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HONOLULU, HAWAII 96813-5097

IN REPLY REFER TO:
HWY-L 2.7106

December 27, 2021

VIA the Office of Environmental Quality Control (Office of Planning and Sustainable Development) on-line Submittal Form. https://planning.hawaii.gov/erp/submittal-form/

TO: MARY ALICE EVANS
DIRECTOR ENVIRONMENTAL REVIEW PROGRAM
OFFICE OF PLANNING AND SUSTAINABLE DEVELOPMENT
DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT AND TOURISM

FROM: JADE T. BUTAY
DIRECTOR OF TRANSPORTATION

SUBJECT: DRAFT ENVIRONMENTAL ASSESSMENT AND ANTICIPATED FINDING OF NO SIGNIFICANT IMPACT FOR KAMEHAMEHA HIGHWAY AT KAAAWA EROSION MITIGATION, KAAAWA, OAHU, HAWAII

With this letter, the State of Hawaii Department of Transportation (HDOT) transmits the Draft Environmental Assessment and Anticipated Finding of No Significant Impact for the proposed Kamehameha Highway at Kaaawa Erosion Mitigation on the island of Oahu for publication in the next available edition of the Environmental Notice. All required information associated with this request for publication is being furnished using the Office of Environmental Quality Control's online submittal form.

Should you have any questions, please contact Ms. Jiangli Guo, HDOT Project Engineer, Materials Testing and Research Branch, Highways Division at (808) 832-3405 extension 118 or by email at jiangli.guo@hawaii.gov and reference letter number HWY-L 2.7106.

Enclosure

From: webmaster@hawaii.gov
To: DBEDT OPSD Environmental Review Program
Subject: New online submission for The Environmental Notice
Date: Tuesday, December 28, 2021 12:00:39 PM

Action Name

Kamehameha Highway at Kaaawa Erosion Mitigation

Type of Document/Determination

Draft environmental assessment and anticipated finding of no significant impact (DEA-AFNSI)

HRS §343-5(a) Trigger(s)

- (1) Propose the use of state or county lands or the use of state or county funds
- (2) Propose any use within any land classified as a conservation district
- (3) Propose any use within a shoreline area

Judicial district

Koʻolauloa, Oʻahu

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

(1) 5-1-002:025

Action type

Agency

Other required permits and approvals

Department of the Army (NWP 3-Maintenance), Conservation District Use Permit

Proposing/determining agency

Hawaii Department of Transportation

Agency contact name

Jiangli Guo

Agency contact email (for info about the action)

jiangli.guo@hawaii.gov

Email address or URL for receiving comments

ssullivan@seaengineering.com

Agency contact phone

(808) 832-3405

Agency address

2530 Likelike Highway
Honolulu, HI 96819
United States
Map It

Was this submittal prepared by a consultant?

Yes

Consultant

Sea Engineering, Inc.

Consultant contact name

Scott Sullivan

Consultant contact email

ssullivan@seaengineering.com

Consultant contact phone

(808) 460-3437

Consultant address

41-305 Kalanianaole Highway
Waimanalo, HI 96795
United States
Map It

Action summary

The project site is an approximately 450-foot length of roadside shoreline along Hawaii State Route 83 (HI-83), known as Kamehameha Highway. Kamehameha Highway is the only highway serving windward Oahu coastal communities, and is the primary access for police, fire, and emergency medical services. The project site is located on the makai side of the highway, in the community of Kaaawa, and is located directly seaward of Kaaawa Elementary School. A 400-foot-long section of Kamehameha Highway has become undermined due to shoreline erosion. The undermining has destabilized the highway shoulder, and if it continues may result in damage to the highway itself. The proposed action is to construct an engineered sloping rock riprap revetment to mitigate the erosion threat to the highway. The revetment crest will be +8 feet, and the structure will be approximately 25 feet wide and approximately 450 feet long.

Reasons supporting determination

See DEA Section 5.

Attached documents (signed agency letter & EA/EIS)

- Draft-EA-Kamehameha-Hwy-at-Kaaawa-Erosion-Mitigation-12-2021.pdf
- HWY-L-2.7106-Kamehameha-Hwy_Kaaawa-DEA-part-1-signed.pdf

Authorized individual

Scott P. Sullivan

Authorization

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

KAMEHAMEHA HIGHWAY AT KAAAWA EROSION MITIGATION

DRAFT ENVIRONMENTAL ASSESSMENT

KAAAWA, OAHU, HAWAII

Proposing and Approving Agency:
State of Hawaii, Department of Transportation

December 2021

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Project Information Summary

This Environmental Assessment (EA) has been prepared in accordance with the requirements of Chapter 343, Hawaii Revised Statutes (HRS), and Title 11, Chapter 200.1, Hawaii Administrative Rules (HAR), Department of Health, which set for the requirements for the preparation of environmental assessments.

Type of Document:	Environmental Assessment (EA)
Project Name:	Kamehameha Highway at Kaaawa Erosion Mitigation
Proposing and Approving Agency:	Hawaii Department of Transportation 2530 Likelike Highway Honolulu, HI 96819 Contact: Jiangli Guo (808) 832-3405 jiangli.guo@hawaii.gov
Consultant:	Sea Engineering, Inc. 41-350 Kalanianaole Highway Waimanalo, Hawaii 97795 Contact: Scott Sullivan (808) 460-3437 ssullivan@seaengineering.com
EA Triggers:	Use of State lands, Use of State funds, Use of land in the conservation district, Use within a shoreline area
Project Location:	Kaaawa, Oahu, Hawaii
Tax Map Key (TMK):	(1) 5-1-002:025
Project Area:	Approximately 450 linear feet of shoreline, 12,600 SF footprint
State Land Use District:	Urban and Conservation (Resource Subzone)
County Zoning:	P-1
Flood Zone:	VE

Proposed Action:	A 400-foot -long section of Kamehameha Highway passing through Kaaawa in the vicinity of the elementary school has become undermined due to chronic and episodic coastal erosion. The undermining extends up to 10 feet under the shoulder of the road, extending as far inshore as the makai travel way stripe. This section of road is in danger of failure and collapse. Kamehameha Highway is the only roadway providing access to windward communities from the south, and if this section of road fails, transportation services, emergency services, and commuter lines will be significantly impaired. The Hawaii Department of Transportation proposes to construct a rock riprap revetment to mitigate the shoreline erosion and protect the highway.
Required Permits And Approvals:	HEPA Environmental Assessment and FONSI Department of the Army Permit (Nationwide 3-Maintenance) State Conservation District Use Permit
Anticipated Determination:	Finding of No Significant Impact (FONSI)
Estimated Cost:	$2,000,000
Time Frame:	Construction will begin when the necessary permits and approvals are obtained and a construction contract is awarded, currently estimated for Fall 2022. The on-site construction period is estimated to be 120 days.
Unresolved Issues:	Permit requirements

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

APPENDICES

CONTENT CHECKLIST

The Draft EA, at a minimum, shall contain the following information as required by Hawaii Administrative Rules (HAR) Chapter 11-200.1-18.

HAR Section	Requirement	DEA Chapters/Sections
(d) (1)	Identification of the applicant	Project Summary
(d) (2)	Identification of the approving agency	Project Summary
(d) (3)	List of required permits and approvals	Project Summary / Section 1.7
(d) (3)	Approvals which necessitate environmental review	Section 1.7
(d) (4)	dentification of agency/community consultation	Section 6.1
(d) (5)	General description of the action's characteristics	Chapter 2
(d) (6)	Description of the affected environment	Chapter 3 / Appendix A
(d) (7)	Description of impacts and alternatives considered	Section 1.6 / Chapter 3
(d) (8)	Proposed mitigation measures	Appendix B
(d) (9)	Approving agency anticipated determination	Chapter 5
(d) (10)	Written comments and responses	To be determined

1. INTRODUCTION

The community of Kaaawa is located on a narrow strip of coastal plain between the steep Koolau mountains and the Pacific Ocean, on Oahu's northeast windward coastline. The approximately 1.9-mile-long intermittent sandy shoreline lies between Ka Oio Point to the south and Swanzy Beach Park to the north.

The project coastline is characterized by a wide and shallow fringing limestone reef flat stretching 1,000 to 3,000 feet offshore. The fringing reef is divided with deep channels and depressions at numerous locations with abundant sand patches. The fringing reef's shallow reef crest and reef flat protect the shoreline from direct wave action in many locations. During typical conditions, wave breaking over the shallow depths of the reef significantly reduces wave energy reaching the shoreline compared to the deep-water environment. Some energy does still reach the shore, particularly at higher water levels or periods of elevated surf. Nearshore currents are relatively persistent in Kaaawa, even during seemingly quiescent periods, but their intensity increases from low to high with increased wave heights.

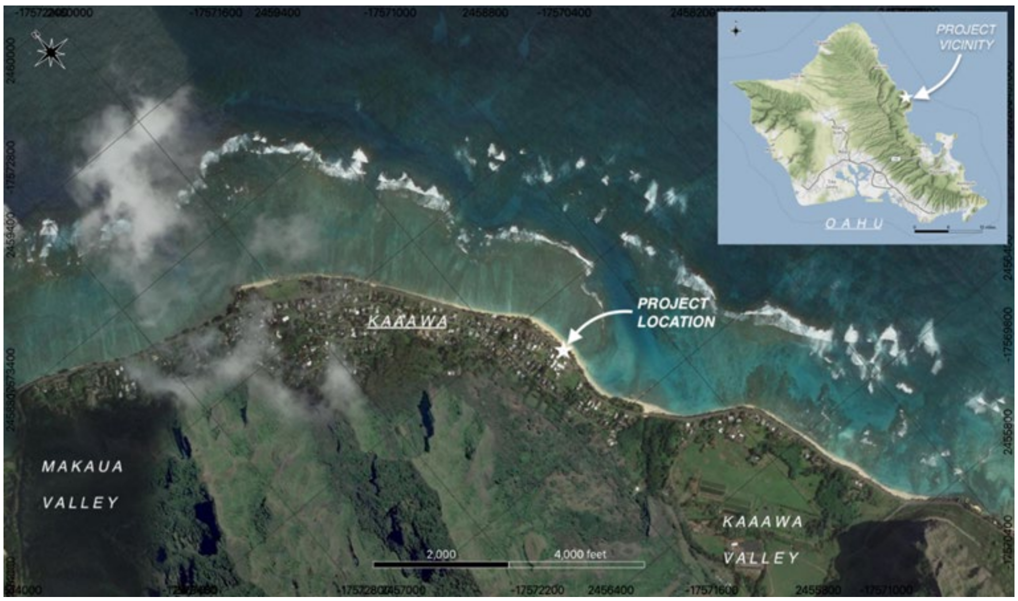
The Kaaawa shoreline is shaped by its distinct geography and its interaction over the millennia with the prevailing trade wind-generated waves. These waves experience significant refraction and diffraction past the deeper outer reefs and again over the shallower fringing reefs, resulting in a very complex nearshore wave pattern. The Kaaawa Valley Stream, along with other smaller perennial streams, bisect the local shoreline in multiple places. The Kaaawa Stream, in particular, creates a large cobblestone alluvial apron at the shoreline, which functions much like a breakwater in stabilizing and accreting significant beach width at this location.

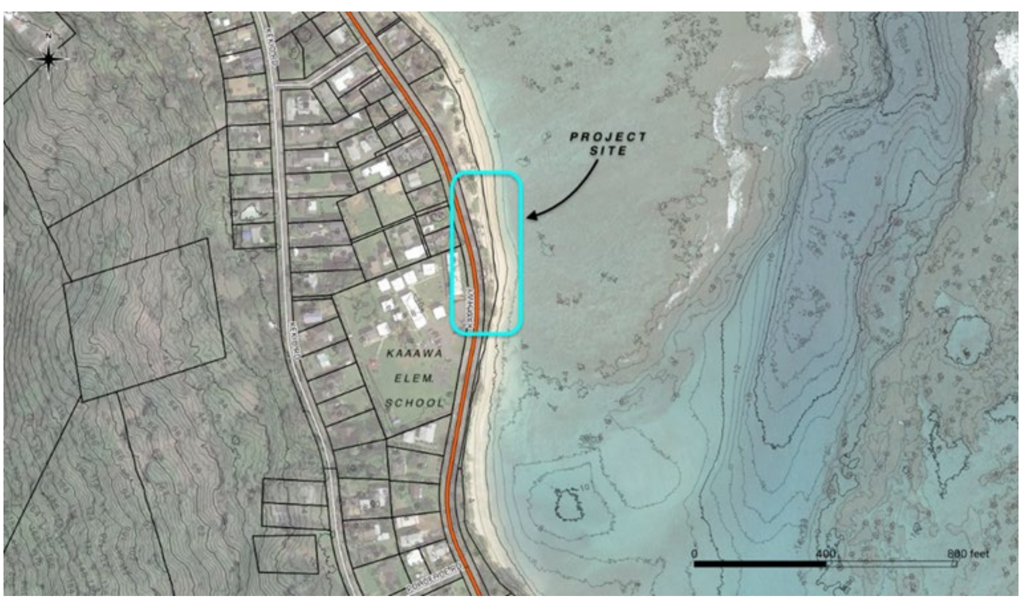
Oahu "Shoreline Study Erosion Maps" developed by the University of Hawaii's Coastal Geology Group indicate the shoreline in the project vicinity to be persistently and chronically eroding with an estimated long-term shoreline recession rate of 0.5 – 1 foot per year. Nearly 50 years ago, in 1975, a joint Army Corps of Engineers and City and County beach nourishment project placed 9,300 cubic yards of sand along this shoreline. However, no follow-on replenishment has been accomplished since that time. Following the recent renovation of the nearby Kaaawa Beach Park comfort station, erosion threatened the refurbished structure, and it was then protected by a grouted rock revetment.

1.1 Project Location and General Description

The project site is an approximately 450-foot length of roadside shoreline along Hawaii State Route 83 (HI-83), known as Kamehameha Highway. Kamehameha Highway extends from Kaneohe, near the east end of the island, and runs along the northeast (windward) coast up to and around Kahuku Point in the north. It then turns back west to the town of Haleiwa. It is the only highway connecting the coastal communities of Kaneohe, Kahaluu, Kaaawa, Punaluu, Hauula, and Laie, and is the primary access for police, fire, and emergency medical services. The Hawaii Department of Transportation-Highways Division (HDOT-H) records the Annual Average Daily Traffic count as 13,000 vehicles per day. Many portions of the highway directly follow the coastline and are within feet of the water line in places and only a few feet above it in other places. Coastal erosion and shoreline recession are an increasing threat to the highway. The project site is located on the makai side of the highway, in the community of Kaaawa, and is located directly seaward of Kaaawa Elementary School.

The specific area of interest is located between Kaaawa Beach Park to the north and a concrete seawall made from horizontal square piles fronting Kaaawa Elementary School to the south. The project site's shoreline is a narrow strand of sandy beach, with the mean higher high water (MHHW) waterline located between 25 to 70 feet seaward from the edge of the roadway. To the north of the site, at Kaaawa Beach Park, the highway is increasingly further from the shoreline, while to the south of the site, the shoreline is partially protected by the seawall. The project's location and vicinity are shown on Figure 1-1 and Figure 1-2.

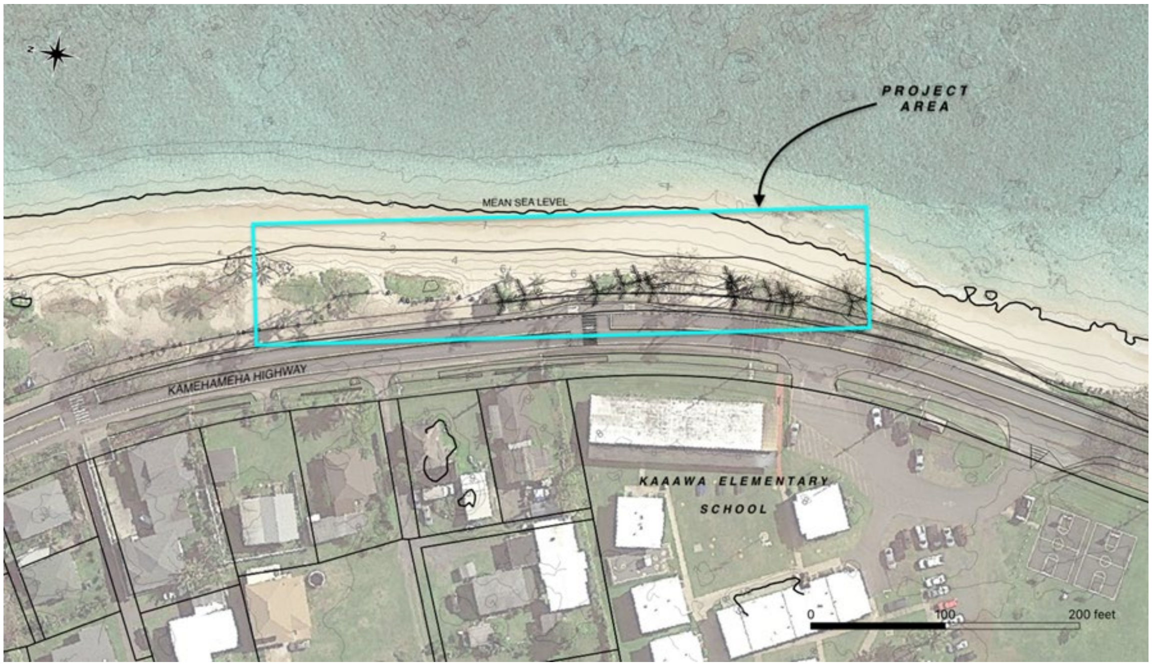




1.2 Site Condition

A project site investigation, which included a detailed inspection of the shoreline's existing condition was completed at the start of the project design effort in February 2021. A project site map is presented in Figure 1-3, and the existing shoreline condition is illustrated in Figure 1-4. A general summary of the existing conditions, as observed in early January 2021, is provided below.

- The shoulder and road deck elevation varies between +7 and +8 feet above mean sea level (MSL). The elevation of the nearshore fringing reef flat, where the end of the sandy beach slope intersects the underlying flat hard bottom, is approximately -3 feet MSL. The maximum vertical relief of the project site is approximately 10 ft.
- A series of large stones have been placed in discrete areas along the shoreline, as temporary measures to mitigate advancing erosion and protect the highway. Separate areas of low-strength concrete surfacing were also constructed between the highway's asphaltic pavement and the boulders to tie-in and stabilize the road shoulder. The sand, earth, and gravel materials forming the embankment are being eroded away, and the stone slope has settled significantly with many units displaced seaward. The existing stones are no longer effective at providing erosion protection.
- The roadside embankment and road shoulder are severely undermined, with void spaces extending up to approximately 10 feet under the concrete shoulder slab. The result has been destabilized concrete slabs on the road shoulder, which have cracked, tilted, separated, and displaced seaward. These failed concrete slabs are in the process of sliding onto the beach or into the water itself. If or when this occurs, it would reveal a vertical earthen embankment or scarp immediately seaward of the road. It is expected that rapid undermining of the highway's paved lanes of travel would then begin.
- There is a narrow low-lying strand of sandy beach along most of the shore at this location, which is often submerged at high tide. Due to the limited beach area fronting the project site, there is minimal natural protection against wave action on the shore, increasing the potential for further erosion.
- There are a number of severely undermined mature coconut trees and three *milo* trees growing along the shoreline, which will likely need removal prior to construction of any erosion control measure.


PROJECT AREA
MEAN SEA LEVEL
KAMEHAMEHA HIGHWAY
KAAAWA ELEMENTARY SCHOOL
0
100
200 feet

1.3 Previous Shore Protection Measures

The shoreline in the project vicinity has been armored previously both north and south of the project site, and this armoring has typically been to protect the highway in response to an emergency situation. The existing shore protection measures at the project site are temporary in nature, and not engineered with respect to the required ocean engineering design conditions.

1.4 Purpose and Need

The intent of this project is to provide much needed erosion mitigation along the shoreline for a limited stretch of Kamehameha Highway. Kamehameha Highway extends from Kaneohe near the east end of the island along the northeast (Windward) coast to the North Shore town of Haleiwa. It is the only highway connecting the coastal communities of Kaneohe, Kahaluu, Kaaawa, Punaluu, Hauula, Laie, and Kahuku. The HDOT records the Annual Average Daily Vehicle Traffic count as 13,000 vehicles. It is the primary access for police, fire, and emergency medical vehicles. If the ongoing erosion forces closure of the highway at the project site all vehicles would have to detour through narrow backshore residential streets to bypass the closure, including trucks, busses, emergency vehicles, and commuters going to work. The proposed project would eliminate this possible significant impact on transportation in Kaaawa.

The project purpose is limited and focused on providing near to mid-term protection for a limited section of highway in the most effective and efficient manner possible. It is not, for instance, a response to possible future sea level rise.

The project's approximate design life is 25 years, which is considered to be a short-term to a medium-term solution with respect to typical infrastructure lifespans. Global climate change and sea level rise are affecting Hawaii's coastlines—from now into the future—and will necessitate long-term planning for the future, which may entail significant changes from current coastal land use and activities.

1.5 Summary Description of the Proposed Action

The proposed action is to construct an engineered rock riprap revetment along the 450-foot length of the threatened project shoreline. The most common method of construction is to place layered riprap, sized according to the design wave height and other oceanographic design criteria, on top of a scour-reducing geotextile filter fabric. The goal of this design is to prevent progressive erosion and scour from undermining and destabilizing the northbound lane of Kamehameha Hwy. Porous rock revetments absorb a significant fraction of incoming wave energy and would prevent the downward motion of reflected wave energy from the currently vertical erosion scarp. This downward motion of reflected wave energy results in scour of the natural sediment at the base of the scarp.

The proposed revetment section is shown in Figure 1-5. The stone riprap units would be basalt rock, with a median armor stone weight of 1,064 lbs. and rock gradation ranging from 100 lbs. to 5,320 lbs., placed over underlayer stone and geotextile filter fabric. The design crest elevation is +8 ft MSL, equivalent to the highway elevation, with a width of 10 ft, and a front slope of 1:1.5 (vertical-to-horizontal). A rock toe scour apron extends another 4 ft seaward. The horizontal footprint and general layout of the proposed revetment are illustrated in the plan view presented in Figure 1-6. In its completed form, the new revetment will be approximately 25 feet wide as measured from the landward edge of the crest across to the seaward edge of the toe, and with a length of approximately 450 feet measured end to end.

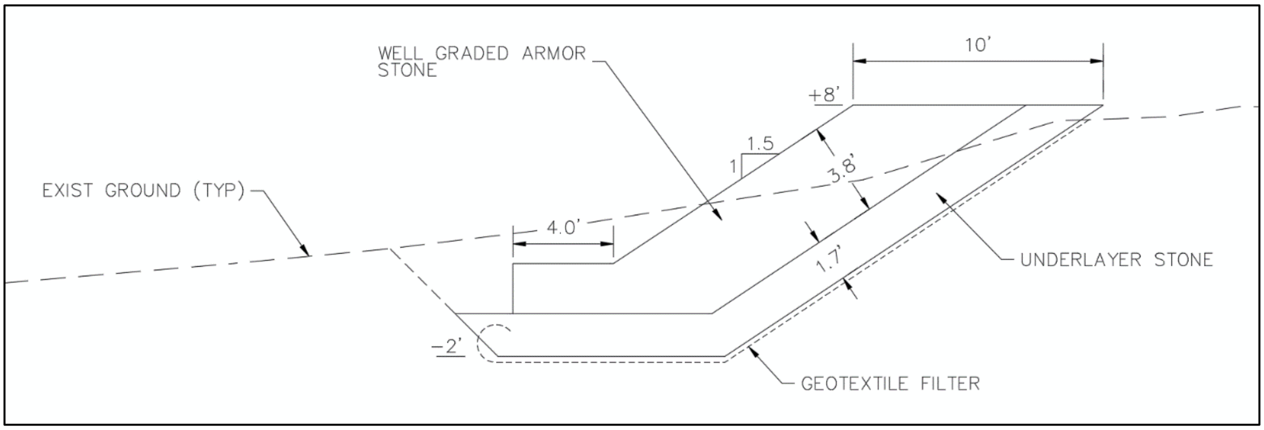


Figure 1-5. Riprap rock revetment, typical section

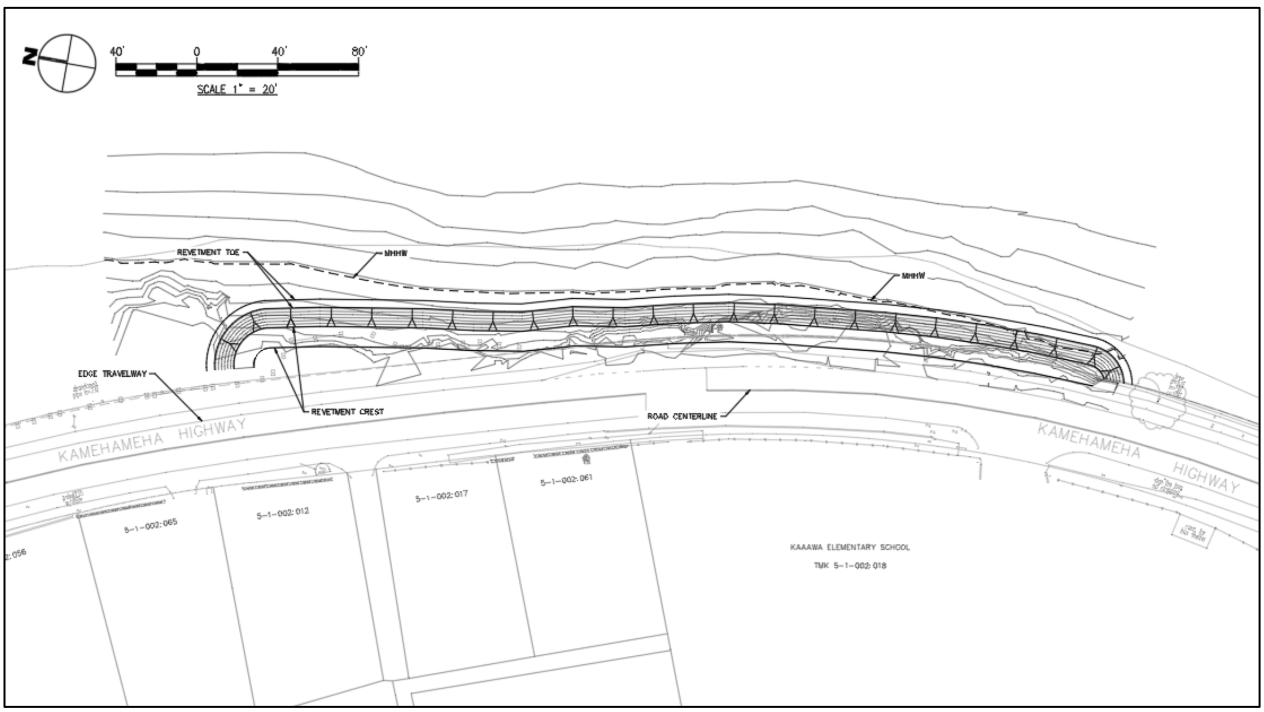


Figure 1-6. Riprap rock revetment, plan view

Kamehameha Highway's paved shoulder is narrow at this location, and construction access is relatively limited. For this reason, closure of the northbound lane (makai side) will be required during active construction activities. There is a small open area at the south end of Kaaawa Beach Park, which would be the primary staging area. Revetment construction will be initiated from this area and proceed to the south. Construction will proceed incrementally in approximately 25-foot units with clearing, excavating, filling, grading, stockpiling of salvaged material (existing stone for use as riprap), slope preparation, geotextile filter fabric installation, underlayer stone placement, and finally armor layer stone placement. Underlayer stone placement will not advance more than 25 feet ahead of armor stone placement in case of an unforeseen increase in potentially damaging wave action. Excavated beach sand will be cast to the side on the beach above the MHHW water line (+1.1 ft MSL) to the north (updrift) side of the advancing revetment construction.

1.6 Alternatives Considered

1.6.1 No-Action

The no-action alternative comprises leaving the cracked and displaced concrete shoulder slabs, along with the slumped and scattered riprap, in place and as is, with no additional construction elements or actions. This condition is expected to result in continued erosion of the underlying and now exposed earthen embankment, the progressive undermining of the road shoulder, and the development and expansion of new void spaces beneath the pavement of the northbound lane of travel. Without appropriate erosion mitigation, Kamehameha Highway will likely become fully undermined, rendering it unusable until repair can be accomplished. This would result in significant disruption of a major transportation corridor, leaving residents and visitors without the primary access for critical services.

1.6.2 Highway Relocation

At the project site, Kamehameha Highway is immediately adjacent to Kaaawa Elementary School and a densely developed private residential property neighborhood. Residential streets which parallel the highway are very narrow and not designed for heavy vehicles such as trucks and busses that regularly transit the highway. Landward of the narrow strip of residential areas, the ground rises steeply into a conservation district with dense rainforest growth on the rugged coastal Koolau mountains. Highway relocation would require extensive alteration and grading, requiring a large amount of private land acquisition in order for highway bypass construction to proceed. Highway relocation is not considered practical or even feasible as an alternative for the 400-foot-long shoreline problem area.

1.6.3 Protective Beach

Constructing or nourishing a protective beach by placing suitable sand in an appropriately designed manner along a shoreline can be an effective and attractive means of mitigating beach loss, protecting against shoreline recession, protecting the backshore area, and providing for recreational and aesthetic enjoyment. Beach nourishment, however, requires a source of suitable beach quality sand and sufficient quantity to meet the needs of the project. Chronically eroding shorelines would require extensive regular nourishment in order to maintain the effectiveness of the beach for shore protection. The project site is a chronically eroding shoreline, and a previous attempt to simply place sand along the shore was not successful. The project shoreline is exposed to significant wave energy and wave driven longshore currents flowing north to south, which would quickly remove additional sand placed at the project site. Thus structures, such as groins, would be necessary to stabilize the beach fill. A groin is a shore perpendicular structure designed to prevent longshore transport of sand and slow sand movement and erosion of a beach. Groins can be used to trap sand and build a protective beach where there is significant longshore sand volume available and effects on the downdrift shoreline are not considered to be a concern. A series of groins is typically utilized when the shoreline reach is long. The sand resource in the project vicinity is very limited, and outside sources of suitable beach sand are also very limited, which greatly constrains the implementation of a protective beach. Given the limited project purpose - to protect the highway in the most effective, efficient, and least impactful manner - and the short 400-foot-long project reach, construction of a large-scale stable protective beach is considered beyond the project scope.

1.6.4 Alternative Revetment Material

ElcoRock sand-filled geotextile containers were considered as an alternative means of revetment construction (refer to https://www.geofabrics.co/products/elcorock). ElcoRock is a proprietary coastal construction system utilizing robust geotextile containers designed to be filled on site with sand and then placed to form a stable and durable structure. Large 2.5m³ containers would be proposed for use, each weighing approximately 10,000 pounds, which will provide a very stable structure for the project site wave conditions. The large textile containers are also efficient to install and remove. The non-woven geotextile fabric is promoted as UV and vandal resistant, has excellent abrasion resistance, and its soft finish is attractive and non-abrasive. The ElcoRock filled dimensions are approximately 6ft by 8ft by 2ft high. However, ElcoRock nominal life span is about 10 years in the tropical sun and seawater environment and thus may not provide erosion protection for the 25-year design life project objective.

1.7 Required Federal and State Approvals, and Applicable Regulatory Requirements

1.7.1 Required Federal Approvals

Department of the Army (DA) permits are issued by the U.S. Army Corps of Engineers (COE) pursuant to Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) and Section 404 of the Clean Water Act (33 USC 1344). All work or structures in or affecting the course, condition, location, or capacity of navigable waters, including tidal wetlands, require DA authorization pursuant to Section 10. In addition, activities involving the discharge of dredged or fill material into waters of the United States requires a DA permit pursuant to Section 404. As the proposed project will be partially constructed in navigable waters of the U.S., it is expected to require a DA permit issued pursuant to Section 10 and Section 404. A DA Nationwide Permit #3 (Maintenance) for the project was issued on November 23, 2021.

1.7.2 Required State of Hawaii Approvals

The proposed project will require preparation of a Draft Environmental Assessment (DEA) and Final Environmental Assessment (FEA) pursuant to the State of Hawaii's environmental impact assessment process, Chapter 343, Hawaii Revised Statutes, and its implementing regulations. Hawaii Administrative Rules (HAR) Title 11, Chapter 200.1, addresses the determination of significance and contents of an environmental assessment. If the FEA and Finding of No Significant Impact (FONSI) are approved by the Department of Transportation, the project is then allowed to proceed to implementation once all other required permits and approvals are obtained.

The project will require a Conservation District Use Permit (CDUP) pursuant to Title 13 Chapter 5, Hawaii Administrative Rules (HAR).

1.7.3 Applicable Federal Laws, Regulations and Executive Orders

The approvals and consultations that will be needed from Federal agencies other than the Corps of Engineers include:

Archaeological and Historic Preservation act (16 U.S.C. § 469a-1);

National Historic Preservation Act (NHPA) of 1966 (16 U.S.C.) § 470(f);

Clean Air Act (42 U.S.C. § 7506(C);

Coastal Zone Management Act (16 U.S.C. § 1456(C) (1);

Endangered Species Act (16 U.S.C. 1536(A) (2) and (4));

Fish and Wildlife Coordination Act (FWCA) of 1934, as amended (16 USC §§ 661-666[C] et seq.);

Magnuson-Stevens Fishery Conservation and Management Act (16 USC § 1801 et seq.);

Marine Mammal Protection Act (MMPA) of 1972, as amended (16 USC §§ 1361-1421(H) et seq.);

Executive Order (EO) 13089, Cotal Reef Protection (63 FR 32701)

1.7.4 Property Information

The proposed revetment structure is planned for construction on a section of property listed by the City & County of Honolulu's (C&C) Department of Planning & Permitting (DPP) as 51-329 Kamehameha Highway, or otherwise known as Kaaawa Beach Park. The parcel's current tax map key (TMK) is 5-1-02:25, and is listed as having a building value of $32,300 and a land value of $45,000 for the 2-acre beachfront lot, owned by the C&C. The parcel is zoned as P-1, which is a restricted preservation zone, and lies in Federal Emergency Management Agency (FEMA) flood designation zones AE/VE, subject to the 100-year coastal flood condition and velocity hazard.

1.8 Decision to be Made

The U.S. Army Corps of Engineers, Honolulu District, and the State of Hawaii Department of Land and Natural Resources, will review the analyses and conclusions drawn in this EA and decide whether to issue the necessary permits and approvals that the applicant has requested, to issue the permits and approvals with special conditions, or to deny the permits and approvals. A Department of the Army Nationwide Permit #3 (Maintenance) was issued by the USACE Honolulu District on November 23, 2021.

2. DETAILED DESCRIPTION OF THE PROPOSED ACTION

The proposed action entails the construction of a permeable rock riprap revetment constructed along a stretch of the highly eroded shoreline road shoulder. The erosion mitigation structure would extend for a length of approximately 450 ft, adjacent to the south end of Kaaawa Beach Park along the ocean (makai) side of Kamehameha Highway.

2.1 General Description of Riprap Revetment

A revetment is a sloping uncemented structure built of wave-resistant material. The most common method of revetment construction is to place an armor layer of stone, sized according to the design wave height, over an under-layer and filter designed to distribute the weight of the armor layer and to prevent loss of fine material through voids between stones. An important aspect of revetment design (or any type of structure) on a sandy shoreline is to prevent scour around the toe which could result in collapse and failure of the structure. Toe scour protection can be provided by excavating to place the toe on a solid substrate where possible, constructing the foundation below the maximum depth of anticipated scour, or extending the toe to provide a scour apron of excess stone. Properly designed and constructed rock revetments are durable, flexible, and highly resistant to wave damage. Damage from large waves is typically not catastrophic, and the revetment can still function effectively even if damage occurs. The rough and porous surface and flatter slope absorbs and dissipates wave energy, thus reducing wave reflection, run-up, and overtopping. For smaller design wave heights, less than 5 feet, a graded rock riprap is appropriate and can be more cost-effective than a uniform armor stone layer because it uses a wider range of stone.

2.2 Riprap Revetment Design

The revetment design follows the guidelines provided by the US Army Corps of Engineers (USACE) *Coastal Engineering Manual* (2006) and *EM* 1110-2-1614, *Design of Coastal Revetments, Seawalls, and Bulkheads*.

A site-specific wave modeling analysis has shown a near-structure wave height of 4.2 feet at the shoreline resulting from a 25-year return period deepwater wave offshore and a 5-foot water level rise (MHHW tide, +1.7’ nearshore wave setup, +0.5’ sea level anomaly, +1.7’ future sea level rise).

The design wave height of 4.2 feet is within the standard guidelines (< 5 feet) for use of either a riprap (wide range of well graded stone) or uniform (one or two layers of uniform stone size) armor stone. Given the significant volume of stones already on site, the riprap armor design is selected in order to better utilize the available stone.

Armor Layer - The required revetment armor stone weight for stability under the design wave height is given by the Hudson Formula (Coastal Engineering Manual, 2006):

$$W = \frac{w_r H^3}{K_{rr}(S_r - 1)^3 \cot\theta}$$

where,

W_{50} = median weight in pounds of an individual armor stone
w_r = unit weight of the stone (160 lb/ft^3)
H = wave height (4.2 ft)
K_{rr} = riprap stability coefficient (2.2)
S_r = specific gravity of the stone relative to seawater (2.5)
cot θ = cotangent of the revetment face slope (1.5)

The resultant median armor stone weight is 1,064 lbs. The riprap revetment shall consist of a gradation of stone sizes based on the 15th, 50th, and 100th percentile sizes, and a distribution within percentile sizes of +/- 25%, as follows:

W_{15} = 0.125 x W_{50} = 133 lbs, use 100 to 170 lbs
W_{50} = 1,064 lbs, use 800 to 1,300 lbs
W_{100} = 4 x W_{50} = 4,256 lbs, use 3,200 to 5,320 lbs

In summary, the riprap gradation shall be as follows:

Percentile	**Minimum Weight**	**Maximum Weight**
15	100 lbs	170 lbs
50	800 lbs	1,300 lbs
100	3,200 lbs	5,320 lbs

The armor layer thickness, T = 3.8 feet, is determined from:

$$T = (W_{50} / w_r)^{1/3} \times 2$$

<u>Underlayer</u> - Underlayer stone size will be one-tenth of the armor stone weight, as follows:

Percentile	**Weight**
15	15 lbs
50	100 lbs
100	400 lbs

The underlayer thickness, T, = $(W_{50} / w_r)^{1/3}$ x 2 = 1.7 feet.

The underlayer shall be placed over geotextile filter fabric.

<u>Crest and Toe</u> - The design revetment crest elevation is +8 feet which is the same elevation as the roadway and shoulder. The estimated runup elevation based on the XBeach-NH results and

EurOtop empirical formula is +13.4 feet during the design water level and wave conditions. Thus, the revetment can be expected to significantly overtop, and, given the slightly lower ground elevation landward of the roadway, water would flow inland toward the school. A revetment crest width of 10 feet will help dissipate the overtopping water to a certain degree. However, given the significant wave overtopping during design, and even high prevailing, wave conditions, a scour resistant surface for the highway shoulder and drainage should be considered.

The sand beach at the revetment location will be excavated to place the toe at the -2-foot elevation, the approximate elevation of the reef flat at the shoreline. A stone toe scour apron overlying geotextile filter fabric will be used to provide for toe stability should scour result in some settling of the toe stone. The toe apron can articulate downward as scour occurs.

The north end of the revetment will be terminated by wrapping the end around to tie it into existing ground where the highway is further inland. The south end will tie-back into the existing concrete block seawall.

The revetment plan layout and typical section are shown on Figure 2-1 and Figure 2-2. The plan layout generally follows the existing bank to minimize excavation and loss of shoulder area and maintains a minimum 10-foot-wide road shoulder.

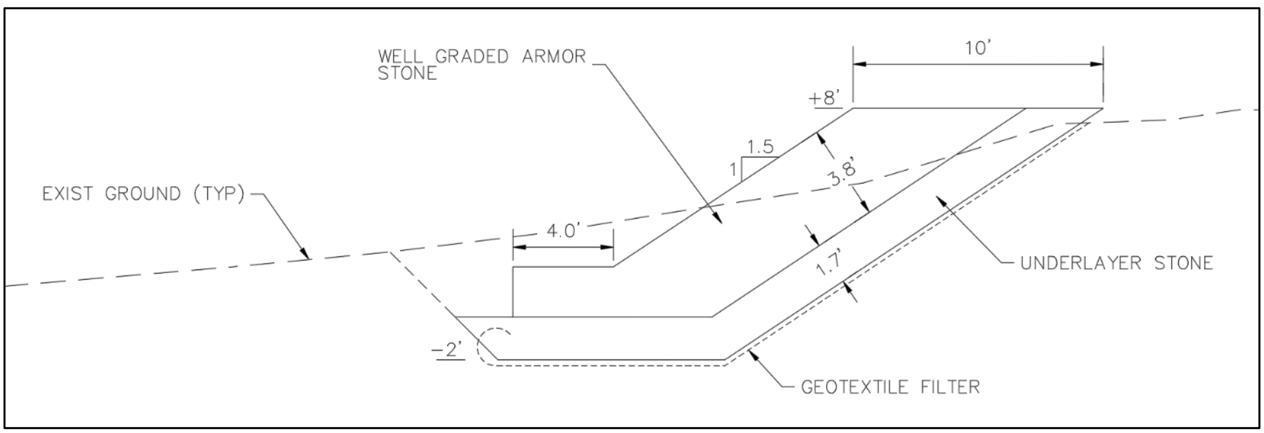


Figure 2-1. Riprap rock revetment typical section

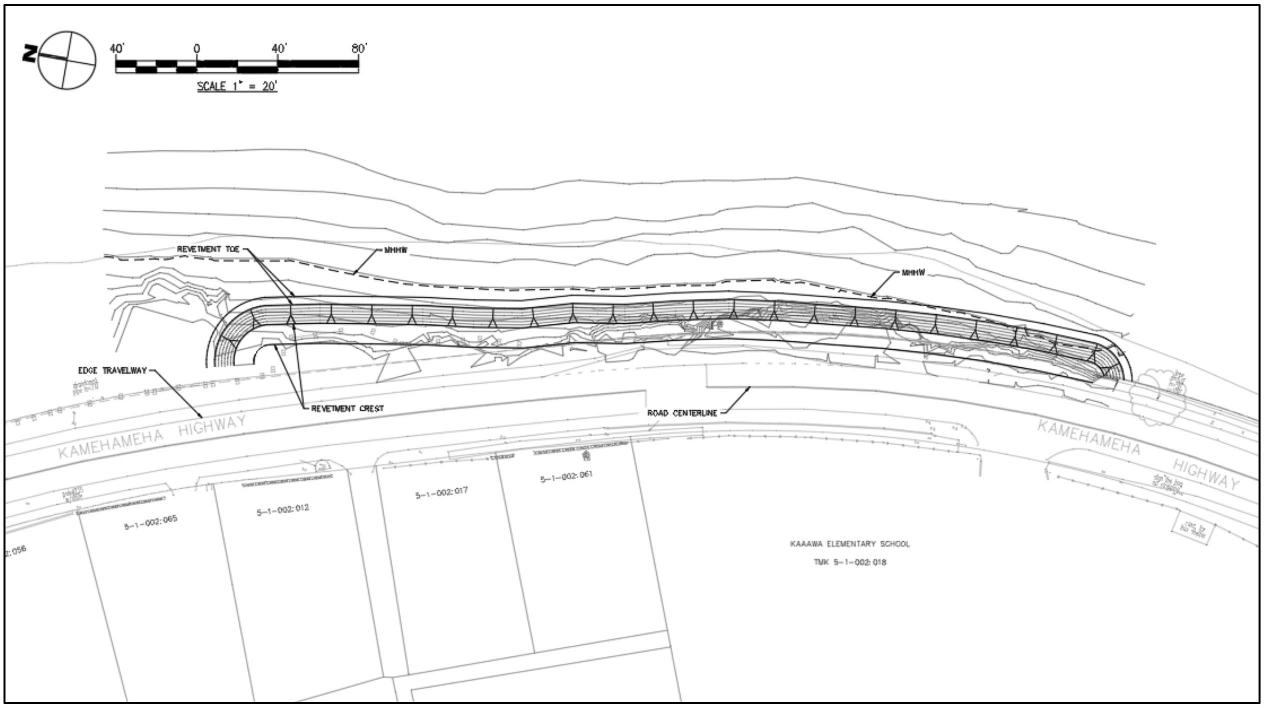


Figure 2-2. Riprap rock revetment plan view

2.3 Construction Methodology

The road shoulder is narrow at the project site, and construction access is anticipated to be limited. Closure of the northbound (makai) lane will likely be required during active construction. There is a small area at the north end of the site adjacent to Kaaawa Beach Park, which could serve as the primary staging area, and this is where construction would be initiated. Revetment construction will start at Station 0+00 and work toward Station 4+00 (Figure 2-2). Work will proceed in approximately 25 ft increments, with clearing, excavating, filling, grading, stockpiling of salvaged material, slope preparation, geotextile filter fabric placement, underlayer stone placement, and finally cover stone placement. Underlayer or core stone placement shall not advance more than 25 feet ahead of cover stone installation in order to mitigate unforeseen environmental situations like sudden increases in nearshore wave heights or heavy rains. Excavated beach sand from the foundation and toe trench shall be stockpiled on the beach above the mean higher high-water line (+1.1 feet) to the north (updrift) side of the advancing revetment construction.

2.4 Summary of Project Costs

The estimated construction cost for the revetment is $2,000,000.

3. ENVIRONMENTAL SETTING, POTENTIAL IMPACTS, AND MITIGATION MEASURES

3.1 Physical Setting

3.1.1 Existing Conditions

Kaaawa is situated on an approximately 500- to 1000-foot-wide coastal plain that lies between the steep windswept cliffs of the Koolau Mountains and the rough waters of the Pacific Ocean on Oahu's northeast windward coastline. The nearly two-mile-long intermittently sandy shoreline runs from Ka Oio Point to the south (back gate of Kualoa Ranch) and Swanzy Beach Park to the north just before Kahana Bay.

The project coastline is characterized by a wide and shallow fringing limestone reef flat stretching 1,000 to 3,000 feet offshore. The fringing reef is divided with deep channels and depressions at numerous locations with abundant sand patches. The fringing reef's shallow crest and broad profile typically provide significant protection to the shoreline from direct wave action.

The windward coastline of northeast Oahu (Koolauloa) is generally oriented along an axis that runs from southeast to northwest. However, at the project vicinity in Kaaawa, the shoreline veers more to a north-south orientation. The roughly 600-ft wide coastal plain at the project site is populated with a medium-density rural community with a mixture of private homes, farm and ranch land, and an elementary school. The two-laned primary roadway Kamehameha Highway dominates the eastern (makai) boundary of this strip of land, with houses seaward of the highway only in limited locations.

3.1.1.1 Topography and Bathymetry

The Kaaawa shoreline terrain is shaped by its distinct geography and its interaction over the millennia with the prevailing trade wind-generated waves and the perennial streams that cut through the backshore valleys. The dominant trade wind waves experience significant refraction and diffraction past the deeper outer reefs and again over the shallower fringing reefs resulting in a very complex nearshore wave pattern that has helped sculpt the nearshore environment and beach shape. The Kaaawa Valley Stream, along with other lesser perennial streams, bisect the local shoreline in multiple places. The Kaaawa Stream in particular has created a large cobblestone alluvial deposit feature at the shoreline, several hundred feet south of the project area, which functions much like a breakwater in stabilizing and accreting significant beach width at this location.

The dominant physical features defining the project's nearshore vicinity are a broad and shallow reef shelf that extends for hundreds of feet offshore, which is interrupted by a deep channel that bisects the fringing reef shelf along a roughly north-south axis. The channel lies to the south and offshore of the project site as shown in the topographic/bathymetric map provided in Figure 3-1. This figure has an aerial image overlaid with elevation contours at a two-foot interval highlighted bold every ten feet. All elevations are referenced to mean sea level (MSL). The topographic data is based on a 2013 light detection and ranging (LiDAR) survey conducted by the US Army Corps of Engineers. In this figure, the previously mentioned cobblestone stream mouth deposit is clearly visible near the bottom center, which appears to head the deep channel that runs offshore. The cobble deposit and deep channel are in fact related, in that both features were likely created by the Kaaawa Stream—built over centuries. The cobbles would have been washed down from the valley and surrounding mountains by the stream during periods of heavy rain and flash flooding building up the stream mouth deposit to its current form. While even further back in time (thousands of years) during periods of much lower sea levels, the now submerged deep channel was once above sea level and was an active stream channel carved out by Kaaawa Stream.

Figure 3-1. Project site topography and bathymetry contours at a 2 ft intervals (MSL)

The extensive shallow reef shelf and adjacent deep channel combine to create the prevailing nearshore circulation pattern at Kaaawa Beach, which is a steady shore-parallel current, that flows along the beach in a north-to-south direction. This longshore current is generated by the mass flow of water driven over the shallow reef by persistent, short period, breaking waves from the prevailing trade winds. This relatively vigorous current terminates south of the project site as it flows off the shallow reef and into a small, slightly deeper (8-10 ft) basin just north of the cobble stream mouth deposit. Here, the current makes a U-turn as it empties into and flows back out through the submerged Kaaawa Stream channel. Local residents and surfers report that this current does not reverse direction but merely varies in intensity by increasing in velocity with increases in the offshore wave height.

A large sand deposit, likely fed by the longshore current, is located at the terminus of the current (directly south of the project shoreline) and is a clear indication of where a large fraction of the Kaaawa Beach sand budget is accruing (see Figure 3-1, center left). Beach material lost by littoral drift from the project site will most likely end up at this location which fittingly may also have the potential to be an appropriate borrow site to nourish Kaaawa Beach sometime in the future.

Elevation profiles were cut from the nearshore bathymetry along the transects shown in Figure 3-2, which were oriented to be roughly shore perpendicular. The eight individual cross sections are provided in Figure 3-3, which show the elevation (above MSL) and distance along profile given in feet.

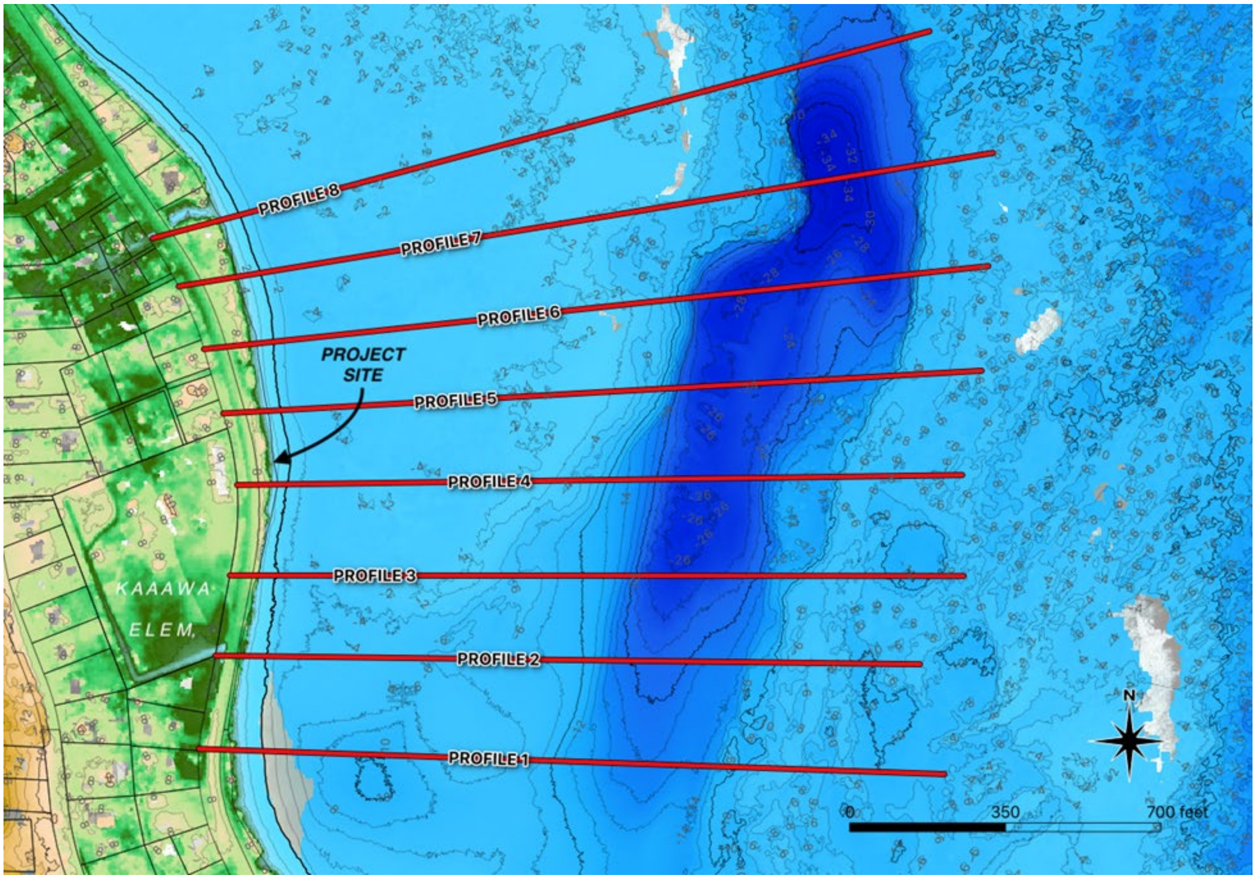


Figure 3-2. Shoreline cross section profile locations

The shoreline profiles in Figure 3-3 reveal the highway road deck at an elevation of approximately +8 feet, where it then quickly steps down to the beach at roughly +2 feet and then continues down to the submerged beach toe at approximately -2 ft. The southern two to three profiles (profile 1 to profile 3) exhibit a less extensive shelf and slightly deeper water than the remaining sections. These profiles, and profile 1 in particular, run through the transitional region between the end of the reef shelf and the start of the channel. The previously described small basin is seen at approximately the 400-ft mark on profile 1, while the peak of the sand deposit is seen at approximately 650 ft. The nearshore rim of the submerged stream channel ranges from 1,000 feet to 1,500 feet offshore and drops down to a maximum depth of nearly 35 feet, with a nominal width of approximately 200 ft.

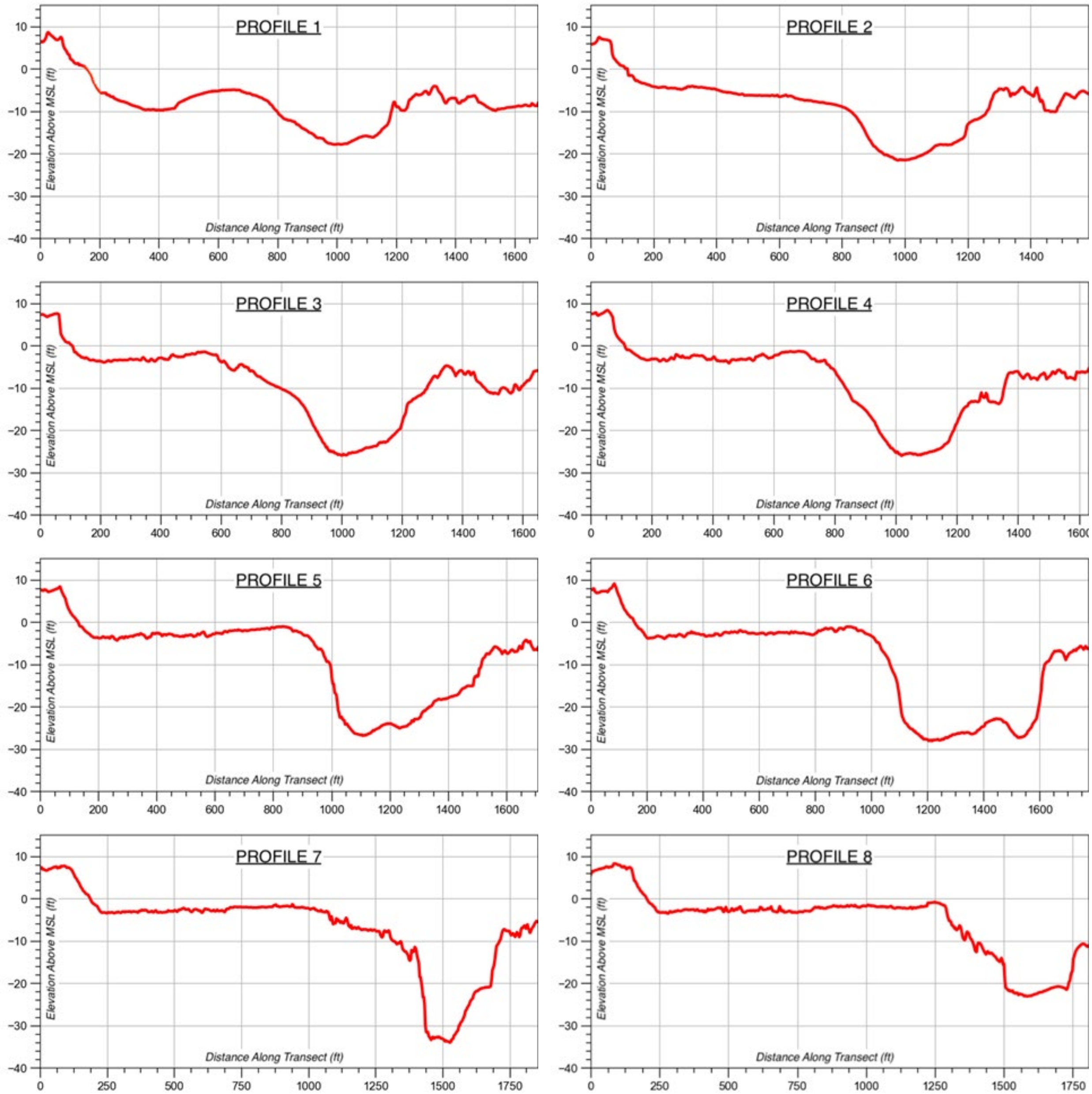


Figure 3-3. Shoreline cross section profiles (distances in feet)

3.1.1.2 Nearshore Coastal Processes

The nearshore coastal processes are primarily driven by the prevailing trade wind waves and the nearshore bathymetry. As previously stated, the extensive shallow reef shelf and adjacent deep channel combine to create the prevailing nearshore circulation pattern and longshore sand transport in the project area. There is a steady shore-parallel (longshore) current that flows along the beach in a north-to-south direction. This longshore current is generated by the mass flow of water-driven over the shallow reef by a persistent, short period, breaking waves from the prevailing trade winds. This relatively vigorous current terminates south of the project site as it flows off the shallow reef and into a small, slightly deeper (8-10 ft) basin just north of the cobble stream mouth deposit.

Here, the current makes a U-turn as it empties into and flows back out through the submerged Kaaawa Stream channel. This current does not reverse direction but simply varies in intensity by increasing in velocity with increases in the offshore wave height. This longshore current is strongest during periods of large winter season north swell wave events. The narrow strand beach along the shore varies in width seasonally and depending on the strength of the longshore current.

Oahu Shoreline Study Erosion Maps prepared by the University of Hawaii, Coastal Geology Group, show the shoreline in the project vicinity to be persistently and chronically eroding with long-term shoreline recession of 0.5 – 1 foot per year. In 1975, a joint Army Corps of Engineers and City and County beach nourishment project placed 9,300 cubic yards of sand along this shoreline. The sand did not stay long, and no re-nourishment has been accomplished since. Following the renovation of the Kaaawa Beach Park comfort station, erosion threatened the building, and it was protected by a cemented rock revetment. The project site is currently bound by the rock revetment to the north and a vertical concrete block seawall to the south.

Figure 3-4 shows the narrow beach fronting the project site, and Figure 3-5 shows the front of a vertical concrete block seawall immediately to the south (the proposed revetment will tie into this seawall).

Figure 3-4. Project site shoreline

Figure 3-5. Concrete block seawall immediately south of project site

3.1.2 Anticipated Impacts and Mitigation Measures

The proposed project will not alter the nearshore bathymetry and will not significantly alter the topography. The revetment will directly abut the existing shoreline bank and will change a near vertical eroding earthen and boulder scarp into a stable sloping porous rock face. It will not alter longshore current or longshore sand transport patterns. The porous revetment will dissipate more wave energy and be less reflective than the existing shoreline and thus may aid in retaining sand along the shoreline, particularly during high wave conditions.

3.2 Soils and Geological Conditions

3.2.1 Existing Conditions

Kaaawa, including the project site, lies on a narrow strip of relatively flat land between the ocean and the steep Koolau Mountains. A large portion of this strip of land rests on ancient beach material deposited during times of higher sea levels. This land is now capped by a stratum of organic material and clays. Soil types within the project area were identified by using data from the U.S. Department of Agriculture, Natural Resources Conservation Service (USDA NRCS); formerly known as the Soil Conservation Service, and Soil Survey of Islands of Kauai, Oahu, Maui, Molokai, and Lanai, State of Hawaii, (August 1972). As depicted in Figure 3-6, from the USDA NRCS Soils Map, the site consists of five main categories of soils. Starting from the shoreline and moving mauka, Kaaawa soils range as follows: Jaucas sand with slopes no greater than 15 percent (labeled as 2w02z); Mokuleia loam (labeled as hqh7); Waialua stony silty clay with slopes between 3 and 8 percent (labeled as hqif); Waialua stony silty clay with slopes between 12 and 30 percent (labeled as hqig); and Rock outcrop (labeled as hqiy).

Jaucas sand areas are mainly comprised of light-colored calcareous sands derived from coral and broken shell material from marine invertebrates. Inland areas are mixed-use and include residential and rural use such as farming and ranching, whereas the beach areas have no farming value. The project site lies entirely within the Jaucas sands classification.

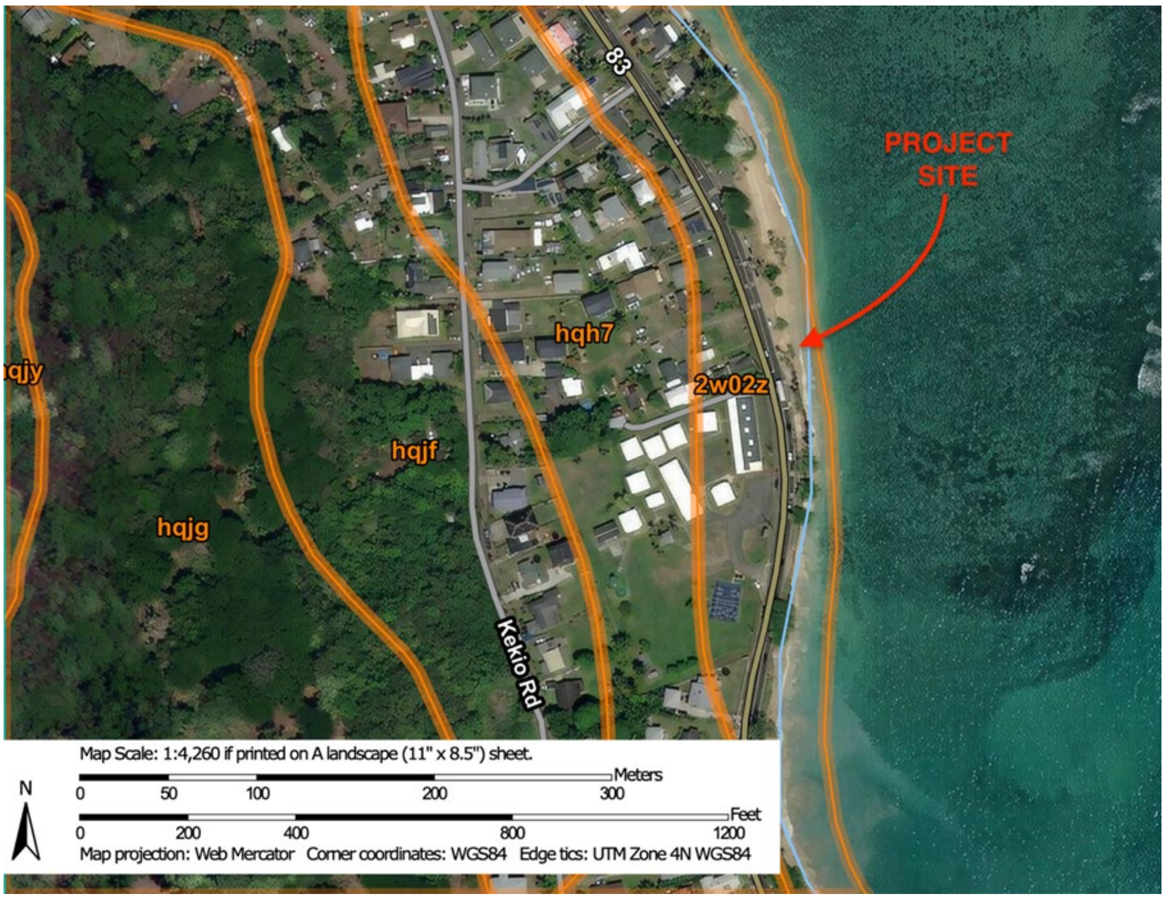


Figure 3-6. Soil map of project area (*source*: USDA Web Soil Survey)

3.2.2 Anticipated Impacts and Mitigation Measures

No impacts to existing soils or geological conditions are anticipated.

3.3 Climate

The Hawaiian Island chain is situated south of the large Eastern Pacific semi-permanent high-pressure cell, the dominant meteorological feature affecting air circulation in the Central Pacific basin. In the vicinity of the Hawaiian Islands, this high-pressure cell persistently produces northeasterly to east-northeasterly winds called trade winds. During the winter months, low-pressure systems and their associated cold fronts sweep across the north-central Pacific Ocean, bringing rain and stormy weather to the Hawaiian Islands, intermittently modifying the trade wind regime.

3.3.1 Temperature and Rainfall

Due to the tempering influence of the Pacific Ocean and the low-latitude tropical location of the Hawaiian Islands, the islands experience extremely small diurnal and seasonal variations in ambient temperature. Measured at Honolulu International Airport (HNL), the average temperatures in the coolest months are 72.9˚ Fahrenheit (F) and in the warmest months 81.4˚F. The temperature variations are notably modest compared to those that occur in the mainland or the continental US. Additional temperature data from Honolulu International Airport is summarized in Table 3-1. Average monthly temperature, rainfall, and humidity at HNL.

Table 3-1. Average monthly temperature, rainfall, and humidity at HNL

Month	**Normal Ambient Temperature (ºF)**		**Average Monthly Rainfall (inches)**		**Average Relative Humidity (%)**
	Daily Minimum	Daily Maximum	Monthly Minimum	Monthly Maximum	
January	65.7	80.4	0.18	14.74	71.0
February	65.4	80.7	0.06	13.68	69.0
March	66.9	81.7	0.01	20.79	65.0
April	68.2	83.1	0.01	8.92	62.5
May	69.6	84.9	0.03	7.23	60.5
June	72.1	86.9	T	2.46	59.0
July	73.8	87.8	0.03	2.33	60.0
August	74.7	88.9	T	3.08	60.0
September	74.2	88.9	0.05	2.74	61.5
October	73.2	87.2	0.07	11.15	63.5
November	71.1	84.3	0.03	18.79	67.0
December	67.8	81.7	0.04	17.29	74.75

Note: "T" signifies a trace amount of rainfall (i.e., less than 0.01 inch).
Source: State of Hawaii Data Book 2003 (Data from Honolulu International Airport).

The persistent northeast trade winds, in combination with the islands' high relief topography, evolved to become the two primary factors that influence the amount of precipitation that falls on a given location on Oahu or the rest of the Hawaiian Islands. On the windward side of Oahu, the summit areas of the Koolau mountain range that are fully exposed to the trade winds, rainfall is aided by orographic forcing, which typically averages nearly 250 inches per year (635 cm/year).

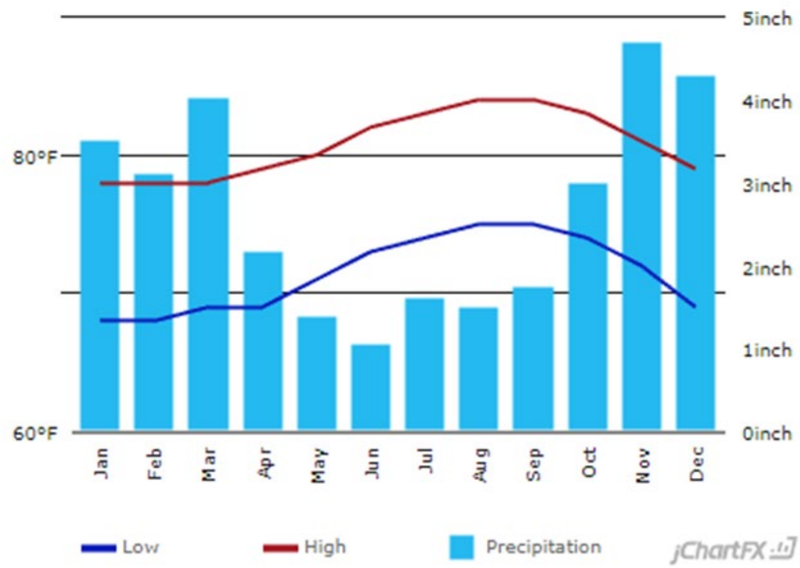


Figure 3-7. Seasonal rainfall and temperature patterns for Hawaii (1981-2010)

3.3.2 Wind

The prevailing trade winds coming from the northeast to the east-northeast blow almost directly onshore at the project area. The trade winds are typically present for approximately 80 percent of the time annually, mostly during the summer season from April to November, with nominal wind speeds of 10 to 20 mph. During the winter months, there is a general weakening of the driving meteorological features that power the trade winds, which allows for the intermittent occurrence of southerly to west-northwesterly winds (Kona winds). These sporadic spells of south and west winds are due to local low-pressure systems and their associated frontal boundaries passing near or through the islands. A wind rose plot of wind measurements at Honolulu International Airport are shown in Figure 3-8

A table of annual maximum wind speeds is summarized in Table 3-2. Annual maximum 2-minute wind speed, recorded at HNL, with values expressed as 2-minute averaged wind speeds, measured at Honolulu International Airport (HNL) for the 44-year period from 1969 to 2012, ordered by descending wind speed. Some of the annual maxima shown are associated with specific storm events. The highest value of 46 miles per hour, recorded in November of 1982, occurred during the passage of Hurricane Iwa. Other events include Hurricane Iniki in 1992 at 38 miles per hour, and several intense Kona (low-pressure) storms with wind speeds up to 40 miles per hour.

An extreme value distribution was applied to the 44 annual maximum 2-minute averaged wind speed records to develop expected extreme wind speeds for various return periods ranging from 1 to 100 years. The extreme value wind speeds are presented in Table 3-3. The maximum 2-minute averaged wind listed in Table 3-2 (46 mph) is equivalent to the 50-year wind speed from Table 3-3.

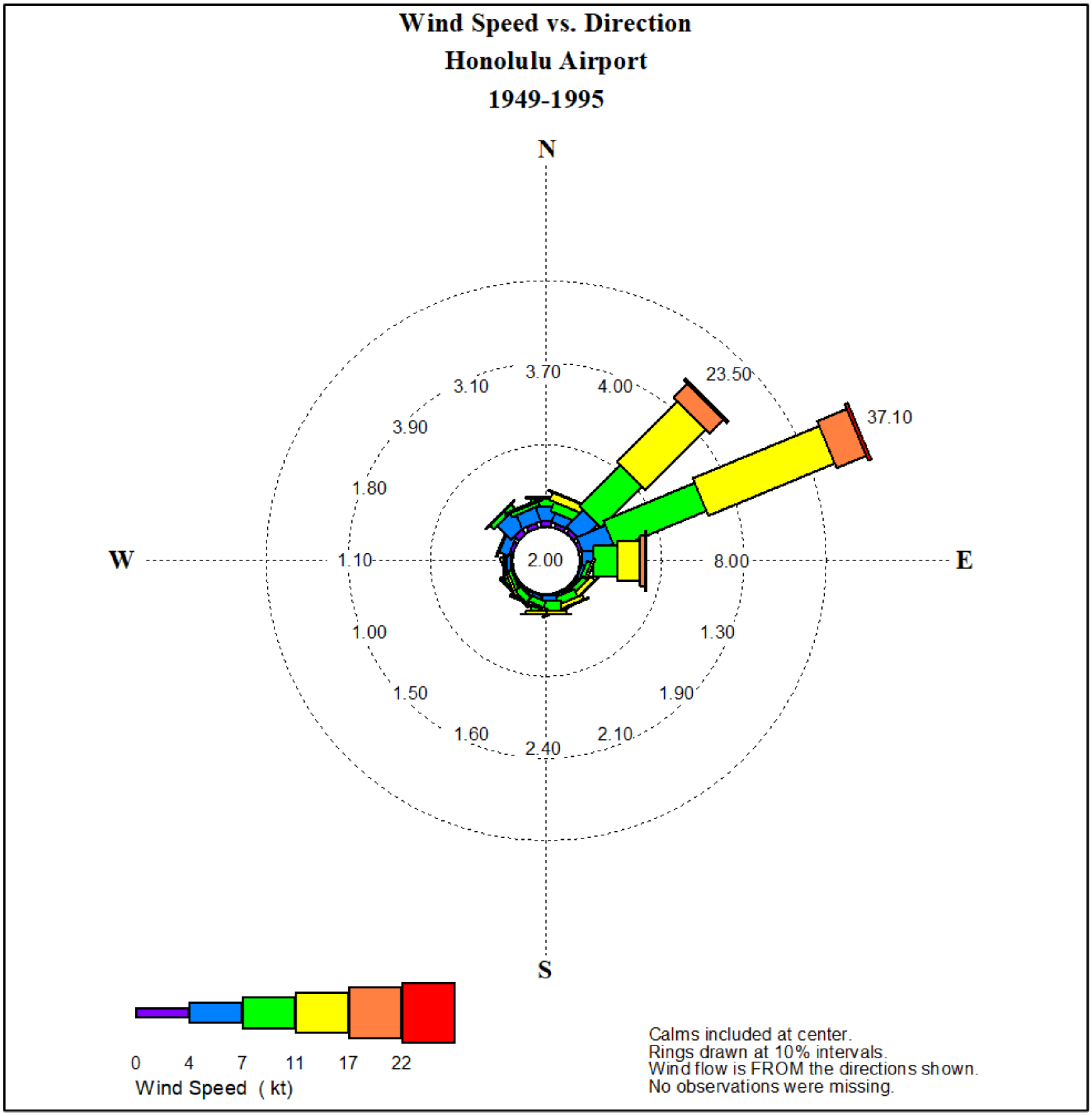


Figure 3-8. Wind rose plot (frequency of occurrence) for HNL, 1949 to 1995

Table 3-2. Annual maximum 2-minute wind speed, recorded at HNL

Year	Wind Speed (MPH)	Year	Wind Speed (MPH)
1982	46	1972	33
1969	40	1973	33
1970	40	1993	33
2004	40	1999	33
2007	39	2010	33
2011	39	1997	32
1976	38	2003	32
1992	38	2005	32
1977	37	1994	31
2008	37	2006	31
1975	36	1981	30
2002	36	1985	30
1980	35	1986	30
1990	35	1989	30
2000	35	2012	30
2001	35	1987	29
2009	35	1988	29
1971	34	1984	28
1974	34	1991	28
1978	34	1995	28
1979	34	1996	28
1998	34	1983	23

Table 3-3. Extreme value distribution for maximum wind speeds at HNL (1969-2012)

Return Period (years)	Wind Speed (MPH)
1	33.3
2	35.6
5	38.7
7	39.8
10	41.0
15	42.3
20	43.3
25	44.0
30	44.6
40	45.6
50	46.3
75	47.7
100	48.6

3.3.3 Air Quality

The U.S. Environmental Protection Agency (EPA) has set national ambient air quality standards (NAAQS) for ozone, nitrogen dioxide, carbon monoxide, sulfur dioxide, 2.5-micron and 10-micron particulate matter (PM2.5 and PM10), and airborne lead. These ambient air quality standards establish the maximum concentrations of pollution considered acceptable, with an adequate margin of safety, to protect public health and welfare. The State of Hawaii has additionally adopted ambient air quality standards for some pollutants. In some cases, the State requirements are more stringent than the Federal standards. At present, the State of Hawaii has set standards for five of the six criteria pollutants (excluding PM2.5) in addition to hydrogen sulfide (DOH, 2003).

Air quality in the Islands is generally acknowledged as quite good due in part to the state's location in the middle of the Pacific Ocean, far away from any major sources of pollution. Air quality in the vicinity of the project site is typically excellent due to the steady and persistent onshore trade winds, which bring ashore clean air from the open ocean as well as quickly evacuating airborne pollutants. The State of Hawaii Department of Health (DOH) monitors ambient air quality on the island of Oahu using a system comprised of nine monitoring stations. The primary purpose of the monitoring network is to measure ambient air concentrations of the six criteria NAAQS pollutants. DOH monitoring data for the year 2008 show that air quality in the area during this year never exceeded the short-term or long-term State or National standards for the six pollutants measured [particulate matter (PM2.5 and PM10), nitrogen dioxide (NO2), sulfur dioxide (SO2), carbon monoxide (CO), and hydrogen sulfide (H2S)]. The Department of Health's only ozone monitoring station on Oahu is located on Sand Island. Existing ozone concentrations at that location also meet State and Federal ambient air quality standards.

3.3.4 Anticipated Impacts and Mitigation Measures

No impacts to the existing climate are anticipated.

3.4 Oceanographic Conditions

3.4.1 Water Level

The water level at the shoreline during typical prevailing conditions is comprised of the astronomical tide and typically occurring sea level anomalies. During high surf conditions, nearshore breaking waves can result in an increased water level at the shoreline (wave setup). Presently occurring climate change and related sea level rise is a factor that will greatly affect water levels in the future.

3.4.1.1 Astronomical Tides

Hawaii tides are semi-diurnal with pronounced diurnal inequalities (i.e., two high and low tides each 24-hour period with different elevations). Variation of the tidal range results from the relative position of the moon and the sun. During full moon and new moon phases, the moon and sun act together to produce larger "spring" tides; when the moon is in its first or last quarter, smaller "neap" tides occur. The cycle of spring to neap tides and back is half the 27-day period of the moon's revolution around the earth and is known as the fortnightly cycle. The combination of diurnal, semi-diurnal, and fortnightly cycles dominate variations in sea level throughout the Hawaiian Islands.

Tidal predictions and historical extreme water levels are provided by the National Ocean and Atmospheric Administration (NOAA) NOS Center for Operational Oceanographic Products and Services. A tide station is located at Mokuoloe (Coconut Island) in Kaneohe Bay, immediately south of the project site. Water level data based on the 1983 to 2001 tidal epoch is shown in Table 3-4.

Table 3-4. Water level data for Mokuoloe, Station 1612480 (NOAA)

Datum	Elevation (feet, MLLW)	Elevation (feet, MSL)
Mean Higher High Water (MHHW)	+2.1	+1.1
Mean High Water (MHW)	+1.8	+0.8
Mean Sea Level (MSL)	+1.1	0.0
Mean Low Water (MLW)	+0.3	-0.7
Mean Lower Low Water (MLLW)	0.0	-1.1

Elevations in this EA are referred to the MSL tidal datum. A tide elevation of +1.1 feet, the regularly occurring mean higher high water (MHHW), is used for design.

3.4.1.2 Sea level Anomaly

The ocean surface does not have a consistent elevation. Sea level anomalies (SLA) are defined as the difference between the measured and predicted tides recorded at tide stations. SLA exist as a result of such processes as El Nino, global warming, geostrophic currents due to the rotation of the earth, and mesoscale eddies that propagate across the ocean. Hawaii is subject to periodic extreme tide levels due to large oceanic eddies and other oceanographic phenomena that have recently been recognized and that sometimes propagate through the islands. Mesoscale eddies produce tide levels that can be up to 0.5 feet higher than normal for periods up to several weeks (Firing and Merrifield, 2004). An additional temporary sea level rise on the order of 0.5 feet has also been associated with phenomena related to the El Niño /Southern Oscillation (ENSO). The start of 2020 marked an extended period of large SLA. Figure 3-9 illustrates the difference between measured and predicted tide at the Mokuoloe tide station. An SLA of 0.5 feet is used for design.

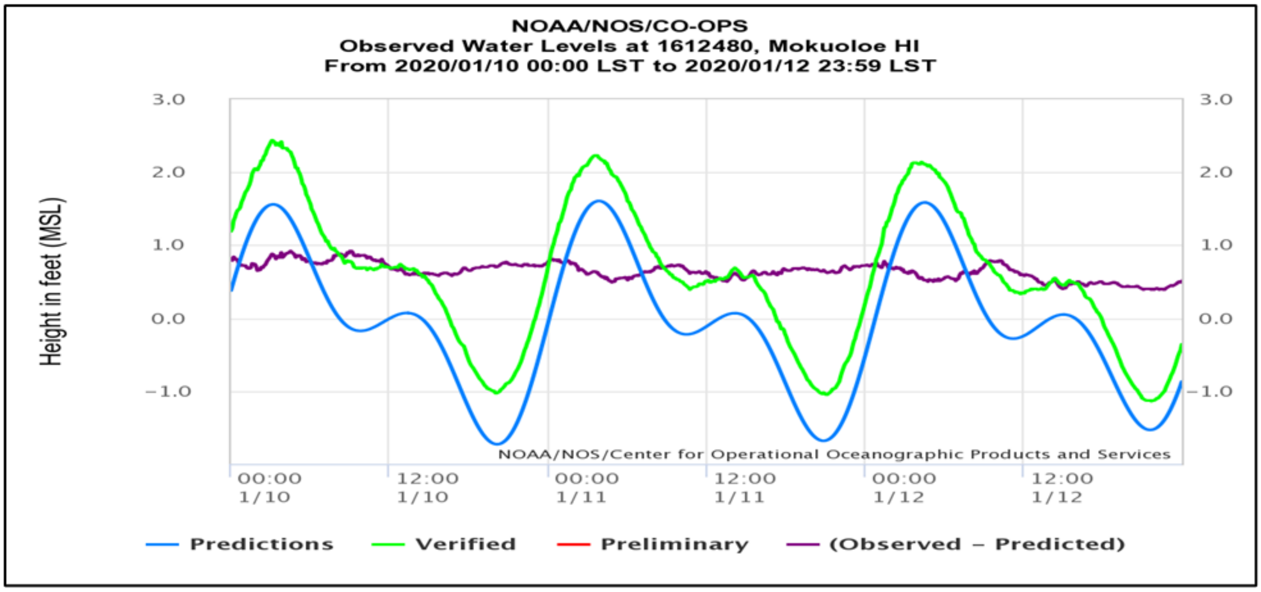


Figure 3-9. Predicted and measured tides at Mokuoloe (January 10, 2020)

Illustrating the occurrence of the sea level anomaly

3.4.1.3 Sea Level Rise

The present rate of global mean sea level change is +3.4 ± 0.4 mm/yr (NOAA, 2017), where a positive number represents a rising sea level. Global mean sea level rise (SLR) has accelerated over preceding decades compared to the mean of the 20th century. Factors contributing to the rise in sea level include melting of land-based glaciers and ice sheets and thermal expansion of the ocean water column.

Rates of sea level rise are variable in time throughout the oceans due to variations in temperature, atmospheric pressure, winds, currents, and vertical land motion. The relative sea level trend for Honolulu Harbor for the period of 1905 to 2019 is shown in Figure 3-10 (NOAA, 2019). The rate of sea level change is shown in Figure 3-10 as being +1.51 ± 0.21 mm/year based on monthly data for the period 1905 to present.

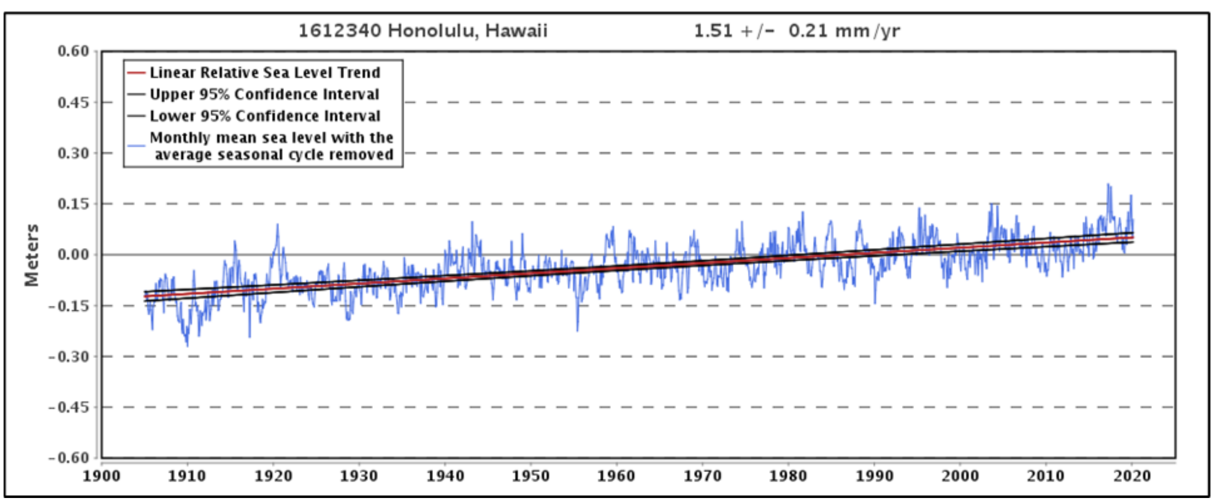


Figure 3-10. Mean sea level trend, Honolulu Harbor, 1905 to 2019 (NOAA, 2020)

NOAA recently revised their sea level change projections through 2100 taking into account up-to-date scientific research and measurements (Sweet et al. 2017). According to the NOAA global sea level rise projections, the Intermediate scenario represents approximately 3.3 feet of sea level rise by 2100 and the Extreme scenario represents more than 8 feet of sea level rise by 2100 (Table 3-5). The NOAA report describes the Extreme scenario as "physically plausible" and corresponds to a business as usual trajectory for increasing greenhouse gas emissions (i.e., no reductions in the increasing rate of emissions) and worst case for glacier and polar ice loss in this century.

Hawaii thus far has seen a rate of sea level rise that is less than the global average; however, this is expected to change. Hawaii is in the "far field" of the effects of melting land ice. This means that those effects have been significantly less in Hawaii compared to areas nearer to the ice melt. Over the next few decades, this effect will spread to Hawaii, which is projected to experience sea level rise greater than the global average. Table 3-6 and Figure 3-11 present estimates of Hawaii's mean sea level rise scenarios based on the revised NOAA (2017) projections, taking into account the far field effects. While the projections are based on the most current scientific models and measurements, discretion is necessary in selecting the appropriate scenario. Selecting the appropriate sea level rise projections is a function of many parameters, including but not limited to existing uses and site conditions, presence and type(s) of infrastructure, design life, the potential for resilience, and socioeconomic value.

Table 3-5. Global mean sea level rise scenarios (NOAA, 2017)

Scenario (feet)	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Low	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
Intermediate-Low	0.1	0.3	0.4	0.6	0.8	1.0	1.1	1.3	1.5	1.6
Intermediate	0.1	0.3	0.5	0.8	1.1	1.5	1.9	2.3	2.8	3.3
Intermediate-High	0.2	0.3	0.6	1.0	1.4	2.0	2.6	3.3	3.9	4.9
High	0.2	0.4	0.7	1.2	1.8	2.5	3.3	4.3	5.6	6.6
Extreme	0.2	0.4	0.8	1.3	2.1	3.0	3.9	5.2	6.6	8.2

Table 3-6. Hawaii local mean seal level rise scenarios (adapted from NOAA, 2017)

Scenario (feet)	2010	2020	2030	2040	2050	2060	2070	2080	2090	2100
Low	0.1	0.2	0.3	0.5	0.6	0.7	0.9	1.0	1.2	1.3
Intermediate-Low	0.1	0.3	0.5	0.7	0.9	1.1	1.4	1.6	1.9	2.1
Intermediate	0.1	0.4	0.6	1.0	1.3	1.8	2.3	2.9	3.5	4.2
Intermediate-High	0.2	0.4	0.7	1.1	1.7	2.4	3.2	4.1	5.0	6.3
High	0.2	0.4	0.8	1.4	2.1	3.0	4.0	5.3	7.0	8.4
Extreme	0.2	0.4	0.9	1.6	2.4	3.5	4.8	6.5	8.3	10.5

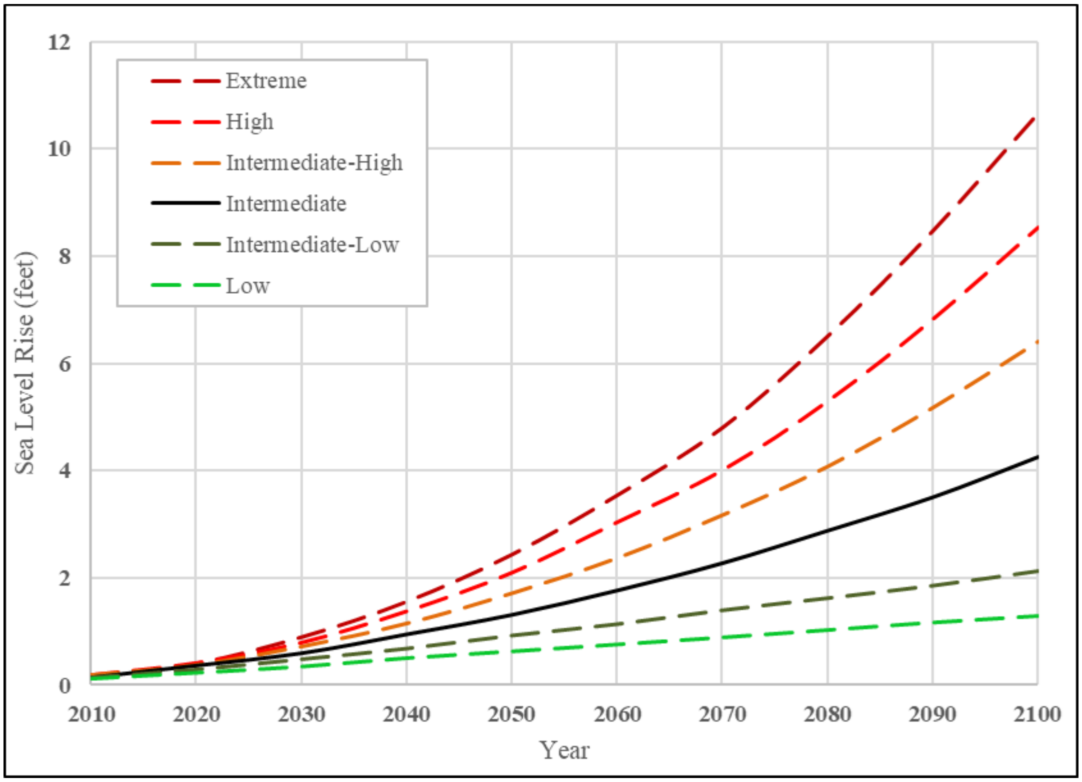


Figure 3-11. Hawaii local mean sea level rise projection (adapted from NOAA 2017)

Sea Engineering, Inc. participated in the Hawaiian Islands and Affiliated Pacific Islands regional climate assessment team, which contributed to the 4th National Climate Assessment (2018). The consensus from the regional team, which included representatives from NOAA, USGS, and UH, was that the NOAA Intermediate-High scenario projections are recommended for planning purposes in Hawaii. The Intermediate-High scenario projects that sea level in Hawaii will rise 1.7 feet by the year 2050, 3.2 feet by the year 2070, and 6.3 feet by the year 2100 (Table 3-6 and Figure 3-11). Given the mid-term (25 years) design life project purpose, a SLR of 1.7 feet is considered appropriate for project design.

3.4.1.4 Total Design Water Level

The total design water level is the sum of the astronomical tide (+1.1 feet), the sea level anomaly (0.5 feet), and sea level rise (1.7 feet), or 3.3 feet above MSL.

3.4.1.5 Wave Setup

Wave setup at the shoreline is the result of the shoreward mass transport of water by breaking waves in the nearshore zone and is typically about 10-12% of the incident breaker height. Numerical models used to calculate wave heights at the shoreline determined wave setup to be 1.7 feet during the design wave conditions.

3.4.2 General Hawaii Wave Conditions

Ocean waves that affect people and the built environment, on a normal basis, can generally be categorized into three groups (excluding tsunami), including: long period swell (characteristically with periods[1] between 12 to 20+ seconds) generated by distant north or south Pacific storm systems; short period wind waves (typically with 6 to 12 second periods) generated by regional winds; and the unpredictable and episodic wave events associated with intense local storms (with periods often between 12 and 17 seconds). More specifically, the Hawaiian Islands receive waves from six well documented sources, which are: (1) northeast trade winds waves; (2) southeast trade winds waves; (3) south swells from the southern hemisphere; (4) north swells from the Aleutians or other parts of the North Pacific; (5) Kona storm wind waves; and (6) hurricane swells. Conceptually, the dominant deepwater wave exposure windows for Hawaii are as illustrated in Figure 3-12.

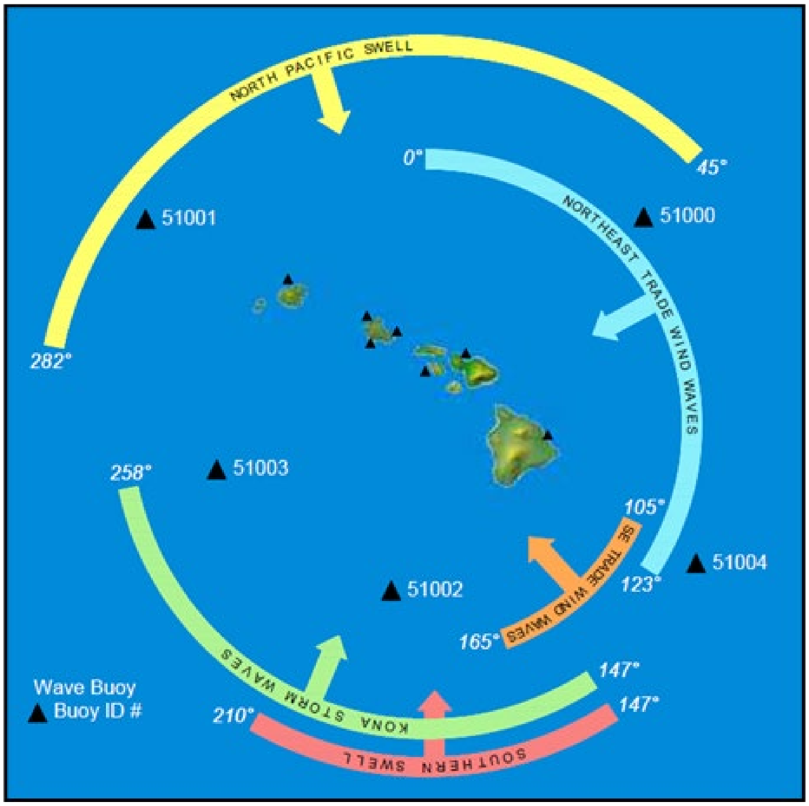


Figure 3-12. Dominant deepwater wave exposures for Hawaii

Trade wind waves occur throughout the year and are typically most persistent and intense from April through September when they tend to dominate the wave climate in Hawaiian waters. These waves are produced from the strong and steady trade winds generally blowing from the northeast quadrant, over long fetches of open ocean in the east and central pacific. The deep-water wave conditions for this source are typically between 3 to 8 feet high, with periods of 5 to 10 seconds depending on maximum wind speeds and how far east of the Hawaiian Islands the *fetch*[2] extends.

[1] Wave period is the time observed between two successive wave crests passing through a stationary observation position, measured in time (seconds). Wavelength is the distance between successive wave crests.

[2] A fetch is the area in which ocean waves are generated by the wind, or simply the length over which the wind is blowing to produce the waves.

The direction of approach, like the trade winds themselves, varies between north-northeast and east-southeast but is generally centered on the east-northeast direction.

During the winter months in the northern hemisphere, strong storms frequently track through the North Pacific's mid-latitudes (40 to 50 degrees north). Often near the Aleutian Islands, a string of volcanic islands that dot the very northern Pacific Ocean stretching from Alaska in the east to Eastern Asia (Russia) in the west. These powerful storms generate the large and infamous North Pacific swells that approach from west-northwest to the northeast and arrive at north-facing Hawaiian shores with little loss of energy. These are the waves that have made surfing beaches on the north shores of Oahu and Maui famous. Deep water wave heights often reach 15 feet and in extreme cases can reach 40 feet. The wave period for these northwest swells typically varies between 12 and 18 seconds (sometimes up to 21 seconds on rare occasions) depending on the track and intensity of the originating storm. Swells from the northwest can grow to exceptional heights and are very energetic. Because of this, they have the potential to bring a significant amount of energy to the northeast shorelines of Oahu as they refract around the northern tip of the island at Kahuku Point and wrap into the east side's fringing reefs. The project site is exposed to those winter swells, either large enough in size or with enough north in their approach angle to do just that.

South swells are generated by intense storms thousands of miles away in the southern hemisphere's mid-latitudes and are most prevalent during the late spring and summer months of April through September. Traveling distances of up to 5,000 miles, these waves arrive with relatively small deep-water wave heights of 1 to 5 feet but characteristically having long periods of 15 to 20 seconds or greater. South swells' direction of approach to the Islands is typically between southwest to southeast, depending on the originating storm's track across the Southern Ocean. South swells can occasionally become significant in size; however, there is no exposure to wave energy from the south in Kaaawa due to the site's northeastern orientation and the complete sheltering it receives from the island of Oahu's landmass to any swell from the south.

Wind swell from Kona storms is episodic and fairly infrequent, occurring usually about 10 percent of the time during a typical year. A Kona storm is a seasonal low-pressure system, generally classified as extratropical (cold core). These low-pressure systems typically approach the Islands with strong southerly and westerly winds that can also bring additional hazards. Hazards include heavy rain, flash flooding, hail, and even blizzards at high elevations as on the upper slopes of Mauna Kea or Haleakala. Kona storm wind waves are typically experienced as short period wind swells that range in periods from 6 to 10 seconds, along with wave heights of 5 to 20 feet. Deep-water wave heights generated during a particularly intense Kona storm of January 1980 were up to 17 feet. The combined large wave heights along with characteristically short periods result in a very steep and consistent wave field that can have a significant impact on the west-facing shores of Oahu. Depending on the Kona storm's track and position, the waves it produces typically approach the island from directions ranging between south and west. For this reason, as with south swells, there is no significant exposure at Kaaawa to wave energy from the south or west due to the site's northeastern orientation and the complete sheltering it receives from the island's landmass to any swell from the south or west.

Tropical storms and hurricanes (i.e., cyclonic storms, or cyclones) typically form during the months of June through November in the south-east and south-central North Pacific Ocean, when large swathes of sea surface temperatures (SSTs) rise above the crucial threshold of 78° F (26° C). Severe tropical storms and hurricanes (warm core cyclonic storms) have the capacity to generate extremely large waves, which potentially could result in extreme wave heights at the project site. Since the 1980s, two powerful hurricanes, Iwa and Iniki, have significantly impacted Oahu in 1982 and 1992, respectively. In recent years there have been several close-approach hurricanes. Including Category 3, Hector (2018), which pounded south and west shores of Oahu with dangerously large surf, and Category 5 Lane (2018) which was forecasted to make landfall on Oahu but unexpectedly (and fortunately) weakened rapidly and veered off to open ocean just hours before its predicted impact. Two years later, in late July 2020, a Category 1 Hurricane Douglas was at one point forecast to directly strike the windward coast of Oahu, with its estimated track actually clipping Kahuku Point (see Figure 3-13). Although the storm eventually veered northward sending it further out to sea and avoiding landfall, Douglas still passed dangerously close to northeast Oahu. Wave heights climbed precipitously high offshore of the project site during the near miss, with a stretch of Kamehameha Highway along the project site becoming partially submerged and inundated by wave runup at times during the passage of the storm. The photograph in Figure 3-14 was taken at the project site in the hours following the passage of the storm and clearly illustrates the powerful hydrodynamic forces acting along the shoreline during the storm surge and elevated wave heights.

Notably, for as long as official records have been kept, tropical storms and hurricanes have had a relatively low probability of occurrence in the vicinity of the Hawaiian Islands. However, the potential for damage to Hawaii's offshore and coastal infrastructure is substantial. The frequency and severity of storms is expected to increase with global warming related climate change.

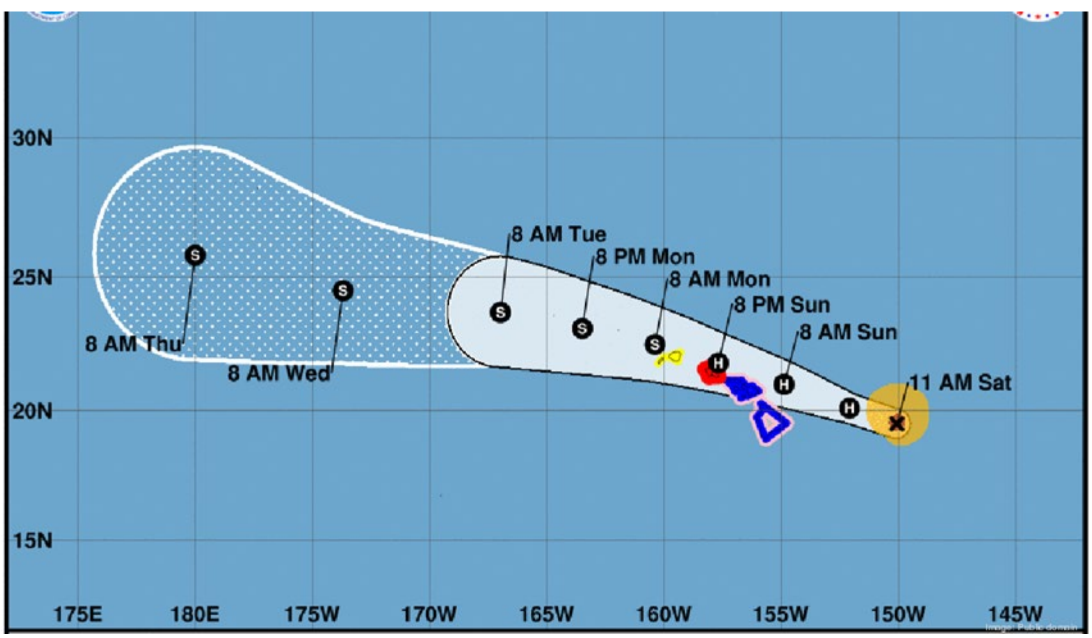


Figure 3-13. Forecast cone for Hurricane Douglas, 27 July 2020. Source: NOAA NWS CPHC

Figure 3-14. Kamehameha Highway at Kaaawa, 27 July 2020

3.4.3 Project Design Wave Heights

3.4.3.1 Prevailing Deepwater Waves

The deepwater wave conditions for the project site are well defined by the Coastal Data Information Program (CDIP) buoy station 098 (CDIP 098), located approximately 14.2 miles southeast of the project site. CDIP 098 is a Datawell directional buoy that measures wave height, wave direction, and peak period every half-hour. The buoy has recorded data continuously since it was installed in August 2000, with occasional data gaps due to maintenance.

The deepwater wave climate in the vicinity of CDIP 098 is dominated by the occurrence of Trade wind waves with a peak direction (Dp) from the northeast through east-northeast directions, clockwise. Buoy data shows that the area is also exposed to a longer period North swell. The percent occurrences of wave height by direction and wave period by direction are presented below. Figure 3-15 and Table 3-7 show the wave height rose diagram and histogram, respectively. Figure 3-16 and Table 3-8 show the wave period rose diagram and histogram, respectively. The color scheme on the histograms provides a visual aid to illustrate the differences in percent occurrence over time.

The figures show that waves are predominantly from the east-northeast and have a significant wave height (Hs) between 4 and 8-feet occurring 50 percent of the time, with peak periods typically between 6 to 10 seconds. The figures also show that the project site is exposed to longer period swells from the north with an average wave height of 6.3 feet.

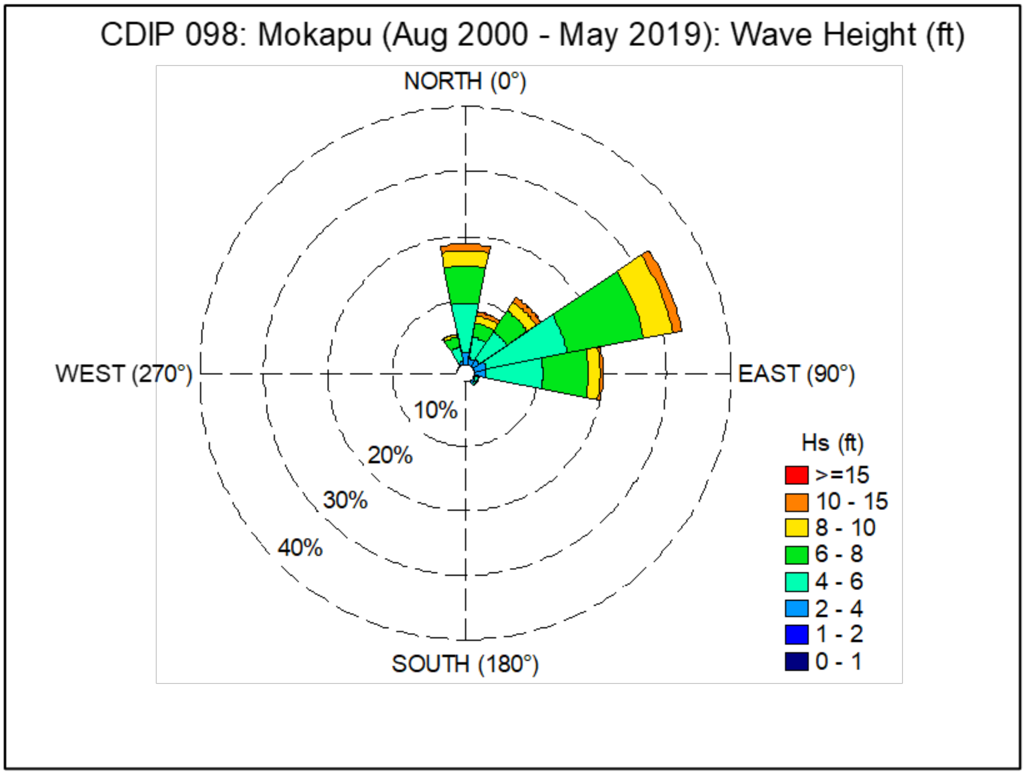


Figure 3-15. CDIP 098 wave height rose (Aug 2000 to Jan 2019)

Table 3-7. Wave height percent frequency of occurrence (Aug 2000 to Jan 2019)

Hs (ft)\Dir (deg)	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	Total
0-1																	0.00
1-2	0.0	0.0	0.0	0.0	0.0	0.0	0.0										0.01
2-3	0.3	0.2	0.2	0.3	0.2	0.1	0.2	0.0	0.0						0.0	0.1	1.44
3-4	1.8	0.9	1.1	1.7	1.6	0.2	0.3	0.0	0.0					0.0	0.0	0.5	8.14
4-6	7.5	3.3	5.2	12.8	8.9	0.4	0.4	0.0								2.3	40.81
6-8	5.9	2.3	3.8	12.1	7.1	0.1	0.1	0.0							0.0	1.6	32.99
8-10	2.4	1.1	1.7	4.5	1.9	0.0	0.0									0.5	12.08
10-12	0.8	0.5	0.6	1.2	0.4	0.0	0.0									0.1	3.53
12-14	0.2	0.1	0.2	0.2	0.0	0.0										0.0	0.80
14-16	0.0	0.0	0.0	0.0	0.0												0.14
16-20	0.0	0.0	0.0	0.0	0.0												0.05
20+			0.0		0.0												0.00
Total	18.75	8.43	12.88	33.00	20.08	0.89	0.86	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.01	100.000
	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	Overall
Mean	6.3	6.3	6.4	6.4	6.0	4.7	4.2	3.9	3.0	0.0	0.0	0.0	0.0	3.3	5.2	5.9	6.2
StDev	2.0	2.3	2.2	1.8	1.7	1.4	1.3	0.9	0.4	0.0	0.0	0.0	0.0	0.0	1.9	1.6	1.9
Min	1.8	1.7	1.8	1.9	1.9	1.8	1.8	2.1	2.7	0.0	0.0	0.0	0.0	3.3	2.9	2.1	1.7
Max	18.4	20.0	20.5	19.1	21.2	12.3	10.4	7.5	3.3	0.0	0.0	0.0	0.0	3.3	7.0	14.0	21.2

Note: The color scheme on the histogram is a visual aid to help view the differences in percent occurrence. Empty cells indicate where the value is precisely zero. Cells ranging from green to yellow to red indicate lower to intermediate to higher values, respectively.
Legend: Hs (ft) = wave height in feet; Dp = peak direction; deg = degree

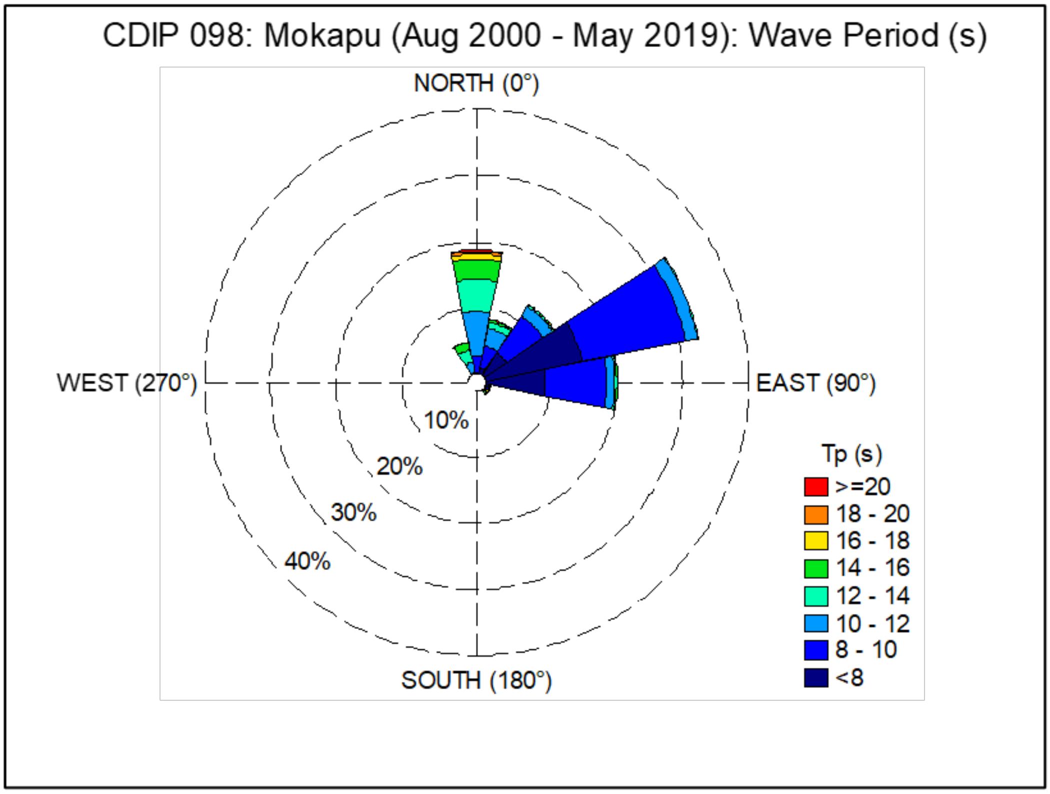


Figure 3-16. CDIP 098 wave period rose (Aug 2000 to Jan 2019)

Table 3-8. Wave period percent frequency of occurrence (Aug 2000 to Jan 2019)

Tp(s)\Dir(deg)	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	Total
3-6	0.0	0.1	0.4	2.4	2.5	0.1	0.0	0.0								0.0	5.44
6-8	0.2	0.9	3.8	12.7	6.7	0.3	0.1	0.0								0.0	24.56
8-10	2.5	3.4	6.7	16.0	9.1	0.3	0.1	0.0								0.2	38.27
10-12	6.6	2.7	1.7	1.8	1.2	0.1	0.0	0.0								1.6	15.86
12-14	4.9	1.0	0.3	0.1	0.3	0.1	0.1	0.0	0.0					0.0	0.0	1.9	8.65
14-16	3.1	0.3	0.1	0.0	0.2	0.1	0.3	0.1	0.0						0.0	1.2	5.35
16-18	0.8	0.0	0.0	0.0	0.0	0.0	0.2	0.0								0.1	1.14
18-20	0.4	0.0	0.0			0.0	0.1	0.0								0.0	0.51
20+	0.2	0.0				0.0	0.0									0.0	0.21
Total	18.75	8.43	12.88	33.00	20.08	0.89	0.86	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.01	100.000

	0	22.5	45	67.5	90	112.5	135	157.5	180	202.5	225	247.5	270	292.5	315	337.5	Overall
Mean	12.4	10.3	8.8	8.1	8.1	9.0	14.3	13.6	14.4	0.0	0.0	0.0	0.0	13.3	14.1	12.8	9.5
StDev	2.3	2.0	1.6	1.4	1.7	2.7	3.2	2.3	1.4	0.0	0.0	0.0	0.0	0.0	0.4	1.6	2.6
Min	3.6	3.9	3.9	3.7	3.9	3.9	5.3	5.3	13.3	0.0	0.0	0.0	0.0	13.3	13.3	3.9	3.6
Max	25.0	25.0	18.2	16.7	16.7	20.0	20.0	18.2	15.4	0.0	0.0	0.0	0.0	13.3	14.3	20.0	25.0

Note: The color scheme on the histogram is a visual aid to help view the differences in percent occurrence. Empty cells indicate where the value is precisely zero. Cells ranging from green to yellow to red indicate lower to intermediate to higher values, respectively.

Legend: Hs (ft) = wave height in feet; Dp = peak direction; deg = degree

3.4.3.2 Extreme Deepwater Waves

Historical wave buoy data allows a statistical basis for the prediction of the return period for various frequency of occurrence wave events. These are infrequent, larger, low probability wave events that are typically used for design purposes. For example, a 25-year return period wave event is an extreme event with a 1/25 (i.e. 4%) chance of occurring in any given year.

The extreme wave height data were used to generate a Weibull extreme value distribution for return period wave heights. The Weibull Distribution is a tool for looking at the relationship between the size of waves and how frequently they occur at a given location. Analysis requires a long-term data set with well-documented wave events. These events are sorted by size, and frequency of occurrence can be assessed by how often these events occur in the record. The relationship is logarithmic, and a linear fit can be established with a best fit linear regression of the data. Though not all wave events will be co-located on the line, its general trend represents the nature of the size and frequency relationship of wave events at a specific location.

Extreme wave height versus return period is shown in Figure 3-17 and Table 3-9.

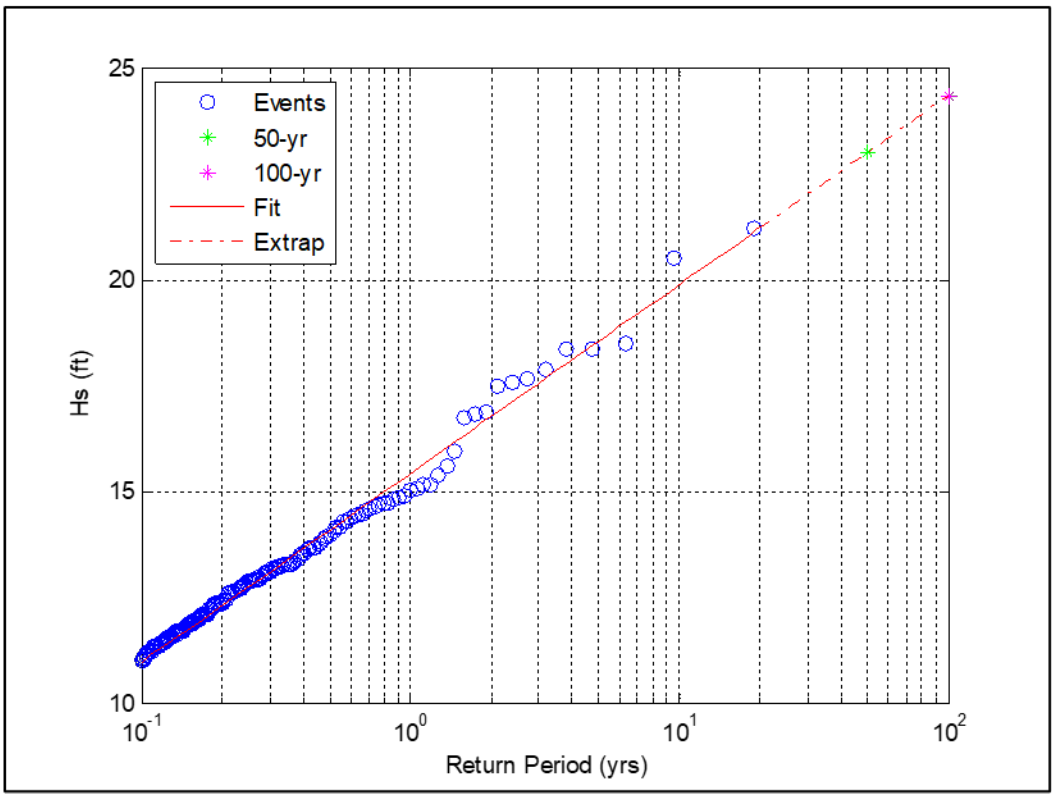


Figure 3-17. CDIP 098 return period 17-yr (Aug 2000 – Jan 2019)

Table 3-9. Return period significant wave heights at CDIP 098

Return Period (yrs)	Hs (ft)
1	15.4
2	16.8
5	18.5
10	19.9
25	21.7
50	23.0

Note that there is little difference in the 5-year return period wave event and the 50-year event, indicating that the project site is regularly exposed to large deepwater waves. For this project, a 25-year return period deepwater wave height of 21.7 feet is selected for design, consistent with the mid-term (25-year) design life objective.

3.4.4 Wave Heights and Water Level at the Shoreline

Nearshore bathymetry and water depths are available from the 2013 USACE SHOALS LiDAR dataset. This was supplemented by topographic surveys of the beach and reef flat fronting the beach. The project site is fronted by a wide (500 feet plus), shallow (-2 to -4 feet) fringing reef. Deepwater waves approaching the shore initially break on the reef edge, expending most of their energy, and then proceed shoreward as smaller reformed waves. Wave energy is further dissipated by bottom friction as they propagate across the reef. Waves that reach the shore are "depth limited", i.e. their height is a function of and limited by the water depth at the shoreline. Thus, while there may be large differences in the wave heights for different return periods (frequency of occurrence) deepwater waves, there is less variability in the water depth at the shoreline and so less difference in return period wave heights at the shoreline.

The one-dimensional numerical wave model XBeach-NH was used to estimate wave height at the shoreline for the selected deepwater wave. XBeach-NH propagates waves from offshore to the shoreline along a bottom profile corresponding to the local bathymetry derived from the USACE SHOALS dataset. The model includes shoaling as waves move into shallower water, bottom friction energy dissipation, and energy dissipation due to wave breaking. Model output includes the time-varying water surface elevation, which is used to determine the significant wave height and wave setup at the shoreline.

The model results show a wave height of 4.2 feet at the shoreline, which is used for structural design. Wave setup at the shoreline is modeled to be +1.7 feet above the still water level (total design water level = +5.0 feet MSL). Wave runup was determined using an empirical formula for wave runup on armored slopes based on the EurOtop Manual (EurOtop, 2018). For armored slopes in shallow water the runup level, above the still water level, is two times the wave height at the toe of the structure. Therefore, the total runup elevation above MSL is 13.4 feet. The runup elevation exceeds the road and backshore elevation, which shows that during the design event there would be considerable wave overtopping of the proposed revetment and inundation of the roadway and backshore.

3.4.5 Anticipated Impacts and Mitigation Measures

The proposed project would not alter existing oceanographic conditions in the project vicinity.

3.5 Coastal Hazards

3.5.1 Flooding

The National Flood Insurance Program (NFIP), administered by FEMA (the Federal Emergency Management Agency), produces maps identifying flood hazards and associated zones of risk, known as Flood Insurance Rate Maps or FIRMs. Figure 3-18 presents the FEMA flood hazard map for the project site, with Kaaawa Beach Park's parcel highlighted with the cyan outline. This map indicates that the parcel is rated as Flood Zone VE (EL 10) over the north half and changes to Zone AE (EL 10) over the southern portion. Zone VE indicates a coastal flood zone with a velocity hazard, along with a base flood elevation (BFE) value of 10 feet in parentheses. For the southern half of the property, a Zone AE designation means that a BFE has been calculated for these areas; however, without an additional velocity hazard. A BFE value represents the water surface elevation for a 1% annual chance flood (in this case, based on the 100-yr tsunami inundation limits). The BFE can also be defined as the elevation—expressed as a height above mean sea level—that floodwaters are estimated to have a 1 percent chance of reaching or exceeding in any given year. The BFE value for the northern and southern portions of the property are equivalent, at 10 ft above MSL. Roughly 400 to 500 feet inland from the site, the designation turns to Zone X, which is an area that is determined to be outside of the 0.2% chance (500-year) flood plain, due to the steeply rising terrain.

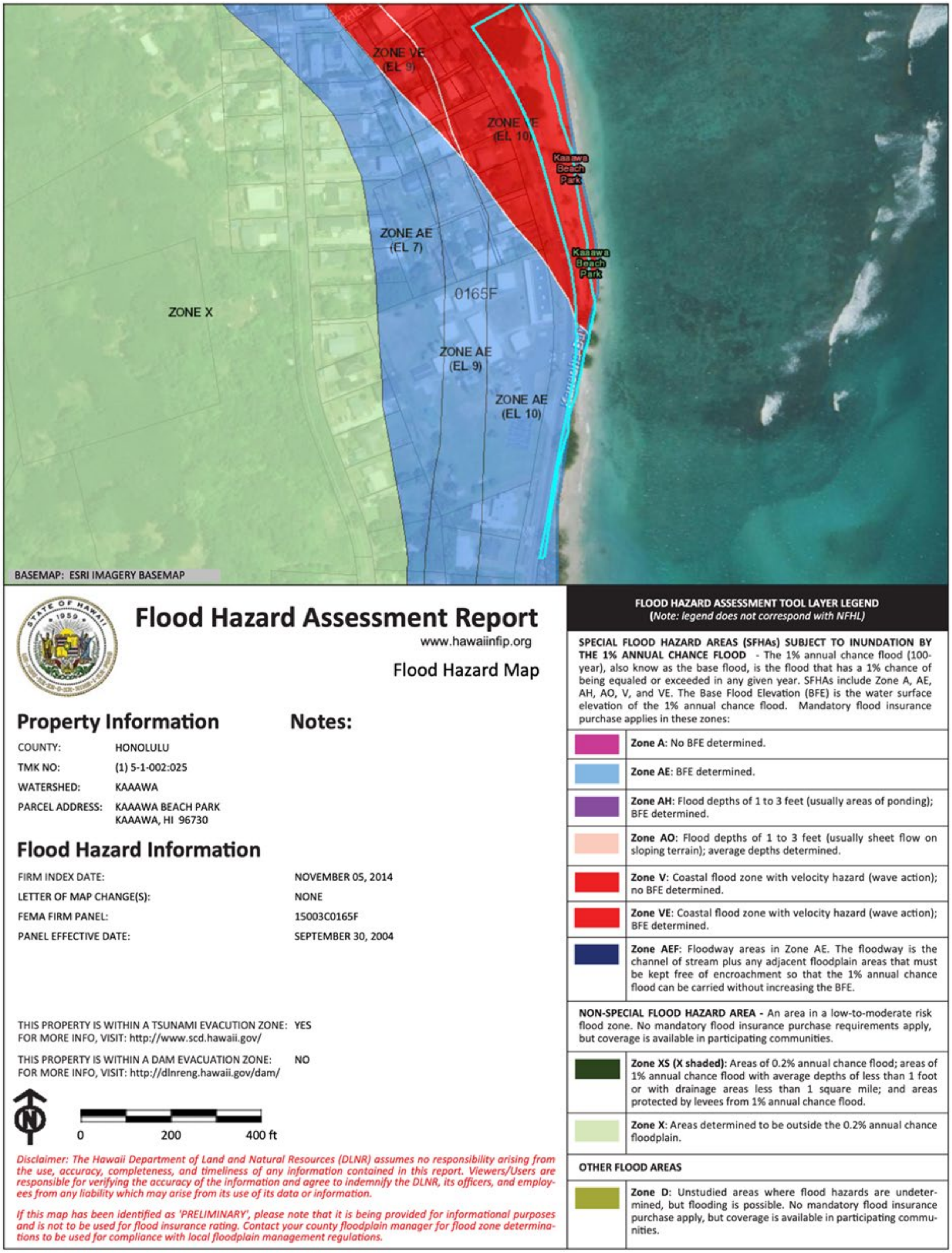


Figure 3-18. Flood hazard map for Kaaawa Beach Park parcel

3.5.2 Tsunami

Tsunamis are long-period solitary waves that typically result from large-scale seafloor displacements. Tsunamis are commonly caused by seismic events such as earthquakes that occur adjacent to or under the ocean and involve significant vertical motions of large areas of the substrate. Regular oscillatory waves—which are simply wind-generated waves, such as the waves one typically sees at the beach—have orbital velocity fields under the wave that decay exponentially with depth from their maxima at the surface and typically vanish within hundreds of feet from the surface. In contrast, the velocity field of tsunami extends vertically through the entire water column, from the ocean surface down to the seafloor—which could be miles deep. Tsunami wave heights have been observed as 1-2 ft (or less than a meter) when measured in deep water far at sea and quickly rise in height as they approach coastal areas. Increasingly shallower water forces the tsunami's extensive velocity field to swell upward. Tsunamis can have wavelengths on the order of hundreds of miles and travel at speeds near 500 miles per hour (equivalent to the speed of trans-pacific airline flights).

Most tsunamis that have impacted the State of Hawaii have originated from the tectonically active areas that ring the Pacific (a.k.a., The Ring of Fire) such as Japan, the Aleutian Islands, Alaska, Chile, etc. Seismic waves originating from earthquakes in these locations take hours to reach Hawaii even at jetliner speeds. The network of sensors that are part of the Pacific tsunami warning system can give Hawaii several hours of advance warning of a tsunami from these locations. Less commonly, tsunamis can and have originated from seismic activity locally within the Hawaiian Islands and by virtue of its proximity, there is also much less advance warning for the arrival of these waves. The 1975 Halape earthquake on the east coast of Hawaii Island registered as a 7.4 magnitude tremor. The shock affected several of the Hawaiian Islands and resulted in two deaths and 28 injured. The east side of the Big Island suffered over $4 million in damage from the event. The earthquake generated a large tsunami that was estimated at 47 feet (14 m) at Halape, on the Big Island. Major alterations to the existing shoreline were found along the south side of the Big Island, with subsidence of up to 12 feet (3.7 m) observed in places, permanently submerging some nearshore areas. The source of the quake was determined to be the Hilina Slump, near Kilauea, which was also deemed responsible for the more powerful 1868 Hawaii earthquake and tsunami.

Fletcher et al. (2002) report that 10 of the 26 tsunamis with flood elevations greater than 3.3 feet (1 m) that have made landfall in the Hawaiian Islands during recorded history have had "significant damaging effects on Oahu." This means that, on average, one damaging tsunami reaches Oahu every 19 years. The recent record (1946 to the present) has seen four tsunami cause damage on Oahu, a rate that is very close to the longer-term average.

3.5.3 Hurricanes

Tropical cyclones originate over warm ocean waters, and they are considered hurricane strength when they generate sustained wind speeds over 64 knots (74 mph). Hurricanes form near the equator, and in the central North Pacific usually move toward the west or northwest. During the primary hurricane season of July through September, hurricanes generally form off the west coast of Mexico and move westward across the Central Pacific. Based on storms observed over the past several decades, these cyclones typically pass south of the Hawaiian Islands but occasionally have a northward curvature, taking them near the islands. Late season hurricanes appear to follow a somewhat different pattern, forming south of Hawaii and moving north toward the islands. Three hurricanes have passed over or through the Hawaiian Islands in the past 25 years, including:

Hurricane Iwa in 1982 passing near the island of Kauai, Iniki in 1992 passing over the island of Kauai, and Hurricane Iselle in 2014 passing over the island of Hawaii. These storms caused extremely high surf and wave damage on multiple shores of the islands. Section 3.4.2 above also presents a discussion on hurricane-related waves. The Windward Oahu Hurricane Vulnerability Study (Sea Engineering, 1990) indicates that a theoretical model hurricane passing over the island from the south/southwest could result in deep-water waves 44.2 feet high with periods of 14.6 seconds for Oahu North and East shores.

3.5.4 Anticipated Impacts and Mitigation Measures

The proposed project is not expected to affect the project area exposure to coastal hazards. The proposed erosion mitigation would, however, help protect the highway during coastal hazard conditions.

3.6 Marine Biological Environment

3.6.1 Marine Biota

The Pacific Island Ocean Observing System's (PacIOOS) mapping program, Voyager, displays the National Oceanographic and Atmospheric Administration's (NOAA) benthic maps for the region. These maps show coral reef geomorphology and biology for the Kaaawa Beach Park area. Figure 3-19 illustrates the benthic biology of the reef flat offshore of the project site, as classified by NOAA scientists and biologists. Immediately adjacent to the shoreline and parallel to the beach park and moving south into the channel is a strip of nearshore sand that is classified as un-colonized. Moving offshore from that zone, the substrate transitions to macroalgae with a coverage of 10-50%, while further offshore the edge of the reef transitions to coralline algae at a coverage of 10-50%, and finally to the reef face with live coral at 10-50% coverage.

Figure 3-19. Kaaawa Beach Park offshore benthic biology *(source: PacIOOS Voyager)*

A biological survey of the nearshore project site was conducted in January 2021 (Marine Research Consultants, Inc., 2021), which covered the entire shoreline area fronting the project area and included the reef flat out to 50 m from the shoreline. The complete survey results are provided in Appendix A. Results of the biological survey indicate that the marine habitat was essentially unchanging from the shoreline to the outer limits of the survey and consisted of a flat sand/rubble surface with little vertical relief. Several piles of large stones or boulders were interspersed over the area. The most abundant benthic biota were various species of algae. The most common *were Acanthophora specifera, Halimeda spp., Caulerpa spp. and Padina spp*. Corals were relatively rare and consisted primarily of small, isolated colonies of typical Hawaiian reef species of *Porites and Pocillopora*. Fish communities were notably lacking in numbers of individuals and variety of species. The few fish observed during the survey were all small in size. The lack of fish and the overall small size of individuals is likely a response to heavy fishing pressure in the area, in turn owing to the proximity to the shoreline and major roadway.

3.6.2 Essential Fish Habitat

The 1996 Sustainable Fishery Act amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) and subsequent Essential Fish Habitat (EFH) Regulatory Guidelines (NOAA, 2002) describe provisions to identify and protect habitats of federally managed marine and anadromous fish species. Under the various provisions, federal agencies that fund, permit, or undertake activities that may adversely affect EFH are required to consult with the National Marine Fisheries Service (NMFS). EFH is defined as “those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity.” EFH is further defined by existing regulations as (MSFCMA, 1996; NOAA, 2002). “Waters” include aquatic areas and their associated physical, chemical, and biological properties that are used by fish and may include aquatic areas historically used by fish where appropriate; “substrate” includes sediment, hard bottom, structures underlying the waters, and associated biological communities; “necessary” is defined as required to support a sustainable fishery and the managed species’ contribution to a healthy ecosystem; and “spawning, breeding, feeding, or growth to maturity” covers a species’ life cycle.

The marine water column from the surface to a depth of 1,000 meters from the shoreline to the outer boundary of the Exclusive Economic Zone (EEZ) (5,150 kilometers/200 nautical miles/ 230 miles), and the seafloor from the shoreline out to a depth of 700 m around each of the Hawaiian Islands, have been designated as Essential Fish Habitat (EFH). As such, the water column in the proposed project area is designated as EFH and supports various life stages for the management unit species (MUS) identified under the Western Pacific Regional Fishery Management Council’s Pelagic and Hawaii Archipelago Fishery Management Plan. There are no areas within the project area that have been designated as Habitat Areas of Particular Concern (HAPC) under the EFH regulations, and no portion of the proposed project area would qualify as an HAPC.

The project area is located on a highly utilized shoreline for fishing, swimming, and other nearshore recreation and is immediately adjacent to a beach park. Consequently, the project area is subject to chronic anthropogenic impacts from human use.

3.6.3 Potential Impacts and Mitigation Measures

The revetment would be constructed almost entirely landward of the water line, with only a portion of the toe scour apron extending seaward of mean higher high water (+1.1 feet), with a footprint of 0.01 acre. This footprint area is also a shifting sand shoreline, essentially devoid of marine life. Thus, the project impacts on the marine biological environment are not considered significant.
The only potential negative effect to the marine environment that could arise from the proposed project could be temporary increases in turbidity. Results of the marine survey indicate that the marine habitats fronting the project site do not represent fragile or unique areas that would be susceptible to such temporary impacts. As the area is subjected to persistent longshore currents, any increase in turbidity would be temporary in nature, and would not likely settle on the bottom. The paucity of corals in the area indicates it is not an ideal habitat for reef development, and the existing corals are pre-adapted to stressful conditions. The present lack of fish indicates that there is little potential for any effect on the existing populations from temporary increases in turbidity (MRC, 2021). Silt curtains would be deployed around areas of active construction to contain and control potential turbidity.

3.7 Protected Species

3.7.1 Marine Species

Listed species, such as sea turtles, Hawaiian monk seals, and humpback whales, can occur in the general project vicinity. No listed endangered or threatened species (USFWS, 2013) were observed during the January 2021 marine surveys. State protected species, such as hermatypic corals, were not observed at the project site.

<u>Sea turtles</u>—Of the sea turtles found in the Hawaiian Islands, only the green sea turtle (*Chelonia mydas)* is common in the project vicinity. In 1978, the green sea turtle was listed as a threatened

species under the Endangered Species Act (ESA; USFWS, 1978, 2001). Since protection, the green sea turtle has become the most common sea turtle in Hawaiian waters with a steadily growing population (Chaloupka et al., 2008). Threats to the green sea turtle in Hawaii include disease and parasites, accidental fishing take, boat collisions, entanglement in marine debris, loss of foraging habitat to development, and ingestion of marine debris (NMFS-USFWS, 1998). Green sea turtle nesting mostly occurs on beaches of the Northwestern Hawaiian Islands, with 90% occurring at French Frigate Shoals (Balazs et al., 1992). Green sea turtles are not known to nest in the project vicinity.

The green sea turtle diet consists primarily of benthic macroalgae (Arthur and Balazs, 2008), which the shallow reefs of the main Hawaiian Islands provide in abundance. Red macroalgae generally make up 78% of their diet, whereas green macroalgae make up 12%. Turbidity (murky water) does not appear to deter green sea turtles from foraging and resting. Green sea turtles are adaptable and tolerant of construction-related disturbances (Brock, 1998a,b). During the January 2021 marine survey, no green sea turtles were observed, although algal food species are found here.

<u>Hawaiian monk</u> seals - The beaches and coastline of Oahu are used by the endangered Hawaiian monk seal (*Monachus schauinslandi*) for hauling out and for pupping and nursing. The majority of monk seal sighting information collected in the main Hawaiian Islands is reported by the general public and is highly biased by location and reporting effort. Systematic monk seal count data come from aerial surveys conducted by the Pacific Islands Fisheries Science Center (PIFSC). Aerial surveys of all the main Hawaiian Islands were conducted in 2000-2001 and 2008 (Baker and Johanos, 2004, PIFSC unpublished data). One complete survey of Oahu was conducted for each of these years. The 2000 survey was conducted from an airplane and the 2001 and 2008 surveys were conducted by helicopter. No Hawaiian monk seals were sighted in the project area during any of the three surveys.

Hawaiian monk seal critical habitat for the island of Oahu is shown in Figure 3-20 (Federal Register, Volume 80, No. 162 published on August 21, 2015). The project area is not considered critical habitat.

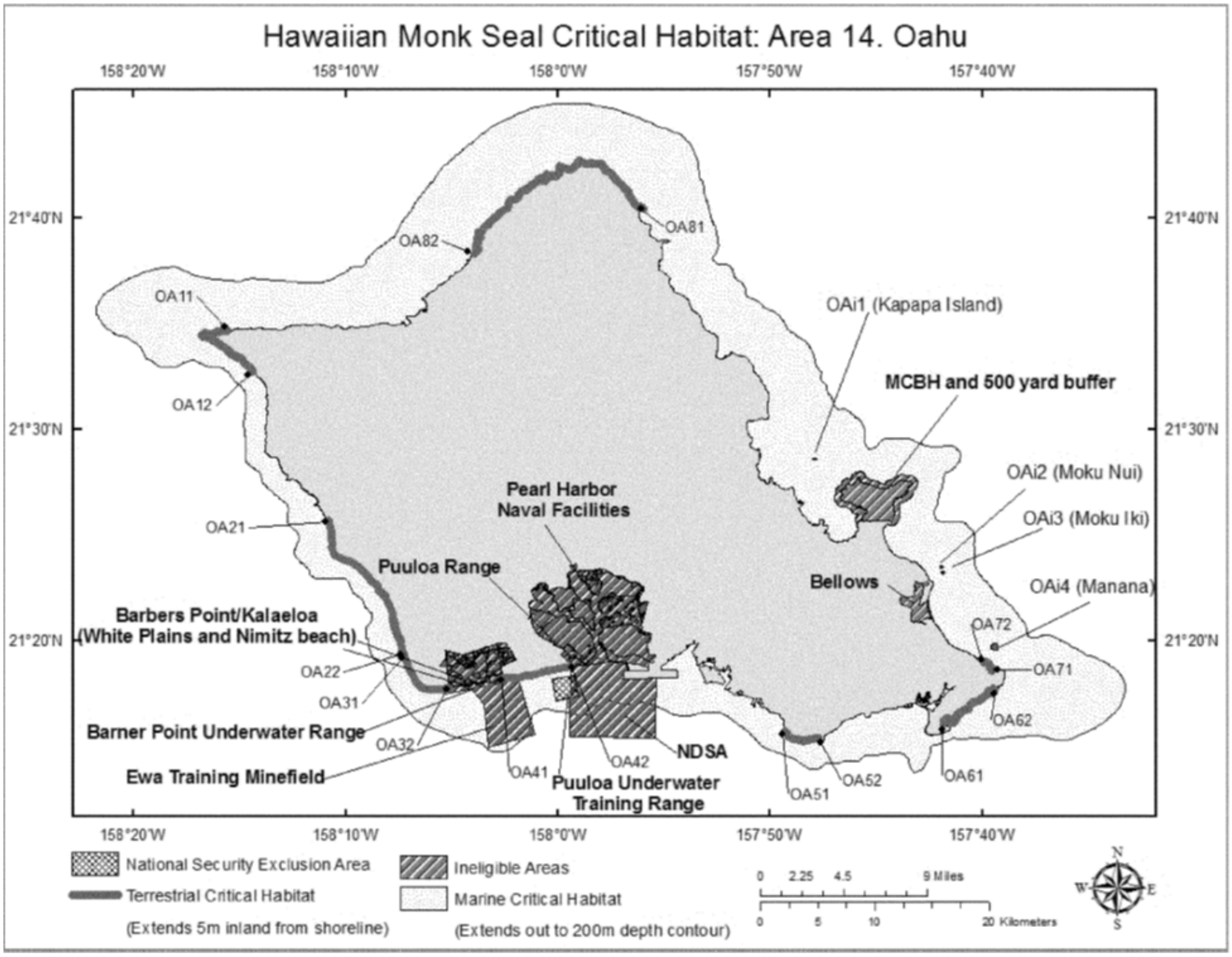


Figure 3-20. Hawaiian Monk Seal Critical Habitat Area14, Oahu

Humpback whales - The humpback whale, or *koholā* (*Megaptera novaeangliae*), was listed as endangered in 1970 under the ESA. In 1993 it was estimated that there were 6,000 humpback whales in the North Pacific Ocean and that 4,000 of these regularly came to the Hawaiian Islands. The population is estimated to be growing at between 4 and 7% per year. Today, as many as 10,000 humpback whales may visit Hawaii each year (HIHWNMS, 2014).

Humpback whales normally occur in Hawaiian waters annually from November to May, with the peak between January and March and can be observed along the windward coast offshore of the project site. However, the wide and shallow fringing reef in the project vicinity prevents whales from nearing the shore. The project will not directly affect humpback whales, and sounds generated from revetment construction activities are not anticipated to be substantial enough to cause an acoustic disturbance to protected species in nearshore waters.

Coral—Coral species are protected under Hawaii State law, which prohibits "breaking or damaging, with any implement, any stony coral from the waters of Hawaii, including any reef or mushroom coral" (HAR §13-95-70, DLNR, 2010). It is also unlawful to take, break or damage with any implement, any rock or coral to which marine life of any type is visibly attached (HAR §13-95-71, DLNR, 2002). No coral would be directly impacted by the project.

3.7.2 Flora

The only flora listed by U.S. Fish and Wildlife Service's (USFWS) Information for Planning and Consultation (IPaC) website and database for the general project vicinity is the flowering plant known as Kauila (*Colubrina oppositifolia*), which is listed as endangered. Kauila is a native Hawaiian tree that grows to a height of 15 to 30 ft and is hardy enough to tolerate the briny soils and salty air of nearshore terrain. It is one of the hardest of all native woods and is in fact so dense it will sink in water. Its wood is prized by woodworkers due to its rarity and difficulty to acquire. No Kauila would be affected by the proposed project. Several coconut palms and milo trees are located within the footprint of the proposed revetment, and these would require removal.

3.7.3 Fauna

Hawaiian hoary bat, *ope'ape'a* (*Lasiurus cinereus semotus*) - The Hawaiian hoary bat roosts in both exotic and native woody vegetation and, while foraging, will leave young unattended in "nursery" trees and shrubs when they forage. If trees or shrubs suitable for bat roosting are cleared during the breeding season, there is a risk that young bats could inadvertently be harmed or killed since they are too young to fly or may not move away. To minimize impacts to the endangered Hawaiian hoary bat, woody plants greater than 15-feet (4.6 meters) tall should not be disturbed, removed, or trimmed during the bat birthing and pup rearing season (June 1 through September 15). Site clearing would be timed to avoid disturbance to Hawaiian hoary bats in the project area.

Birds - Several bird species, including wetland, forest, and sea birds are listed for the general project vicinity. A summary of these bird species and their endangered status is provided in Table 3-10. Two species of sea birds were listed, the Band-rumped Storm-petrel and the Short-tailed albatross. Sea birds fly at night and are attracted to artificially lighted areas which can result in disorientation and subsequent fallout due to exhaustion or collision with objects such as utility lines, guy wires, and towers that protrude above the vegetation layer. Once grounded, they are vulnerable to predators or often struck by vehicles along roadways. Any increase in the use of night-time lighting, particularly during each year's peak fallout period (September 15 through December 15), could result in additional seabird injury or mortality. Project construction would not involve nighttime work or any new/additional lighting.

Table 3-10. List of endangered birds listed for Kaaawa Beach Park area

Common Name	Scientific Name	Status
\`I\`iwi	Drepanis coccinea	Threatened
Band-rumped Storm-petrel	Oceanodroma castro	Endangered
Hawaiian Duck - koloa	Anas wyvilliana	Endangered
Hawaiian Common Gallinule	Gallinula galeata sandvivensis	Endangered
Hawaiian Coot	Fulica americana alai	Endangered
Hawaiian Stilt	Himantopus mexicus knudseni	Endangered
Newell's Townsend's Shearwater	Puffinus auricularis newelli	Threatened
Oahu Creeper	Paroreomyza maculate	Endangered
Oahu Elepaio	Chasiempis ibidis	Endangered
Short-tailed Albatross	Phoebastria albatrus	Endangered

3.7.4 Potential Impacts and Mitigation Measures

The project area is fronted by a wide, shallow reef flat. Green sea turtles are not commonly seen foraging in the nearshore waters or nesting in the area. Turtles would be expected to move away from the construction activities, and as the impact area is very small and primarily on sandy bottom construction would not significantly affect turtle foraging area. Hawaiian monk seals are also not commonly observed in the project vicinity. Construction of the groin will not involve in-water work, such as pile driving, which could be expected to result in significant underwater sound that would adversely affect marine creatures. Endangered Humpback whales can regularly be seen in Hawaiian waters during the winter; however, the shallow nearshore waters prevent them from coming close to shore. The project area has not been designated as critical habitat by the Federal Government or the State of Hawaii for endangered species.

The following Best Management Practices (BMPs) and avoidance and minimization measures, as typically recommended by the U.S. Fish and Wildlife Service and NOAA-National Marine Fisheries Service pursuant to Section 7 of the Endangered Species Act for federally listed threatened and endangered species, will be implemented.

1. Turbidity containment devices (silt curtains) shall be installed around the area of groin construction, sand recovery, and sand placement.
2. Visual monitoring for turbidity outside the confines of the silt curtains shall be conducted. In the event that turbidity is observed outside of the silt curtains, work shall stop, and the silt curtains shall remain in place until the turbidity dissipates. Silt curtains shall be inspected after dissipation and prior to returning to project operations.
3. All construction personnel on site shall be informed of the potential for endangered species that may occur within or transit through the project area. It shall be made clear that any intentional physical interactions with identified threatened or endangered species is explicitly prohibited.
4. A competent observer shall be designated to observe the construction work areas and areas immediately adjacent to the work for the presence of federally listed species, including but not limited to, green sea turtles, hawksbill sea turtles, and Hawaiian monk seals. Visual

surveys for these species shall be made prior to the start of work each day and prior to resumption of work following any break of more than one half hour to ensure that no protected species are within 150 feet of the work area. The construction areas include both in-water areas as well as beach areas, as shown on the construction plans.

5. A 150-foot safety zone shall be established around the project area where a competent observer shall visually monitor the zone for the presence of marine protected species 30 minutes prior to and 30 minutes post-project in-water activity. The observer shall record information on the species, numbers, behavior, time of observation, location, start and end time of project activity, characteristics of the marine species, and any observed disturbances of the work on the species (visual or acoustic).
6. Activity shall be conducted only if the safety zone is clear of all marine federally protected species.
7. Upon sighting of a marine federally protected species within the safety zone during project activity the activity shall immediately halt until the animal has left the zone. In the event that a protected species enters the safety zone and the project activity cannot be halted, observations shall be made, and NOAA-NMFS staff in Honolulu shall be immediately contacted to facilitate agency assessment of collected data. Work may continue only if there is no possibility for the activity to adversely affect the animal.
8. All equipment and material shall be free of contaminants of any kind including excessive silt, sludge, anoxic or decaying organic matter, clay, dirt, oil, floating debris, grease, foam, or any other pollutant that would produce an undesirable condition to the shoreline or water quality.
9. Cease construction work if unusual conditions, such as large tidal events or high surf conditions, affect the project site, except for efforts to avoid or minimize damage to natural resources, such as the temporary removal of silt curtains.
10. Construction site inspections and debris sweeps will be made at the end of each workday, and all project-related debris and trash shall be removed and disposed of. Equipment that is not actively being used shall be properly stored and secured so as not to cause unintended damage to the beach or adversely affect federally listed and endangered species. A full inspection of the project site shall be conducted at the end of the project to ensure that no visible debris or project waste is present upon completion of the project.
11. Nighttime work and/or work requiring artificial light sources is prohibited. No new permanent lighting shall result from this project.
12. Any incidental injuries or take of green or hawksbill sea turtles on land shall be immediately reported to the U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office at (808) 792-9400, and the Army Corps of Engineers at (808) 835-4303 and CEPOH-RO@usace.army.mil. Similarly, any incidental injury or take of green or hawksbill sea turtle or monk seal in the water shall be immediately reported to NOAA-NMFS 24-hour hotline at 1-888-256-9840, and the Corps at (808) 835-4303 and CEPOH-RO@usace.army.mil. The incident should also be reported to the Pacific Island Protected Species Program Manager, Southwest Region, (808) 973-2987.

By using the above BMPs, noise/physical disturbance to green sea turtles and Hawaiian monk seals is expected to be temporary and insignificant and not result in adverse behavioral changes.

Based on the in-water work being conducted in very shallow water with turbidity containment barriers surrounding the work area, any exposure of marine protected species to turbidity is expected to be temporary and not significant. There would be no loss of turtle foraging area.

3.8 Water Quality

3.8.1 Existing Conditions

The waters offshore of the project site are classified in the Hawaii Water Quality Standards (HDOH, 2012) as (a) marine waters, (b) open coastal, (c) reef flat, (d) Class A, and (e) Class II marine bottom ecosystem. It is the objective of Class A waters that their use for recreational purposes and aesthetic enjoyment be protected. Other uses are permitted as long as compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. Class A waters shall not act as receiving waters for any discharge which has not received the best degree of treatment or control.

State water quality criteria for open coastal marine waters incorporate "wet" and "dry" criteria values based on the average percent of freshwater inflow, where terrestrial freshwater input exceeds three million gallons per day, wet criteria are applied; where the freshwater input is less than three million gallons per day, dry criteria apply. There is a DOH Clean Water Branch Water Quality Sampling Site at Kaaawa Beach Park (Site 000179) located just south of the restroom structure, at the shoreline of the project site. Shown in Table 3-11 are the averages of the parameters measured at that site from 2005 to 2020.

Table 3-11. Average values for parameters at DOH CWB Site 000179

Variable	Average
Clostridium (CFU/100mL)	2.183
Enterococcus (CFU/100mL)	16.511
Water Temperature (°C)	24.569
Salinity (PSU)	34.202
Turbidity (NTU)	2.615
Dissolved Oxygen (mg/L)	5.835
Oxygen Saturation (%)	86.422
pH	7.891

Project site water quality investigations were conducted on January 3, 2021, and the detailed results are provided in Appendix A. Water quality constituents included all specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (b) (Open Coastal Waters) of the State Department of Health Water Quality Standards. These include total nitrogen, nitrate + nitrite nitrogen, ammonium nitrogen, total phosphorus, chlorophyll α, turbidity, temperature, pH, and salinity. In addition, dissolved silica and orthophosphate phosphorus were measured as these are indicators of biological activity and the degree of groundwater mixing. The measurements showed several patterns of constituent distribution, the dissolved nutrients silica (Si) and nitrate + nitrite ($NO3$) showed a progressive decrease in concentration with distance from the shoreline, and salinity displayed the opposite trend. As there were no streams discharging to the ocean at the time of the sampling, the horizontal gradients of these constituents likely represent groundwater flow to the ocean near the shoreline. However, the gradients were relatively small, indicating only low volume groundwater discharge. The distributions of turbidity and chlorophyll α also showed the highest values near shore. This is likely due to the suspension of fine-grained particulate material, including plant fragments, by breaking waves in the nearshore zone and on the shoreline. None of the dissolved nutrient constituents exceeded Water Quality Standards for the "not to exceed more than 10% of the time" criteria. However, all measured values of turbidity exceeded the 10% criteria.

3.8.2 Potential Impacts and Mitigation Measures

None of the water quality parameters are likely to be affected beyond the range of natural variability by the proposed project. Silt curtains will be deployed to contain/control turbidity around the limited areas of actual construction in the water. All stone would be washed and clean of earthen and other deleterious material.

3.9 Noise

3.9.1 Existing Conditions

Hawaii Administrative Rules §11-46, "Community Noise Control" establishes maximum permissible sound levels (see allowable levels summarized in Table 3-12) and provides for the prevention, control, and abatement of noise pollution in the State from stationary noise sources and from equipment related to agricultural, construction, and industrial activities. The standards are also intended to protect public health and welfare and to prevent the significant degradation of the environment and quality of life. The limits are applicable at the property line rather than at a selectively pre-determined distance from the sound source. HAR §11-46-7 grants the Director of the Department of Health the authority to issue permits to operate a noise source that emits sound in excess of the maximum permissible levels specified in Table 3-12 if it is in the public interest; however, it may be subject to reasonable conditions. Those conditions can include requirements to employ the best available noise control technology.

Existing ambient noise levels vary considerably within the project temporally (i.e., from one time to another), but in general, existing background levels at the project site can be relatively high due to its proximity to Kamehameha Highway. During peak commute times in the early morning and late afternoon, and midday during weekends and holidays, traffic levels at the site can be quite high, and the amount of vehicular noise generated during those periods can therefore also be elevated.

Table 3-12. Maximum permissible sound levels in dBA

Zoning Districts	Daytime (7 a.m. to 10 p.m.)	Nighttime (10 p.m. to 7 a.m.)
Class A	55	45
Class B	60	50
Class C	70	70

Table Notes:
(1) Class A zoning districts include all areas equivalent to lands zoned residential, conservation, preservation, public space, open space, or similar type.
(2) Class B zoning districts include all areas equivalent to lands zoned for multi-family dwellings, apartments, business, commercial, hotel, resort, or similar type.
(3) Class C zoning districts include all areas equivalent to lands zoned agriculture, country, industrial, or similar type.
(4) The maximum permissible sound levels apply to any excessive noise source emanating within the specified zoning district, and at any point at or beyond (past) the property line of the premises. Noise levels may exceed the limit up to 10% of the time within any 20-minute period. Higher noise levels are allowed only by permit or variance issued under sections 11-46-7 and 11-46-8.
(5) For mixed zoning districts, the primary land use designation is used to determine the applicable zoning district class and the maximum permissible sound level.
(6) The maximum permissible sound level for impulsive noise is 10 dBA (as measured by the "Fast" meter response) above the maximum permissible sound levels shown.

Source: Hawaii Administrative Rules §11-46, "Community Noise Control"

3.9.2 Potential Impacts and Mitigation Measures

It is not feasible to mitigate construction noise to the extent that it does not at times exceed existing background noise levels or is inaudible to nearby residents. The noise impact is also exacerbated by the presence of Kaaawa Elementary School immediately *mauka* (landward) of the project site. Some noise reduction is practical, however, and the following measures would be implemented.

- Equipment operation on the shoreline will be limited to the hours between 7:30 am and 5 pm.
- Broadband noise backup alarms in lieu of higher frequency beepers will be required for construction vehicles and equipment. Broadband noise alarms tend to be less audible and intrusive with distance as they blend in with other background noise sources.
- The project will specify the use of the quietest locally available equipment, e.g., high insertion loss mufflers, fully enclosed engines, and rubber-tired equipment when possible.
- The use of horns for signaling will be prohibited.
- Worker training on ways to minimize impact noise and banging will be required.

3.10 Historic, Cultural, and Archaeological Resources

3.10.1 General History

International Archaeology, LLC (IA) conducted a review of historic documents pertaining to the project area to support the permit and approval process and consultation with agencies such as the State Historic Preservation Division. The following discussion is taken from the IA study report.

The literal translation of Kaaawa is "the yellow wrasse", which is a common Hawaiian reef food fish. An alternate interpretation refers to the broad reef passage (*awa*) that exposes the shoreline to northern swells. A traditional Hawaiian *'olelo no'eau* notes the dynamic geomorphology of Kaaawa's coastal landscape: *"He kai 'a'ao ko Ka'a'awa"* (Kaaawa has a sea that wears away the land – which seems apt given the documented erosion of the shoreline. The *ahupua'a* of Kaaawa is mentioned in numerous legends beginning as early as the 1300's AD. Unfortunately, early (pre-western contact) settlement of the area is poorly documented. Missionary records from the 1830s indicate that several hundred people lived in Kaaawa, and less than 3,000 in the entire district of Koolauloa. The mid-19th century Mahele, which divided the land among the king, chiefs, and the government, introduced private land ownership to Hawaii. The majority of Kaaawa Valley was purchased by Dr. Gerrit P. Judd in 1870 and became Oahu Plantation and later Kualoa Ranch Ltd. in 1927. Also, in 1927 the Kaaawa Military Reservation was established to support the Jungle Warfare Center in Kahana Valley. This was located approximately where Swanzy Beach Park is today. The reservation land was returned to the Territory of Hawaii in 1953. Kaaawa Elementary School, directly landward of the project site was founded in 1904 and is one of the longest continuously operating public elementary schools in the state.

Kamehameha Highway, as a modern paved automobile roadway, was constructed along the Ko'olauloa coastline during the late 1920s. The modern road was constructed on top of the 19th century coastal government road known as the Alanui Aupuni, which in turn followed the same path as a pre-Contact trail documented in the earliest historical records. The highway in Kaaawa was severely damaged by a tsunami in 1946.

3.10.2 Archaeology

Only a relatively small number of archaeological investigations have been conducted in the Kaaawa area, which is attributable to the limited development of this rural area. Many of the archaeological investigations have been in response to inadvertent discoveries of human skeletal remains, and others are small archaeological inventory surveys and monitoring projects, all of which were close to the coast. No large landscape-scale archaeological inventory surveys have been completed in Kaaawa and knowledge about the archaeological record of the mauka area is lacking.

McAllister (1933) included Kaaawa in his island-wide reconnaissance survey, which was primarily focused on monument features (e.g., heiau) and traditional sites in oral history. However, McAllister did document human remains eroding out of the beach berm south of the project site. More recently numerous inadvertent burials have been documented, at least 20 traditional Hawaiian burials (or fragmentary remains) have been documented along the coastline of Kaaawa Ahupua'a. Investigation of one burial site between 1991 and 2017 has shown not only traditional Hawaiian materials and burials but also a small amount of post-Contact material has been found in the deposit. This suggests that this paleosurface was used spanning Contact, or that materials from more recent times have been introduced down into the deposit by mechanical, erosional, or other means. Radiocarbon dates place the age of this deposit sometime between the early 1800s and the first half of the 1900s.

3.10.3 Potential Impacts and Mitigation Measures

Construction of the project would involve a very small amount of excavation in a dynamic and already heavily altered sand and sediment shoreline bank; thus, the discovery of archaeological remains is considered unlikely.

3.11 Recreation

The relatively calm shoreline conditions and narrow sand beach make Kaaawa Beach Park and project vicinity an ideal location for coastal recreation, and the shoreline is heavily utilized by the local community. The broad offshore reef helps dissipate wave energy allowing for year-round use by shoreline fisherman, snorkelers, swimmers, paddlers, sailors, surfers, and spearfishermen. On weekends the park and adjacent shoreline are crowded with people. The proposed project would result in temporary shoreline recreation impacts during construction but would not result in long-term recreation impacts.

3.12 Socio-Economic Setting

Kaaawa is a rural Oahu middle-class community with primarily modest homes and a very “local” population. Many families have lived here for generations. There is no business or commercial activity, except for a post office, gas station and 7-11 convenience store, and a small barbeque restaurant. The proposed project would not alter the existing community setting.

3.13 Scenic and Aesthetic Resources

The coastal highway along the Windward coast of Oahu is a very scenic drive, with the ocean view only occasionally obstructed by homes. The proposed revetment crest would be the same as the highway elevation, so it would not obstruct the view. While the revetment would have an obvious man-made look to it, it would be constructed of native basalt rock and would not look unlike much of the rocky windward coast. Numerous locations on the Windward coast have rock revetment protection for the highway, and this project would look the same.

3.14 Public Infrastructure and Services

3.14.1 Transportation

Kamehameha Highway extends from Kaneohe near the east end of the island along the northeast (Windward) coast to the North Shore town of Haleiwa. It is the only highway connecting the coastal communities of Kaneohe, Kahaluu, Kaaawa, Punaluu, Hauula, Laie, and Kahuku. The HDOT records the Annual Average Daily Vehicle Traffic count as 13,000 vehicles. It is the primary access for police, fire, and emergency medical vehicles. If the ongoing erosion forces closure of the highway at the project site all vehicles would have to detour through narrow backshore residential streets to bypass the closure, including trucks, busses, emergency vehicles, and commuters going to work. The proposed project would eliminate this possible significant impact on transportation in Kaaawa.

Project construction will require some closure the closure of the northbound (makai) lane during periods of active construction activity. Closure would be limited to the hours of 8:30 am to 3:30

pm Monday – Friday. No work would be permitted on weekends or State holidays. A traffic control plan will be utilized to manage traffic flow during periods of the lane closure.

3.14.2 Water

The Honolulu Board of Water Supply (BWS) is responsible for Oahu's municipal water system, an integrated, island-wide system with interconnections between water sources and service areas. No BWS pipelines or other facilities are present on the makai side of the highway or in the construction area.

3.14.3 Telecommunication and Electric Power

Telecommunication and power lines are located mauka of the highway and would not be affected by the proposed project. One power pole guy wire pole is located on the makai side within the project footprint, and temporary stabilization of the power pole will be required during construction. The existing guy wire configuration will be replaced following the completion of construction.

3.14.4 Schools

Kaaawa Elementary School is located immediately makai of the project site. Construction activity will result in some noise and access impacts to the school. Construction noise mitigation measures as discussed in section 3.9.2 will be utilized.

3.14.5 Police, Fire, and Emergency Medical Services

The Kaaawa area is served by the Honolulu Police Department District 4, which covers the area from Waimanalo to Kahuku. The Kaneohe Substation is located approximately 11 miles south of the project site. The Kaaawa Fire Station is located immediately north of the project site, and also provides emergency medical services. The nearest medical clinic (Kaiser Koolau) is located in Kaneohe.

Potential highway damage and closure would adversely affect access and response time for emergency vehicles. The proposed project would eliminate this adverse impact.

4. RELATIONSHIP TO RELEVANT PLANS AND POLICIES

4.1 Hawaii State Plan

The Hawaii State Planning Act (Chapter 226 HRS) establishes a statewide planning system that provides goals, objectives, and policies that detail priority directions and concerns of the State. Specific objectives and policies of the State Plan that pertain to the project are as follows.

Section 226-11 Objectives and policies for the physical environment – land-based, shoreline, and marine resources.

- *(a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:*
  - *(1) Prudent use of Hawaii's land-based, shoreline, and marine resources.*
  - *(2) Effective protection of Hawaii's unique and fragile environmental resources.*
- *(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:*
  - *(1) Exercise an overall conservation ethic in the use of Hawaii's natural resources.*
  - *(2) Take into account the physical attributes of areas when planning and designing activities and facilities.*
  - *(3) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.*
  - *(4) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.*
  - *(5) Pursue compatible relationships among activities, facilities, and natural resources.*

Discussion: The project's use of the area is consistent with State and County land use districts and zoning designations. No endangered plant species, animal species, or habitats are found in the project area. The project is not anticipated to pose threats to Native Hawaiian endangered plant or animal species or habitats. However, as noted in Section 3.7.1 the federally listed threatened green sea turtle may be found in the project area. NOAA-NMFS recommended turtle avoidance procedures will be utilized during construction to avoid potential impacts.

Construction activities will be limited to daylight hours and will not use construction work lights in order to avoid attracting seabirds or disorienting sea turtles. The project has minimal intrusion into the marine environment and is not anticipated to have significant or substantial impacts on environmental and marine resources.

Section 226-12 Objectives and policies for the physical environment – scenic, natural beauty, and historic resources.

- *(a) Planning for the State's physical environment shall be directed towards achievement of the objective of enhancement of Hawaii's scenic assets, natural beauty, and multi-cultural/historical resources.*
- *(b) To achieve the scenic, natural beauty, and historic resources objectives, it shall be the policy of the State to:*
  - *(1) Promote the preservation and restoration of significant natural and historic resources.*

(2) *Promote the preservation of views and vistas to enhance the landscapes, and other natural features.*
(3) *Encourage the design of developments and activities that complement the natural beauty of the islands.*

Discussion: The project will not result in adverse impacts to existing scenic vistas or archaeological/historical resources at the project site. The proposed revetment crest elevation is the same as the adjacent shoreline/highway elevation, thus it will not block the seaward vista. The rock revetment will be similar in appearance to other nearby natural and manmade rocky shorelines. A historical/archaeological literature review was conducted for the project, and no effects on historical or archaeological resources are anticipated. The project involves minimal excavation on the shoreline.

Section 226-13 Objectives and policies for the physical environment – land, air, and water quality.
- *(a) Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:*
  - *(1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.*
- *(b) To achieve the land, air, and water quality objectives, it shall be the policy of the State to:*
  - *(1) Promote the proper management of Hawaii's land and water resources.*
  - *(2) Reduce the threat to life and property from erosion, flooding, tsunamis, hurricanes, earthquakes, volcanic eruptions, and other natural or man-induced hazards and disasters.*
  - *(3) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.*

Discussion: The proposed project will eliminate the significant threat to important public infrastructure, the primary highway access for Windward Oahu communities, due to chronic shoreline erosion. The project is appropriately scaled and will not adversely affect coastal resources. Use of Construction Best Management Practices will minimize adverse effects to land, air, and water quality.

4.2 Hawaii State Land Use District

Under Chapter 205 HRS, all lands of the State are to be classified in one of four categories: urban, rural, agricultural, and conservation lands. The Urban district generally includes lands characterized by "city-like" concentrations of people, structures, and services. The Conservation district includes all coastal marine waters.

Discussion: The project site is located within the State Urban District, and the project is consistent with permitted uses for the Urban District. It will not require district reclassification to amend the existing land use designation. A portion of the revetment is also located in the Conservation District (Resource Subzone), and thus will require a Conservation District Use Permit from the State Department of Land and Natural Resources.

4.3 Hawaii Coastal Zone Management

The Coastal Zone Management Act of 1972 (16 USC Section 1451) created the coastal management program and the National Estuarine Research Reserve. The Hawaii Coastal Zone Management (CZM) Program received federal approval in the late 1970s. The objectives of the State's CZM Program as stated in Chapter 205A-2 HRS are to protect valuable and vulnerable coastal resources such as coastal ecosystems, special scenic and cultural values, and recreational opportunities. The objectives are also to reduce coastal hazards and to improve the review process for activities proposed within the coastal zone.

<u>Discussion</u>: The project is generally consistent with the CZM Program Objectives and policies. Implementation of the proposed project will mitigate a significant coastal hazard to the existing primary highway serving the Windward coast.

4.4 City and County of Honolulu General Plan

The General Plan for the City and County of Honolulu (1992 Edition, amended in 2002, Revised General Plan submitted to the City Council April 2018) sets for the long-range objectives for the general welfare and prosperity for the people of Oahu and broad policies to obtain those objectives. The project is consistent with the applicable objectives and policies of the City and County of Honolulu Revised 2035 Oahu General Plan described below.

<u>*Natural Environment*</u>
Objective A: To protect and preserve the natural environment.

- *Policy 1: Protect Oahu's natural environment, especially the shoreline, valleys, and ridges from incompatible development.*
- *Policy 2: Seek the restoration of environmentally damaged areas and natural resources,*
- *Policy 4: Require development projects to give due consideration to natural features such as slope, flood and erosion hazards, water-recharge areas, distinctive landforms, and existing vegetation, as well as plan for coastal hazards that threaten life and property.*
- *Policy 7: Protect the natural environment from damaging levels of air, water, and noise pollution.*
- *Policy 8: Protect plants, birds, and other animals that are unique to the State of Hawaii and the island of Oahu and protect their habitats.*

Objective B: To preserve and enhance natural landmarks and scenic views of Oahu for the benefit of both residents and visitors as well as future generations.

- *Policy 2: Protect Oahu's scenic views, especially those seen from highly developed and heavily traveled areas.*
- *Policy 4: Promote public access to the natural environment for recreational, educational, and cultural purposes and the maintenance thereof in a way that does not damage natural or cultural resources.*

<u>*Public Safety and Community Resilience*</u>
Objective B: To protect residents and visitors and their property against natural disasters and other emergencies, traffic and fire hazards, and unsafe conditions.

- *Policy 2: Require all developments in areas subject to floods and tsunamis, and coastal erosion, to be located and constructed in a manner that will not create any health or safety hazards or cause harm to natural and public resources.*

<u>Culture and Recreation</u>
Objective B: To protect, preserve and enhance Oahu's cultural, historic, architectural, and archaeological resources.

- *Policy 2: Identify, and to the extent possible, preserve and restore buildings, sites, and areas of social, cultural, historic, architectural, and archaeological significance.*

Objective D: To provide a wide range of recreational facilities and services that are readily available to residents and visitors alike, and to balance access to natural areas with the protection of those areas.

- *Policy 7: Ensure and maintain convenient and safe access to beaches, ocean environments, and mauka recreation areas in a manner that protects natural and cultural resources.*

<u>Discussion:</u> The project supports the objectives of the Revised General Plan Update, including:

- Protects existing highway infrastructure from damage due to chronic shoreline erosion.
- Eliminates a coastal safety hazard resulting from shoreline erosion.
- Does not affect scenic views from the coastal highway travel way.
- Does not affect natural or cultural resources.
- Construction Best Management Practices will be utilized to prevent adverse impacts on the natural environment.
- No impacts to historic/archaeologic sites are anticipated.
- Use of existing shoreline recreation opportunities will be maintained.

4.5 City and County of Honolulu Koolau Loa Sustainable Communities Plan

The Koolau Loa Sustainable Communities Plan (adopted January 2021) seeks to preserve Koolau Loa's country character and distinctive sense of "old Hawaii". It includes policies that define how community needs should be balanced with the protection and enhancement of Koolau Loa's spectacular natural, scenic, and cultural qualities. Transportation systems are addressed in the plan, including Kamehameha Highway as "*the only roadway linking the northerly windward Oahu coastline communities to the North Shore to the west and Koolau Poko to the southeast" … "Planned highway improvements include a long-term bridge replacement program, shoreline reinforcement in areas such as Kaaawa, Punaluu, and Hauula where coastal erosion has impacted Kamehameha Highway…"*

4.6 Ola: Oahu Resilience Strategy

The Office of Climate Change, Sustainability, and Resiliency (OCCSR) was established in 2016 and tasked with tracking climate change science and its potential impacts, as well as developing a resiliency strategy. OCCRS published Ola: Resilience Strategy in May 2019. One of the Strategy goals is Pre-Disaster Preparation.

Discussion: The project site is directly exposed to natural hazards approaching from the north and east. The proposed project is consistent with the Strategy's goals for pre-disaster preparation – protection against shoreline erosion and highway damage associated with natural hazards. The proposed revetment stone size design incorporates a Sea Level Rise (SLR) of 1.7 feet, presently estimated to occur by the year 2050. However, the project is not a response to possible future seal level rise.

5. FINDINGS SUPPORTING THE ANTICIPATED DETERMINATION

5.1 Proposed Project

The existing stretch of Kamehameha Highway within the proposed area of mitigative activities—which is generally defined as the shoreline fronting Kaaawa Elementary School—is routinely overtopped during periods of extreme high tides or elevated surf, which has left the road shoulder dangerously undermined and cracked in many places. The highway serves as the only route of transportation for a number of isolated windward Oahu communities. A primary objective of the proposed project is to protect the threatened stretch of primary roadway from future collapse due to progressive erosion.

The proposed action consists of installing an approximately 450-ft long rock (riprap) revetment to front of the existing shoreline erosion scarp, which supports portions of the existing road shoulder. The riprap revetment is a sloping, permeable, un-cemented structure built of wave resistant material. A typical cross section of the proposed structure would start with an underlayment of geotextile filter cloth to form a base that protects the underlying sediments from dissolving and eroding, followed by a core layer of smaller stone, upon which an outer armor layer of larger stone units is placed, forming the complete revetment section.

A riprap revetment is the preferred option because it is a longer-term solution for the protection of the critical roadway, which also minimizes reflected energy at the shoreline. Lateral access to the beach is expected to improve following the installment of the revetment due to the absorptive and permeable nature of rock revetments. Revetments generally tend to better facilitate sand deposition than do vertical earthen embankments like the existing condition.

5.2 Anticipated Determination

Based on a review of the significance criteria outlined in Chapter 343 HRS and Chapter 11-200.1-13 HAR, the project has been determined to not result in significant adverse effects on the natural or human environment. A Finding of No Significant Impact (FONSI) is anticipated.

5.3 Reasons Supporting the Anticipated Determination

The project is not expected to significantly alter or affect presently ongoing shoreline processes, wave-driven currents, circulation patterns, overall water quality, or offshore wave breaking. The construction activities have been designed to avoid and minimize impacts to marine biota so far as practicable, and no long-term impacts to marine biota are anticipated. The riprap revetment will be placed on existing nearshore sand and rubble deposits; thus, there should be no significant loss of marine habitat. The rock apron may benefit the nearshore ecosystem by providing habitat for fish, *opihi,* and other marine biota. Construction Best Management Practices (BMPs)will be used to avoid impacts to the environment and protected marine species, such as the green sea turtle (See Appendix B).

Chapter 343, Hawaii Revised Statutes (HRS), and Hawaii Administrative Rules (HAR) §11-200.1 establish certain categories of action that require the agency processing an applicant's request for approval to prepare an environmental assessment. HAR §11-200.1-11 establishes procedures for the determination of whether an environmental assessment (EA) is sufficient or whether an Environmental Impact Statement (EIS) should instead be prepared due to actions that may have a significant effect on the environment. HAR §11-200.1-13(b) lists the following significance criteria to be used when making such a determination.

(1) Involves an irrevocable commitment to, loss, or destruction of any natural or cultural resource.

Installment of the engineered riprap protection is expected to stabilize the adjacent beach and backshore area, which includes two lanes of roadway forming Kamehameha Highway and Kaaawa's public elementary school beyond that. Currently, the shoreline of interest is hardened with a mixture of temporary un-engineered emergency repairs completed by the State DOT during multiple efforts that are failing in multiple locations. Continued progressive failure of the existing non-engineered shore protection measures would further destabilize the 450-foot-long project shoreline, likely resulting in significant undermining and subsequent collapse, or partial collapse, of the motorway. Further failure of the unprotected earthen slope that supports the roadway would result in a sudden and possibly continued release of backshore material, including harmful silts and clays, into the intertidal and nearshore waters. The proposed project would install a stable riprap revetment with an appropriate filter cloth foundation, greatly reducing the likelihood of slope failure and nearshore water quality degradation.

There are no significant flora or fauna which would be lost due to the emplacement of an engineered riprap revetment on the project shoreline. No threatened or endangered species would be impacted by the project. No known cultural resources are located on the property.

The Kaaawa area has a rich historical and cultural legacy. However, two aspects of the project make it unlikely that it would have a significant adverse effect on historic or archaeological sites:

1) Implementation of the project does not involve construction on or excavation of backshore land areas that might contain physical remains. Care will be taken when working on the beach to avoid disturbing previously undisturbed sandy sediments that might hide subsurface deposits. However, large changes in observed seasonal beach shape at this location suggest very limited, if any, portions of the beach remain undisturbed for more than several months.
2) Construction of the revetment would take place between the sandy beach and the existing road shoulder. Due to the previous construction of the highway, it is unlikely that construction of the revetment will involve modification of any previously undisturbed soft earthen deposits, which could reasonably be expected to have the potential to hide archaeological materials or burials.

There do not appear to be any known traditional Hawaiian cultural practices that would be adversely affected by the proposed project, nor is it expected that the activities associated with the project will conflict with traditional cultural practices as expressed in legend. The proposed project would be accomplished in an area that has been substantially altered by natural as well as anthropomorphic processes, where the existence of any cultural artifacts or remains is very unlikely. Based on this assertion, the proposed project is unlikely to have an adverse effect on rights customarily and traditionally exercised for subsistence, cultural, and religious purposes. In the unlikely event that cultural artifacts or remains are found during the installation of the riprap structure, construction activities will cease immediately, and the proper authorities will be contacted.

(2) Curtails the range of beneficial uses of the environment.

Permeable rock revetment structures are intrinsically designed to absorb a significant fraction of incoming wave energy. Reducing the level of potentially harmful reflected waves, which tend to energize nearfield erosional processes. Beach sand levels may potentially increase in the vicinity of the revetment due to the reduction in wave energy resulting from the revetment.

No negative impact on public lateral access to the shoreline is expected. Once the revetment is installed, public lateral access to the shoreline is anticipated to improve. There are no expected impacts to fishing or other cultural activities on the reef flat seaward of the project site.

(3) Conflicts with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 343, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders.

The proposed project is consistent with Hawaii's State Environmental Policy as established in Chapter 343(4)(A), HRS, to establish, preserve, and maintain recreation areas, including the shoreline, for public recreational use. The proposed Riprap Revetment is located within Conservation land and in designated critical habitat for the Hawaiian Monk Seal, as discussed in Section 3.8.2: Protected Species in this EA. In consultation with the U.S. Fish and Wildlife Service (USFWS) and the National Oceanic and Atmospheric Administration (NOAA) Fisheries, Section 7.1 includes a discussion of mitigation measures should there be a siting of rare, threatened, or endangered species during the construction of the proposed Riprap Revetment. If endangered or threatened species are encountered, all Best Management Practices (BMPs) and mitigation measures will be implemented (Section 7).

(4) ***Substantially affects the economic welfare, social welfare, and cultural practices of the community or State.***

The project would have no adverse social or economic impact on the state. The Riprap Revetment is expected to have some positive economic impact to the applicant as it has been designed to reduce return wave energy reflected by the current shore protection and reduce the forces causing sinkholes and undermining damaging the roadway.

(5) Substantially affects public health.

The proposed project is expected to have no adverse public health impacts. The contractor will be required to provide ample clearance for emergency vehicles at all times. The proposed project does not involve any activities that would permanently alter the need for or ability to provide emergency services.

(6) Involves substantial secondary impacts, such as population changes or effects on public facilities.

The project is not expected to alter the existing land use pattern in and around the project site. The proposed project is not expected to affect public infrastructure and services. The proposed Riprap Revetment has little potential to affect public infrastructure and services. The project is intended to protect the critically important public roadway. Once in operation, it will not require water or electrical power. In and of itself, it does not generate a need for additional sanitary wastewater collection and treatment facilities, and it would not affect stormwater runoff that might impact the City's stormwater system. Most people visiting that end of the beach would come by foot rather than in vehicles, and the improvements are not expected to increase the resident or visitor population of the island.

(7) Involves a substantial degradation of environmental quality.

The project is not expected to have significant long-term adverse environmental impacts, nor is it expected to degrade environmental quality. The project should not permanently degrade water quality nor impact marine flora and fauna. Reduced return wave energy from the revetment would decrease natural nearshore turbidity generated during wave and swell events and could promote beach accretion. In addition, the proposed Riprap Revetment would be visually and environmentally consistent with much of the neighboring shoreline.

(8) Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions.

The proposed Riprap Revetment would be a stand-alone project, with no cumulative impacts or commitment for larger actions. Its intended purpose is to protect the critically important public roadway from erosion damage. It will also improve long-term protection of the backshore.

(9) Substantially affects a rare, threatened, or endangered species, or its habitat.

The affected environment should have a long-term positive effect on the coastal environment by reducing erosion of earthen bank materials and return wave energy, possibly allowing sand to accumulate when there is available material in the littoral cell.

Per consultation with USFWS and NOAA Fisheries, the following are species that may be impacted by the proposed action: 1) Hawaiian hoary bat, ope'ape'a (*Lasiurus cinereus semotus*), 2) Wedge-Tailed Shearwater, 'ua'u kani (*Puffinus pacificus*), 3) Hawksbill Sea Turtle, honu'ea (*Eretmochelys imbricata*), 4) Green Sea Turtle, honu (*Chelonia mydas*), 5) Hawaiian Monk Seal, 'ilio holo I ka uaua (*Neomonachus schauinslandi*). Please refer to Sections 3.7 for a detailed discussion and analysis on the potential impacts and mitigation measures for the five (5) species listed above. Furthermore, Section 3.7.4 lists Best Management Practices (BMPs) to mitigate impacts to rare, threatened, or endangered species and their habitats.

(10) ***Detrimentally affects air or water quality or ambient noise levels.***

No debris, petroleum products, or other construction-related substances or materials will be allowed to flow, fall, leach, or otherwise enter the coastal waters. All construction material will be free of contaminants or pollutants. Best Management Practices will be adhered to during construction to minimize environmental pollution and damage. There is expected to be some additional noise above ambient during construction resulting from equipment operation.

(11) Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters.

The proposed Riprap Revetment is located along the eroding earthen embankment that is threatening the public roadway. The conditions may include prevailing wave environment at the shoreline, particularly during winter season high surf, storm conditions, and large Tradewind wave events. The proposed riprap Revetment is designed to protect the roadway from erosion damage and may also promote beach accretion by reducing reflected wave energy. It is not expected to negatively alter erosion or coastal processes because it is an improvement to the existing, failing, non-engineered material that has been placed on the shoreline.

(12) Substantially affects scenic vista and view planes identified in county or state plans or studies.

Scenic vistas and view planes are not expected to be negatively impacted by the proposed action.

(13) Requires substantial energy consumption.

The project is a passive structure and will require no additional energy consumption.

5.4 Summary

Based on the above findings, further evaluation of the project's impacts through the preparation of an Environmental Impact Statement is not warranted. The EA recommends mitigation measures to alleviate impacts when such impacts are identified. A Finding of No Significant Impact (FONSI) is anticipated for this project. The project will have the benefit of protecting Kamehameha Highway, the primary access roadway for communities located on the Windward coast of Oahu while resulting in minimal impacts to the surrounding environment.

6. CONSULTATION

6.1 Agencies Consulted

Consultation has been initiated with the following agencies and community groups.

Federal

U.S. Army Corps of Engineers, Honolulu District (Nationwide Permit #3 [Maintenance] issued November 23, 2021)

NOAA-National Marine Fisheries Service, Protected Resource Division (Essential Fish Habitat, Endangered Species Act)

U.S. Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office (Endangered Species Act)

State

Department of Land and Natural Resources, Office of Conservation and Coastal Land

State Senator Gil Riviere

City and County of Honolulu

Department of Planning and Permitting

Department of Parks and Recreation

Community Groups and the Public

Kaaawa Community Association

6.2 List of Agencies, Organizations, and Individuals Receiving Copies of the EA

The following agencies and organizations will be provided copies of the Draft EA for their review and comment.

	Receiving Draft EA	Comments Received	Receiving Final EA/FONSI
Federal Agencies			
U.S. Army Corps of Engineers	X		
U.S. Fish and Wildlife Service	X		
NOAA- NMFS	X		
State of Hawaii Agencies			
Dept. of Accounting and General Services	X		
DBEDT-Office of Planning	X		
Dept. of Health	X		
Dept. of Land and Natural Resources (DLNR)	X		
DLNR – DAR	X		
DLNR – SHPD	X		
DLNR – OCCL	X		
HDOT – Highways Division	X		
Office of Hawaiian Affairs	X		

UH Environmental Center	X
State Senator Gil Riviere	X
State Representative Sean Quinlan	X
<u>City and County of Honolulu Agencies</u>	
Dept. of Design and Construction	X
Dept. of Facility Maintenance	X
Dept. of Planning and Permitting	X
Dept. of Parks and Recreation	X
Office of Climate Change, Sustainability and Resiliency	X
Council Member Heidi Tsuneyoshi	X
Kaaawa Community Association	X
Koolauloa Neighborhood Board	X

6.3 EA Preparers

The Kamehameha Highway at Kaaawa Erosion Mitigation DEA has been prepared by Sea Engineering, Inc. Mr. Scott P. Sullivan, MS Ocean Engineering, was the Principal-in Charge. Technical consultants included Marine Research Consultants Inc. (marine biology and water quality) and International Archaeology LLC (historical context and archaeology).

APPENDIX A

Baseline Assessment of Marine Water Chemistry and Biotic Communities

BASELINE ASSESSMENT OF MARINE WATER CHEMISTRY AND BIOTIC COMMUNITIES

KAMEHAMEHA HIGHWAY SHORELINE EROSION MITIGATION AT KA'A'AWA, OAHU, HAWAII

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I.

INTRODUCTION AND PURPOSE

Kamehameha Highway extends from Kaneohe near the east end of the island of Oahu along the northeast (windward) coast to the north shore town of Haleiwa. It is the only highway connecting the coastal communities of Kaneohe, Kahalu'u, Ka'a'awa, Punalu'u, Hau'ula, and La'ie, and is the primary access for police, fire, and emergency medical vehicles. The State Department of Transportation-Highways Division (DOT-H) records the Annual Average Daily Traffic count as 13,000 vehicles. Many portions of the highway follow the coastline, within feet of the waterline, and only a few feet above it. Coastal erosion and shoreline recession are an increasing threat to the highway. A 400 foot (120 meters [m]) section of Kamahemeha Highway passing through the community of Ka'a'awa has become undermined as a result of both chronic and episodic coastal erosion. The undermining extends up to 3 m under the shoulder of the road, extending as far inshore as the makai shoulder stripe. This section of road is in danger of imminent failure and collapse. Sea Engineering, Inc. and AECOM are working with the State DOT-Highways to develop a plan for erosion mitigation to protect the highway.

The purpose of this document is to provide the results of a rapid ecological assessment (REA) of two aspects of the marine ecosystem fronting the affected area of Kamehameha Highway. Water chemistry was assessed by collecting a set of samples along three transects extending from the shoreline to the open coastal ocean directly fronting the project area. The physical composition of marine habitats as well as biotic community structure were also documented. One primary focus of the assessment of biotic communities is coral reef assemblages. As coral communities are both long-lived and attached to the bottom, they serve as the best indicators of the time-integrated forces that affect offshore reef areas. Evaluation of the existing condition of the water chemistry and marine communities provides an insight into the physical and chemical factors that influence the marine setting. Understanding the existing physical, chemical, and biological conditions of the marine environment provides a basis for predicting potential affects that might occur as a result of the proposed shoreline erosion mitigation.

II. METHODS

A. Water Quality/Chemistry

Water chemistry fieldwork was conducted on January 3, 2021, by swimmers working from shore. Water chemistry was assessed along three survey transects that spanned the length of the Kamehameha Highway shoreline mitigation site, and extended perpendicular to the shoreline originating at the sand-water interface of the beach for a distance of approximately 75 m offshore. Water samples were collected at four locations along each transect at distances of approximately 1, 10, 25, and 75 m from the shoreline (Figure 1). Such a sampling scheme is designed to span the greatest distance from shore that could potentially experience impacts from the shoreline work. Sampling was more concentrated in the nearshore zone because this area receives the most terrestrial input, and hence is most important with respect to identifying the effects of shoreline modification. Owing to the shallow depth of the near-shore shelf (~ 2 m), only surface samples (within 20 centimeters [cm] of the surface) were collected.

Water quality constituents evaluated included all specific criteria designated for open coastal waters in Chapter 11-54, Section 06 (b) (Open Coastal waters) of the State of Hawaii Department of Health (DOH) Water Quality Standards. These criteria include: total nitrogen (TN), nitrate + nitrite nitrogen (NO_3^- + NO_2^-, hereafter referred to as NO_3^-), ammonium nitrogen (NH_4^+), total phosphorus (TP), Chlorophyll a (Chl *a*), turbidity, temperature, pH, and salinity. In addition, dissolved silica (Si) and orthophosphate phosphorus (PO_4^{-3}) were also reported as these constituents are sensitive indicators of biological activity and the degree of groundwater mixing.

Laboratory analyses were conducted by Marine Consulting and Analytical Resources LLC (MCAR) (Lab number HI 00928). Analyses for Si, NH_4^+, PO_4^{-3}, and NO_3^- were performed with a Seal Analytical AutoAnalyzer 3 HR (AA3HR) using standard methods for seawater analysis. TN and TP were analyzed in a similar fashion following digestion. Salinity was determined using a Mettler Toledo Seven Excellence Multi-parameter meter with an InLab 731-ISM conductivity probe.

Chl *a* was measured by filtering 150 ml through a GFF/F glass-fiber filters; pigments on filters were extracted in 90% acetone in the dark at -20 °C for 24 hours. Fluorescence of the extract was measured with a Turner Designs Trilogy Fluorometer model 7200-000 equipped with an extracted chlorophyll non-acidification module. Salinity was determined using a Mettler Toledo Seven Excellence Multi-parameter meter with an InLab 731-ISM conductivity probe, calibrated to a Hach Instruments traceable salinity standard of 35.00 parts per thousand (‰ or ppt), 53.0 mS/cm, with a readability of 0.01 ppt. Turbidity was determined using a Hanna Instruments Model #HI88703 Turbidimeter and reported in nephelometric turbidity units (NTU) (precision of 0.01 NTU).

In situ field measurements of water temperature, pH, dissolved oxygen, and salinity were acquired using RBR Concerto CTDs calibrated to factory specifications. The CTD has a readability of 0.001°C, 0.001pH units, 0.001% saturation, and 0.001 ppt (salinity).

EPA and Standard Methods (SM) methods that were employed for chemical analyses, as well as detection limits, are listed in the Code of Federal Regulations (CRF) Title 40, Chapter 1, Part 136, are as follows:

NH_4^+: EPA 350.1, Rev. 2.0 or SM4500-NH3 G, detection limit 0.042 µg/L.
NO_3^- + $NO2^-$: EPA 353.2, Rev. 2.0 or SM4500-NO3F, detection limit 0.084 µg/L
PO_4^{-3}: EPA 365.5 or SM4500-P F, detection limit 0.28 µg/L.
Total P: EPA 365.1, Rev. 2.0 or SM4500-P E J, detection limit 0.93 µg/L.
Total N: SM 4500-N C., detection limit 1.96 µg/L.

Si: EPA 370.1 or SM 4500 SiO2 E, detection limit 0.45 µg/L.
Chlorophyll *a*: SM 10200, detection limit 0.006 µg/L.
pH: EPA 150.1 or SM4500H+B, detection limit 0.002 pH units
Turbidity: EPA 180.1, Rev. 2.0 or SM2130 B, detection limit 0.008 NTU.
Temperature: SM 2550 B, detection limit 0.01 degrees centigrade.
Salinity: SM 2520, detection limit 0.003 ppt.
Dissolved Oxygen: SM4500 O G, and detection limit 0.01% sat.

All fieldwork was conducted by Dr. Steven Dollar and Ms. Andrea Millan.

B. Marine Biotic Community Structure

Physical and biotic composition of the survey area was assessed by divers using snorkel and working from shore. Dive surveys were conducted by swimming in a zigzag pattern from the shoreline to approximately 75 m offshore throughout the area that fronted the Kamehameha Hwy mitigation project area (Figure 1). During these underwater investigations, notes on species composition were recorded, and numerous digital photographs recorded the existing conditions of the area. The baseline assessment was conducted by Dr. Steven Dollar and Ms. Andrea Millan

III. RESULTS

A. Water Quality/Chemistry

1. Distribution of Chemical Constituents

Table 1 shows results of all water chemistry analyses on samples collected along three transects off Kamehameha Hwy shoreline mitigation project site on January 3, 2021. Several patterns of distribution are evident in Table1. It can be seen that the dissolved nutrients, Si and NO_3^-, display a progressive decrease in concentrations with distance from the shoreline. While not as consistent as Si and NO_3^- salinity displays the opposite trend, with lower concentrations in the nearshore samples (Table 1). Over the entire sampling area, the range in NO_3^- is approximately 5 µg/L, while the range of salinity is approximately 0.15 ppt.

As there were no streams discharging to the ocean at the time of the sampling, the horizontal gradients of Si, NO_3^-, and salinity likely represent input of groundwater to the ocean near the shoreline. Low salinity groundwater, which typically contains high concentrations of Si and NO_3^-, percolates to the ocean at the shoreline, resulting in a nearshore zone of mixing. In many areas of the Hawaiian Islands, such groundwater percolation results in steep horizontal gradients of increasing salinity and decreasing nutrients with increasing distance from shore. The gradients in the nearshore zone off the Kamehameha Hwy mitigation site in Ka'a'awa, however, are comparatively small, indicating only low volume groundwater discharge. PO_4^{-3} is also generally elevated in groundwater relative to ocean water. In the data set collected off the Kamehameha Hwy mitigation site, there is a pattern of decreasing concentration of PO_4^{-3} with respect to distance from the shoreline suggesting some groundwater flux. Horizontal gradients of TN/TON and TP/TOP mirror the patterns of NO_3^- and PO_4^{-3}, respectively.

Ammonium nitrogen (NH_4^+) is usually not elevated in groundwater relative to ocean water. However, concentrations of NH_4^+ on the transects off of the Kamehameha Hwy mitigation site also show weak gradients of decreasing values with distance from the shoreline (Table 1). It is not evident if these gradients originate from groundwater discharge or biotic metabolic activity.

Similar to the patterns of dissolved inorganic nutrients (Si and NO_3^-), the distributions of turbidity and Chl *a* also display highest values near the shoreline, with diminishing values moving seaward (Table 1). Overall, values of Chlorophyll *a* are considered low with all values below 0.30 µg/L. The progressive decrease in values of turbidity and Chl *a* with distance from shore is likely a response to resuspension of fine-grained particulate material, including plant fragments, stirred by breaking waves in the nearshore zone. With decreasing wave energy and increasing water depth, turbidity in the water column decreases. Temperature and dissolved oxygen displays no gradient of consistent change across the transects (Table 1).

2. Compliance with DOH Criteria

State of Hawaii Department of Health Water Quality Standards (HDOH-WQS) that apply to the areas offshore of Kaanapali Beach Club area are listed as "open coastal water" in HRS Chapter §11-54-6(b). Two sets of standards are listed depending on whether an area receives more than 3 million gallons per day (mgd) of freshwater input per shoreline mile ("wet standards"), or less than 3 mgd of freshwater input per shoreline mile ("dry"). As the Ka'a'awa shoreline area probably receives less than 3 mgd per mile, dry criteria were used for this evaluation.

The HDOH-WQS are also separated into three standards: geometric means, "not to exceed more than 10% of the time," and "not to exceed more than 2% of the time." As these classifications require multiple samplings, they cannot be used for a strict evaluation of whether waters at the sampling site were within compliance standards. However, these values provide a guideline to evaluate the overall status of sampled waters in terms of the relation with State standards.

It can be seen in Table 1 that none of the dissolved nutrient constituents exceeded State of Hawaii water quality standards for the most stringent percentage standard "not to exceed more than 10% of the time" criteria under dry conditions. However, all measured values of turbidity exceeded the 10% criterion on all three transects. The elevated concentrations of turbidity are likely a result of resuspension of fine-grained, naturally occurring sediment by breaking waves in the nearshore zone.

B. Coral Reef Community Structure

1. Physical Structure

The section of Kamehameha Hwy in Ka'a'awa where shoreline mitigation is planned abuts a steep eroded soil and rock escarpment that terminates in a sand beach (Figure 1). The sand extends through the intertidal zone where it abruptly transitions into a mixed sand and rubble zone (Figures 1 and 2). The sand and rubble zone extends seaward for the entire offshore range of the study area and beyond. With distance offshore, the amount of sand decreases while the amount of solid rock bottom increases (Figure 3). In the approximate center of the study area, off the terminus of Transect 2, an isolated aggregation of large rocks was piled on the bottom (Figure 3). It is not apparent if the rock pile is a natural feature or of human origin.

The entire sand/rubble/rock zone is shallow in depth, never exceeding approximately two m. The offshore area beyond the sand intertidal area displays is overall a homogeneous environment with little distinct zonation in physical structure in either the offshore or alongshore directions.

2. Biotic Community Structure

Biotic composition of the reef communities fronting the survey section of Kamehameha Highway can be generally considered an algal dominated system. Most of the sand and rubble/rock surfaces were covered with a variety of turf or filamentous algae (Table 2, Figures 4-5). The most common macroalgae is the invasive alien red alga *Acanthophora specifera*, which is ubiquitous throughout the Ka'a'awa reef flat. In the 50 years since its unintended introduction from Guam, *Acanthophora specifera* has become one of the most successful and abundant algae on Hawaiian reef flats. (Figure 4). Other common species were *Halimeda opuntia, Gracilaria salicornia*, *Asparagopsis taxifolia* and encrusting calcareous algae (Table 2, Figure 5).

Reef building corals occur throughout the rubble and rock zones, although colonies are generally isolated with no true accreting "reef structure." Over the entire survey area, it was estimated that stony corals accounted for no more than 1% of bottom cover. The most common corals are those typically found on shallow reef flats, including *Porites lutea, P. compressa, Pocillopora meandrina, P. damicornis*, and *Montipora* spp. (Table 2, Figures 6, 7 and 8). Some of the larger corals are truncated with flat upper surfaces, likely as a response to reaching the upper limit of growth in the shallow water column (Figure 8). Several corals were considered rare in occurrence, with only several observations. These rare corals included *Psammocora stellata* and *Cyphastrea ocellina* (Figure 9). While coral occurrence was generally sparse, there were several area at the outer limits of the study approximately 75 m from shore where mixed assemblages of several species occurred in a small area (Figure 10).

Other macro-invertebrates that were observed on the surface of the outer reef were several species of sea urchins (*Echinometra matheai*, *Echinothrix diadema, Tripneustes gratilla,* and *Heterocentrotus mammilatus*) (Table 2). The only urchin that was considered common was *Echinometra matheai* which bores into the limestone surface of reef rock. The only other common non-coral invertebrate were sea cucumbers (*Actinopyga* spp.) which were observed on sand patches (Figure 10).

Reef fish were relatively uncommon on the reef flat, and the fish that were observed were generally small in size (less than 20 cm)(Table 3). The most common and conspicuous fish were the surgeonfish *Acanthurus nigrofuscus* and *A. triostegus* occupying the water column over the reef platform. Other commonly observed fish were five species of Labridae (wrasses) and the dameselfish *Dascyllus albisella*. Of note is that butterfly fish (Chaetodontidae) were conspicuously rare over the entire reef. The relative paucity of fish, and the small size, is likely a response to heavy fishing pressure in the area.

Green sea turtles (*Chelonia mydas*) are commonly found within the nearshore areas of the northeast coast of Oahu. However, no turtles were observed during the present survey, although they undoubtedly occur on the reefs off the Kamehameha Highway site.

IV. DISCUSSION and CONCLUSIONS

The purpose of this assessment is to assemble the information to make valid evaluations of the potential for impact to the marine environment from the proposed shoreline erosion mitigation fronting Kamehameha Highway in Ka'a'awa, on the northeast shoreline of Oahu, Hawaii. Permanent shore protection is intended to prevent future erosion damage and avoid recurring efforts at temporary emergency protection measures. The information collected in this study provides a baseline data set that describes the physical, chemical and biotic composition of the area, as well as the processes driving such structure. Such information can be used to address any concerns that might be raised concerning effects to the marine environment that might arise during the planning process for the shoreline mitigation.

Results of this baseline study reveal that the composition of the nearshore area consists of a homogeneous shallow sand and rubble/rock reef flat. The predominant biotic composition of the area is a varied assemblage of filamentous macroalgae. The most common alga is the alien invasive species *Acanthophora specifera*, which occurs ubiquitously throughout the survey area. Beyond the nearshore zone, corals are present, but in relatively low abundance, most likely in response to shallow water depth, and effects of wave-generated energy which limits settlement and growth. Fish community structure was noticeably depauperate, likely in response to high fishing pressure.

Results of analyses of water chemistry indicate a small component of groundwater entering the ocean near the shoreline. The groundwater input is rapidly mixed to background coastal oceanic values through wind, wave and current action. The magnitude of effect from such terrestrial input is so low that it does not result in elevation above State of Hawaii DOH water quality standards. The only constituent with values above DOH limits is turbidity, which peaks at the shoreline and decreases steadily with distance from shore as a result of wave resuspension of naturally occurring bottom sediments. None of these factors are likely to be affected beyond the range of natural variability by the proposed erosion mitigation program.

In summary, it is not likely that the proposed action to stabilize shoreline erosion adjacent to Kamehameha Highway in Ka'a'awa would have any negative effect to existing biotic communities. Best Management Practices (BMPs) will be implemented to restrict or eliminate any transfer of terrigenous material to the marine environment. The nearshore sand and rubble zones extends seaward to a distance that is likely beyond the limit of influence of any shoreline activities. As the area is essentially an open coastline subjected to wind, waves, and tides, normal currents flush the area on a regular basis, preventing the buildup of any input of materials from land. In addition, biota inhabiting the area appear to be pre-adapted to resuspension of sediment as sand is a major component of the nearshore habitat. Perhaps most importantly, the ongoing erosion of the shoreline is likely causing some input of terrigenous material to the nearshore ocean. The proposed mitigation is intended to halt such erosion along with any associated detrimental effects. Thus, the proposed project has the potential to eliminate any such impacts, and may provide long-term improvement to both water quality and marine biota resources.

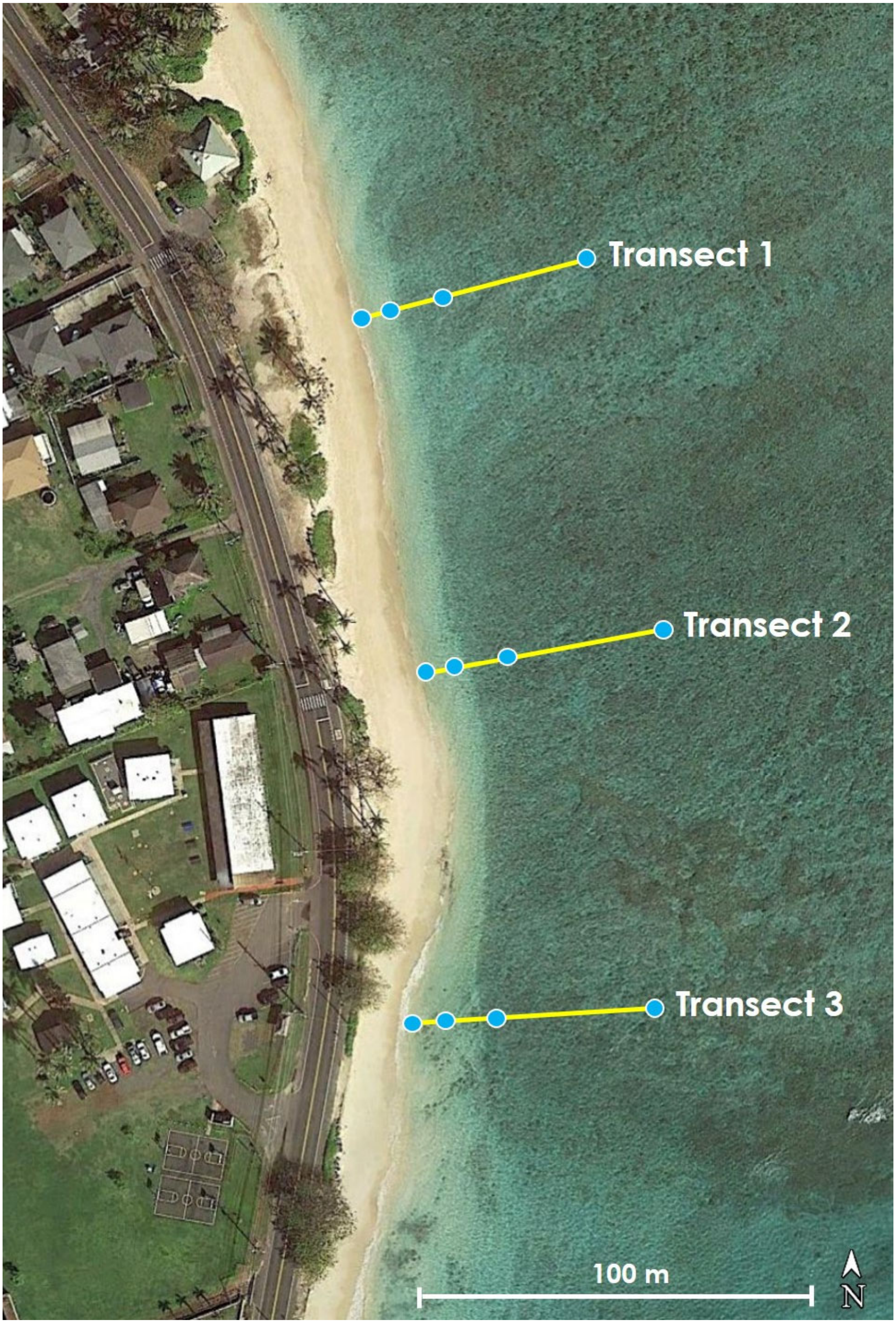

FIGURE 1. Aerial view of portion of Kamehameha Highway in Ka'a'awa, Oahu, Hawaii where shoreline erosion mitigation if proposed. Note that right side of highway abuts sand beach. Also shown are the locations of three water sampling transects. Water samples were collected along each transect at distances of 1, 10, 25 and 75 meters from shore (blue circles). Marine biological community structure was assessed from the shoreline to approximately 100 meters offshore.

TABLE 1. Results of water chemistry analyses from three ocean sampling transects in the vicinity of the Kamehameha Highway Shore Protection at Kawaaa Project. Samples were collected on January 3, 2021, 2021. See Figure 1 for locations of sampling stations. Also shown are DOH WQS for "open coastal waters" under "wet" and "dry" conditions, "not to exceed more than 10% and 2% of the time" criteria. Shaded values exceed the "not to exceed more than 10% of the time under dry conditions" standards.

SITE	DFS	DEPTH	PO_4^{3-}	NO_3^-+NO_2^-	NH_4^+	Si	TP	TN	TOP	TON	TURB	SALT	pH	Chl-a	TEMP	Diss. O_2
	(m)	(m)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(NTU)	(o/oo)	(std. units)	(µg/L)	deg. C	% sat.
T-1	1	0.1	4.40	4.05	1.47	97.68	12.00	80.84	7.42	90.22	2.07	34.69	8.02	0.30	24.70	100.5
	10	0.5	3.81	3.22	2.21	68.46	10.96	84.45	7.03	82.42	1.84	34.80	8.03	0.24	24.85	100.8
	25	1.0	3.50	2.16	1.16	56.46	10.52	87.29	7.31	76.98	1.73	34.72	8.04	0.26	24.79	98.9
	75	2.0	2.76	0.97	1.12	37.86	9.58	80.21	7.24	64.42	0.81	34.76	8.06	0.22	24.98	104.1
T-2	1	0.1	4.59	5.29	3.12	71.84	11.60	97.41	6.62	109.99	1.66	34.72	8.04	0.22	24.82	102.4
	10	0.5	2.88	2.69	1.90	51.57	10.11	89.88	7.02	101.45	1.06	34.76	8.05	0.21	24.84	103.9
	25	1.0	2.54	0.87	2.07	35.57	9.67	86.16	7.55	86.75	0.57	34.84	8.06	0.22	24.61	108.1
	75	2.0	2.57	0.75	1.71	34.40	9.88	87.15	7.33	89.72	1.08	34.84	8.07	0.20	24.40	104.6
T-3	1	0.1	4.43	3.01	4.77	67.62	11.17	91.87	8.38	101.94	2.09	34.80	8.05	0.22	24.24	104.6
	10	0.5	3.53	1.88	4.07	58.08	10.21	87.42	8.76	87.48	1.48	34.76	8.05	0.21	24.03	102.4
	25	1.0	2.76	BDL	1.60	37.16	9.90	84.42	7.81	74.36	1.28	34.84	8.07	0.19	24.10	101.4
	75	2.0	2.67	2.72	1.75	34.73	10.05	90.02	7.45	83.56	0.94	34.83	8.07	0.19	24.22	100.6
DOH WQS	DRY	GEOMEAN		3.50	2.00		16.00	110.00			0.20	*	**	0.15	***	****
		10%		10.00	5.00	-	30.00	180.00			0.50	*	**	0.50	***	****
		2%		20.00	9.00	-	45.00	250.00			1.00	*	**	1.00	***	****
	WET	GEOMEAN		5.00	3.50		20.00	150.00			0.50	*	**	0.30	***	****
		10%		14.00	8.50	-	40.00	250.00			1.25	*	**	0.90	***	****
		2%		25.00	15.00	-	60.00	350.00			2.00	*	**	1.75	***	****

* = Salinity shall not vary more than 10% from natural or seasonal changes considering hydrologic input and oceanographic factors.
** = pH shall not deviate more than 0.5 units from a value of 8.1.
*** = Temperature shall not vary more than one degree C. from ambient conditions.
**** = Dissolved Oxygen not less than 75% saturation
DOH = Department of Health
BDL = below detection limit
NTU = nephelometric turbidity units
µg/L = micrograms per liter
WQS = water quality standards

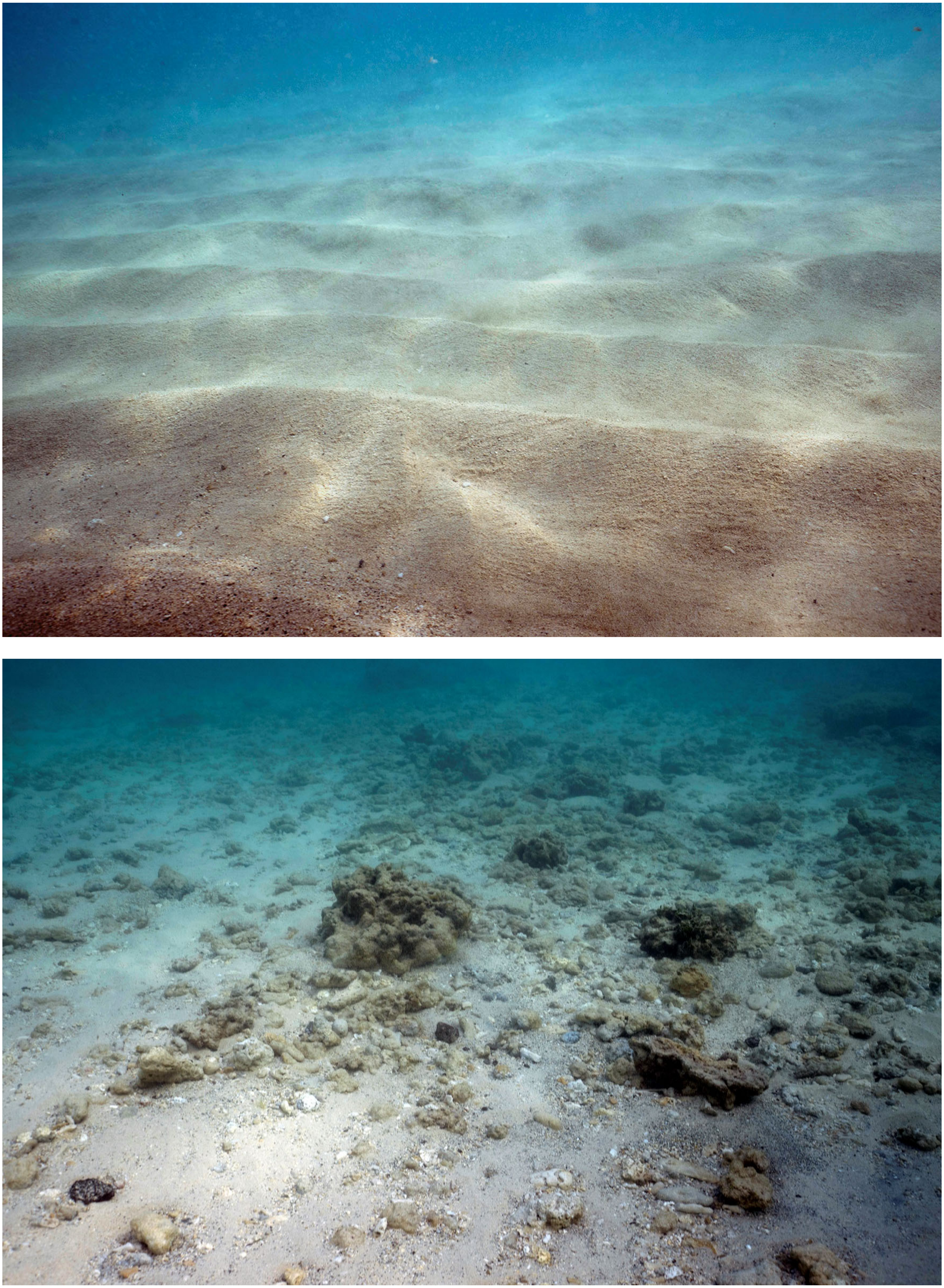

FIGURE 2. Intertidal sand plains off Kamehameha Highway Ka'a'awa shoreline mitigation area (top). Transition for sand to mixed sand and rock/rubble zone that originates at seaward edge of sand plain (bottom).

FIGURE 3. Offshore rock/rubble zone off Kamehameha Highway Ka'a'awa shoreline mitigation area (top). Boulder pile in the at the offshore terminus of Transect 2 (bottom).

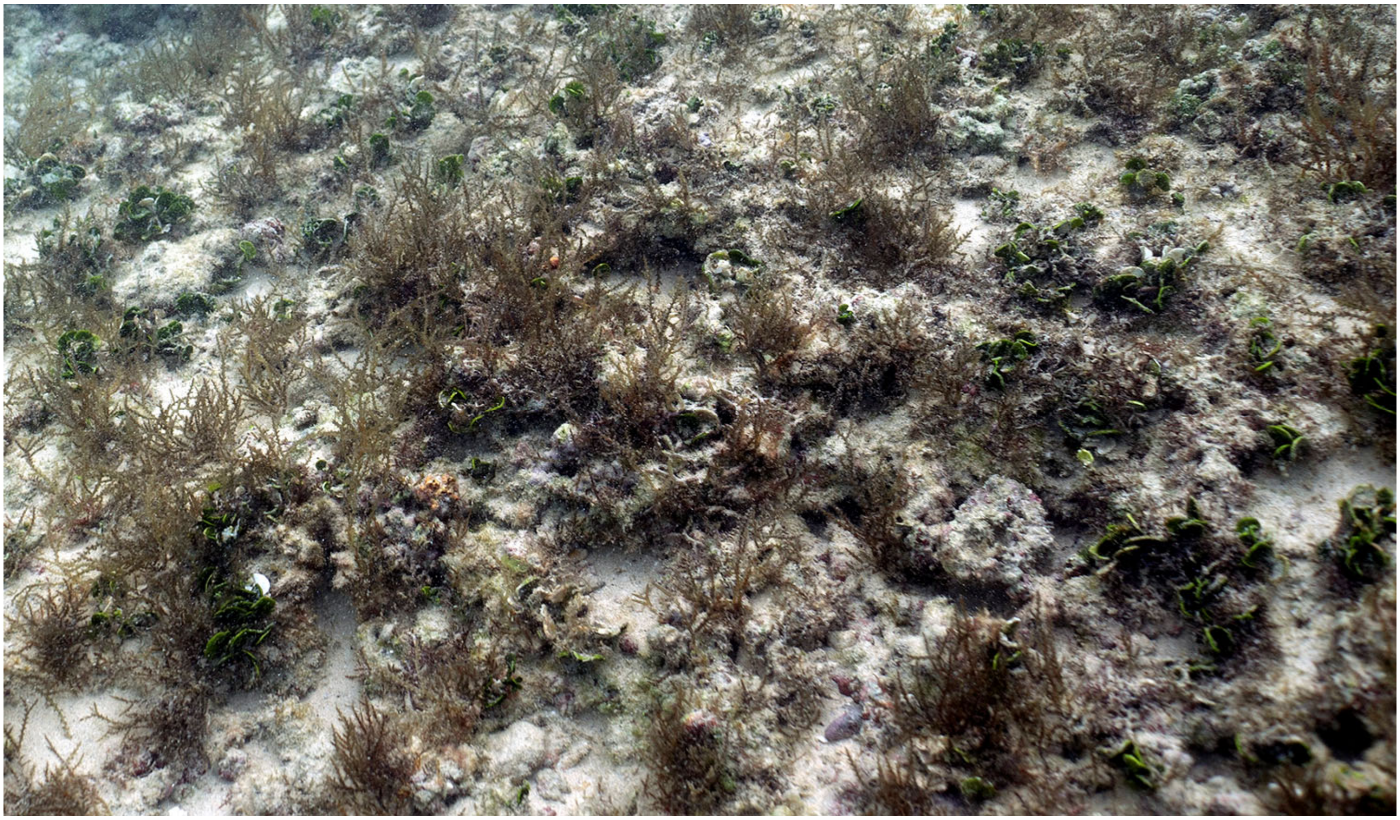

FIGURE 4. Dominant species of algae in the sand/rubble zone off Kamehameha Highway Ka'a'awa shoreline mitigation area: *Acanthophora specifera* and *Halimeda opunita* (top), *Acanthophora specifera* (bottom). Water depth is approximately 1.5 meters.

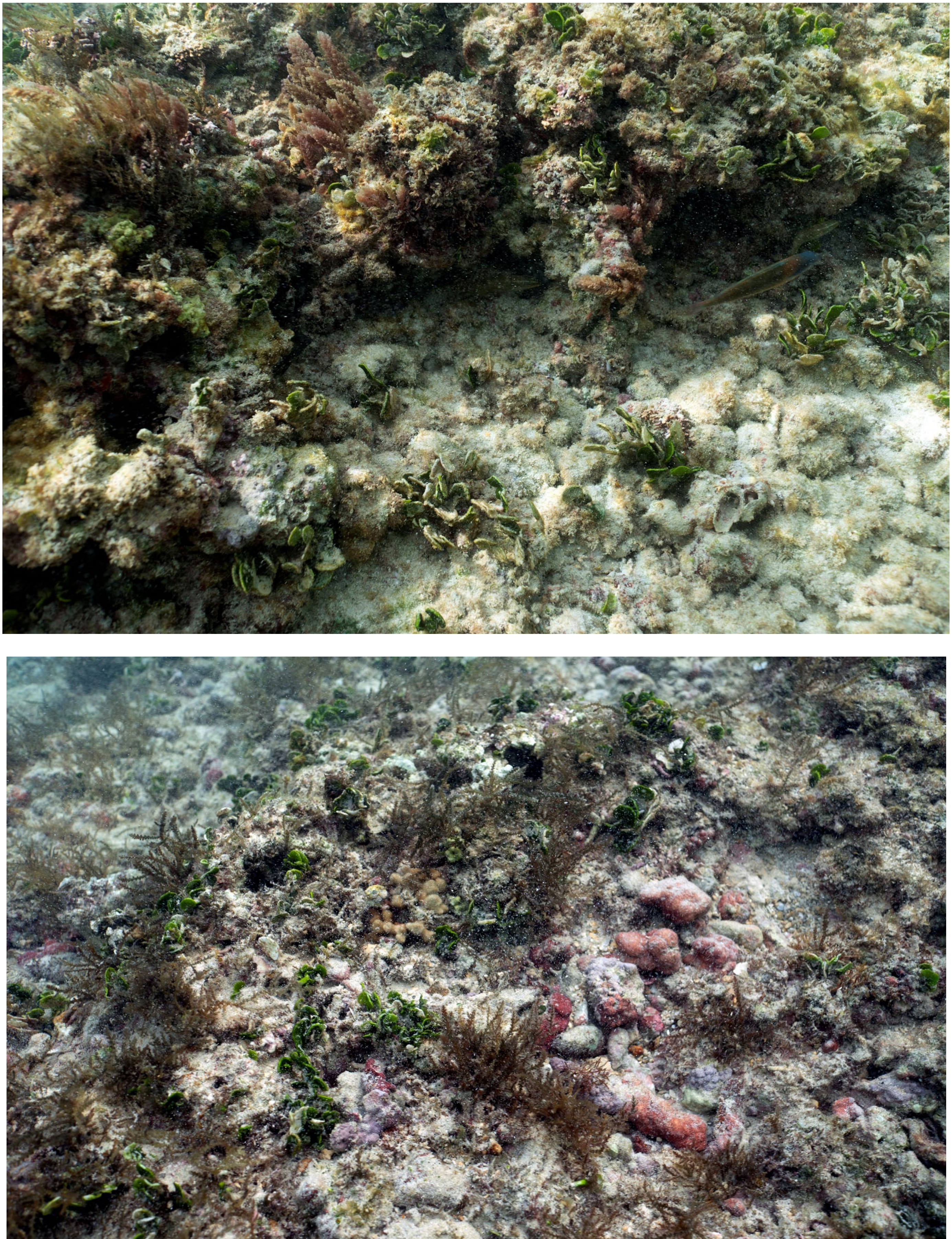

FIGURE 5. Mixed assemblages of common species of algae in the sand/rubble zone off Kamehameha Highway Ka'a'awa shoreline mitigation area. Water depth is approximately 1.5 meters.

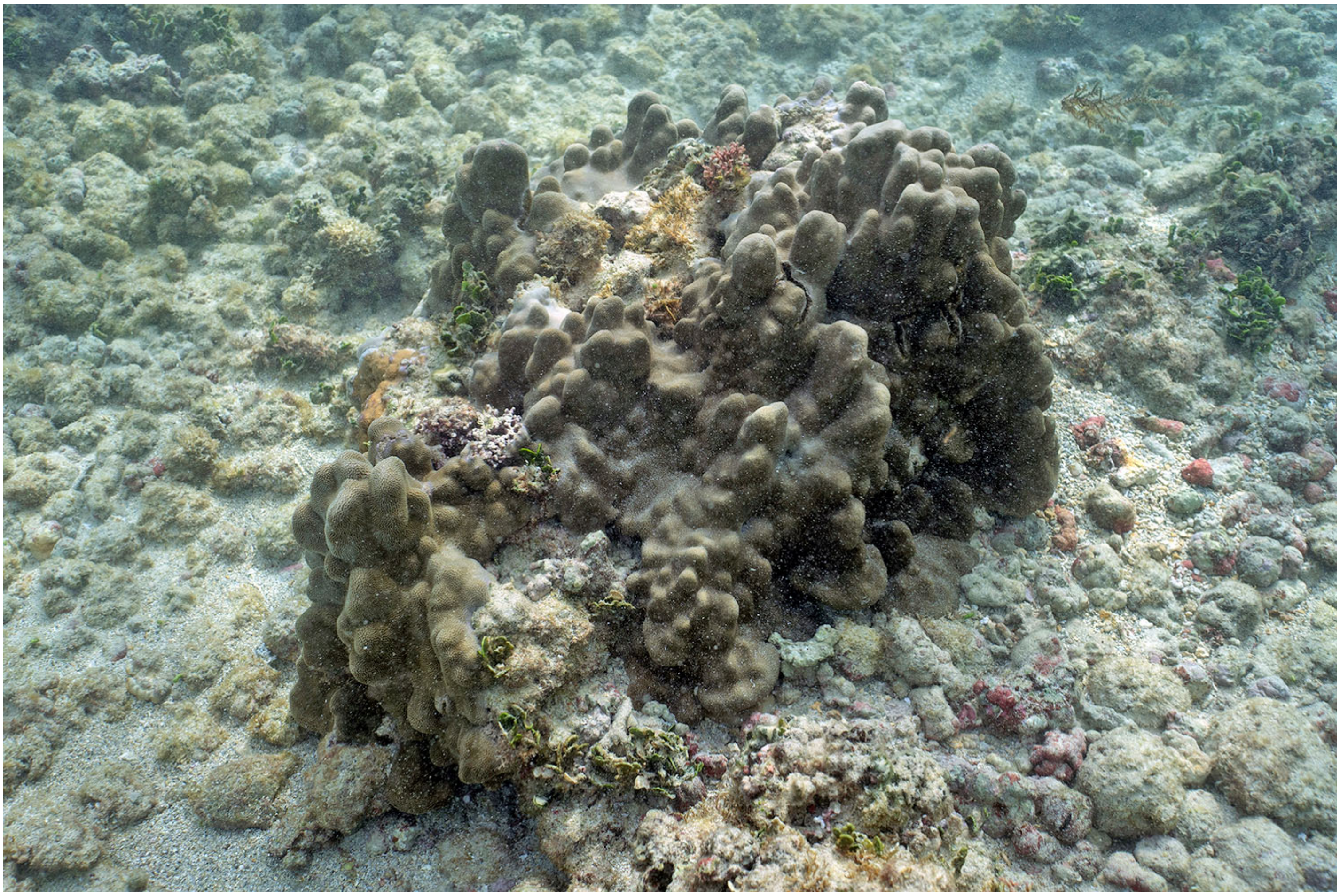

FIGURE 6. Common species of coral in the sand/rubble zone off Kamehameha Highway Ka'a'awa shoreline mitigation area: *Porites lutea* (top), *Porites compressa* (bottom). Water depth is approximately 2 meters.

FIGURE 7. Common species of coral in the sand/rubble zone off Kamehameha Highway Ka'a'awa shoreline mitigation area: *Pocillopora meandrina* (top), *Pocillopora damicornis* (bottom). Water depth is approximately 2 meters.

FIGURE 8. Common species of coral in the sand/rubble zone off Kamehameha Highway Ka'a'awa shoreline mitigation area: *Montipora capitata, Porites compressa* (top), *Porites lobata* (bottom). Water depth is approximately 2 meters.

FIGURE 9. Uncommon species of coral in the sand/rubble zone off Kamehameha Highway Ka'a'awa shoreline mitigation area: *Psammocora stellata* (top), *Cyphastrea ocellina* (bottom). Water depth is approximately 2 meters.

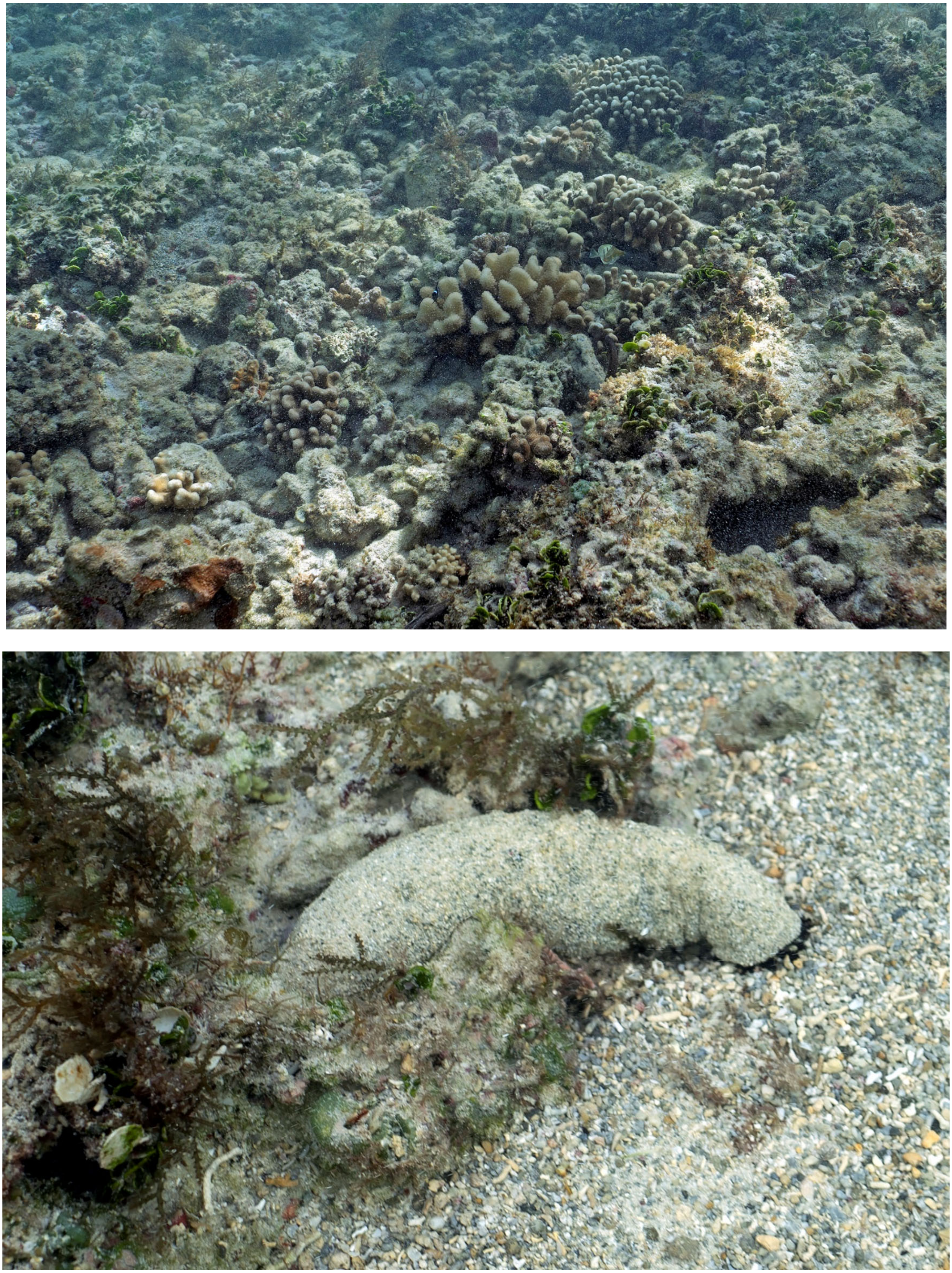

FIGURE 10. Mixed species of corals in the rock/rubble zone off Kamehameha Highway Ka'a'awa shoreline mitigation area (top). Sea cucumber *Actinopyga* sp. (bottom). Water depth is approximately 2.5 meters.

TABLE 2. Coral, algae and non-coral invertebrate species abundance off Kamehameha Highway at Ka'a'awa Erosion Mitigation area.

ALGAE SPECIES	ABUNDANCE
Acanthophora spicifera	*Common*
Asparagopsis taxifolia	*Common*
Gracilaria salicornia	*Common*
Halimeda spp.	*Common*
Neomeris annulata	*Common*
CORAL SPECIES	
Cyphastrea ocellina	*Rare*
Montipora capitata	*Common*
Montipora patula	*Common*
*Palythoa tuberculosa**	*Occasional*
Pocillopora damicornis	*Occasional*
Pocillopora meandrina	*Common*
Porites compressa	*Occasional*
Porites lobata	*Common*
Porites lutea	*Common*
Psammacora stellata	*Rare*
NON-CORAL INVERTEBRATES	
Tripneustes gratiila	*Rare*
Echinometra matheai	*Common*
Echinothrix diadema	*Rare*
Heterocentrotus mammilatus	*Rare*
Actinopyga spp.	*Rare*
Palythoa tuberculosa	*Rare*
Sponges	*Rare*

TABLE 3. Fish species abundance off Kamehameha Highway at Ka'a'awa Erosion Mitigation area.

Acanthuridae (Surgeonfishes)	**ABUNDANCE**
Acanthurus nigrofuscus	*Common*
A. triostegus	*Common*
Labridae (Wrasses)	
Cheilio inermis	*Rare*
Novaculichthys taeniourus	*Rare*
Stethojulis balteata	*Rare*
Thalassoma duperrey	*Common*
Thalassoma purpureum	*Rare*
Ostraciidae (Boxfishes)	
Ostracion meleagris	*Occasional*
Pomocentridae (Damselfishes)	
Dascyllus albisella	*Common*
TOTAL FISH SPECIES	9

APPENDIX B

BEST MANAGEMENT PRACTICES PLAN

ATTACHMENT 3

BEST MANAGEMENT PRACTICES PLAN

KAMEHAMEHA HWY AT KAAAWA EROSION MITIGATION
KAAAWA, OAHU, HAWAII
TAX MAP KEY (1) 5-1-002:025

JUNE 2021

GENERAL REQUIREMENTS

This section covers the requirements of environmental and pollution control during construction activities. The Contractor shall be responsible for conformance to all appropriate State of Hawaii Statutes.

1. With the exception of those measures set forth elsewhere in this plan, environmental protection shall consist of the prevention of environmental pollution as the result of construction operations under this project. For the purpose of this plan, environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare, unfavorably alter ecological balances of importance to human life, affect other species of importance to man, or degrade the utilization of the environment for aesthetic and recreational purposes. This includes Water Pollution, as defined by Hawaii Revised Statute Title 19, Chapter 342D.1.

2. The work shall include the following:

   A. Make sure that all permits required for this plan are obtained and valid for the construction period.

   B. Provide all facilities, equipment and structural controls for minimizing adverse impacts upon the environment during the construction period.

3. Applicable Regulations: In order to provide for abatement and control of environmental pollution arising from the construction activities of the Contractor and his subcontractors in the performance of the work performed shall comply with the intent of the applicable Federal. State, and local laws and regulations concerning environmental pollution control and abatement, including, but not limited to the following regulations:

   A. State of Hawaii, Department of Health, Administrative Rules. Chapter 55. WATER POLLUTION CONTROL: Chapter 54, WATER QUALITY STANDARDS.

   B. State of Hawaii, Department of Health, Administrative Rules, Chapter 59, AMBIENT AIR QUALITY: Chapter 60, AIR POLLUTION CONTROL LAW.

   C. State of Hawaii, Occupational Safety and Health Standards, Title 12, Department of Labor and Industrial Relations, Subtitle 8, Division of Occupational Safety and Health, Subparagraph 12-202-13, ASBESTOS DUST: Environmental Protection Agency, Code of Federal Regulations Title 40, Part 61 Subpart A, NATIONAL EMISSION STANDARDS FOR AIR POLLUTANTS and Subpart B, NATIONAL EMISSION STANDARDS FOR ASBESTOS; and U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Asbestos Regulations, Code of Federal Regulations Title 29, Part 1910.

PROJECT RELATED PRACTICES

Material Management

1. All equipment and material shall be free of contaminants of any kind including excessive silt, sludge, anoxic or decaying organic matter, clay, dirt, oil, floating debris, grease, foam, or any other pollutant that would produce an undesirable condition to the beach or water quality.

2. All materials shall be free from any objectionable sludge, oil, grease, scum, excessive silt, organic material or other floating material.

3. Only a minimum quantity of materials necessary for the work will be stored on site.

4. Mean higher high water (mhhw), also representing mean high water mark, will be marked along the shoreline prior to conducting operations to ensure that no unauthorized fill is placed, nor unauthorized equipment operated below mhhw.

5. All flammable and reactive liquids will be kept in sealed and clearly labeled original or compatible containers and stored under cover more than fifty (50) feet from the edge of the property and away from the nearest drain and receiving waters.

6. Storage and stockpiling area on land or onboard boats will be kept clean and well organized to prevent spills or run out.

7. Materials will be used in strict accordance with the manufacturer's instructions.

8. All asbestos-containing material must be double wrapped in plastic while wet, labeled as asbestos-containing material and disposed of in an approved asbestos landfill. Verification of proper handling and disposal shall be required. Transportation requirements for hazardous materials found in 49 CFR 172-177 shall be strictly followed.

9. Submit Material Safety Data Sheets (MSDS) for all hazardous materials to be brought to the work site. This includes, but is not limited to, paints, solvents, welding rods and fluxes, petroleum products, caulking, and sealant. This submittal shall also include a list showing the quantities of hazardous materials to be stored on-site.

10. Use of calcium chloride in any concrete is prohibited.

Waste Management

Note: No hazardous wastes are anticipated for this project.

1. A Solid Waste Disclosure Form must be completed and submitted to the HDOH in accordance with WQC0901. The form can be downloaded at: https://health.hawaii.gov/shwb/files/2013/06/swdiscformnov2008.pdf

2. All waste will be collected and placed daily in the container located in the upland area inshore of the project area and then disposed of off-site.

3. The Contractor will arrange for pick up and disposal of the filled container as necessary.

4. Cleanup of waste will be conducted through sweeping, shoveling, or vacuuming operations only.

5. Pick up solid wastes, and place in covered containers which are regularly emptied. Prevent contamination of the site or other areas when handling and disposing of wastes. At project completion, leave the areas clean. Recycling is encouraged.

6. Manage spent hazardous material used in construction, including but not limited to, aerosol cans, waste paint, cleaning solvents, contaminated brushes, and used rags, as per environmental law.

7. Non-hazardous or less hazardous materials should be used whenever possible.

8. Hazardous waste shall be placed in secondary containment.

9. Hazardous waste shall not be mixed with other waste and repair debris placed in the dumpster.

10. Flammable or reactive waste will be placed in a separate area more than 50 feet from the edge of the property, nearest drain inlet, and the shoreline.

10. The Contractor and the owner are responsible for the proper handling, storage and/or disposal of all waste generated by project activities.

11. Any construction activity related debris that may pose an entanglement hazard to marine protected species must be removed from the project site if not actively being used and/or at the conclusion of the construction activity.

12. The Contractor shall not dispose of any concrete, steel, wood, and any other debris into State or Federal waters. Any debris that falls into the State and Federal water shall be removed at the Contractor’s own expense.

13. No contamination (trash or debris disposal, alien species introductions, etc.) of marine (reef flats, lagoons, open oceans, etc.) environments adjacent to the project site shall result from project related activities.

14. The Contractor shall remove all floating or submerged materials and/or debris at the end of each day, with the exception of any silt or debris containment devices.

15. In the event that floating hydrocarbon (oil, gas) products are observed, the Contractor or his designated individual will be responsible for directing that in-water work be halted so that appropriate corrective measures are taken in accordance with the Oil Spill Response Plan. Work may continue only after the issue is no longer visible.

16. No contamination of the marine environment shall result from the permitted activities. Particular care must be taken to ensure that no petroleum products, trash or other debris enter

near-shore and open ocean waters. When such material is found within the project area, the Contractor, or his designated construction agent, shall collect and dispose of this material at an approved upland disposal site.

17. Waste materials and waste waters directly derived from construction activities shall not be allowed to leak, leach or otherwise enter marine waters.

18. All debris shall have a sheet of plastic under the pile and plastic over the pile to prevent exposure to rainwater and the generation of runoff into the existing drainage system.

19. A job site dumpster will remain on site throughout the duration of the project to collect any construction-related waste or debris.

20. Construction operations shall be conducted so as to prevent the discharge or accidental spillage of pollutants, solid waste, debris, and other objectionable wastes in surface waters and underground water sources.

21. Care shall be exercised in the removal and transporting of debris and rubbish for disposal.

22. Any spillage on the work surfaces will be cleaned up immediately.

23. Loads will be covered when transported.

24. A debris containment device will be under the workspace to catch falling materials during work.

25. No debris shall be allowed to enter the water. The contractor shall provide a temporary platform or other suitable positive means of capturing debris from construction and demolition operations. These facilities shall be in place prior to starting demolition work.

26. Project site inspection and debris sweeps will be completed at the end of each work day. A full inspection of the project site will be conducted at the end of the project to ensure that no visible debris or project waste is present at the site upon completion of the project.

Vehicle and Equipment Management

1. Fueling operations will be monitored to prevent spills, leaks, and overflows. Equipment will be fueled away from any drain or shoreline. A spill pan will be used to catch spill/leaks. Equipment will not be "topped off." Spill cleanup materials will be readily accessible.

2. Construction equipment (except small tools, generators, welders, etc.) shall be maintained off-site. If emergency repairs or maintenance on large equipment must be performed, drip pans or drop cloth will be placed under the vehicle or equipment to catch any spills/leaks.

3. Conduct the fueling and lubricating of equipment and motor vehicles in a manner that protects against spills and evaporation. Manage all used oil generated on site in accordance with 40 CFR 279. Determine if any used oil generated while on-site exhibits a characteristic of hazardous waste. Used oil containing 1000 parts per million of solvents will be considered a

hazardous waste and disposed of at Contractor's expense. Used oil mixed with a hazardous waste will also be considered a hazardous waste.

4. Wherever trucks and/or vehicles leave the site and enter surrounding paved streets, the Contractor shall prevent any material from being carried onto the pavement. Wastewater shall not be discharged into existing streams, waterways, or drainage systems such as gutters and catch basin unless treated to comply with the State Department of Health water pollution regulations.

5. Fuel tanks are required to have secondary containment in accordance with 40 CFR112 (SPCC). Secondary containment design includes but is not limited to berms and double wall construction.

6. An operators daily checklist shall be filled out prior to operation of equipment on a daily basis. Any leaks or deterioration of hoses shall be noted and corrected prior to operation on equipment. At the end of a shift, the manlift or equipment shall be positioned or located away from nearby drains and drip cloth shall be placed under the equipment. Spill kits shall be staged within close proximity to the manlift or equipment.

Historic or Cultural Features

1. No adverse impacts to any historical or cultural feature are expected since the project involves only minimal excavation or alteration of existing fast land inland of the shoreline.

2. Should any unanticipated archaeological site(s), such as walls, platforms, pavements, mounds, or remains such as artifacts, burials, or concentrations of charcoal or shells be uncovered by the work activity, all work shall cease in the immediate area and the contractor shall notify the State Historic Preservation Division at 808-692-8015. No work shall resume until the owner/contractor obtains clearance from the Historic Preservation Division.

Environmental Protection

1. All permits and clearances shall be obtained prior to the start of any construction activities. The Contractor and his sub-contractors shall ensure that all construction work complies with all permit conditions and commitments made with environmental agencies.

2. Any project related debris that may pose an entanglement hazard to protected species must be removed from the project site if not actively being used and/or at the conclusion of construction activities.

3. All construction activities shall be confined to areas defined by the drawings and specifications. No project materials shall be stockpiled in the marine environment outside of the immediate project area.

4. Visual inspections will be documented with photographs and written descriptions, if necessary.

5. The Contractor shall perform the work in a manner that minimizes environmental pollution and damage as a result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work shall be protected

during the entire duration of the construction activities.

6. The contractor shall complete daily inspection of equipment for conditions that could cause spills or leaks; clean equipment prior to operation near the water; properly site storage, refueling, and servicing sites; and implement spill response procedures and stormy weather preparation plans.

7. The project shall be completed in accordance with all applicable State and County health and safety regulations.

8. Project operations must cease if unusual conditions, such as large tidal events and high surf conditions affect the project site, except for efforts to avoid or minimize resource damage.

9. Preserve the natural resources within the project boundaries and outside the limits of permanent work. Restore to an equivalent or improved condition upon completion of work. Confine construction activities to within the limits of the work indicated or specified. Conform to the national permitting requirements of the Clean Water Act.

10. Do not intentionally disturb fish and wildlife. Do not alter water flows or otherwise significantly disturb the native habitat adjacent to the project and critical to the survival of fish and wildlife, except as indicated or specified.

11. Provide and maintain, during the life of the contract, environmental protection measures to control pollution that develops during normal construction practice. Plan for and provide environmental protective measures required to correct conditions that develop during the construction of permanent or temporary environmental features associated with the project. Comply with Federal, State, and local regulations pertaining to the environment, including water, air, solid waste, hazardous waste and substances, oily substances, and noise pollution.

Protected Species

1. The project manager shall designate a competent observer, who has been apprised of any listed species potentially present in the project area and the protections afforded to those species under federal laws, to survey the marine areas adjacent to the proposed action for ESA-listed marine species, including but not limited to the green sea turtle, hawksbill sea turtle, and Hawaiian monk seal.

2. Constant vigilance shall be kept for the presence of Federally Listed Species.

3. Visual surveys for ESA-listed species shall be made prior to the start of work each day, and prior to resumption of work following any break of more than one-half hour, to ensure that no protected species are in the area (typically within 50 yards of the proposed work). During the survey period, the Observer shall record the environmental and project-related information, including but not limited to date, time, weather, action undertaken, and any ESA-listed marine animals. If no ESA-listed marine animal is sighted during the survey period, the project activities may commence. If an ESA-listed marine animal is sighted during the survey period, the Observer shall alert the on-site construction supervisor immediately, and the animal shall be monitored continuously. If the animal is within 50 yards (150 feet) of construction activity,

animal behavior observations shall be recorded. Work may not commence until the animal departs the area voluntarily or after 30 minutes passed since the last animal sighting.

4. Work shall be postponed or halted when ESA-listed species are within 50 yards of the proposed work, and shall only begin/resume after the animals have voluntarily departed the area. If ESA-listed marine species are noticed after work has already begun, that work may continue only if there is no way for the activity to adversely affect the animal(s). For example, divers performing surveys or underwater work (excluding the use of toxic chemicals) is likely safe. The use of heavy machinery is not.

5. Do not attempt to feed, touch, ride, or otherwise intentionally interact with any ESA listed species.

6. All on-site project personnel must be apprised of the status of any listed species potentially present in the project area and the protections afforded to those species under federal laws.

7. The Contractor shall immediately report any incidental take of marine mammals. The incident must be reported immediately to NOAA Fisheries' 24-hour hotline at 1-888-256-9840, and the Regulatory Branch of the USACE at 808-835-4303. In Hawaii, any injuries incidents of disturbance or injury to sea turtles must be immediately reported and must include the name and phone number of a point of contact, the location of the incident, and the nature of the take and/or injury. The incident should also be reported to the Pacific Island Protected Species Program Manager, Southwest Region (Tel: 808-973-2987, fax: 808-973-2941).

8. Before any equipment or material enters the water, a responsible party shall verify that no ESA-listed species are in the area where the equipment or materials are expected to contact the substrate.

9. All objects lowered to the bottom shall be lowered in a controlled manner. This can be achieved through the use of buoyancy controls such as lift bags, or the use of cranes, winches, or other equipment that affect positive control over the rate of decent.

10. For any equipment used in undertaking the authorized work, the 160 dB and 120 dB isopleths shall not exceed the 50-yard shut-down range for impulsive and continuous sounds sources, respectively.

11. Should protected species enter the area while in-water work is already in progress, the activity may continue only when that activity has no reasonable expectation to adversely affect the animal(s).

Oil and Spill Containment

1. The Contractor shall ensure that the Emergency Spill Response Plan, detailed in this document, is in place which shall detail procedures for managing the accidental release of petroleum products to the aquatic environment during construction. Fueling of project related vehicles and equipment should take place away from the water. Absorbent pads, containment booms, and skimmers will be stored on site to facilitate the cleanup of petroleum spills.

2. Any spills or other contaminations shall be immediately reported to the DOH Clean Water Branch (808-586-4309) and through email: cleanwaterbranch@doh.hawaii.gov.

3. Prevent oil or hazardous substances from entering the ground, drainage areas, or navigable waters. In accordance with 40 CFR 112, surround all temporary fuel oil or petroleum storage tanks with temporary berms or containment of sufficient size and strength to contain the contents of the tanks, plus 10 percent freeboard for precipitation. The berm will be impervious to oil for 2 hours and be constructed so that any discharge will not permeate, drain, infiltrate, or otherwise escape before cleanup occurs.

4. Exercise due diligence to prevent, contain, and respond to spills of hazardous material, hazardous substances, hazardous waste, sewage, regulated gas, petroleum, lubrication oil, and other substances regulated by environmental law. Maintain spill cleanup equipment and materials at the work site. In the event of a spill, take prompt, effective action to stop, contain, curtail, or otherwise limit the amount, duration, and severity of the spill/release.

5. Maintain spill cleanup equipment and materials at the work site. Clean up all hazardous and non-hazardous waste spills.

Monitoring/Measures for Visually Detected Containment

1. All work operations shall be performed in conformance with the applicable provisions of the Hawaii Administrative Rules (HAR), Title 11 Chapter 55 Water Pollution Control and Title 11, Chapter 54 Water Quality Standards, and to the Erosion and Sedimentation Control Standards and Guidelines of the Department of Public Works, State of Hawaii.

2. The Contractor shall keep construction activities under surveillance, management and control to avoid pollution of surface or marine waters. Daily visual inspection of the construction site and its environs will be conducted to verify that the permitted activities do not result in uncontrolled adverse environmental impacts. Visual inspections will be documented with photographs, a photo orientation map, and written descriptions, if necessary.

3. Daily Inspection: The project site will be inspected daily to ensure BMP's are maintained to confine and isolate potential pollutants from being discharged into surrounding areas. The site will be inspected to ensure that materials are properly stored, rubbish is being collected and disposed of properly, etc.

4. Deficiencies identified by daily inspections shall be corrected immediately. Work activities will stop and remain stopped until the deficiencies have been corrected.

Water Quality Monitoring (If Applicable)

1. The Contractor shall follow the accepted Water Quality Monitoring Plan and Applicable Monitoring and Assessment Program.

2. The Contractor shall incorporate all erosion control measures shown in the drawings and the BMPP for this project. The plans may be modified as necessary to adjust to conditions that

develop during construction. Any changes to the BMPP must be submitted immediately to the DOH for review. The project may only proceed after DOH issues a written acceptance of the modified BMPP.

3. Turbidity outside the active project site shall not exceed the baseline turbidity geometric value. The Contractor shall cease all work if unusual turbidity is observed and take the necessary remedial action to correct the problem.

4. Applicable Water Quality Monitoring and Assessment Program: Trained professionals (with degrees in marine sciences) will be conducting the monitoring, including pre-construction, during construction and post-construction monitoring. Monitoring and sample testing shall comply with the DOH CWB – "General Monitoring Guideline for Section 401 Water Quality Certification Projects."

Erosion and Sediment Control Measures

1. A silt curtain as shown on the construction plans will be installed around the project area.

2. Silt curtains and/or silt fences will be individually anchored and regularly inspected during project operations.

3. Silt curtains and/or silt fences will be left in place each night. All anchors will be inspected prior to sunset.

6. Visual inspections will include monitoring of the effectiveness of the debris containment device and silt curtain to ensure proper function.

7. Visual inspections will be documented with photographs and written descriptions, if necessary.

8. Construction shall not be done during storms or periods of high surf.

9. Visual monitoring will include ongoing inspections for turbidity outside of the confines of the silt curtains. In the event that turbidity is observed outside of the silt curtains, work shall stop and the silt curtains shall remain in place until the turbidity dissipates. Silt curtains shall be inspected after dissipation and prior to returning to construction operations.

10. Drainage outlets shall be maintained to minimize erosion and pollution of the waterways during construction. Surface runoff shall be controlled in order to minimize silt and other contaminants entering the water. Should excessive siltation or turbidity result from the Contractor's method of operation, the Contractor shall install silt curtains, fences, or other silt contaminant devices as required to correct the problem.

11. Should excessive siltation or turbidity, as defined in HAR Title 11 Chapter 54.4 and HAR Title 11 Chapter 54.6, result from the Contractor's method of operation, the Contractor shall install additional silt curtains or other silt contaminant devices as required to correct the problem.

Noise Control

1. Best management practices shall be utilized to minimize adverse effects to air quality and noise

levels, including the use of emission control devices and noise attenuating devices.

2. Noise shall be kept within acceptable levels at all times in conformance with HAR Title 11 Chapter 46 Community Noise Control, State Department of Health, Public Health Regulations. The contractor shall obtain and pay for a community noise permit from the State Department of Health when equipment or other devices emit noise at levels exceeding the allowable limits.

3. Equipment shall be equipped with suitable mufflers to maintain noise within levels complying with applicable regulations.

4. Starting of equipment meeting allowable noise limits shall not be done prior to 7:00 a.m. without prior approval. Equipment exceeding allowable noise limits shall not be started up prior to 7:30 a.m. Equipment meeting allowable noise limits shall not be operated after 10:00 p.m. without prior approval.

5. Make the maximum use of low-noise-emission products, as certified by the EPA.

Dust Control

1. If necessary, containment methods shall be employed to prevent uncontrolled release of dust or debris outside the designated construction and/or abatement control barriers/boundaries.

2. Dust, which could damage crops, orchards, cultivated fields, and dwellings, or cause nuisance to persons, shall be abated and control measures shall be performed. If there is dust, standard dust mitigation procedures will be used.

3. The Contractor, for the duration of the contract, shall maintain all excavations, embankments, haul roads, permanent access roads, plant sites, waste disposal areas, borrow areas, and all other work areas within or without the project limits free from dust which would cause a hazard to the work, or the operations of other contractors, or to persons or property. Industry accepted methods of stabilization suitable for the area involved, such as sprinkling or similar methods will be permitted. Chemicals or oil treating shall not be used.

4. The Contractor shall prevent dust from becoming airborne at all times including non-working hours, weekends and holidays in conformance with the State Department of Health, Administrative Rules, Title 11, Chapter 60 - Air Pollution Control.

5. Keep dust down at all times, including during nonworking periods. Sprinkle or treat, with dust suppressants, the soil at the site, haul roads, and other areas disturbed by operations. Dry power brooming will not be permitted. Instead, use vacuuming, wet mopping, wet sweeping, or wet power brooming. Air blowing will be permitted only for cleaning nonparticulate debris such as steel reinforcing bars. Prevent the spread of dust and debris and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, flooding, or pollution. Vacuum or sweep the work area daily.

Air Pollution Control

1. Emission: The Contractor shall not be allowed to operate equipment and vehicles that show excessive emissions of exhaust gases until corrective repairs or adjustments are made.

2. The contractor shall not use nighttime lighting at the project site so as so not disorient any birds.

Operational Controls

1. This plan will be reviewed with the project field staff prior to the start of work.

2. All activities significantly impacting the environment will not begin until appropriate BMP's are properly installed.

3. Construction will be immediately stopped, reduced or modified; and/or new or revised BMP's will be immediately implemented as needed to stop or prevent polluted discharges to receiving waters. New or revised BMP's will be approved by appropriate regulatory agencies prior to re-commencing work.

4. The Contractor is responsible for all regulatory notification requirements in accordance with Federal, State and local regulations. Submit copies of all regulatory notifications to the Contracting Officer prior to the commencement of work activities.

5. The Contractor is responsible for meeting all permit requirements and including how they will be addressed in the work plans. The Contractor will provide the personnel, materials, and equipment necessary to meet the permit requirements for the project.

Structure, Authority, and Responsibility

1. The Project Manager/Superintendent/Project Engineer will ensure compliance with this plan.

2. The Project Manager/Superintendent/Project Engineer will appoint and train one (1) additional individual to properly install all BMP's and to comply with all aspects of this plan.

3. The Property Owner(s) is also responsible for compliance to the BMPP.

Training

1. Employees will be instructed in the proper installation of the BMPP materials.

2. BMP's will be covered in a toolbox safety meeting.

3. BMP's will be discussed, as applicable, for each new phase of work.

4. Train each employee performing work that disturbs lead, who performs MCL/PWL disposal, and air sampling operations prior to the job in accordance with 29 CFR 1926.21, 29 CFR

1926.62, and State and local regulations where appropriate.

Inspection and Monitoring

1. The Project Manager/Superintendent/Project Engineer or the assigned trained individual will conduct a visual inspection of all BMPP's daily.

2. All minor repairs and maintenance of the BMP's will be completed within 48 hours of detection. Major repairs of BMP's shall be completed as soon as practical, and in-water work shall be stopped until repairs are complete.

3. If any BMPP is damaged, work will immediately be stopped and shall not resume until repairs to the BMPP have been completed.

Emergency Procedures

1. Natural disaster-related pollutant discharge: See Contingency Plan

2. Spill prevention and control: See Emergency Spill Response Plan.

Record Keeping and Documentation

1. A copy of this plan will be kept on site.

2. All BMP inspection reports will be kept on site.

Suspension of Work

1. Violations of any of the above requirements or any other pollution control requirements which may be specified in the Technical Specifications herein shall be cause for suspension of the work creating such violation. No additional compensation shall be due to the Contractor for remedial measures to correct the offense. Also, no extension of time will be granted for delays caused by such suspensions.

2. If no corrective action is taken by the Contractor within 72 hours after a suspension is ordered by the Owner, the Owner reserves the right to take whatever action is necessary to correct the situation and to deduct all cost incurred by the Owner in taking such action from monies due to the Contractor.

3. The Owner may also suspend any operations which they feel are creating pollution problems although they may not be in violation of the above-mentioned requirements. In this instance, the work shall be done by force account.

Contingency Plan

The following plan will be implemented by the Contractor to prevent/respond to polluted discharges resulting from a severe storm or natural disaster. It is the Contractor's responsibility to abide by the following plan as well as any other binding plan, agreement, regulation, rule, law, or ordinance applicable.

Contractor will follow this plan when a severe storm is either forecast or anticipated. Contractor must:

a. Regularly monitor local weather reports for forecasted and/or anticipated severe storm events, advisories, watches, warnings or alerts. The contractor shall inspect and document the condition of all erosion control measures on that day prior, during, and after the event. The contractor shall prepare for forecasted and/or anticipated severe weather events to minimize the potential for polluted discharges.

2. Secure the construction site. Securing the site should generally include:
    i. Removing or securing equipment, machinery, and maintenance materials.
    ii. Cleaning up all maintenance debris.
    iii. Implementing all Best Management Practices (BMPs) detailed in this BMPP. This includes BMPs for materials management, spill prevention, and erosion and sediment control.

4. In the event of a severe weather advisory (hurricanes, tropical storms, natural disasters) or when deemed necessary, cease regular construction operations. Work crews must finalize securing the project site and evacuate until the severe weather condition has passed.

4. Upon return to the site, all BMPs shall be inspected, repaired, and/or re-installed as needed. If repair is necessary, it shall be initiated immediately after the inspection and repairs or replacement will be complete within 48 hours. To facilitate repair or replacement, the contractor will be required to store surplus material on the project site if the site is located where replacement materials will not be readily available.

5. When there either has been a discharge which violates Hawaii Water Pollution rules and regulations or there is an imminent threat of a discharge which violates Hawaii Water Pollution rules and regulations and/or endangers human and/or environmental health, the permittee shall at a minimum execute the following steps:
    i. Assess whether construction needs to stop or if additional BMPs are needed to stop or prevent a violation.
    ii. Take all reasonable measures to protect human and environmental health.
    iii. Immediately notify the DOH of the incident. The notification shall also include the identity of the pollutant sources and the implemented control or mitigation measures.
        1. Department of Health Clean Water Branch (during regular working hours): 808-586-4309;
        2. Hawaii State Hospital Operator (after hours): 808-247-2191
    iv. Document corrective actions, take photographs of discharge and receiving waters.
    v. Revise BMPP to prevent future discharges of a similar nature.

Emergency Spill Response Plan

Pre-Emergency Planning

a. An initial and periodic assessment shall be made of the project site and potential hazardous spills that may be encountered during the normal course of work. This plan is not intended to address issues relating to materials such as PCB, Lead, Asbestos, etc., since these types of materials would have specific work plans already developed. This plan should be revised as necessary to correspond to the assessment and resubmitted to the appropriate regulatory agencies.
b. A Hazardous Materials inventory list and MSDS sheets, to include subcontractors' materials, will be filed in a binder and located in the Project Office. The inventory list and MSDS sheets will be updated and maintained by the Project Manager and site safety officer as new materials are added.
c. Personnel will consult the applicable MSDS sheet prior to its use.
d. Personnel will handle hazardous materials safely and use personal protective equipment (PPE), recommended/required by the MSDS, when handling hazardous materials.
e. Personnel will receive "Hazard Communication" training within three (3) working days of arrival and "product specific" training prior to the initial use/exposure of a product. This training will be conducted by the Project Manager/Superintendent or site safety officer.
f. All personnel will be trained on the contents of this plan within the first month of maintenance and at least annually thereafter. The training should include a rehearsal of this plan. An attendance sheet will be kept on file at the Project Office.
g. Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids. Approved safety cans or DOT approved containers shall be used for the handling and use of flammable liquids in quantities of five (5) gallons or less. For quantities of one (1) gallon or less, only the original container or approved metal safety can shall be used, for storage, use and handling of flammable liquids.
h. Flammable or combustible liquids shall not be stored in areas used for exits, stairways, or normally used for the safe passage of people.

Personal Protective and Emergency Spill Response Equipment

a. ABC fire extinguishers will be located in the project field office and in each of the company vehicles. There will be at least one fire extinguisher, rated at not less than 10B, within 50 feet of any stockpile of 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas storage.

NOTE: Fire extinguishers should not be located "directly" with hazardous materials, so as to endanger first responders.

b. Spill kits will be located at the project field office and/or within 50 feet of the hazardous material storage area. The spill kit contents shall be determined by the Project Manager/Superintendent based on the anticipated hazardous materials to be stored and/or used on the project. The spill kits will be inventoried quarterly and appropriate logbook entries made.
c. Emergency response personal protective equipment (PPE) consists of:

i. Face shield
ii. Tyvex coveralls
iii. Rubber gloves
iv. Air-purifying respirators with HEPA and organic vapor combination cartridges will be issued to the Emergency Response Team members and maintained in the project office. Separate Respiratory Protection Equipment shall be designated and labeled as such; this equipment will be inspected at least every 30 calendar days and appropriate logbook entries made.

Personnel Roles, Lines of Authority and Communication

a. Emergency Response Coordinator (ERC)
    i. The Project Superintendent is the designated ERC. If the Project Superintendent is not available, the safety officer is the designated ERC.
    ii. The ERC will be in charge of and will coordinate the appropriate emergency response procedures in this plan.
b. Emergency Response Team (ERT)
    i. The ERT consists of Construction General Foreman, Labor Foreman, and a Laborer designated by the Project Superintendent.
    ii. The ERT will appropriately respond to the emergency in accordance with this plan at the direction of the ERC.

Emergency Alerting and Response Procedures

a. Any person causing or discovering a known hazardous or unknown release or spill will:
    i. Immediately alert nearby personnel who may be exposed to the effects of the release or spill.
    ii. Report the release or spill immediately to the ERC and the ERT. All pertinent information regarding the release should be provided to the ERC, such as the amount and type of material released, location of the release, and other factors, which may affect the response operation.
    iii. If the spill or release is a petroleum product or known non-toxic chemical, the person will take immediate and appropriate measures to stop or limit the rate of release, (i.e., close the spigot to the drum or form oil or curing compound) and or contain or stop the migration of the release (i.e., create a berm of dirt around the release) until the ERC and ERT arrive.
    iv. If the spill release is a toxic, highly flammable, or unknown chemical, the person will first notify the ERC before approaching the spill area from upwind to determine the source, type, and quantity of the release. The person should monitor the spill until the ERC and ERT arrive.
    v. The ERC will assess possible hazards to human health or the environment that may result from the release, fire, or explosion.
    vi. If the spill or release is less than 25 gallons of a known petroleum product or non-toxic chemical, the ERC will direct the ERT to contain and cleanup the spill or release.
    vii. If the spill or release is toxic or unknown, the ERC will immediately notify the City & County of Honolulu Fire Department and ask for assistance from the HAZMAT Response Team.

viii. Immediately after the emergency, the ERC will arrange for disposing of the recovered waste, contaminated soil or any other material that results from the release, fire, or explosion at the project site in accordance with the City & County of Honolulu and State regulations and manufacturer's instructions (if source of spill or release is known).

Emergency Notification and Reporting Procedures

a. In the event that a release enters the storm or sewer system, the ERC will immediately notify the National Response Center (NRC) at 1-800-424-8802, and the Hawaii Department of Health, Hazard Evaluation and Emergency Response Office (HEER) at 808-586-4249.
b. The ERC will immediately notify appropriate agencies and submit written follow-up notification in accordance with the Hazardous Substance Release Notification Guideline.

Safe Distance Staging Area

a. A staging area at a safe distance upwind and higher than the location of the spill or release and its source will be immediately established.
b. Access to the spill or release location will be cleared for emergency vehicles and equipment to be used to contain and clean up the spill or release.

Site Security and Control

a. If the spill or release is located on or near the roadway, stop all traffic until the release is cleaned up.
b. If the spill or release is located away from vehicle or pedestrian traffic, install barricades/safety fencing around the affected area.
c. If the spill or release occurs during night operations, provide adequate light and use ground guides to escort emergency vehicles to the affected area.

Evacuation Routes and Procedures

a. Persons injured during the emergency condition will be evacuated to the staging area where they will be treated and or further evacuated to the nearest medical facility. The appropriate MSDS(s) will be provided to emergency service personnel and are intended to be delivered to the emergency room physicians.
b. Persons working at the affected area and who are not needed in the response effort will report to the staging areas for accountability.

Decontamination and Disposal Procedures

a. Persons involved in the spill clean-up are required to perform personal hygiene, utilizing soap and fresh water prior to eating, drinking, or smoking.
b. Contaminated PPE shall be appropriately cleaned and disinfected if possible. If this is not possible it shall be disposed of per the same requirements of the contaminated substance.
c. Sorbent pads/materials and the spilled substance will be placed in appropriate containers and disposed of as specified by the appropriate MSDS.

d. Contaminated soil will be placed in an appropriate container(s) or on plastic sheeting. The ERC will arrange with an environmental services company to properly characterize, prepare the manifest, label the containers, transport, and dispose of the contaminated soil. The generator's copy of the manifest will be kept in the project files for a minimum of three (3) years.
e. In the event of a substantial release (25 gallons or more) of a suspected or known toxic chemical, the Fire Department HAZMAT Response Team will be called to control/cleanup the release. They will establish and provide the decontamination operations as required.

Emergency Medical Treatment and First Aid

a. First aid kits will be maintained at the project field office, all company vehicles, and gang boxes.
b. Injured person(s) will be treated at the staging area by a certified first aid trained individual at the project site until the ambulance arrives or they are evacuated to the nearest medical facility.
c. The appropriate MSDS(s) will be provided to emergency service personnel and are intended to be delivered to the emergency room physicians.

After the Spill Procedures

a. The ERC will review what happened and implement changes, corrections, and/or improvements to prevent the spill from occurring and to improve the spill response and clean-up procedures. This plan will be revised to reflect those changes, corrections, and/or improvements implemented.
b. The ERC will prepare a record of the spill response and keep it in the project files for a minimum of three (3) years.
c. The ERC will submit Follow-up Notification to HEER when required.
d. Spill response kits shall be replenished directly after the emergency.

Emergency Contacts

Control Tower, Port Operation, Pearl Harbor		*1-808-474-6262*
National Response Center (NRC)		*1-800-424-8802*
Coast Guard Operations Center, Honolulu	(working hours)	*1-808-522-8264*
	(after hours)	*1-808-927-0830*
Hawaii State Department of Health Hawaii Evaluation and Emergency Response (HEER)		*1-808-586-4249*
State Historic Preservation Division		*1-808-692-8015*
Honolulu Fire Department		*911*
In the event that a release enters the storm or sewer system, the ERC will immediately notify NRC and HEER		*1-808-935-2785*
Project Manager, State DOT-Highways *TBD*		*1-808-TBD*
Scott Sullivan, Design Engineer and Permit Agent, Sea Engineering, Inc.		*1-808-460-3437*

ATTACHMENTS:

1. **Inspection and Maintenance Report Form**
2. **Pac-SLOPES General Conditions**
3. **Pac-SLOPES Activity-Specific Conditions**

Best Management Practice Plan (BMPP)
Inspection and Maintenance Report Form

Report No. _____ Weather: ____________________________________ Date: ___/___/____

Activities: ____

Type of Report: ☐ Daily ☐ Weekly ☐ Other: ____

DUST CONTROL MEASURES:	YES	NO	N/A
Are adequate dust control measures employed?	☐	☐	☐
Are the nearshore waters and travel ways kept clean of waste?	☐	☐	☐
Are the loads in the truck beds covered?	☐	☐	☐

DUST CONTROL MEASURES REQUIRED:

IN-WATER CONFINEMENT MEASURES:	YES	NO	N/A
Are silt curtains deployed?	☐	☐	☐
Are stakes place in correct locations and orientation?	☐	☐	☐
Are joins between curtain segments securely connected?	☐	☐	☐
Is turbidity apparent outside of the silt curtains?	☐	☐	☐
Do the turbidity values at the IDU exceed the thresholds?	☐	☐	☐
Are the control measures adequate to prevent water and/or sediment from being discharged into the ocean?	☐	☐	☐

IN-WATER CONFINEMENT MEASURES REQUIRED:

PROTECTION AROUND CRITICAL AREAS:	YES	NO	N/A
Is there someone on-site during construction to monitor for endangered species?	☐	☐	☐
Did the on-site observer observe any protected and/or endangered species (i.e. green sea turtle, hawksbill sea turtle, Hawaiian Monk seal, etc.) prior to start of work? Time and Description: _________________________	☐	☐	☐
If protected and endangered species present, were photographs taken to assist with identification of the protected and endangered species?	☐	☐	☐
If protected and endangered species present, was work ceased until the species voluntarily left the project site?	☐	☐	☐
If protected and endangered species present, were any agencies notified of the species? If yes, agency:______________________________________	☐	☐	☐
Have any historic properties been identified in the project area?	☐	☐	☐

PROTECTION OF CRITICAL AREAS REQUIRED:

HOUSEKEEPING:	YES	NO	N/A
Are areas kept clean of rubbish, construction debris, spills, etc.?	☐	☐	☐
Is waste frequently vacuumed/cleaned?	☐	☐	☐

HOUSEKEEPING REQUIRED:

MATERIAL/WASTE MANAGEMENT:	YES	NO	N/A
Are materials stored under shelter or covered and above ground?	☐	☐	☐
Are flammable/reactive materials stored properly?	☐	☐	☐
Are material containers in good condition (not rusted, damaged or leaking)?	☐	☐	☐
Are all construction debris collected and placed daily in the covered dumpster?	☐	☐	☐

CORRECTIVE MEASURES REQUIRED:

VEHICLE AND EQUIPMENT MANAGEMENT:	YES	NO	N/A
Are vehicles and equipment cleaned before being brought on-site?	☐	☐	☐
Is equipment fueled away from any drain or the shoreline?	☐	☐	☐
Are spill cleanup materials readily accessible?	☐	☐	☐
Is all equipment leak free or if leaking, a spill pan placed to catch the leaks?	☐	☐	☐

CORRECTIVE MEASURES REQUIRED:

PUBLIC PROTECTION:	YES	NO	N/A
Are protective measures installed around the work site to prevent pedestrians from entering?	☐	☐	☐
Are there signs informing the public of the project activities?	☐	☐	☐

MAINTENANCE PUBLIC PROTECTION REQUIRED:

Photographs shall be date stamped and attached to the applicable Report Form.

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.

Inspected by: ____ Title: ______________________

Signature: ____ Date: ______/______/______