadings to the Nebula Treatment System are assumed to be design influent conditions after all proceeding unit process.
▪ Based on the influent conditions provided no reduction in Total Suspended Solids (TSS) or Biological Oxygen Demand (BOD_5) has been taken into consideration in the process design due to screening or other pre-treatment unit processes.

▪ COD has not been given. For typical domestic wastewater a factor of 2.2 has been utilized for design purposes.
▪ A ratio of 100 mg/L BOD_5:5 mg/L NH_3N:1 mg/L P is required as a nutrient for cell growth.
▪ Flow data was not provided. A 1.5x peaking factor for organic and nitrogen loading has been utilized for design purposes.
Nitrification
▪ The system is designed to meet the Ammonia Nitrogen (NH_3N) effluent limit at 10˚ C. While lower temperatures may be acceptable for short durations, nitrification and denitrification below 10˚ C is unpredictable and requires close operator attention.
▪ Sufficient alkalinity is required for nitrification. Approximately 7.1 mg/L alkalinity as Calcium Carbonate ($CaCO_3$) is required for every 1 mg/L of Ammonia Nitrogen (NH_3N) nitrified. In the event, the raw wastewater cannot support this requirement while maintaining a minimum residual concentration of 50 mg/l, supplemental alkalinity shall be provided. (By Others)
Biofilm Media Design
▪ Biofilm media loading rates for COD, BOD_5 and NH_3N agree with published rates and have been utilized for design purposes. The design values provided are also based on empirical data collected from operating systems.
Aeration/Mixing System Design
▪ The aeration system has been designed to provide 1.4 lbs O_2/lb BOD_5 and 4.6 lbs O_2/lb of Total Kjeldahl Nitrogen (TKN) applied at the design loading conditions.
▪ The aeration system is designed to provide process oxygen, mixing and periodic air scouring within each treatment stage.
Clarifier/Settler Design
▪ The Clarifier will receive biologically treated wastewater and periodically sloughed biomass from the last Stage of the Nebula Treatment System.
▪ The sludge concentration is assumed to settle and compact to 1.0% solids (10,000 mg/l).
▪ Biological solids from the Clarifier / Settling basin shall be wasted to the sludge storage tank.
Biological Sludge Production
▪ Sludge production is based on design flow and average organic loading conditions.

Equipment

▪ The process is designed to operate as a plug flow system with an over/under flow distribution pattern through flow control wall ports.
▪ Influent is assumed to enter at the top of the tank in a 90˚ elbow.
▪ Tank design is based on 1.5 ft of freeboard.
▪ All dimensions are based on a painted steel package plant.
▪ Where aeration is designed for mixing only, .25 scfm/ft2 has been utilized.
▪ The Clarifier/Settler includes a baffle to direct the flow downwards to assist with solids settling.
▪ Clarification/Settling basin is required.
▪ Settler shall include an integral hopper bottom for capture of sloughed biomass and TSS.

NEBULA™ MULTISTAGE BIOFILM SYSTEM
Process Design Summary

Project Name:	Pats at Punaluu	**Engineer:**	Laulea LLC
Project Locatio	Hauula, HI	**Rep:**	
Proposal No.:	6563-19	**Bid Date:**	

Thank you for your interest in the Aquarius NEBULA™ MultiStage Biofilm System.

The influent and effluent parameters for the process are as follows:

Influent/Effluent Parameters	Design Influent		Design Effluent	
COD	660	mg/L		mg/L
BOD5 - Average Conc.	300	mg/L	30	mg/L
TSS - Average Conc.	300	mg/L	30	mg/L
TKN - Average Conc.	39.2	mg/L		mg/L
NH3 - Average Conc.	28	mg/L	1	mg/L
Total Nitrogen (TN)	--	mg/L		mg/L
Total Inorganic Nitrogen (TIN)	--	mg/L		mg/L
Total Phosphorus (TP)	8	mg/L		mg/L
Fats, Oils, Grease (FOG)	40	mg/L		mg/L
Alkalinity as CaCO3	300	mg/L		mg/L
pH	7	S.U.	7	S.U.

The process is designed with the following flows and site conditions:

Process Flows & Site Conditions	US Units		Metric Units	
Max Month Flow - MMF	0.032	MGD	121	m^3/day
Peak Daily Flow - PDF	0.043	MGD	163	m^3/day
Site Elevation, Altitude amsl	6	ft	2	m
Min. Temperature (ww)	68	°F	20	°C
Max. Temperature (ww)	68	°F	20	°C
Min. Temperature (air)	64	°F	18	°C
Max. Temperature (air)	84	°F	29	°C

The system loadings are as follows:

System Loadings	Max Monthly		Max Daily	
COD	176.1	lb/day	236.7	lb/day
BOD5	80.1	lb/day	107.6	lb/day
TSS	80.1	lb/day	107.6	lb/day
TKN	10.5	lb/day	14.1	lb/day
NH3	7.5	lb/day	10.0	lb/day
TP	2.1	lb/day	2.9	lb/day

NEBULA™ MULTISTAGE BIOFILM SYSTEM
Process Design Summary

Project Name:	Pats at Punaluu	**Engineer:**	Laulea LLC
Project Locatio	Hauula, HI	**Rep:**	
Proposal No.:	6563-19	**Bid Date:**	

The treatment system will have the following dimensions.

Basin Design	US Units		Metric Units	
No. of Treatment Basins	1	basins	1	basins
Treatment Basin Width	12.0	ft	3.66	m
Treatment Basin Length	18.8	ft	1.91	m
Design Side Water Depth	10.5	ft	3.20	m
No. of Stages per Basin	6	stages	6	stages
Stage Width	6.0	ft	1.83	m
Stage Length	6.3	ft	1.91	m
Volume per Basin	2,363	ft^3	67	m^3
(	17,672	gal)		
Total System Volume	2,363	ft^3	67	m^3
(	17,672	gal)		

The treatment process design will have the following parameters.

Process Design	US Units		Metric Units	
Treatment System HRT at MMF	13	hr	13	hr
Organic Loading Rate	34	$lb/1000ft^3/day$	0.54	$kg/m^3/day$
Average AOR	160.2	lb O_2/day	72.7	kg O_2/day
Maximum AOR	240.3	lb O_2/day	109.0	kg O_2/day

The following table is a summary of the Clarifier(s) Dimensions:

Clarifier Design	US Units		Metric Units	
No. of Clarifiers	1	clarifiers	1	clarifiers
Clarifier Width	12.00	ft	3.66	m
Clarifier Length	3.50	ft	1.07	m
Clarifier Side Water Depth	10.50	ft	3.20	m
Clarifier Surface Area	42.00	ft^2	3.90	m^2
Design Surface Overflow Rate at MMF Flow	800.00	gpd/ft^2		
Design Surface Overflow Rate at PDF Flow	1,200.00	gpd/ft^3		

NEBULA™ MULTISTAGE BIOFILM SYSTEM
Process Design Summary

Project Name:	Pats at Punaluu	**Engineer:**	Laulea LLC
Project Locatio	Hauula, HI	**Rep:**	
Proposal No.:	6563-19	**Bid Date:**	

The following table is a summary of the Sludge Holding Tank's Dimensions:

Sludge Holding Tank Design	US Units		Metric Units	
Number of Sludge Holding Tanks	1	tanks		
Tank Width	12.0	ft		
Tank Length	6.3	ft		
Tank Side Water Depth	10.5	ft		
Sludge Holding Time	12.3	days		
Sludge Holding Volume	787.5	ft^3		
(	5890.5	gal)		

Biological Sludge Production Analysis for MultiStage Biofilm System vs. Suspended Growth

The multiple stages of biofilm creates a plug flow pattern and a food chain of microbes to reduce biological solids.
A biological sludge production comparison for the MultiStage Biofilm System and a Suspended Growth Process follows:

Parameter	Biofilm	Suspended	Units	Notes
Max. Month Flow - MMF	0.032	0.032	MGD	
BOD5 - Loading	80	80	lb/day	
TSS - Loading	80	80	lb/day	
Aerobic Yield Coefficient	0.5	0.7	lbs TSS/lb BOD	
Daily Sludge Production	**40**	**56**	**lbs TSS/day**	
Daily Sludge Production Diff. (lbs)	**29%**			
Equivalent TSS Conc For Sludge at MMF	150	3,210	mg/L	
Compaction Factor	143	3		
Estimated Sludge Conc. After Settling	10,000	10,000	mg/L	Assumption
Vol. of Settled Sludge in Clarifier(s)	**480**	**672**	**gal/day**	
Daily Sludge Production Diff. (gal)	**29%**			

Low Pressure Membrane Disc Fine Bubble

Diffused Aeration System Design

for

Pat's at Panuluu

Nebula

Consulting Engineer : Laulea

Aquarius Project Number 6563-19

November 20, 2019

The enclosed Aeration System Design is based on preliminary data received and does not reflect a fully designed project. These recommendations are based on models and assumptions widely utilized in the industry, however, Aquarius Technologies, LLC assumes no responsibility for the validity or risk associated with their use. Adequate project information is required to assist in the development of a fully designed solution. The pricing provided is for information only and not intended to convey an offer to sell.

Aeration System Design Parameters

Project Information

Project Name:	**Pat's at Panuluu**
Aquarius Project Number:	**6563-19**
Tank or Process Label:	**Nebula**
Client Engineer:	**Laulea**
Number Design Conditions:	**2**
Total Number Process Trains:	**1**
Number Passes Per Process Train:	**6**
Diffuser Model:	**Low Pressure Membrane Disc Fine Bubble**

Tank Dimensions

	Dim	Common						
Pass Number			**1**	**2**	**3**	**4**	**5**	**6**
Length	ft	6.25	6.25	6.25	6.25	6.25	6.25	6.25
Width	ft	6	6	6	6	6	6	6
Water Depth	ft	10.5	10.5	10.5	10.5	10.5	10.5	10.5
Volume	ft3/tank		393.75	393.75	393.75	393.75	393.75	393.75
Surface Area	ft2/tank		37.5	37.5	37.5	37.5	37.5	37.5
Parallel Passes in each train			1	1	1	1	1	1
Number Taper Zones in pass			1	1	1	1	1	1
Train Volume	KCF/train	2.3625						
Train Surface Area	ft2/train	225						

Design Conditions (Given)

Condition Label			**Avg AOR**	**Max AOR**
Number Trains in Operation			1	1
Design Safety Factor	%			
Diffuser submergence	ft	9.75	9.75	9.75
Plant Elevation	ft	6		
Plant Carbonaceous Loading	lb-CBOD5/d			
Plant Autotrophic Loading	lb-N/d			
Carbonaceous Oxidation Coefficient	O2/CBOD5			
Autotrophic Oxidation Coefficient	O2/N			
Carbonaceous Loading Rate	lb-CBOD5/d-KCF			
AOR	lb-O2/d		160	240
alpha			0.55	0.55
beta		0.99		
theta		1.024		
Water Temp.	deg.C		20	20
Operating D.O.	mg-O2/l		2	2
SOR	lb-O2/d			
Air Rate	SCFM			
Design Conditions (Evaluated)				
C*sc	mg-O2/l		10.02	10.02
Ct	mg-O2/l		9.14	9.14
C20	mg-O2/l		9.14	9.14
Ambient Pressure	Psia	14.73		
AOR/SOR			0.435	0.435

Aeration System Layout

ITEM	Dimension	Common or Total						
GRID LAYOUT								
Pass Number			**1**	**2**	**3**	**4**	**5**	**6**
Zone			**1**	**2**	**3**	**4**	**5**	**6**
Grid Number			**1**	**2**	**3**	**4**	**5**	**6**
Zone Length	ft		6.25	6.25	6.25	6.25	6.25	6.25
Zone Width	ft		6.00	6.00	6.00	6.00	6.00	6.00
Zone Volume	ft3/zone/tank		394	394	394	394	394	394
Zone Surface Area	ft2/zone/tank		38	38	38	38	38	38
Parallel Passes in Each Train			1	1	1	1	1	1
Train Volume	KCF/train	2.3625						
Train Surface Area	ft2/train	225						
Mark with "X" if unaerated								
Orifice Diameter (13/64 is std.)	inch	**1/4**						
Design Fraction Avg. SOTR			100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Number Grids/tank/zone			**1**	**1**	**1**	**1**	**1**	**1**
Grid Length	ft		6.3	6.3	6.3	6.3	6.3	6.3
Inlet Temp	deg.F	112						
Compression Factor		0.829						
Max Drop Velocity @ 3 SCFM/disc	fps	50						
Required Dropleg Diameter	**in**		**4**	**4**	**4**	**4**	**4**	**4**
Dropleg Velocity	ft/s		4.3	4.3	4.3	4.3	4.3	4.3
GRID DETAIL								
Dist. Parallel with Length (L) or Width (W) of tank?			L	L	L	L	L	L
Manifold at End (E) or Center (C) of distributors?			E	E	E	E	E	E
Dropleg at End (E) or Center (C) of Manifold?			E	E	E	E	E	E
Max Discs/dist			5	5	5	5	5	5
Min Discs/dist			2	2	2	2	2	2
Max Distributors/Grid			4	4	4	4	4	4
Min Distributors/Grid			2	2	2	2	2	2
Design Number Discs/Distributor			3	3	3	3	3	3
Design Number Distributors			3	3	3	3	3	3
Design Discs/Grid			9	9	9	9	9	9
Design Density			9.8%	9.8%	9.8%	9.8%	9.8%	9.8%
Design At/Ad			10.16	10.16	10.16	10.16	10.16	10.16
Diffusers/Train		54	9	9	9	9	9	9
Distributor Spacing	ft		1.33	1.33	1.33	1.33	1.33	1.33
Disc Spacing	ft		2.46	2.46	2.46	2.46	2.46	2.46

Aeration Performance Table

CONDITION:	Dimension	Common	Avg AOR	Max AOR
OVERALL SUMMARY				
Total Number Diffusers in Plant		54		
Total Number Grids in Plant		6		
Number Trains in Operation			1	1
Total Aerated Volume	ft3		2,363	2,363
Total AOR	lbs-O2/plant-d		160	240
AOR/SOR			0.435	0.435
Total SOR	lbs-O2/plant-d		368	552
Total Air Rate	SCFM/plant		66	106
Diffuser Air Rate	SCFM/diff		Variable	Variable
SOTE			22.16%	20.81%
Max Dropleg Pressure	Psig		4.53	4.53
Est. Blower Pressure	Psig		4.83	4.83
Est. Blower Efficiency		0.7		
Est. Blower Power	BHP		1.8	2.9
Est. Motor Load	KW		1.5	2.3
Est. SAE	lbs-O2/KWH		10.6	9.9
Oxygen Transfer Safety Factor		0.0%		
Pass 1, Zone 1 - Grid 1				
1 tank(s)/pass/train, 1 grid(s)/tank, 1 grid(s)/train, 1 grid(s) total, 4 inch dropleg.				
Sub-total Operating Volume	ft3/zone		394	394
Number Grids in Operation			1	1
Diffuser Floor Density		9.8%		
Number Diffusers in Operation			9	9
Diffuser Air Rate	SCFM/diff		1.228	1.961
Surface Mixing Rate	SCFM/ft2			
Sub-Total Air Rate	SCFM/zone		11	18
SOTE			22.16%	20.81%
Sub-total SOR	lbs-O2/d-zone		61	92
SOTR	mg-O2/l-h		103.9	155.8
Diffuser Headloss	in-water		6.3	8.4
Dropleg Pressure	Psig		4.45	4.53
Pass 2, Zone 2 - Grid 2				
1 tank(s)/pass/train, 1 grid(s)/tank, 1 grid(s)/train, 1 grid(s) total, 4 inch dropleg.				
Sub-total Operating Volume	ft3/zone		394	394
Number Grids in Operation			1	1
Diffuser Floor Density		9.8%		
Number Diffusers in Operation			9	9
Diffuser Air Rate	SCFM/diff		1.228	1.961
Surface Mixing Rate	SCFM/ft2			
Sub-Total Air Rate	SCFM/zone		11	18
SOTE			22.16%	20.81%
Sub-total SOR	lbs-O2/d-zone		61	92
SOTR	mg-O2/l-h		103.9	155.8
Diffuser Headloss	in-water		6.3	8.4
Dropleg Pressure	Psig		4.45	4.53

Aeration Performance Table

CONDITION:	Dimension	Common	Avg AOR	Max AOR
Pass 3, Zone 3 - Grid 3				
1 tank(s)/pass/train, 1 grid(s)/tank, 1 grid(s)/train, 1 grid(s) total, 4 inch dropleg.				
Sub-total Operating Volume	ft3/zone		394	394
Number Grids in Operation			1	1
Diffuser Floor Density		9.8%		
Number Diffusers in Operation			9	9
Diffuser Air Rate	SCFM/diff		1.228	1.961
Surface Mixing Rate	SCFM/ft2			
Sub-Total Air Rate	SCFM/zone		11	18
SOTE			22.16%	20.81%
Sub-total SOR	lbs-O2/d-zone		61	92
SOTR	mg-O2/l-h		103.9	155.8
Diffuser Headloss	in-water		6.3	8.4
Dropleg Pressure	Psig		4.45	4.53
Pass 4, Zone 4 - Grid 4				
1 tank(s)/pass/train, 1 grid(s)/tank, 1 grid(s)/train, 1 grid(s) total, 4 inch dropleg.				
Sub-total Operating Volume	ft3/zone		394	394
Number Grids in Operation			1	1
Diffuser Floor Density		9.8%		
Number Diffusers in Operation			9	9
Diffuser Air Rate	SCFM/diff		1.228	1.961
Surface Mixing Rate	SCFM/ft2			
Sub-Total Air Rate	SCFM/zone		11	18
SOTE			22.16%	20.81%
Sub-total SOR	lbs-O2/d-zone		61	92
SOTR	mg-O2/l-h		103.9	155.8
Diffuser Headloss	in-water		6.3	8.4
Dropleg Pressure	Psig		4.45	4.53
Pass 5, Zone 5 - Grid 5				
1 tank(s)/pass/train, 1 grid(s)/tank, 1 grid(s)/train, 1 grid(s) total, 4 inch dropleg.				
Sub-total Operating Volume	ft3/zone		394	394
Number Grids in Operation			1	1
Diffuser Floor Density		9.8%		
Number Diffusers in Operation			9	9
Diffuser Air Rate	SCFM/diff		1.228	1.961
Surface Mixing Rate	SCFM/ft2			
Sub-Total Air Rate	SCFM/zone		11	18
SOTE			22.16%	20.81%
Sub-total SOR	lbs-O2/d-zone		61	92
SOTR	mg-O2/l-h		103.9	155.8
Diffuser Headloss	in-water		6.3	8.4
Dropleg Pressure	Psig		4.45	4.53

Aeration Performance Table

CONDITION:	Dimension	Common	Avg AOR	Max AOR
Pass 6, Zone 6 - Grid 6				
1 tank(s)/pass/train, 1 grid(s)/tank, 1 grid(s)/train, 1 grid(s) total, 4 inch dropleg.				
Sub-total Operating Volume	ft3/zone		394	394
Number Grids in Operation			1	1
Diffuser Floor Density		9.8%		
Number Diffusers in Operation			9	9
Diffuser Air Rate	SCFM/diff		1.228	1.961
Surface Mixing Rate	SCFM/ft2			
Sub-Total Air Rate	SCFM/zone		11	18
SOTE			22.16%	20.81%
Sub-total SOR	lbs-O2/d-zone		61	92
SOTR	mg-O2/l-h		103.9	155.8
Diffuser Headloss	in-water		6.3	8.4
Dropleg Pressure	Psig		4.45	4.53

Low Pressure Membrane Disc Fine Bubble

Diffused Aeration System Design

for

Pat's on Punaluu

ASHT

Consulting Engineer : Laulea LLC

Aquarius Project Number 6563-19

November 20, 2019

The enclosed Aeration System Design is based on preliminary data received and does not reflect a fully designed project. These recommendations are based on models and assumptions widely utilized in the industry, however, Aquarius Technologies, LLC assumes no responsibility for the validity or risk associated with their use. Adequate project information is required to assist in the development of a fully designed solution. The pricing provided is for information only and not intended to convey an offer to sell.

Aeration System Design Parameters

Project Information

Project Name:	**Pat's on Punaluu**
Aquarius Project Number:	**6563-19**
Tank or Process Label:	**ASHT**
Client Engineer:	**Laulea LLC**
Number Design Conditions:	**1**
Total Number Process Trains:	**1**
Number Passes Per Process Train:	**1**
Diffuser Model:	**Low Pressure Membrane Disc Fine Bubble**

Tank Dimensions	**Dim**	**Common**	
Pass Number			**1**
Length	ft	12	12
Width	ft	6.25	6.25
Water Depth	ft	10.5	10.5
Volume	ft3/tank		787.5
Surface Area	ft2/tank		75
Parallel Passes in each train			1
Number Taper Zones in pass			1
Train Volume	KCF/train	0.7875	
Train Surface Area	ft2/train	75	
Design Conditions (Given)			
Condition Label			**.25 Scfm/sf**
Number Trains in Operation			1
Design Safety Factor	%		
Diffuser submergence	ft	9.75	9.75
Plant Elevation	ft	6	
Plant Carbonaceous Loading	lb-CBOD5/d		
Plant Autotrophic Loading	lb-N/d		
Carbonaceous Oxidation Coefficient	O2/CBOD5		
Autotrophic Oxidation Coefficient	O2/N		
Carbonaceous Loading Rate	lb-CBOD5/d-KCF		
AOR	lb-O2/d		
alpha			
beta		0.99	
theta		1.024	
Water Temp.	deg.C		
Operating D.O.	mg-O2/l		
SOR	lb-O2/d		
Air Rate	SCFM		19
Design Conditions (Evaluated)			
C*sc	mg-O2/l		10.02
Ct	mg-O2/l		
C20	mg-O2/l		9.14
Ambient Pressure	Psia	14.73	
AOR/SOR			

Aeration System Layout

ITEM	Dimension	Common or Total	
GRID LAYOUT			
Pass Number			**1**
Zone			**1**
Grid Number			**1**
Zone Length	ft		12.00
Zone Width	ft		6.25
Zone Volume	ft3/zone/tank		788
Zone Surface Area	ft2/zone/tank		75
Parallel Passes in Each Train			1
Train Volume	KCF/train	0.7875	
Train Surface Area	ft2/train	75	
Mark with "X" if unaerated			
Orifice Diameter (13/64 is std.)	inch	**1/4**	
Design Fraction Avg. SOTR			100.0%
Number Grids/tank/zone			**1**
Grid Length	ft		12.0
Inlet Temp	deg.F	112	
Compression Factor		0.829	
Max Drop Velocity @ 3 SCFM/disc	fps	50	
Required Dropleg Diameter	**in**		**4**
Dropleg Velocity	ft/s		8.7
GRID DETAIL			
Dist. Parallel with Length (L) or Width (W) of tank?			L
Manifold at End (E) or Center (C) of distributors?			E
Dropleg at End (E) or Center (C) of Manifold?			E
Max Discs/dist			11
Min Discs/dist			3
Max Distributors/Grid			4
Min Distributors/Grid			2
Design Number Discs/Distributor			4
Design Number Distributors			3
Design Discs/Grid			12
Design Density			6.6%
Design At/Ad			15.24
Diffusers/Train		12	12
Distributor Spacing	ft		1.42
Disc Spacing	ft		3.56

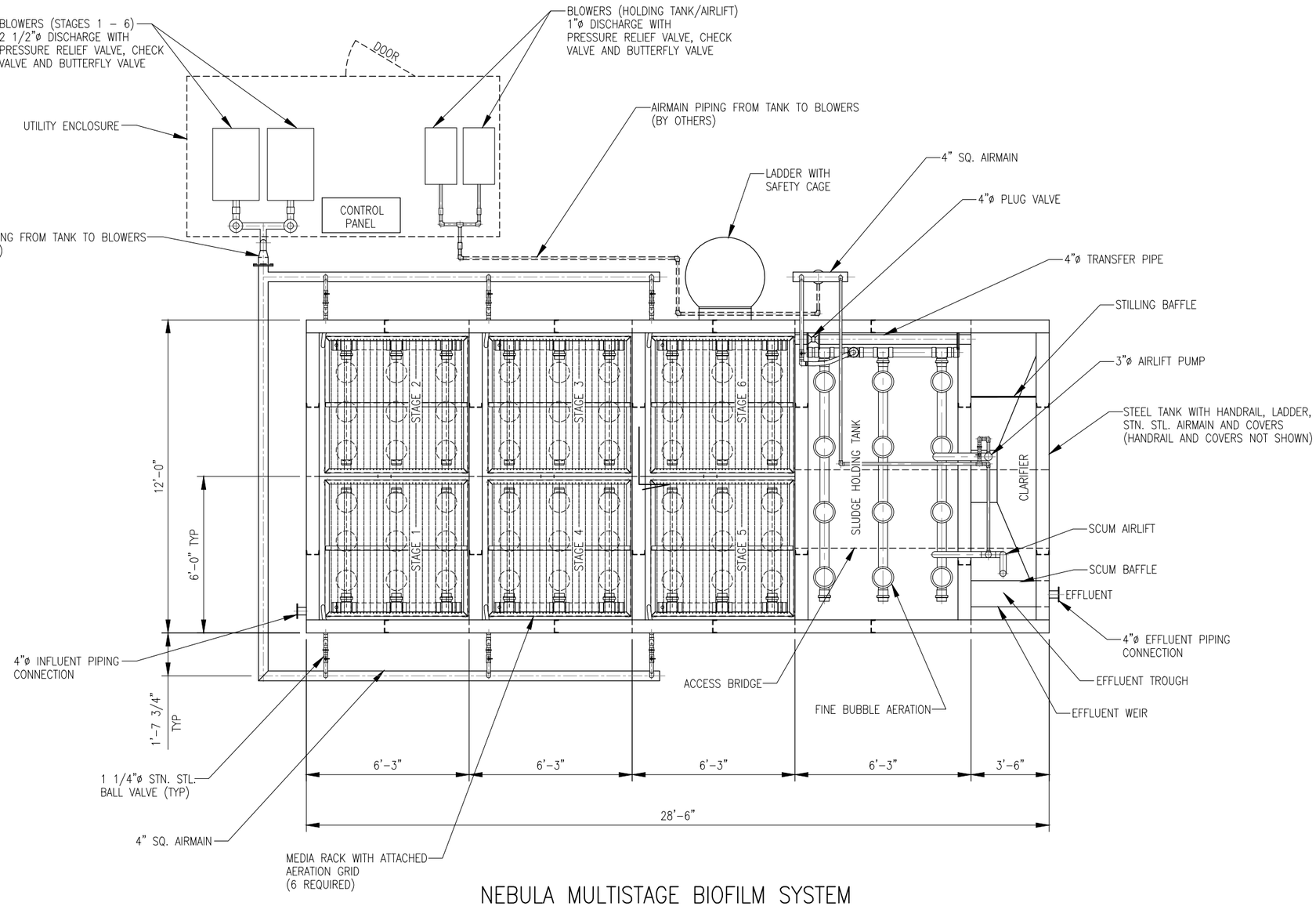
Aeration Performance Table

	Dimension	Common	
CONDITION:			.25 Scfm/sf
OVERALL SUMMARY			
Total Number Diffusers in Plant		12	
Total Number Grids in Plant		1	
Number Trains in Operation			1
Total Aerated Volume	ft3		788
Total AOR	lbs-O2/plant-d		
AOR/SOR			
Total SOR	lbs-O2/plant-d		98
Total Air Rate	SCFM/plant		19
Diffuser Air Rate	SCFM/diff		1.58
SOTE			20.68%
Max Dropleg Pressure	Psig		4.49
Est. Blower Pressure	Psig		4.79
Est. Blower Efficiency		0.7	
Est. Blower Power	BHP		0.5
Est. Motor Load	KW		0.4
Est. SAE	lbs-O2/KWH		9.9
Oxygen Transfer Safety Factor		0.0%	

Pass 1, Zone 1 - Grid 1

1 tank(s)/pass/train, 1 grid(s)/tank, 1 grid(s)/train, 1 grid(s) total, 4 inch dropleg.

Sub-total Operating Volume	ft3/zone		788
Number Grids in Operation			1
Diffuser Floor Density		6.6%	
Number Diffusers in Operation			12
Diffuser Air Rate	SCFM/diff		1.583
Surface Mixing Rate	SCFM/ft2		
Sub-Total Air Rate	SCFM/zone		19
SOTE			20.68%
Sub-total SOR	lbs-O2/d-zone		98
SOTR	mg-O2/l-h		83.3
Diffuser Headloss	in-water		7.2
Dropleg Pressure	Psig		4.49



NEBULA MULTISTAGE BIOFILM SYSTEM
WITH INTEGRAL SLUDGE HOLDING TANK
PLAN VIEW (1)

PATS AT PUNALUU
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NEBULA MULTISTAGE
BIOFILM SYSTEM
PLAN VIEW

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NEBULA™ MultiStage Biofilm System

THE PROCESS

The Nebula™ MultiStage Biofilm System is a proprietary process for treatment of municipal and industrial wastewater based on spatial separation of microbial populations fixed on a media surface. Multiple successive stages of biofilm media provide different microbial environments. Spatial separation of microbial populations and food sources create a highly efficient food chain within the biological process.

High food to microorganism (F/M) ratios create feast conditions in the first stages encouraging rapid growth of lower life forms.

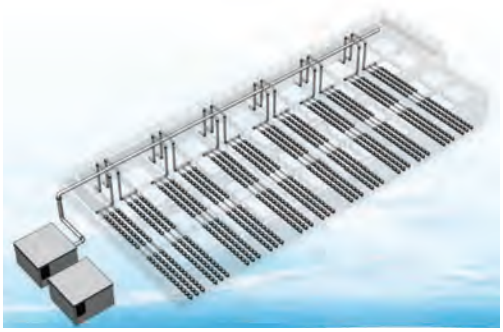
Low F/M ratios and famine conditions in later stages promote higher life forms that consume the lower life forms.

A plug flow system configuration with multiple stages reduces biological sludge up to 80% compared to suspended growth technology.

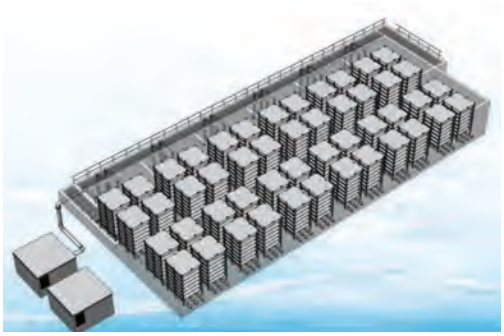
Fixed biofilm media can be added to an existing process to enhance removal efficiencies and achieve complete nitrification and denitrification.

Process Advantages

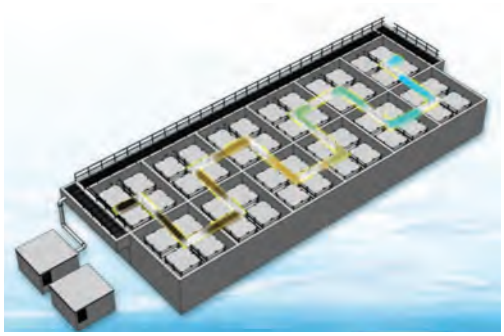
- Configurations Designed to Meet a Range of Biological Treatment Objectives
- Creation of a Microbial Food Chain Results in Low Biological Sludge Yield
- Sludge Minimization Saves on Costly Sludge Handling, Storage and Disposal
- High Density Fixed Biomass Tolerates Varying Organic and Hydraulic Loading Conditions
- Biomass Recycling is Eliminated for Most Applications



Quantaer™ Aeration System



Nebula Biofilm Media Racks



Nebula Flow Pattern

Nebula MultiStage Biofilm System Configurations

Nebula systems can be installed in concrete (poured or pre-cast), steel, or fiberglass tanks/basins. They can be designed as packaged, retrofits to existing, side stream treatment, and new treatment plant systems. The number of treatment stages and the most efficient system layout is created within the basin/tank (new or existing) by baffle walls to create plug flow conditions.

Applications range from pretreatment to secondary and nutrient removal treatment objectives.

Treatment Objectives	# of Treatments
Organic (cBOD) Removal	2 or More
Ammonia (NH3-N) Removal	2 or More
Total Nitrogen Removal	2 or More + Anoxic Stages
Reducing Biological Sludge	8 to 12

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THE SYSTEM

The Nebula System includes:

- Proprietary Biofilm Media and Media Racks
- Biofilm Media Pre-assembled on Racks (Package Systems)
- Diffused Aeration System
- Aeration Blowers
- Controls and Instrumentation
- Clarifier (Integral or Independent)

Every system includes a process operating strategy and an essential biofilm media and aeration system designed to ensure a successful installation.

Why a MultiStage Biofilm System is a Smart Choice

- Lowest Cost of Ownership
- Sludge Minimization Saves on Costly Sludge Handling, Storage and Disposal Costs
- Compact Footprint Due to Higher Surface Loading Rates
- Simple Operation with No Internal Moving Parts
- Energy-Efficient Diffused Aeration Systems
- Control Systems Designed with the Operator in Mind
- Proven Technologies
- Complete Package Treatment Systems to Meet Industrial or Municipal Treatment Objectives

The Nebula™ Biofilm Media/Media Rack

Successful fixed biofilm systems depend on the design of the media and media support rack.

Our chemically resistant, highly-durable, hydrophilic textile media provides more surface area than other types of fixed submerged media available.

Steel support racks provide the framework to vertically attach the media, which has demonstrated a lifespan of over 10 years without replacement.

The Quantaer™ Aeration System

Diffused aeration is integral to the success of the fixed biofilm system. It is designed to provide efficient and effective:

- Transfer of Oxygen to the Biomass
- Mixing within the Treatment Stage
- Scouring of the Media to Control Biofilm Thickness

The aeration diffusers are positioned beneath the biofilm media racks and anchored to the floor or attached to the media rack.

Nebula MultiStage Biofilm Media Rack

Quantaer Fine Bubble Aeration System

Nebula Biofilm Media Installation

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COST OF OWNERSHIP

When evaluating treatment solutions, the treatment process and mechanical system design are equally important to the cost of ownership and success of the installation.

We endeavor to understand our customer's needs and work together to evaluate each unit process required to meet the overall treatment objectives and cost of ownership.

Where the Nebula MultiStage Biofilm System is the right solution, we are committed to meeting or exceeding performance, operational and customer support expectations.

Customers We Serve

- Public Utilities
- Housing Developments (Condos, Single Home Subdivisions, Hotels)
- Schools, Universities, Commercial Buildings
- Parks, Camps, Recreational Areas
- Food & Beverage Industry
- Oil & Gas Industry
- Personal Care Products Industry
- Pharmaceutical & Chemical Industries
- Power Plants and Pulp & Paper Industries

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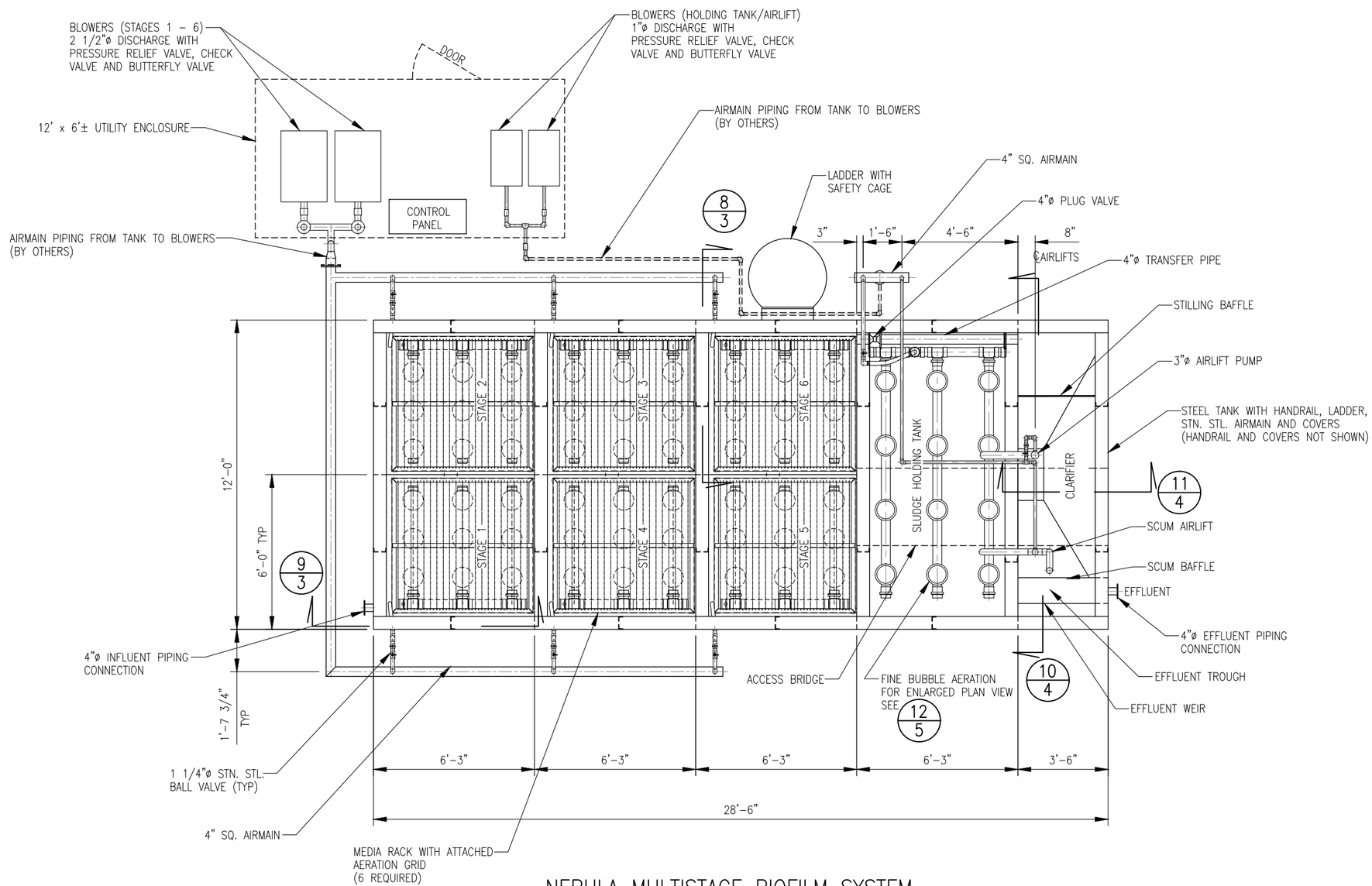
0418

11.3 Aquarius Technologies: Nebula Multistage Biofilm System Drawings

Consists of the following:

- Aquarius Nebula Multistage Biofilm System Plan View
- Aquarius Nebula Multistage Biofilm System Steel Tank
- Aquarius Nebula Multistage Biofilm System Sections
- Aquarius Nebula Multistage Biofilm System Aeration Grid Details
- Aquarius Nebula Multistage Biofilm System Hydraulic Profile
- Aquarius Nebula Multistage Biofilm System Controls and Instrumentation Diagram



NEBULA MULTISTAGE BIOFILM SYSTEM
WITH INTEGRAL SLUDGE HOLDING TANK
PLAN VIEW 1

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X
X

DESIGNATES PLAN VIEW, SECTION
OR DETAIL NUMBER

DESIGNATES SHEET ON WHICH
PLAN VIEW, SECTION OR DETAIL
CAN BE FOUND

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NEBULA MULTISTAGE
BIOFILM SYSTEM
PLAN VIEW

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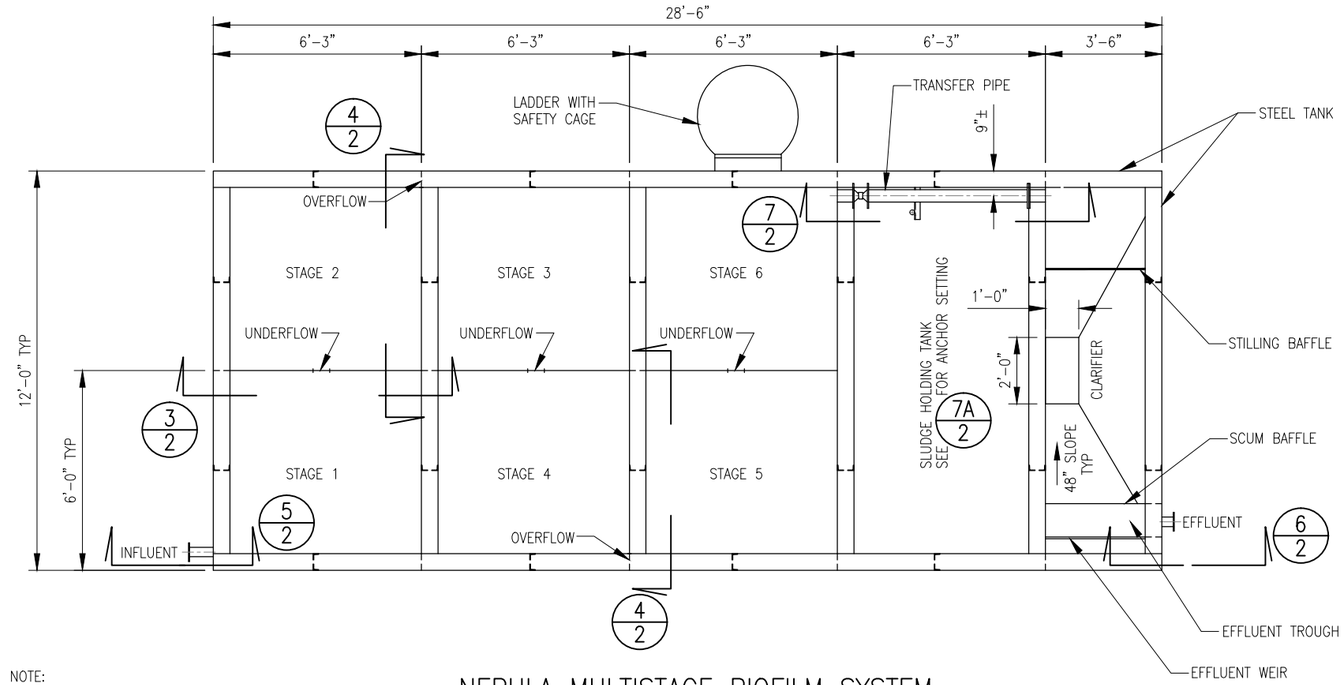
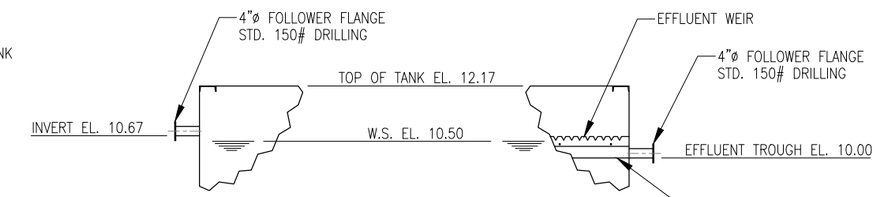


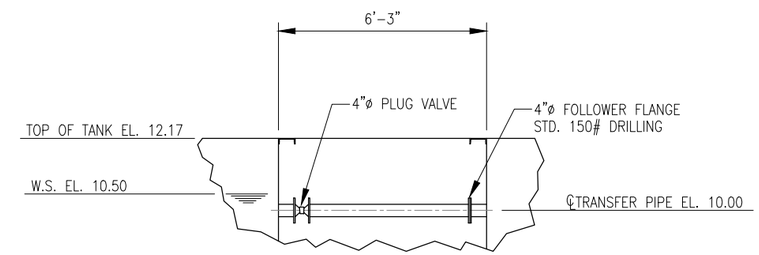
NOTE:
TANK COVERS AND HAND RAILING NOT SHOWN

NEBULA MULTISTAGE BIOFILM SYSTEM
STEEL TANK
PLAN VIEW 2

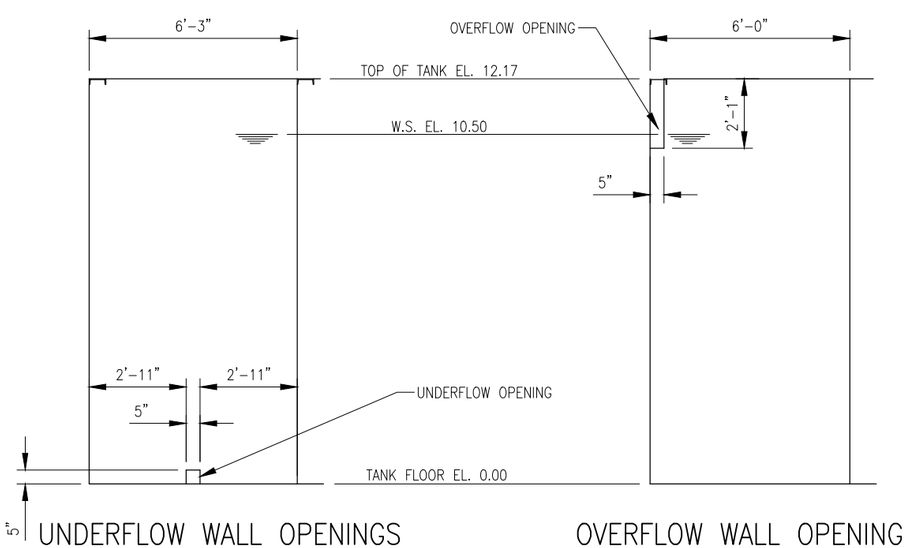


INFLUENT PIPE SECTION 5

EFFLUENT PIPE SECTION 6



TRANSFER PIPE SECTION 7

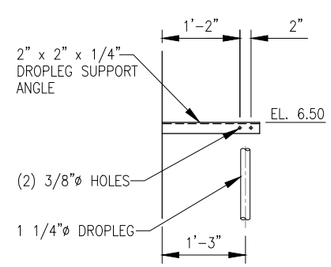


UNDERFLOW WALL OPENINGS SECTION 3

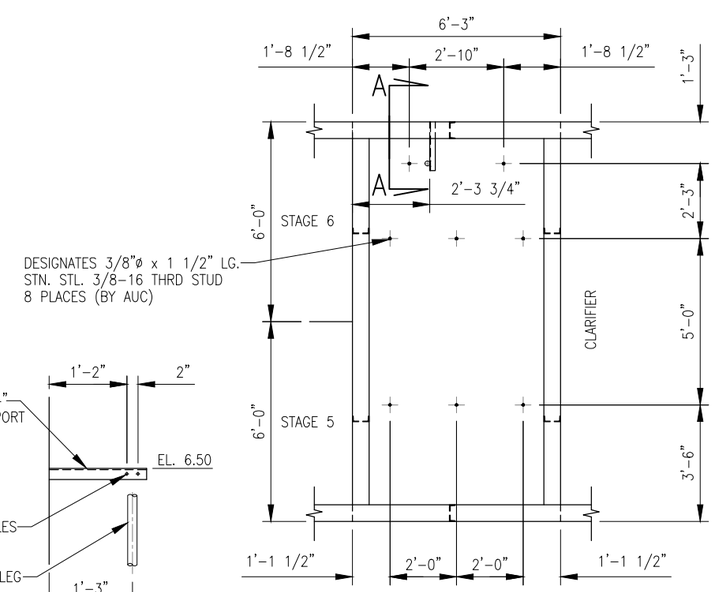
TYP 3 PLACES PER TANK

OVERFLOW WALL OPENING SECTION 4

TYP 2 PLACES PER TANK



SECTION A-A



SLUDGE HOLDING TANK - ANCHOR SETTING
PLAN VIEW 7A

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NEBULA MULTISTAGE
BIOFILM SYSTEM
STEEL TANK

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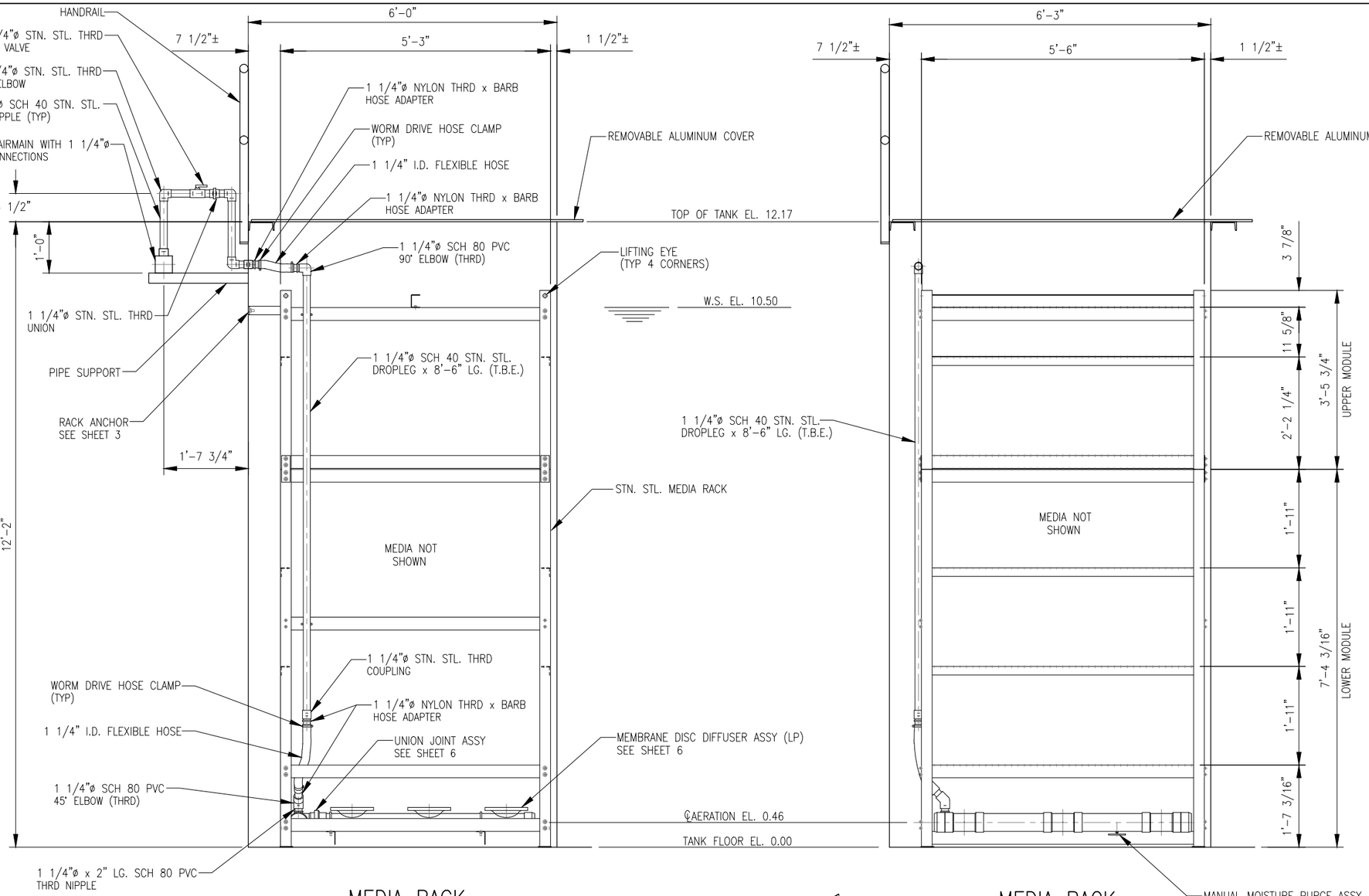
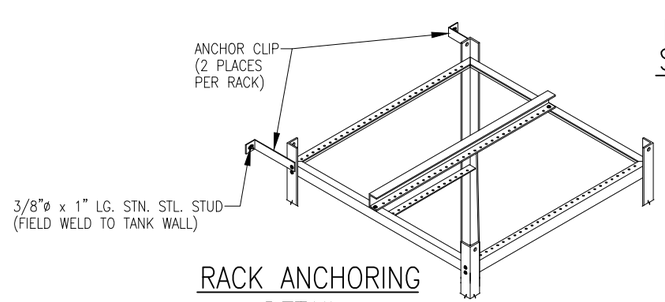


MEDIA RACK SECTION 8

MEDIA RACK SECTION 9



RACK ANCHORING DETAIL

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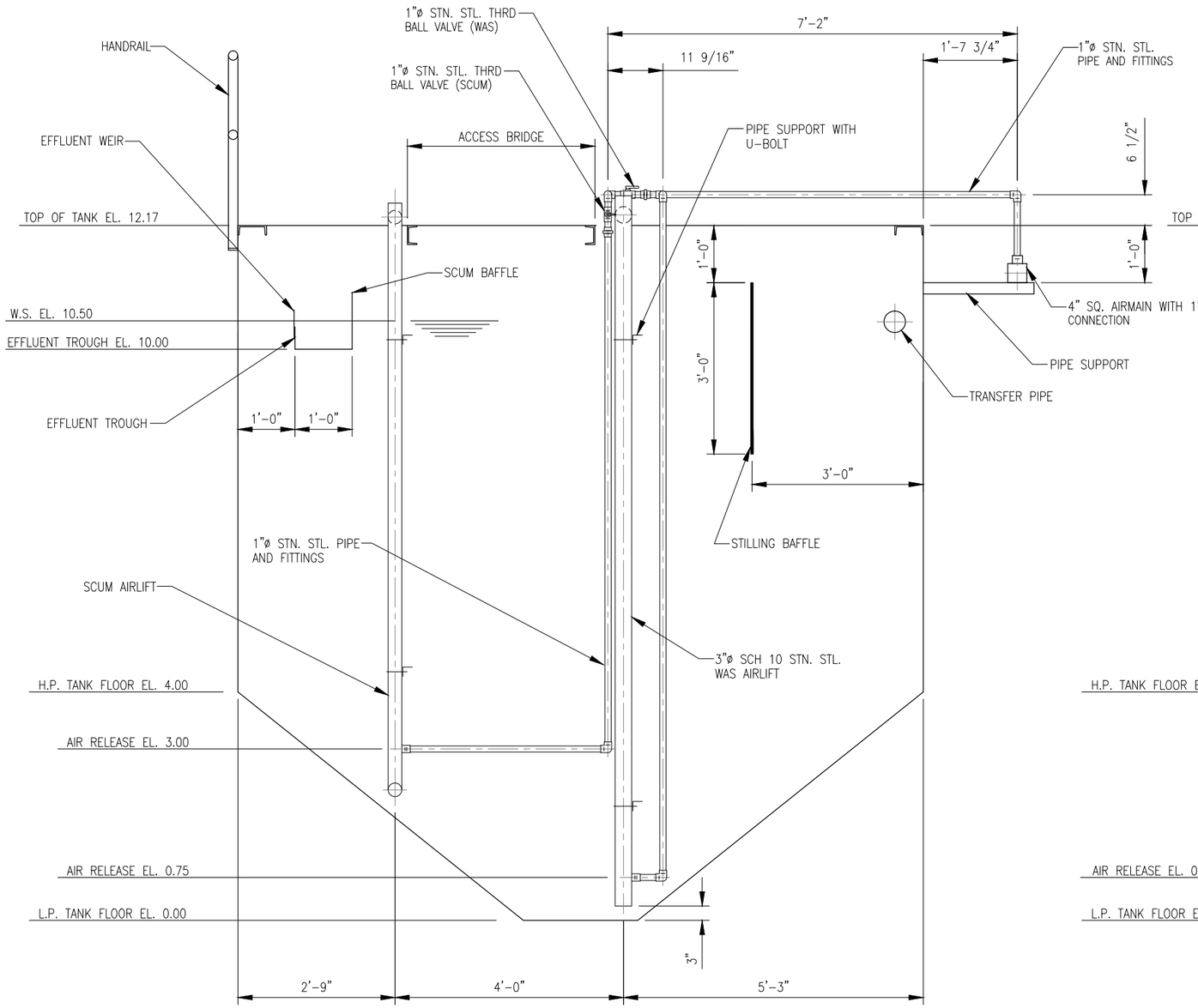
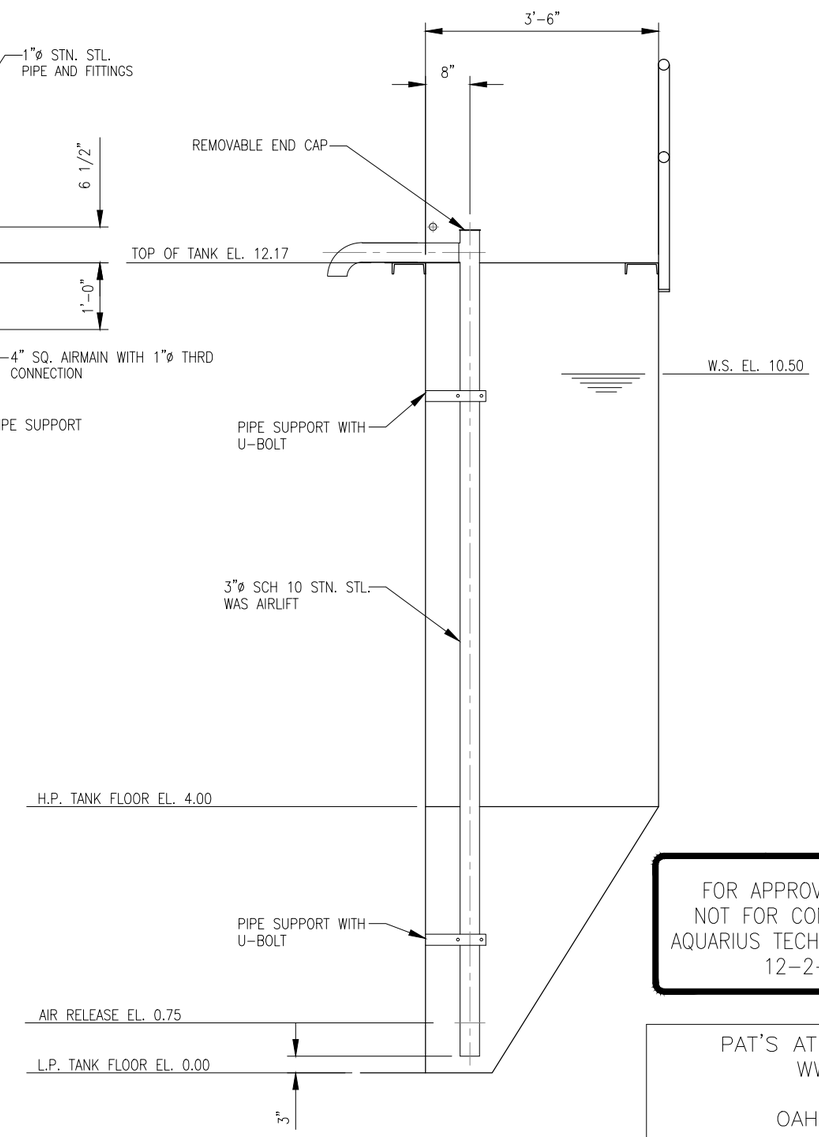


CLARIFIER/AIRLIFT SECTION 10



CLARIFIER/AIRLIFT SECTION 11

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NEBULA MULTISTAGE BIOFILM SYSTEM SECTIONS

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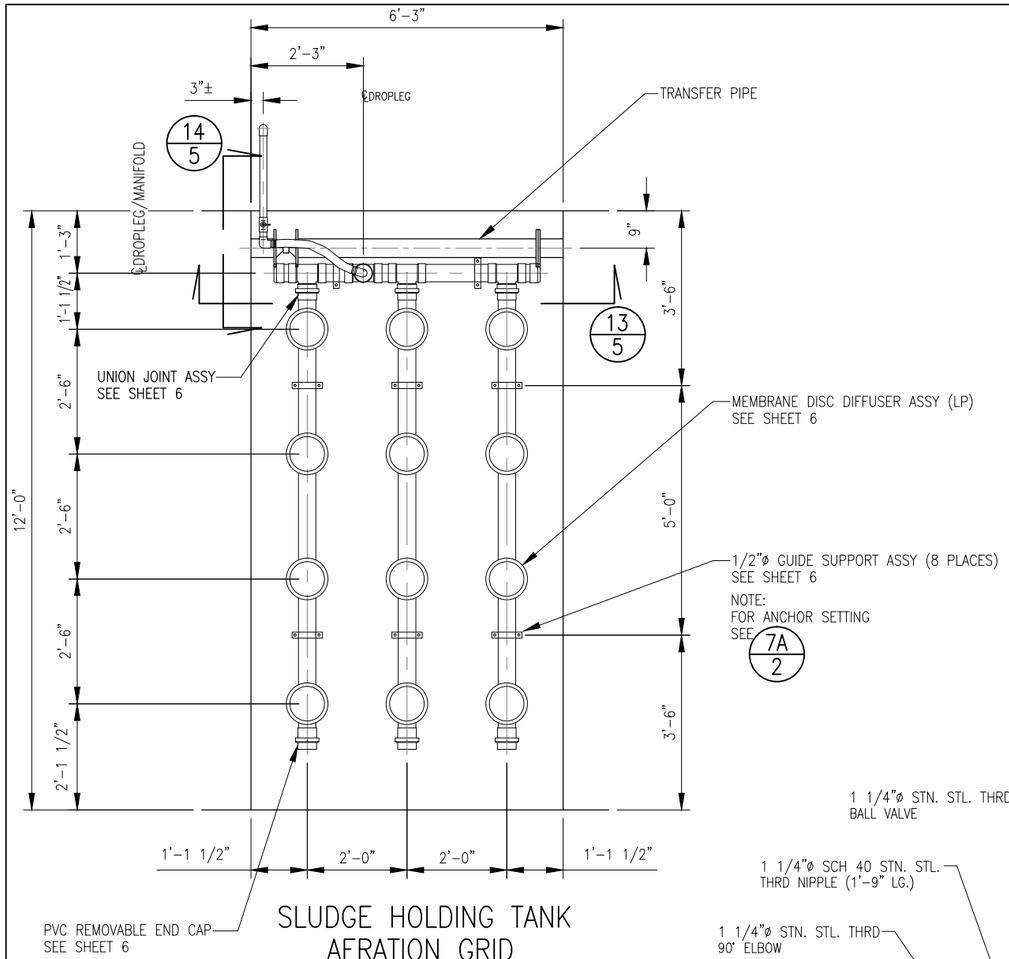
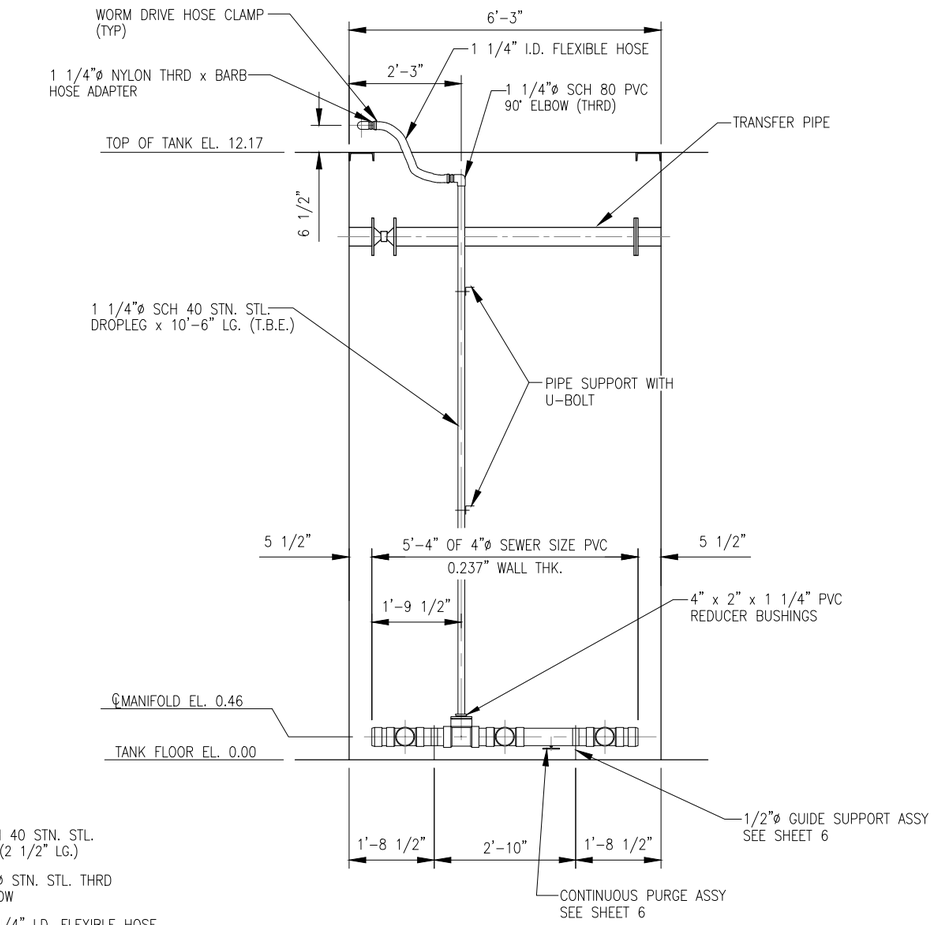
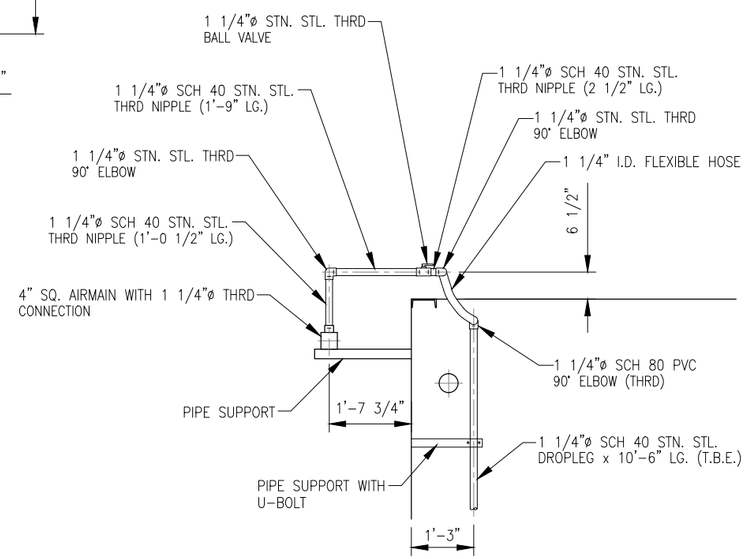


SLUDGE HOLDING TANK
AERATION GRID
PLAN VIEW 12



SLUDGE HOLDING TANK
AERATION GRID
SECTION 13



SLUDGE HOLDING TANK
AERATION GRID
SECTION 14

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NEBULA MULTISTAGE
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AERATION GRID DETAILS

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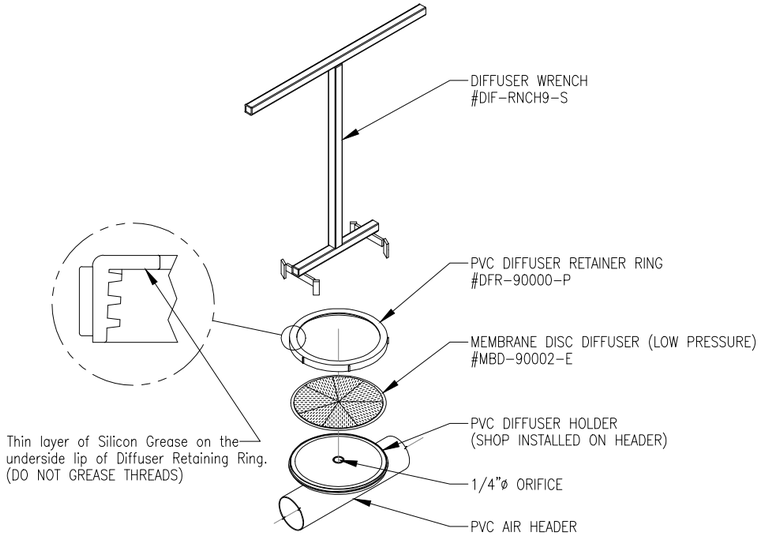
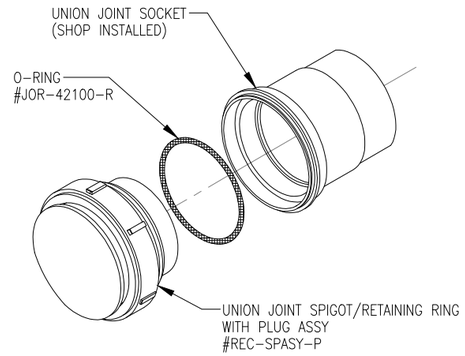


MEMBRANE DISC DIFFUSER ASSY (LP)

Installation Procedure:

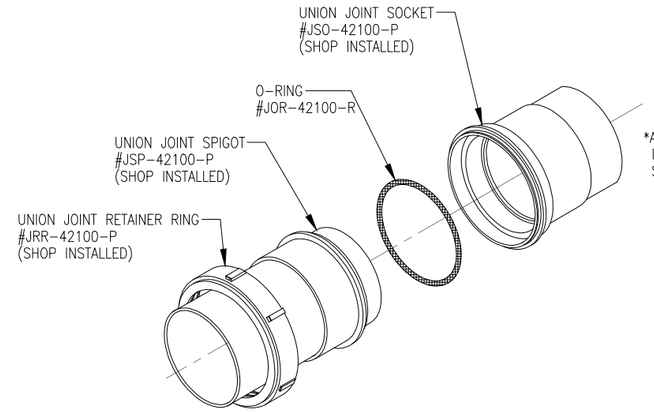
1. Place the Membrane Disc Diffuser on the Diffuser Holder.
2. Place a thin layer of the provided Silicon Grease on the underside lip of the Diffuser Retainer Ring. CAUTION- Do not place grease on the thread of the Difffuser Retainer Ring.
3. Install the Diffuser Retainer Ring on the Diffuser Holder and tighten "Hand-Tight". CAUTION- Do not cross thread the Diffuser Retainer Ring.
4. Use the Diffuser Wrench and continue tightening the Diffuser Retainer Ring to a position approx. 1/4 - 1/3 maximum past "Hand-Tight".

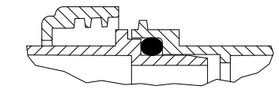


PVC REMOVABLE END CAP

Installation Procedure:

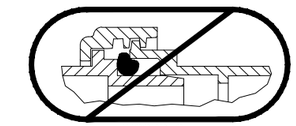
1. See "Union Joint Assy"





CORRECT

*AFTER JOINT IS PUSHED TOGETHER, VISUALLY INSPECT TO ENSURE O-RING IS PROPERLY SEATED BEFORE TIGHTENING RETAINER RING.



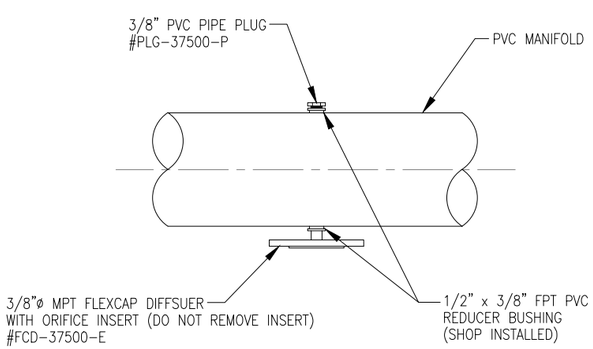
INCORRECT

*O-RING IS NOT PROPERLY SEATED, DO NOT USE RETAINER RING TO FORCE O-RING INTO PLACE.

UNION JOINT ASSY

Installation Procedure:

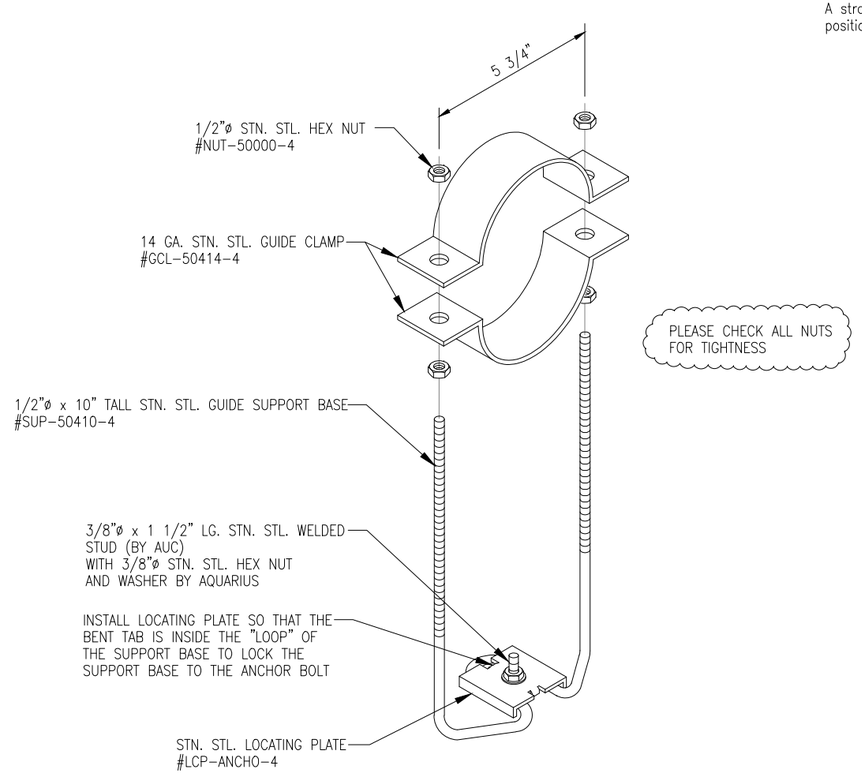
1. Lubricate the O-ring with a solution of water and household dish soap. CAUTION- Do not use grease to lubricate the O-ring.
2. Place the O-ring on the Union Joint Spigot of the Union.
3. Join the Union Joint Spigot to the Union Joint Socket, compressing the soap lubricated O-ring into the Union Joint Socket.
4. Thread the Union Joint Retainer Ring "Hand-Tight" to the Union joint Socket. A strap wrench can be used to continue tightening the Retainer Ring to a position approx. 1/4 maximum past "Hand-Tight".



CONTINUOUS PURGE ASSEMBLY

Installation Procedure:

1. Apply teflon tape or pipe putty to threads of Flexcap Diffuser, install into bushing at invert of pipe and hand tighten.
2. Apply teflon tape or pipe putty to threads of pvc pipe plug, install into bushing at top of pipe and tighten with wrench.



1/2"ø GUIDE SUPPORT ASSY

FOR APPROVAL ONLY-
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
12-2-19

PAT'S AT PUNALUU
WWTP

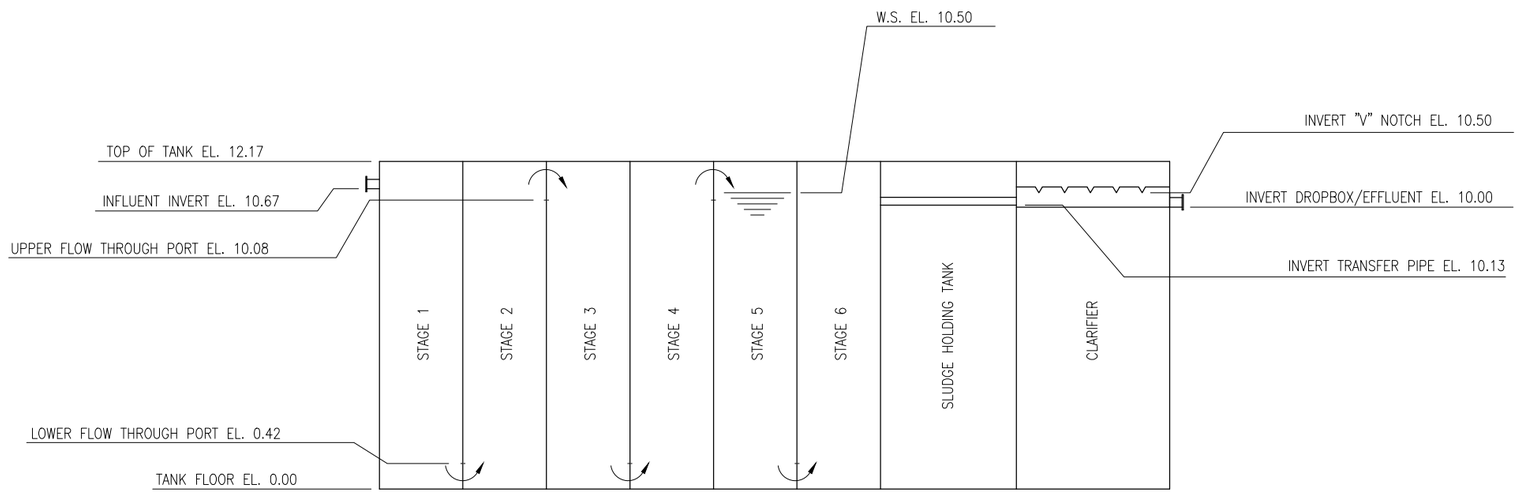
OAHU, HI

NEBULA MULTISTAGE
BIOFILM SYSTEM
AERATION GRID DETAILS

AQUARIUS Technologies LLC

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: SP	DATE: 12-2-19	JOB #: 6563-19
CHKED BY:	DATE:	SHEET PS-6
APPRD BY:	DATE:	



HYDRAULIC PROFILE

FOR APPROVAL ONLY–
NOT FOR CONSTRUCTION
AQUARIUS TECHNOLOGIES, LLC
12–2–19

PAT'S AT PUNALUU
WWTP

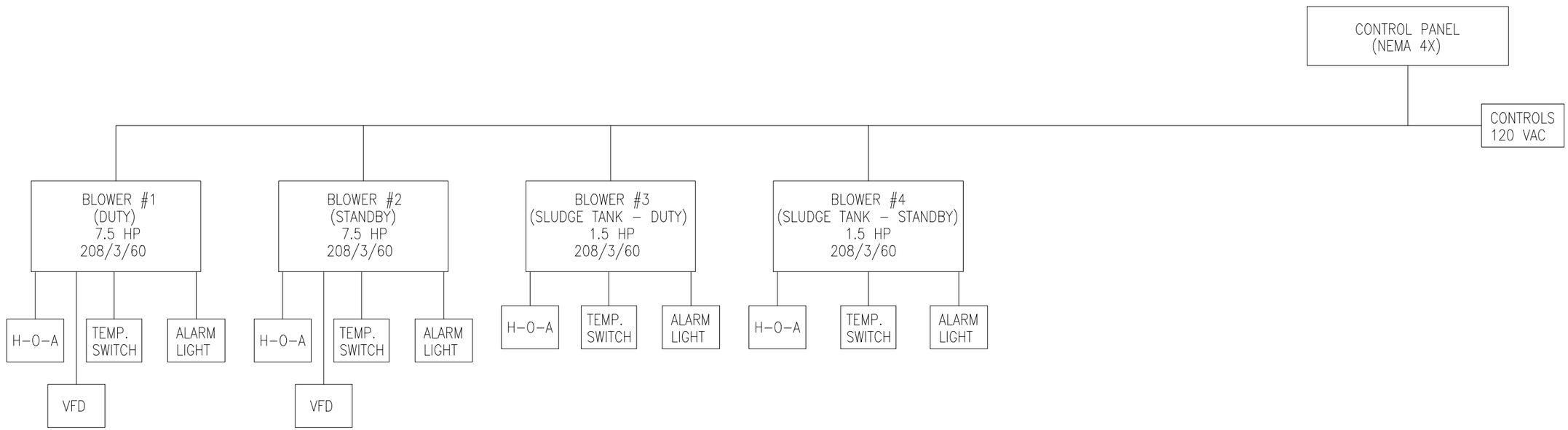
OAHU, HI

NEBULA MULTISTAGE
BIOFILM SYSTEM
HYDRAULIC PROFILE

AQUARIUS Technologies LLC

REV	DATE	REVISION	BY
D			
C			
B			
A			

DRAWN BY: SP	DATE: 12–2–19	JOB #: 6563–19
CHKED BY:	DATE:	
APPRD BY:	DATE:	SHEET PS–7



CONTROL & INSTRUMENTATION DIAGRAM

NOTE:
VERIFY ALL ELECTRICAL WORK COMPLIES
WITH NEC, AND SPECIFICALLY NEC 110.11

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AQUARIUS TECHNOLOGIES, LLC
12–2–19

PAT'S AT PUNALUU
WWTP

OAHU, HI

NEBULA MULTISTAGE
BIOFILM SYSTEM
CONTROL AND INSTR. DIAG.

AQUARIUS Technologies

REV	DATE	REVISION	BY
D			
C			
B			
A			

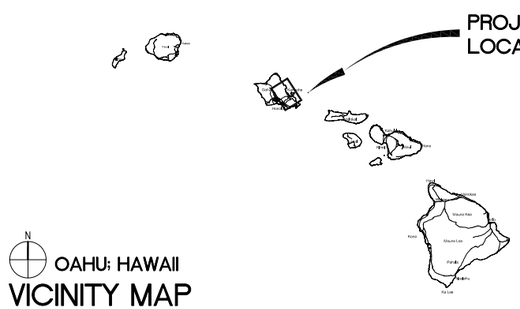
DRAWN BY: SP	DATE: 12–2–19	JOB #: 6563–19
CHKED BY:	DATE:	SHEET PS–8
APPRD BY:	DATE:	

APPENDIX C

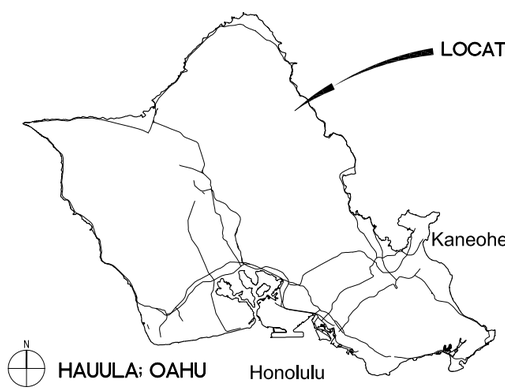
Drawings for Wastewater Treatment Works Replacement

PAT'S AT PUNALU'U WWTW REPLACEMENT
WASTEWATER TREATMENT WORKS

PROJECT LOCATION
HAU'ULA, OAHU



VICINITY MAP



LOCATION MAP

Drawing Index

PREPARED FOR:
PAT'S AT PUNALU'U WWTW
REPLACEMENT
53-567 KAMEHAMEHA HWY
HAU'ULA, OAHU, HI 96717

PREPARED BY:
LAULEA ENGINEERING, LLC.
P.O. BOX 907
KAILUA, HI 96734

SYM	DESCRIPTION	DATE

LAULEA
ENGINEERING, LLC
LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealic.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE — EXP. DATE: APRIL 30, 2020

PAT'S AT PUNALU'U WWTW REPLACEMENT
53-567 KAMEHAMEHA HWY
HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: TITLE SHEET

www.laulealic.com

SCALE: NTS

PROJECT NO.

T-1

60% SUBMITTAL MARCH 2020
NOT FOR CONSTRUCTION

CONSTRUCTION NOTES:

1. ALL APPLICABLE CONSTRUCTION WORK SHALL BE DONE IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR PUBLIC WORK CONSTRUCTION, SEPTEMBER 1984, AS AMENDED, OF THE DEPARTMENT OF PUBLIC WORKS, CITY & COUNTY OF HONOLULU AND THE COUNTIES OF KAUAI, NAUI, AND HAWAII.

2. VERIFY AND CHECK ALL DIMENSIONS AND DETAILS SHOWN ON THE DRAWINGS PRIOR TO THE START OF CONSTRUCTION. ALL CONFLICTS SHALL BE IMMEDIATELY BROUGHT TO THE ATTENTION OF THE CONTRACTING OFFICER.

3. THE UNDERGROUND PIPES, CABLES OR DUCTING LINES KNOWN TO EXIST BY THE ENGINEER FROM HIS SEARCH OF RECORDS ARE INDICATED OF THE PLANS. THE CONTRACTOR SHALL VERIFY THE LOCATIONS AND DEPTHS OF THE FACILITIES AND EXERCISE PROPER CARE IN EXCAVATING IN THE AREA, WHEREVER CONNECTIONS OF NEW UTILITIES TO EXISTING UTILITIES ARE SHOWN ON THE PLANS, THE CONTRACTOR SHALL EXPOSE THE EXISTING LINES AT THE PROPOSED CONNECTIONS TO VERIFY THEIR LOCATIONS AND DEPTHS PRIOR TO EXCAVATION FOR THE NEW LINES.

4. NO CONTRACTOR SHALL PERFORM ANY CONSTRUCTION OPERATION AS TO CAUSE FALLING ROCKS, SOIL OR DEBRIS IN ANY FORM TO FALL, SLIDE OR FLOW INTO EXISTING CITY OR STATE DRAINAGE SYSTEMS, OR ADJOINING PROPERTIES, STREETS OR NATURAL WATERCOURSES, SHOULD SUCH VIOLATIONS OCCUR, THE CONTRACTOR MAY BE CITED AND THE CONTRACTOR SHALL IMMEDIATELY MAKE ALL REMEDIAL ACTIONS NECESSARY.

5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CONFORMANCE WITH THE APPLICABLE PROVISIONS OF THE WATER QUALITY AND WATER POLLUTION CONTROL STANDARDS CONTAINED IN HAWAII ADMINISTRATIVE RULES, TITLE 11, CHAPTER 55, "WATER POLLUTION CONTROL", AS WELL AS CHAPTER 14 OF THE REVERSED ORDINANCES OF HONOLULU, AS AMENDED, BEST MANAGEMENT PRACTICES SHALL BE EMPLOYED AT ALL TIMES DURING CONSTRUCTION.

6. THE CONTRACTOR SHALL FIRST NOTIFY THE CIVIL ENGINEERING BRANCH, DEPARTMENT OF PLANNING AND PERMITTING, AT 768-8084 TO ARRANGE FOR INSPECTIONAL SERVICES AND SUBMIT FOUR (4) SETS OF APPROVED CONSTRUCTION PLANS SEVEN (7) DAY PRIOR TO COMMENCEMENT OF CONSTRUCTION WORK.

7. CONFINED SPACE

   FOR ENTRY BY STATE PERSONNEL, INCLUDING INSPECTORS AND REPRESENTATIVES, INTO A PERMIT REQUIRED CONFINED SPACE AS DEFINED IN 29 CFR PART 1910.146(B), THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROVIDING:

   I. ALL SAFETY EQUIPMENT REQUIRED BY THE CONFINED SPACE REGULATIONS APPLICABLE TO ALL PARTIES OTHER THAN THE CONSTRUCTION INDUSTRY, TO INCLUDE, BUT NOT LIMITED TO, THE FOLLOWING:

      a. FULL BODY HARNESSES FOR UP TO TWO PERSONNEL
      b. LIFELINE AND ASSOCIATED CLIPS
      c. INGRESS/EGRESS AND FULL PROTECTION EQUIPMENT
      d. TWO-WAY RADIOS (WALKIE-TALKIES) IF OUT OF LINE-OF-SIGHT,
      e. EMERGENCY (ESCAPE) RESPIRATOR (10 MINUTE DURATION).
      f. CELLULAR TELEPHONE TO CALL FOR EMERGENCE ASSISTANCE.
      g. CONTINUOUS GAS DETECTOR (CALIBRATED) TO MEASURE OXYGEN, HYDROGEN SULFIDE, CARBON MONOXIDE AND FLAMMABLES (CAPABLE OF MONITORING AT A DISTANCE AT LEAST 20 FEET AWAY).
      h. PERSOANL MULTI-GAS DETECTOR TO BE CARRIED BY INSPECTOR.

   II. CONTINUOUS FORCED AIR VENTILATION ADEQUATE TO PROVIDE SAFE ENTRY CONDITIONS.

   III. ONE ATTENDANT/RESCUE PERSONNEL TOPSIDE (TWO, IF CONDITIONS WARRANT IT).

   IV. ALL SAFETY EQUIPMENT SHALL COMPLY WITH THE STANDARDS OF THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION AND ALL APPLICABLE FEDERAL, STATE, AND CITY LAWS AND REGULATIONS RELATING TO SAFETY.

8. ALL EXISTING UTILITIES TO REMAIN IN USE, WHETHER OR NOT SHOWN ON THE PLANS BY THE CONTRATOR DURING CONSTRUCTION. ALL DAMGES TO EXISTING UTILITIES SHALL BE REPAIRED AND PAID FOR BY THE CONTRACTOR.

9. WHEN TRENCH EXCAVATION IS CLOSE TO OR UNDER EXISTING STRUCTURES OR FACILITIES, THE CONTRACTOR SHALL BE RESPONSIBLE FOR PROPERLY SHEETING, SHORING AND BRACING THE EXCAVATION AND STABILIZING THE EXISTING GROUND TO RENDER IT SAFE AND SECURE FROM POSSIBLE SLIDES, CAVE-INS AND SETTLEMENT AND FOR PROPERLY SUPPORTING EXISTING STRUCTURES AND FACILITIES WITH BEAMS, STRUTS OR UNDER-PINNING TO FULLY PROTECT THEM FROM DAMAGE.

10. THE CONTRACTOR SHALL RESTORE TO THEIR ORIGINAL CONDITION OR BETTER, ALL IMPROVEMENTS DAMAGED AS A RESULT OF THE CONSTRUCTION, INCLUDING PAVEMENTS, EMBANKMENTS, CURBS, SIGNS, LANDSCAPING, STRUCTURES, UTILITIES, WALLS, FENCES, ETC. UNLESS PROVIDED FOR SPECIFICALLY IN THE PROPOSAL. DEMOLITION AND RESTORATION OF EXISTING ITEMS SHALL BE INCIDENTAL AND INCLUDED WITHIN THE AMOUNT PAID FOR UNCLASSIFIED TRENCH EXCAVATION.

11. ALL CONCRETE AND A.C. PAVEMENT TO BE TRENCHED OR RECONSTRUCTED SHALL BE SAW-CUT TO THE REQUIRED WIDTH PRIOR TO THE CONSTRUCTION.

12. PURSUANT TO CHAPTER 6E, HRS, IN THE EVENT ANY ARTIFACTS OR HUMAN REMAINS ARE UNCOVERED DURING CONSTRUCTION OPERATIONS, THE CONTRACTOR SHALL IMMEDIATELY SUSPEND WORK AND NOTIFY THE HONOLULU POLICE DEPARTMENT AND THE STATE DEPARTMENT OF LAND AND NATURAL RESOURCES-HISTORIC PRESERVATION DIVISION (692-8015). IN ADDITION, FOR NON-CITY PROJECTS, THE CONTRACTOR SHALL INFORM THE CITY DEPARTMENT OF PLANNING PERMITTING, CIVIL ENGINEERING BRANCH.

13. THE EXISTING TOPOGRAPHIC DATA WAS TAKEN FROM THE TOPOGRAPHIC SURVEY PREPARED BY CONTROLPOINT SURVEYING, INC., ENTITLED "TOPOGRAPHIC SURVEY MA, "KUPUNA HOME O'WAIALUA TREATMENT PLANT IMPROVEMENTS, KAMANAUI, WAIALUA, OAHU, HAWAII", DATED DECEMBER 8, 2008.

14. FOR PROJECT BENCHMARK, SEE SHEET C-2.

SEWER NOTES: (PRIVATE)

1. ALL SEWER CONSTRUCTION SHALL BE PERFORMED IN ACCORDANCE WITH THE STANDARD SPECIFICATIONS FOR PUBLIC WORKS CONSTRUCTION, SEPT. 1985, THE DEPARTMENT OF PUBLIC WORKS STANDARD DETAILS, SEPT. 1984, CURRENT CITY PRACTICES AND REVISE ORDINANCES OF HONOLULU, 1990 AS AMENDED, AND THE DESIGN STANDARDS OF THE DEPARTMENT OF WASTEWATER MANAGEMENT VOL. 1, JULY 198CRUSHED ROCK CRADLE IS PERMITTED WHERE SOIL IS STABLE. IN AREAS OF UNSTABLE SOIL, THE DESIGNER OF RECORDADN THE CONTRACTING OFFICER WILL DETERMINE THE PIPE SUPPORT REQUIRED.

2. THE UNDERGROUND PIPES, CABLES OR DUCTUNES KNOWN TO EXIST BY THE ENGINEERFROM HIS RESEARCH OF RECORDS ARRE INDICATED ON THE PLANS. THE CONTRACTOR SHALL VERIFY THE LOCATION AND DEPTH OF THE FACILITIES, INCLUDING AND AFFECTING SEWER LINES, IN THE PRESENCE OF THE WASTEWATER INSPECTOR AND EXERCISE PROPER CARE IN EXCAVATING THE AREA. THE CONTRACTOR SHALL BE RESPONSIBLE AND SHALL PAY FOR ALL DAMAGED UTILITIES.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING CONTINUOUS SEWER SERVICE TO ALL AFFECTED AREAS DURING CONSTRUCTION.

4. THE CONTRACTOR SHALL BE RESPONSIBLE FOR CLEAN UP OF ANY SEWAGE SPILLS CAUSED DURING CONSTRUCTION. THE CONTRACTOR SHALL NOTIFY THE CONTRACTING OFFICER AND STATE DEPARTMENT OF HEALTH AND UTILIZE APPROPRIATE SAMPLING AND ANALYZING PROCEDURES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL PUBLIC NOTIFICATIONS AND PRESS RELEASES.

5. THE CONTRACTOR SHALL INSTALL "RAINSTOPPER" MANHOLE INSERTS IN ALL NEW SEWER MANHOLES WITH TYPE "SA" FRAME AND COVER.

6. GEOTEXTILE FABRIC SHALL ENVELOP THE PIPE CRADLE AND PIPE FOR ALL SEWER LINES.

7. NO RUNGS SHALL BE INSTALLED INSIDE NEW SEWER MANHOLES.

WATER NOTES: (PRIVATE)

1. UNLESS OTHERWISE SPECIFIED, ALL MATERIALS AND CONSTRUCTION OF WATER SYSTEM FACILITIES AND APPURTENANCES SHALL BE IN ACCORDANCE WITH THE CITY AND COUNTY OF HONOLULU BOARD OF WATER SUPPLY'S "WATER SYSTEM STANDARDS", DATED 2002. THE "WATER SYSTEM EXTERNAL CORROSION CONTROL STANDARDS", VOLUME 3, DATED 1991, AND ALL SUBSEQUENT AMENDMENTS AND ADDITIONS.

2. THE EXISTENCE AND LOCATION OF UNDERGROUND UTILITIES AS SHOWN ON THE PLANS ARE FROM THE LATEST AVAILABLE DATA BUT IS NOT GUARANTEED AS TO THE ACCURACY OF ENCOUNTERING OF OTHER OBSTACLES DURING THE COURSE OF THE WORK. THE CONTRACTOR SHALL NOT ASSUME THAT WHERE NO UTILITIES ARE SHOWN, THAT NONE EXIST.

3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL WATER LINES DURING CONSTRUCTION. THE COTRACTOR SHALL BE SPECIALLY CAREFUL WHEN EXCAVATING BEHIND WATER LINES, TEES, AND BENDS WHEREVER THERE IS A POSSIBILITY OF WATER LINE MOVEMENT DUE TO THE REMOVAL OF THE SUPPORTING EARTH BEYOND THE EXISTING REACTION BLOCKS (WITH BWS APPROVAL) AND/OR MODIFYINGHIS CONTRUCTION METHOD.

4. PRIOR TO ANY EXCAVATING, THE CONTRACTOR SHALL VERUFY IN THE FIELD THE LOCATION OF EXISTING WATER MARKS AND APPURTENANCES.

PUBLIC HEALTH SAFETY AND CONVENIENCE NOTES:

1. CONTRACTOR SHALL OBSERVE AND COMPLY WITH ALL FEDERAL, STATE, AND LOCAL LAWS REQUIRED FOR THE PROTECTION OF PUBLIC HEALTH, SAFETY AND ENVIRONMENTAL QUALITY.

2. THE CONTRACTOR, AT HIS OWN EXPENSE, SHALL KEEP THE PROJECT AND ITS SURROUNDING AREAS FREE FROM DUST NUISANCE. THE WORK SHALL BE IN CONFORMANCE WITH THE AIR POLLUTION STANDARDS AND REGULATIONS OF THE STATE DEPARTMENT OF HEALTH. THE CITY SHALL REQUIRE SUPPLEMENTARY MEASURES IF REQUIRED.

3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE CLEANING AND REMOVAL OF ALL SILT AND DEBRIS GENERATED BY HIS WORK AND DEPOSITED AND ACCUMULATED WITHIN DOWNSTREAM WATERWAYS. DITCHES AND DRAIN PIPES AND PUBLIC AND PRIVATE ROADWAYS. THE CONTRACTOR AGREES TO REIMBURSE THE STATE OF HAWAII FOR ALL COSTS EXPENDED IN PERFORMANCE OF ABOVE WORKIF REQUIRED FOR PUBLIC HEALTH AND SAFETY OR MADE NECESSARY BY NON-PERFORMANCE BY THE CONTRACTOR.

4. THE CONTRACTOR SHALL NOT PERFORM ANY CONSTRUCTION OPERATION SO AS TO CAUSE FALLING ROCKS, SOIL OR DEBRIS IN ANY FORM TO FALL, SLIDE OR FLOW INTO THE EXISTING CITY OR STATE DRAINAGE SYSTEMS, OR ADJOINING PROPERTIES, STREETS OR NATURAL WATERCOURSES, SHOULD SUCH VIOLATION OCCUR, THE CONTRACTOR MAY BE CITED AND THE CONTRACTOR SHALL IMMEDIATELY MAKE ALL REMEDIAL ACTIONS NECESSARY.

5. THE CONTRACTOR SHALL PROVIDE, INSTALL AND MAINTAIN ALL NECESSARY SIGNS, LIGHTS, FLARES, BARRICADES, MARKERS, CONES, AND OTHER PROTECTIVE FACILITIES AND SHALL TAKE ALL NECESSARY PRECAUTIONS FOR THE PROTECTION, CONVENIENCE AND SAFETY OF THE PUBLIC.

6. THE CONTRACTORS ATTENTION IS DIRECTED TO CHAPTER 46, PUBLIC HEALTH REGULATIONS, STATE DEPARTMENT OF HEALTH, STATE OF HAWAII, "COMMUNITY NOISE CONTROL" IN WHICH MAXIMUM PERMISSIBLE NOISE LEVELS HAVE BEEN SET. IF THE CONSTUCTION WORK REQUIRES A PERMIT FROM THE STATE DIRECTOR OF HEALTH, THE CONTRACTOR SHALL OBTAIN A COPY OF CHAPTER 46 AND BECOME FAMILIAR WITH THA NOISE LEVEL RESTRICTIONS AND THE PROCEDURES FOR OBTAINING A PERMIT FOR THE CONSTRUCTION ACTIVITIES. APPLICATION AND INFORMATION ON VARIANCES ARE AVAILABLE FROM THE ENVIRONMENTAL PROTECTION AND HEALTH SERVICES DIVISION. 1250 PUNCHBOWL ST. HONOLULU 96813 OR BY TELEPHONE (586-4576)

GRADING NOTES:

1. ALL GRADING WORK SHALL BE DONE IN ACCORDANCE WITH CHAPTER 14, ARTICLES 13, 14, 15 AND 16, AS RELATED TO GRADING, SOIL EROSION AND SEDIMENT CONTROL, OF THE REVISED ORDINANCES OF HONOLULU, 1990, AS AMENDED.

2. NO COTRACTOR SHALL PERFORM ANY GRADING OPERATION AS TO CAUSE FALLING ROCKS, SOIL OR DEBRIS IN ANY FORM TO FALL, SLIDE OR FLOW ONTO ADJOINING PROPERTIES, STREETS OR NATURAL WATERCOURSES. SHOULD SUCH VIOLATIONS OCCUR, THE CONTRACTOR MAY BE CITED AND THE CONTRACTOR SHALL IMMEDIATELY MAKE ALL REMEDIAL ACTIONS NECESSARY.

3. THE CONTRACTOR, AT HIS OWN EXPENSE, SHALL KEEP THE PROJECT AREA AND SURROUNDING FREE FROM DUST NUISANCE. THE WORK SHALL IN CONFORMANCE WITH THE AIR POLLUTION CONTROL. STANDARDS CONTAINED IN THE HAWAII ADMINISTRATIVE RULES, TITLE 11, CHAPTER 60.1, "AIR POLLUTION CONTROL".

4. THE UNDERGROUND PIPES, CABLES OR DUCTUNES KNOWN TO EXIST BY THE ENGINER FROM HIS SEARCH OF RECORDS ARE INDICATED ON THE PLANS. THE CONTRACTOR SHALL VERIFY THE LOCATIONS AND DEPTHS OF THE FACILITIES AND EXERCISE PROPER CARE IN EXCAVATING IN THE AREA. WHEREVER CONNECTIONS OF NEW UTILITIES ARE SHOWN ON THE PLANS, THE CONTRACTOR SAHLL EXPOSE THE EXISTING LINES AT THE EXCAVATION FOR THE NEW LINES.

5. ADEQUATE PROVISIONS SHALL BE MADE TO PREVENT SURFACE WATER FROM DAMAGING THE CUT FACE OF AN EXCAVATION OR THE SLOPED SURFACES OF A FILL . FURTHERMORE, ADEQUATE PROVISIONS SHALL BE MADE TO PREVENT SEDIMENT-LADEN RUNOFF FROM LEAVING THE SITE.

6. ALL SLOPES AND EXPOSED AREAS SHALL BE SODDED OR PLANTED AS SOON AS FINAL GRADES HAVE BEEN ESTABLISHED, PLANTING SHALL NOT BE DELAYED UNTIL ALL GRADING WORK HAS BEEN COMPLETED. GRADING TO FINAL GRADE SHALL BE CONTINUOUS, AND ANY AREA WITHIN WHICH WORK HAS BEEN INTERRUPTED OR DELAYED SHALL BE PLANTED.

7. FILLS ON SLOPES STEEPER THAN 5:1 SHALL BE CONTINUOUSLY KEYED AND BENCHED.

8. THE CITY SHALL BE INFORMED OF THE LOCATION OF THE BORROW/DISPOSAL SITE FOR THE PROJEST WHEN THE APPLICATION FOR A GRADING PERMIT IS MADE. THE BORROW/DISPOSAL SITE MUST ALSO FULFILL THE REQUIREMENTS OR THE GRADING ORDINANCE. THE DEPARTMENT OF PLANNING AND PERMITTIG, SITE DEVELOPMENT DIVISION, CIVIL ENGINEERING BRANCH, PERMITTING AND INSPECTION SECTION SHALL BE NOTIFIED OF ANY SUBSEQUENT CHANGES IN THE LOCATION OF THE BORROW/DISPOSAL SITES (PHONE NUMBER 768-8084).

9. NO GRADING WORK SHALL BE DONE ON SATURDAYS, SUNDAYS AND HOLIDAYS AT ANY TIME WITHOUT PRIOR NOTICE TO THE DIRECTOR, DEPARTMENTOF PLANNING AND PERMITTING, PROVIDED SUCH GRADING WORK IS ALSO IN CONFORMANCE WITH THE COMMUNITY NOISE CONTROL STANDARDS CONTAINED IN THE HAWAII ADMINISTRATIVE RULES, TITLE 11, CHAPTER 46, "COMMUNITY NOISE CONTROL".

10. THE LIMITS OF THE AREA TO BE GRADED SHALL BE FLAGGED BEFORE THE COMMENCEMENT OF THE GRADING WORK.

11. ALL GRADING OPEARATIONS SHALL BE PERFORMED IN THE CONFORMANCE WITH THE APPLICABLE PROVISIONS OF THE WATER QUALITY AND WATER POLLUTION CONTROL STANDARDS CONTAINED IN HAWAII ADMINISTRATIVE RULES, TITLE 11, CHAPTER 54, "WATER QUALITY STANDARDS", AND TITLE 11, CHAPTER 55, "WATER POLLUTION CONTROL", AND IF APPLICABLE, THE NPDES PERMIT FOR THE PROJECT , BEST MANAGEMENT PRACTICES SHALL BE EMPLOYED AT ALL TIMES DURING THE CONSTRUCTION PERIOD.

12. WHERE APPLICABLE AND FEASIBLE, THE MEASURES TO CONTROL THE EROSION AND OTHER POLLUTANTS SHALL BE IN THE PLACE BEFORE ANY EARTH MOVING PHASE OF THE GRADING IS INITIATED.

13. TEMPORARY EROSION CONTROLS SHALL NOT BE REMOVED BEFORE THE PERMANENT EROSION CONTROLS ARE IN-PLACE AND ESTABLISHED.

14. TEMPORARY EROSION CONTROL PROCEDURES SHALL BE SUBMITTED FOR APPROVAL PRIOR TO APPLICATION FOR GRADING PERMIT.

15. IF THE GRADING WORK INVOLVES CONTAMINATED SOIL, THEN ALL GRADING WORK, SHALL BE DONE IN CONFORMANCE WITH APPLICABLE STATE AND FEDERAL REQUIREMENTS. CONTACT THE SOLID AND HAZARDOUS WASTE BRANCH OF THE STATE DEPARTMENT OF HEALTH FOR MORE INFORMATION (PHONE NUMBER 586-4226).

16. THE CONTRACTOR SHALL NOTIFY THE CIVIL ENGINEERING BRANCH, D.P.P. AT 768-8084 TO ARRANGE FOR INSPECTIONAL SERVICES AND SUBMIT THREE (3) SETS OF APPROVED CONSTRUCTION PLAN SEVEN (7) DAYS PRIOR TO COMMENCEMENT OF CONSTRUCTION WORK.

17. PURSUANT TO CHAPTER 6E, HRS. IN THE EVENT ANY ARTIFACTS OR HUMAN REMAINS ARE UNCOVERED DURING CONSTRUCTION OPERATIONS, THE CONTRACTOR SHALL IMMEDIATELY SUSPEND WORK AND NOTIFY THE HONOLULU POLICE DEPARTMENT, THE STATE DEPARMENT OF LAND AND NATURAL RESOURCES-HISTORIC PRESERVATION DIVISION (692-8015). IN ADDITION, FOR NON-CITY PROJECTS, THE CONTRACTOR SHALL INFORM THE CIVIL ENGINEERING BRANCH, D.P.P. (768-8084); AND FOR CITY PROJECTS, NOTIFY THE RESPONSIBLE CITY AGENCY.

18. FOR ALL PROJECTS, WHICH WILL DISTURB ONE (1) ARE OR MORE OF LAND, THE CONTRACTOR SHALL NOT START CONSTRUCTION UNTIL A NOTICE OF GENERAL PERMIT COVERAGE (NGPC) IS RECEIVED FROM THE DEPARTMENT OF HEALTH, STATE OF HAWAII, AND HAS SATISFIED ANY OTHER APPLICABLE REQUIREMENTS OF THE NPDES PERMIT PROGRAM. ALSO, FOR NON-CITY AND OTHER NON-GOVERNMENTAL AGENCY PROJECTS, THE CONTRACTOR SHALL PROVIDE A WRITTEN DOPY OF THE NGPC TO THE PERMITTING AND INSPECTION SECTION, CIVIL ENGINEERING BRANCH D.P.P., ATLEAST SEVEN (7) CALENDAR DAYS BEFORE THE START OF THE CONSTRUCTION. FOR CITY OF OTHER GOVERNMENTAL PROJECTS , THE CONTRACTOR SHOULD PROVIDE A WRITTEN COPY OF THE NGPC TO THE APPROPRIATE CITY DEPARTMENT OR GOVERNMENTAL AGENCY PER THEIR REQUIREMENTS.

19. ALL GRADING AND CONSTRUCTION WORK SHALL IMPLEMENT MEASURES TO ENSURE THAT THE DISCHARGE OF POLLUTANTS FROM THE CONSTRUCTION SITE WILL BE REDUCED TO THE MAXIMUM EXTENT PRACTICABLE AND WILL NOT CAUSE OR CONTRIBUTE TO AN EXCEEDANCE OF WATER QUALITY STANDARDS.

20. NON-COMPLIANCE TO ANY OF THE ABOVE REQUIREMENTS SHALL MEAN IMMEDIATE SUSPENSION OF ALL WORK, AND REMEDIAL WORK SHALL COMMENCE IMMEDIATELY. ALL COSTS INCURRED SHALL BE BILLED TO THE VIOLATOR. FURTHERMORE, VIOLATORS SHALL BE SUBJECTED TO ADMINISTRATIVE, CIVIL AND/OR CRIMINAL PENALTIES.

21. FOR BENCH MARK, SEE DRAWING C-2.

ABBREVIATIONS

Ø	DIAMETER	HTCo.	HAWAIIAN TELEPHONE COMPANY
A	AIR	ICV	IRRIGATION CONTROL VALVE
A.C.A.	ASPHALT CONCRETE	I.D.	INNER DIAMETER
A/C	AIR CONDITIONING	INV.	INVERT
APPROX.	APPROXIMATE	IRR	IRRIGATION
APT.	APARTMENT	L	LENGTH
ARV	AIR RELEASE VALVE	LAT	LATERAL
AVG.	AVERAGE	LB	POUND
AVE.	AVENUE	LF	LINEAR FOOT
B	BYPASS	LP.	LIGHT/LAMP POLE
BC	BOTTOM CURB	MAX.	MAXIMUM
BFP	BACK FLOW PREVENTER	MGD	MILLION GALLONS PER DAY
BLDG.	BUILDING	MH	MANHOLE
B.O.D.	BIOCHEMICAL OXYGEN DEMAND	MIN.	MINIMUM/MINUTE
BOT	BOTTOM	MON.	MONUMENT
BW	BOTTOM WALL	N	NORH
BWS	BOARD OF WATER SUPPLY	O/H	OVERHEAD ELECTRIC LINE
	CENTERLINE	O.C.	ON CENTER
C.L.	CHAIN-LINK	P/PAVT.	PAVEMENT
CMU	CONCRETE MASONRY UNIT	P	PROPERTY LINE
C.O.	CLEAN OUT	PSI	POUND PER SQUARE INCH
COL.	COLUMN	PVC	POLYVINYL CHLORIDE
COMM.	COMMUNICATION	Qo	PIPE CAPACITY
C/CONC.	CONCRETE	Qr	DESIGN PEAK FLOW
CONT.	CONTINUATION	RCP	REINFORCED CONCRETE PIPE
C.Y.	CUBIC YARD	S	SEWER
D	DIAMETER OR DRAIN	SDWB	SAFE DRINKING WATER BRANCH
DET.	DETAIL	SF	SQUARE FEET
D.I.	DRAIN INLET	SHT.	SHEET
D-BOX	DISTRIBUTION BOX	S.L.	SEWERLINE/STREETLIGHT
DPW	DEPARTMENT OF PUBLIC WORKS	SMH	SEWER MANHOLE
DWG.	DRAWING	ST.M.	STREET
E	EAST	STA.	STATION
E/ELEC.	ELECTRIC	STD.	STANDARD
ELEV/EL	ELEVATION	S.T.P.	SEWAGE TREATMENT PLANT
EMH	ELECTRIC MANHOLE	S/W	SIDEWALK
EP	ELECTRIC POLE	STRUCT.	STRUCTURAL
EXIST.	EXISTING	SYM.	SYMMETRICAL
FG	FINISH GRADE	TC	TOP CURB
FM	FORCE MAIN	TDH	TOTAL DYNAMIC HEAD
FRP	FIBERGLASS REINFORCE PLASTIC	T/TEL.	TELEPHONE
FT	FEET	TEMP.	TEMPORARY
G	GAS	TMK	TAX MAP KEY
GAL.	GALLONS	TMH	TELEPHONE MANHOLE
GND.	GROUND	TP	TOP PIPE
G.P.	GUY POLE/GATE POST	TS	TOP STEM
GPD	GALLONS PER DAY	T.S.S.	TOTSL SUSPENDED SOLIDS
GPM	GALLONS PER MINUTE	TV	TOP VALVE
GV	GATE VALVE	TW	TOP WALL
G.W.	GUY WIRE	TYP.	TYPICAL
HAR	HAWAII ADMINISTRATIVE RULES	U.P.	UTILITY POLE
H/HT.	HEIGHT	U.P./S.L.	UTILITY POLE W/ STREET LIGHT
H.B.	HOSE BUB	VFD	VARIABLE FREQUENCY DRIVE
HECO	HAWAIIAN ELECTRIC COMPANY	W	WATER/WIDTH
HDPE	HIGH-DENSITY POLYETHYLENE	WL	WATERLINE
HP	HORSEPOWER	WM	WATER METER
HPHA	HAWAII PUBLIC HOUSING AUTHORITY	WV	WATER VALVE BOX

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC

LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealc.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE | APRIL 30, 2020 EXP. DATE

PAT'S AT PUNALU'U WWTW REPLACEMENT
53-567 KAMEHAMEHA HWY
HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: GENERAL NOTES

www.laulealc.com

SCALE: NTS

PROJECT NO.

T-2

60% SUBMITTAL MARCH 2020
NOT FOR CONSTRUCTION

DESIGN DATA:

INFLUENT FLOWS

QAVE DAT:	0.032MGD
QPEAK DAY:	0.043 MGD

INFLUENT WASTEWATER CHARACTERISTICS FROM EXISTING IMHOFF TANK

AVERAGE BOD (5 DAY) :	300 mg/L
AVERAGE TSS:	300 mg/L
AVERAGE NH3:	28 mg/L
MINIMUM TEMPERATURE:	68°F
MAXIMUM TEMPERATURE:	68°F

PRELIMINARY EFFLUENT LIMITATIONS

AVERAGE BOD (5 DAY) mg/L:	<30 mg/L
AVERAGE TSS mg/L:	<30 mg/L
AVERAGE NH3:	28 mg/L

AQUARIUS MULTISTAGE FIXED BIOFILM SYSTEM

HYDRAULIC RETENTION TIME:	13HR
ORGANIC LOADING:	34 lb/1000ft3/day
BOD MEDIA LOADING RATE:	1.6 lb/1000ft3/day
VOLUME PER BASIN:	2,363 CF 17,672 gal
# OF BASINS	1 EA
SIDE WATER DEPTH:	10.5 FT
STAGES PER BASIN:	6
CLARIFIER:	1
CLARIFIER WIDTH:	12 FT
CLARIFIER LENGTH:	3.5 FT
TANK MATERIAL:	STEEL

AQUARIUS MULTISTAGE FIXED BIOFILM SYSTEM (CONT.)

TOTAL NO. OF RACKS:	6 (1 PER BASIN/1 PER STAGE)
AERATION GRIDS:	6
BLOWERS:	2 EA (1 DUTY, 1 STANDBY)
RATE/PRESSURE:	125 SCFM @ 4.86 PSIG
HP:	20 HP VFD
CONTROL PANEL:	230V, SINGLE PHASE POWER CONTROL PANEL WITH NEMA 4X ENCLOSURE, INDICATOR LIGHTS, AND AUTODIALER
CONTROL STATION:	2 COMBINATION STARTERS WITH 120V CONTROL AND HAND-OFF-AUTO SWITCHES

SLUDGE HOLDING TANK

NUMBER OF TANK:	1
WIDTH:	12 FT
LENGTH:	6.3 FT
SIDE WATER DEPTH:	10.5 FT
VOLUME:	787.5 CF
HOLDING TIME:	12.3 DAYS
TOTAL NO. OF RACKS:	1
AERATION GRIDS:	1 (12 TOTAL DIFFUSERS)
SLUDGE HOLDING BLOWERS:	2 EA (1 DUTY, 1 STANDBY)
HP:	2 HP

SYMBOLS:

EXISTING	PROPOSED	
	S_6	SEWER LINE W/ SIZE
		SEWER MANHOLE
		ABANDON OR REMOVE EXISTING SEWER
		VENT LINE
		DIRECTION OF WASTE WATER FLOW
		DIRECTION OF RUN OFF
	B1	BORING LOCATION AND IDENTIFICATION
E — D_{18}		DRAIN LINE W/ SIZE
— G_2 —	G_2	GAS LINE W/ SIZE
W		ELECTRICAL LINE
HTCO		TELEPHONE LINE
		WATER LINE
IRR		IRRIGATION LINE
		PROPERTY LINE AND/OR RIGHT-OF-WAY

SHEET NUMBERING NOMENCLATURE

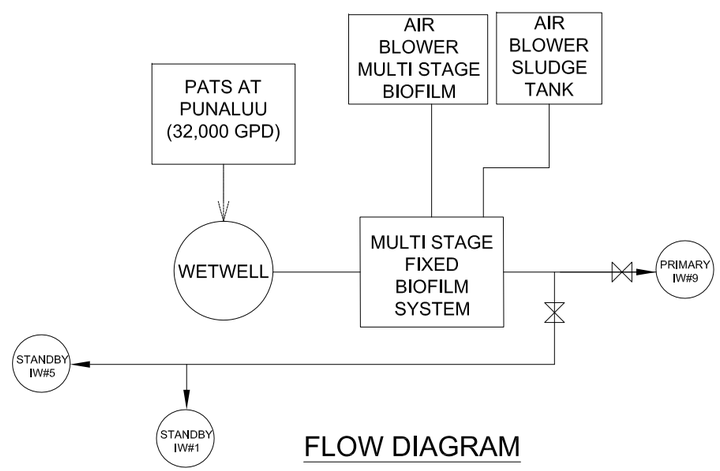
ALL SHEET WILL BE NUMBERED BEGINNING W/ A LETTER FOLLOWED BY DASH "-" AND TWO NUMBERS AS FOLLOWS:

C-8
- SHEET NUMBER
- DISCIPLINE LETTER

T - TITLE
C - CIVIL
S - STRUCTURAL
E - ELECTRICAL

DETAIL/SECTION TITLE

X / C - 8 DETAIL NAME
SCALE: 1/2"=1'-0"



FLOW DIAGRAM

NOTES:

1. APPROXIMATE SIZE LOCATION, AND PIPING OF THE EXIST. WTP IS SHOWN BASED RECORD DRAWINGS AND INFORMATION PROVIDED BY SITE MAINTENANCE PERSONNEL. CONTRACTOR SHALL VERIFY THE LOCATION, PIPING, AND INVERTS OF THE EXISTING WTP.

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC
LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealc.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

APRIL 30, 2020
SIGNATURE EXP. DATE

PAT'S AT PUNALU'U WWTW REPLACEMENT
53-567 KAMEHAMEHA HWY
HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: DESIGN DATA, FLOW DIAGRAM AND NOTES

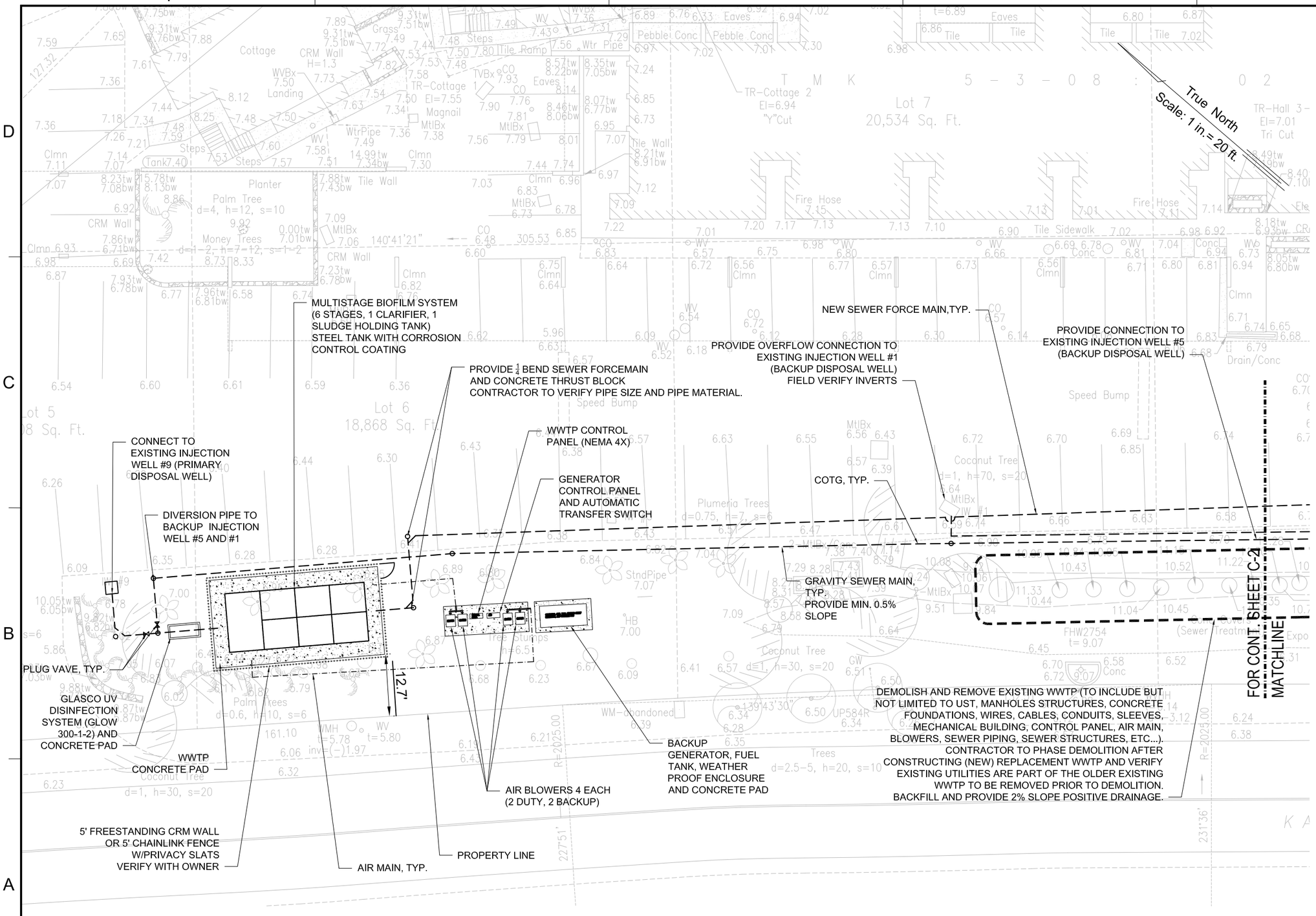
www.laulealc.com

SCALE: NTS

PROJECT NO.

T-3

60% SUBMITTAL MARCH 2020
NOT FOR CONSTRUCTION



GENERAL SITE PLAN- NORTH

20' 0 20' 40'

GRAPHIC SCALE

HORIZONTAL: 1" = 20'

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC

LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealc.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

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HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: GENERAL SITE PLAN

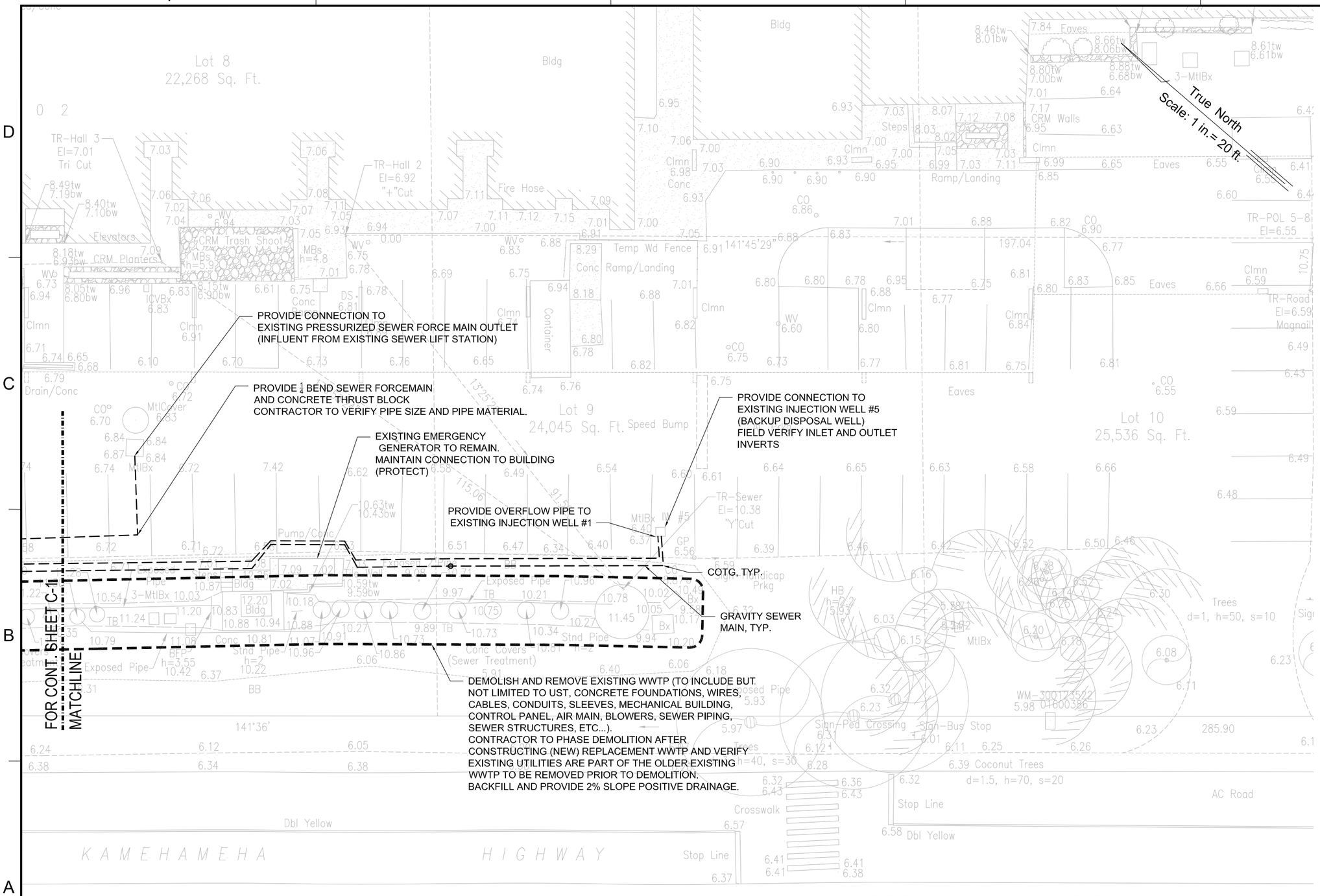
www.laulealc.com

SCALE: 1" = 30'

PROJECT NO.

C-1

60% SUBMITTAL MARCH 2020
NOT FOR CONSTRUCTION



GENERAL SITE PLAN- SOUTH

20' 0 20' 40'

GRAPHIC SCALE

HORIZONTAL: 1" = 20'

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC

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PO BOX 907
KAILUA, HI 96734
www.laulealc.com

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LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

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TMK: (1) 5-3-008:002

SHEET TITLE: GENERAL SITE PLAN

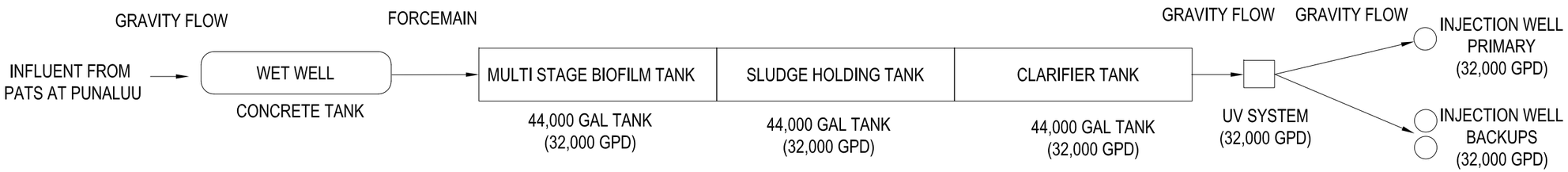
www.laulealc.com

SCALE: 1" = 30'

PROJECT NO.

C-2

60% SUBMITTAL MARCH 2020
NOT FOR CONSTRUCTION



PROCESS SCHEMATIC

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC
LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealic.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION

SIGNATURE — EXP. DATE: APRIL 30, 2020

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TMK: (1) 5-3-008:002

SHEET TITLE: PROCESS SCHEMATIC

www.laulealic.com

SCALE: NTS

PROJECT NO.

C-3

60% SUBMITTAL MARCH 2020
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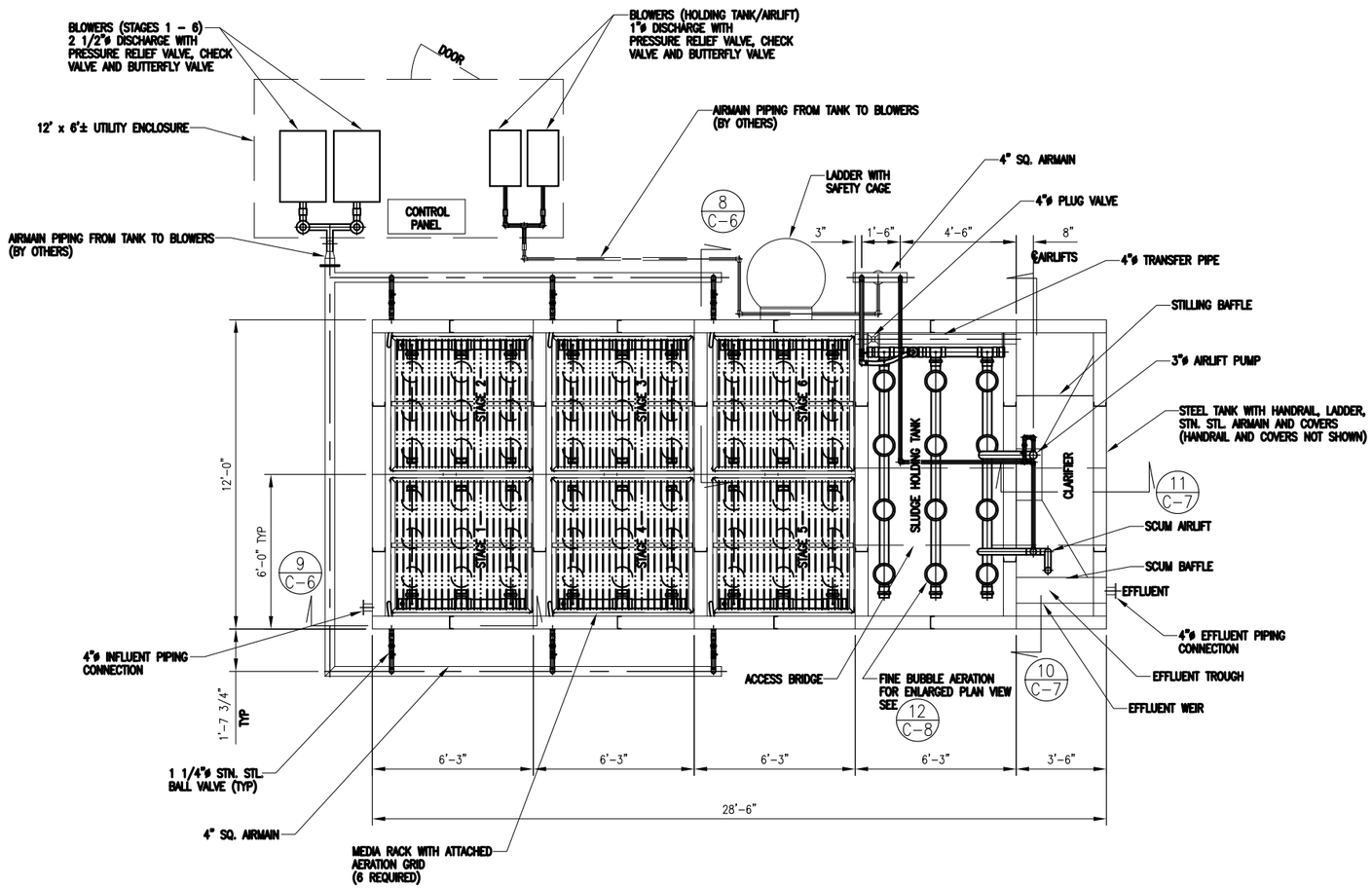

MULTISTAGE FIXED BIOFILM SYSTEM
MEDIA RACK LAYOUT
PLAN VIEW

NOT TO SCALE
(RACK COVERS NOT
SHOWN)

SYM	DESCRIPTION	DATE

LAULEA
ENGINEERING, LLC

LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealc.com

WESLEY J. WONG
LICENSED
PROFESSIONAL
ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

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HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: MEDIA RACK LAYOUT

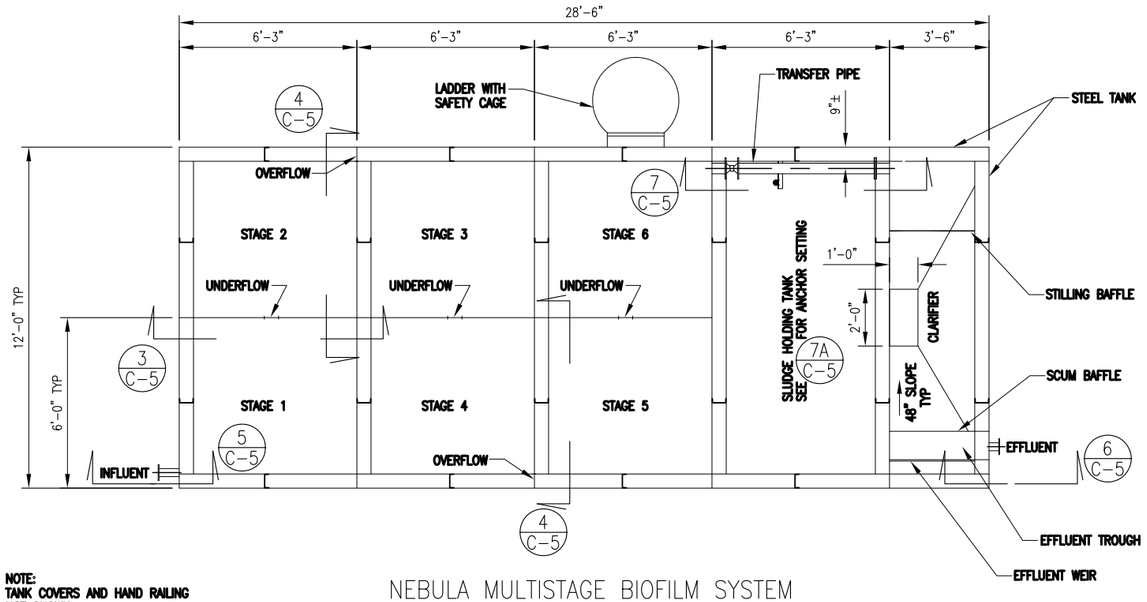
www.laulealc.com

SCALE: NTS

PROJECT NO.

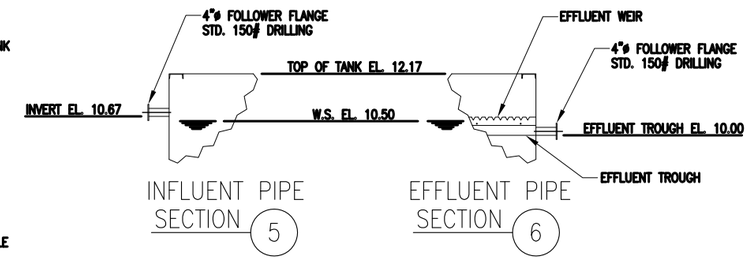
C-4

60% SUBMITTAL JANUARY 2020
NOT FOR CONSTRUCTION



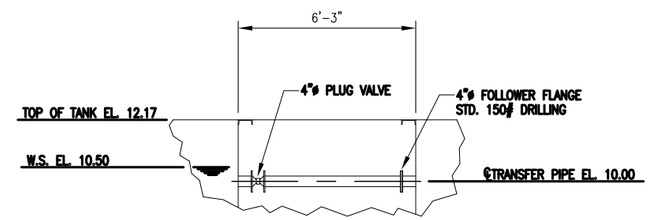
NEBULA MULTISTAGE BIOFILM SYSTEM
STEEL TANK
PLAN VIEW (2)

NOTE:
TANK COVERS AND HAND RAILING NOT SHOWN

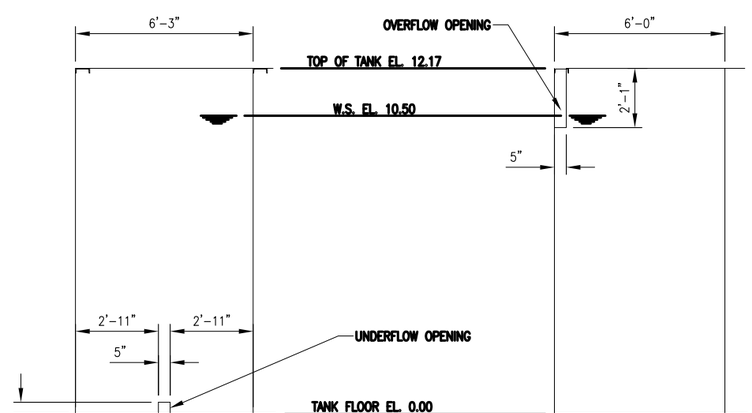


INFLUENT PIPE SECTION (5)

EFFLUENT PIPE SECTION (6)



TRANSFER PIPE SECTION (7)

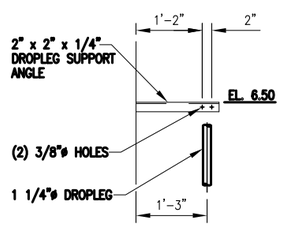


UNDERFLOW WALL OPENINGS SECTION (3)

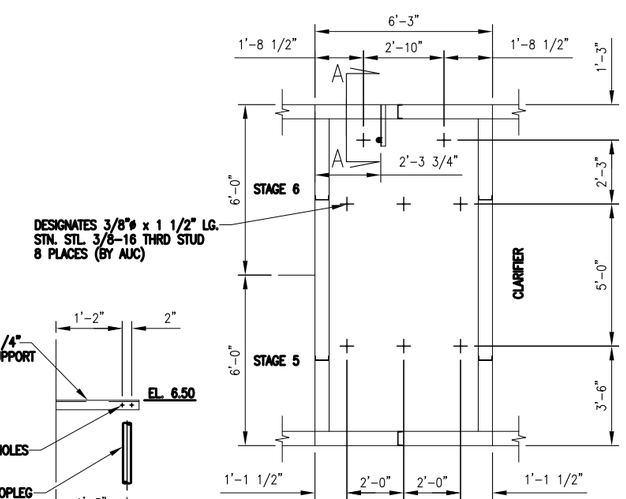
TYP 3 PLACES PER TANK

OVERFLOW WALL OPENING SECTION (4)

TYP 2 PLACES PER TANK



SECTION A–A



SLUDGE HOLDING TANK – ANCHOR SETTING
PLAN VIEW (7A)

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC

LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealc.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

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SHEET TITLE: STEEL TANK

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SCALE: NTS

PROJECT NO.

C-5

60% SUBMITTAL JANUARY 2020
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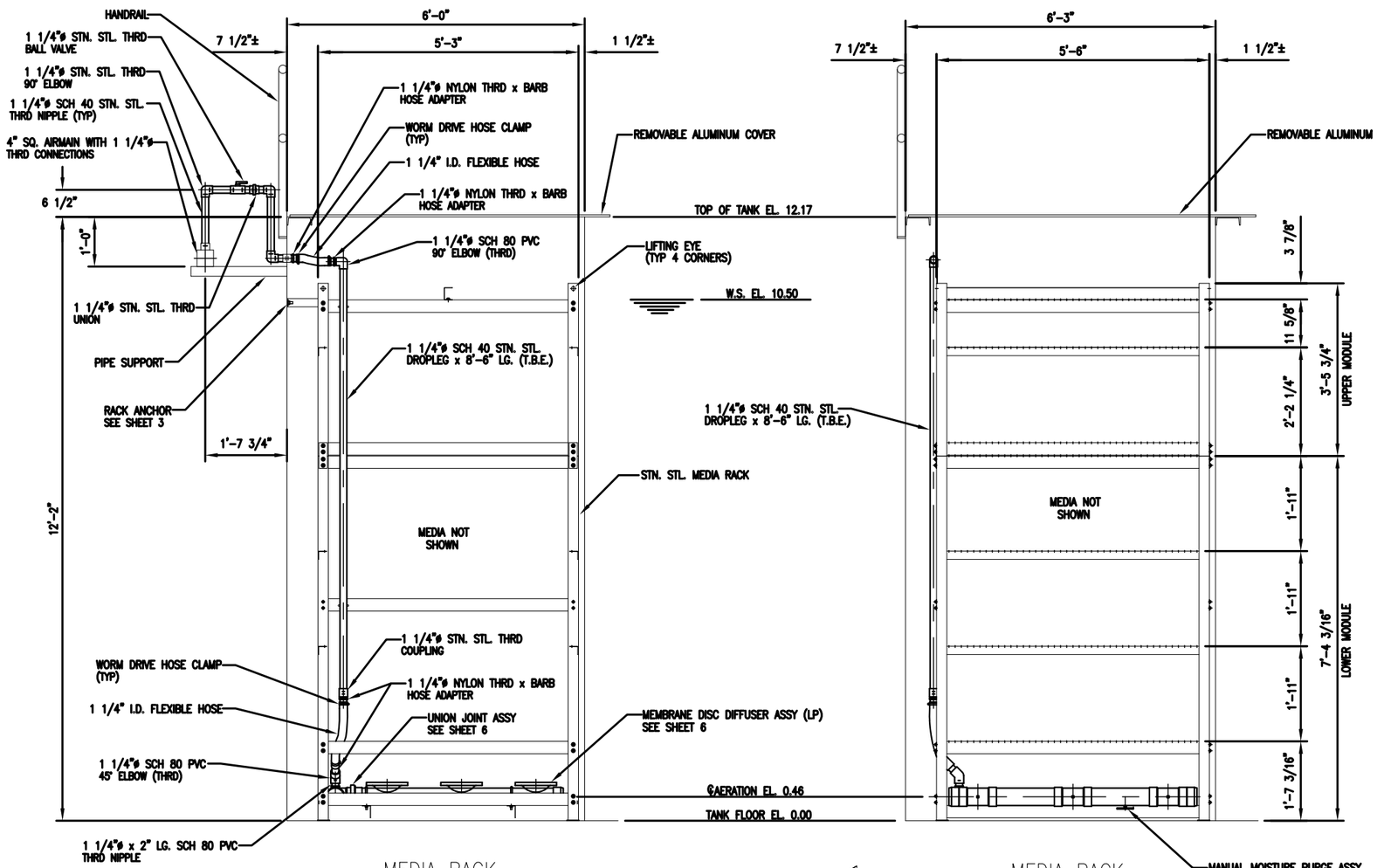
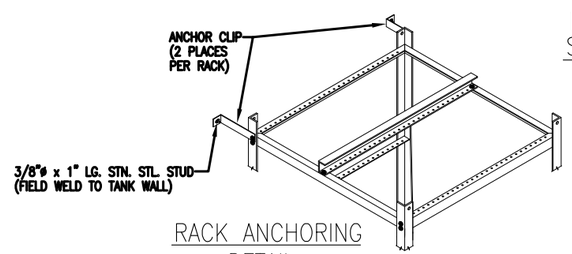


MEDIA RACK SECTION 8

MEDIA RACK SECTION 9



RACK ANCHORING DETAIL

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC

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KAILUA, HI 96734
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SHEET TITLE: SECTIONS 1

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SCALE: NTS

PROJECT NO.

C-6

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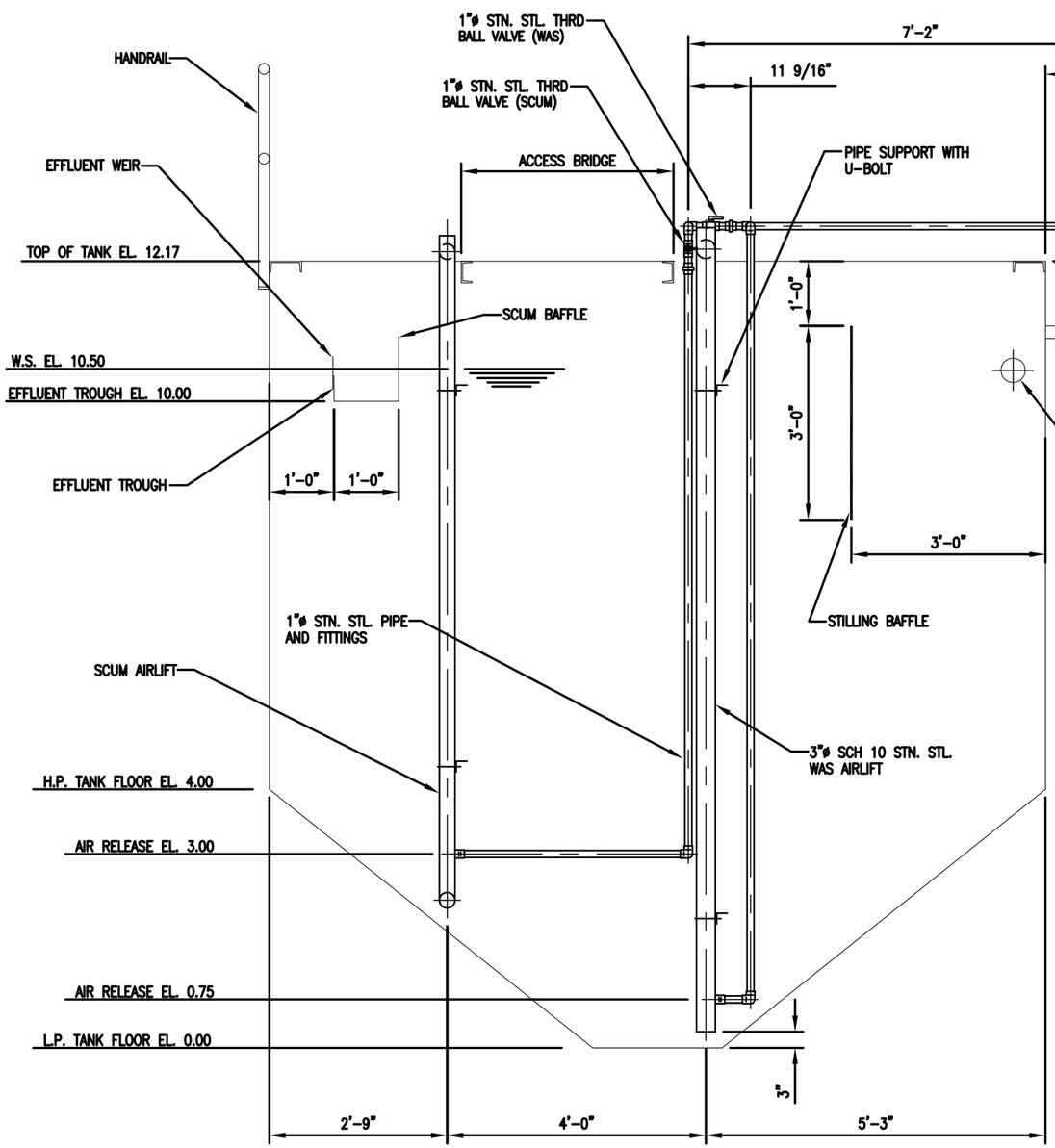
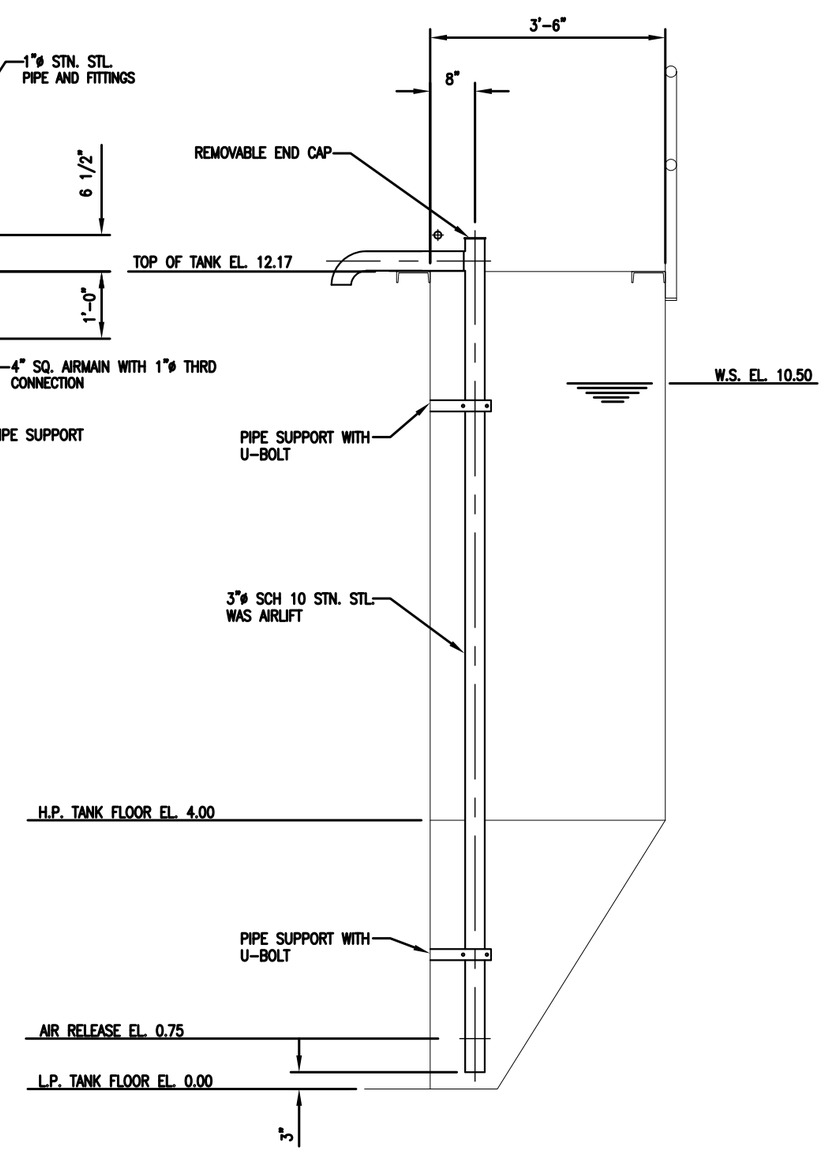


CLARIFIER/AIRLIFT SECTION 10



CLARIFIER/AIRLIFT SECTION 11

SYM	DESCRIPTION	DATE

LAULEA ENGINEERING, LLC

LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealc.com

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LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

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HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: SECTIONS 2

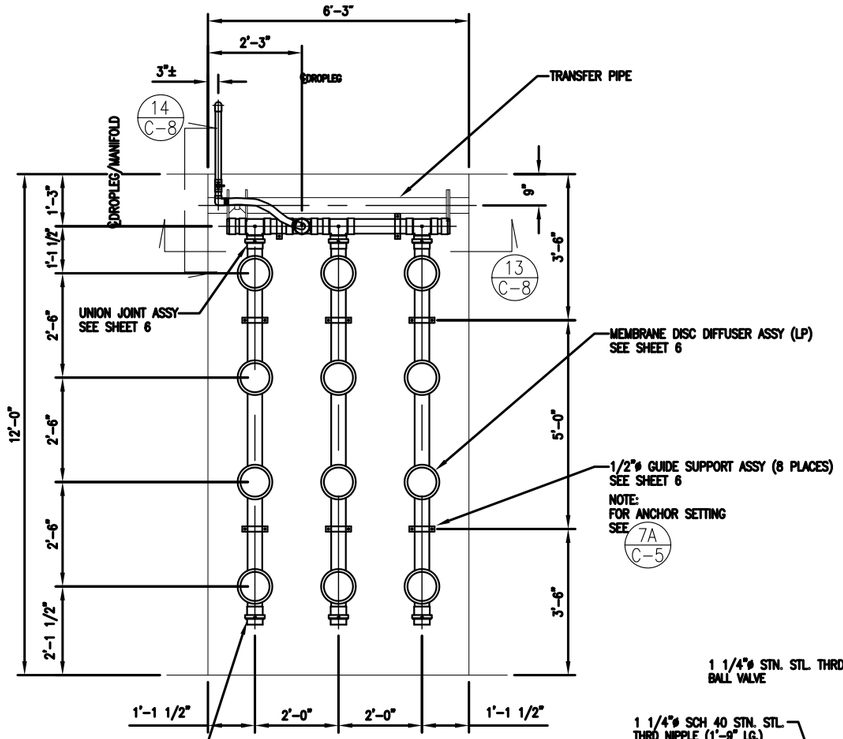
www.laulealc.com

SCALE: NTS

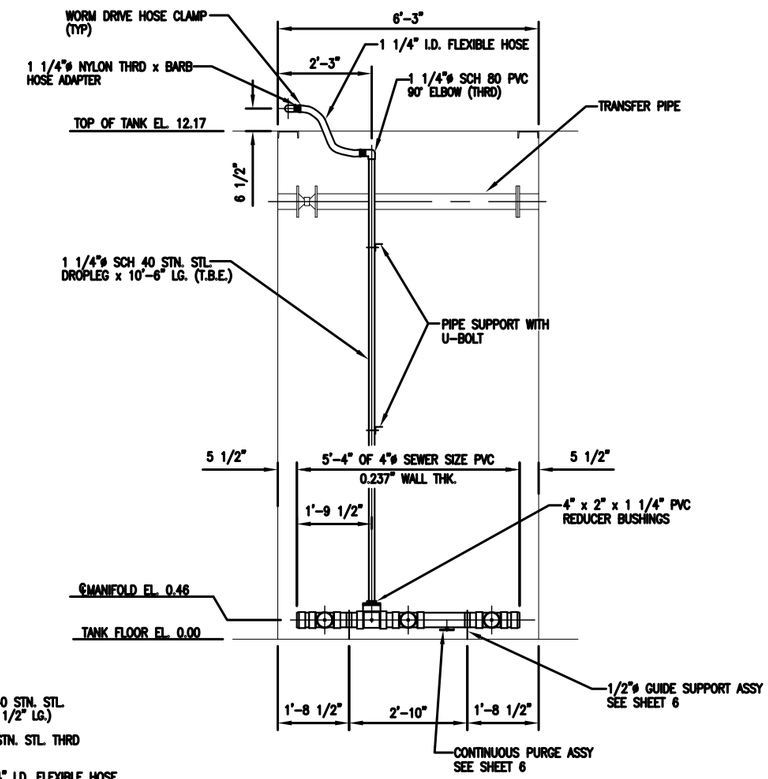
PROJECT NO.

C-7

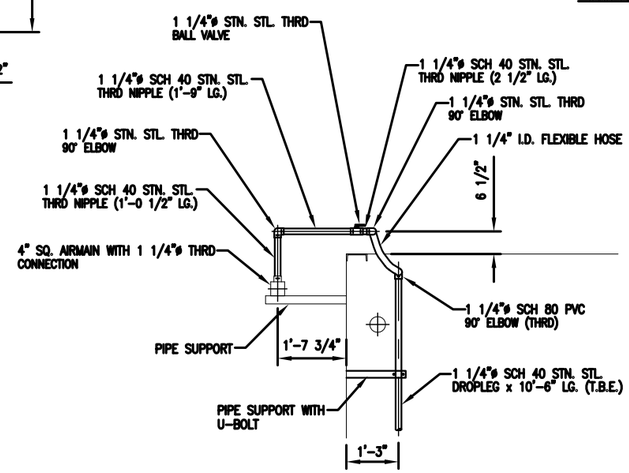
60% SUBMITTAL JANUARY 2020
NOT FOR CONSTRUCTION



SLUDGE HOLDING TANK
AERATION GRID
PLAN VIEW 12



SLUDGE HOLDING TANK
AERATION GRID
SECTION 13



SLUDGE HOLDING TANK
AERATION GRID
SECTION 14

SYM	DESCRIPTION	DATE

LAULEA
ENGINEERING, LLC

LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.lauleallc.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

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53-567 KAMEHAMEHA HWY
HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: AERATION GRID DETAILS 1

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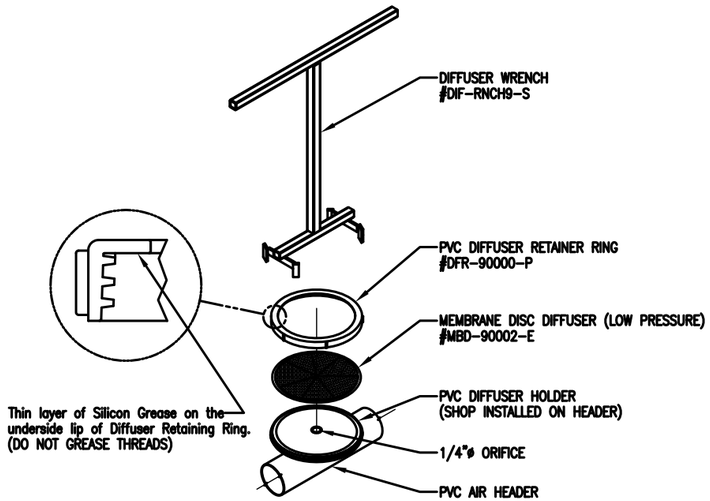
SCALE: NTS

PROJECT NO.

C-8

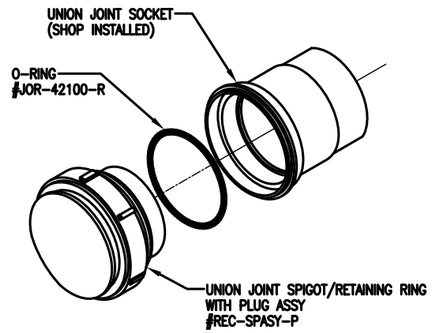
60% SUBMITTAL JANUARY 2020
NOT FOR CONSTRUCTION



MEMBRANE DISC DIFFUSER ASSY (LP)

Installation Procedure:

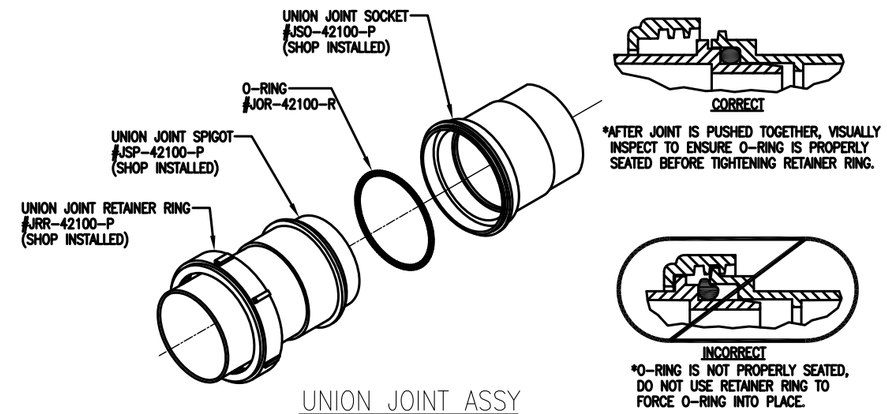
1. Place the Membrane Disc Diffuser on the Diffuser Holder.
2. Place a thin layer of the provided Silicon Grease on the underside lip of the Diffuser Retainer Ring. CAUTION– Do not place grease on the thread of the Diffuser Retainer Ring.
3. Install the Diffuser Retainer Ring on the Diffuser Holder and tighten "Hand–Tight". CAUTION– Do not cross thread the Diffuser Retainer Ring.
4. Use the Diffuser Wrench and continue tightening the Diffuser Retainer Ring to a position approx. 1/4 – 1/3 maximum past "Hand–Tight".



PVC REMOVABLE END CAP

Installation Procedure:

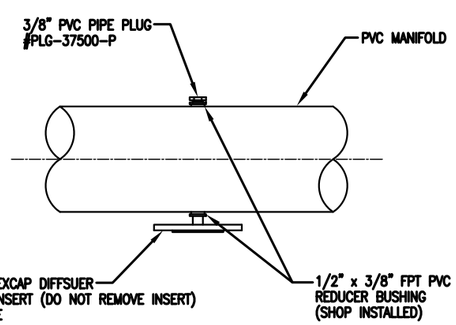
1. See "Union Joint Assy"



UNION JOINT ASSY

Installation Procedure:

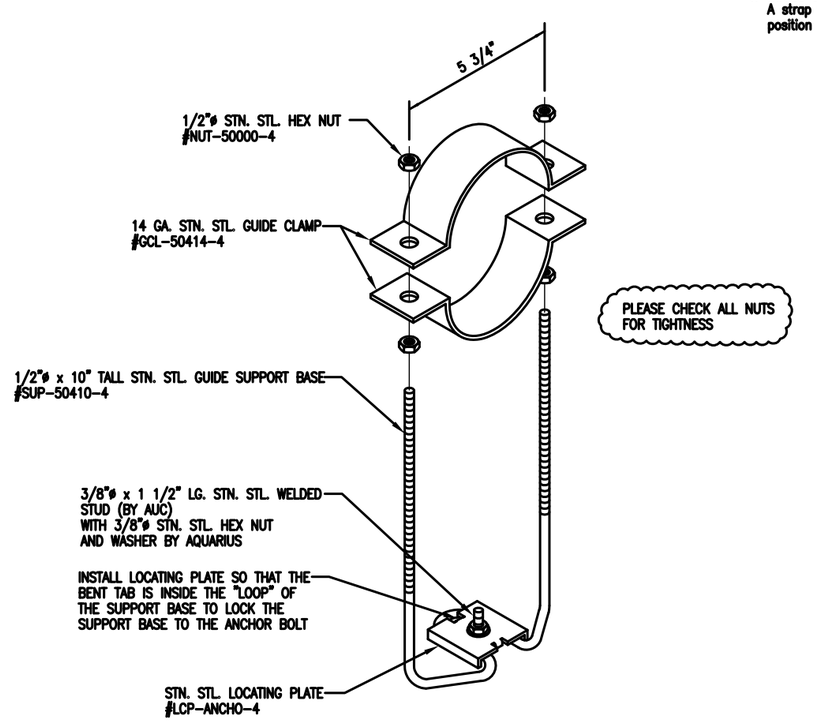
1. Lubricate the O–ring with a solution of water and household dish soap. CAUTION– Do not use grease to lubricate the O–ring.
2. Place the O–ring on the Union Joint Spigot of the Union.
3. Join the Union Joint Spigot to the Union Joint Socket, compressing the soap lubricated O–ring into the Union Joint Socket.
4. Thread the Union Joint Retainer Ring "Hand–Tight" to the Union joint Socket. A strap wrench can be used to continue tightening the Retainer Ring to a position approx. 1/4 maximum past "Hand–Tight".



CONTINUOUS PURGE ASSEMBLY

Installation Procedure:

1. Apply teflon tape or pipe putty to threads of Flexcap Diffuser, install into bushing at invert of pipe and hand tighten.
2. Apply teflon tape or pipe putty to threads of pvc pipe plug, install into bushing at top of pipe and tighten with wrench.



1/2"ø GUIDE SUPPORT ASSY

SYM	DESCRIPTION	DATE

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PO BOX 907
KAILUA, HI 96734
www.laulealc.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

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PAT'S AT PUNALU'U WWTW REPLACEMENT
53-567 KAMEHAMEHA HWY
HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

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C-9

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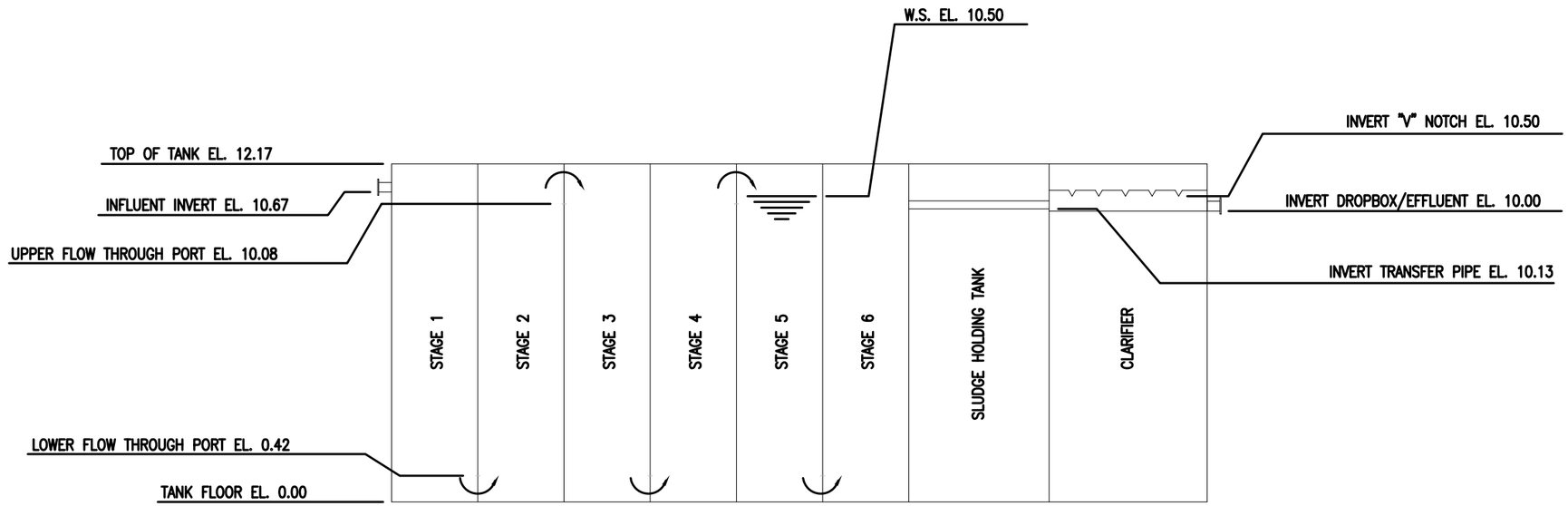

MULTISTAGE FIXED BIOFILM SYSTEM
HYDRAULIC PROFILE

NOT TO SCALE
(RACK COVERS NOT SHOWN)

SYM	DESCRIPTION	DATE

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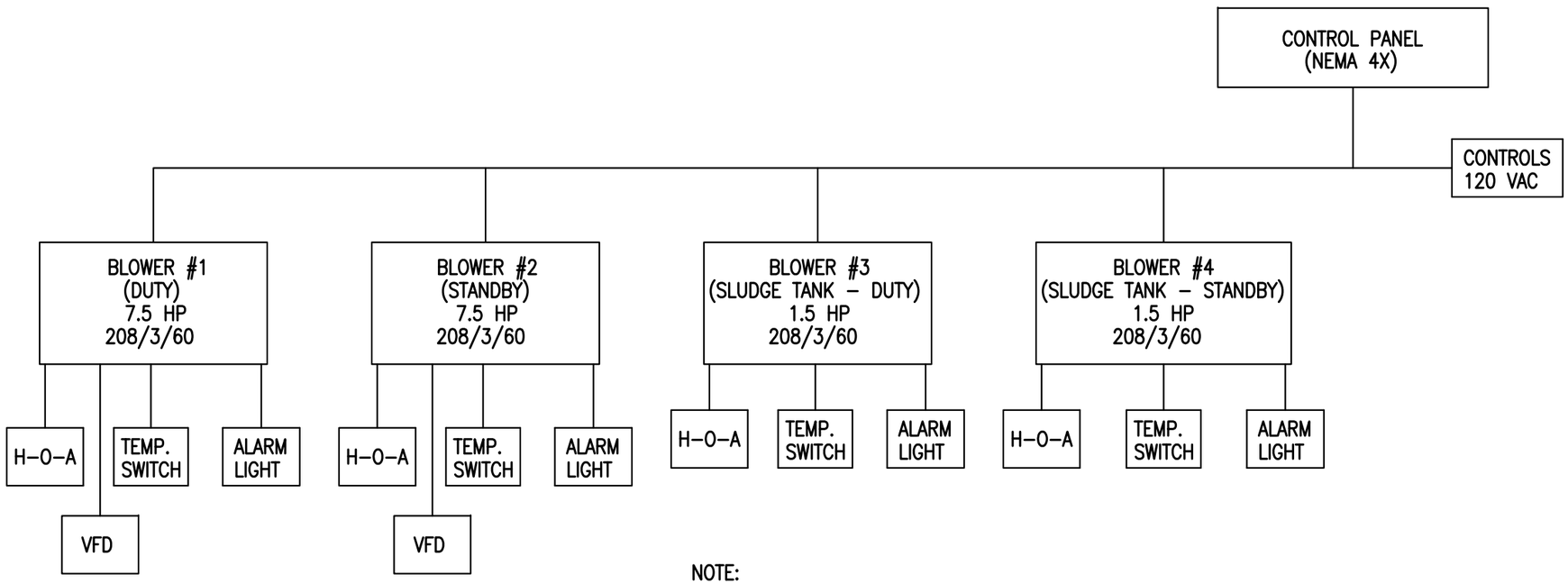

NOTE:
VERIFY ALL ELECTRICAL WORK COMPLIES
WITH NEC, AND SPECIFICALLY NEC 110.11

MULTISTAGE FIXED BIOFILM SYSTEM
CONTROLS AND INSTRUMENTATION DIAGRAM

NOT TO SCALE

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SHEET TITLE: CONROLS AND INSTRUMENTATION DIAGRAM

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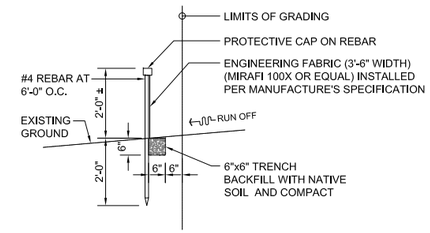
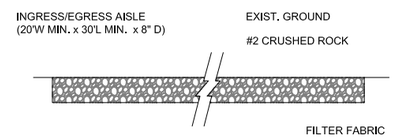


TYPICAL SILT FENCE DETAIL

NOT TO SCALE



INGRESS/EGRESS AISLE DETAIL

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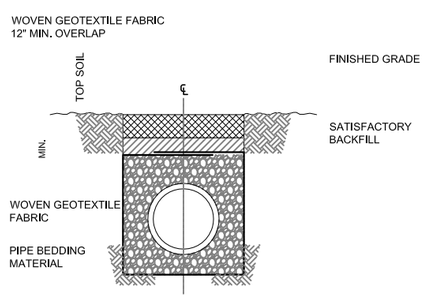

SEWER LINE TRENCH DETAIL

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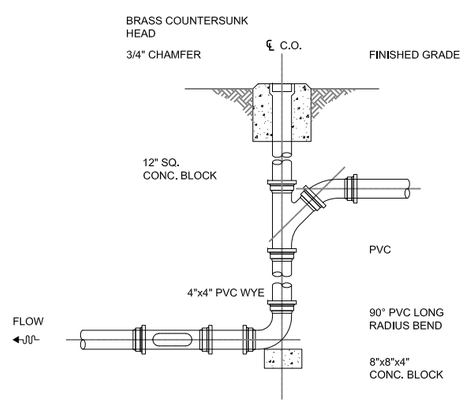
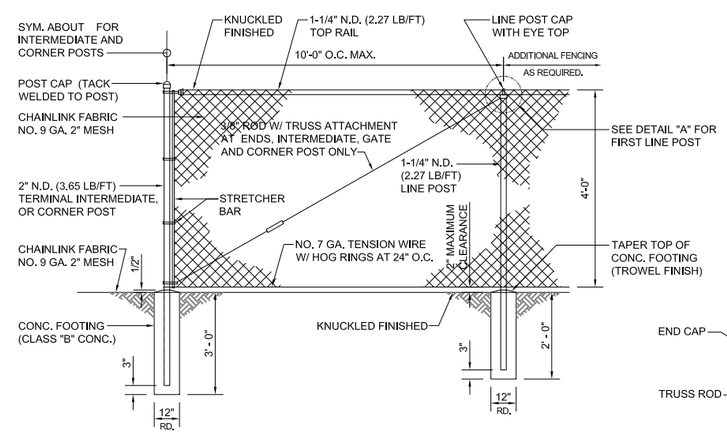


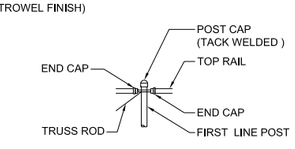
DROP SEWER CLEAN OUT TO GRADE DETAIL

NOT TO SCALE



TYPICAL 4' CHAIN LINK FENCE DETAIL

NOT TO SCALE



DETAIL "A"

SYM	DESCRIPTION	DATE

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LAULEA ENGINEERING LLC
PO BOX 907
KAILUA, HI 96734
www.laulealic.com

WESLEY J. WONG
LICENSED PROFESSIONAL ENGINEER
NO. 14805-C
HAWAI'I U.S.A.

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HAU'ULA, OAHU, HAWAII 96717
TMK: (1) 5-3-008:002

SHEET TITLE: DETAILS 1

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C-12

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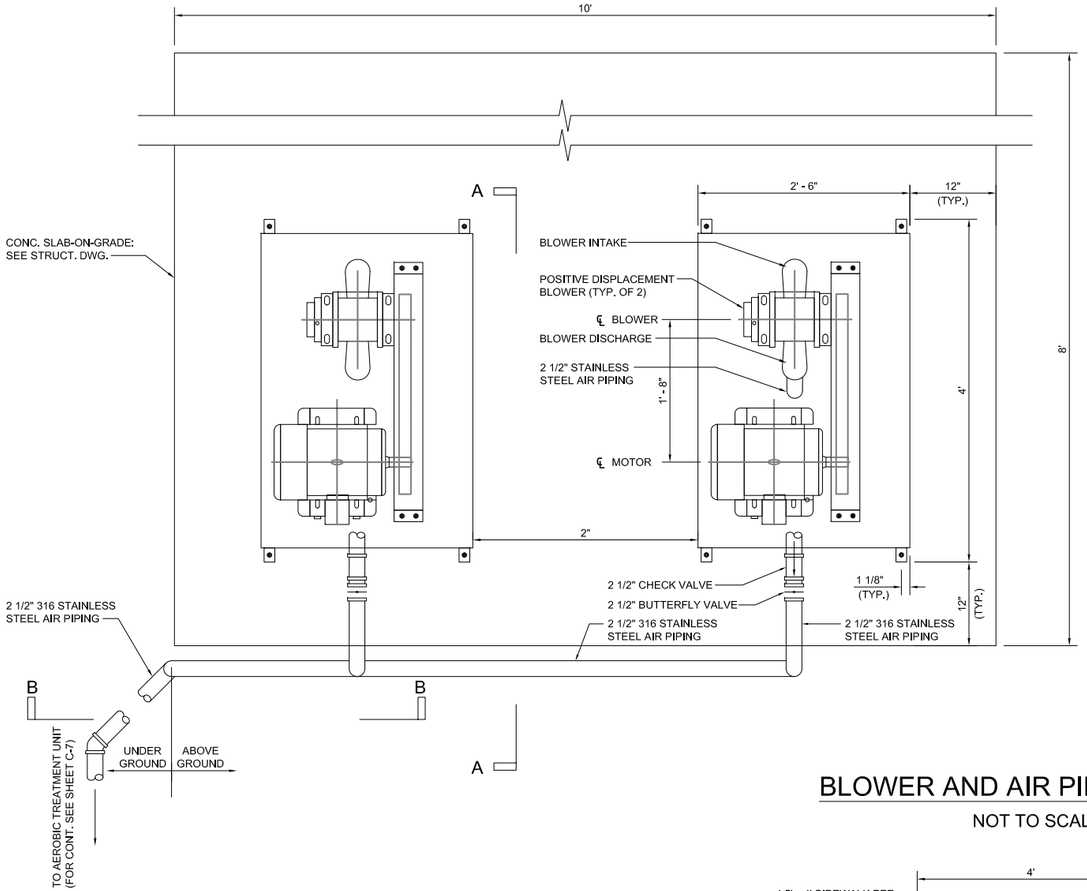
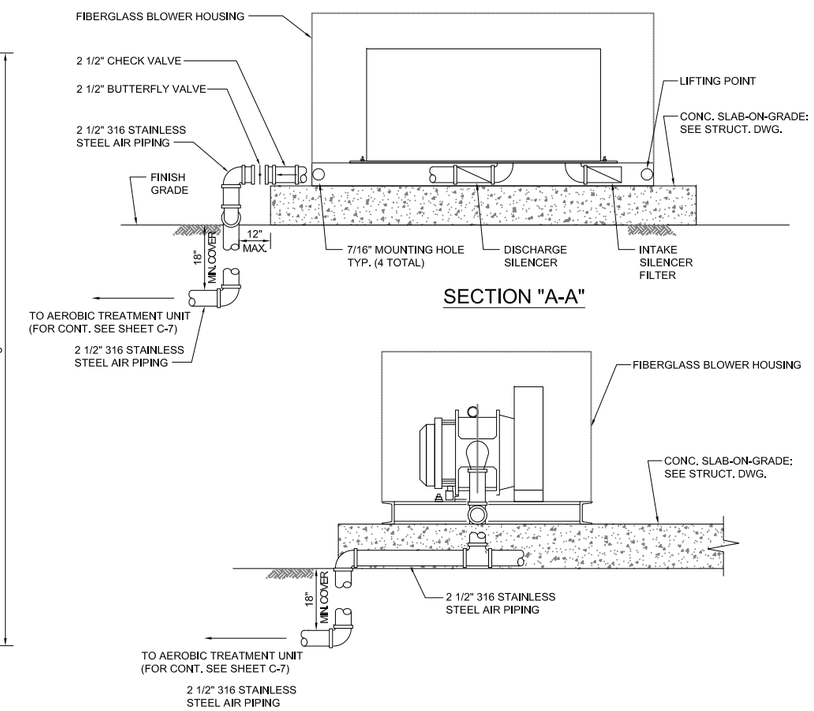
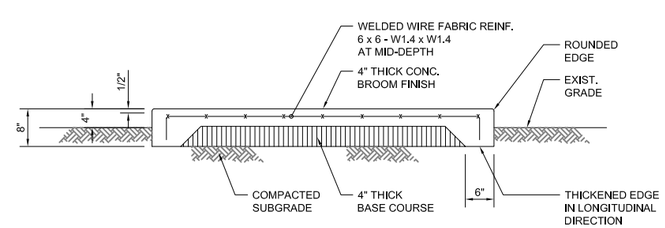




BLOWER AND AIR PIPING DETAIL

NOT TO SCALE



SIDEWALK DETAIL

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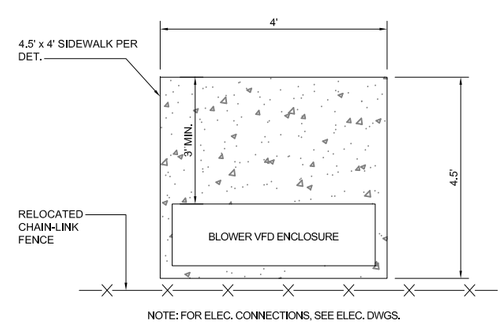

BLOWER VFD ENCLOSURE PLAN

NOT TO SCALE

SYM	DESCRIPTION	DATE

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LAULEA ENGINEERING LLC
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KAILUA, HI 96734
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HAU'ULA, OAHU, HAWAII 96717
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SHEET TITLE: DETAILS 2

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PROJECT NO.

C-13

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APPENDIX D

Injection Well Installation and Testing Report

Final Report for Injection Well No. 9

New Injection Well Underground Injection Control UIC

UIC Permit No. UO-1342

Pat's at Punaluʻu

Prepared for:

Pat's at Punaluʻu
Association of Apartment Owners of Pat's at Punaluʻu
53-567 Kamehameha Highway
Hauʻula, Hawaiʻi 96717

Prepared by:

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

INTERA Incorporated
74 Kihapai Street
Kailua, Hawaiʻi 96734
808-386-6853

Final Report for Injection Well No. 9

New Injection Well Underground Injection Control UIC
UIC Permit No. UO-1342
Pat's at Punalu'u

Report Date: October 31, 2018

Prepared for:
Pat's at Punalu'u
Association of Apartment Owners of Pat's at Punalu'u
53-567 Kamehameha Highway
Hau'ula, Hawai'i 96717

Prepared by:
INTERA Incorporated
74 Kihapai Street
Kailua, HI 96734

This work was prepared by me or under my supervision

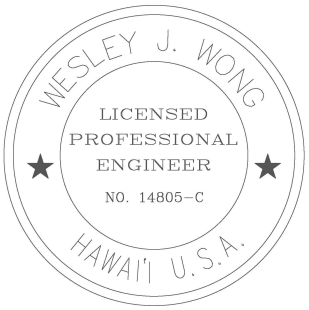
Signature _____ December 31, 2018 Expiration date

INTERA
GEOSCIENCE & ENGINEERING SOLUTIONS

Final Report for Injection Well No. 9

New Injection Well Underground Injection Control UIC
UIC Permit No. UO-1342
Pat's at Punalu'u

Prepared for:
Pat's at Punalu'u
AOAO Pat's at Punalu'u
53-567 Kamehameha Highway
Hau'ula, Hawaii 96717



Wesley Wong

Signature

April 30, 2020

Expiration date

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ACROYNMS AND ABBREVIATIONS

bgs	below ground surface
BOD	biochemical oxygen demand
DLNR	Department of Land and Natural Resources
DPP	Department of Planning and Permitting
DTW	depth to water
FEMA	Federal Emergency Management Agency
gpm	gallons per minute
IW	injection well
LUC	Land Use Commission
mg/L	milligrams per liter
mS/cm	milli-siemens per centimeter
MSL	mean sea level
PVC	poly vinyl chloride
Q	discharge in gallons per minute
s	head buildup in feet
TE	tidal efficiency
TSS	total suspended solids
USGS	United States Geological Survey

1.0 GENERAL INFORMATION

1.1 Facility Name

Pat's at Punaluʻu

1.2 Address

53-567 Kamehameha Highway, Hauʻula, HI 96717

1.3 Applicant (Permittee)

Mr. Leslie Harper
Board President
Association of Apartment Owners of Pat's at Punaluʻu
53-567 Kamehameha Highway
Hauʻula, Hawaiʻi 96717

2.0 PHYSICAL CHARACTERISTICS OF THE AREA

2.1 Location and Accessibility

The well is located on the northwestern (mauka and Kahuku-side) corner of the Pat's at Punaluʻu property (**Figure 2-1**). It is adjacent to the northern driveway and is accessible by vehicle.

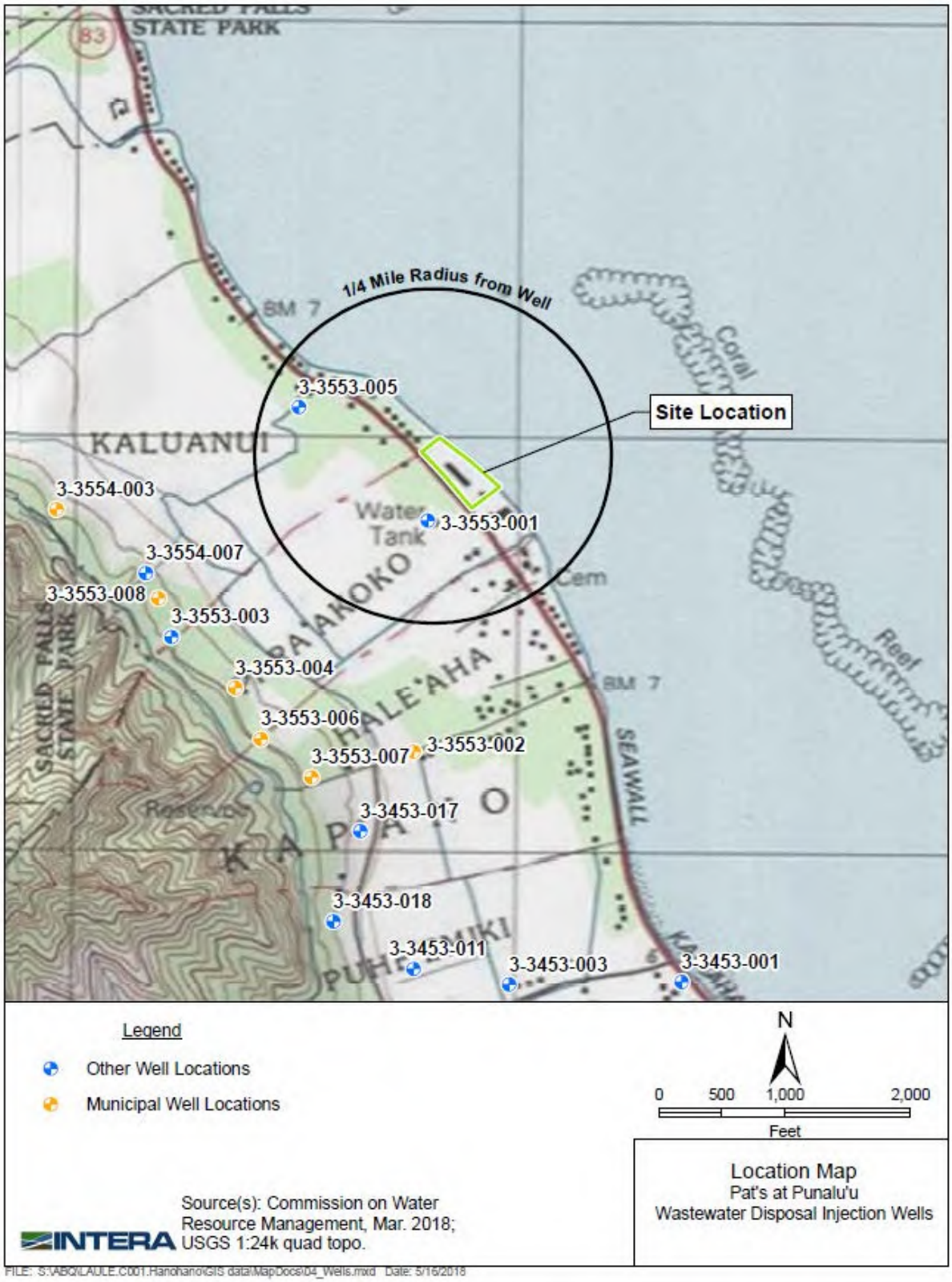

Figure 2-1 Location Map

2.2 Climate

The project site is located along the eastern shoreline of O‘ahu and is generally characterized by moderate, subtropical temperatures. Punalu‘u averages 61 inches of rain per year with higher monthly rainfall between October and April and lower rainfall accumulation in the summer months (**Figure 2-2**). Prevailing winds are northeasterly trade winds that generally blow directly on-shore off the ocean. Tradewinds occur 70 percent of the time, with a frequency range from approximately 45 percent in January to about 90 percent in July. Monthly average temperatures range from 70 degrees Fahrenheit in January to 78 degrees Fahrenheit in August. Average annual rainfall increases with elevation inland from the project site.

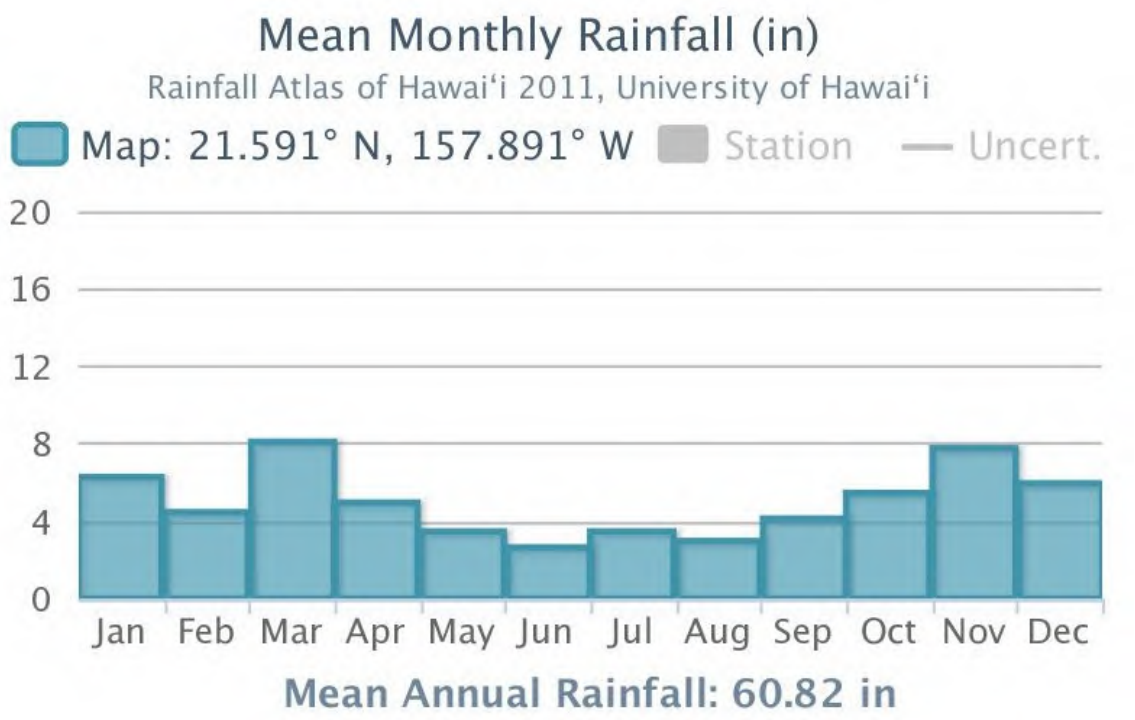

Figure 2-2 Monthly average rainfall (Giambelluca et al 2018)

2.3 Topography

The project site is essentially level. The ground elevation is approximately 6 to 8 feet above sea level (**Appendix A Site Plan**).

2.4 Geologic and Foundation Condition

Pat's at Punaluʻu is located on Holocene and Pleistocene sedimentary deposits of the Windward Oʻahu coastal plain. The sedimentary deposits are generally known as Caprock. Caprock is composed of marine, estuarine and fluvial consolidated and unconsolidated sediments. The sediments can be coral, sand dunes, lagoonal sands and mud and terrigenous alluvium. The Punaluʻu caprock overlies the Koʻolau Basalt. The HAR Chapter 11-23 defines caprock as:

"Caprock" means a geological formation or formations composed of terrigenous or marine sediments deposited over a formation or formations of volcanic origin. Caprock is substantially less permeable than volcanic formations, and is considered a "confining material".

The caprock in the Punaluʻu area is mostly composed of beach sands, lagoonal silty sand, muds, clays with occasional coral layers. **Figures 4-1a** and **4-1b** show the geologic log for Well #9.

The foundation conditions at the site are suitable for injection wells.

2.5 Earthquake Considerations

Oʻahu has been designated as Seismic Zone D_0 **(Figure 2-3)** according to the nomenclature of the International Building Code (USGS 2018). According to the Federal Emergency Management Agency (FEMA 2018) there could be "very strong shaking" in this zone with slight to great damage. Although buildings may be subject to damage, there will not be a significant seismic hazard to the injection well and no special considerations are necessary for seismic hazard.

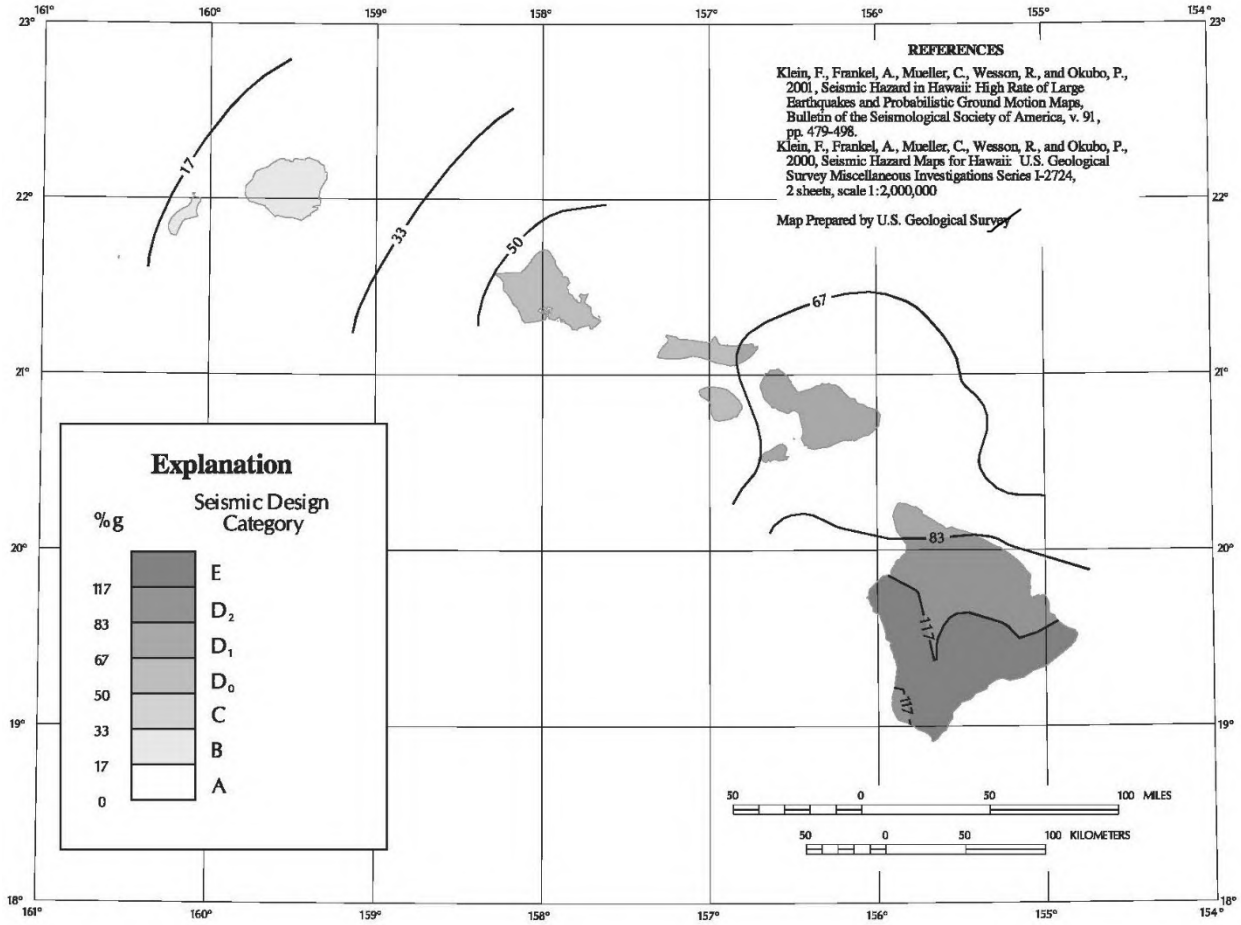

FIGURE R301.2(2) SEISMIC DESIGN CATEGORIES
- SITE CLASS D (continued)

Figure 2-3 Map showing seismic zones in Hawai‘i (USGS 2018)

2.6 Flood Potential Including Tsunami and Inundation Zones

Pat’s at Punalu‘u is within the tsunami evacuation zone according to the National Oceanographic and Atmospheric Administration (**Figure 2-4**). The residential condominium and all the condominium infrastructure are within the tsunami evacuation zone.

Pat’s at Punalu‘u is in flood zone AE or the 100-year flood zone (1% annual chance flood; DLNR 2018) See **Appendix B** for the Flood Hazard Assessment Report.

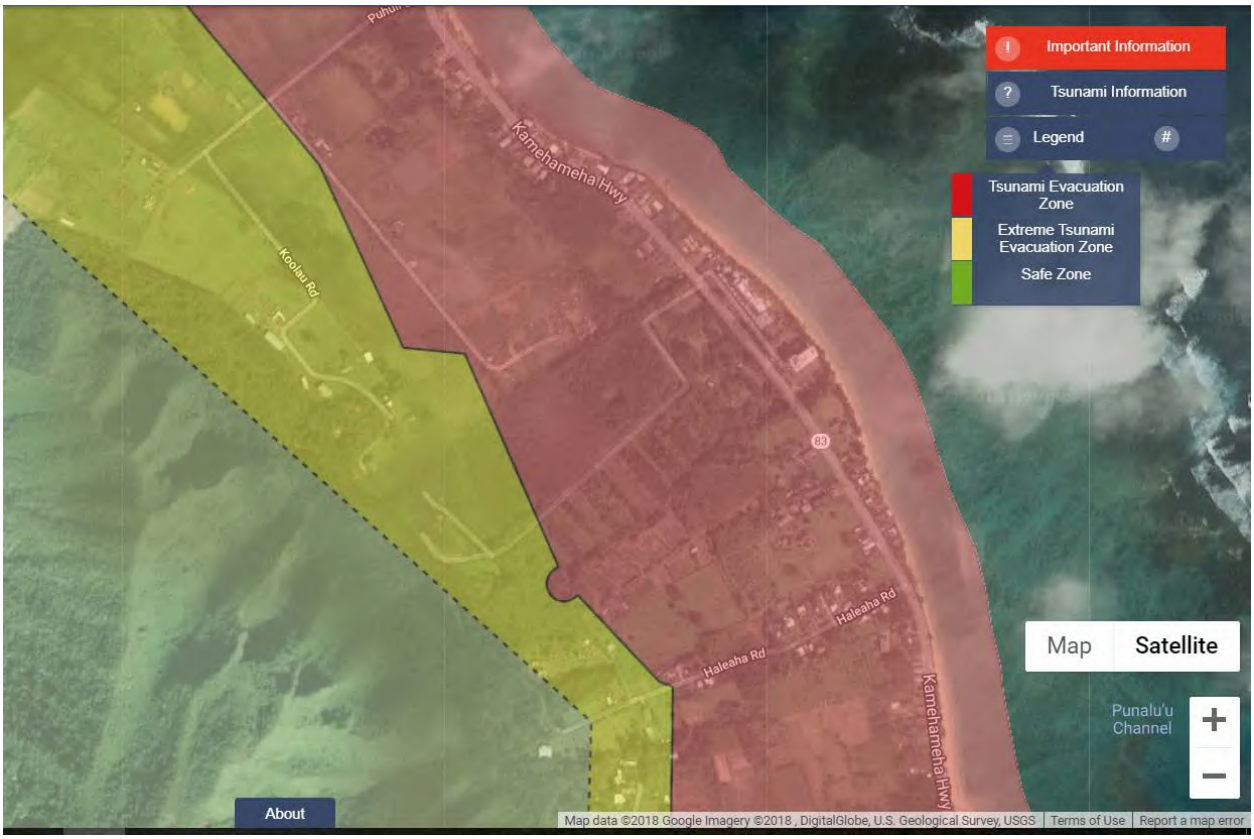

Figure 2-4 Tsunami Evacuation Map (NOAA 2018b)

2.7 Conformance with Land-use planning and Zoning Regulations

The parcel for Pat's at Punalu'u is zoned A-2 according to the City and County of Honolulu (**Figure 2-5**). The title for the A-2 map designation is "Apartments, Medium-density". The current land use conforms with zoning regulations.

The project site is in the is in the Urban State Land Use District (**Figure 2-6**). Condominium and apartment use conform to the urban land use district.

Figure 2-5 City and County of Honolulu Zoning Map (DPP 2018)

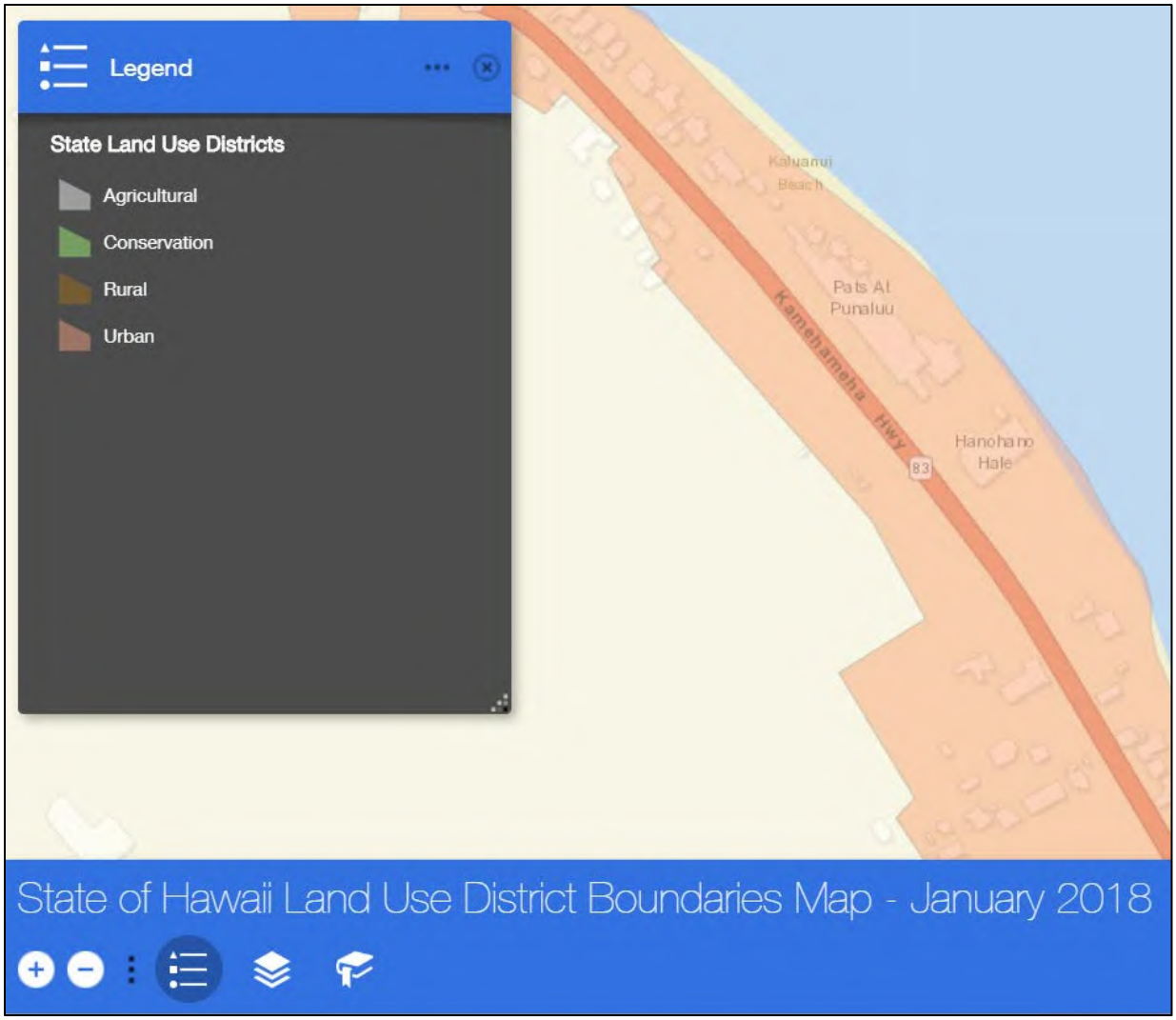

Figure 2-6 land use district map (LUC 2018)

2.8 Sensitive Environments, Natural or Community-related

As far as we know, there are no sensitive environments, natural or community-related, on the Pat's at Punalu'u property that will be affected by the proposed use.

3.0 INJECTION WELL SYSTEM

3.1 Actual Number of Injection Wells Constructed or Modified

There is a total of eight permitted injection wells on the property. The condominium association permitted and drilled one additional well, Well No. 9, for on-site treated wastewater disposal. Well No. 5 is permitted and scheduled to be re-drilled to function as a backup well for No. 9.

Pats at Punaluʻu, located on the shore in Punaluʻu near Hauʻula, contains eight (8) permitted class V, Subclass AB Injection wells designated as Injection Wells 1-8, that receive intermittent wastewater effluent, treated by the wastewater treatment plant, from the main condominium building. The site is used entirely for residential purposes. The wastewater treatment works onsite consists of gravity flow sewer lines connecting the main building to a 1,200-gallon lift station, which then pumps the effluent to the following elements in sequential order: a 1,200-gallon preloader used as an equalization basin, a 54,627 -gallon activated sludge aeration tank and a chlorinator. The treated, chlorinated effluent is then disposed by means of the eight injection wells with a permitted BOD and TSS of no more than 60mg/L. The effluent was tested on January 18, 2018 and the BOD was 14 mg/L and the TSS was 13.6 mg/L. The permitted design capacity of the system is 42,500 gallons per day. The treated, chlorinated effluent will be disposed of by means of Well #9 when the well is approved.

3.2 Date of Construction or Modification

Well construction and testing of Well #9 started on September 11, 2018 and was finished on October 10, 2018.

3.3 Security from Unauthorized Access

The well is on Pat's at Punaluʻu property. There is security staff on duty from 6 am to 3 am, seven days a week. The wellhead will be secured with a heavy steel plate or manhole cover.

3.4 Site Plan (drawn to scale) Showing Location of Constructed or Modified Injection Well

See **Appendix A.**

3.5 Description of any Change from the Permit Application

Figure 3-1 shows the as-built construction of the well.

The approximate ground elevation at the site is 7.7 feet (changed from 9 feet in the permit application).

The completed well depth is 75 feet below ground surface (permit stated 90 feet). The well was drilled to 87 feet bgs. As casing was installed, cuttings in the well settled and the cased depth is 75 feet bgs.

The permit application stated that there would be 47 square inches per linear foot open space in the casing. The actual open space in the Schedule 80 flush-joint PVC casing is 45.3 square inches per linear foot.

The permit stated that there would be 8-feet of solid casing including 3-feet of stickup. The asbuilt was 4 feet of solid casing with 0-feet of stickup.

The permit stated that 3/8” to 1/8” rounded pea gravel would be used in the annular space. This was not available. We used 3/8” to 5/8” rounded silica rock.

The as-built depth of the cellar is 3 feet. The permit stated 4 feet.

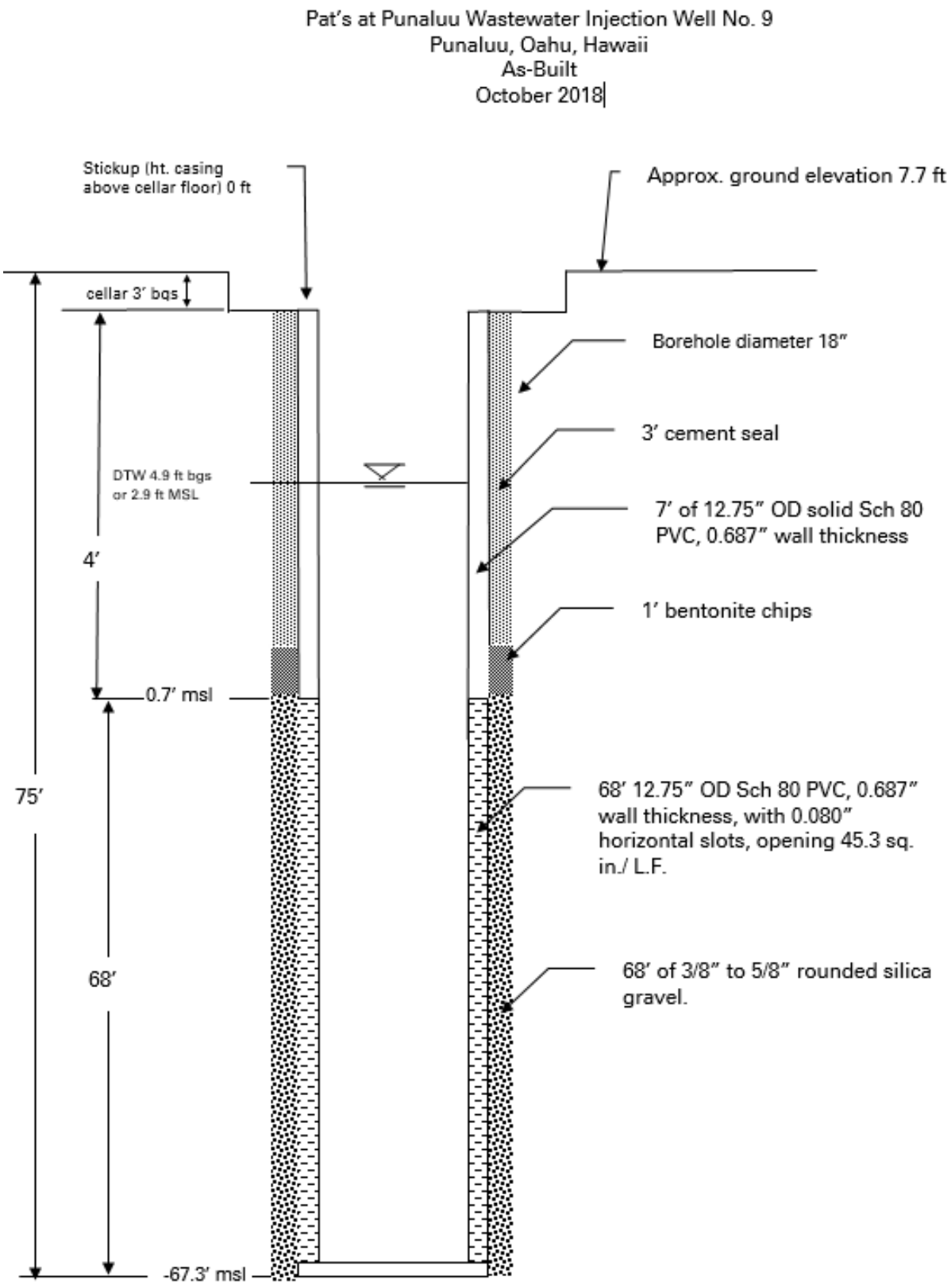

Figure 3-1 Injection Well No. 9 As-built

4.0 HYDROGEOLOGIC CHARACTERISTICS

4.1 Well log (geologic profile) by geologist

See **Figures 4-1a** and **4-1b** for the well log.

Project: Pat's at Punaluu IW#9			*Client:* Pat's at Punaluu
Address, City, State 53-567 Kamehameha Hwy, Hauula, HI 96717			*Drilling Contractor:* Precision Well Drilling
Logged By: Kevin Gooding	Date	*Started:* 9/11/2018	*Total Depth of Boring:* 85 ft bgs
Drill Crew: Tomas Fernandez		*Completed:* 10/10/2018	*Elevation:* 7.7 ground level ft MSL
		Well completed 75 ft bgs	*Notes* drilled 0-5 ft auger, 5-13 auger and mechanical bit
	Groundwater Depth: DTW 4.3 bgs 9/14/18		drilled 13-85' mud rotary log compiled from drill cuttings

Depth bgs (feet)	Sampled interval (ft)	Graphic Log	Lithology **Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifierm color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.
0	0-5		0-2 organic topsoil
			2-5 medium grained calcareous sand with shells and concrete rubble
5	5-10		medium grained silty sand
10	10-15		medium grained silty sand, coral fragments up to 4" long
15	15-20		medium to coarse grained silty sand, coral fragments up to 4" long
20	20-25		coarse silty sand with 1/8" grains, angular coral fragments up to 2"
25	25-30		coarse silty sand with 1/8" grains, angular coral fragments up to 1"
30	30-35		coarse silty sand, 3/8" diameter coral and shell fragments,
35	35-40		coarse silty sand, 3/8" diameter coral and shell fragments,
40	40-45		coarse silty sand, >1" diameter coral fragments
45	45-50		coarse silty sand, >1/2" diameter coral fragments
50	50-55		coarse silty sand, >1/2" diameter coral fragments
55	55-60		coarse silty sand, >1.5" diameter coral fragments

Boring Log: Sheet 1 of 2

Figure 4-1a Geologic cuttings log from IW#9 Sheet 1

Project: Pat's at Punaluu IW#9				*Client:* Pat's at Punaluu
Address, City, State 53-567 Kamehameha Hwy, Hauula, HI 96717				*Drilling Contractor:* Precision Well Drilling
Logged By: Kevin Gooding	Date	*Started:* 9/11/2018		*Total Depth of Boring:* 85 ft bgs
Drill Crew: Tomas Fernandez		*Completed:* 10/10/2018		*Elevation:* 7.7 ground level ft MSL
		Well completed 75 ft bgs		*Notes* drilled 0-5 ft auger, 5-13 auger and mechanical bit
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Depth bgs (feet)	Sampled interval (ft)	Graphic Log	Lithology **Soil Group Name:** modifier, color, moisture, density/consistency, grain size, other descriptors **Rock Description:** modifierm color, hardness/degree of concentration, bedding and joint characteristics, solutions, void conditions.
60	60-65		fine silty sand, 1/4" coral fragments
65	65-70		fine silty sand, 1/4" coral fragments
70	70-75		silty clay
75	75-80		silty clay
80	80-85		silty clay

Boring Log: Sheet 2 of 2

Figure 4-1b Geologic cuttings log from IW#9 Sheet 2

4.2 Injection Testing

4.2.1 Hydraulic conductivity

The Zanger method as applied in Williams and Soroos (1973) was used to calculate hydraulic conductivity. This method can be used in confined and unconfined aquifers. The head buildup data from the long-term constant rate injection test was used in the Zanger calculation. The hydraulic conductivity calculated using the long-term injection test data was 8.2 ft/day. **Table 4-1** shows the calculations and **Table 4-2** shows the range of hydraulic conductivity values obtained from the step buildup test and long-term tests.

The hydraulic conductivity values obtained from the step build-up test are comparable with the long-term test. 8.2 ft/day is also comparable with other published values. Fetter (1988) indicated a range between about 0.5 and 50 ft/day for silty sands. Hunt (1996) wrote that lagoonal sands varied from 1 to 500 ft/day.

ZANGER METHOD		parameter		r(h)=2piD/ln(D/r(d)	K=Q/(2pi*s(w)*r(h))
Depth	D =	70	ft	96	**8.2**
injection rate	Q =	24.3	gpm		
radius	r(d)=	0.708	ft		
head buildup	s(w)=	0.95	ft		
		Williams and Soroos (1973)			

Table 4-1 Zanger hydraulic conductivity calculations

Rate (gpm)	Head build-up in well (ft)	Calculated Hydraulic conductivity using the Zanger method (K, ft/day)
23.4 (long term test)	0.95	8.1
15 (step test)	0.75	6.4
22 (step test)	0.98	7.2
31 (step test)	1.13	8.8
46 (step test)	1.55	9.5

Table 4-2 Zanger hydraulic conductivity calculations at various injection rates

4.2.2 Graphical results of Injection Test

4.2.2.1 Stepped injection test

The step test was conducted between 13:40 and 16:07 on October 9, 2018. Each injection rate was run for a minimum of 30 minutes and there were four rates. **Table 4-3** shows the injection rates and respective head buildups.

rate (gpm	head buildup (ft)
15	0.75
22	0.98
31	1.13
46	1.55

Table 4-3 Step Test data

Figure 4-2 shows a hydrograph of the step test water levels. The increased head early in the first step was due to difficulties in adjusting the discharge rate. **Figure 4-3** shows a graph of rate versus head buildup. This graph is used to calculate the maximum injection rate in Section 4.2.3.

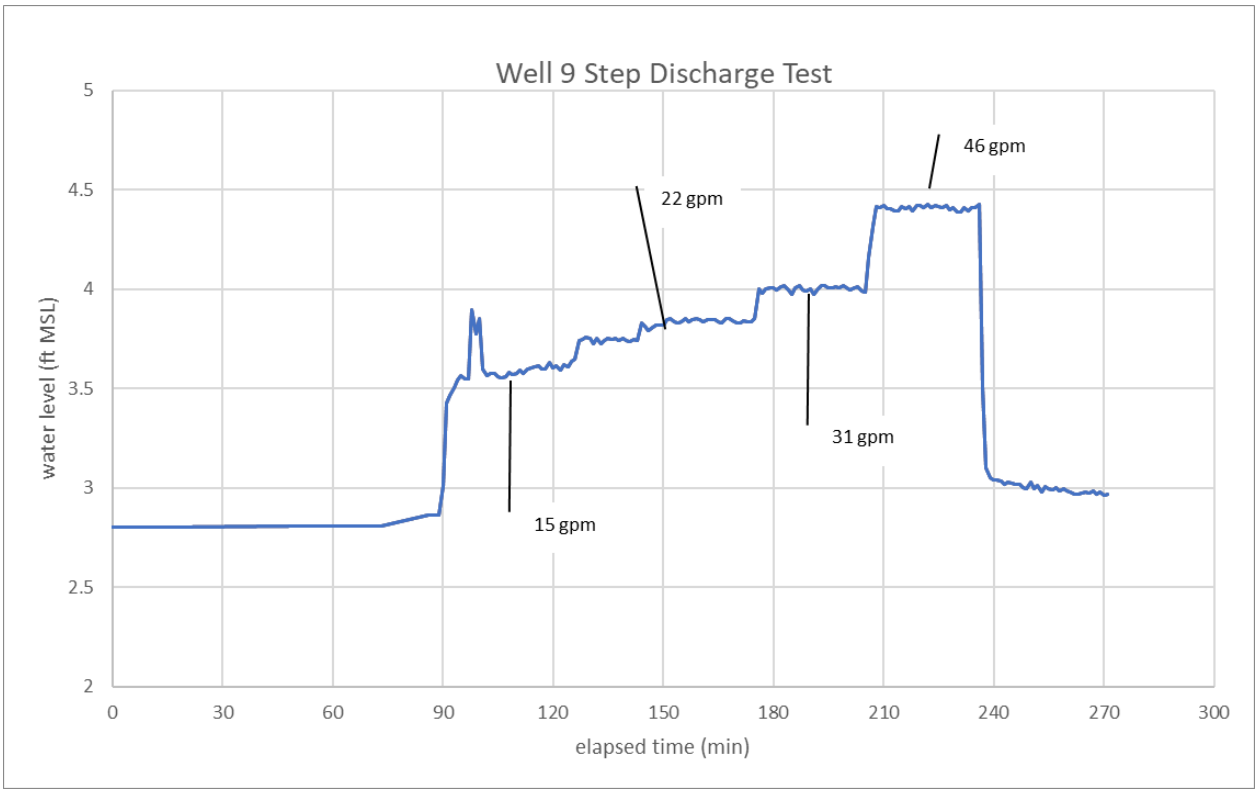

Figure 4-2 Hydrograph of the Step Discharge Test

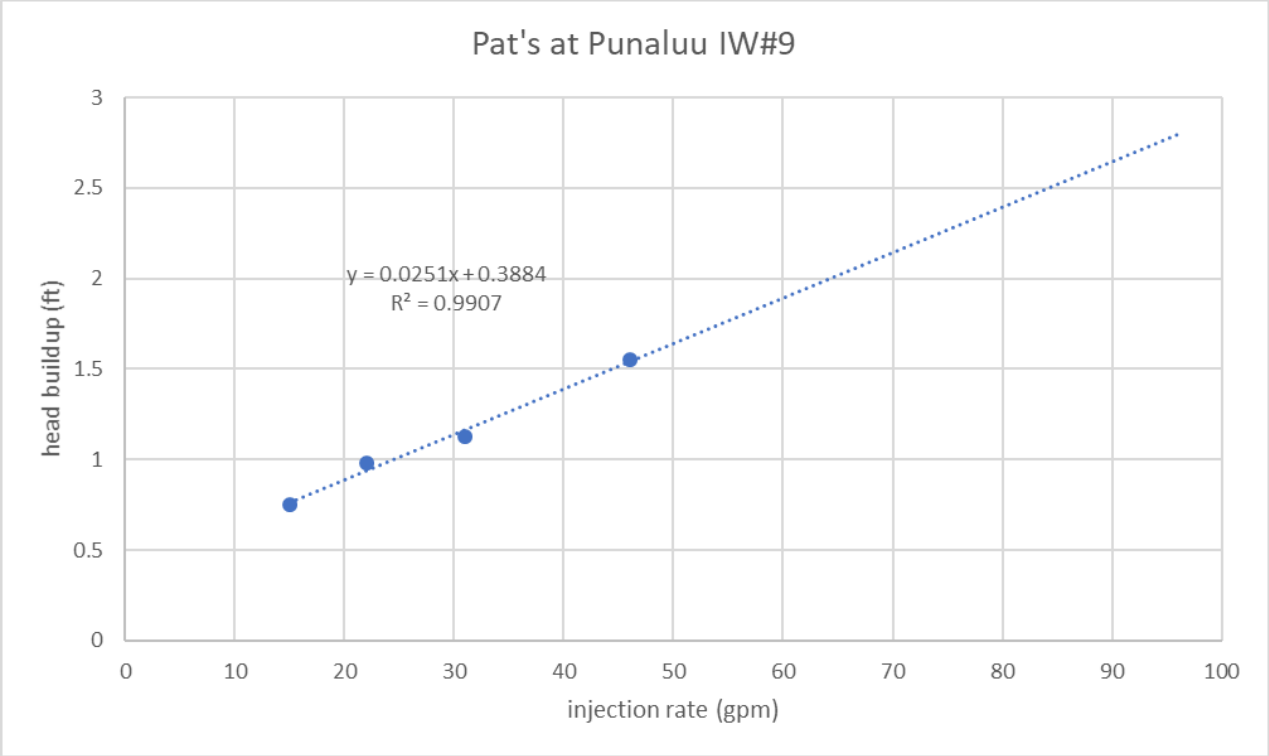

Figure 4-3 Injection rate versus head buildup from step discharge test

4.2.2.2 Long Term Injection Test

The long-term test was run for 14.5 hours between 16:42 on October 9 and 07:13 on October 10, 2018 at an average rate of 24.3 gpm. **Figure 4-4** shows a hydrograph of the groundwater levels during the test.

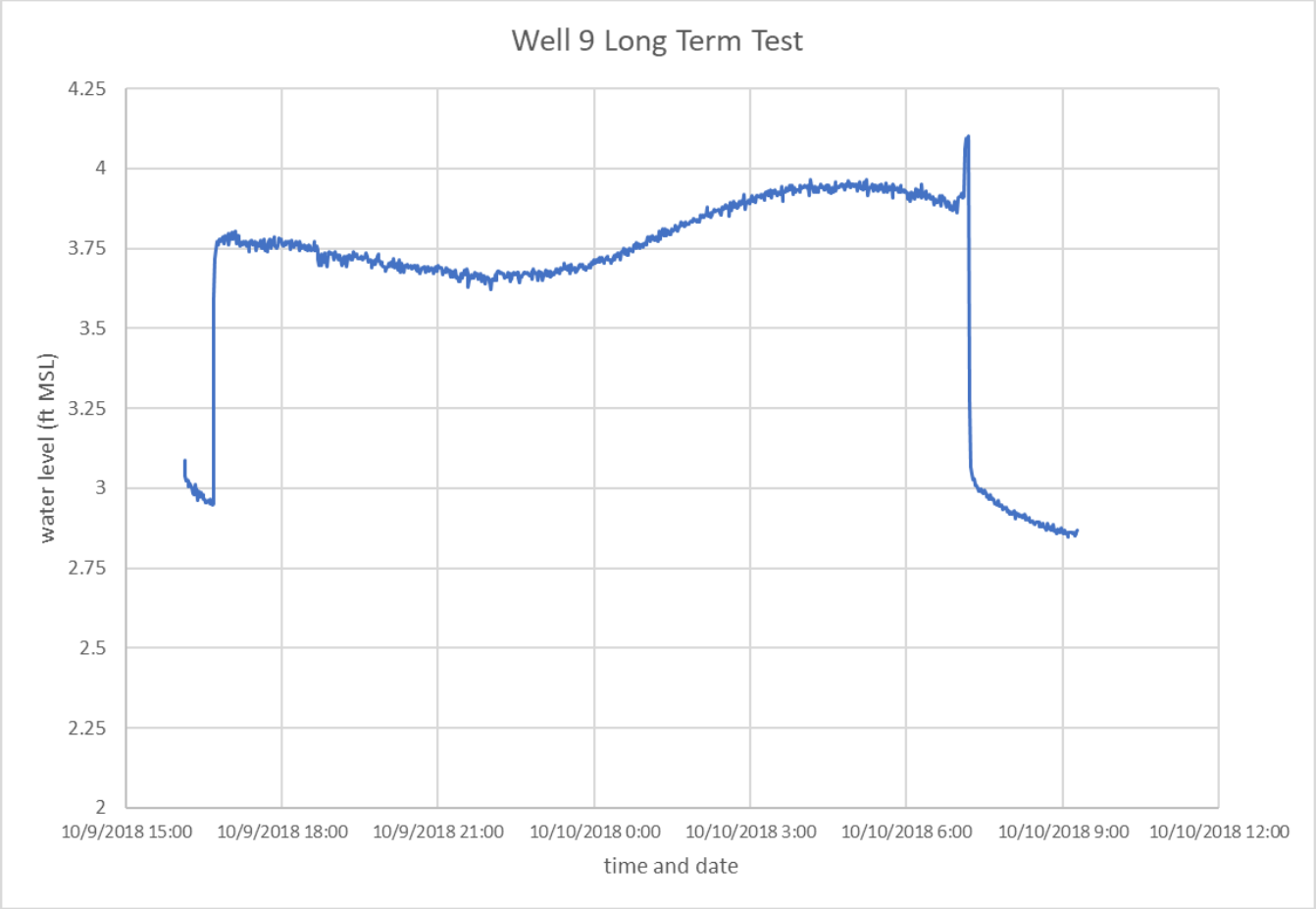

Figure 4-4 Hydrograph of Long Term Injection Test

4.2.3 Maximum Capacity

The operational maximum capacity was calculated using a linear regression of the results from the step build-up test (Section 4.2.2; **Figure 4-3**). The maximum capacity was conservatively estimated using the maximum predicted tidal influence of 0.39 feet and a factor of safety of 1.5 feet. The estimated maximum operational injection capacity is 104 gpm (**Table 4-4**).

Maximum Capacity		
Pat's at Punaluu Well #9		
tidal correction (max)	0.39	ft
safety factor	1.5	ft
Static Water Level	2.80	ft MSL
Ground elevation	7.7	ft MSL
maximum possible head buildup (DTW static)	4.90	ft
max possible minus tidal correction buildup DTW	4.51	ft
safety factor correction buildup DTW	3.01	ft
Linear best fit equation for step build-up (Figure X-x)	s=0.0251Q+0.3884	
Possible Head buildups	**s (ft)**	**Q (gpm)**
maximum	4.9	180
max minus tidal correction	4.51	164
max minus tidal correction & safety factor	3.01	104

Table 4-4 Maximum Capacity Calculations

4.3 Groundwater Characteristics

4.3.1 Water Levels

The first water level measured after the well was completed was 2.80 feet MSL, measured at 12:12 on 10/9/2018. Water level information was collected before, during and after the hydraulic well testing. Additional groundwater level data is presented in **Figures 4-2 and 4-4.**

4.3.2 Tidal Influence

Tidal efficiency may be expressed as TE = s_w/s_t, where s_w is the range of groundwater level fluctuation and s_t is the range of tidal fluctuation (Ferris and others 1962). Tidal efficiency is used to estimate the maximum effect of tide on the injection well.

Water levels were collected before, during and after the hydraulic testing of the well (**Figure 4-5**). Tidal data for was obtained for Station 1612480 Mokuoloe, Hawai‘i, from the National Atmospheric and Oceanographic Administration website (NOAA 2018a). During the data collection period the tidal range was 2.17 feet. During the same period, groundwater levels in the well varied by 0.29 feet. Therefore TE = 0.29 feet /2.17 feet = 0.13. Water level data used for the tidal influence calculation were collected during the long-term injection test, but this is not expected to influence the tidal calculation because the injection rate was constant. The maximum recorded tidal range at Moku o Lo’e Station (NOAA 2018) in Kaneohe Bay is 2.99 feet. Therefore, the maximum tidal range and tidal efficiency in Well No. 9 can be used to calculate the maximum expected groundwater level variation in Well No 9.

0.13 X 2.99 feet = 0.39 feet

Note that this is a conservative estimate of maximum tidal range based on the maximum and minimum recorded water levels at the station. The mean diurnal tidal range at Moku o Lo,e is 2.12 feet.

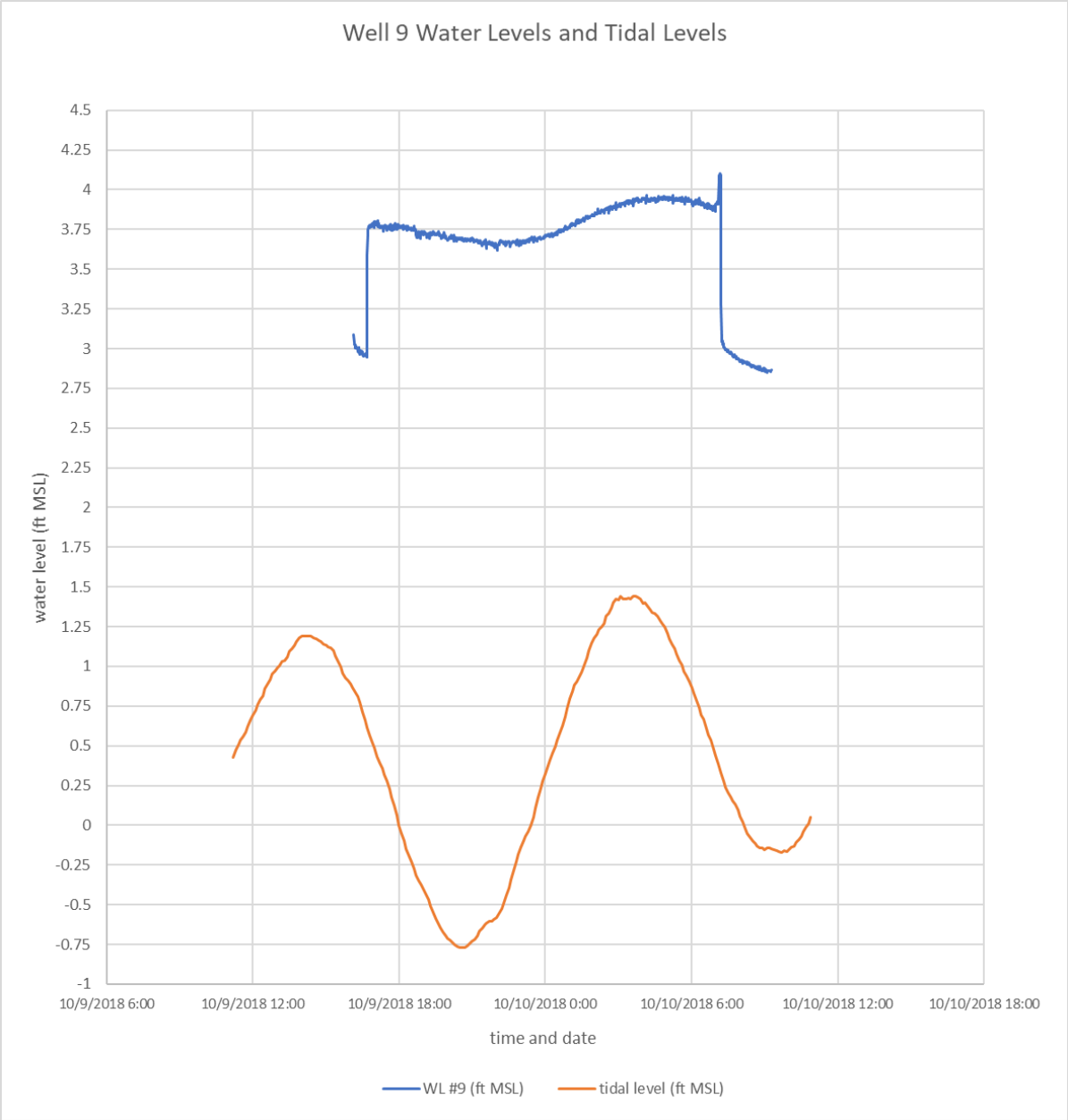

Figure 4-5 Hydrographs of tide levels and groundwater levels

4.3.3 Water Quality

Water samples were collected at 5-foot intervals in the open casing. The samples were collected between 12:30 and 13:20 on October 9, 2018. The samples were collected before the introduction of injection test water. The well had also been resting since October 5, 2018, when the well was completed. These samples were analyzed using a Horiba U-52 multi-parameter water quality meter for

specific conductivity and temperature. **Table 4-5** show the conductivity and temperature of the water column at 5-foot intervals. **Figure 4-6** shows the conductivity data graphed versus depth.

Elevation (ft MSL)	Temperature (deg C)	Conductivity (mS/cm)
-2.9	25.63	1.11
-7.9	25.83	1.09
-12.9	25.61	1.09
-17.9	25.47	1.09
-22.9	25.32	0.985
-27.9	25.6	0.969
-32.9	25.53	0.968
-37.9	25.33	2
-42.9	25.23	2.86
-47.9	25.18	2.49
-52.9	25.37	1.54
-57.9	25.21	5.93
-62.9	25.23	4.35
-65.9	24.96	7.74

Table 4-5 Vertical profile elevation, temperature and conductivity data

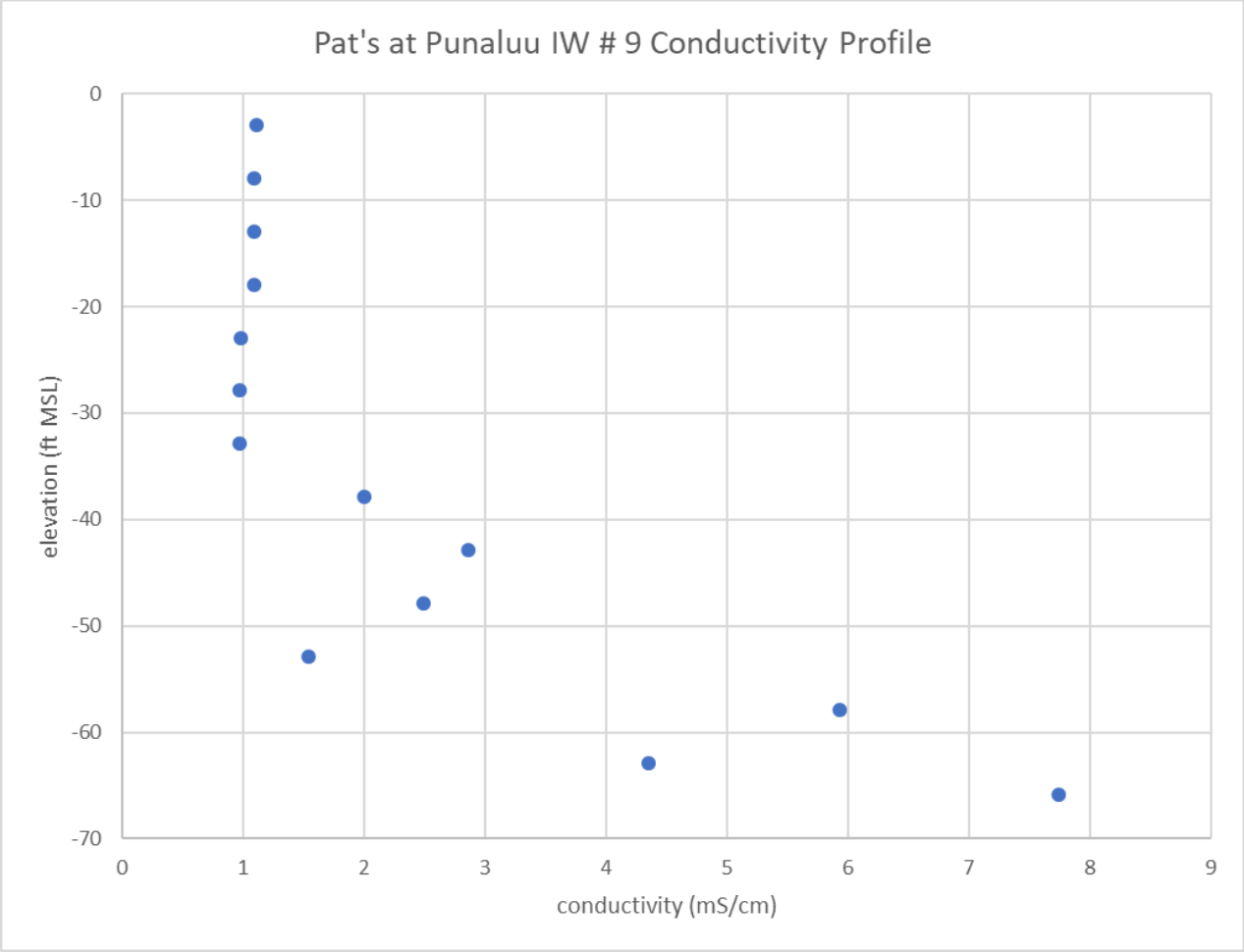

Figure 4-6 Graph of elevation versus conductivity in IW#9

Table 4-6 shows field water quality parameters collected on October 9, 2018 from 4 feet below water surface using a bailer. The analysis was conducted using a Horiba U-52 multi-parameter water quality meter.

Parameter	Measurement	Unit
specific conductivity	1.00	mS/cm
dissolved oxygen	8.68	mg/L
field pH	7.19	
field temperature	25.63	deg C

Table 4-6 Field-measured water quality data

The following samples were collected at 1045 on October 4, 2018 and delivered to AECOS, Inc for analysis (**Appendix C** and **Table 4-7**). The samples were collected during well development. The development pumping (discharge) rate was approximately 150 gpm.

Parameter	Measurement	Unit
Total dissolved solids	3580	mg/L
chloride	1700	mg/L
nitrate+nitrite as N	3.1	mg/L N

Table 4-7 Laboratory analysis data (**Appendix C**)

5.0 SPECIAL CONSIDERATION TO BE ADDRESSED

None.

6.0 REFERENCES

DLNR, Department of Land and Natural Resources, 2018. Flood Hazard Assessment Tool webpage accessed on October 12, 2018, http://gis.Hawaiʻinfip.org/fhat/.

DPP, Honolulu Department of Planning and Permitting, Honolulu Land Information System, 2018. Parcel and Zoning Information. Webpage accessed on October 12, 2018, http://cchnl.maps.arcgis.com/apps/Viewer/index.html?appid=bc24f3eb50f94f698d830aed9c428548.

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NOAA, National Oceanographic and Atmospheric Administration, 2018a, webpage accessed on 10/11/18, https://tidesandcurrents.noaa.gov/stationhome.html?id=1612480.

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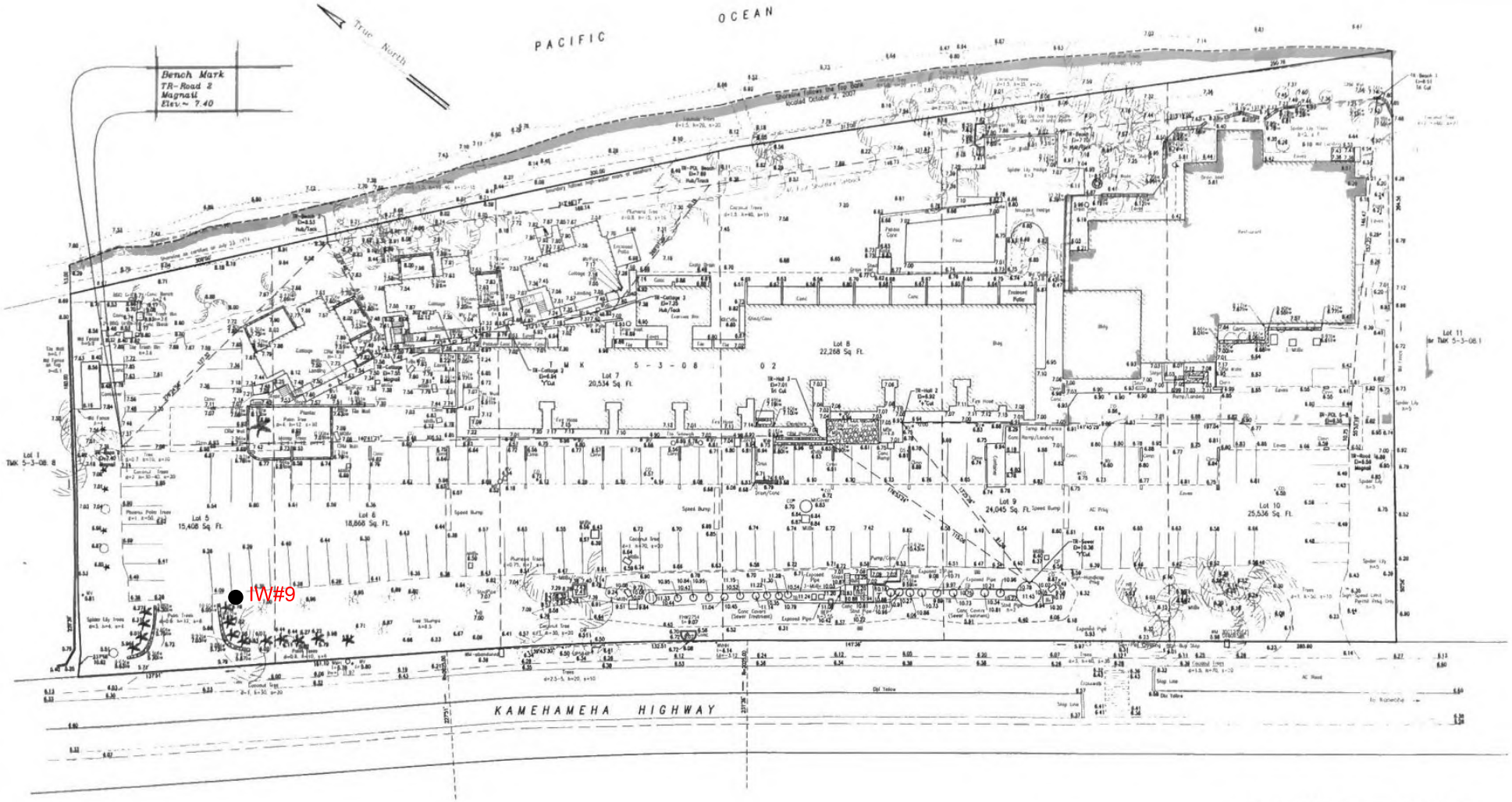
Williams, J.A. and R.L. Soroos, 1973, Evaluation of Methods of Pumping Test Analysis for Application to Hawaiʻian Aquifers, Technical Report No. 70. University of Hawaiʻi Water Resources Research Center, Manoa Hawaiʻi.

APPENDIX A:
SITE PLAN



NOTES:

Location of all underground utility lines and appurtenances from record information available and are approximate only.

Elevations refer to USGS BM, SS-5-3 Elev = 6.58, on Brass Disk.

Boundaries shown graphically in relation pipes found. No boundary study or stakeout performed.

MILES S. HORIE
LICENSED
PROFESSIONAL
LAND
SURVEYOR
No. 10007
HAWAII, U.S.A.

This work was prepared by me or under my direct supervision
Engineers Surveyors Hawaii, Inc

Miles S. Horie (Exp. 4-30-08)
Licensed Professional Land Surveyor
Certificate Number 10007

Topographic Survey Worksheet

of Lots 5-10, inclusive, as shown on Map 2
Land Court Application 1365
T.M.K. : 5-3-08 : parcel 2
at Papaakoko, Koolauloa, Oahu, Hawaii

Client: Andy Anderson
March 15, 2007
January 8, 2008

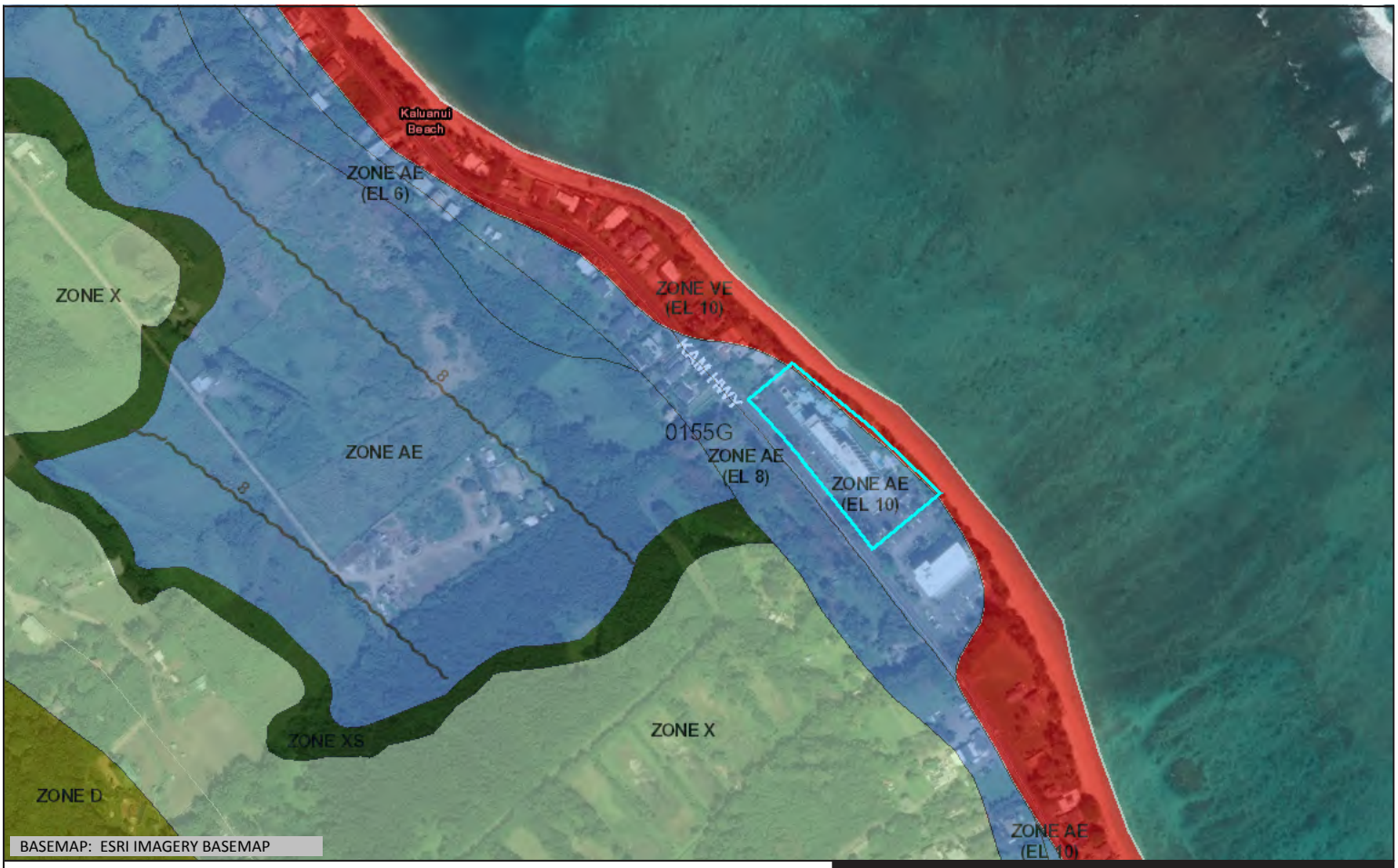
Job No. 56-66
Field Book : 1557

20 10 0 20 40
Graphic Scale in Feet

Engineers Surveyors Hawaii, Inc.

Civil Engineers ~ Land Surveyors ~ Construction Management

APPENDIX B:
FLOOD HAZARD ASSESSMENT REPORT



Flood Hazard Assessment Report

www.hawaiinfip.org

Property Information

COUNTY:	HONOLULU
TMK NO:	(1) 5-3-008:002
WATERSHED:	HALEHAA
PARCEL ADDRESS:	53-567 KAMEHAMEHA HWY HAUULA, HI 96717

Notes:

Flood Hazard Information

FIRM INDEX DATE:	NOVEMBER 05, 2014
LETTER OF MAP CHANGE(S):	NONE
FEMA FIRM PANEL:	15003C0155G
PANEL EFFECTIVE DATE:	JUNE 02, 2005

THIS PROPERTY IS WITHIN A TSUNAMI EVACUTION ZONE: YES
FOR MORE INFO, VISIT: http://www.scd.hawaii.gov/

THIS PROPERTY IS WITHIN A DAM EVACUATION ZONE: NO
FOR MORE INFO, VISIT: http://dlnreng.hawaii.gov/dam/

0 400 800 ft

Disclaimer: The Hawaii Department of Land and Natural Resources (DLNR) assumes no responsibility arising from the use, accuracy, completeness, and timeliness of any information contained in this report. Viewers/Users are responsible for verifying the accuracy of the information and agree to indemnify the DLNR, its officers, and employees from any liability which may arise from its use of its data or information.

If this map has been identified as 'PRELIMINARY', please note that it is being provided for informational purposes and is not to be used for flood insurance rating. Contact your county floodplain manager for flood zone determinations to be used for compliance with local floodplain management regulations.

FLOOD HAZARD ASSESSMENT TOOL LAYER LEGEND
(*Note: legend does not correspond with NFHL)*

SPECIAL FLOOD HAZARD AREAS (SFHAs) SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD - The 1% annual chance flood (100-year), also know as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. SFHAs include Zone A, AE, AH, AO, V, and VE. The Base Flood Elevation (BFE) is the water surface elevation of the 1% annual chance flood. Mandatory flood insurance purchase applies in these zones:

- **Zone A**: No BFE determined.
- **Zone AE**: BFE determined.
- **Zone AH**: Flood depths of 1 to 3 feet (usually areas of ponding); BFE determined.
- **Zone AO**: Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined.
- **Zone V**: Coastal flood zone with velocity hazard (wave action); no BFE determined.
- **Zone VE**: Coastal flood zone with velocity hazard (wave action); BFE determined.
- **Zone AEF**: Floodway areas in Zone AE. The floodway is the channel of stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without increasing the BFE.

NON-SPECIAL FLOOD HAZARD AREA - An area in a low-to-moderate risk flood zone. No mandatory flood insurance purchase requirements apply, but coverage is available in participating communities.

- **Zone XS (X shaded)**: Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.
- **Zone X**: Areas determined to be outside the 0.2% annual chance floodplain.

OTHER FLOOD AREAS

- **Zone D**: Unstudied areas where flood hazards are undetermined, but flooding is possible. No mandatory flood insurance purchase apply, but coverage is available in participating communities.

APPENDIX C:
AECOS WATER QUALITY ANALYSIS

AECOS, Inc.

45-939 Kamehameha Hwy, Suite 104 · Kaneohe, HI 96744
Telephone: (808) 234-7770 · Fax: (808) 234-7775 · aecos@aecos.com

CLIENT: Intera
41-038 Manana Street
Waimanalo HI 96795
ATTENTION: Kevin Gooding 808-382-6853
KGooding@intera.com

FILE No.:	2018-MI
REPORT DATE:	10/22/18
PAGE:	1 of 1

AECOS REPORT OF ANALYTICAL RESULTS

SAMPLE TYPE: Brackish water
DATE SAMPLED: 10/04/18
***AECOS* LOG No.:** 36715
DATE RECEIVED: 10/04/18

ANALYTE (UNITS)		Total Dissolved Solids (mg/L)	Chloride (mg/L)	Nitrate+Nitrite (mg/L)
	Method⇒	SM2540C	EPA 300.0	EPA 353.2
	Date / Analyst⇒	10/05-20/18 ml, jw	10/13/18 TA	10/18/18 TA
SAMPLE ID ⇩	Time sampled ⇩			
Pun Pats 9	3580	1700	3.1 *	

Project: Pats at Punaluu

* Compound was found in the blank and the sample

Ann Mello
for J. Mello, Laboratory Director

AECOS, Inc.

45-939 Kamehameha Highway Suite 104
Kaneohe, Oahu, HI 96744
Tel: (808) 234-7770 Fax: 234-7775

CHAIN OF CUSTODY FORM

PROJECT FILE No.:

LOG NUMBER [036715]

CLIENT: INTERA
ADDRESS: 94-038 Mamam St
Waimanalo HI 96795

CONTACT: Kevin Gooding
PHONE No.: ☎ 382-6853
Purchase Order No.: Pat's at Punaluu

☐ RUSH
☒ SEE REVERSE
SPECIAL INSTRUCTIONS

	☑	SAMPLE ID	SAMPLED DATE	SAMPLED TIME	SAMPLE TYPE	CONTAINER(S)		REQUESTED ANALYSES	PRESERVATION
1		PunPots 9	10/4/18	1045	Brackish Water	1	1L Poly	TDS, chloride	N/A-chill
2		PunPots 9	10/4/18	1045	↓	1	250mL Poly	Nitrate, Nitrite	H2SO4
3									
4									
5									
6									
7									
8									
9									
10									

CLIENTS PROVIDING SAMPLES TO THE LABORATORY SHOULD COMPLETE AS MUCH OF THE ABOVE FORM AS POSSIBLE, NOTE: NAME AND DATED SIGNATURE OF PERSON COLLECTING THE SAMPLE MUST BE ENTERED BELOW ↓. INFORMATION REQUESTED IN SHADED BOXES ABOVE TO BE FILLED IN BY THE LABORATORY.

SAMPLED BY: Kevin Gooding (PRINT NAME) DATE Oct 4, 2018
RELINQUISHED: (SIGNATURE) TIME 1340 DATE Oct 4 2018

RECEIVED BY: (SIGNATURE) DATE 20__ TIME
RELINQUISHED: (SIGNATURE OR INITIALS) DATE 20__ TIME

RECEIVED FOR LABORATORY: (SIGNATURE) DATE 10 4 2018 TIME 1340
RELINQUISHED: (SIGNATURE OR INITIALS) DATE 20__ TIME

COMMENTS: Temp = 21.8°C

PRECAUTIONS:

DISPOSAL:

RETURN SAMPLE TO CLIENT ☐

USE (BLACK) INK

APPENDIX D:

SIGNATORY AND CERTIFICATION STATEMENT FOR UNDERGROUND INJECTION CONTROL (UIC) SUBMITTALS

SIGNATORY AND CERTIFICATION STATEMENT
FOR UNDERGROUND INJECTION CONTROL (UIC) SUBMITTALS

Submitted Statement shall bear an original signature and date.
Photocopy signatures are unsatisfactory.

Facility Name: Pat's at Punaluu

e-Permitting Submission No. (if applicable): HND-TNJR-93ZK5

UIC No. (if assigned): UO-1342

Please check one:

- ☐ I certify that for a municipality, I am a principal executive officer or ranking elected official.
- ☐ I certify that for a state, non-federal or other public agency, I am a principal executive officer or ranking elected official.
- ☐ I certify that for a federal agency, I am the chief executive officer of the agency, or I am the senior executive officer having responsibility for the overall operations of a principal geographic unit of the agency.
- ☐ I certify that I am a general partner for a partnership.
- ☐ I certify that I am the proprietor for a sole proprietorship.
- ☐ I certify that I am a trustee for a trust.
- ■ I certify that for a corporation/association of apartment owners/home owners association, I am the President, Vice President, Secretary or Treasurer of the corporation/association of apartment owners/home owners association and in charge of a principal business function, or I perform similar policy or decision making functions for the corporation/association of apartment owners/home owners association.
- ☐ I certify that for a corporation, I am the manager of one or more manufacturing, production or operating facilities employing more than 250 persons or having gross annual sales or expenditures exceeding $25 million (in second-quarter 1980 dollars), and authority to sign documents has been assigned or delegated to me in accordance with corporate procedures.
- ☐ I certify that for a limited liability company (LLC), I am the Manager or a Member authorized to make management decisions for the LLC and am in charge of a principal business function, or I perform similar policy or decision making functions for the LLC.

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Signature: _____ Date: Oct 24/18

Name (Print): Leslie G. Harper Title: Board President

Company Name: AOAO Pat's at Punaluu

Address: 53-567 Kamehameha Highway, Hauula, HI 96717

Phone Number: 8084628166 Fax Number: _____

Email: lgharper08@gmail.com

APPENDIX E

Pre-Consultation Letters and Agency Responses

DAVID Y. IGE
GOVERNOR

RECEIVED
JUN 05 2020

JADE T. BUTAY
DIRECTOR

Deputy Director
LYNN A.S. ARAKI-REGAN
DEREK J. CHOW
ROSS M. HIGASHI
EDWIN H. SNIFFEN

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-PS 2.2962

May 29, 2020

Ms. Stephanie Davis
Project Manager
ESI
354 Uluniu Street, Suite 304
Kailua, Hawaii 96734

Dear Ms. Davis:

Subject: Preliminary Consultation for Environmental Assessment
Pat's at Punaluu Condominium Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
Tax Map Key No. (1) 5-3-008:007 and 002

Thank you for your letter dated April 21, 2020 requesting comments on the subject project prior to preparation of the Draft Environmental Assessment (EA).

The owners of Pat's at Punaluu Condominium proposes to upgrade their onsite deteriorated wastewater management system. The existing 1,200-gallon wet well/holding tank and injection wells would be retained. A new primary treatment system would be installed onsite.

The Hawaii Department of Transportation has reviewed the materials provided and has the following comments relative to State highways for consideration in the EA:

1. The site is accessed from and adjacent to Kamehameha Highway (State Route 83). Identify the State Right-of-Way (ROW) boundaries and site driveway(s) on EA site maps.

2. Describe any work or improvements proposed within the State ROW during construction and the long-term operational use of the improvements, including modifications to site access/egress on Kamehameha Highway.

3. A Permit to Perform Work Upon State Highways and a Traffic Management Plan are required for any work within the State ROW.

4. Describe existing conditions of and assess potential impacts to existing multimodal (e.g., cars, trucks, bikes, pedestrians, transit) transportation safety and traffic conditions in the vicinity of the site. While operation of the new wastewater system is unlikely to adversely impact traffic conditions and safety, there is potential for construction-phase impacts. Recommend mitigation for any direct, indirect and cumulative adverse impacts to multimodal transportation that are identified in the impact analysis.

5. Describe existing and proposed stormwater management at the site during construction and operations. No additional discharge of surface water run-off onto the State highway ROW is permitted.

If you have any questions, please contact Jeyan Thirugnanam, Systems Planning Engineer, Highways Division, Planning Branch at (808) 587-6336 or by email at jeyan.thirugnanam@hawaii.gov. Please reference file review number PS 2020-076.

Sincerely,

JADE T. BUTAY
Director of Transportation

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 16, 2020 ESI Project No. 119029

Jeyan Thirugnanam
State of Hawaii Department of Transportation
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Mr. Thirugnanam,

Thank you for commenting on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. We acknowledge your comments relative to State highways (file review number PS 2020-076) and they will be addressed in the Draft Environmental Assessment for the project.

Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project Manager

BOARD OF WATER SUPPLY

CITY AND COUNTY OF HONOLULU
630 SOUTH BERETANIA STREET
HONOLULU, HI 96843
www.boardofwatersupply.com

RECEIVED
MAY 12 2020

May 8, 2020

Ms. Stephanie Davis
Environmental Science International
354 Uluniu Street, Suite 304
Kailua, Hawaii 96734

Dear Ms. Davis:

Subject: Your Letter Dated April 21, 2020 Requesting Comments on the Draft Environmental Assessment for the Proposed Pat's at Punaluu Wastewater Treatment System Replacement in Hauula – Tax Map Key: 5-3-008: 002

Thank you for the opportunity to comment on the proposed wastewater treatment system replacement project. The replacement of Wastewater Treatment Systems should be coordinated with the State Department of Health.

The existing water system is adequate to accommodate the proposed wastewater treatment system replacement project. 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 proposed project is subject to BWS Cross-Connection Control and Backflow Prevention requirements prior to the issuance of the Building Permit Applications.

Water conservation measures are required for all proposed developments. These measures include utilization of nonpotable water for irrigation using rain catchment, drought tolerant plants, xeriscape landscaping, efficient irrigation systems, such as a drip system and moisture sensors, and the use of Water Sense labeled ultra-low flow water fixtures and toilets.

The construction drawings should be submitted for our review.

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 Robert Chun, Project Review Branch of our Water Resources Division at 748-5443.

Very truly yours,

ERNEST Y. W. LAU, P.E.
Manager and Chief Engineer

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 1, 2020 ESI Project No. 119029

Mr. Ernest Y. W. Lau, P.E.
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Mr. Lau,

Thank you for commenting on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. We acknowledge that the applicant will be required to pay your Water System Facilities Charges for resource development, transmission, and daily storage. We understand that the project will be subject to BWS Cross-Connection Control and Backflow Prevention requirements prior to the issuance of the Building Permit Applications and that water conservation measures are required for this development. Additionally, construction drawings will be provided for review during the design and permitting phases of the project.

Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project Manager

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 3RD FLOOR
HONOLULU, HAWAII 96813
Phone: (808) 768-8305 • Fax: (808) 768-4730 • web: www.honolulu.gov

KIRK CALDWELL
MAYOR

WES FRYSZTACKI
DIRECTOR

JON Y. NOUCHI
DEPUTY DIRECTOR

TP4/20-811318

May 8, 2020

Stephanie Davis, Project Manager
Environmental Science International
354 Uluniu Street, Suite 304
Kailua, Hawaii 96734

Dear Ms. Davis:

SUBJECT: Pat's at Punalu`u Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, TMK 5-3-008: 002

This is in response to correspondence dated April 21, 2020, requesting our input and comments on the subject project. We recommend the area representatives, neighborhood board, as well as the area residents, businesses, emergency personnel (fire, ambulance, and police), Oahu Transit Services, Inc. (TheBus and TheHandi-Van), etc. be kept apprised of the details and status throughout the project and of the impacts that the project may have on the adjoining local street area network. Construction materials and equipment should be transferred to and from the project site during off-peak traffic hours (8:30 a.m. to 3:30 p.m.) to minimize any possible disruption to traffic on adjoining streets.

Thank you for the opportunity to review this matter. Should you have any questions, please contact Virginia Sosh, of my staff, at 768-5461.

Very truly yours,

Wes Frysztacki
Director

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 1, 2020 ESI Project No. 119029

Mr. Wes Frysztacki, Director
State of Hawaii Department of Transportation Services
650 South King Street, 3rd Floor
Honolulu, Hawaii 96813

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Mr. Frysztacki,

Thank you for commenting on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. We acknowledge your recommendations and they will be addressed either in the Draft Environmental Assessment and/or during the design and permitting phases of the project.

Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project Manager

HONOLULU FIRE DEPARTMENT

CITY AND COUNTY OF HONOLULU

636 South Street
Honolulu, Hawaii 96813-5007
Phone: 808-723-7139 Fax: 808-723-7111 Internet: www.honolulu.gov/hfd

KIRK CALDWELL
MAYOR

MANUEL P. NEVES
FIRE CHIEF

LIONEL CAMARA JR.
DEPUTY FIRE CHIEF

RECEIVED
MAY 06 2020

May 4, 2020

Ms. Stephanie Davis
Project Manager
Environmental Science International
354 Uluniu Street Suite 304
Kailua, Hawaii 96734

Dear Ms. Davis:

Subject: Pat's at Punaluu Wastewater Treatment System Replacement
53-567 Kamehameha Highway
Hauula, Hawaii 96717
Tax Map Key: 5-3-008: 002

In response to your letter dated April 21, 2020, regarding the abovementioned subject, the Honolulu Fire Department (HFD) reviewed the submitted information and requires that the following be complied with:

1. Fire department access roads shall be provided such that any portion of the facility or any portion of an exterior wall of the first story of the building is located not more than 150 feet (46 meters) from fire department access roads as measured by an approved route around the exterior of the building or facility. (National Fire Protection Association [NFPA] 1; 2012 Edition, Section 18.2.3.2.2.)

   A fire department access road shall extend to within 50 feet (15 meters) of at least one exterior door that can be opened from the outside and that provides access to the interior of the building. (NFPA 1; 2012 Edition, Section 18.2.3.2.1.)

2. A water supply approved by the county, capable of supplying the required fire flow for fire protection, shall be provided to all premises upon which facilities or buildings, or portions thereof, are hereafter

> constructed, or moved into or within the county. When any portion of the facility or building is in excess of 150 feet (45,720 millimeters) from a water supply on a fire apparatus access road, as measured by an approved route around the exterior of the facility or building, on-site fire hydrants and mains capable of supplying the required fire flow shall be provided when required by the AHJ [Authority Having Jurisdiction]. (NFPA 1; 2012 Edition, Section 18.3.1, as amended.)

Should you have questions, please contact Battalion Chief Wayne Masuda of our Fire Prevention Bureau at 723-7151 or wmasuda@honolulu.gov.

Sincerely,

JASON SAMALA
Assistant Chief

JS/WM:bh

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 1, 2020 ESI Project No. 119029

Wayne Masuda, Battalion Chief
Fire Prevention Bureau
Honolulu Fire Department
City and County of Honolulu
636 South Street
Honolulu, Hawaii 96813

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Chief Battalion Masuda,

Thank you for commenting on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. We acknowledge that the Honolulu Fire Department has determined there will be no significant impact to fire department services. We acknowledge your recommendations and they will be addressed in the design and permitting phases of the project.

Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project Manager

POLICE DEPARTMENT
CITY AND COUNTY OF HONOLULU
801 SOUTH BERETANIA STREET · HONOLULU, HAWAII 96813
TELEPHONE: (808) 529-3111 · INTERNET: www.honolulupd.org

RECEIVED
MAY 12 2020

KIRK CALDWELL
MAYOR

SUSAN BALLARD
CHIEF

JOHN D. McCARTHY
CLYDE K. HO
DEPUTY CHIEFS

OUR REFERENCE EO-TS

May 6, 2020

Ms. Stephanie Davis
Project Manager
Environmental Science International
354 Uluniu Street, Suite 304
Kailua, Hawaii 96734

Dear Ms. Davis:

This is in response to your letter of April 21, 2020, requesting input on the Draft Environmental Assessment for the proposed Pat's at Punaluu Wastewater Treatment System Replacement project located in Hauula.

The Honolulu Police Department recommends that all necessary signs, lights, barricades, and other safety equipment be installed and maintained by the contractor during the construction of the project, as well as adequate notification be made to any affected areas regarding pedestrian and vehicular traffic issues.

If you have any questions, call Major Crizalmer Caraang of District 4 (Kaneohe, Kailua, Kahuku) at 723-8639.

Thank you for the opportunity to review this project.

Sincerely,

ALLAN T. NAGATA
Assistant Chief
Support Services Bureau

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 1, 2020 ESI Project No. 119029

Allan T. Nagata, Assistant Chief
Support Services Bureau
Honolulu Police Department
City and County of Honolulu
801 South Beretania Street
Honolulu, Hawaii 96813

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Assistant Chief Nagata,

Thank you for commenting on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. We acknowledge your safety and notification recommendations and they will be addressed in the design and permitting phases of the project.

Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project Manager

DAVID Y. IGE
GOVERNOR OF HAWAII

BRUCE S. ANDERSON, Ph.D.
DIRECTOR OF HEALTH

STATE OF HAWAII
DEPARTMENT OF HEALTH
P. O. BOX 3378
HONOLULU, HI 96801-3378

In reply, please refer to:
File:

LUD – 1 5 6 008 002 53-567 Kam Hwy
Pat's at Punaluu Replacement WWTP ID 5114

May 12, 2020

Ms. Stephanie Davis, Project Manager
Environmental Science International
354 Uluniu Street Suite 304
Kailua, Hawaii 96734
Email: sdavis@esciencei.com

Dear Ms. Davis:

Subject: Pat's at Punaluu Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Hawaii 96717
TMK (1) 5-3-008: 002

Thank you for allowing us the opportunity to provide comments for the subject project.

The Wastewater Branch supports the construction of a new WWTP for the subject property. The Wastewater Branch issued a Notice and Finding of Violation and Order to the Association of Apartment Owners of Pat's at Punaluu on November 2, 2018. In the Order, the Wastewater Branch required that a new wastewater treatment plant (WWTP) be constructed for the Pat's at Punaluu Condominiums.

The design and construction of the new WWTP shall meet applicable requirements of Chapter 11-62, Hawaii Administrative Rules, "Wastewater Systems." Please be informed that the proposed treatment wastewater system may have to include design considerations to address any effects associated with the construction of and/or discharges from the wastewater systems to any public trust, Native Hawaiian resources or the exercise of traditional cultural practices.

Should you have any questions, please call Mr. Mark Tomomitsu of my staff at 586-4294.

Sincerely,

SINA PRUDER, P.E., CHIEF
Wastewater Branch

LM/MST:lmj

c: Ms. April Matsumura, WWB, Oahu via email

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 1, 2020 ESI Project No. 119029

Sina Pruder, P.E., Chief
Wastewater Branch
State of Hawaii Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801-3378

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Wastewater Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Sina Pruder,

Thank you for commenting on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. Your comments regarding (1) design considerations to address any effects associated with the construction of and/or discharges from the wastewater systems to any public trust, Native Hawaiian resources or the exercise of traditional cultural practices; and (2) design and construction plans for the new WWTP conform to applicable provisions of the Hawaii Administrative Rules, Chapter 11-62, "Wastewater Systems'", will be addressed either in the Draft Environmental Assessment and/or during the design and permitting phases of the project.

Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project Manager

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

May 12, 2020

LD 459

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division *(via email: DLNR.Engr@hawaii.gov)*
X Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
__Office of Conservation & Coastal Lands
X Land Division – Oahu District
X Historic Preservation *(via email: DLNR.Intake.SHPD@hawaii.gov)*

FROM: Russell Y. Tsuji, Land Administrator *Russell Tsuji*

SUBJECT: **Pat's at Punalu'u Wastewater Treatment System Replacement, Pre-Assessment Consultation for Draft Environmental Assessment**

LOCATION: 53-567 Kamehameha Highway, Hauula, Island of Oahu
TMK: (1) 5-3-008:002

APPLICANT: Environmental Science International, in cooperation with Laulea Engineering, LLC.

Transmitted for your review and comment is information on the above-referenced subject. Please submit any comments to Land Division by **May 20, 2020.**

If no response is received by the above date, we will assume your agency has no comments. If you have any questions about this request, please contact Barbara Lee via email at barbara.j.lee@hawaii.gov. Thank you.

( ) We have no objections.
(✓) We have no comments.
( ) Comments are attached.

Signed: Barry Chung

Print Name: BARRY CHUNG

Date: 5/14/2020

Attachments
Cc: Central Files

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 1, 2020 ESI Project No. 119029

Mr. Barry Cheung
Land Division, Oahu District Branch
State of Hawaii Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Mr. Cheung,

Thank you for informing us that the DLNR Land Division – Oahu District has no comments on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project Manager

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

May 12, 2020

LD 459

MEMORANDUM

TO: **DLNR Agencies:**
X Div. of Aquatic Resources
__Div. of Boating & Ocean Recreation
X Engineering Division *(via email: DLNR.Engr@hawaii.gov)*
X Div. of Forestry & Wildlife
__Div. of State Parks
X Commission on Water Resource Management
__Office of Conservation & Coastal Lands
X Land Division – Oahu District
X Historic Preservation *(via email: DLNR.Intake.SHPD@hawaii.gov)*

FROM: Russell Y. Tsuji, Land Administrator Russell Tsuji

SUBJECT: **Pat's at Punalu'u Wastewater Treatment System Replacement, Pre-Assessment Consultation for Draft Environmental Assessment**

LOCATION: 53-567 Kamehameha Highway, Hauula, Island of Oahu
TMK: (1) 5-3-008:002

APPLICANT: Environmental Science International, in cooperation with Laulea Engineering, LLC.

Transmitted for your review and comment is information on the above-referenced subject. Please submit any comments to Land Division by **May 20, 2020.**

If no response is received by the above date, we will assume your agency has no comments. If you have any questions about this request, please contact Barbara Lee via email at barbara.j.lee@hawaii.gov. Thank you.

( ) We have no objections.
( ) We have no comments.
(X) Comments are attached.

Signed: _____

Print Name: Brian J. Neilson- DAR Administrator

Date: May 15, 2020

Attachments
Cc: Central Files

DAVID Y. IGE
GOVERNOR OF
HAWAII

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
DIVISION OF AQUATIC RESOURCES
1151 PUNCHBOWL STREET, ROOM 330
HONOLULU, HAWAII 96813

Date: 5/14/2020
DAR # CV0009

MEMORANDUM

TO: Brian J. Neilson
DAR Administrator

FROM: Daniel Lager, Aquatic Biologist
5/14/20

SUBJECT: Pat's at Punalu‘u Wastewater Treatment System Replacement

Request Submitted by: Environmental Science International Inc. with Laulea Engineering, LLC

Location of Project: 53-567 Kamehameha Highway, Hau‘ula, O‘ahu, Hawai‘i
TMK No. (1) 5-3-008:002

Brief Description of Project:

The current waste water treatment plant (WWTP) at Pat's at Punalu‘u Condominiums was built in the 1970's. Since its construction the system has deteriorated and requires replacement. This project will involve replacement components of the system and will incorporate parts of the existing system which still function properly.

The current WWTP consists of a 1,200-gallon wet well/trash tank for preliminary treatment, a 54,627-gallon tank aerobic treatment unit, a clarifier, and a chlorine contact tank. Then the treated effluent is discharged to a primary/active gravity driven injection well. The system also has 8 backup gravity driven wells.

Comments:

☐ No Comments ☒ Comments Attached

Thank you for providing DAR the opportunity to review and comment on the proposed project. Should there be any changes to the project plan, DAR requests the opportunity to review and comment on those changes.

Comments Approved: _____ Date: May 15, 2020
Brian J. Neilson
DAR Administrator

DAR# CV0009

Brief Description of Project

The updated system will continue to use the existing wet well/lift station/trash tank. Then the waste will travel to a new primary treatment tank/system which is a multi-stage fixed biofilm system. This component has an integrated clarifier tank and a sludge holding tank. The waste will then travel to the existing multiple injection well disposal system.

Based on the diagrams provided about the project the new components to the WWTS will be located on the footprint of the existing system which runs along the road side of the property.

DAR# CV0009

Comments

The Division of Aquatic Resources (DAR) is in general support of this project. DAR understands the need to improve the existing waste water facilities to more effectively manage waste water. Any accidental discharge of inadequately treated waste water from aging and outdated systems into the near shore habitat can be detrimental to various aquatic resources. The addition of the high levels of nutrient found in waste water can result in unnaturally rapid algae growth which can negatively impact the near shore habitat.

DAR would like to request that the contractor(s) implement the practice of utilizing erosion control and land-based sources of pollution (LBSP) barrier measures at all of the proposed project sites where there is the opportunity for sediment discharge into nearby waters (e.g. any site where there will be excavation, grading, or sediment/pollutant producing activities). These measures would include any type of barrier (e.g. sediment fences, silt screens, bags, environmental socks, petroleum absorption diapers) that limits the amount of sediment or LBSP (e.g. petroleum products, chemicals, debris, etc.) to the maximum extent practicable. This is important given the immediate proximity to Hale‘aha stream and the near shore marine habitat. Periods of heavy precipitation increase run-off across these types of surfaces and there is a higher risk of LBSP ending up in the near shore habitat. If there are any leaks or spills of waste water during the upgrade project it should be reported promptly and the impact to the freshwater and marine habitats need to be assessed by DAR..

Thank you for providing DAR the opportunity to review and comment on the Draft Environmental Assessment for this proposed project. Should there be any changes to the project plans DAR requests the opportunity to review and comment on those changes.

Regards,

Daniel Lager
Aquatic Invasive Species Biologist
Dept. of Land and Natural Resources
Division of Aquatic Resources
1039 Sand Island Parkway
Honolulu, HI 96819
daniel.j.lager@hawaii.gov

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 1, 2020 ESI Project No. 119029

Daniel Lager
Aquatic Invasive Species Biologist
Dept. of Land and Natural Resources
Division of Aquatic Resources
1039 Sand Island Parkway
Honolulu, HI 96819

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Mr. Lager,

Thank you for commenting on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. Your comments regarding (1) utilization of erosion control and land-based sources of pollution (LBSP) barrier measures at all of the proposed project sites where there is the opportunity for sediment discharge into nearby waters (e.g. any site where there will be excavation, grading, or sediment/pollutant producing activities); and (2) prompt reporting of any leaks or spills of waste water during the upgrade project, will be addressed either in the Draft Environmental Assessment and/or during the design and permitting phases of the project.

Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project Manager

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

May 12, 2020

LD 459

MEMORANDUM

FROM:

~~TO:~~ **DLNR Agencies:**
_X_ Div. of Aquatic Resources
__ Div. of Boating & Ocean Recreation
_X_ Engineering Division *(via email: DLNR.Engr@hawaii.gov)*
_X_ Div. of Forestry & Wildlife
__ Div. of State Parks
_X_ Commission on Water Resource Management
__ Office of Conservation & Coastal Lands
_X_ Land Division – Oahu District
_X_ Historic Preservation *(via email: DLNR.Intake.SHPD@hawaii.gov)*

TO:
~~FROM:~~ Russell Y. Tsuji, Land Administrator *Russell Tsuji*

SUBJECT: **Pat's at Punalu'u Wastewater Treatment System Replacement, Pre-Assessment Consultation for Draft Environmental Assessment**

LOCATION: 53-567 Kamehameha Highway, Hauula, Island of Oahu
TMK: (1) 5-3-008:002

APPLICANT: Environmental Science International, in cooperation with Laulea Engineering, LLC.

Transmitted for your review and comment is information on the above-referenced subject. Please submit any comments to Land Division by **May 20, 2020.**

If no response is received by the above date, we will assume your agency has no comments. If you have any questions about this request, please contact Barbara Lee via email at barbara.j.lee@hawaii.gov. Thank you.

( ) We have no objections.
( ) We have no comments.
(✓) Comments are attached.

Signed: _____

Print Name: Carty S. Chang, Chief Engineer
Date: May 14, 2020

Attachments
Cc: Central Files

DEPARTMENT OF LAND AND NATURAL RESOURCES
ENGINEERING DIVISION

LD/Russell Y. Tsuji
Ref: Pat's at Punalu'u Wastewater Treatment System Replacement, Pre-Assessment Consultation for Draft Environmental Assessment
TMK(s): (1) 5-3-008:002
Location: 53-567 Kamehameha Highway, Hauula, Island of Oahu
Applicant: Environmental Science International, in cooperation with Laulea Engineering LLC

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.hawaiinfip.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) 241-4896.

Signed: _____
CARTY S. CHANG, CHIEF ENGINEER

Date: May 14, 2020

Environmental Science International
354 Uluniu Street Suite 304, Kailua, Hawaii 96734
(808) 261-0740 phone / (808) 261-0749 fax

June 1, 2020 ESI Project No. 119029

Carty Chang, P.E., Chief Engineer
Engineering Division
State of Hawaii Department of Land and Natural Resources
P.O. Box 621
Honolulu, Hawaii 96809

Subject: Response to comments on the preparation of an Environmental Assessment for the Proposed Pat's at Punalu'u Treatment System Replacement
53-567 Kamehameha Highway, Hauula, Oahu, Hawaii
TMK No. (1) 5-3-008:002

Dear Mr. Chang,

Thank you for commenting on the proposed Pat's at Punalu'u Wastewater Treatment System Replacement. We have reviewed the rules and regulations regarding developments that fall within a Special Flood Hazard Area and they will be addressed in the Draft Environmental Assessment and/or during the design and permitting phases of the project.

The Flood Hazard Zone designation for the project has been determined to be in Zone AE, an area subject to inundation by the 1%-annual-chance flood event for which Base Flood Elevations have been determined. This will be noted in the Draft Environmental Assessment.

Should you have any questions in the future, please contact the undersigned at (808) 261-0740, extension 142, at the letter head address, via e-mail at sdavis@esciencei.com, or by fax (808) 261-0749.

Sincerely,

Stephanie Davis
Project 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

In Reply Refer To:
01EPIF00-2019-TA-0100

December 14, 2018

Ms. Kathy K. Sokugawa, Acting Director
Department of Planning and Permitting
City and County of Honolulu
650 South King Street, 7th Floor
Honolulu, Hawai‘i 96813

Subject: Response to your Request for Technical Assistance

Dear Ms. Sokugawa,

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,

Island Team Manager
Pacific islands Fish and Wildlife Office

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.

Scientific Name	**Common Name / Hawaiian Name**	**Federal Status**	**May Occur In Project Area**
Mammals			
Lasiurus cinereus semotus	Hawaiian hoary bat/ ‘ōpe‘ape‘a	E	☒
Reptiles			
Chelonia mydas	Green sea turtle/honu - Central North Pacific DPS	T	☒
Erectmochelys imbricata	Hawksbill sea turtle/ Honu ‘ea	E	☐
Birds			
Anas wyvilliana	Hawaiian duck/ koloa	E	☐
Branta sandvicensis	Hawaiian goose/ nēnē	E	☐
Fulica alai	Hawaiian coot/ ‘alae kea	E	☐
Gallinula galeata sandvicensis	Hawaiian gallinule/ ‘alae ‘ula	E	☐
Himantopus mexicanus knudseni	Hawaiian stilt/ Ae‘o	E	☐
Oceanodroma castro	Band-rumped storm-petrel/ ‘akē‘akē	E	☒
Pterodroma sandwichensis	Hawaiian petrel/ ‘ua‘u	E	☒
Puffinus auricularis newelli	Newell’s shearwater/ ‘a‘o	T	☒
Ardenna pacificus	Wedge-tailed Shearwater/ ‘ua‘u kani	MBTA	☐
Gygis alba	White Tern/ manu-o-kū	MBTA	☐
Buteo solitarius	Hawaiian hawk/ ‘io	E	☐
Insects			
Manduca blackburni	Blackburn’s sphinx moth	E	☐
Megalagrion pacificum	Pacific Hawaiian Damselfly	E	☐
M. xanthomelas	Orangeblack Hawaiian Damselfly	E	☐
M. nigrohamatum nigrolineatum	Blackline Hawaiian Damselfly	E	☐

Plants				
Scientific Name	**Common Name or Hawaiian Name**	**Federal Status**	**Locations**	**May Occur In Project Area**
Abutilon menziesii	Koʻoloaʻula	E	O, L, M, H	☐
Achyranthes splendens var. *rotundata*	ʻEwa hinahina	E	O	☐
Bonamia menziesii	No common name	E	K, O, L, M, H	☐
Canavalia pubescens	ʻĀwikiwiki	E	Ni, K, L, M	☐
Colubrina oppositifolia	Kauila	E	O, M, H	☐
Cyperus trachysanthos	Puʻukaʻa	E	K, O	☐
Gouania hillebrandii	No common name	E	Mo, M	☐
Hibiscus brackenridgei	Maʻo hau hele	E	O, Mo, L, M, H	☐
Ischaemum byrone	Hilo ischaemum	E	K, O, Mo, M, H	☐
Isodendrion pyrifolium	Wahine noho kula	E	O, H	☐
Marsilea villosa	ʻIhiʻihi	E	Ni, O, Mo	☐
Mezoneuron kavaiense	Uhiuhi	E	O, H	☐
Nothocestrum breviflorum	ʻAiea	E	H	☐
Panicum fauriei var. *carteri*	Carter's panicgrass	E	Molokini Islet (O), Mo	☐
Panicum niihauense	Lauʻehu	E	K	☐
Peucedanum sandwicense	Makou	E	K, O, Mo, M	☐
Pleomele (Chrysodracon) hawaiiensis	Halapepe	E	H	☐
Portulaca sclerocarpa	ʻIhi	E	L, H	☐
Portulaca villosa	ʻIhi	E	Le, Ka, Ni, O, Mo, M, L, H, Nihoa	☐
Pritchardia affinis (maideniana)	Loulu	E	H	☐
Pseudognaphalium sandwicensium var. *molokaiense*	ʻEnaʻena	E	Mo, M	☐
Scaevola coriacea	Dwarf naupaka	E	Mo, M	☐
Schenkia (*Centaurium*) *sebaeoides*	ʻĀwiwi	E	K, O, Mo, L, M	☐
Sesbania tomentosa	ʻŌhai	E	Ni, Ka, K, O, Mo, M, L, H, Necker, Nihoa	☐
Tetramolopium rockii	No common name	T	Mo	☐
Vigna o-wahuensis	No common name	E	Mo, M, L, H, Ka	☐

Location key: O=Oʻahu, K=Kauaʻi, M=Maui, H=Hawaiʻi Island, L=Lānaʻi, Mo=Molokaʻi, Ka=Kahoʻolawe, Ni=Niʻihau, Le=Lehua

APPENDIX F

Prior Archaeology Reports (on CD)

AN ARCHAEOLOGICAL ASSESSMENT OF THE SEWAGE SYSTEM UPGRADE PROJECT HANOHANO HALE CONDOMINIUM PAPA'AKOKO, PUNALUU, O'AHU, HAWAI'I [TMK: 5-3-08: 01]

By

David B. Chaffee, B.A.

and

Robert L. Spear, Ph.D.

Nov., 1993

For

The Owners' Association
Hanohano Hale Condominium

SCIENTIFIC CONSULTANT SERVICES Inc.

HAWAII

47-269 D HUI IWA STREET KANEOHE, HAWAII 96744

Dr. Tom Dye
Department of Land and Natural Resources
State Historic Preservation Division
33 So. King Street 6th Floor
Honolulu, Hawaii 96813

Dear Dr. Dye:

At the request of the Owners' Association of Hanohano Hale Condominium, an archaeological assessment was conducted by Scientific Consultant Services, Inc. for the site of a proposed sewerage and sewage disposal upgrading at the Hanohano Hale Condominium Project at Papa'akoko, Punaluu, Hawaii (Figure 1). The project area is further identified by Tax Map Key (TMK) number 5-3-08:1 (Figure 2).

The project area is bounded on the east by the ocean, on the south by a drainage channel, on the west by Kamehameha Hwy., and on the north by residential condominium development. The project area of the proposed sewage system upgrade is within the present parking lot of the Hanohano Hale condominium.

The soil within the project area is listed as Jaucas sand, with a 0 to 15% slope. Permeability is rapid and runoff is very slow to slow. The hazard of water erosion is slight, but wind erosion is a severe hazard where vegetation has been removed. Vegetation on this salty soil in the depressions consists of salt-tolerant plants (Foote, et al. 1972: 48-49, Map 48).

A review of Land Commission Award (LCA) books found no LCAs within the bounds of the project area, nor were any LCAs noted on adjacent lots.

The only archaeological site in the immediate vicinity of the project area is site number 50-80-06-3970 situated north of the project area at an adjacent condominium project, Pat's at Punaluu. This site was recorded by Bath and Smith in 1988. In an internal memorandum to the State Historic Preservation Division (SHPD) following inspection of a possible burial, Bath notes that;

> "The profiles of the trenches, which were in the parking lot between the highway and the building, showed several layers of driveway and fill below the present asphalt. Below the fill layers, there is a truncated humic dark sand cultural layer. Several pits and postholes were noted."

It is possible that a site like 50-80-06-3970 existed in the project area before the installation of a sewage system when the Hanohano Hale condominium was constructed. However, the current area of study has undergone considerable alteration due to that earlier construction.

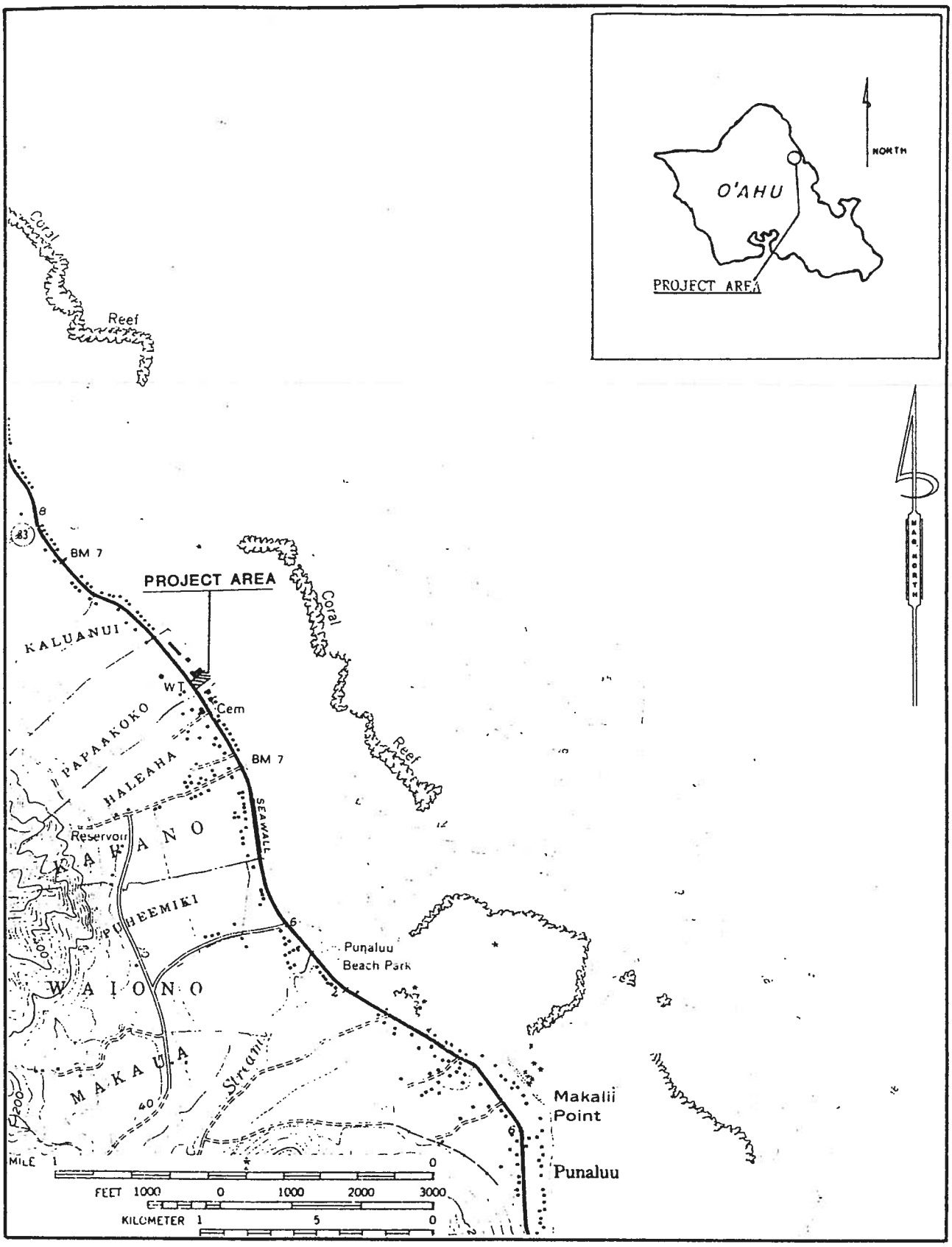


FIGURE 1: USGS KAHANA QUADRANGLE SHOWING PROJECT AREA, (SHADED).

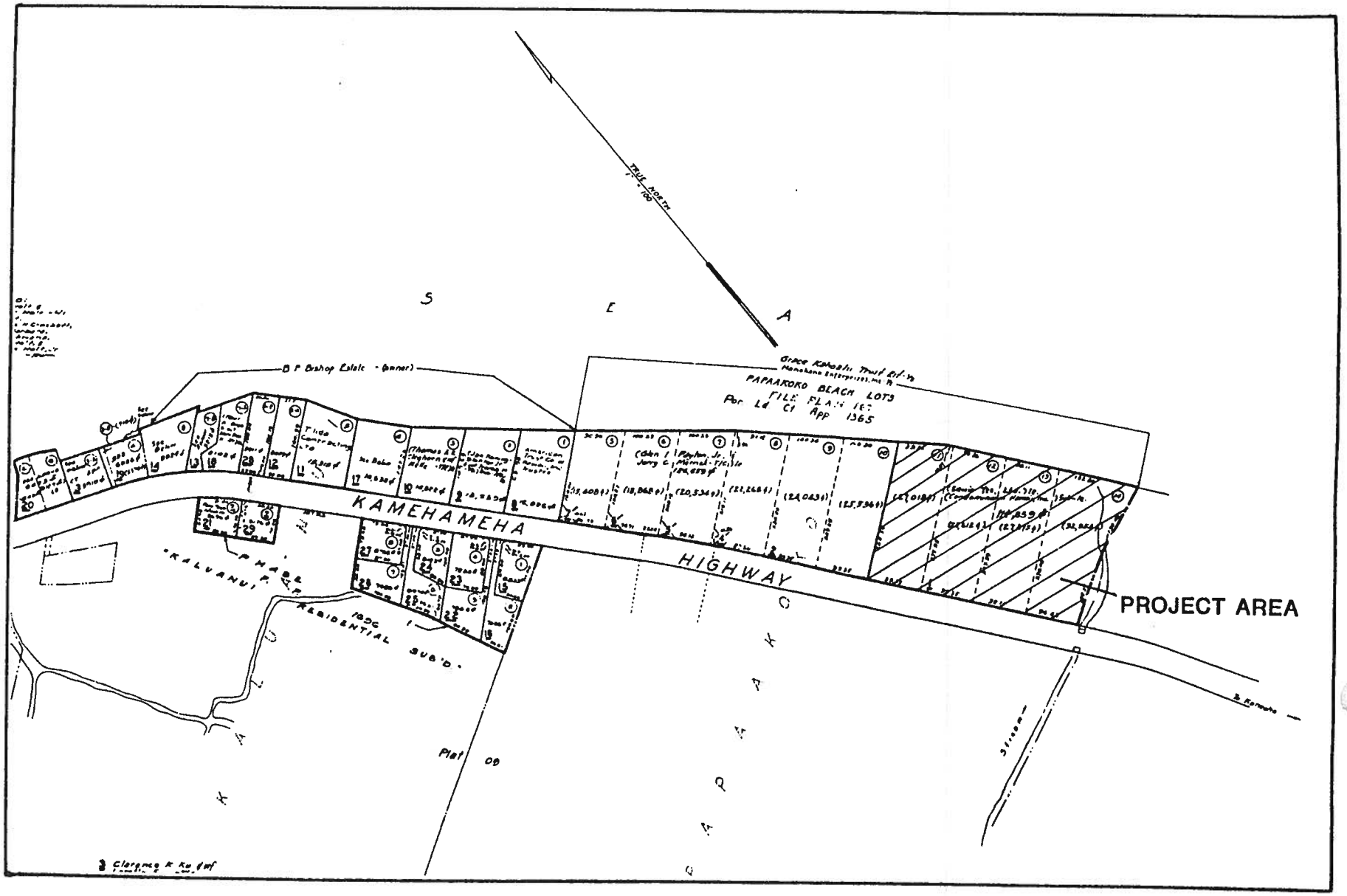


FIGURE 2: TAX MAP KEY: 5-3-08: 01. SITE OF HANOHANO HALE CONDOMINIUM, PUNALU'U, HAWAI'I.

The present sewage treatment system utilizes cavitation and seepage pits drilled into the strata beneath the parking lot. As can be seen in the project area planview (Figures 3) and the profile (Figure 4), the trenching, grading, and excavation in the project area has been extensive.

In addition to the recorded ground disturbance, the contamination and soil alteration likely to be present in the leech fields surrounding the sewage seepage pits would have contaminated any cultural materials that may have been used for samples (such as radiocarbon).

It is our opinion that the sewage system upgrade in the project area would have "no effect" on any significant archaeological sites. It is our recommendation that no further archaeological investigations need to be performed.

Human burials have been recovered from the coast to the north and south of this project area. It is possible that burials might be encountered during the current phase of work. If this should occur, all work in the vicinity should cease immediately and the Historic Preservation Division should be notified.

Sincerely,

Robert L. Spear, Ph.D.
President
Scientific Consultant Services Inc.

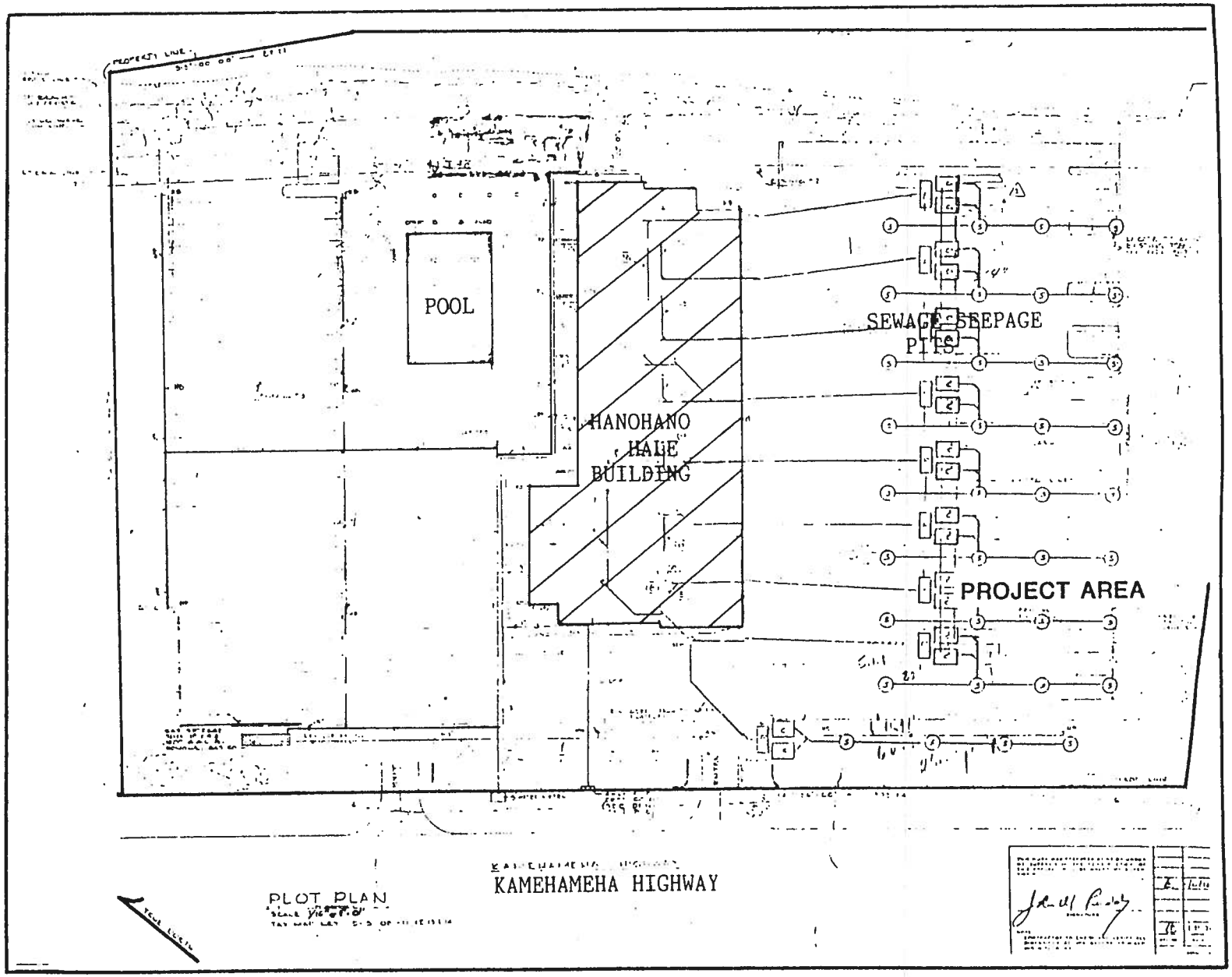


FIGURE 3: PLANVIEW OF PRESENT SEWAGE TREATMENT FACILITIES AT HANOHANO HALE. REPRINTED $\frac{1}{4}$ SIZE FROM ORIGINAL BY LEMMON, FREETH, HAINES & JONES (1970).

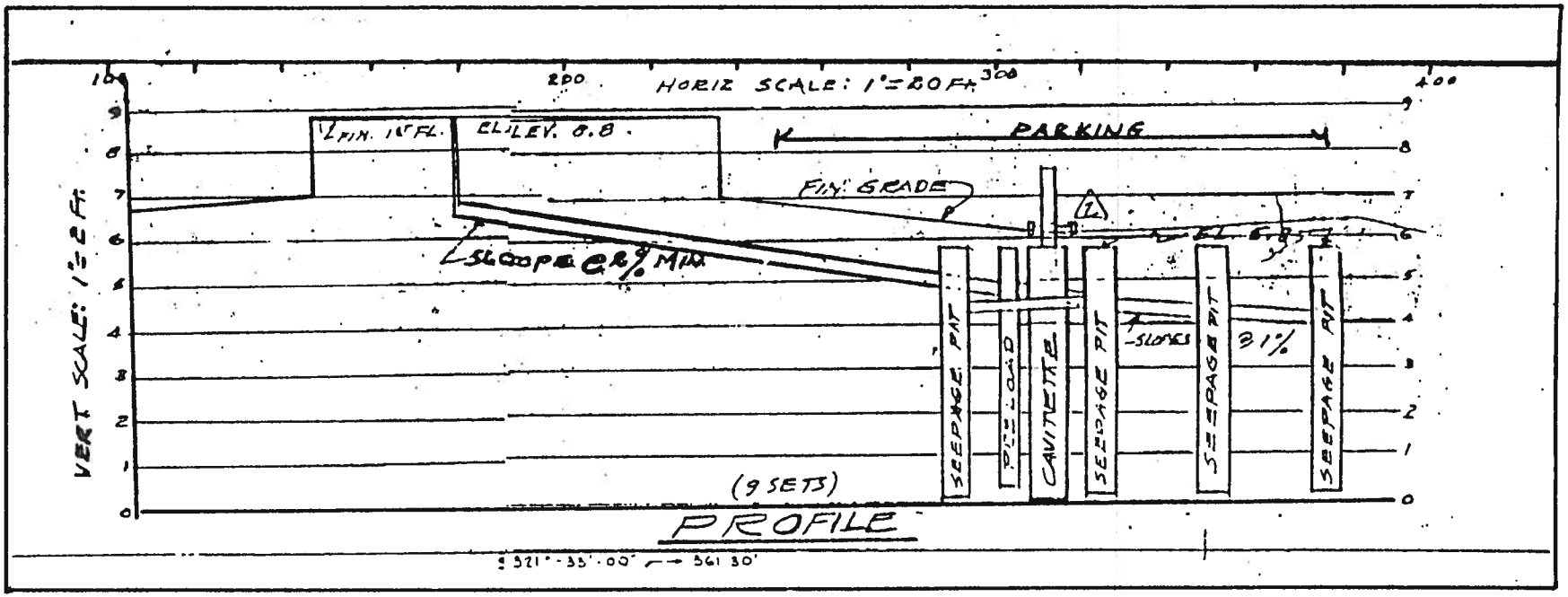


FIGURE 4: PROFILE OF EXISTING SEWAGE TREATMENT FACILITIES AT HANOHANO HALE CONDOMINIUM. REPRINTED ½ SIZE FROM ORIGINAL BY LEMMON, FREETH, HAINES & JONES (1970)

REFERENCES CITED

Award Books

n.d. Award Books (with maps of each LCA parcel), on file, Division of Land Management, State of Hawai'i.

Bath, J., and M. Smith

1988 Burial call from Pat's at Punaluu. Punaluu, Koolauloa, O'ahu. TMK 3-5-8: 1 and 2. Memo to Files, SHPD, Honolulu.

Foote, D. E., E Hill, S. Nakamura, F. Stephans

1972 Soil Survey of the Islands of Oahu, Maui, Molokai, and Lanai, State of Hawaii, US Dept. of Agriculture.

SCS Project Number 1118-AMR-1

AN ARCHAEOLOGICAL MONITORING REPORT FOR A GREYWATER SYSTEM (GWS) INSTALLATION PROJECT AT HANOHANO HALE CONDOMINIUM PAPA`AKOKO AHUPUA`A, KO`OLAULOA DISTRICT, O`AHU ISLAND, HAWAI`I [TMK: (1) 5-3-008: 001]

Prepared by:
Elizabeth Pestana, B.A.
and
Robert L. Spear, Ph.D.

May 2010
FINAL

Prepared for:
Owner's Association
Hanohano Hale Condominium
53-549 Kamehameha Highway
Hauula, Hawaii 96717

SCIENTIFIC CONSULTANT SERVICES Inc.

HAWAII

711 Kapiolani Blvd. Suite 975 Honolulu, Hawai`i 96813

ABSRACT

Scientific Consultant Services Inc. (SCS) conducted Archaeological Monitoring at the Hanohano Hale condominium beachfront parcel, Punalu`u Ahupua`a, Ko`olauloa District, O`ahu Hawai`i TMK (1) 5-3-008: 001 during the installation of a Greywater System (GWS) for the condo's laundry facilities. During work for the GWS installation one new site, State Site No. 50-80-06-7120 was documented. Ten burial features, and a total of 12 sets of native Hawaiian remains from the pre-Contact era, were recorded in Site -7120. Burial features encountered during excavations were identified in both previously disturbed and *in situ* contexts. No traditional artifacts, or cultural layers, were noted in the project area, although traditional type cultural materials were observed in direct association with burial features. Modern debris (ceramics, cow bone, glass bottles) was observed in imported fill-soils coverig the project area and previously disturbed, natural sandy substratum that occurred below. Consultation with the State Historic Preservation Division (SHPD) and Oahu Island Burial Council representative Cy Bridges guided burial mitigation and burial treatment measures concerning burial disinterment/recovery including interim on-site curation for proposed burial reinterment, and long term protection and conservation of all human remains documented during this work. Numerous burials have been documented along Punalu'u's coastal corridor surrounding the project area parcel and the potential that additional burials or significant buried historic cultural properties may still be present in intact beach sand deposits in or secondary contexts remains high. Based on the known distribution of native Hawaiian burials encountered in the fairly confined space of the project area, it is the recommendation of SCS that any future ground disturbing activities to be undertaken on Hanohano Hale property be subject to Archaeological Monitoring.

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INTRODUCTION

Scientific Consultant Services Inc. (SCS) conducted Archaeological Monitoring at Hanohano Hale condominium 53-549 Kamehameha Highway, Punalu`u Ahupua`a, Ko`olauloa District, O`ahu Hawai`i [TMK (1) 5-3-008: 001] (Figures 1 and 2). Monitoring was conducted at the request of Hanohano Hale management on behalf of the Owner's Association in response to the inadvertent discovery of human remains during the installation of a Greywater System (GWS) in the beachfront property project area (Figure 3).

In December of 2009 at the onset of ground altering work for a GWS installation project at Hanohano Hale condominium, human remains were encountered by construction personnel during manual excavation. In response to the inadvertent discovery, Field Inspection was conducted by Cultural Surveys Hawaii which documented the remains to be of native Hawaiian ancestry, probably interred in pre-Contact times (McDermott 2009). Accordingly, State Historic Preservation Division (SHPD) initiated an Archaeological Monitoring program for the remainder of work on the project, for which SCS Archaeologists monitored all remaining excavations. As a result of this work 10 burial features and 12 sets of human remains were recorded, and documented as new State Site No. 50-80-06-7120 as designated by the State of Hawaii State Inventory of Historic Places (SIHP) national register (see Figures 1, 2, and 3).

As required by the State Historic Preservation Division (SHPD), Archaeological Monitoring was conducted in this project area due to to the known presence of human remains and the potential of multiple archaeological properties and additional human burials to be encountered. This Monitoring program ensured that when human remains were identified during subsurface work, appropriate and lawful protocol concerning the Inadvertent Discovery of Human Remains (pursuant to 13-300-40a, b, c, HAR) was followed.

This Archaeological Monitoring Report (AMR) was written in accordance with DLNR/SHPD Hawaii Adminitrative Rules (HAR §13-279-5). The text herin provides a summary of the project area location and historic background, reasons for monitoring, monitoring methodologies and scope of work, and discusses in detail monitoring results.

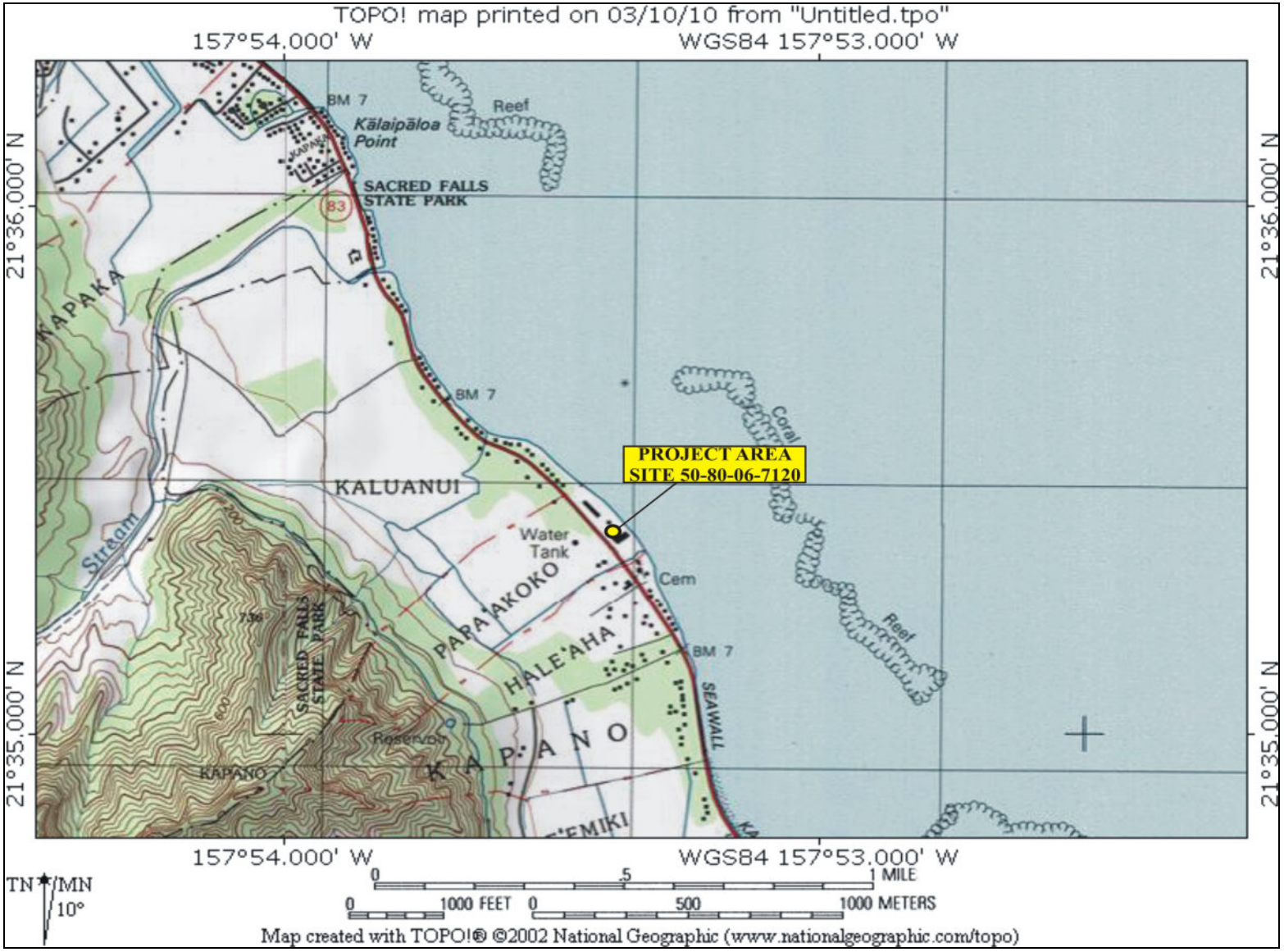

Figure 1: USGS Kahana Quadrangle Showing Project Area.

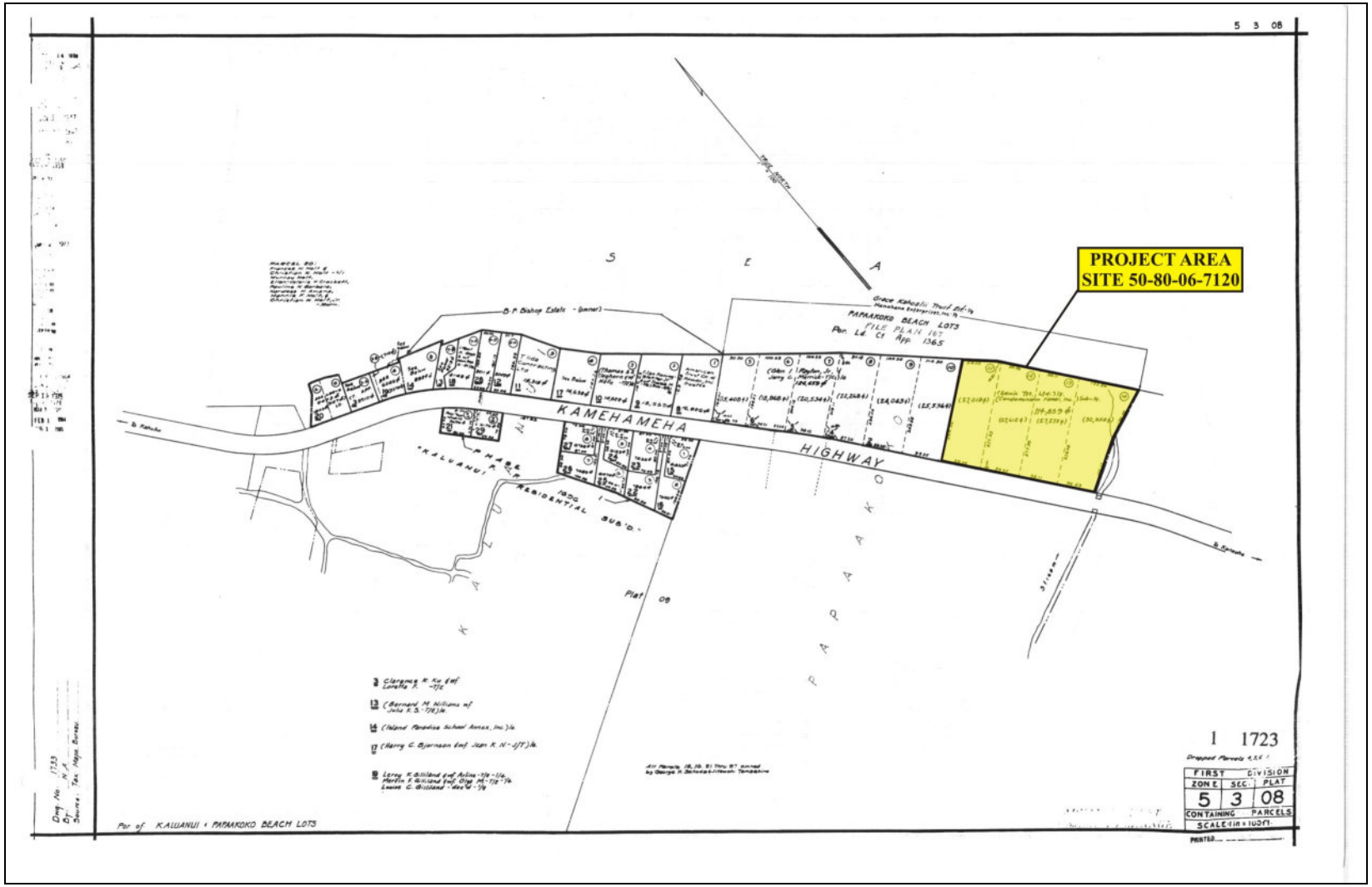

Figure 2: Tax Map Key [TMK] Showing Project Area.

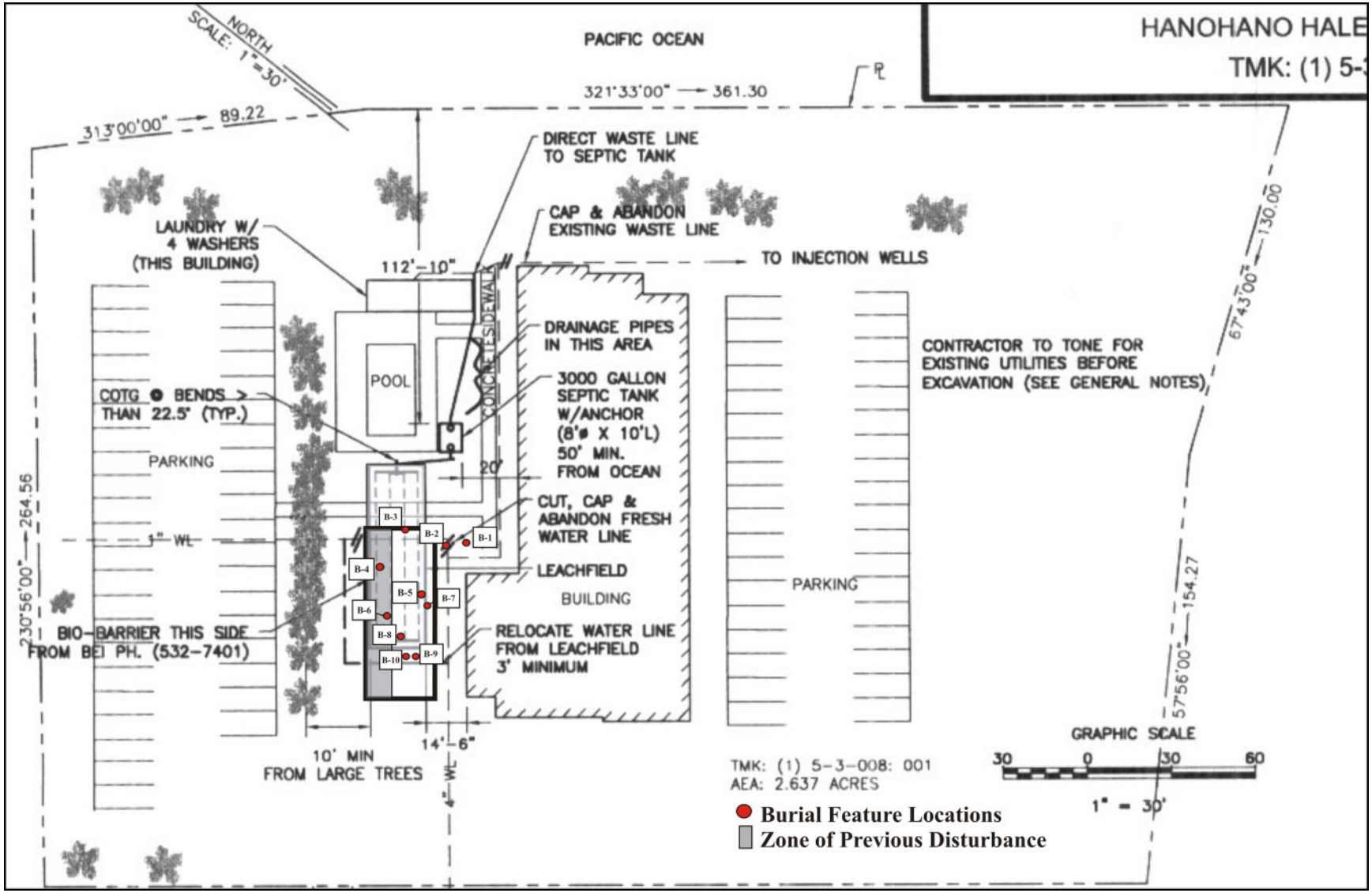

Figure 3: Revised GWS Excavation Plan Depicting Site 50-80-06-7120 Burial Feature Locations and Zone of Previous Disturbance (Note: Revised Excavation Plan Overlays Original Plan.

PROJECT AREA LOCATION AND ENVIRONMENT

The Project area is located on O'ahu's north coast in Punalu'u at the Hanohano Hale condominium beach front property. Work for the GWS occurred in the property's landscaped courtyard fronting the building's north side security entrance (Figure 4). The property is bounded by the coastline on the east (*makai*), Kamehameha Highway on the west (*mauka*), and neighboring properties "Pat's at Punalu'u" to north and St. Joachim Mission Church to south. The elevation is approximately 0 to 20 feet above mean sea level (amsl).

The combined synopsis of sediment research completed in the area by Foote *et al.* (1972) indicates that sediments in the area are predominantly composed of Jaucus Sand (JaC). Jaucus sands develop in wind and water deposited sand and occurs on 0 to 15 percent slopes. These soils occur as narrow strips along the coastline and consist mainly of light colored sands derived from coral and seashells (*ibid.*). Beach and Jaucus sands are primary environments for traditional Hawaiian burials. Numerous human burials and a subterranean cultural layer related to the traditional occupation of the area have been documented in the Punalu'u area.

Overall, this soil type was indeed present within the project area landscape. However, the property has been subject to extensive development and the observed natural sand substrata is overlain with imported fill-soils up to approximately 0.80 to 1.0 meter thick. The water table was fairly shallow at approximately 180 centimeters below the surface (cmbs) and was marked by a very coarse coralline basal substratum.

TRADITIONAL AND HISTORIC SETTING

TRADITIONAL SETTLEMENT PATTERN

Papa'akoko Ahupua'a, encompassed within the wider demographic of Punalu'u, is not very often named specifically in traditional oral histories or historical accounts of the Koolauloa region. The historic synthesis and archaeological record of occupation of Punalu'u suggests a late pre-Contact settlement pattern.

According to Handy and Handy (1972), permanent habitation of Koolauloa was primarily located along the coastal zone while the foothills and slopes of inland zones between Kahana and La'ie were continuously and extensively terraced for purposes of irrigated cultivation (taro *lo'i*, *auwai*) (Hunt 1993). Concerning the occupation of this section of coastal lands, Handy and Handy recorded that, "undoubtedly this midsection of Koolau Loa on Oahu was an area of early

Figure 4: Photographic Overview of Project Area. View to East.

settlement and of dense population, second only to that of the Waikiki-Nuuanu-Manoa complex" (Handy and Handy 1972:271; *ibid.*).

Although Papa'akoko Ahupua'a is not mentioned, the lowlands of adjacent Kaluanui is described "all the way from the sea the grasslands and the canefields, …show[ing] clearly the outlines of old terraces, watered by Punalu'u Stream widening from quarter of a mile above to half a mile at the base of the valley and spreading out like a fan on the coastal plain over an area four tenths of a mile long and eight tenths of a mile wide", clearly highlighting the prehistoric and early post-Contact presence of intensive occupation for the area (Hunt 1993).

TRADITIONAL LAND USE

According to Kamakau (1961), traditional Hawaiian land tenure was a system formed in order to care for the land. Around the 14th century, various individual island *mō`ī* (king/monarch) believed the land should be surveyed and be permanently marked. The land

system was needed to avoid disputes between neighboring *ali`i* (chiefs). A *kahuna* (priest/expert) named Kālaika`ōhia is said to have carved the land into districts (*moku*) and numerous smaller divisions (i.e.: *ahupua`a, `okana, `ili* etc.) were also coordinated.

The idea of holding land was not synonymous with owning it, but more like a trusteeship between the caretakers and the nature gods Lono and Kane (Handy & Handy 1972:41). The *ahupua`a* is the most well known of all traditional land divisions and is still relevant today. The *ahupua`a* land divisions vary in size and generally encompass land from the mountain to the sea. Traditionally, the areas were governed by a designated caretaker (*konohiki*) and those residing within the region had designated access to all mountain and marine resources. Chinen (1961:5) explains that all chiefs and commoners were entitled to a portion of the mountain and marine resources. Prior to a later migration, early traditional Hawaiians concentrated on caretaker and nature entities.

According to Pukui *et al*. (1972), somewhere between the 11th and 13th centuries, a priest in Tahiti named Pa`ao, killed his son and nephew. He left his homeland, ventured to Hawai`i, and brought a heightened emphasis on fighting with his war god Kūkā`ilimoku. The first Hawaiians had no god representing war (Pukui *et al*. 1972:212). Exceeding all motives, dispute of land was the most common cause of war. Even religious rites incorporated this aggression: "The religious heiau, once open to all, was walled off from the common people. Religious rites now included acts of cruelty. Human sacrifices were made." (*ibid*: 212). Pukui *et al*. further explains that the war god Kūkā`ilimoku had become the ascendant deity and the Hawaiian population was on the decrease because of constant wars. Continued beliefs and honor of the nature god Lono created some sanctuary during a four month season where war was prohibited, known as *makahiki.* However, segregation had been created that caused new burdens, changing ancient ways forever.

THE MĀHELE

The Māhele of 1848 set the stage for vast changes to land holdings within the islands as it introduced the foreign concept of land ownership to the Islands. Although it remains a complex issue, many scholars believe that in order to protect Hawaiian sovereignty from foreign powers, Kauikeaouli (Kamehameha III) was forced to establish laws changing the traditional Hawaiian economy to that of a market economy (Kuykendall Vol. I, 1938:145 footnote 47, 152, 165–166, 170; Daws 1982:111; Kelly 1983:45; Kame`eleihiwa 1992:169–170, 176). Among other things, foreigners demanded

private ownership of land to insure their investments (Kuykendall Vol. I, 1938:138, 145, 178, 184, 202, 206, 271; Kame`eleihiwa 1992:178; Kelly 1998:4).

For natives that had been cultivating and living on the lands, lengthy and costly procedures enabled them to possibly claim some of the plots. The first Land Commission was formed in 1845, during which time all individuals holding land were required to submit their claims or forfeit their lands. Once lands were made available and private ownership was instituted the *maka`āinana* (commoners) were able to claim the plots on which they had been cultivating and living, if they had been made aware of the foreign procedures (*kuleana* lands, Land Commission Awards, LCA). These claims could not include any previously cultivated or presently fallow land, *`okipū* (on O`ahu), stream fisheries or many other resources necessary for traditional survival (Kelly 1983; Kame`elehiwa 1992:295; Kirch and Sahlins 1992). If occupation could be established through the testimony of two witnesses, the petitioners were awarded the claimed Land Commission Award (LCA), issued a Royal Patent number (RP), and could then take possession of the property (Chinen 1961: 16).

In 1848, the Māhele (division) led to the introduction and implementation of privatization that required both chiefs and commoners to retain private land title. If informed of the tedious and lengthy procedures, Hawaiians were permitted to claim lands in which they had worked or lived. The land that *maka`āinana* received was less than one percent of total lands, all of which needed to be surveyed. A total of 88,000 people submitted 14,000 requests for land and of these only 8,500 were awarded (Kame`eleihiwa 1992). A large amount of Hawaiian land was lost due to mortgage default.

Under the Māhele and the first Land Commission of the Trust Territory of Hawai`i, lands were allocated in three ways: one third became Crown Lands that belonged to the *ali`i*, one third was distributed to the chiefs, and one third was awarded to the general populace. In 1850, it became legal for foreigners to purchase land and they received large portions for diminutive prices. According to Kame`eleihiwa (1992: 228–230), the amount of land given to the *ali`i* was determined by genealogical rank. Each needed to list the claimed lands by name of the *ahupua`a*, surrender half of their land (50–71%), and pay the commutation fee, which was one third of the value of land.

LCA of Papa'akoko and Relationship to Project Area Burials

A late pre-Contact to early historic settlement pattern of Punalu'u is reflected in the documented testimonials of *Māhele* claimants. *Māhele* claims provided general information

regarding properties and activities (*i.e.* food crops, structures, burial/graveyard etc.) associated with the lands of the claimants.

Land Commission Award (LCA) 2289, Royal Patent 5590 represents the entire Ahupua'a of Papa'akoko (Appendix A). As documented in the Mahele Database, (www.waihona.com accessed 2010) this land was awarded to Kauhola who claimed rights of ownership in his testimonial dated February 4, 1854 which stated:

> To the Land Commissioners of the Hawaiian Islands, Greetings: I…hereby state my claim for land held anciently from Kamehameha I. Kalaau, my makuakane, and Kamookeawe, my makuahine , lived with Kamehameha and sailed with him to the battle of Nuuanu. When the battle was over, Kamehameha gave the land of Papaakoko to him, until the time of Kamehameha III, when it was divided, half for the ali`i and half for me. My half adjoins Kaluanui; that is my claim, given by Kamehameha III, Kooloauloa, Island of Oahu.

No land uses were listed on this *Māhele* land claim but according to the data available, one of two *ʻāpana* was acquired by Kauhola adjacent Kaluanui Ahupua'a, likely utilized for residential and small scale agriculture purposes. Concurrent with contemporary property records including the Tax Map Key (TMK) for the project area parcel, Hanohano Enterprises and Hanohano Family Inc. (SHPD/OIBC recognized lineal descendants) acquired all the land of Papa'akoko subsequent to Kauhola, and according to family genealogy held ownership over several generations (personal communication).

PREVIOUS ARCHAEOLOGICAL STUDIES

Sterling and Summers mention that Kaumaka`ula`ula Heiau, one of the most sacred heiau in Ko`olauloa, was located on the coast somewhere between present day Punalu`u Beach Park and Maipuna Stream (1978). The heiau had apparently been destroyed and there are no other references to the site in any of the archaeological investigations conducted in the area.

Previous archaeological studies in the *ahupua`a* of Punalu`u and Kahana have led to the documentation of intensive land use related to pre-Contact and historic period occupation, agricultural activities, animal husbandry, religious sites including *heiau* and *koa*, fishing sites and multiple burial sites (Figure 5). The current parcel has not been subject to significant archaeological studies.

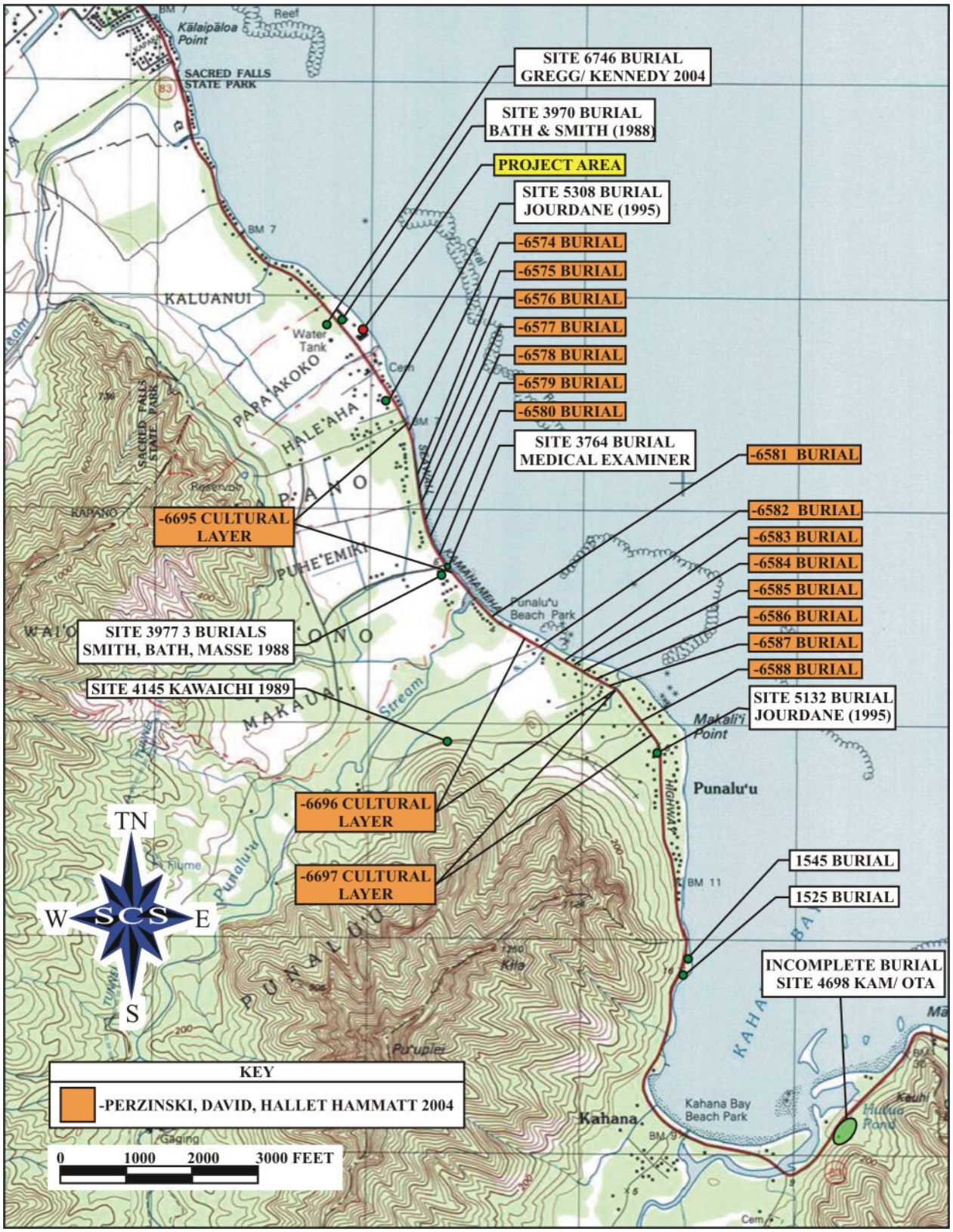

Figure 5: Portion of USGS Showing Location of Previously Identified Archaeological Sites and Documented Burials in Punalu`u.

Immediately south of the current project area, Perzinski and Hammatt conducted an archaeological monitoring program in conjunction with the installation of a water main along Kamehameha Highway (2004). During this three year project a total of 18 archaeological sites were identified. These 18 sites consisted of 15 burial sites, 50-30-06-6574 to 6588, comprised of 64 complete and partial burials, and an extensive cultural layer, nearly 2 km in length, which was assigned 3 SIHP site numbers, 50-30-06-6695 to 6697 (see Figure 5).

In addition to this recent study many additional burial sites have been documented over the years in the Kamehameha Highway corridor during various construction projects. In July 1988 the Honolulu city and county medical examiners office identified a human burial on the makai side of the road at 53-183 Kamehameha Hwy. At that time no professional osteological analysis occurred at the site. Observations of a local police officer offered, "…it looked like an old Hawaiian gravesite" (Honolulu Medical Examiner 1988).

In October 1988, on the other side of Kamehameha Hwy (53-368), Smith, Bath, and Masse (1988) identified 3 human burials and a canine burial, SIHP site number 50-30-06-3977 (see Figure 5). Analysis conducted on site at this project determined that the burials came from different time periods. One burial, within an identified burial pit, was recorded as pre-Contact and another was determined from its context to be from historic times. In addition to the burials, excavated construction trenches revealed subsurface pit features, an *imu*, and a historic rubbish pit containing late 19th and early 20th century bottles along with a poi pounder. In addition, Site 50-80-06-3970 was documented during a Field Inspection conducted by Bath and Smith (1988) immediately next door to the current project area at Pat's at Punalu'u condominium to investigate a possible burial in the property's parking lot (see Figure 5). This site consisted of a humic sandy cultural layer, as well as several pit and posthole features and was identified below several layers of old driveway and fill material under the modern asphalt driveway

In 1995 SHPD recorded two burial sites disturbed during construction located along Kamehemeha Hwy (see Figure 5). SIHP Site 50-80-06-5132 consisted of one individual interred within the Jaucus sand/Mokuleia loam matrix (Jourdane 1995). SIHP Site 50-80-06-5308 consisted of one individual within a Jaucus sand matrix with an identifiable burial pit. Both burials were assessed as pre-Contact Hawaiian burial sites based on context and lack of historic materials. In 2004 Gregg and Kennedy identified a burial site, SIHP Site 50-80-06-6746, containing 5 individuals that were determined from context to be a traditional Hawaiian burial.

In July 1989 Kawachi and Smith identified SIHP site 50-80-06-4145. The burial site located upland of the coast contained multiple individuals (see Figure 5). In 1981 a human cranium was identified in Huilua Fishpond (Kam and Ota 1981). This site, designated SIHP site 50-80-06-4698, could not be assessed as it came from an indeterminate context.

In addition to burials other archaeological studies in the general area have identified numerous sites related to habitation and expansive agricultural systems irrigated by Punalu`u Stream. The Bishop Museum conducted Archaeological Reconnaissance of 200 acres of Punalu`u lands (Figure 6). The survey area extended from the north side of Kahana Bay to past Punalu`u beach park and incorporated inland valleys. These surveyed lands are located directly adjacent, across Kamehameha Hwy, to the project area. During this investigation, 12 agricultural complexes were identified on valley slopes, 5 of which were irrigated. One complex encompassed an area of 4,500 square meters. The location of these complexes adjacent to Punalu`u Stream has enabled intensive agricultural use of the area during both pre-Contact and post-Contact time periods. Terraces, retaining walls, mounds and *`auwai* features were constructed in association with direct access to the permanent streams along the valley floor. Residential complexes comprised of platforms, retaining walls, and circular stone fireplace were also identified during this study. Cultural remains and artifacts, including a poi pounder, bi-facial grinding stone and assorted bottles and ceramics, which were associated with both pre and post-Contact activities were identified during the survey (Denison 1975). No archaeological testing was conducted at the time of the study.

These studies have revealed the presence of subsurface archaeological sites and human burials related to both traditional and historic occupation of the area. As the general area was impacted historically by sugarcane and later by residential development and road construction no surface structures are present in the project area. Considering the depth of excavation (36 inches on average) for the underground "sandbag" berm construction there is a fair probability that subsurface cultural materials and/or human burials will be identified during monitoring.

Previous work conducted in nearby areas prompted by modern development has yielded several significant cultural deposits, including human burials. Archaeological Monitoring conducted for a new water main along Kamehameha Highway by Cultural Surveys Hawai`i is in direct proximity to the project area. This monitoring study identified an extensive cultural layer and 18 burial sites comprised of 64 individuals.

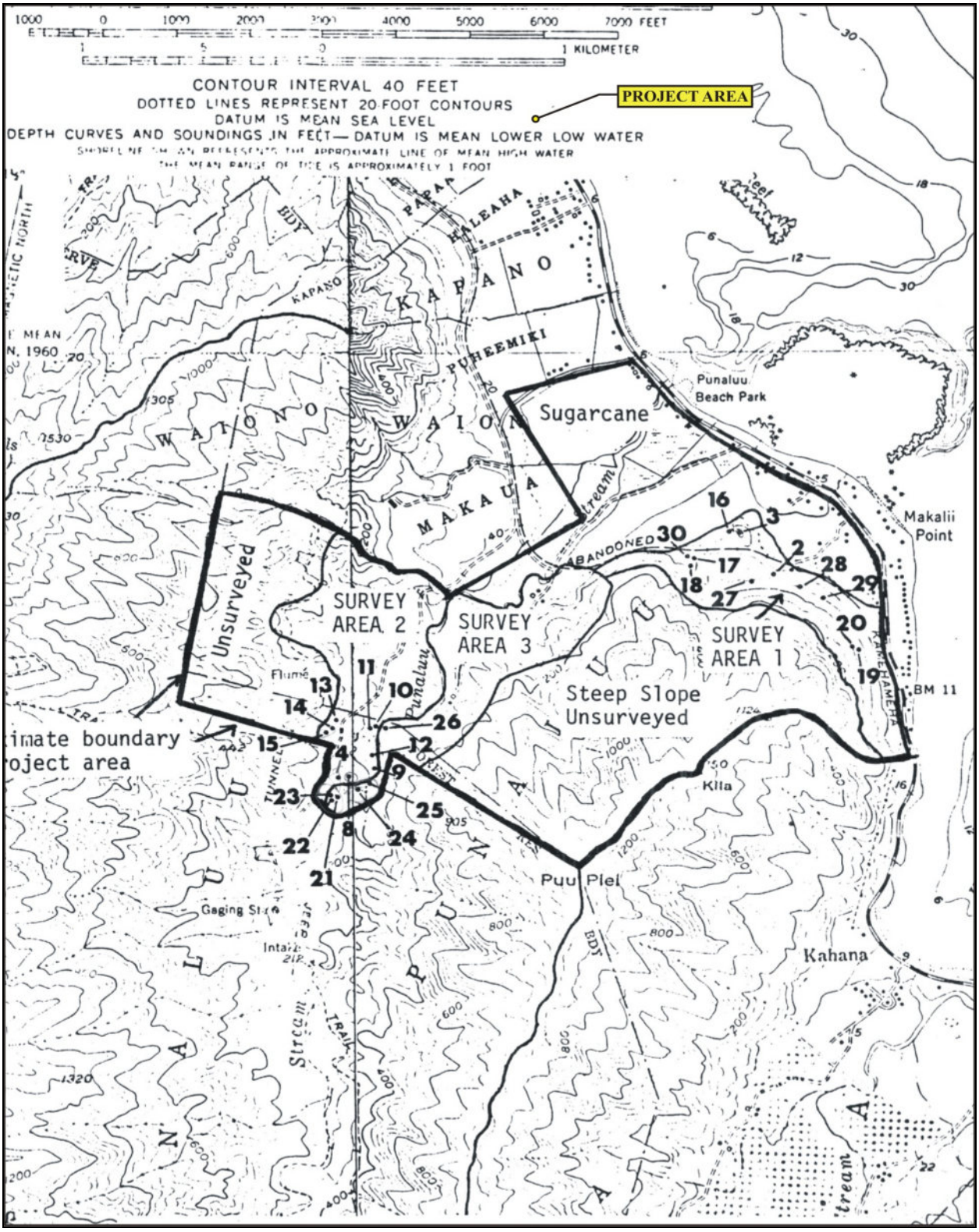

Figure 6: Map of Archaeological Reconnaissance of Punalu`u Lands From Bishop Museum Denison 1975.

PROJECT AREA ARCHAEOLOGY

The Punalu'u region of O'ahu's north coast has been fairly well documented in previous archaeological studies with exception to the current *ahupua'a*. A portion of the project area parcel however was subject to Archaeological Assessment (Spear and Chaffee 1993).

In 1993 SCS, Inc. conducted an Archeological Assessment on the parcel for a Sewer System Upgrade Project (*ibid.*). Investigations were limited to an area within the Tenant/Guest parking lot on the south side of the condominium building. Trenches excavated for the project exposed strata of asphalt, mixed gravel and contaminated fill-soils over natural sandy sediments. No traditional, or cultural, properties were documented.

In connection with the current project, Cultural Surveys Hawaii conducted a Field Inspection at the request of the SHPD after the initial inadvertent discovery of human remains (Site -7120, Feature B-1) by construction personnel. Inspection involved assessment and documentation of the general context of the burial, including race if possible, while left in place (McDermott 2010). Disinterment was postponed until on-site relocation of the remains could be coordinated with the property owners and the SHPD in accordance with the Burial Sites Program.

REASON FOR MONITORING

Monitoring was conducted on this parcel due to the possibility that subsurface excavations could impact significant cultural features and/or indavertant burials. The current parcel contains intact sandy deposits, which are known for containing human burials. These soils were ideal places for traditional Hawaiian burials, but may also contain other subsurface evidence of traditional occupation activities. Archaeological Monitoring is necessary in order to mitigate any such archaeological finds or inadvertant burials.

MONITORING METHODOLOGY

Archaeological Monitoring was conducted in compliance with DLNR/SHPD draft rules (DLNR/SHPD 2002).

The construction crew were informed of the relevant archaeological methods, expectations, and protocols (*e.g.*, should human remains be uncovered) at the start of monitoring activities described in this report. If any potentially important find or deposit was exposed in

excavation, work in the area was ceased immediately so the SCS archaeologist could render a professional judgment as to its significance, and the appropriate documentation undertaken.

SCS archaeologists Elizabeth Pestana, B.A., Guerin Tomei, B.A., and Jon Wilson monitored excavations associated with the installation of the GWS from February 9 through March 9, 2010 under the overall supervision of Principle Investigator Robert L. Spear. The excavations were accomplished by mechanical excavator to excavate a large volume of area.

Documentation consisted of standard archaeological description forms (daily field notes), sectional profiles of one wall for each excavation were illustrated by the monitoring archaeologist (*e.g.*, profile sketch maps), and photographed (never including human remains). All measurements were recorded utilizing the metric system, excavation depths recorded in centimeters below surface (cmbs). Soil matrices were recorded using the United States Department of Agriculture (USDA) Munsell (2000) soil color descriptions.

LABORATORY ANALYSIS

Any samples collected during the project have undergone analysis at the SCS laboratory in Honolulu, in accordance with SHPD rules (§13-279, HAR). All artifacts and/or midden samples if collected from the field are cleaned, sorted, and analyzed at SCS Honolulu. Significant artifacts are photographed, sketched, and classified (qualitative analysis). These data are presented in tabular form for presentation in the final report. All stratigraphic profiles have been electronically drafted for presentation in the final report.

Midden samples, if any, are minimally identified to major 'class' (e.g., bivalve, gastropod mollusk, echinoderm, fish, bird, and mammal). All metric measurements and weights are recorded (quantitative analysis). All data were recorded on standard laboratory forms which also include number and weight (as appropriate) of each constituent category. If applicable these counts are included in the final report. Since no midden samples were observed or collected during field work these analyses were not required. Any amenable charcoal samples collected from the site may undergo radiocarbon dating analysis at the request of the client if deemed necessary.

CURATION

All collected materials, except human remains which will remain in an on-site storage facility until reinterment, are being curated at SCS facilities in Honolulu. All materials gathered during this project (including documentation) are ultimately the property of the Hanohano Hale condominium Owner's Association, and the lineal/cultural descendents, who may request their transfer subsequent to the acceptance of the final Archaeological Monitoring Report. Any recovered cultural materials associated with burial features will be prepared for reburial with the remains at the time of reinterment.

RESULTS OF MONITORING

A total of ten burial features consisting of twelve human burials were recorded in Site -7120. The first burial feature (B-1) was inadvertently discovered by construction personnel while manually probing the subsurface during initial exploratory work associated with the GWS installation. After consultation with the SHPD a Monitoring Program was put into effect to fulfill the requirements referenced under Hawaii Administrative Rules (HAR) Chapter 13-13-279, and work on the project was resumed. During this course of work SCS monitors identified and documented nine additional burial features (consisting of 11 burials), some with defined burial pits.

The following text provides a summary of Site -7120, detailed descriptions of all burial features and burial contexts, consultation, burial recovery procedures, interim curation, and proposed burial treatment of the 12 sets of human remains recovered.

STATE SITE NO. 50-80-06-7120 ARCHAEOLOGICAL SUMMARY

Site -7120 Features B-1 through B-10 were identified in an excavated area of c. 1,344 ft^2 located in the landscaped courtyard fronting the north building entrance abutting the tenant parking lot of Hanohano Hale (Figure 7; see Figure 4). Per SHPD, the first burial feature encountered was left in place and trenching plans were adjusted to create a buffer as an interim protection measure. However, as additional burial features continued to be encountered SHPD advised SCS archeologists to disinter the remains of Burial Feature 1, and those of the additional burial features from their locations in the GWS excavations as they were encountered.

Figure 7: Photographic Overview of Extensive Leach Field Excavation in Progress. View to South.

Modern cultural materials and debris were observed in fill layers and sections of previous disturbance including ferrous metal (carpenters nails, wire, etc.) a blue on white ceramic sherd,red on white ceramic sherd, modern bottle glass, and cow bone fragments. No historic, or traditional, artifacts were observed in the project area.

All data recorded from Site -7120 supports the interpretation that all the burial features consist of native Hawaiian remains interred during late pre-Contact to early historic times, this postulation is based on the absence of historic artifacts in relationship to any of the burial features and observed osteological pathologies. Traditional cultural materials noted and collected near or in direct proximity to the remains included water worn cobbles and pebbles, non-worked coral, volcanic glass and little charcoal. Vertebrate faunal remains of fish, sea turtle, sea bird, and pig were also noted in near proximity of burial features in the sandy strata.

PROJECT AREA SOILS

Soils observed in the project area consisted of imported fill-soils and the noted natural Jaucus beach sands. The majority of excavations for the project were those required for the leach field which went to a base depth of ca. 155 cmbs (5 ft.). The maximum depth excavated was ca. 300 cmbs (approximately 10 ft.) required for a 3,000 gallon GWS tank.

The stratigraphy exposed in the project area comprised up to five distinct, fairly uniform layers of imported fill-soils, and approximately three layers of the naturally occurring beach sands. Fill-soils consisted of loam, crushed coral/gravel and silty clay over the natural beach sand deposit (see Figure 7). The fill-soils intruded into the natural sandy substrata of the project area and ranged in thickness from ca. 30 to a maximum of ca. 80 centimeters below the surface (cmbs). The natural partially intact beach sand deposit observed below the fill-soils consisted of a very dark gray to black loamy sand layer directly below the fill soils and in juxtaposition to very pale brown, well sorted, medium to fine grain sands. The basal most extent of excavations exposed very coarse white to pinkish gray sands that consisted largely of fragments of coral and marine shell. The transition of fine/medium grain sands to very course coralline sands was fairly sudden and marked by the presence of the water table at approximately 180 cmbs (6 ft.). The overall soil profile of the project area was recorded as follows:

- **Layer I (LI):** Compact, very dark brown (7.5 YR 3/3 to 2.5/2 dry) clay loam with grass roots. LI is fill-soil.
- **Layer II (LII):** Compact, yellow to yellowish brown and very pale brown (10YR 5/6 and 7/6-3 dry) mixed coral, sand and gravel. LII is fill-soil.
- **Layer III (LIII):** Compact, dark brown (7.5 YR 3/3, dry) silty clay. LIII is fill-soil.
- **Layer IIIa (LIIIa):** Compact, brown (10 YR 4/3, dry). LIIIa is fill-soil noted around Feature B1 only.
- **Layer IVa (LIVa):** Compact, light yellowish brown (10 YR 6/4, dry) silty clay. LIVa is fill-soil noted around Feature B1 only.
- **Layer IV (LIV):** Compact, very dark gray to black (10YR 3/1 to 2/1, dry) sand. LIV is a probable former A-horizon of the natural beach sand deposit.
- **Layer V (LV):** Semi-loose to loose, light yellowish brown and pale brown to very pale brown (10 YR 6/3-4 and 8/3, moist/dry) sand. LV is a sterile, natural beach sand stratum.
- **Layer VI (LVI):** Semi-loose light gray to pinkish gray (5 YR 6/1 to 7/2, moist) marine shell and coral. LVI is a natural coral substratum.

Subsurface disturbance by previous landscaping/construction activities was indicated by observed fragmented human remains within fill-soil layers LII and LIII, and the intrusion of the fill-soils over *in situ* portions of the underlying sand strata and subsurface features. Additionally, the majority of the north wall of the leach field excavation exposed a zone of previous disturbance, clearly indicated by comingled substrata of fill-soil matrices intermingled with beach sand across the north wall profile (Figure 8; see Figure 3).

FEATURE B-1

B-1, originally recorded by CSH (McDermott December 2010) after the discovery, was encountered during initial excavation by construction personnel while manually trying to locate a buried waterline, and was located in nearest proximity to the condominium structure (see Figure 3).

The right temporal portion of an intact cranium was exposed at c. 110 centimeters below surface (cmbs) in the sandy matrices, below c. 60 centimeters of multiple imported fill-soil layers (Figure 9). A burial pit was observed in association with the remains and appeared to have been truncated at the upper extent. Full exposure of Feature B-1 revealed incomplete, disarticulated human remains; suggesting that Feature B-1 had been subject to previous disturbances. An estimated 10% of skeletal remains of this individual were recovered from the feature and included the entire cranium and fragments of clavicle, humerus and radius. Based on craniofacial features it was determined that B-1 was male, interred at adulthood (36-50 years).

FEATURE B-2

Feature B-2 was identified during mechanical excavation for the placement of a 3,000 gallon septic tank. Bone fragments were observed in the excavator bucket after it had withdrawn from within the natural sandy strata c. 110 cmbs at the working edge of the excavation approximately 3 meters west of Feature B-1 (see Figure 3). Based on feature context, percentage of remains recovered, and proximity to Feature B-1, it is likely that Feature B-2 was altered by previous disturbance, but remained partially *in situ*.

Upon investigation of the feature location in the trench, a pit feature was not observed in the concentration of the fragmented remains except for a faint discoloration noted in the area of a nearly intact cranium (Figure 10). At full exposure, the cranium was observed on its right side facing west, possibly *in situ*. The remains were recovered from c. 110 to 140 cmbs across a span

Figure 8: Photographic overview of Exposed West Section of Zone of Previous Disturbance in North Wall of Leach Field. View to West.

of 112 to 75 cm (east/west axis). Approximately 40% to 50% of the total skeletal remains of this individual was recovered and included cervical vertebra, metacarpals and bases, phalanges (hand and foot), metatarsals, talus, calcaneous and fragments of clavicle, scapula, humerus, radius, ulna, and other indeterminate fragments.

The interment position of this burial was difficult to ascertain considering disturbance to the feature. Though based on the concentration of remains identified and recovered from their location in the trench it was deduced that this burial was interred in a flexed position.

Burial 2 was assessed as female adult (36 – 49 yrs). Traditional cultural materials noted and collected in the area of B-2 concentration consisted of volcanic glass and charcoal.

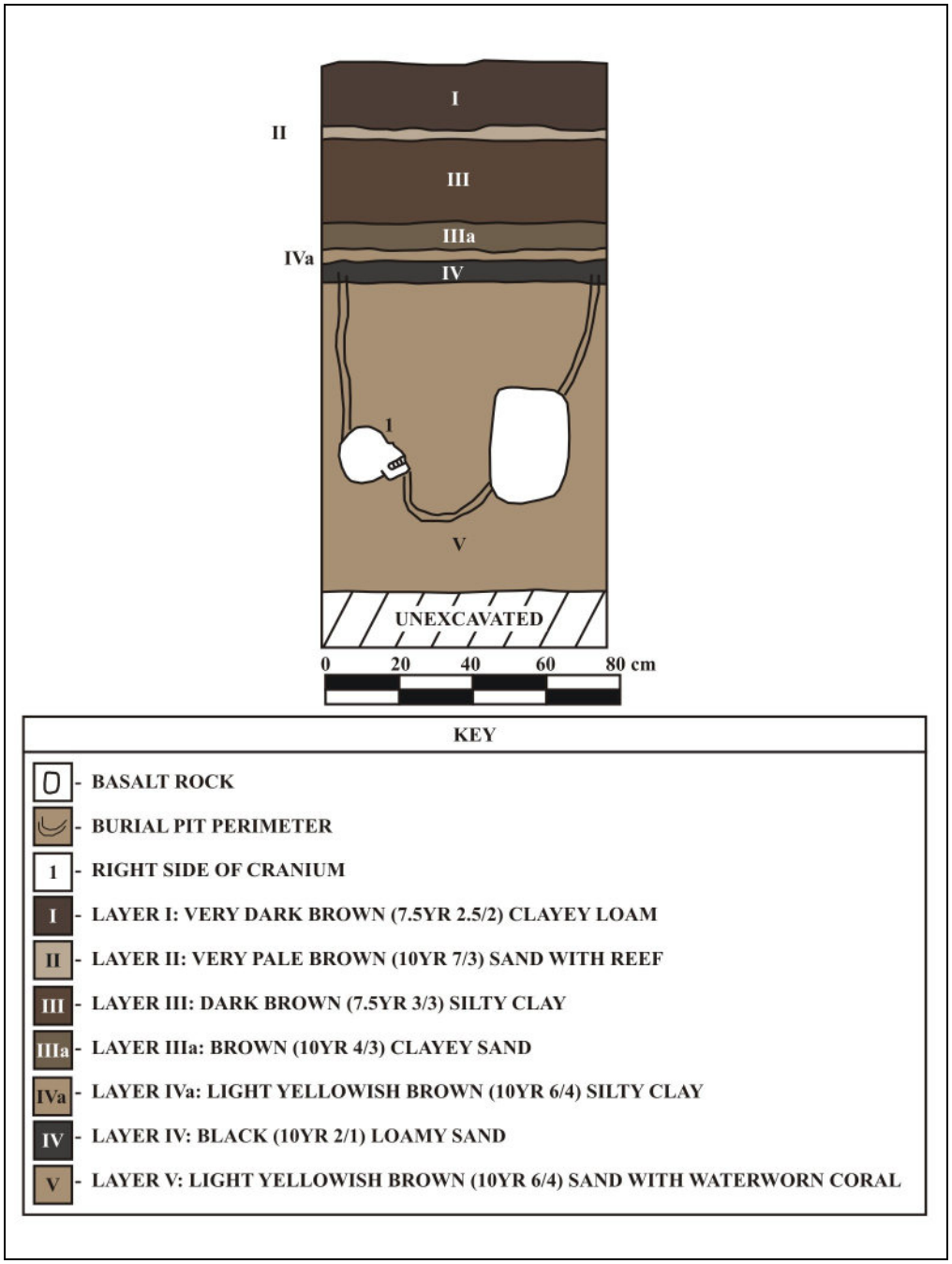

Figure 9: Stratigraphic Profile Illustrating Burial Feature 1. South Wall.

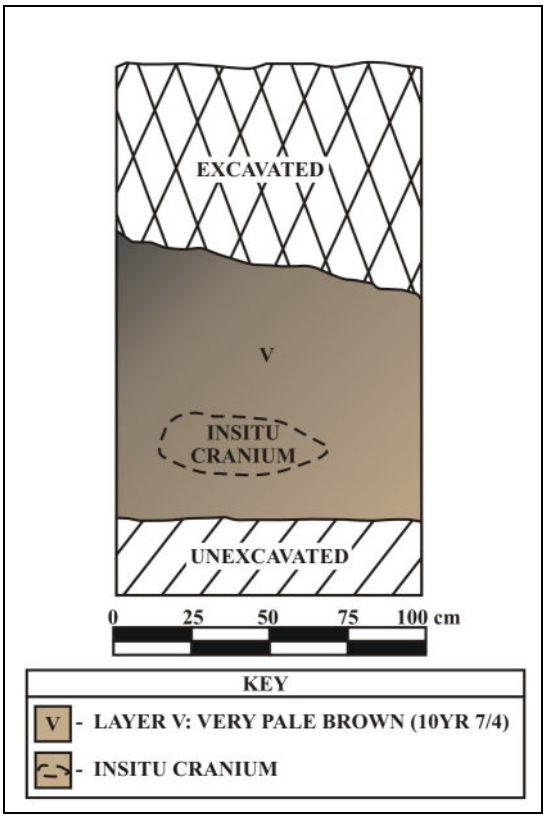

Figure 10: Stratigraphic Profile Depicting Feature B-2, In Situ Cranium Location. North Wall Profile.

FEATURE B-3

Similar to Feature B-2, Feature B-3 was revealed when the excavator bucket vertically scraped the north/northeast wall of the leach field, approximately 5 ft. from a concrete walkway adjacent the condo's swimming pool (see Figure 3). The cross-section of a radius and ulna, etc. was exposed in the trench wall at 100 cmbs, and observed within a well defined pit stain feature that occurred at 70 to115 cmbs, within the intact beach sand deposit just 2 to 5 cm below imported fill-soil layers (Figure 11).

During disinterment of very friable remains it appeared the feature contained a single *in situ* burial probably interred in an extended position oriented east/west (63˚ E/ 243˚ W) lying on its right side, based on arrangement and extent of partially articulated remains within the wall of the excavation. Later analyses of the remains however established an MNI of N=2 for this burial feature. Primarily only the long bones of a second individual were present. In its entirety, the feature extended ca. 85 cm into the east wall of the leach field excavation, and though not significantly indicated by the stratum exposed at Feature B-3, possibility exists that the feature

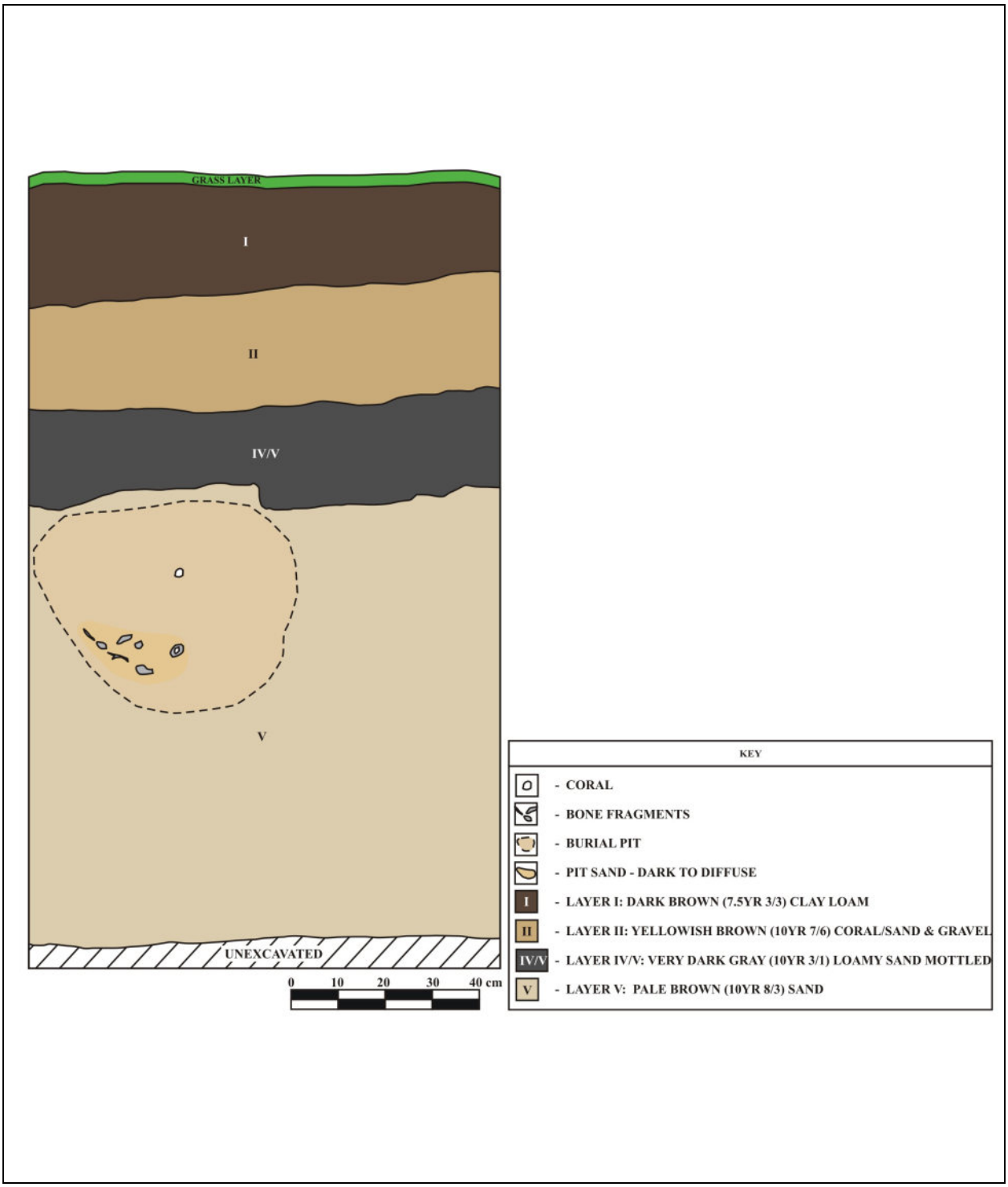

Figure 11: Stratigraphic Profile of Feature B-3 Depicting Burial Pit and Cross Section of Skeletal Remains. East Wall Profile.

was subject to previous disturbance, having primarily impacted the second individual. Large cobble sized fragments of coral were noted in direct association with these remains.

Approximately 85% of the total skeletal remains of one individual and 15% of the total of a second was recovered from this feature and included premolar, maxilla, mandible, clavicle, scapula, humerus, radius, ulna, rib, sacrum, femur, tibia, fibula, patella, talus, metacarpals and bases, metatarsals, and phalanges (hand and foot), and several indeterminate fragments. The friable and fragmented condition of the remains did not allow for sexing, both were assessed as adult (12 – 35 yrs).

FEATURE B-4

B-4 was an incomplete burial identified in a section of the leach field excavation located in the north end of the west wall at c. 80 to 100 cmbs (see Figure 3). Femur fragments were observed in the trench floor in an area where the west wall met the north wall (Figure 12). Evidence of previous disturbances likely related to earlier development and construction of the property were clearly displayed across the greater part of the north wall of the leach field excavation, and extended to the base of excavations associated with the current GWS project (c. 155 cmbs).

This burial had been completely removed from its original context previous to the current project, thus neither a burial pit nor associated traditional cultural materials could be observed with or near the remains. Investigation of the immediate vicinity of the remains exposed a scatter of human bone fragments across a 2 m^2 area within loamy-sand matrices within which modern debris was observed (*e.g.* carpenter's nails, plastic, etc.). It was during exploration of this burial that skeletal remains were observed in secondary context within surface fill layers of the overall zone of previous disturbance along the northern limit of the leach field excavation. Fill-soil was also noted embedded in the recesses of fractures and grain of the bones of B-4 remains. An estimated 15% of the total skeletal remains of this individual were identified and recovered including coronal, temporal and occipital cranium, maxilla, clavicle, scapula, radius, metacarpal, cuboid, phalanges and indeterminate fragments which were assessed as a sub-adult/adult male (c. 12 – 35 yrs).

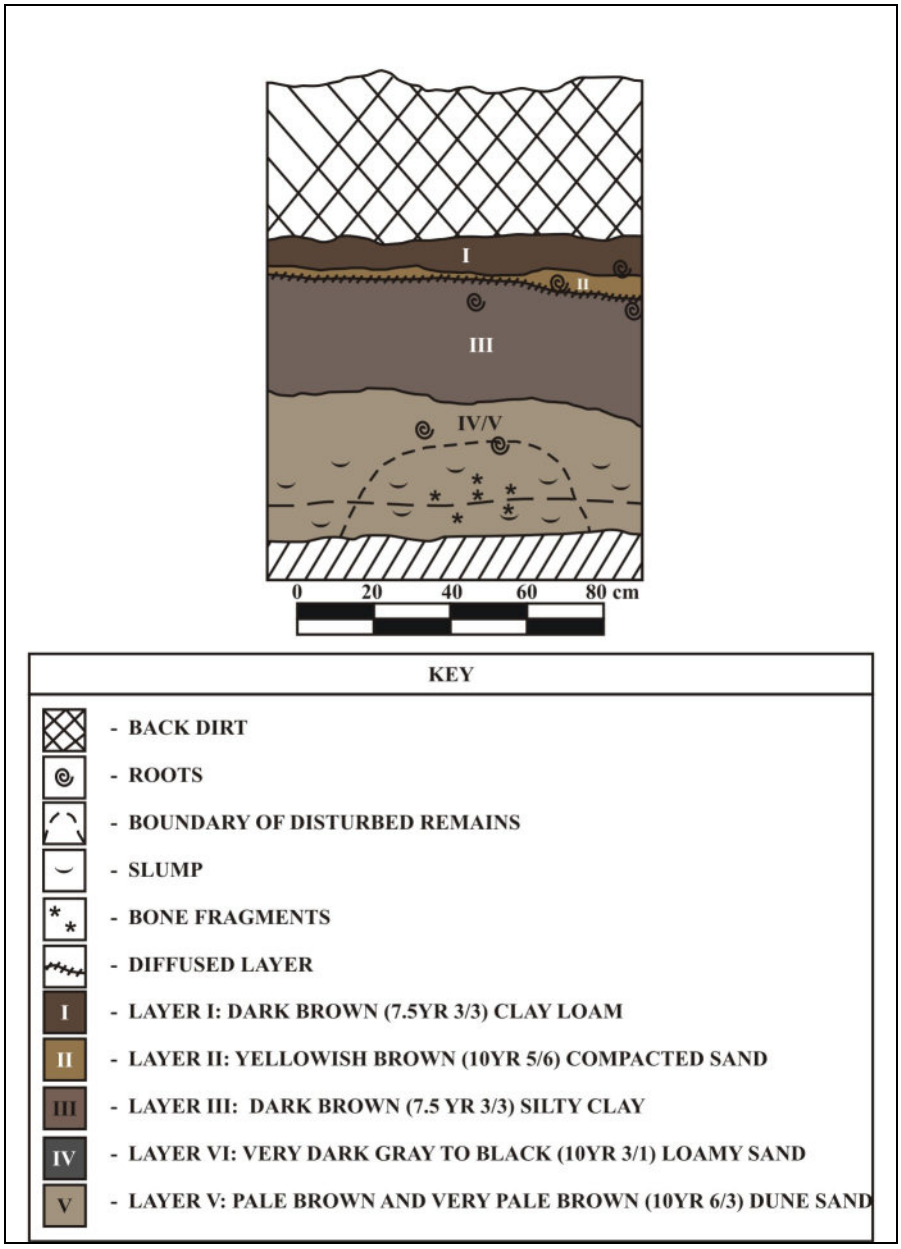

Figure 12: Feature B-4 Stratigraphic Profile Depicting Location of Previously Disturbed Remains. West Wall Profile.

FEATURE B-5

Burial Feature 5 was a burial identified during excavation of the west wall at the south corner of the leach field in the intact beach sand deposit (see Figure 3). Though the skeletal remains of the burial had been completely displaced by the excavator a well defined burial pit feature typically suggestive of *in situ* provenience could still be observed in the wall at a depth of 80 cmbs (Figure 13). No artifacts or cultural materials were noted in association with the burial matrix.

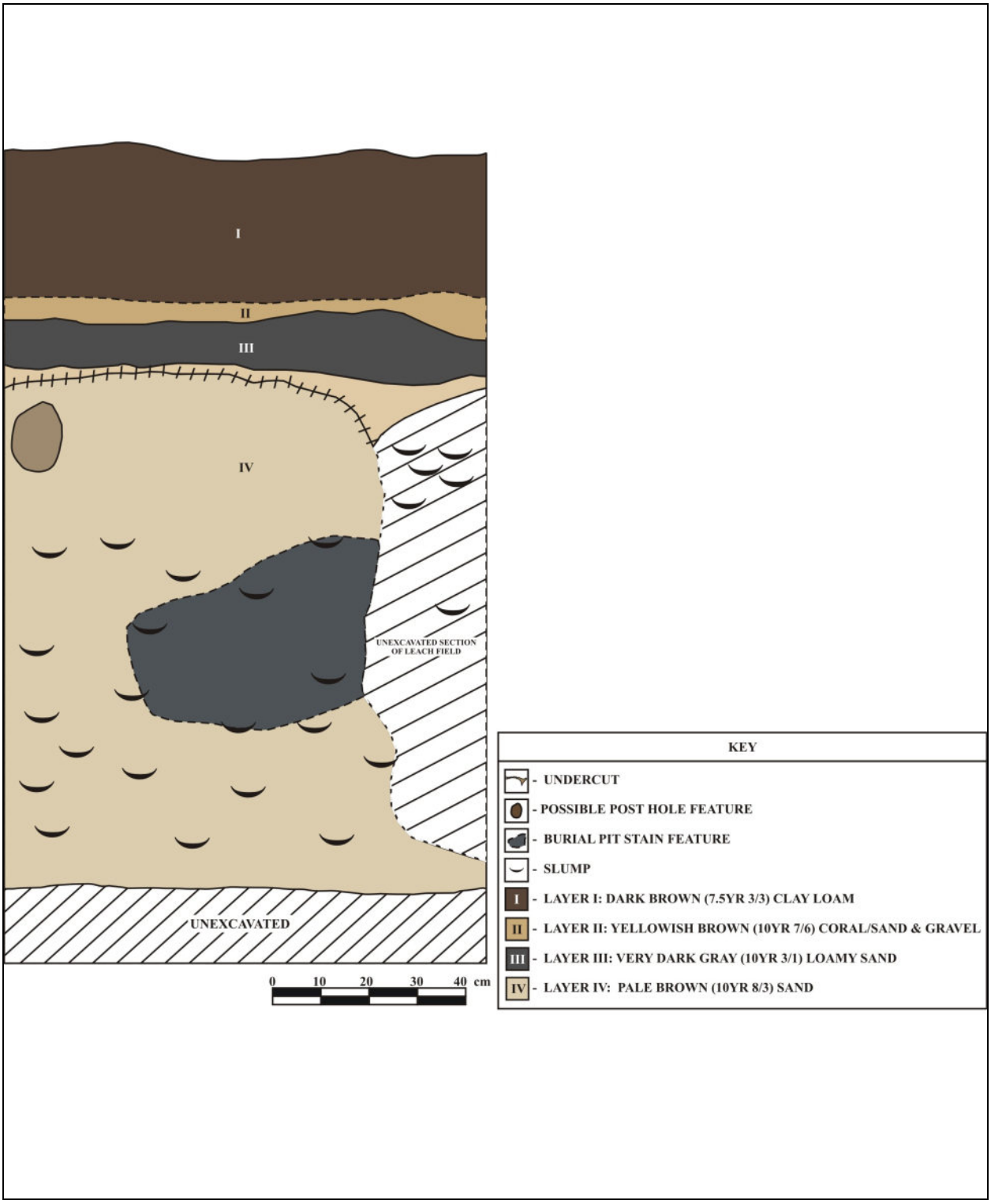

Figure 13: Stratigraphic Profile of Feature B-5 Depicting In Situ Cranium. West Wall Profile.

Approximately 20% of the total skeletal remains of this individual was identifiable and recovered from the excavated floor and back dirt and included molar, scapula, clavicle, humerus, radius, ulna, rib, vertebra, sacrum, os coxae, femur, fibula, tibia, talus, metatarsals and many indeterminate fragments. The burial was assessed as a single adult (21 – 35 yrs) of indeterminate sex.

FEATURE B-6

Burial 6 was identified in the north end of the west wall within the segment of previous disturbance approximately 2 to 3 m *mauka* of B-4 remains (see Figure 3). Remains of this individual were exposed at 50 cmbs when pressure applied to the ground surface by foot collapsed that portion of the wall of the leach field excavation (Figure 14). The remains were completely disarticulated and fairly fragmented. The sandy matrices occurring around the remains and in this portion of the excavation were very loose and mottled with soil from the surface which also was of much lesser thickness over the location of the remains; indicating a possible secondary context for this burial similar to Feature B-4. The remains were assessed as those of a single child (5 – 6 yrs).

An estimated 25% to 30% of total skeletal remains of this individual was recovered and included coronal and temporal cranium, mandible, scapula, humerus, radius, rib, metacarpals, hand phalanges, metatarsals, os coxae, sacrum, femur, tibia, fibula, and indeterminate fragments.

FEATURE B-7

Burial Feature 7 located c. 2 meters west (*mauka*) of Feature B-5, was observed between 37 cmbs of the sand stratum to 130 cmbs in an intact sand deposit that appeared to have been truncated at the upper extent of the burial pit where it would have intruded into the upper stratum, presently fill-soil (Figure 15; see Figure 3). *In situ* skeletal remains were first exposed at c. 94 cmbs but were partially displaced mechanically at the burial's lower half. Once all skeletal remains were exposed, an additional set of remains were identified among the disturbed lower portion of the burial feature. These additional remains were immediately recognized as those of an infant, or fetus, and had been totally disinterred with the lower portion of the remains of the primary individual.

In contrast to the remains of all the other burials encountered, the remains of Feature B-7 were in exceptionally good condition. This was perhaps attributed to the burial's basal level in the sand stratum, within the reaches of the water-table. No artifacts were found in association

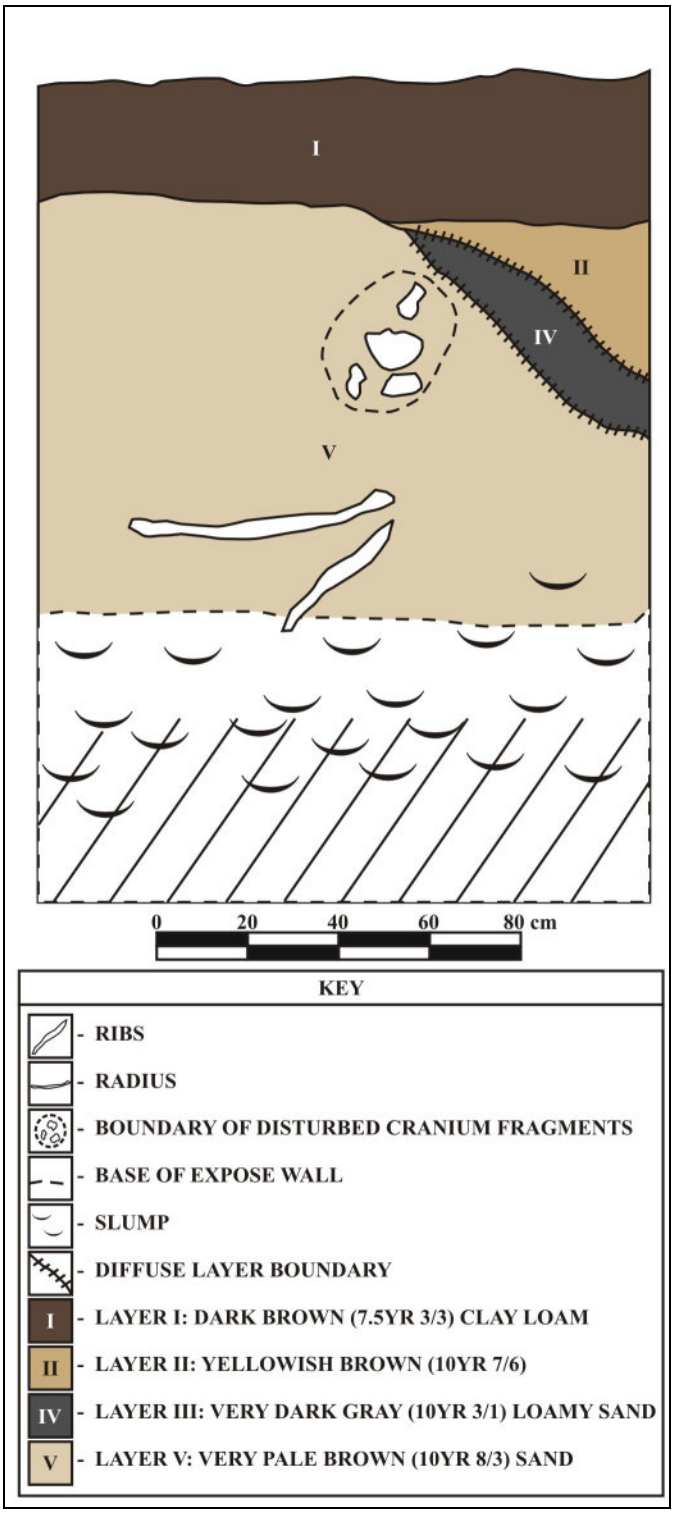

Figure 14: Stratigraphic Profile of Feature B-7 Depicting Remains in Area of Previous Disturbance. West Wall Profile.

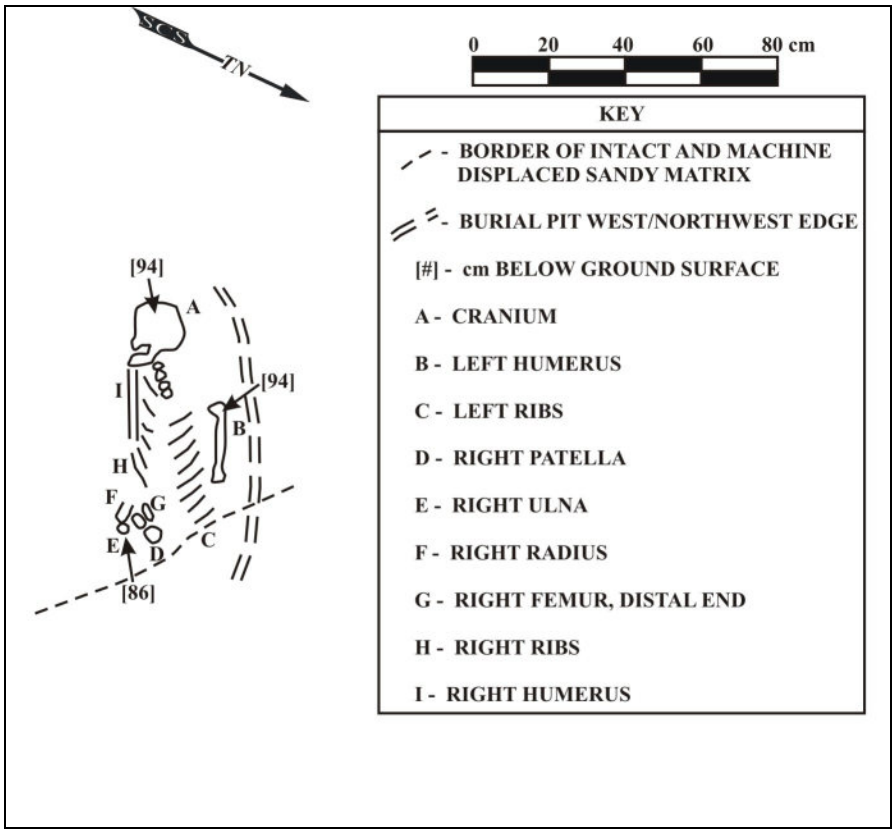

Figure 15: Planview of Feature B-7 Illustrating Partially *In Situ* Remains.

with this burial feature, although cultural materials including large fish vertebra, small water worn cobbles and coral were noted in the sandy matrix occurring around the skeletal remains.

Disturbance to this feature was fairly minimal having been only slightly impacted at the lower extreme, and based on placement of intact *in situ* portions of the feature it was determined the remains were likely interred in a flexed supine position facing south, in an east/west axis (235˚ W/75˚ E). The remains of the primary individual were assessed as an adult female (>18 yrs) and were fully (100%) recovered from the disturbed sandy matrices, and *in situ* contexts. An estimated 30% to 40% of total skeletal remains of the infant/fetus (0 – 1 yr) was recovered from within the disturbed portion of the burial feature and included coronal and temporal cranium, maxilla, scapula, humerus, radius, ribs, phalange, vertebra, os coxae, femur, tibia and epiphyses.

FEATURE B-8

Burial Feature 8 was encountered by the monitoring archaeologist while manually scraping the top of the exposed sand layer horizontally after the fill-soils layers had been

mechanically removed from the top of the natural sand deposit in attempt to minimize impact to possible burials within the c. 288 ft.^{2} of remaining excavation (see Figure 3).

While methodically scraping the wall vertically a small possible pit feature became visible in the sidewall of the sandy stratum at 53 cmbs (Figure 16). In investigating the feature, the top of the sand layer was manually scraped horizontally over the top surface of the pit feature excavating downward toward its interior. A portion of cranium was exposed at 58 cmbs. Full horizontal exposure of the interior of the feature revealed a single partially intact cranium positioned crown down, mandible up, facing south.

This section of the trench was the mid point between the zones of previous disturbance (north portion) and the intact sand deposit (south portion) in the west wall of the leach field excavation (see Figure 3). An approximate 10 to 15% of this individual's total skeletal remains were recovered from the pit feature limited to cranium, a rib fragment and few indeterminate fragments. Cultural materials present in the pit feature included small pieces of coral. The friable condition of the remains did not allow for age/sex determinations.

FEATURE B-9

Similar to Feature B-8, this feature, located in the west wall c. 2 meters west (*mauka*) of dual Burial Feature 7, was encountered by the monitoring archaeologist while manually investigating a well defined pit feature after the fill-soil strata had been mechanically removed (see figure 3). The pit feature was observed in the intact sand layer at a depth of 83 cmbs to 100 cmbs, very close to the fill-soil layer and probably intruded into the upper strata (Figure 17). A portion of a humerus was first observed in the wall at c. 104 cmbs. Once the remains were fully exposed in plan view a complete *in situ* single burial was revealed between depths of c 83 cmbs to 105 cmbs.

This burial was in a flexed position lying on its left side in a north/northwest south/southeast axis (130˚ NW/310˚ SE) facing east. During the disinterment process this burial was estimated as a male adult (12 – 20 yrs) based on features of the cranium and dentition. One hundred percent of the remains were recovered but were found to be extremely friable and fragile and did not remain intact for analysis. No artifacts or cultural materials were observed with or near feature B-9.

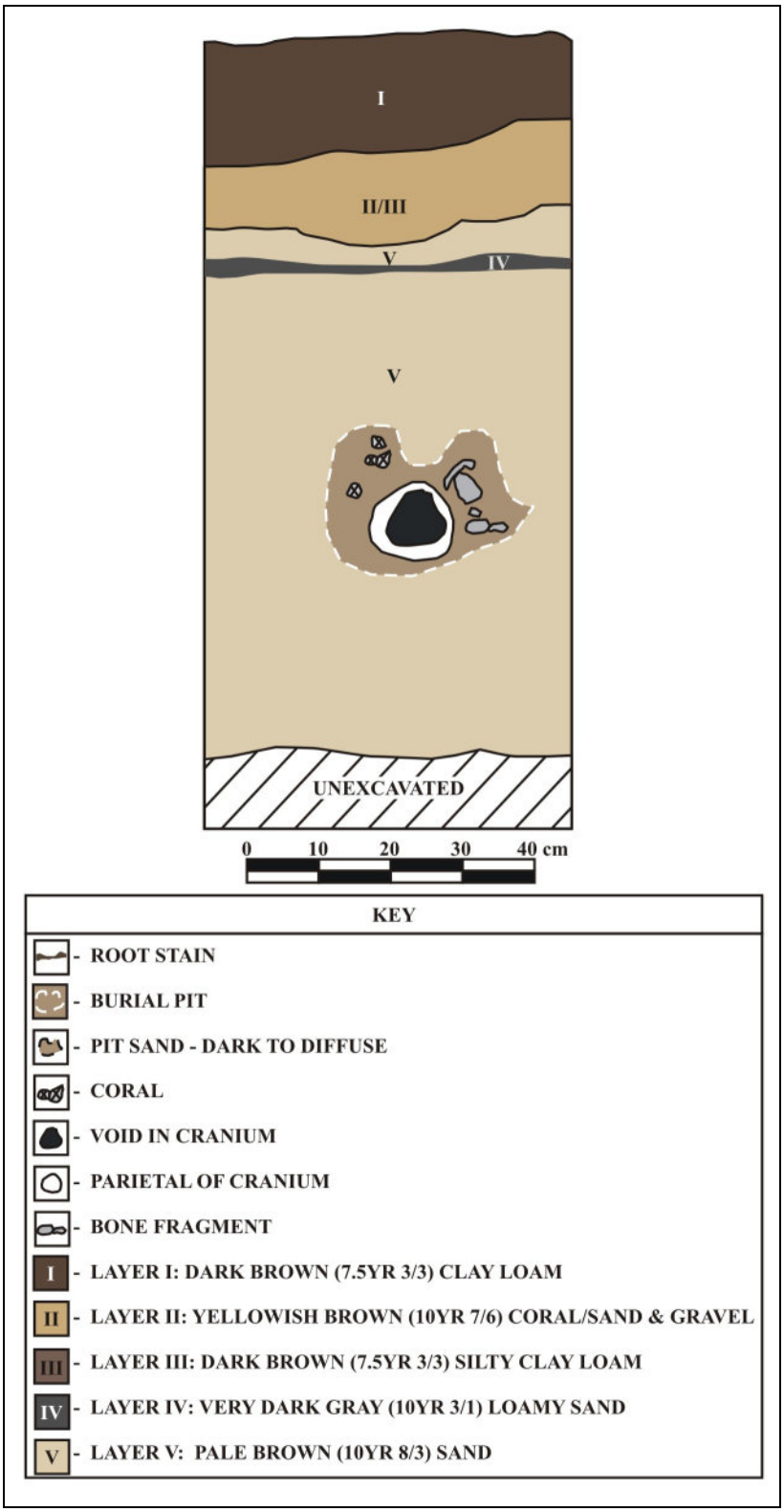

Figure 16: Stratigraphic Profile of Feature B-8 Depicting Burial Pit Feature and Skeletal Remains.

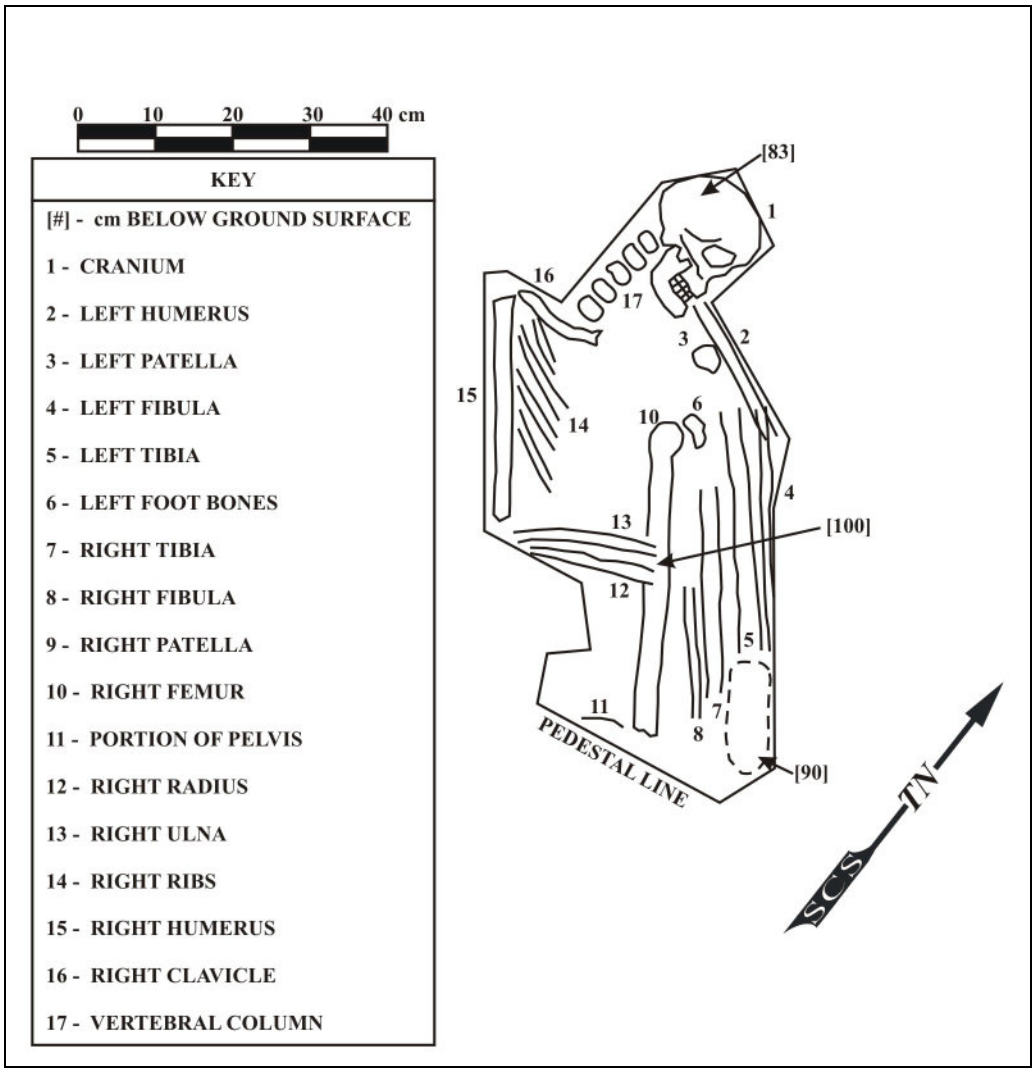

Figure 17: Plan View of Feature B-9 Illustrating *In Situ* Remains.

FEATURE B-10

This burial feature was also identified during manual exploration of a pit feature observed in the west wall just within a 2 meter distance north of B-9 (see Figure 3). The pit feature observed at 44 to 60 cmbs from the surface appeared to be truncated and otherwise altered in itsupper extent (Figure 18). Cranium was encountered within the boundary where the fill-soil above had intruded into the sand layer.

Once the full horizontal extent of the burial was exposed, between 44 to 53 cmbs, partially articulated remains of a child (0 – 3 yrs) were observed in the loamy-sand matrix. The burial appeared to be supine, orientated northwest/southeast (146˚ NW/326˚ SE) in long axis, but the remains were severely friable and the actual interment position was indiscernible.

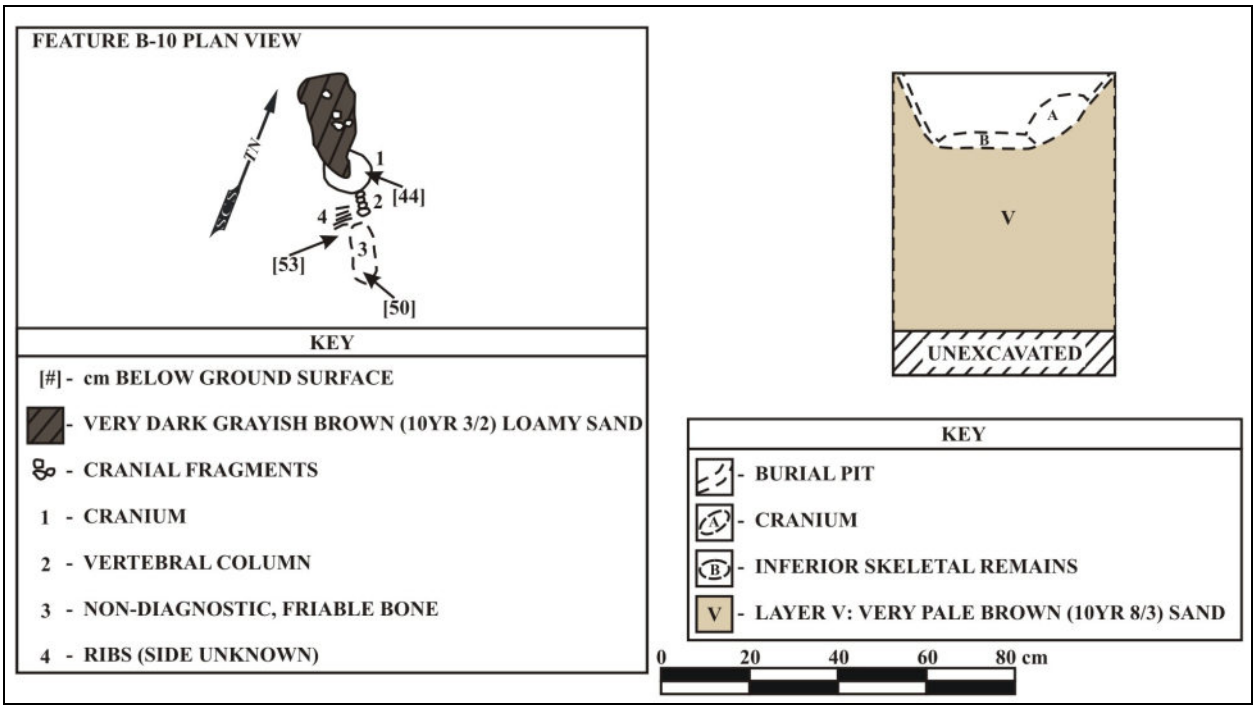

Figure 18: Feature B-10 Plan View (Left), and Stratigraphic Profile of West Wall (Right) Depicting Truncated Burial Feature.

No artifacts or cultural materials were found in association with this burial feature. Approximately <10% of the total skeletal remains of this individual was recovered from the feature and included fragmented cranium, mandible and dentition, clavicle, humerus, radius, sternal manubrium and many indeterminate fragments.

DISINTERMENT METHODS AND INTERIM CURATION

The SHPD determined that the burials encountered during the GWS project would be best protected if they were disinterred from their locations in the project area. Therefore SCS archaeologists were instructed to remove all human skeletal remains as they were encountered during excavations associated with the GWS installation.

When human remains were identified, all *in situ* and displaced human remains within the excavation were exposed with a trowel and soft brush. Burial data was recorded in metric plan view and/or profile field maps, standardized Subsurface Feature and Human Burial Exposure forms, field notebooks, and with GPS unit recording coordinates for each burial (Appendix B). Once all pertinent data had been recorded each set of remains was wrapped in muslin and placed in *lau hala* containers. Disturbed matrices of burial features and displaced sediments containing skeletal remains were screened through 1/8 inch mesh screens. The *lau hala* burial containers

(*lau hala hina'i*) were placed in plain brown cardboard boxes and locked in a storage facility on-site provided by Hanohano Hale management where they are to remain until final reinterment.

Evaluation

All subject burials described above were evaluated for age/sex determinations and were assessed as native Hawaiian, interred during late pre-Contact to early historic times. All burial features identified during the GWS project were found to have originated in the natural beach sand deposit that occurs below the fill-soils of the project area parcel. Only traditional type cultural materials were noted within burial contexts; no historic cultural properties were found in association with any of the burial features.

Previous disturbance to burials present in the project area was evidenced by skeletal remains observed in surface fill layers and other such altered contexts of the upper extent of the natural sand stratum. All observed human remains were recovered or disinterred per SHPD as a measure of protection due to the ongoing GWS project. Following the completion of work in the project area all twelve sets of remains as well as those found in isolated contexts of previous disturbance are proposed for reinterment in a permissible location on the project area parcel.

SIGNIFICANCE ASSESSMENTS

Site -7120 has been evaluated for significance according to the criteria established for the Hawai`i State Register of Historic Places. The five criteria are defined as follows:

Criterion A: Site is associated with events that have made a significant contribution to the broad patterns of our history;

Criterion B: Site is associated with the lives of persons significant to our past;

Criterion C: Site is an excellent site type and embodies distinctive characteristics of a type, period, or method of construction, or represents the work of a master, or possesses high artistic values, or represents a significant and distinguishable entity whose components may lack individual construction;

Criterion D: Site has yielded or has the potential to yield information important in prehistory or history;

Criterion E: Site has cultural significance to an ethnic group; examples include religious structures, burials, major traditional trails, and traditional cultural places.

As a pre-Contact era burial site, Site -7120 is considered to be significant under criterion D and E for the information it contains and its cultural significance as a pre-Contact Hawaiian burial ground, and a traditional cultural place as a center of pre-Contact burial practices.

The parcel has been subject to extensive development and the project area locus no longer fully possesses integrity of setting/feeling etc. as is requisite for properties listed in the Hawai'i Register of Historic Places. The burials of Site -7120 are considered significant under criterion E significant as traditional cultural properties and await reinterment to an alternative location in the project area parcel, under SHPD's Burial Sites Program. The on-site reinterment location shall offer appropriate conditions for long term protection and conservation of the burials (refer to the separate Burial Component of the Data Recovery Plan).

DISCUSSION AND RECOMMENDATIONS

Initial research of the general project area environs developed a land use model that points to the project area as the location of pre-Contact fishing, farming and habitation. The subject property is in alignment to many documented burials associated with pre-Contact habitation in Punalu`u Ahupua`a. Additionally a coastal heiau, Kaumaka`ula`ula Heiau, one of the most sacred heiau in Ko'olauloa, was located on the coast somewhere between present day Punalu'u Beach Park and Maipuna Stream (Sterling 1978). These data clearly point to an intensive traditional occupation for the general Koolauloa Punalu'u area including the subject project area

Due to the known distribution of native Hawaiian burials recorded in the project area, and its location within coastal environs in intact Jaucus beach sand deposits newly documented Site -7120 is interpreted to have functioned as a pre-Contact burial site. All data is in agreement with land use models and the archaeological record documented by previous archaeological studies conducted in the surrounding Punalu'u region.

Despite numerous prior archaeological investigations, significant sites and features continue to be identified throughout the area. There continues to be possibility that burials may be inadvertently encountered both within previously disturbed and intact Jaucus beach sand deposits in the general area. It is the recommendation of SCS that all future ground disturbing activities in the project area be subject to Archaeological Monitoring.

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APPENDIX A

DOCUMENT DELIVERY

Mahele Database Documents
Number: 02289*O

Claim Number:	**02289*O**
Claimant:	**Kauhola**
Other claimant:	
Other name:	
Island:	**Oahu**
District:	**Koolauloa**
Ahupuaa:	**Papaakoko, Kaluanui**
Ili:	**Haleaha**

Apana:	**2**	Awarded:	**1**
Loi:		FR:	
Plus:		NR:	**431v3**
Mala Taro:		FT:	
Kula:		NT:	**197v10,338v10**
House lot:		RP:	**5590**
Kihapai/Pakanu:		Number of Royal Patents:	**1**
Salt lands:		Koele/Poalima:	**No**
Wauke:		Loko:	**No**
Olona:		Lokoia:	**No**
Noni:		Fishing Rights:	**No**
Hala:		Sea/Shore/Dunes:	**No**
Sweet Potatoes:		Auwai/Ditch:	**No**
Irish Potatoes:		Other Edifice:	**No**
Bananas:		Spring/Well:	**No**
Breadfruit:		Pigpen:	**No**
Coconut:		Road/Path:	**No**
Coffee:		Burial/Graveyard:	**No**
Oranges:		Wall/Fence:	**No**
Bitter Melon/Gourd:		Stream/Muliwai/River:	**No**
Sugar Cane:		Pali:	**No**
Tobacco:		Disease:	**No**

Koa/Kou Trees:		Claimant Died:	**No**
Other Plants:		Other Trees:	
Other Mammals:	**No**	Miscellaneous:	**claims ahupua`a**

No. 2289*O, Kauhola
N.R. 431-432v3

To the Land Commissioners of the Hawaiian Islands, Greetings: I, the one whose name is below, hereby state my claim for land held anciently from Kamehameha I. Kalaau, my makuakane, and Kamookeawe, my makuahine, lived with Kamehameha and sailed with him to the battle of Nuuanu. When the battle was over, Kamehameha gave the land of Papaakoko to him, until the time of Kamehameha III, when it was divided, half for the ali`i and half for me. My half adjoins Kaluanui; that is my claim, given by Kamehameha III, Koolauloa, Island of Oahu.

Claim 2 on Hawaii. the one below was from Kamehameha II, from the battle of Kuamo`o. When the battle was over, Kamehameha gave the land of Pahoehoe in Kona and Kahei in Kohala to Kalaau /and he held it from this time/I until Kamehameha III. Kamehameha III gave me Pahoehoe in Kona, and that is my claim, from the ali`i nui.
KAUHOLA
Honolulu, Oahu, December 31, 1837

N.T. 197v10
No. 2289, Kauhola

COPY
Kauhola's land as listed in Mahele Book
Papaakoko ahupuaa, Koolauloa, Oahu.
Kapehu ahupuaa, Hilo, Hawaii
TRUE COPY
A.G. Thruston, Secretary
Interior Department, 11 February 1853
Continued page 338 Kauhola

N.T. 338v10
No. 2289, Kauhola, (from page 197)

Kauhola's land
Papaakoko ahupuaa, Koolauloa, Oahu
Kapehu ahupuaa, Hilo Hawaii
Register claim and make settlement
S.P. Kalama
Royal Palace, 4 February 1854

[Award 2289; R.P. 5590; Papaakoko Koolauloa (ahupuaa); 59.10 Acs; Haleaha Kaluanui Koolauloa; 1 ap.; 17.10 Acs; R.P. 1654; Kapehu Hilo; 1 ap.; 241.6 Acs]

APPENDIX B

Table 1: GPS Coordinates of Project Area Burial Feature Locations.

BURIAL FEATURE #	East	North	UTM Datum/Zone
1	614938	2387827	WGS84
2	614943	2387822	WGS84
3	614935	2387825	WGS84
4	614940	2387820	WGS84
5	614933	2387825	WGS84
6	614933	2387824	NAD83
7	614933	2387824	NAD83
8	614935	2387821	NAD83
9	614935	2387821	NAD83
10	614932	2387823	NAD83
11	614933	2387820	NAD83
12	614932	2387822	NAD83

DRAFT—Archaeological Inventory Survey in Support of New Construction at Pat's at Punalu'u, Papa'akoko Ahupua'a, Ko'olauloa District, Island of O'ahu, Hawai'i

TMK (1) 5-3-008:002 por.

Prepared for:

Pat's at Punaluu AOAO
PO Box 6403
Kaneohe, Hawai'i 96744

Prepared by:

David Byerly, BA
and
Michael Desilets, MA, RPA

Garcia and Associates
146 Hekili St., Suite 101
Kailua, Hawai'i 96734

Hawai'i SHPD Permit No. 17-20

GANDA Report No. 2369-1

GANDA

24 May 2017

MANAGEMENT SUMMARY

At the request of Pat‘s at Punalu‘u AOAO, Garcia and Associates conducted an archaeological inventory survey in support of proposed new construction at TMK (1) 5-3-008:002 por., Papa‘akoko Ahupua‘a, Ko‘olauloa District, O‘ahu. Excavation of 14 test trenches produced one previously-identified historic property—State Inventory of Historic Places (SIHP) Site 50-80-06-3970, a truncated pre-Contact Hawaiian cultural layer.

SIHP Site 50-80-06-3970 consists of a charcoal-enriched, sandy cultural layer observed across almost the entire survey area. The base of the deposit exhibits numerous discrete pit features, 12 of which were recorded during this survey. Three of the pit features contained significant quantities of marine invertebrate remains, fish bone, and macroscopic charcoal. Two lithic artifacts were also recovered—a volcanic glass flake and a basalt flake. Radiocarbon dating of wood charcoal from short-lived taxa from two pit features produced date ranges of Cal AD 1425–1470 and Cal AD 1665–Post 1950.

SIHP Site 50-80-06-3970 has produced, and is likely to continue to produce, important information regarding pre-Contact Hawaiian habitation and marine resource procurement along the Ko‘olauloa coast. The deposit has also produced Hawaiian burials on the project parcel and on a neighboring parcel. It is therefore a significant historic property under Hawai‘i Administrative Rules §13-284-6 Criteria “d” and “e.” The effect determination for this site is “effect with agreed-upon mitigation commitment.” The recommended mitigation commitment for the site is archaeological data recovery prior to earth-disturbing construction activities. However, proposed ground disturbing construction activities associated with Apartment Unit 115 renovations will occur only at previously installed footing and will therefore have “no effect” on significant historic properties.

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FIGURES

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1.0 INTRODUCTION

At the request of Pat‘s at Punalu‘u AOAO, Garcia and Associates conducted an archaeological inventory survey (AIS) in support of demolition and eventual new construction at TMK (1) 5-3-008:002 por., Papa‘akoko Ahupua‘a, Ko‘olauloa District, O‘ahu. (Figures 1 and 2).

The primary objective of the AIS was to identify and document extant historic properties, including possible subsurface cultural deposits, within the parcel. Michael Desilets, M.A., served as the Principal Investigator for the Project. Mr. Desilets meets the professional qualifications outlined in Hawai‘i Administrative Rules (HAR) §13-281-3 and is permitted to conduct archaeological investigations under State Historic Preservation Division (SHPD) Permit No. 17-20 (Permit No. 16-27 at the time of the fieldwork).

The archaeological survey was conducted on 25–28 October 2016 and 1 November 2016 by Patrick O’Day, PhD, David Byerly, BA, and Mr. Desilets. The AIS consisted of the excavation of 10 test trenches using a backhoe and mini-excavator.

1.1 Project Description

This AIS supports two new construction projects proposed for the project area. For the first project, Pats at Punaluu AOAO proposes to remodel existing Apartment Unit 115, located adjacent to the recently demolished Pats and Punaluu Restaurant. The location of the unit is shown in Figure 3 below. The construction will involve renovations to support development and utilization of the apartment unit. The portion of the work that is of concern for archaeological resources is the proposed subsurface excavation for the footings. To support renovation work, excavation will be required at the locations of nine (9) concrete pier footings. The locations of these footings are shown in Figure 4 below. Excavation depth to install the new footings will range from 12 to 18 inches. Importantly, the newly planned concrete footings are in the same locations as the existing concrete footings that supported the previous structure at the site. The existing footings will be demolished and removed, and the new footings installed in their place.

The second project has not yet reached the design stage, but involves construction of condominium units on the remainder of the project area. Construction is anticipated to involve excavation for a concrete foundation, roughly corresponding to the location of the existing concrete pad located east of the parking lot. Utilities lines are already in place from the previous structure, so no new utility trenching is anticipated. Work at the existing parking lot will consist only of repaving.

1.2 Project Authority

This AIS was conducted pursuant a Hawaii Revised Statutes Chapter 6E-42 Historic Preservation Review of Building Permit Applications A2016-06-0024 and A2016-06-00250, for addition/alteration of an existing apartment and demolition of an abandoned restaurant, respectively, by property owner “Pat’s at Punaluu”. Based on a review of the archaeological and historic potential of the parcel, SHPD determined that an AIS was necessary (July 13, 2016 Log No. 2016.01405, 2016.01406, Doc. No. 1606AK07). The present AIS was completed in accordance with HAR §13-276, Rules Governing Standards for Archaeological Inventory Surveys and Reports.

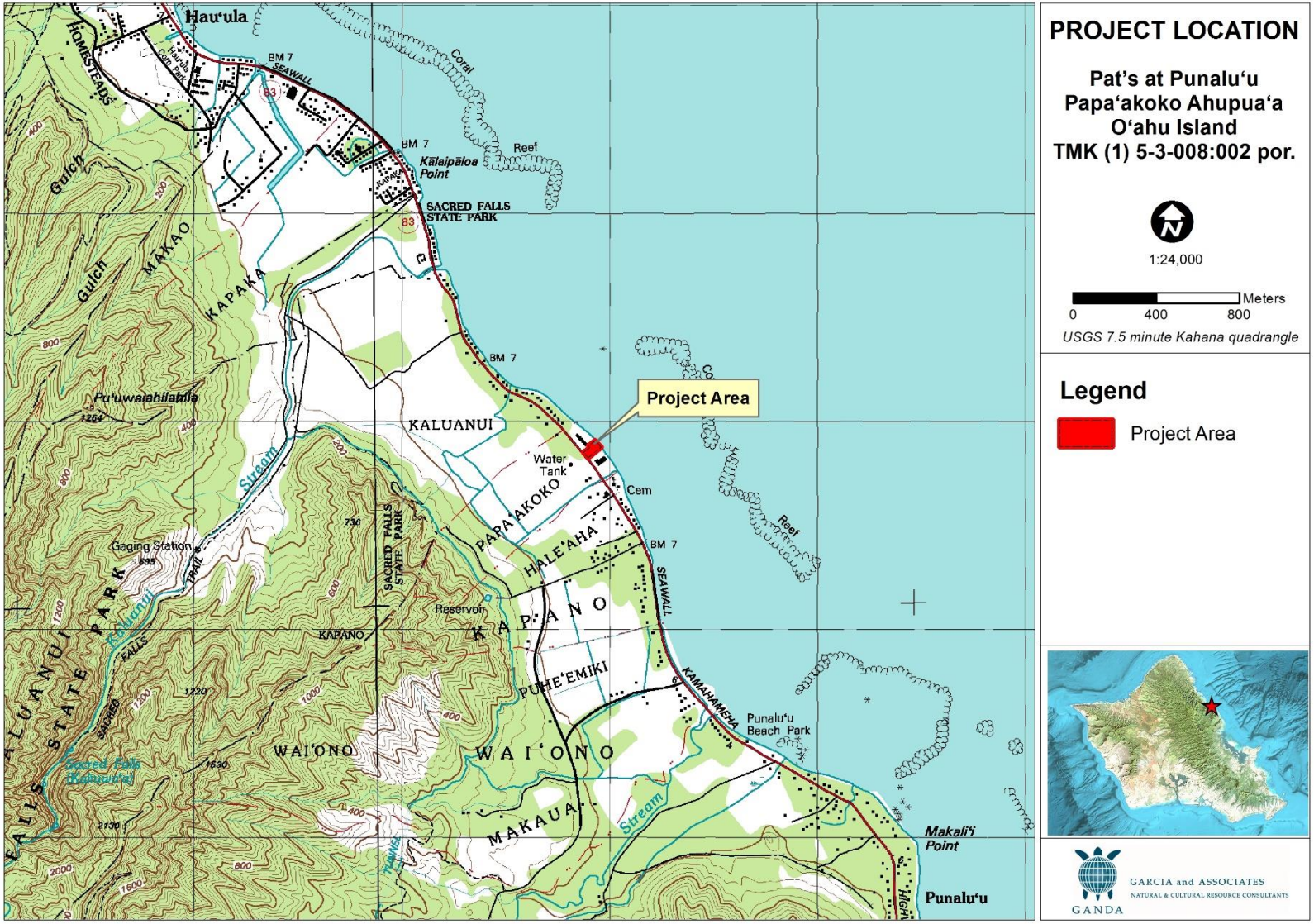

Figure 1. Project location on 1:24,000 scale USGS 7.5 minute 1998 Kahana quadrangle map.

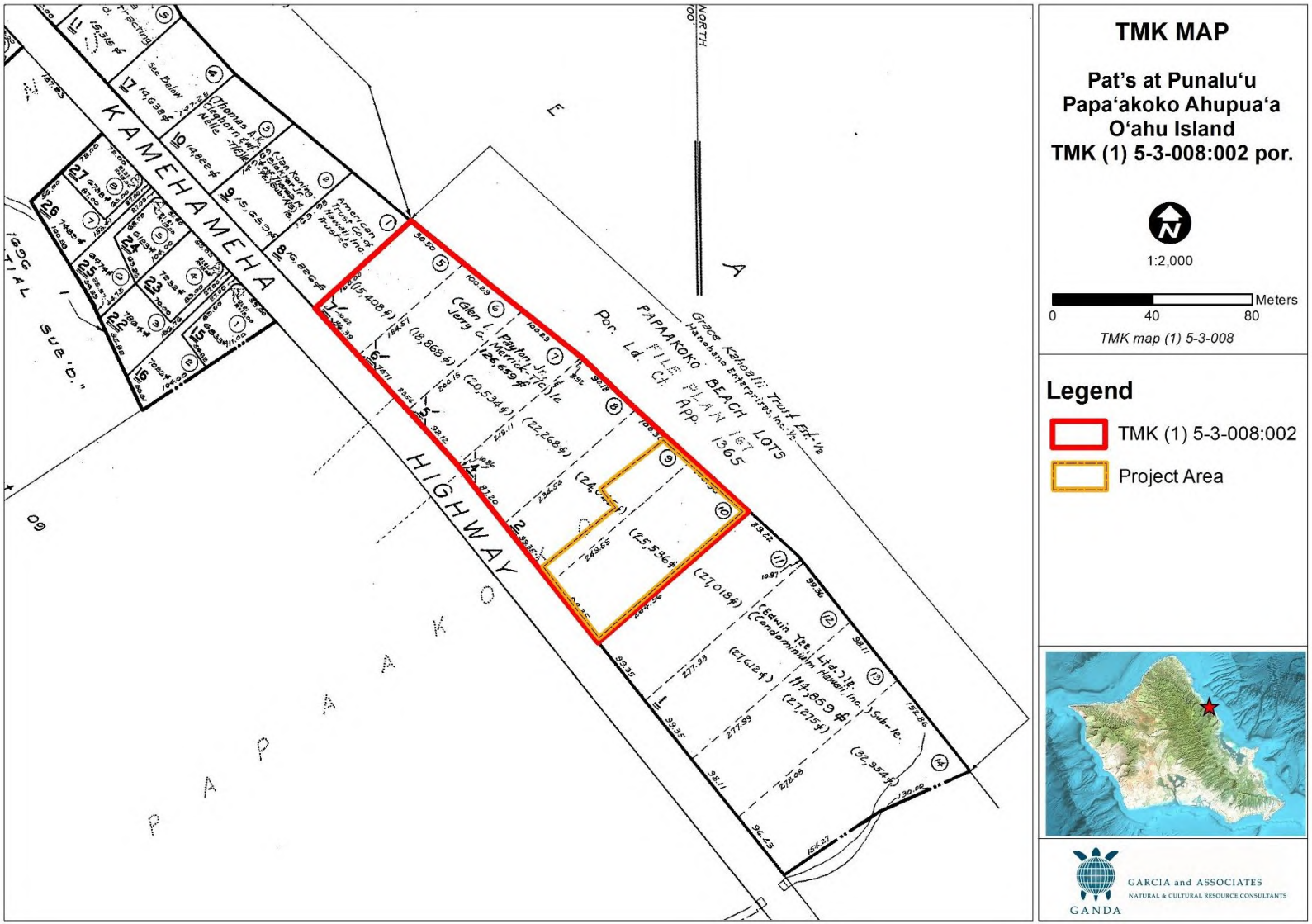

Figure 2. Project area shown on TMK map (1) 5-3-008.

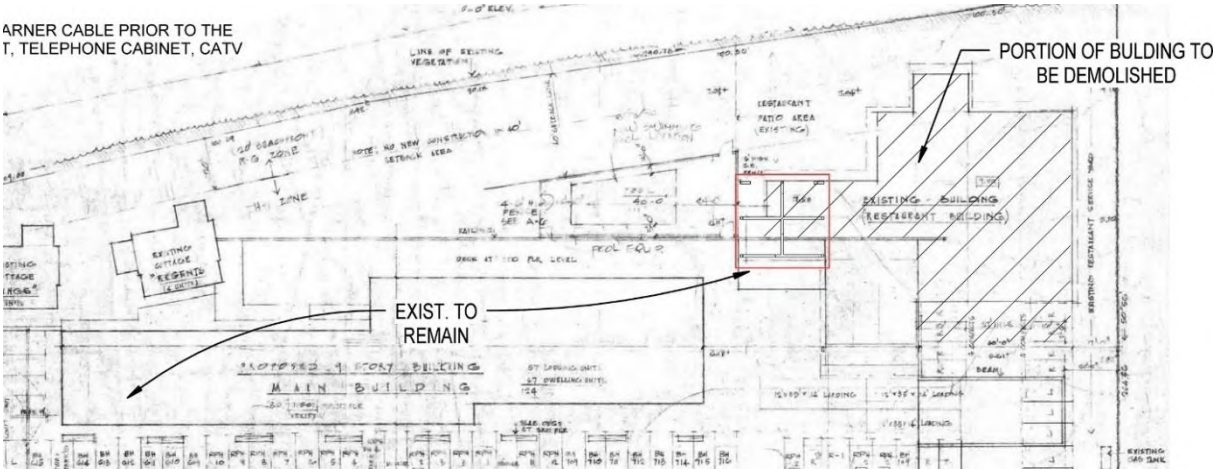

Figure 3. Proposed renovation area for Apartment Unit 115 outlined in red. Shoreline at top of figure.

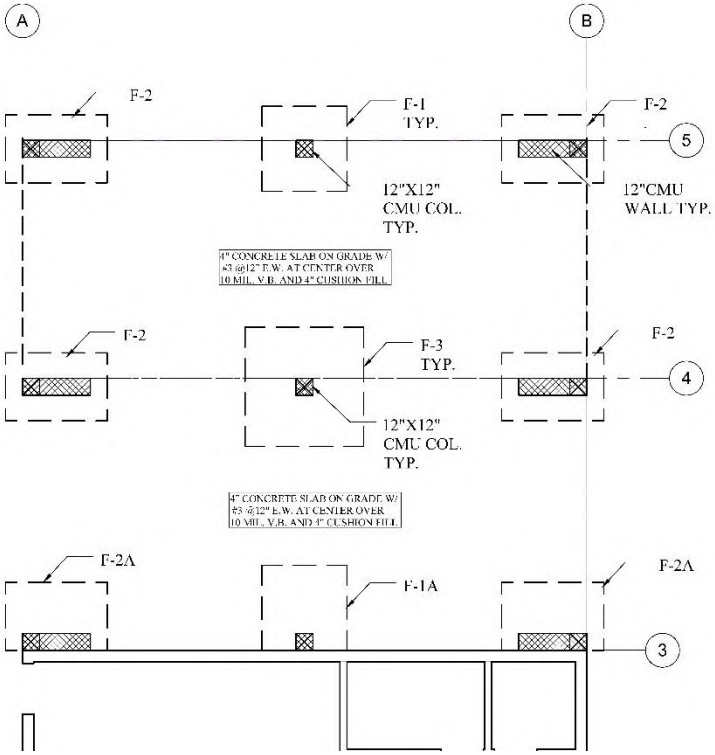

Figure 4. Concrete footing locations for Apartment Unit 115.

2.0 BACKGROUND

The following background section presents environmental, historical, and archaeological information pertinent to the project area. This information provides a contextual framework from which cultural resources identified during the AIS can be interpreted and evaluated for significance.

2.1 Project Location and Environmental Setting

The 0.77-acre project area is located on Oʻahu's northeastern coast at the Pat's at Punaluʻu beachfront condominiums (Figure 5). The property is bounded by Kamehameha Highway on the southwest and the Pacific Ocean on the northeast. Neighboring coastal properties include the Hanohano Hale condominiums on the southeast and private residences on the northwest. Historic modifications associated with residential construction have extensively altered the original topography of this stretch of coastline. The project area is presently a built environment almost entirely covered by asphalt and concrete. Vegetation around the property is limited to landscaped grass, ornamental plants, and palm trees. The project area has a mean annual rainfall of 154 cm with 62 percent of the rain occurring between the months of October and March (Giambelluca et al. 2013).

2.1.1 Soils

Soils within the project area are predominantly composed of Jaucus Sand (Soil Survey Staff 2016) (Figure 6). Jaucus Sand, 0–15 percent slopes, as defined by Foote et al. 1972, consist of excessively drained calcareous soils that occur as narrow strips on coastal plains adjacent to the ocean. These sands are developed from coral and sea shell and deposited by wind and water. The permeability of these sands is rapid and runoff is very slow to slow. Due to the extensive development of the project area, it is expected that the natural Jaucus Sand layer is buried underneath layers of imported fill material used during the construction of the condominiums. It is important to note that Jaucus Sand is the primary context in which traditional Hawaiian cultural deposits and burials have been documented in the region.

2.2 Traditional Land Use in Papaʻakoko Ahupuaʻa

Papaʻakoko literately means "secured blood" and was once the site of a place of refuge (Pukui et al 1974:179). Aside from this reference, there is very little information about traditional land use in Papaʻakoko Ahupuaʻa. It is rarely mentioned in traditional oral histories or historic accounts. In such a case, the modes of traditional land use can only be extrapolated from historic narratives of neighboring *ahupuaʻa* and the development of the traditional Hawaiian economy generally.

The traditional Hawaiian economy, typical throughout the islands, was subsistence based, focusing on agricultural production, coastal exploitation of marine resources, and the collection of wild plants and animals (Kirch 1985:2–3). The Hawaiian people planted a wide variety of cultigens, the most important being taro (*Colocasia esculenta*) and sweet potato (*Ipomoea batatas*). Taro was grown wherever there was adequate rainfall or water. River valleys, where pond fields could be irrigated, provided ideal conditions for growing taro and were among the

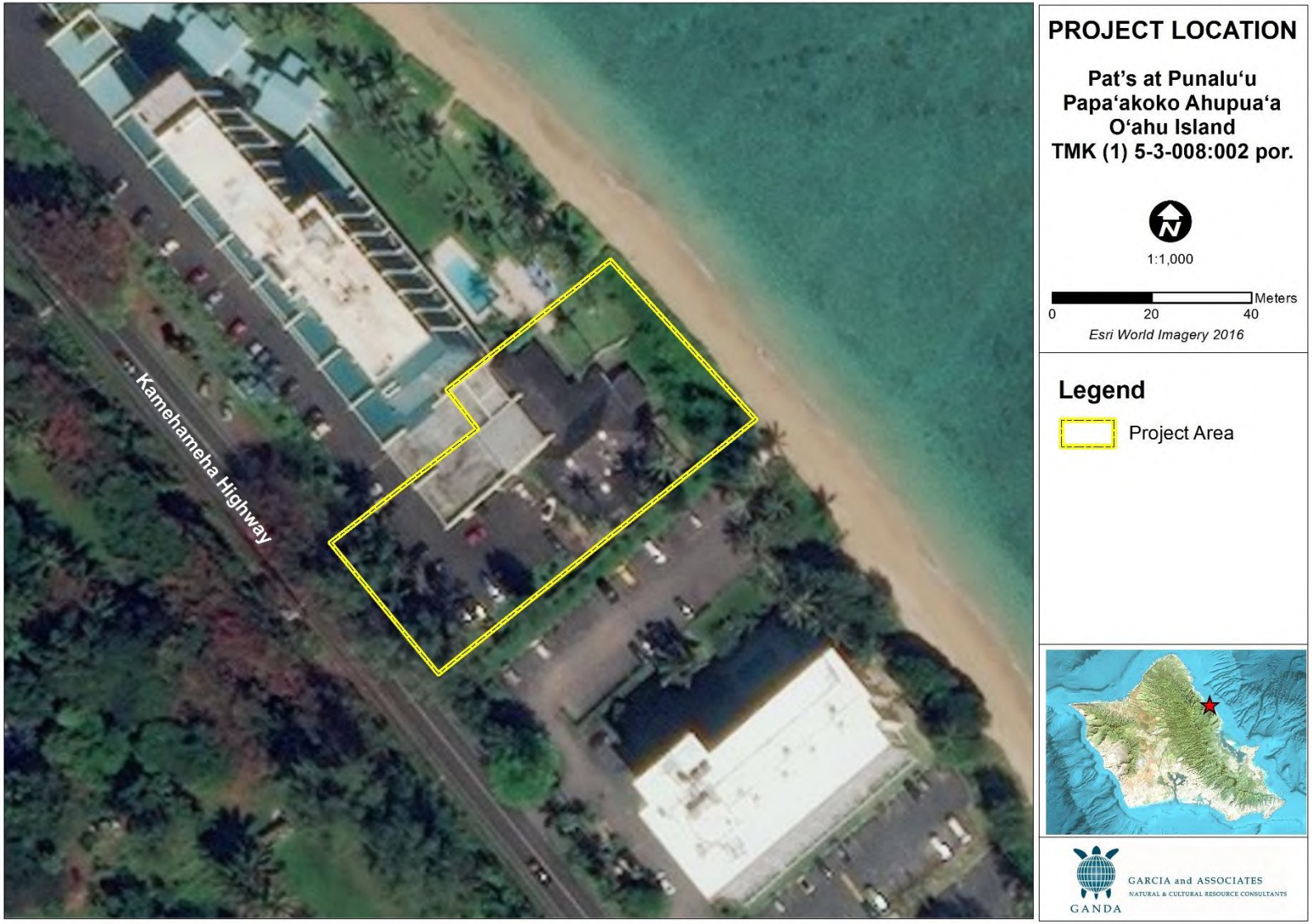

Figure 5. Project area shown on Esri World Imagery 2016 aerial image.

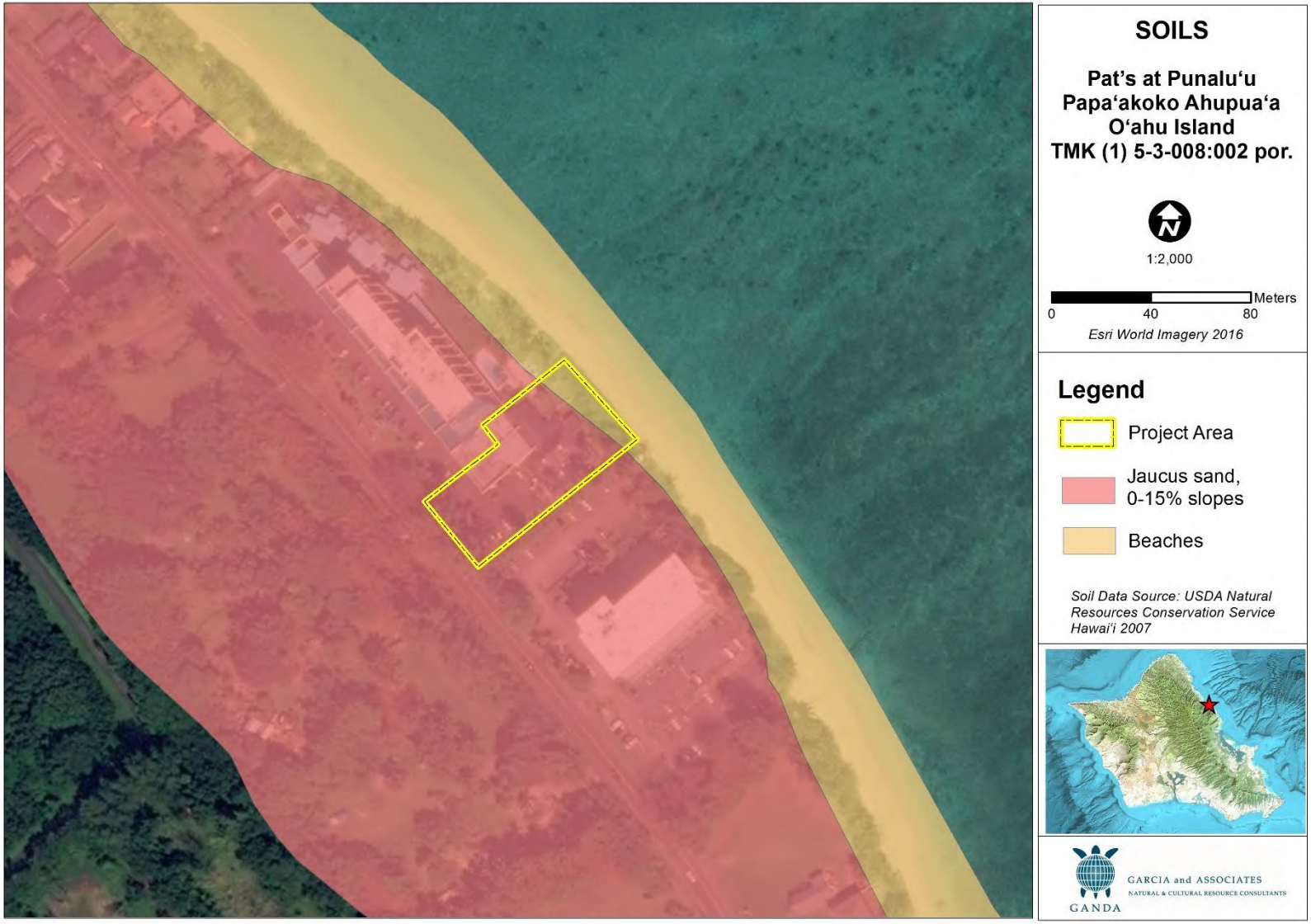

Figure 6. Project area soils map.

most agriculturally productive. Dryer areas, which could not support taro cultivation, were often planted with sweet potato. Other important cultigens included arrowroot (*Tacca leontopetaloides*), sugarcane (*Saccharum officinarum*), ti (*Cordyline terminalis*), banana (*Musa paradisiacal*), and coconut (*Cocos nucifera*).

The exploitation of coastal marine resources was often equally important and centered on fishing, the collection of *limu* (seaweed) and marine invertebrates, salt production, and aquaculture. The construction of fishponds along the coast was a unique and advanced innovation that was developed to trap and raise fish such as mullet (*Mugil cephalis*) and milkfish (*Chanos chanos*), supplementing other resource exploitation actives. While the construction of a fishpond was a labor intensive investment, the fishponds productive yield guaranteed a steady supply of fish. The *mauka* areas beyond the limits of agriculture also provided a wide range of natural resources. Use of these upper areas included the collection of wild plants for subsistence, medicinal, and ceremonial purposes, and the collection of wild fauna. These areas were also noted as a locus for the collection of bird feathers, especially from the *ʻōʻō* (*Moho nobilis*), *ʻiʻiwi* (*Vestiaria coccinea*), and *ʻapapane* (*Himatione sanguinea*). These species provided colorful feathers that were used to construct and adorn many symbols of chiefly power including *ʻahu ʻula* (feathered capes), *mahiole* (helmets), and *akua hulu manu* (feathered gods). These were a direct measure of a chief's power and influence (Valeri 1985:246).

Handy and Handy (1972:271) describe general land use along the Koʻolauloa coast:

> Midway along the coastland called Koʻolau Loa (Long Koʻolau) with its northeast exposure, we come upon what were once extensive wet-taro lands, beginning at Laʻie and continuing through Hauʻula to Punaluʻu and Kahana valleys. This was also an ideal area off shore reef and bay fishing.

They also note that "undoubtedly this midsection of Koʻolau Loa on Oahu was an area of early settlement and of dense population, second only to that of the Waikiki-Nuʻuanu-Manoa complex".

While there is no specific mention of Papaʻakoko, Handy (1940) describes the lowlands of the adjacent northern *ahupuaʻa* of Kaluanui:

> …the level lowlands of Kaluanui, now all in cane, must formerly have been in terraces throughout, irrigated mostly by Kaliuwaa Stream, but also by two smaller streams, Waimanamana north of Kaliuwaa and Kuumi south of Kaliuwaa. The terraces extend well into the mouth of Kaliuwaa, but the interior of the valleys is too narrow and the sides are too precipitous along the stream to support any terraces. [Handy 1940:91]

South of Papaʻakoko, in Punaluʻu, Handy (1940) describes the extensive system of terraces once used for taro cultivation as being primarily covered in sugarcane.

> In the upper valley, reached by forest reserve trail, and above the water gate (about 2.5 miles from the sea) there is a level area beside the stream, now covered with *puhala* and *hau*, which was once planted in taro. Beyond this point, where the stream winds back into the mountains, are similar flatlands by the stream side. A quarter of a mile below the water gate, broad flats

> begin on alternate sides of the winding stream; at first these are only about 100 yards wide but gradually widen to 300 or 400 yards before the valley opens into the broad coastal plain of Punaluu.
>
> These flats were terraces. On the steep western hillside above the above the upper flats there are old breadfruit trees. At the lower end of the valley on the southern side is a flourishing plantation with about 25 terraces now in taro. From here the valley becomes increasingly broad for about three quarters of a mile and is planted in cane, with some grasslands along the streams and on the hillsides, and few banana groves. All the way to the sea the grasslands and the cane fields, when cut over or newly planted, show clearly the outlines of old terraces. This, then, was formerly a continuous area of terraces, watered by Punaluu Stream, widening from a quarter of a mile above to half a mile at the base of the valley and spreading out like a fan on the coastal plain over an area four tenths of a mile long and eight tenths of a mile wide. [Handy 1940:91–92]

2.3 Historic Land Tenure

In 1848, the Māhele instituted a change from the traditional Hawaiian system of land tenure to a system based on the western concept of fee-simple ownership. During the Māhele, the Hawaiian chiefs and *konohiki* were required to present their claims to the Land Commission and receive awards for the land quit-claimed to them by Kamehameha III. Until an award for these lands was issued, the title remained with the government. A land commission award (LCA) gave complete title to the lands except for the government's right to commutation. Upon satisfaction of the commutation, which could be settled by a cash payment or through the exchange of land of equal value, a Royal Patent was issued by the minister of the interior. A Royal Patent quitclaimed the government's interest in the land and served as proof that the government's right to commutation no longer existed.

The *Kuleana* Act of 1850 provided a framework by which native commoners could apply for and be granted land to sustain their livelihood, however, the restrictions of the act made it difficult to receive a land award, thereby discouraging Hawaiians who did not actively cultivate land. The Act of August 10, 1854 provided for the dissolution of the Land Commission so that an LCA recipient was still protected if they had not obtained a Royal Patent (Chinen 1958:13–14). This act stated that "a Land Commission Award shall furnish as good and sufficient a ground upon which to maintain an action for trespass, ejectment, and other real action, against any person or persons, whatsoever, as if the claimant, his heirs or assigns, had received a Royal Patent for the same" (Chinen 1958:14). The Māhele represents a significant shift in Hawaiian land use history, marking the final dramatic transition from a redistributive economy to a market based system. This ultimately resulted in a decline of native land tenure and opened the way for wealthy investors to purchase land.

During the Māhele, the entirety of Papaʻakoko Ahupuaʻa was awarded to Kauhola under Royal Patent 5590 and LCA 2289. The *Register* (Vol. 3, p. 431) documented the native testimony of Kauhola who claimed rights of ownership of Papaʻakoko:

> To the Land Commissioners of the Hawaiian Islands, Greetings: I, the one whose name below, hereby state my claim for land held anciently from

> Kamehameha I. Kalaai, my makuakane, and Kamookeawe, my makuahine, lived with Kamehameha and sailed with him to the battle of Nuuanu. When the battle was over, Kamehameha gave the land of Papaakoko to him, until the time of Kamehameha III, when it was divided, half for the Aliʻi and half for me. My half ajoins Kaluanui; that is my claim, given by Kamehameha III, Koolauloa, Island of Oahu.

2.3.1 Development of Sugarcane Cultivation in Koʻolauloa

As with much of Hawaiʻi, sugarcane cultivation had a dramatic effect on the landscape and dominated many areas for nearly a century. This is the case with Papaʻakoko. Although crops were largely confined to the valleys and side-slopes, other related infrastructure, such as railroad lines used to get crops to processing plants and markets, were more coastal and fall within the project area vicinity.

In 1890, the Kahuku Plantation Company was developed by James Castle and Alexander Young on lands leased from James Campbell. The plantation planted roughly 2,500 acres of sugarcane in Lāʻie and Kahuku in 1892. By 1903, the plantation was a complete operation with a railway from Lāʻie to the Kahuku sugar mill. The initial success of the Kahuku Plantation Company led Castle to develop his own plantation and railway venture under the Koolau Agricultural Company and the Koolau Railway Company, Limited. Castle planned on revitalizing the Heeia Agricultural Company plantation, which went out of business in 1903, and establish a railway from Heʻeia to Kahuku creating an agricultural enterprise along Oʻahu's northeastern coast. By 1908, the Koolau Railway completed an 11 mile track of 36-inch narrow gauge railroad running along the coast from Kahuku to Kahana Bay. In 1908, an article published by the Pacific Commercial Advertiser reported on the development of the new railroad track:

> From Laie and on, especially between Hauula and Punaluu the right of way of the little line had to be cut through miles of dense hau wood forests, the surveyors in running their preliminary lines having to practically tunnel their way. Going over the same ground today makes the statement hard to believe. The land on both sides has been cleared off, grubbed out, and a considerable portion of it ploughed and planted in rice and cane. Two thousand cords of hau have been shipped over the line to Kahuku Plantation during the year, the marketing of this wood furnishing freight to the line as it pushed ahead... (cited in Condé and Best 1973:300)

The Koolau Agricultural Company was never very successful due to the difficult topography of the region and the competition from other areas on Oʻahu that could simply produce sugar more efficiently. The Kahuku Plantation Company bought out the Koolau Agricultural Company in 1924 and subsequently acquired the Koolau Railway Company, Limited in 1931.

Mr. Harry Hanohano, a lifetime resident of Papaʻakoko, reported during an interview with Terry Hunt (1993) that the lands of Papaʻakoko were planted in sugarcane up until the early 1960s.

2.3.2 The Modern Era

Use of railroads for transporting sugarcane went into a steep decline in the middle of the twentieth century. Following World War II, almost all rail in Hawaii was decommissioned, to be

replaced by truck transport. The Kahuku Plantation Co. line that ran past the project parcel was abandoned in 1954, a late holdout relative to many other lines on Oʻahu (Treiber 2008).

With the decline and eventual collapse of the sugarcane industry in the early 1960s, much of the land in Papaʻakoko went fallow, was leased for small-scale agriculture, or was developed into residential lots. The coastline saw the most development, likely due to the desirability waterfront property. This development eventually resulted in the construction of the former restaurant building on the project parcel, the Hanohano Hale condominiums adjacent to the project area, and the Oceanside Hawaii Assisted Living and Memory Care facility 650 meters *mauka* of the project area.

2.4 Previous Archaeological Research

While there have been a wide range of archaeological studies conducted within the region, especially within Punaluʻu Ahupuaʻa to the south and Kaluanui to the north, archaeological investigations conducted within Papaʻakoko Ahupuaʻa itself have been very limited, primarily consisting of projects in support of urban development along the coast. Archaeological projects conducted in the vicinity of Papʻakoko, however, have documented a history of intensive land use within the region ranging from pre-Contact settlement and agriculture to historic commercial agriculture.

Thomas G. Thrum (1909) and J. Gilbert McAllister (1933) conducted the earliest archaeological surveys in the region. During their work in the vicinity of Papaʻakoko, they documented numerous *heiau*, including the famous Pohaku peʻe o Kamapuaa (Site 290) in Kaluanui associated with the hiding place of the deity Kamapuaa. Kaumakʻulaʻula Heiau (Site 295) in Punaluʻu, considered one of the most sacred *heiau* within the district, was also documented. Of significance for Papaʻakoko Ahupuaʻa, Thrum documented a small *heiau* in "Papaʻakoko, Haleaha" called Pupuka. Thrum notes that the *heiau* is located "Between Punaluu and Kaluanui. Only foundations remain." The *heiau* is described as being "30 by 50 feet, little of which now remains." This *heiau* was not given a site number by Thrum or McAllister and the exact location of the *heaiu* remains unknown. The site may have been long since destroyed by McAllister's time due to historic ranching activities or commercial agriculture.

2.4.1 Modern Archaeological Studies conducted in Papaʻakoko

Research conducted at the SHPD Library indicates that there have been a total of five archaeological projects conducted within Papaʻakoko Ahupuaʻa (Figure 7 and Table 1). A description of these studies and their findings are presented below.

In 1988, Joyce Bath and Marc Smith conducted a field inspection of a possible burial located under the parking lot of the Pat's at Punaluʻu condominiums, which is also the location of the current study area. Bath and Smith documented a burial and a subsurface cultural deposit (State Inventory of Historic Places [SIHP] Site 50-80-06-3970) that were disturbed during construction activities. The site consisted of a truncated dark humic sandy cultural layer identified below several layers of fill material under the asphalt parking lot. Several posthole and pit features were also noted.

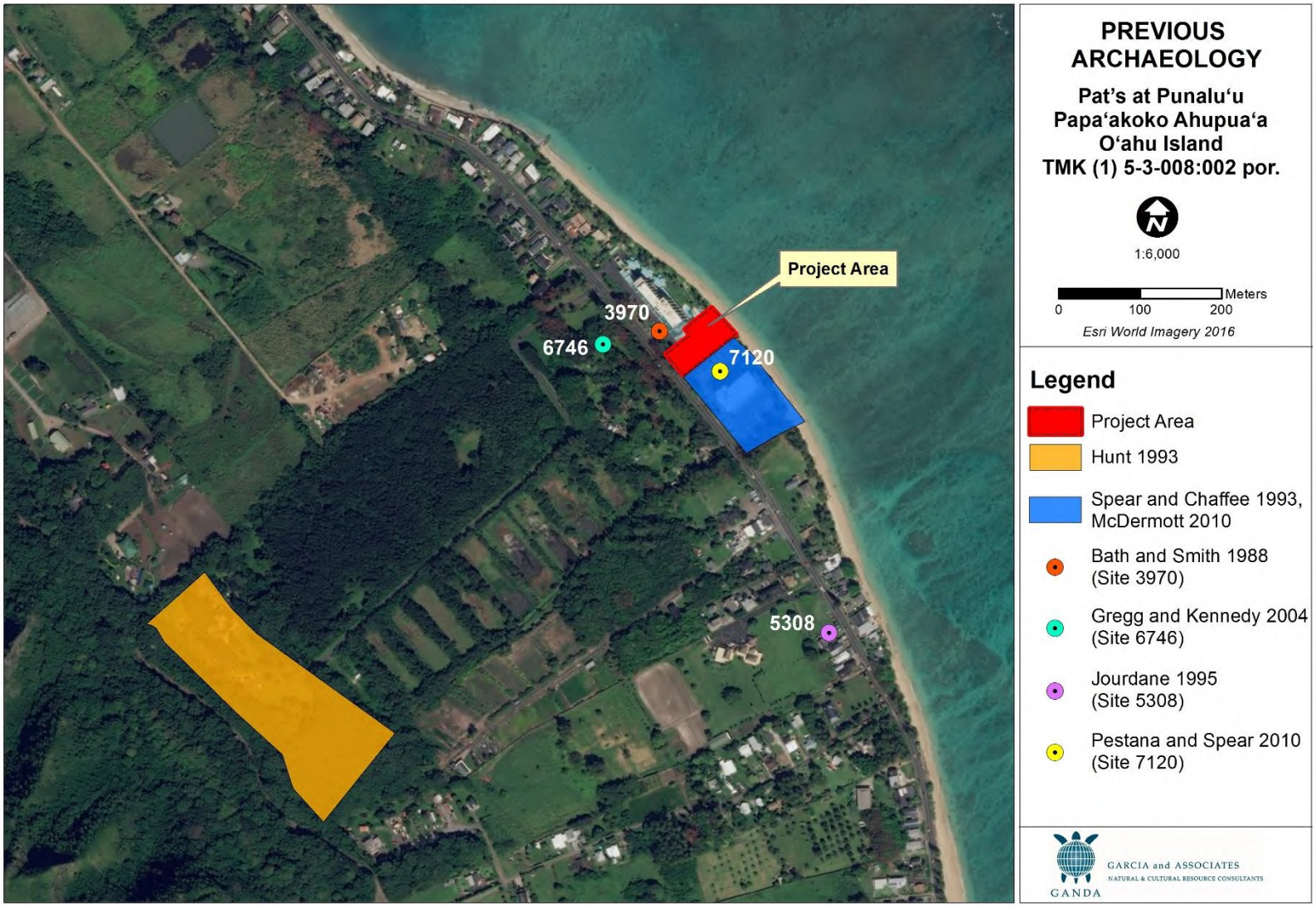

Figure 7. Previous archaeological research and sites in the vicinity of the project area.

Table 1. Previous Archaeology in the Vicinity of the Project Area

Reference	Nature of Study	Location	Results
Bath and Smith 1988	Field Inspection	Pat's at Punalu'u condominiums	Recorded SIHP Site 50-80-06-3970 consisting of one human burial and a subsurface cultural layer.
Hunt 1993	Archaeological Inventory Survey	TMK (1) 5-3-009:058	Noted historic features related to sugarcane cultivation on the northern edge of parcel. Subsurface testing resulted in no findings.
Spear and Chaffee 1993	Archaeological Inventory Survey	Hanohano Hale condominiums	Negative AIS findings presented in AA report.
McDermott 2010	Field Inspection	Hanohano Hale condominiums	Identified one pre-contact human burial (SIHP Site 50-80-06-7120).
Pestana and Spear 2010	Archaeological Monitoring	Hanohano Hale condominiums	Monitoring resulted with the identification of ten burial features consisting of 12 individual set of pre-Contact human remains (SIHP Site 50-80-06-7120).

In 1993, Terry Hunt conducted an archaeological inventory survey with subsurface testing of a seven acre parcel in support of the development of low income housing for the elderly. This parcel is now the Oceanside Hawaii Assisted Living and Memory Care facility located roughly 650 meters southwest of the project area. The survey noted the historic remains of a railway bed and a flume system for sugarcane at the northern edge of the parcel, but that the majority of the parcel had been extensively bulldozed by past sugarcane activities. The subsurface testing consisted of the excavation of ten test trenches. None of these trenches revealed buried archaeological features.

Scientific Consultant Services, Inc., conducted an archaeological inventory survey in support of sewer system upgrades at the Hanohano Hale condominiums (Spear and Chaffee 1993). Hanohano Hale is the adjacent property to the southeastern of the current project area. Subsurface test excavations were limited to the parking lot on the southern side of the building. No historic properties were identified.

Cultural Surveys Hawai'i, Inc., conducted a field inspection at the Hanohano Hale condominiums after the inadvertent discovery of human remains during the installation of a graywater system for the condominium's laundry facility (McDermott 2010). The inspection documented the general context of the burial (SIHP Site 50-80-06-7120) and its cultural affiliation. In response to the inadvertent discovery, SHPD initiated an archaeological monitoring program for the remaining installation. Scientific Consultant Services, Inc., monitored the remaining subsurface work (Pestana and Spear 2010). Archaeological monitoring resulted in the documentation of ten burial features consisting of 12 individual sets of pre-Contact native Hawaiian remains (SIHP Site 50-80-06-7120). Burial features encountered during excavations were identified in both previously disturbed and in situ contexts.

2.4.2 Inadvertent Burial Discoveries in the Vicinity of the Project Area

There have been numerous inadvertent burial discoveries documented along Oʻahu's northeastern coastal corridor and within *ahupuaʻa* that neighbor Papaʻakoko. A review of reports documenting burial discoveries in adjacent *ahupuaʻa* is presented below to provide further contextual information.

In 1988, Smith, Bath, and Masse identified three human burials (SIHP Site 50-80-06-3977) within a burial pit at 53-368 Kamehameha Highway. Onsite analysis of the burials determined that the individual human remains were associated with different time periods from pre-Contact to the historic period. Also in 1988, the Honolulu city and county medical examiner responded to a burial discovery at 53-183 Kamehameha Highway. While the skeletal remains were not analyzed, a police officer reported that "it looked like an old Hawaiian gravesite" (Honolulu Medical Examiner 1988). The burial was assigned SIHP Site 50-80-06-3764.

Two burials inadvertently disturbed during construction along Kamehameha Highway were documented by SHPD in 1995 (Jourdane 1995). Both individual burials were determined to be traditional pre-Contact Hawaiian based on the context of the sites. SIHP Site 50-80-06-5308 and 50-80-06-5132 consisted of individuals interred within Jaucus sand, each within an identifiable burial pit. In 2004, Archaeological Consultants of the Pacific, Inc. responded to a report of human remains at 53-606 Kamehameha Highway, 260 meters northwest of the current project area (Gregg and Kennedy 2004). A total of five individuals were documented and determined to be traditional Hawaiian in cultural affiliation. The site was assigned SIHP Site 50-80-06-6746.

Southeast of the current project area, Cultural Surveys Hawaiʻi, Inc., conducted archaeological monitoring for the installation of a water main along Kamehameha Highway (Perzinski and Hammatt 2004). The three-year undertaking resulted in identification of 18 archaeological resources of which 15 were burial sites. SIHP Site 50-80-06-6574 to 6588 consisted of 64 sets of complete to partial skeletal remains. SIHP Site 50-80-06-6695 to 6697 are an extensive subsurface cultural layer nearly 2 kilometers in length, extending from Punaluʻu to Kapano.

2.4.3 Archeological Summary

Traditionally, coastal areas with ease of access to the ocean were often favored environments for habitation as well as burial of the dead. While the project area is currently a built environment composed of buildings and parking lots, the underlying sediments (beneath the modern fill deposits) primarily consist of Jaucus sand.

One human burial and a subsurface cultural deposit (SIHP Site 50-80-06-3970) have previously been documented on the subject property, although not within the project area. Ten burial features consisting of a total of 12 individual sets of human skeletal remains (SIHP Site 50-80-06-7120) were also documented beneath the parking lot of the adjacent property at Hanohano Hale condominiums. A review of archaeological findings along the Punaluʻu coast clearly demonstrates the widespread practice of burial in coastal sand deposits. There is thus a high probability of encountering traditional Hawaiian burials and/or subsurface cultural layers associated with traditional habitation in the current project area.

3.0 METHODOLOGY

Archaeological field investigations consisted of the mechanical excavation of 14 test trenches using a backhoe and a miniature tracked excavator. The distribution and orientations of the trenches are shown in Figure 8. The distribution was intended to provide even coverage across the project area. Note that no trenches extend into the far northeastern portion of the project area. In accordance with state regulations, there is a 50-foot setback for new construction on the parcel. There will therefore be no construction in this area. Furthermore, it is expected that this near-shore beach area is sedimentologically active and subject to periodic erosion and progradation events. The likelihood of cultural remains is consequently low.

Prior to subsurface testing, the archaeologist met with the backhoe operator to explain the purpose of subsurface testing, review the types of subsurface archaeological resources that may be present, and clearly explain the protocols and procedures for dealing with archaeological resources.

Trench walls were stratigraphically profiled and photographed. In cases where stratigraphy was consistent, only localized spot profiles were recorded. For trenches which exhibited variable or complex stratigraphy, or had an abundance of cultural features, long sections were profiled. Detailed soil descriptions in accordance with the U.S. Soil Conservation Service standards were recorded in both cases.

Standards of documentation and recording for the Project were in accordance with Hawai‘i Administrative Rules §13-276 and the Secretary of the Interior’s Standards and Guidelines.

3.1 Feature Sampling and Analysis

When subsurface features were encountered, they were sampled in bulk from the trench sidewall and transported to the Garcia and Associates laboratory for analysis. Samples were at least one gallon (3.8 liters) in volume when possible. Many were sampled at a higher volume in an effort to obtain more cultural material. Samples were taken from the portion of the feature that could be observed to contain the highest concentration of charcoal and/or midden. This material was generally quite clustered and centralized within the feature.

Bulk feature sediment was sifted through 1/8th in mesh and all resulting cultural items were extracted and sorted according to material type and weighed and/or measured as appropriate. Faunal remains and marine shell were further sorted by species and element, to the extent possible. Lithic artifacts were examined for manufacturing attributes, evidence of retouch, and macroscopically visible use-wear.

3.1.1 Radiocarbon Analysis

Charcoal from features was evaluated for possible radiocarbon dating analysis through species and element identification. All potential dating samples were submitted to the International Archaeological Research Institute’s (IARII) Wood Identification Laboratory to be identified to the lowest taxonomic level possible. Suitable samples were then submitted to BetaAnalytic for radiocarbon analysis.

3.2 Site Boundary Determination

Defining site boundaries for O‘ahu’s typically extensive Jaucas sand cultural deposits is difficult when working within a narrowly circumscribed project area. The limits of archaeological investigation are necessarily bounded by the limits of the proposed project and/or the TMK parcel on which it will occur. Cultural deposits do not respect these boundaries and, in most cases, exceed the limits of O‘ahu’s small coastal parcels. Furthermore, in the case of the present project area boundary determination is complicated by the presence of a large concrete pad covering a large portion of the project area. It is very difficult to cut access holes through this pad, so excavation of small ‘boundary-finding’ test pits is not practical.

Given the above, the minimum site boundaries for any cultural deposits identified during testing will first be defined empirically by their presence or absence in the walls of the test trenches. If the deposit is present to the outer limits of the trenching, then the deposit will be assumed to extend beyond this to the boundary of the TMK parcel. This is an approximation, but it does account for the likely broad extent of cultural deposits while not encroaching on untested adjacent parcels. As a corollary, previously reported (but not empirically documented) cultural deposits on adjacent parcels will be assumed to cover their entire parcel until proper boundaries can be determined. If these adjacent parcel deposits adjoin the deposits on the subject parcel, the deposits will be considered continuous and part of the same overall ‘site.’

4.0 RESULTS

The project area is a completely built environment consisting of a concrete building foundation, an asphalt parking lot, and landscaped property borders. The test trenches were laid out according to the proposed testing strategy approved by SHPD with the exception of Trenches 10, 11, and 12 which were adjusted by a few meters due to a large spoil pile located in the center of the project area.

Subsurface testing resulted in the identification of one previously recorded historic property, SIHP Site 50-80-06-3970, a truncated pre-Contact Hawaiian cultural layer (Figure 8). This cultural layer was observed, in varying degree, in all but one test trench.

4.1 Project Area Stratigraphy

The stratigraphic sequence documented during the AIS testing was quite consistent across the project area, consisting of three principal strata. Technical descriptions for these strata, and their substrata, are presented in Table 2.

Layer I is of modern, anthropogenic origin. It includes the asphalt or concrete surface that covers the project area (Layer Ia) as well as a variety of imported fill sediments. The modern fill layers consisted primarily of gravel, terrigenous silt and clay loams, and crushed coral. These layers are associated with late twentieth century development and construction at the project area. Although the layers are distinguished in the profile drawings for the trenches, no effort was made to assign individual sublayer designations.

Figure 8. Trench locations and observed limits of traditional Hawaiian cultural layer.

Table 2. Stratigraphic Descriptions for Project Area Sediments

Layer	Depth Range (cmbs)	Technical Description	Interpretation
Ia	0–10	Asphalt and/or concrete.	Modern surfacing.
Ib	10–28/70*	Variants: 7.5YR 3/2 dark brown to 7.5YR 3/4 dark brown mixed coral, sand, and gravel; 10YR 6/6 brownish yellow silty clay loam (around utility pipes); 10YR 4/2 dark grayish brown sand, 2.5YR 3/3 dark reddish brown terrigenous clay loam; G1 4/1 dark greenish gray fine-grained gravel. Very abrupt, smooth lower boundary.	Modern fill.
IIa	10/70–70/110	Dark brown (10YR 3/2) calcareous sand; semi-compact, unstructured; abrupt lower boundary; occasional lighter (10YR 4/2) banding.	Disturbed traditional Hawaiian cultural layer.
IIb	40/95–70/170	Very dark gray to black (10YR 3/1 to 7.5YR 2.5/1) calcareous sandy loam. Loose, unstructured; charcoal impregnated; very sparse concentrations of marine invertebrate shell, fish bone, and basalt; clear, undulating lower boundary.	Intact traditional Hawaiian cultural layer.
IIIa	48/100–120/150	Yellow (10YR 7/6) unconsolidated calcareous sand. Loose, structureless; Very sparse marine invertebrate shell.	Intact marine-deposited sediment.
IIIb	80/155–120/180	Bluish gray (GLEY G2 6/1) unconsolidated calcareous sand; wet; structureless; observed at water table.	Intact saturated marine-deposited sediment.

*denotes highest and lowest depth recorded for upper and lower boundaries of layer.

Layer II is an anthropogenic soil associated with traditional Hawaiian occupation of the project area, designated SIHP Site 50-80-06-3970 by previous investigators (Bath and Smith 1988). It is identifiable as very dark brown to black charcoal-impregnated calcareous sand. The upper part of the later has been disturbed in many places and is designated Layer IIa, where present. Underlying this is the intact portion of the cultural layer (Layer IIb) which extends to sterile sand. This layer was observed across the project area, with or without the overlying disturbed sediment. It has clearly been truncated by modern activities in most places. The bottom of the layer exhibits numerous single-event pit features, but it was not possible to distinguish any internal sequencing. At least some of these features were likely intrusive into the original cultural layer, but the feature boundary margins have long since been obscured, except where they border Layer III intact marine sand.

Layer III consists of culturally sterile calcareous sand. This is an intact marine deposit that underlies the whole project area (Layer IIIa). The water table was observed at approximately 1.5 m in most trenches, at which point the sediments become highly saturated, becoming a bluish-gray gley (Layer IIIb). Trench excavation terminated upon encountering the water table.

4.2 Test Trench Descriptions

A total of 14 test trenches were excavated during the inventory survey. All of the test excavations were oriented on a 45 degree bearing (northeast-southwest). As mentioned previously, an intact traditional Hawaiian cultural layer (Layer IIb; SIHP Site 50-80-06-3970) was identified across most of the project area. It was recorded in 13 of 14 test trenches. The cultural layer contained numerous pit-like features of which 12 appeared to contain cultural material. These features were bulk-sampled for detailed analysis and charcoal from the most promising 3 were further analyzed for radiocarbon dating suitability. Complete feature analysis results are presented in Section 4.3.

The following are summary technical descriptions for each test trench, providing information on dimensions, stratigraphy, features, and cultural material. Features are numbered using a binomial designation; the first part refers to the trench number and the second to the sequential feature number within that trench (e.g., Feature T1-2 denotes the second feature in Trench 1).

Trench 1

Trench 1 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.2 m. The trench contained four stratigraphic layers, as shown on the northwest wall profile in Figure 9 and Figure 10.

Layer Ib extends from 0 to 45 cmbs and is a banded layer of modern fill material likely associated with construction of the nearby condominiums. The fill consists of sublayers of crushed coral, gravel, and terrigenous silty clay loam. Layer IIb extends from 45 to 60 cmbs at the southwestern end of the trench with an average depth of 70 cmbs. A maximum depth of 80 cmbs was recorded at the base of Feature T1-1. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.2 m. Layer IIIa is an undisturbed, culturally sterile beach sand deposit. Layer IIIb was observed only at the northeastern end of the trench and extends from 75 cmbs to the base of excavation. This layer consists of heavily saturated calcareous marine sand.

Feature T1-1 matrix was bulk sampled (3.2 liters), screened, and sorted. It was found to contain a very small amount of midden material including sea urchin spines, test[1], and Aristotles lantern[2] (n=19), *Turbo* sp. (n=1), *Nerita* sp. (n=1), and *Strombus* sp. (n=1) shells. Charcoal was not present.

[1] The urchin's spherical outer skeleton.
[2] The urchin's dental apparatus.

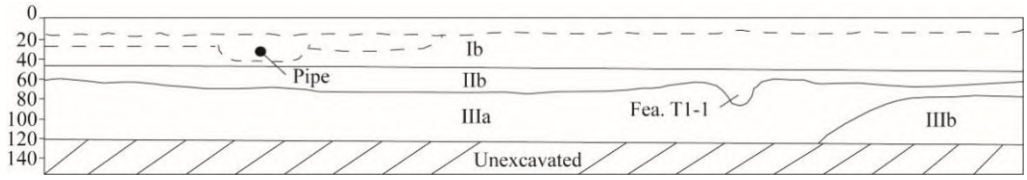

Figure 9. Trench 1, northwest wall.

Figure 10. Feature T1-1, northwest wall of Trench 1.

Trench 2

Trench 2 measured 9 m long by 60 cm wide and was excavated to a maximum depth of 1.2 m. The trench contained four stratigraphic layers, as shown on the southeast wall profile in Figure 11.

Layer Ia extends from 0 to 10 cmbs and is the asphalt surface of the parking lot. Layer Ib extends from 10 to 40 cmbs and is a banded layer of modern fill material likely associated with construction of the nearby condominiums. This fill band consists of sublayers of crushed coral, gravel, and terrigenous silty clay loam. Dark grayish brown sand fill was first observed at about 12 cmbs, surrounding a PVC utility line. Layer IIb extends from 40 to 90 cmbs. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.2 m. Layer IIIa is undisturbed, culturally sterile sand.

A pit feature was identified in Layer IIb, at about 3 m from the northeastern extremity of the trench at 75 cmbs. This feature was designated Feature T2-1. A 3-liter matric sample contained small amounts of midden including urchin spines and Aristotle's lantern (n=35), *Turbo* sp. (n=2), *Nerita* sp. (n=2), *Strombus* sp. (n=1), *Gastropoda* (n=2), and *Bivalvia* shells (n=3). Charcoal was not present.

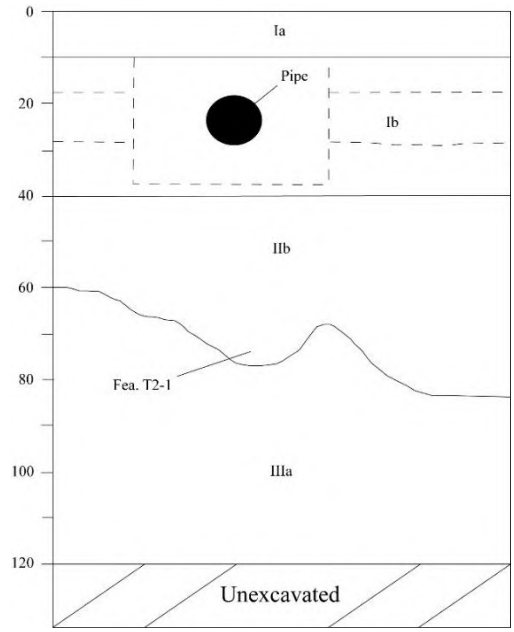

Figure 11. Trench 2, southeast wall.

Trench 3

Trench 3 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.2 m. The trench contained four stratigraphic layers, as recorded on the southeast wall (Figure 12).

Layer Ia extends from 0 to 10 cmbs and is asphalt surfacing for the parking lot. Layer Ib extends from 10 to 42 cmbs and is a banded layer of modern fill associated with the construction of the condominiums. The fill consists of sublayers of crushed coral, gravel, and terrigenous silty clay loam. Layer IIb extends from 42 cmbs to a maximum depth of 58 cmbs. Although it is the culture-bearing stratum, no cultural material or features were observed in Layer IIb. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.2 m. Layer IIIa is undisturbed, culturally sterile sand.

Trench 4

Trench 4 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.2 m. The trench contained four stratigraphic layers, as recorded on the southeast wall (Figure 13).

Layer Ia extends from 0 to 10 cmbs and is asphalt surfacing for the parking lot. Layer Ib extends from 10 to 45 cmbs and is a banded layer of modern fill associated with construction of the condominiums. This banded fill consists of sublayers of crushed coral, gravel, and terrigenous silty clay loam. Layer IIa extends from 45 cmbs to a maximum depth of 1.1 m. Layer IIa is a mixed and heavily disturbed layer of dark brown sand. Due to the heavy disturbance, no cultural features were observed in Layer IIa. Layer IIIa extends from 1.1 m to the base of excavation. At the northeast end of the trench a large pocket of Layer IIIa sand is substantially thicker, extending from 52 cmbs to the base of excavation.

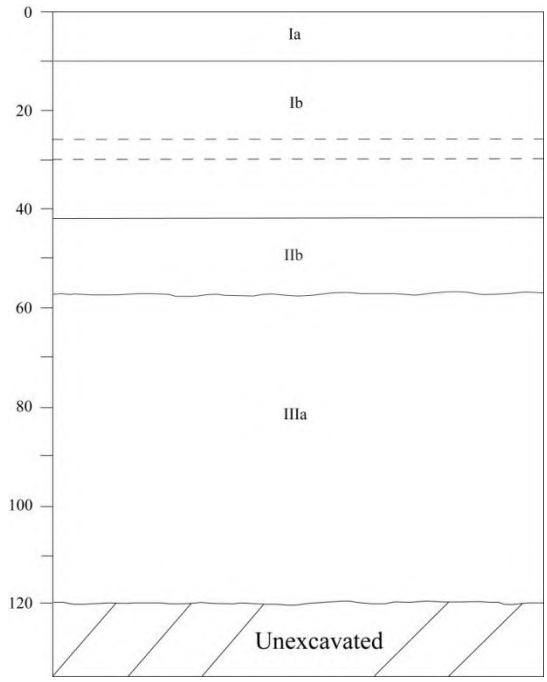

Figure 12. Trench 3, southeast wall.

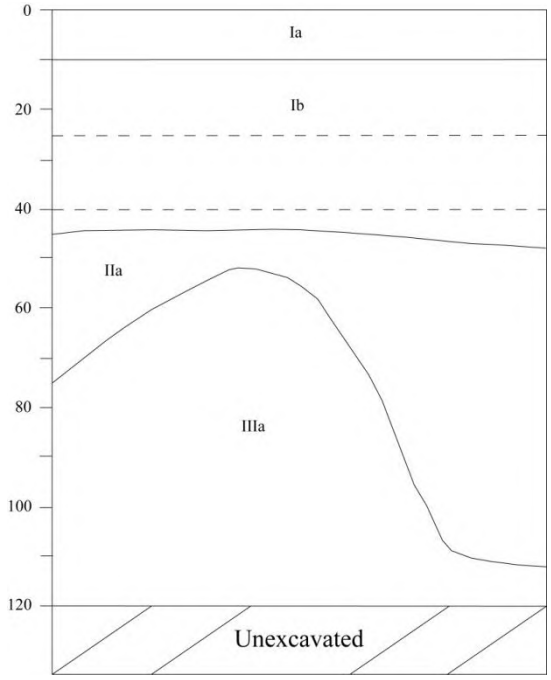

Figure 13. Trench 4, southeast wall.

Trench 5

Trench 5 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.2 m. The trench contained three stratigraphic layers, as recorded on the northwest wall (Figure 14).

Layer Ib extends from 0 to 52 cmbs with a maximum depth of 55 cmbs and is a banded layer of modern fill associated with construction of the condominiums. The fill consists of sublayers of crushed coral, gravel, and terrigenous silty clay loam. Layer IIb extends from 52 cmbs to a maximum depth of 82 cmbs. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.2 m. Layer IIIa is undisturbed, culturally sterile sand.

Two pit features were identified in Layer IIb, both about 4 m from the southwestern terminus of the trench. These pit features were designated Feature T5-1 and Feature T5-2. Feature T5-1 is a small midden deposit located at a depth of 65 cmbs. A 7.1-liter sample of feature matrix contained sea urchin spines and test fragments (n=49), and a *Nerita* sp. shell (1). Feature T5-2 is also a small midden deposit situated adjacent to Feature T5-1 at a depth of 75 cmbs. An 8.2-liter sample of feature matrix contained sea urchin spines (n=31), *Turbo* sp. (n=1), *Nerita* sp. (n=2), *Bivalvia* (n=3), and a *Labridae* tooth (n=1). No charcoal was present in either feature.

Trench 6

Trench 6 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.3 m. The trench contained four stratigraphic layers, as recorded on the northwestern wall (Figure 15).

Layer Ia extends from 0 to 10 cmbs and is asphalt surfacing for the parking lot. Layer Ib extends from 10 to 45 cmbs and is a banded layer of modern fill associated with the construction of the condominiums. This fill band consists of sublayers of crushed coral, gravel, and silty clay loam. Layer IIb extends from 52 cmbs to a maximum depth of 78 cmbs. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.3 m. Layer IIIa is undisturbed, culturally sterile sand.

One pit feature was identified 1 m from the southwestern trench terminus in Layer IIb. The pit feature was designated Feature T6-1. Feature T6-1 is a small midden deposit situated at a depth of 70 cmbs. A 4.5-liter sample of feature matrix contained sea urchin spines and a portion of Aristotle's lantern (n=16), *Nerita* sp. (n=2), and *Bivalvia* shells (n=7). No charcoal was present.

Trench 7

Trench 7 measured 8 m long by 60 cm wide and was excavated to a maximum depth of 1.5 m. The trench contained four stratigraphic layers, as recorded on the northwestern wall (Figure 16).

Layer Ia extends from 0 to 10 cmbs and is asphalt surfacing for the parking lot. Layer Ib extends from 10 to 50 cmbs and is a banded layer of modern fill associated with the construction of the condominiums. This banded fill consists of sublayers of crushed coral, gravel, and

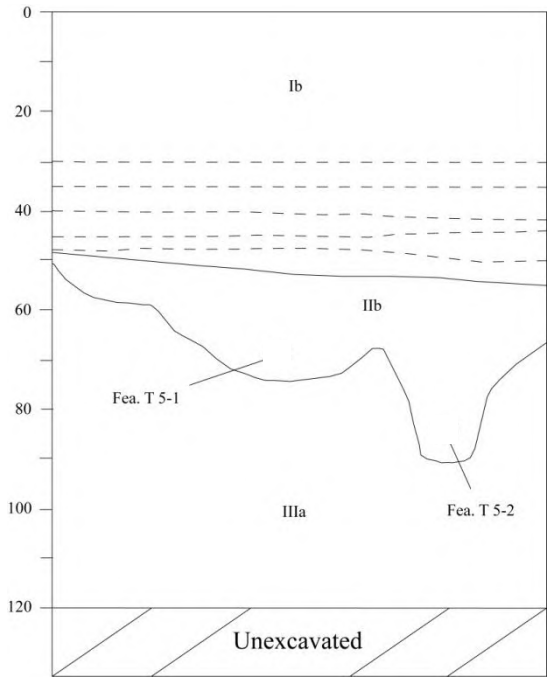

Figure 14. Trench 5, northwest wall.

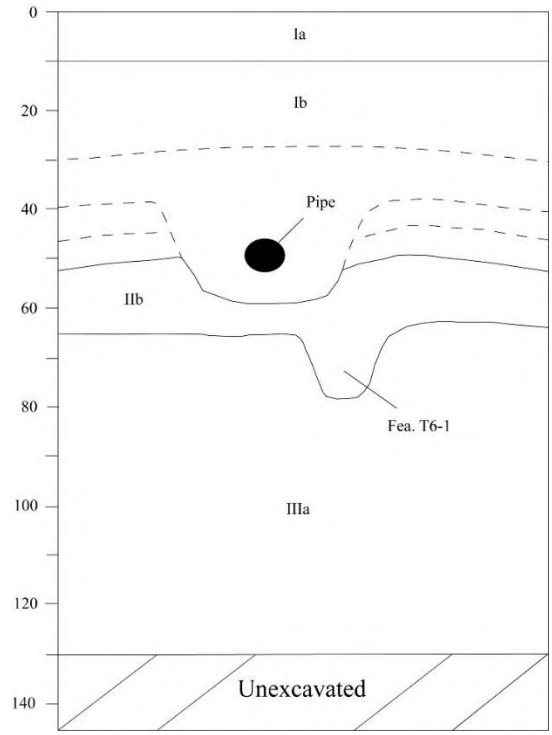

Figure 15. Trench 6, northwest wall.

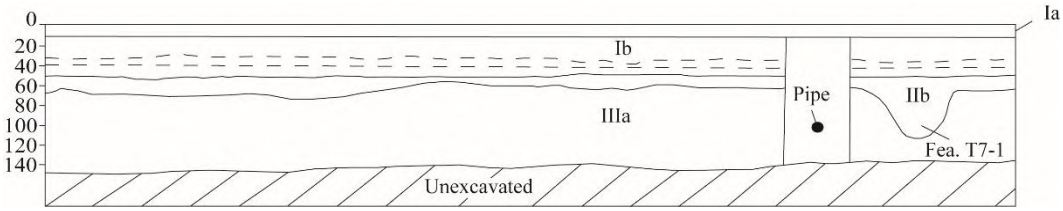

Figure 16. Trench 7, northwest wall.

terrigenous silty clay loam. Layer IIb extends from 50 cmbs to 70 cmbs for most of trench length. At the northeastern end, however, the layer reaches a depth of 100 cmbs. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.4 m. Layer IIIa is undisturbed, culturally sterile sand.

One pit feature was identified 1 m southwest of the *makai* trench terminus. The pit feature was designated Feature T7-1. Feature T7-1 is a small midden deposit at a depth of 90 cmbs. A 6.4-liter sample of this feature contained only sea urchin spines and test (n=8). No charcoal was present.

Trench 8

Trench 8 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.45 m. The trench contained four stratigraphic layers, as recorded on the southeast wall (Figure 17 and Figure 18).

Layer Ia extends from 0 to 10 cmbs and is asphalt surfacing for the parking lot. Layer Ib extends from 10 to 44 cmbs and is a banded layer of modern fill associated with the construction of the condominiums. This fill band consists of sublayers of crushed coral, gravel, and terrigenous silty clay loam. Layer IIb extends from 44 to 58 cmbs. No features or cultural material were observed in Layer IIb. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.45 m. Layer IIIa is undisturbed, culturally sterile sand.

Trench 9

Trench 9 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.5 m. The trench contained five stratigraphic layers, as recorded on the northwest wall (Figure 19 and Figure 20).

Layer Ia extends from 0 to 10 cmbs and is a concrete pad from the previously-existing structure. Layer Ib extends from 10 to 40 cmbs and is a banded layer of modern fill associated with the construction of the condominiums. This fill band consists of two sublayers—terrigenous clay loam fill and sand fill. Layer IIa extends from 40 cmbs to a maximum depth of 85 cmbs. Layer IIa is a mixed and heavily disturbed layer of dark brown sand. Layer IIb extends from 82 cmbs to a maximum depth of 1.2 m. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.5 m. Layer IIIa is undisturbed, culturally sterile sand.

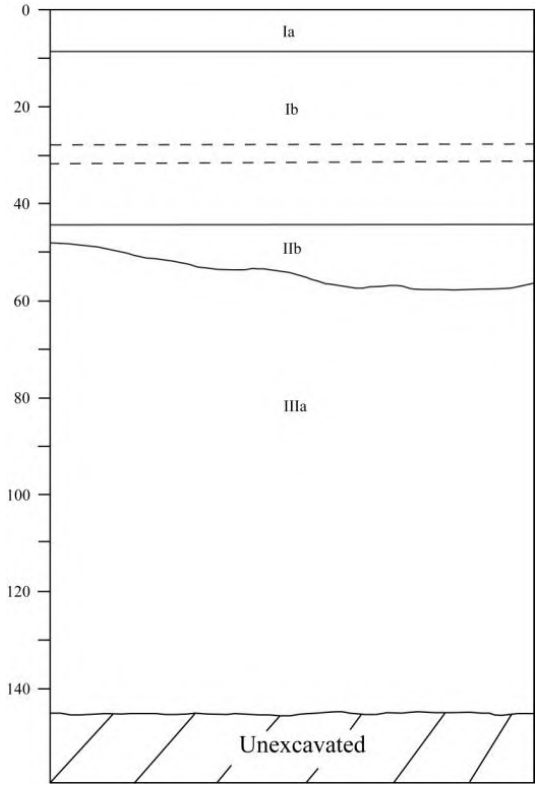

Figure 17. Trench 8, southeast wall.

Figure 18. Trench 8, southeast wall.

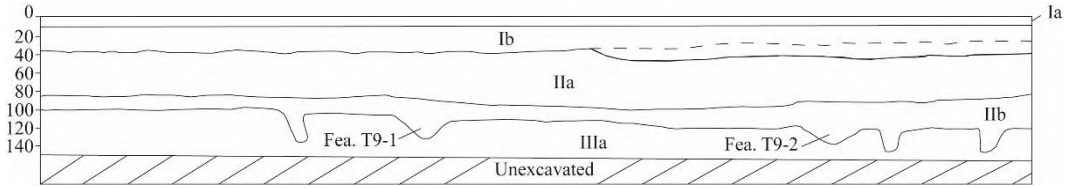

Figure 19. Trench 9, northwest wall.

Figure 20. Trench 9, Feature T9-2 (red oval), northwest wall.

Two pit features were identified in Layer IIb. These pit features were designated Feature T9-1 and Feature T9-2. Cultural material was visible in the profiles of both features. However, after 4-liter bulk matrix samples were processed for each, Feature T9-1 produced only one *Strombus* sp. shell and Feature T9-2 one piece of sea urchin. No charcoal was present in either feature.

Trench 10

Trench 10 measured 9 m long by 60 cm wide and was excavated to a maximum depth of 1.5 m. The trench contained five stratigraphic layers as recorded on the northwest wall (Figure 21 and Figure 22).

Layer Ia extends from 0 to 10 cmbs and is a concrete pad from the previously-existing structure. Layer Ib extends from 10 to 50 cmbs at its maximum depth and consists of a dark brown layer of sand fill. Layer IIa extends from 10 cmbs to 1 m at the southwestern end of the trench. Towards the northeastern end of the trench, Layer IIa extends from 50 cmbs to a depth of 88 cm.

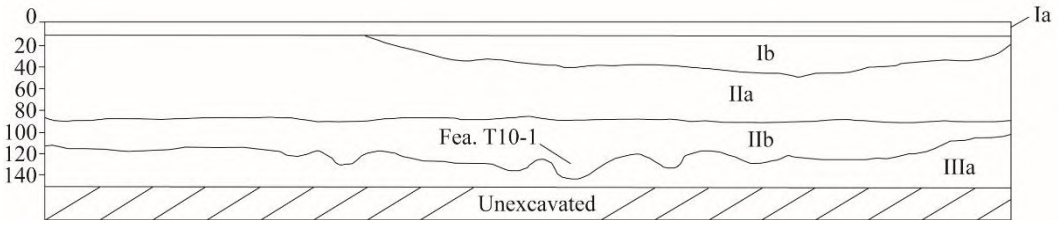

Figure 21. Trench 10, northwest wall.

Figure 22. Trench 10, Feature T10-1 (red oval), view to southwest.

Layer IIa is a mixed and heavily disturbed layer of brown sand. Layer IIb extends from the base of Layer IIa at 88 cmbs to a maximum depth of 1.42 m. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.5 m. Layer IIIa is undisturbed, culturally sterile sand.

One pit feature was identified in Layer IIb, 4 m southwest of the *makai* trench terminus. The feature was situated at a depth of 1.3 m and designated Feature T10-1. A 4-liter matrix sample contained abundant charcoal, sea urchin spines and test (n>50), crab claw fragments (n=3), *Bivalvia* fragments (n=15), *Strombus* sp. (n=2), fire cracked rock (n=3, 15 g), and 1 volcanic glass flake (Figure 23). The presence of charcoal, fire cracked rock, and thermally discolored sand indicates that this is a combustion feature, likely used for cooking. Charcoal was submitted for wood identification but not for radiocarbon dating, as it did not contain short-lived species. Wood identification result can be found in Section 4.3.3.

Figure 23. Close-up of Feature T10-1, charcoal and thermally altered sand visible in side wall.

Trench 11

Trench 11 measured 8 m long by 60 cm wide and was excavated to a maximum depth of 1.45 m. The trench contained four stratigraphic layers, as recorded on the northwest wall (Figure 24).

Layer Ia extends from 0 to 10 cmbs and is a concrete pad from the previously-existing structure. Layer IIa extends from 10 cmbs to an average depth of 85 cmbs along most of trench. At the northeast end the layer descends to a depth of 1.1 m. Layer IIa is mixed and heavily disturbed brown sand. Layer IIb extends from the base of Layer IIa at 85 cmbs to a maximum depth of 1.3 m. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.45 m. Layer IIIa is undisturbed, culturally sterile sand.

Two pit features were identified in Layer IIb. These features were designated Feature T11-1 (Figure 25) and Feature T11-2 (Figure 26). Feature T11-1 is a small midden deposit located at a depth of 1.2 m. A 3.5-liter sample of this deposit contained sea urchin spines (n=2), one *Turbo* sp. fragment, one *Isognomon* sp., fish bone (n=2), and a basalt flake. No charcoal was present.

Feature T11-2 was also situated at a depth of 1.2 m. A 4-liter sample of feature matrix contained abundant charcoal, sea urchin spines (n=5), and fire cracked rock. Charcoal from T11-2 was submitted for wood identification (see Section 4.3.3). Results indicated that all charcoal from the feature was derived from indigenous Hawaiian or Polynesian-introduced species (see Appendix A). A sample of the short-lived *hala* (*pandanus* sp.) was submitted for AMS radiocarbon dating and returned a 2σ date range of Cal AD 1665–Post 1950 (see Appendix B). Given the nature and contents of the deposit, the later portion of this range (Cal AD 1910–Post 1950) is likely specious. Feature T11-2 appears to be a combustion feature dating to the late pre-Contact Period of Hawaiian history.

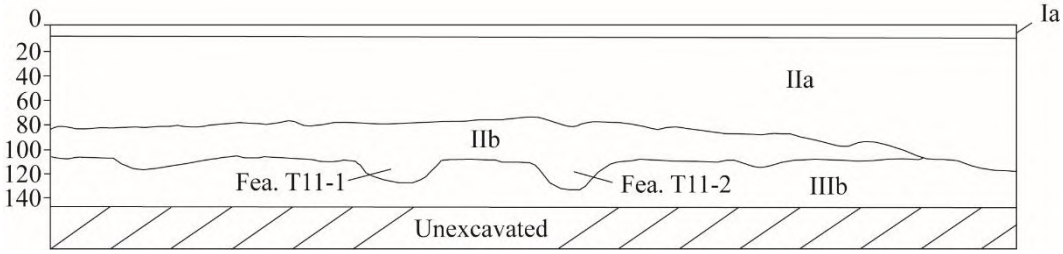

Figure 24. Trench 11, northwest wall.

Figure 25. Trench 11, Feature 11-1, northwest wall.

Figure 26. Trench 11, Feature 11-2 at far right in red circle, northwest wall.

Trench 12

Trench 12 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.5 m. The trench contained four stratigraphic layers, as recorded on the southeast wall (Figure 27 and Figure 28).

Layer Ia extends from 0 to 10 cmbs and is a concrete pad from the previously-existing structure. Layer IIa extends from 10 to 70 cmbs. It is a mixed and heavily disturbed layer of brown calcareous sand. From 70 to 80 cmbs there is a metal utility pipe that parallels the length of the trench. Layer IIb extends from the base of the utility pipe at 80 cmbs to a maximum depth of 1.3 m. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.5 m. Layer IIIa is undisturbed, culturally sterile sand.

One pit feature was identified in Layer IIb at the northeastern end of the trench. It was designated Feature T12-1. A 4.5-liter sample of feature matrix contained abundant charcoal, *Conus* sp. (n=1), sea urchin spines (n=11), and one pharyngeal wrass tooth (*Labridae*).

The abundance of charcoal indicated that this feature might be a good candidate for radiocarbon dating and a sample was therefore submitted for wood identification. Results indicated that all of the charcoal was derived from indigenous Hawaiian or Polynesian-introduced species (see Appendix A). A sample of *ʻakoko* (*Euphobia* sp.), a short-lived shrubby species, was submitted for AMS radiocarbon dating and returned a very tight 2σ calibrated date range of Cal AD 1425–1470 (see Appendix B). Feature T12-1 is clearly a pre-Contact Hawaiian combustion feature (fire pit), likely used for cooking marine foods. Feature contents are quite modest and little else can be said about it.

Trench 13

Trench 13 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.5 m. The trench contained five stratigraphic layers, as recorded on the southeast wall (Figure 29 and Figure 30).

Layer Ia extends from 0 to 10 cmbs and is a concrete pad from the previously-existing structure. Layer Ib extends from 10 to 40 cmbs and consists of a dark reddish brown terrigenous clay loam fill. Layer IIa extends from 40 to 80 cmbs and is a mixed and heavily disturbed layer of brown calcareous sand. Layer IIb extends from 80 to 100 cmbs. No features or cultural material were observed in Layer IIb. Layer IIIa extends from the base of Layer IIb to the base of excavation at a depth of 1.5 m. Layer IIIa is undisturbed, culturally sterile sand.

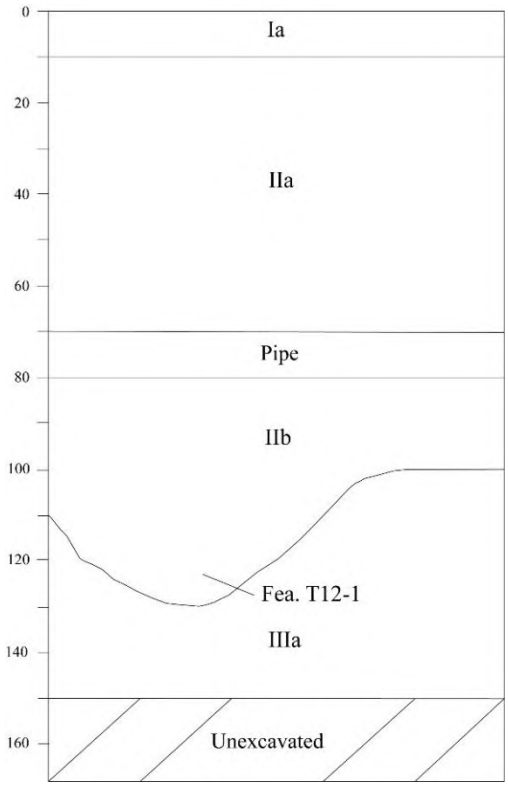

Figure 27. Trench 12, southeast wall.

Figure 28. Feature T12-1 (red oval), southeast wall.

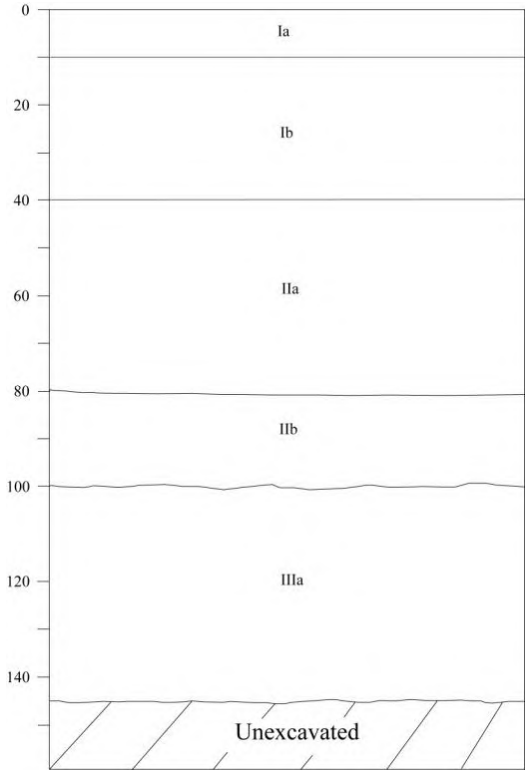

Figure 29. Trench 13, southeast wall.

Figure 30. Trench 13, view to southeast.

Trench 14

Trench 13 measured 10 m long by 60 cm wide and was excavated to a maximum depth of 1.8 m. The trench contained five stratigraphic layers, as recorded on the southeast wall (Figure 31 and Figure 32).

Layer Ia extends from 0 to 10 cmbs and is a concrete pad from the previously-existing structure. Layer Ib extends from 10 to 70 cmbs and consists of crushed coral fill. Layer IIa extends from 70 to 90 cmbs and is a heavily disturbed layer of brown calcareous sand. Layer IIb extends from 80 cmbs to a maximum depth of 1.7 m. Layer IIb was very thick in this trench, although no clear features or cultural material were observed. Layer IIIb extends from the base of Layer IIb to the base of excavation at a depth of 1.8 m. Layer IIIb consists of heavily saturated calcareous marine sand.

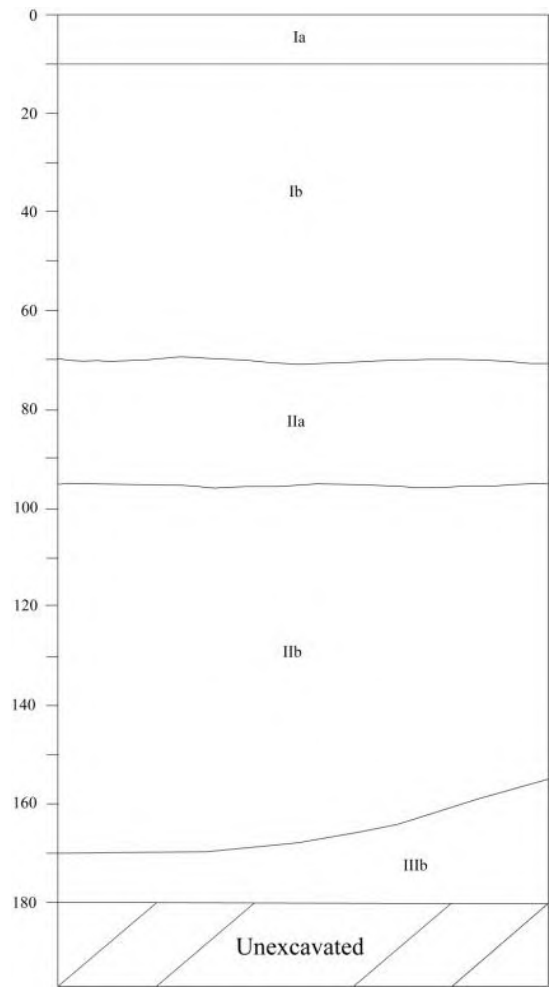

Figure 31. Trench 14, southeast wall.

Figure 32. Trench 14 stratigraphy, southeast wall.

4.3 Laboratory Analysis

Cultural material recovered during subsurface testing was derived exclusively from 12 pit features associated with the traditional Hawaiian cultural layer designated SIHP Site 50-80-06-3970. Major artifact classes included lithic flakes (both basalt and volcanic glass), marine invertebrate remains, fish bone, and charcoal. Each of these are described and analyzed below.

4.3.1 Lithic Artifacts

One volcanic glass flake (artifact no. 1) and one basalt flake (artifact no. 2) were recovered from Features T10-1 and T11-1 respectively (Figure 33).

Artifact no. 1 is a small volcanic glass flake measuring 9.4 millimeters (mm) in length by 2 mm in width. It has a thickness of 1 mm and a weight of 0.1 g. The flake was recovered from a small combustion feature in Trench 10, along with shell midden and fire cracked rock. The volcanic glass flake clearly exhibits conchoidal fracture characteristics on its ventral surface. The dorsal surface is completely covered by cortex.

Artifact no. 2 is a basalt flake that measures 42.9 mm in length by 29.4 mm in width with a thickness of 10.2 mm and a weight of 10.5 g. It was recovered from a combustion feature in Trench 11. The basalt flake exhibits evidence of intentional hard-hammer percussion with diagnostic attributes including percussion bulb, striking platform, and negative flake scars on its dorsal surface. Flake size indicates early to mid-stage reduction, perhaps for adze production, although it was more likely created simply as an expedient flake tool.

Figure 33. Artifact no.1, volcanic glass flake (left) and artifact no. 2, basalt flake (right).

4.3.2 Faunal Assemblage

Small assemblages of marine shell and fish bone were recovered from all of the sampled pit features at Site 3970 (Figure 34). The shell and fish bones remains were cleaned, sorted, and identified to lowest possible taxa. Total counts and weights for each feature and taxa are provided in Table 3. The feature subassemblages all exhibit a low diversity of taxa and have small element counts. Large quantities of highly fragmented sea urchin tend to elevate total counts in some features, but the number of actual urchin individuals represented is probable very small.

The total marine invertebrate and fish bone assemblage consists of 285 individual elements. Marine invertebrates (n=281) comprise 97.8 percent of the total sample. Fish bone (n=4) are 1.4 percent of the assemblage, contributing minimally to the total. Sea urchin (n=227) represents 80.8 percent of the marine invertebrates collected, followed by *Bivalvia* (n=28) at 10 percent. Marine invertebrate taxa break down as follows: *Nerita* sp. (n=8) 2.8 percent, *Turbo* sp. (n=6) 2.1 percent, *Strombus* sp. (n=5) 1.8 percent, crab claw (n=3) 1 percent, miscellaneous *Gastropoda* (n=2) 0.7 percent, *Conus* sp. (n=1) 0.4 percent, and *Isognomon* sp. (n=1) 0.4 percent.

This assemblage clearly represents human food remains. Sea urchin, bivalves, and *Nerita* are the highest percentage of the assemblage by count, and all three were commonly eaten in ancient Hawai‘i. Fish remains are minimal with only four elements recovered, two of which were from the reef-dwelling wrass family (*Labridae* sp.). The assemblage as a whole, consistent across all features, appears to indicate reef gleaning and near-coastal gathering activities.

Figure 34. Sea urchin spines, body fragments, and a *Labridae* tooth (lower right) from Feature T5-2, Site 3970.

Table 3. Faunal Assemblage Data

Trench	Feature	Material	Count	Weight (g)	Comment
1	1-1	Urchin	19	1.1	Spines, test, and Aristotle's lantern
		Turbo sp.	1	0.3	Operculum
		Nerita sp.	1	0.3	-
		Strombus sp.	1	0.8	-
2	2-1	Urchin	35	1.5	Spines and Aristotle's lantern
		Turbo sp.	2	7.7	Operculum
		Nerita sp.	2	0.9	-
		Strombus sp.	1	1.6	-
		Gastropoda	2	1.0	-
		Bivalvia	3	0.4	-

Table 3. (cont.)

Trench	Feature	Material	Count	Weight (g)	Comment
5	5-1	Urchin	49	3.0	Spines and test
		Nerita sp.	1	0.3	-
5	5-2	Urchin	31	1.3	-
		Turbo sp.	1	0.6	Operculum
		Nerita sp.	2	0.4	-
		Bivalvia	3	0.1	-
		Labridae tooth	1	<0.1	Pharyngeal tooth
6	6-1	Urchin	16	1.3	Spines and a portion of Aristotle's lantern
		Nerita sp.	2	0.6	-
		Bivalvia	7	0.7	-
7	7-1	Urchin	8	0.7	Spines, test, and Aristotle's lantern
9	9-1	*Strombus* sp.	1	0.3	-
9	9-2	Urchin	1	<0.1	-
10	10-1	Urchin	50	4.4	Spines and test; only large to medium and mostly complete spines counted, many more very small fragments present
		Crab claw	3	0.2	-
		Bivalve frag.	15	2.5	-
		Strombus sp.	2	4.1	-
11	11-1	*Turbo* sp. frag	1	0.4	-
		Urchin spine	2	<0.1	-
		Fish bone	2	0.7	One scapula
		Isognomon sp.	1	0.5	-
		Turbo sp. frag	1	0.4	-
11	11-2	Urchin spine	5	0.3	-
12	12-1	Urchin spine	11	0.8	-
		Conus sp. frag.	1	3.0	-
		Labridae tooth	1	0.3	Pharyngeal tooth

4.3.3 Wood Identification and Radiocarbon Dating Results

Charcoal samples from Features T10-1, T11-2, and T12-1 were submitted to the IARII Wood Identification Laboratory for identification to the lowest taxonomic level possible. The objectives of this analysis were to determine 1) if any of the features contained modern-introduced species, and 2) to identify charcoal from short-lived species or elements (e.g., nut shell, twigs) suitable for radiocarbon dating.

Analysis results are summarized in Table 4 below and the complete report can be found in Appendix A. All of the identifiable elements from the three features were either endemic to Hawai‘i or Polynesian introductions. This indicates, along with the other matrix contents, that they may be of pre-Contact age. At the very least, this hypothesis is not disproved by the data.

Of the three features, T11-2 and T12-1 contained short-lived species suitable for radiocarbon analysis, and were therefore submitted. Feature T10-1 contained only tree species which had the potential to introduce an “old wood” bias. This is unfortunate, since this feature produced the only volcanic glass fragment found during the investigation.

Radiocarbon dating results for the two features are summarized in Table 5 below. Calibration details can be found in Appendix B. The results indicate clearly that the combustion event that produced Feature T12-1 occurred sometime within a 45-year period in the middle of the fifteenth century. The Cal AD 1425–1470 result is a rather tight date range and is the earliest archaeologically dated feature in the region.

Feature T11-2 is also most likely a product of pre-Contact activity, although the later portions of the calibrated date range introduce some uncertainty. Given the exclusively Hawaiian and Polynesian-introduced charcoal in the features, the presence of traditional Hawaiian tool remains (e.g., basalt and volcanic glass flakes), and the absence of any historic artifacts or intrusive strata, it is unlikely that the features date to the post-Contact portion of the calibrated date range. We interpret the Feature T11-2 results to support a pre-Contact Hawaiian cultural affiliation.

The radiocarbon results indicate a long period of activity in this locale, with usage potentially covering a ca. 550-year span.[3] The cultural layer comprising SIHP Site 3970, as with other similar coastal deposits, is likely a product of centuries of use. Reworking and intermingling of materials during this long period means that internal stratigraphy is unlikely (and was not observed) and that scientific value for the generalized layer is quite limited. The investigation of intact, single-event pit features that extend into sterile sand deposits, such as those identified in this study, remain the primary source of archaeological data. It is, of course, remarkable, that the two features, which are only about 6 meters apart, derive from such different time periods.

[3] Ending in the early 1970s with construction of the condominiums.

Table 4. Charcoal Identification Results

Trench	Feature	Taxa	Hawaiian Name	Origin/Habit	Part	Weight (g)
10	T10-1	*Psychotria* sp.	‘Kōpiko	Native/Trees	wood	0.47
		Metrosideros sp.	‘Ōhi‘a lehua and others	Native/Trees and Shurbs	wood	0.20
		Unknown hardwood	-	-	wood	0.25
		Syzgium sp.	‘Ōhi‘a ‘ai and others	Native and Introduced/Trees	wood	0.09
		Sideroxylon polynesicum	*Keahi*	Native/Shrubs and Trees	wood	0.08
		Diospyros sp.	*Lama*	Native/Small Trees	wood	0.11
11	T11-2	*Euphorbia* sp.	*‘Akoko*	Native/Shrubs and Small Trees	wood	0.06
		Indeterminate hardwood twig	-	-	wood	0.05
		Pandanus sp.	*Hala*	Native/Trees	nutshell	0.37
12	T12-1	*Diospyros* sp.	*Lama*	Native/Small Trees	wood	0.21
		Euphorbia sp.	*‘Akoko*	Native/Shrubs and Small Trees	wood	0.15
		cf. *Morinda citrifolia*	*Noni*	Polynesian Introduced/Small Tree	wood	0.12
		Myrsine sp.	Kōlea	Native/Shrubs and Small Trees	wood	0.25

Table 5. Radiocarbon Dating Results

Feature	Material	Taxa	Lab No.	Conventional Age	2σ Calibrated Range
T11-2	Charcoal	*Pandanus* sp. (*Hala*)	Beta-453635	160 ± 30 BP	Cal AD 1665–1710 Cal AD 1720–1890 Cal AD 1910–Post 1950
T12-1	Charcoal	*Euphorbia* sp. (*‘Akoko*)	Beta-453636	440 ± 30 BP	Cal AD 1425–1470

4.4 SIHP Site 50-80-06-3970: Pre-Contact Hawaiian Cultural Layer

Subsurface testing resulted in the identification of one previously recorded historic property, SIHP Site 50-80-06-3970, a truncated pre-Contact Hawaiian cultural layer. The current boundary of the site is defined by the parcel limits of its observation, inclusive of human burial finds (Figure 35). This includes: 1) occurrences recorded during the present testing, 2) previous documented occurrences on the subject parcel to the north, and 3) previous documented occurrences on the adjacent property (Hanohano Hale condominiums). The total site area thus includes the entirety of TMKs (1) 5-3-008:001 and :002. The total area encompassed by the current site boundary is 5.5 acres. It extends 295 meters lengthwise parallel with the coastline and extends 80 m inland. It is expected that this site boundary will be modified as further archaeological testing is conducted over the years.

Site 3970 was observed in 13 of the 14 test trenches during this project and produced a total of 12 pit features. These features demonstrate that intact, single-event activity loci are present at the base of the deposit despite significant truncation of the overlying general occupational deposit by modern activities. Furthermore, these features have the potential to produce traditional Hawaiian artifact assemblages containing lithic flakes, marine invertebrates, fish bone, and dateable charcoal. Although the quantity and diversity of materials recovered during this project were modest and of limited interpretive value, there remains the potential for more substantial feature contents.

Radiocarbon dating of short-lived taxa from two features confirms that occupation and use of the area, and development of the cultural deposit, dates well into the pre-Contact Period, with earliest use potentially at AD 1425.

5.0 CONCLUSIONS AND RECOMMENDATIONS

In accordance with SHPD requirements issued under the authority of Hawaii Revised Statutes Chapter 6E-42, Garcia and Associates completed an archaeological inventory survey at parcel TMK (1) 5-3-008:002 por. in Papaʻakoko Ahupuaʻa, Koʻolauloa District, Oʻahu. The inventory survey consisted of the excavation of 14 test trenches spaced evenly across the area of proposed development. Test excavation produced wide-spread evidence of previously-recorded SIHP Site 50-80-06-3970, a pre-Contact Hawaiian cultural deposit.

The Site 3970 cultural deposit covers virtually the entire project area and likely extends well beyond into adjacent parcels. Numerous pit features were identified in test trench side-walls, although it was difficult to distinguish discrete single-event features from dips in the undulating base of the cultural deposit. Twelve features appeared to have potential for containing cultural material and were therefore bulk sampled and analyzed. The features produced modest amounts of marine invertebrate remains, fish bone, and lithic artifacts. Of the 12 features, only three produced macroscopic charcoal. Charcoal from two features was found suitable for radiocarbon dating and produced date ranges of Cal AD 1425–1470 and Cal AD 1665–Post 1950, both at a 95% (2σ) confidence level. Given the content of the features, the post-Contact portion latter date range is likely spurious.

Figure 35. Current site boundary for SIHP Site 50-80-06-3970.

5.1 SIHP Site 50-80-06-3970: Significance and Integrity

The Site 3970 cultural deposit was evaluated for significance and integrity following the criteria established in HAR §13-284-6. Results of the evaluation are summarized in Table 6 below.

According to HAR §13-284-6, to be considered 'significant' "a historic property shall possess integrity of location, design, setting, materials, workmanship, feeling, and association, and shall meet one or more of the following criteria:

1) Criterion "a". Be associated with events that have made an important contribution to the broad patterns of our history;
2) Criterion "b". Be associated with the lives of persons significant in our past;
3) Criterion "c". Embody the distinctive characteristics of a type, period, or method of construction, represent the work of a master, or that possess high artistic value;
4) Criterion "d". Have yielded, or is likely to yield, information important for research on prehistory or history; or
5) Criterion "e". Have 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."

Site 3970 is a traditional Hawaiian cultural deposit associated with utilization of the windward coastline for habitation, food processing, and consumption. Although the upper portion of the deposit has been truncated by Historic Period land development activities, the cultural deposit retains substantial integrity and has been shown to contain well-preserved single-event pit features. Radiocarbon dating of charcoal from short-lived taxa from one such feature indicates utilization of the area as early as AD 1425. Another feature, in close proximity, returned a calibrated date range beginning at AD 1665. These data indicate long, likely continuous occupation and utilization of the Papaʻakoko Ahupuaʻa coastline. The two-century spread between such closely-spaced pit features suggests a high potential for features representing other periods as well, all within a very localized area. If enough such features are discovered and analyzed, it may

Table 6. Significance Evaluation Results

SIHP Site	Site Type	Site Function	Significance Criterion
50-80-06-3970	Pre-Contact Hawaiian Cultural Deposit	Possible habitation, food processing, human burial.	d, e

be possible to compile a continuous record of habitation and marine resource consumption at this site. Midden contents of the features so far recorded, admittedly, have been very modest, and only three of 12 produced any charcoal at all. Nevertheless, Site 3970 has clearly yielded, and is likely to yield, information important for research on Hawaiian prehistory. Site 3970 is therefore considered a "significant" historic property under HAR §13-284-6 Criterion "d."

Another important consideration is the fact that previous investigators have recovered Hawaiian skeletal remains from within, or from features that appear associated with, the Site 3970 cultural deposit (Bath and Smith 1988; Pestana and Spear 2010). This suggests that additional burials may potentially be present within or below the cultural layer, anywhere within its broad extent. Traditional Hawaiian burials clearly "have important value to the native Hawaiian people" and therefore Site 3970 is also a signficant historic property under HAR §13-284-6 Criterion "e."

For properties eligible under Criterion d, integrity is based upon the property's potential to yield specific data that addresses important research questions (https://www.nps.gov/nr/publications/bulletins/nrb15/nrb15_8.htm). Site 3970 has demonstrated its potential to yield such data at multiple locales. The pertinent integrity consideration is therefore whether the deposit has been disturbed enough to ruin its information potential more broadly. Stratigraphic data indicates that the deposit has indeed been adversely impacted by modern construction. The upper portion of the deposit in most locations has been highly disturbed, including probable mixing with overlying sediment layers. However, the lower part of the deposit is largely intact. More importantly, the relatively deep single-event pit features that contain the most important scientific information were observed to be intact in most of the test trenches. Therefore, although the integrity of the deposit has been impacted, the impact is not sufficient to negate its information potential, and therefore its significance under Criterion "d."

5.2 Effect Determination and Mitigation Recommendation

Based on the owner's future construction plans for the parcel, the effect determination for this project is "effect with agreed-upon mitigation commitment." The effect will be partial destruction of the cultural deposit and the scientific information in contains. It should be noted, however, that of the two proposed construction actions described in Section 1.1, only the future construction of new condominiums in the project area will affect historic properties (i.e., SIHP Site 50-80-06-3970). Remodeling of Apartment Unit 115, however, will <u>not</u> affect historic properties.

The pertinent factors in evaluating the potential effect of the proposed Apartment Unit 115 renovations are: 1) the depth of proposed excavation, 2) the extent to which proposed excavation is within previously disturbed sediment, and 3) the expected depth of SIHP Site 50-80-06-3970. The proposed depth of excavation for the nine footings is relatively shallow at 12 to 18 inches. This is well above the depth at which the SIHP Site 50-80-06-3970 cultural deposit could be encountered, based on documented stratigraphy from that locale. There is very little chance that these shallow footing excavations would encounter intact Hawaiian cultural deposits. Furthermore, the nine proposed footings will be excavated in the same locations as existing footings in the Apartment Unit 115 locale. This further reduces the chances of impacting intact cultural deposits. For the above reasons, the proposed ground disturbing construction activities

associated with Apartment Unit 115 renovations at "Pats at Punaluu" will have "no effect" on significant historic properties.

The larger construction project associated with the future new condominium building remains a concern. The ground disturbing associated with this construction will reach and exceed the depth of the cultural deposit (ca. 60 cm/24 inches in depth). It is therefore recommended that archaeological data recovery be conducted at the SIHP Site 50-80-06-3970 cultural deposit as mitigation for the adverse effect. This work may be conducted prior to, or in conjunction with, earth-disturbing construction activities. The objective of the archaeological date recovery is to acquire compositional and age data for single-event pit features (or other features types if present) within the cultural deposit and to obtain spatial distribution data for such features using a plow-zone style 'scrapping' excavation technique. This will require slowly removing sediment in thin horizontal layers such that features can be exposed, mapped, and sampled in plan across the project area.

The methodology and stipulations of the data recovery investigation should be presented in an Archaeological Data Recovery Plan, to be approved by SHPD. This plan may be submitted to, and approved by, SHPD prior to the development of engineering plans for the new structure, provided it accounts for all potential disturbance to the cultural deposit.

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APPENDIX A: WOOD IDENTIFICATION RESULTS

RADIOCARBON SCREENING OF SAMPLES FROM PAT'S AT PUNALU'U, O'AHU ISLAND

By:
Jennifer Huebert, IARII

For:
David Byerly, Garcia and Associates (GANDA)

December 7, 2016

METHODS

Three charcoal samples from the Pat's at Punalu'u project were analyzed to facilitate the selection of short lived species or plant parts for radiocarbon dating. The freshly fractured transverse and tangential facets of each charcoal piece were viewed with a dissecting microscope, and further examined with an epi-illuminated microscope at magnifications of 50–500X. Taxonomic identifications were made by comparing anatomical characteristics with wood specimens in the IARII Pacific Islands Wood Collection. Vouchers associated with these specimens have been verified and archived at the Department of Botany, University of Hawai'i, Mānoa. Published references, including books, journal articles, technical documents, and wood atlases, were also consulted.

For each sample, charcoal fragments were examined only until preferred short-lived material (nutshells, twigs, or very small-diameter wood) was located. Unexamined material was returned to its original packaging.

RESULTS

Nine woods were identified in the three samples analyzed. One of these taxa, listed as Unknown hardwood 01, had distinctive anatomical features but a determination could not be made. *Hala* (*Pandanus*) nutshell and a very small twig of an indeterminate hardwood were noted in the sample from TR-11, Fe.2. A detailed list of the identifications is presented below, and anatomical descriptions of some materials are included at the end of this report.

Nutshells and twigs are short-lived and preferred for radiocarbon dating, so the *Hala* endocarp and small twig are recommended. Additionally, many *Euphorbia ('Akoko)* occur as shrubs and small trees and are probably the next best choice for dating. *Lama* (*Diospyros*), *'Ōhi'a lehua* (*Metrosideros*), and *'Ōhi'a 'ai* (*Syzygium*) can occur as large and/or slow-growing trees, and should be avoided when possible as the wood could include many decades of inbuilt age. A copy of two useful papers that discuss the selection of material for radiocarbon dating in more detail can be provided upon request (Allen and Huebert 2014, Athens and Rieth 2013).

WIDL #	Taxa	Common/ Hawaiian Name	Origin/Habit	Part	Weight, g
TR-10, Fe.1 (#2369)					
1635-1	*Psychotria* sp.	*'Kōpiko*	Native/Trees	wood	0.47
1635-2	*Metrosideros* sp.	*'Ōhi'a lehua* and others	Native/Shrubs and Trees	wood	0.20
1635-3	Unknown hardwood 01	--	--	wood	0.25
1635-4	*Syzygium* sp.	*'Ōhi'a 'ai* and others	Native and Introduced/Trees	wood	0.09
1635-5	*Sideroxylon polynesicum*	*Keahi*	Native/Shrubs and Trees	wood	0.08
1635-6	*Diospyros* sp.	*Lama*	Native/Small Trees	wood	0.11
TR-11, Fe.2 (#2369)					
1635-7	*Euphorbia* sp.	*'Akoko*	Native/Shrubs and Small Trees	wood	0.06
1635-8	Indeterminate hardwood twig	--	--	wood	0.05
1635-9	*Pandanus* sp.	*Hala*	Native/Trees	nutshell	0.37
TR-12, Fe.1 (#2369)					
1635-10	*Diospyros* sp.	*Lama*	Native/Trees	wood	0.21
1635-11	*Euphorbia* sp.	*'Akoko*	Native/Shrubs and Small Trees	wood	0.15
1635-12	cf. *Morinda citrifolia*	*Noni*	Polynesian Introduction/Small Tree	wood	0.12
1635-13	*Myrsine* sp.	*Kōlea*	Native/Shrubs and Small Trees	wood	0.25

REVIEW OF TAXA

EBENACEAE
Diospyros sp. (*Lama*)

This small endemic tree, 2 to 10 m tall, is found in wet or dry regions of all the main Hawaiian Islands (Rock 1913:395; Wagner et al. 1990:587). Its hard wood was once used by Hawaiians for houses, enclosures for certain idols (Malo 1951:21), and chisel handles (Buck 1957:38). Hillebrand (1981:275) reported that the small fruits were eaten by the natives.

EUPHORBIACEAE
Euphorbia sp. (*'Akoko*)

The distribution of the 15 endemic shrubs and small trees in this genus range from coastal environments to upper forest zones on the main Hawaiian Islands (Wagner et al. 1990:602-617; Rock 1974:243-262) and was valued for firewood by the Hawaiians (Hillebrand 1981:396). The milky sap was once considered a possible source for rubber (Rock 1974:261).

MYRTACEAE
Metrosideros sp. (*'Ōhi'a lehua* and others)

These endemic species range in habit from prostrate shrubs to tall trees, and in distribution from sea level to 2200 m elevation, in many ecological situations on all of the main Hawaiian Islands (Wagner et al. 1990:967). The hard wood of *'Ōhi'a lehua* (*M. polymorpha*) was once used for making spears and mallets, idols, posts and rafters for houses, and enclosures around temples (Buck 1957:87; Malo 1951:20; Neal 1965:638). In addition to *M. polymorpha*, species in this genus that are native to O'ahu include *M. tremuloides* (*Lehua 'āhihi*), *M. macropus* (also called *'Ōhi'a lehua*), and *M. rugosa* (*Lehua papa*).

MYRSINACEAE
Myrsine sp. (*Kōlea*)

The nine species of *Myrsine* found on O'ahu occur as shrubs and small trees (Wagner et al. 1990:937-947). The red sap and charcoal of these plants were used as tapa dyes, and the wood was used in the construction of houses (Neal 1965:664).

PANDANACEAE
Pandanus sp. (*Hala*)

This indigenous species is a tree, up to about 10 m tall, which occurs in mesic coastal sites and slopes of mesic valleys on all of the main islands except Kaho'olawe (Wagner et al. 1990:1479-1481). The leaves were used for house thatching, mats, baskets, and fans (Buck 1957:103-105; Handy and Handy 1972:201; Neal 1965:52). The wood was used to make calabashes, troughs and boards to mash sweet potatoes (Handy and Handy 1972:202). Lei are made today from the colorful fruit segments or keys, but in the past they were not favored for important occasions as another meaning for *hala* was failure (Pukui and Elbert 1986:51).

RUBIACEAE
cf. *Morinda citrifolia* (*Noni*)

This Polynesian introduction is a small tree or shrub, 3 to 6 m tall, which is now naturalized in dry to mesic sites on all of the main islands except Kaho'olawe (Wagner et al. 1990:1157). It was originally cultivated in Hawai'i for its medicinal properties (Abbott 1992:98-100). A red kapa dye was extracted from the bark and a yellow dye from the root (Buck 1957:167).

Psychotria sp. (*Kōpiko*)

This large genus is distributed over tropical regions of both the New and Old Worlds. The 11 species of *Psychotria* in Hawai'i are small to medium sized endemic trees which are found in the mesic to wet forests. The five species, known from O'ahu, are *P. fauriei*, *P. hathewayi*, *P. hexandra*, *P. kaduana*, and *P. mariniana*. These species range from small trees to trees up to 20 m tall and occur mainly in mesic to wet forests (Wagner et al. 1990:1160-1170). Its wood was previously used as firewood and to make *kapa* logs (Malo 1951:21).

Syzygium sp. (*'Ōhi'a 'ai* and others)

Four species of these trees are found on O'ahu. *Syzygium cumini* (Java plum) and *S. jambos* (rose apple) have naturalized in the mesic forests after their introduction prior to 1871 and in 1825, respectively. The Polynesian introduction *S. malaccense* (mountain apple, *'ōhi'a 'ai*) may be found in low mesic to wet forests while the native *S. sandwicensis* (*'ōhi'a hā*) seems to be restricted to ridges and slopes on Kaua'i, O'ahu, Moloka'i, Lāna'i and Maui (Wagner et al. 1990:975-976). The trunks from *'ōhi'a 'ai* were formerly used for posts, house rafters and temple enclosures; idols were also carved from the wood. The fruit was eaten and the bark, flowers and leaves were used medicinally (Rock 1974:323). A dye for clothing was extracted from the bark (Buck 1957:187).

SAPOTACEAE

Sideroxylon polynesicum (*Keahi*)

This is an indigenous shrub or tree considered to have once been a component of the dry forest, but is now rare in many locations. It has been documented from slopes and lava fields in remnant patches of dry forest on all of the main islands except Ni'ihau and Kaho'olawe (Wagner et al. 1990:1232).

ANATOMICAL DESCRIPTIONS

Diospyros sp.

Small vessels under 50 µm diameter, often chained 2-4 radially; thick-walled fibers; regularly spaced, fine, slightly wavy lines of axial parenchyma 1-2 cells wide; short rays, mostly uniseriate, of small cells with one to several rows of square cells at ends and frequent rhomboid crystals; intervessel pits alternate and very small; vessel-ray pits similar

Euphorbia sp.

Very small-diameter vessels (under 65 µm), round or angular in outline, solitary or in radial multiples; most rays uniseriate and 3-5 cells tall; intervessel pits alternate, oval, smaller (under 5 µm); axial parenchyma mostly absent / not noted

Metrosideros sp.

Vessels 60-130 µm diameter (generally of two size classes), isolated, round; rays mainly bi-seriate with short to long uniseriate ends; slash-like vessel-ray pits

cf. *Morinda citrifolia*

Vessels 55-100 µm, solitary or in radial chains of up to 3-4; irregular and discontinuous bands of axial parenchyma a few cells wide; rays (1)2-4 cells wide, body of procumbent cells with 1-3 uprights at ends; intervessel pits alternate, 6-7 µm, oval, probably vestured; vessel-ray pits similar; raphide crystals scattered across section in places; radial fissures frequent

Myrsine sp.

Small vessels, 50-65 µm diameter, occasionally in pairs, widely spaced, vitrified margins; rays 4-6 cells wide, occasionally larger, of small procumbent cells and square cells; can be tall with occasional sheath

cells; intervessel pits alternate, 6-7 µm diameter and can occur in coalescent apertures; vessel-ray pits similar; chunky crystals noted

Pandanus sp. nutshell
1.8 cm x 1.5 cm x .5 cm thick; locule visible; fragment from proximal end

Psychotria sp.
Very small vessels, sometimes angular in outline, can be difficult to distinguish from parenchyma in cross-section; rays wider than vessels, ~3 cells wide, of small cells with generally one upright at ends; intervessel pits alternate and very small (<4 µm).

Sideroxylon polynesicum
Vitrified and glassy cross-section, brittle; vessels ~100 µm diameter or smaller; narrow bands axial parenchyma ~2 cells wide, regularly spaced; fiber lumens mostly closed; rays very small, of short bi-seriate body with ends 2-3 cells long

Syzygium sp.
Vessels ~50 µm diameter, round, isolated or in pairs; wavy bands of axial parenchyma; somewhat thicker-walled fibers; vessel-ray pits slash-like and enlarged, round to oval; intervessel pits alternate, oval, clearly vestured, medium sized

Unknown hardwood 01
Vessels ~100-120 µm diameter, solitary or in pairs; rays 2-3 cells wide with long uniseriate ends, occasionally interconnected; fibers medium-thick, sometimes rectangular in cross-section; intervessel pits 7-11 µm, oval and alternate and opposite; vessel-ray pits enlarged and occasionally slash-like

Indeterminate hardwood twig
13 mm x 3 mm, hollow, with leaf attachment scars; indeterminate taxon; could be a single year of growth

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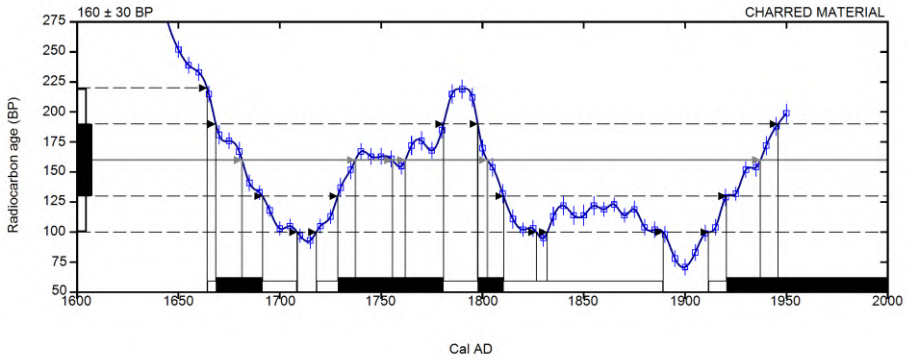
APPENDIX B: RADIOCARBON RESULTS

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -24.8 o/oo : lab. mult = 1)

Laboratory number	**Beta-453635 : 2369 TR11FE2**
Conventional radiocarbon age	**160 ± 30 BP**
Calibrated Result (95% Probability)	**Cal AD 1665 to 1710 (Cal BP 285 to 240)** **Cal AD 1720 to 1890 (Cal BP 230 to 60)** **Cal AD 1910 to Post 1950 (Cal BP 40 to Post 0)**
Intercept of radiocarbon age with calibration curve	Cal AD 1680 (Cal BP 270) Cal AD 1735 (Cal BP 215) Cal AD 1755 (Cal BP 195) Cal AD 1760 (Cal BP 190) Cal AD 1800 (Cal BP 150) Cal AD 1935 (Cal BP 15) Post AD 1950 (Post BP 0)
Calibrated Result (68% Probability)	Cal AD 1670 to 1690 (Cal BP 280 to 260) Cal AD 1730 to 1780 (Cal BP 220 to 170) Cal AD 1800 to 1810 (Cal BP 150 to 140) Cal AD 1920 to Post 1950 (Cal BP 30 to Post 0)



Database used

INTCAL13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

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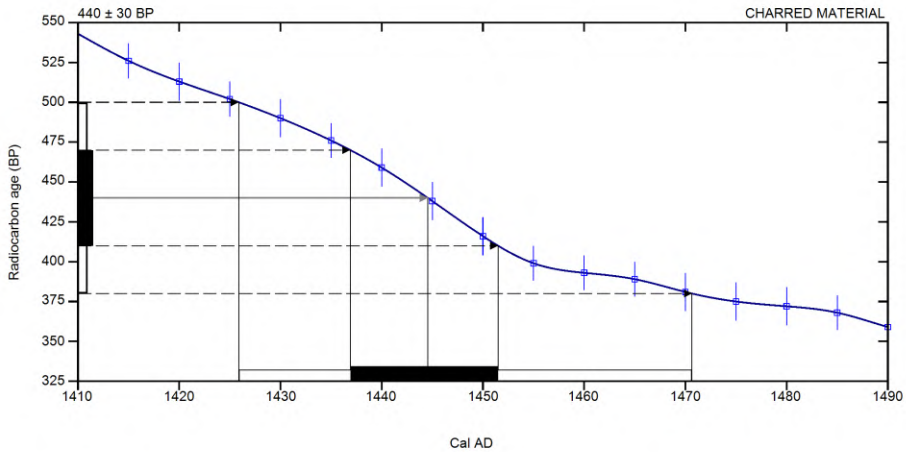
Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • Email: beta@radiocarbon.com

CALIBRATION OF RADIOCARBON AGE TO CALENDAR YEARS

(Variables: C13/C12 = -26.1 o/oo : lab. mult = 1)

Laboratory number	**Beta-453636 : 2369 TR12FE1**
Conventional radiocarbon age	**440 ± 30 BP**
Calibrated Result (95% Probability)	**Cal AD 1425 to 1470 (Cal BP 525 to 480)**
Intercept of radiocarbon age with calibration curve	Cal AD 1445 (Cal BP 505)
Calibrated Result (68% Probability)	Cal AD 1435 to 1450 (Cal BP 515 to 500)



Database used

INTCAL13

References

Mathematics used for calibration scenario

A Simplified Approach to Calibrating C14 Dates, Talma, A. S., Vogel, J. C., 1993, Radiocarbon 35(2):317-322

References to INTCAL13 database

Reimer PJ et al. IntCal13 and Marine13 radiocarbon age calibration curves 0–50,000 years cal BP. Radiocarbon 55(4):1869–1887., 2013.

Beta Analytic Radiocarbon Dating Laboratory

4985 S.W. 74th Court, Miami, Florida 33155 • Tel: (305)667-5167 • Fax: (305)663-0964 • Email: beta@radiocarbon.com