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November 27, 2017

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OFC. OF ENVIRONMENTA
QUALITY CONTROL

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

Dear Mr. Glenn:

Subject: Final Environmental Assessment and Finding of No Significant Impact for the Waikiki (Queen's Surf) Seawall Mitigative Improvements Honolulu, Oahu, Hawaii, TMK: 3-1-30: 001, 003, 004 and 3-1-31: 004 and 005

With this letter, the Department of Design and Construction hereby transmits the Final Environmental Assessment and Finding of No Significant Impact (FEA-FONSI) for the Waikiki (Queens Surf) Seawall Mitigative Improvements project situated at TMK: 3-1-30: 001, 003, 004 and 3-1-31:004 and 005 in the Honolulu District on the island of Oahu for publication in the next available edition of the Environmental Notice.

The Department of Design and Construction has included copies of public comments and the corresponding responses from the applicant that were received during the 30-day public comment period on the Draft Environmental Assessment and Anticipated Finding of No Significant Impact.

Enclosed is a completed OEQC Publication Form, two (2) copies of the FEA-FONSI, an Adobe Acrobat PDF file of the same, and an electronic copy of the publication form in MS Word. Simultaneous with this letter, we have submitted the summary of the action in a text file by electronic mail to your office.

Should there be any questions, please contact Elaine Morisato of our Facilities Division, at 768-8406.

Very truly yours,

for M. Yonamine

Robert J. Kroning, P.E.
Director

RJK:ln

Enclosures

18-235

AGENCY
PUBLICATION FORM

Project Name:	Waikiki (Queens Surf) Seawall Mitigative Improvements
Project Short Name:	Queens Surf Seawall Repairs
HRS §343-5 Trigger(s):	Use of State or County lands
Island(s):	O`ahu
Judicial District(s):	Honolulu
TMK(s):	3-1-30:001 to 005 and 3-1-31: 004 and 005
Permit(s)/Approval(s):	DHSD, SSV, CDUP, Section 401 WQC, DA NWP (PCN), Archaeological Report, MLCD, ESA, NOAA
Proposing/Determining Agency:	Department of Design and Construction
Contact Name, Email, Telephone, Address	Elaine Morisato, 808-768-8406, emorisato@honolulu.gov 650 South King St., 9th floor Hon., HI 96813
Accepting Authority:	
Contact Name, Email, Telephone, Address	
Consultant:	Oceanit
Contact Name, Email, Telephone, Address	Cris Takushi, ctakushi@oceanit.com, 828 Fort Street Mall, Suite 600 Hon., HI 96813

Status (select one)	**Submittal Requirements**
___ DEA-AFNSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEA, and 4) a searchable PDF of the DEA; a 30-day comment period follows from the date of publication in the Notice.
_X_ FEA-FONSI	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; no comment period follows from publication in the Notice.
____ FEA-EISPN	Submit 1) the proposing agency notice of determination/transmittal letter on agency letterhead, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEA, and 4) a searchable PDF of the FEA; a 30-day comment period follows from the date of publication in the Notice.
____ Act 172-12 EISPN ("Direct to EIS")	Submit 1) the proposing agency notice of determination letter on agency letterhead and 2) this completed OEQC publication form as a Word file; no EA is required and a 30-day comment period follows from the date of publication in the Notice.
____ DEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the DEIS, 4) a searchable PDF of the DEIS, and 5) a searchable PDF of the distribution list; a 45-day comment period follows from the date of publication in the Notice.
____ FEIS	Submit 1) a transmittal letter to the OEQC and to the accepting authority, 2) this completed OEQC publication form as a Word file, 3) a hard copy of the FEIS, 4) a searchable PDF of the FEIS, and 5) a searchable PDF of the distribution list; no comment period follows from publication in the Notice.
____ FEIS Acceptance Determination	The accepting authority simultaneously transmits to both the OEQC and the proposing agency a letter of its determination of acceptance or nonacceptance (pursuant to Section 11-200-23, HAR) of the FEIS; no comment period ensues upon publication in the Notice.
FEIS Statutory Acceptance	Timely statutory acceptance of the FEIS under Section 343-5(c), HRS, is not applicable to agency actions.
____ Supplemental EIS Determination	The accepting authority simultaneously transmits its notice to both the proposing agency and the OEQC that it has reviewed (pursuant to Section 11-200-27, HAR) the previously accepted FEIS and determines that a supplemental EIS is or is not required; no EA is required and no comment period ensues upon publication in the Notice.

____ Withdrawal Identify the specific document(s) to withdraw and explain in the project summary section.

____ Other Contact the OEQC if your action is not one of the above items.

Project Summary

Provide a description of the proposed action and purpose and need in 200 words or less.

Queens Surf Seawall protects a part of Kapiolani Park from sea erosion. The oceanside area of the seawall is part of the Waikiki Marine Life Conservation District (MLCD). The seawall is badly damaged and being underminined partly by wave attack. The project purpose is to assess the condition of the seawall and provide planning, permitting, design and construction documents to repair the seawall.

Final Environmental Assessment

Waikīkī Seawall Mitigative Improvements

Honolulu, Island of O‘ahu, Hawai‘i

Tax Map Key: 3-1-30:001, 002, 003, 004 and 005, 3-1-31:004 and 005

Department of Design and Construction
City and County of Honolulu
650 South King Street, 11th Floor
Honolulu, Hawai‘i 96813

November 2017

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FINAL ENVIRONMENTAL ASSESSMENT
Waikīkī Seawall Mitigative Improvements

HONOLULU, O‘AHU, HAWAI‘I

Submitted Pursuant to the
Hawai‘i Environmental Policy Act,
Chapter 343 Hawaii Revised Statues, and
Title 11, Chapter 200, Hawaii Department of Health Administration Rules

by the

Department of Design and Construction
City and County of Honolulu

The following person may be contacted for additional information concerning this document:

Elaine Morisato, P.E., Project Manager
Department of Design and Construction
650 South King Street, 9th floor
Honolulu, Hawai`i 96813
(808) 768-8406

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Acronyms and Abbreviations

AIS	Archaeological Inventory Survey
BLNR	Board of Land and Natural Resources
BMP	Best Management Practice(s)
CDUP	Conservation District Use Permit
CIA	Cultural Impact Assessment
CFR	Code of Federal Regulations
CWA	Clean Water Act
CZM	Coastal Zone Management
dBA	A-weighted decibels
DLNR	Department of Land and Natural Resources
EA	Environmental Assessment
EO	Executive Order
EPA	Environmental Protection Agency
ESA	Endangered Species Act
FHWA	Federal Highways Administration
FONSI	Finding of No Significant Impact
ft	foot or feet
GIS	Geographic Information Systems
HEPA	Hawai‘i Environmental Policy Act
HDOH	Hawai‘i Department of Health
HDOT	Hawai‘i Department of Transportation
mm	millimeter
msl	mean sea level
NEPA	National Environmental Policy Act
OEQC	Office of Environmental Quality Council
OHA	Office of Hawaiian Affairs
NPDES	National Pollution Discharge Elimination System
NHPA	National Historic Preservation Act
OCCL	Office of Conservation and Coastal Lands
PM2.5	suspended particulate matter ≤ microns aerodynamic diameter
PM10	suspended particulate matter ≤ 10 microns aerodynamic diameter
ppt	parts per trillion
SHPD	State Historic Preservation Division
SMA	Special Management Area
SSV	Shoreline Setback Variance
$\mu g/m^3$	Micrograms per cubic meter
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
WQC	Water Quality Certification

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Appendix D Condition Assessment Report
Appendix E Archaeological Monitoring Plan
Appendix F Cultural Impact Assessment

General Information Summary

Applicant:	City and County of Honolulu Department of Design and Construction - Director 650 South King Street, 11th floor Honolulu, Hawai`i 96813
Owner:	Department of Design and Construction
Consultant/Preparer:	Oceanit 828 Fort Street Mall, Suite 600 Honolulu, Hawai`i 96813
Approving Agency:	City and County of Honolulu Department of Design and Construction - Director 650 South King Street, 11th floor Honolulu, Hawai`i 96813
Project Description:	The City & County of Honolulu is planning on repairing the Waikīkī (Queens Surf) Seawall on the island of O‘ahu because it has deteriorated and has been damaged by wave action. The wall was originally built to protect shoreline structures, but currently fails to protect land side areas from erosion. This project involves planning and design for repair or reconstruction of the Queens Surf Seawall.

Consulted Organizations	<u>Federal Agencies</u> U.S. Army Corps of Engineers, Honolulu District, Regulatory Branch U.S. Department of Commerce National Marine Fisheries Service U.S. Department of Interior Geological SurveyFish & Wildlife Service National Park Service <u>State Agencies</u> Department of Agriculture Department of Accounting and General Services Department of Business, Economic Development and Tourism Strategic Development Division Office of Planning Tourism Authority Department of Hawaiian Home Lands Department of Health Environmental Health Administration Department of Land and Natural Resources Historic Preservation Division Office of Conservation and Coastal Lands Department of Transportation Office of Hawaiian Affairs Univeristy of Hawai‘i, Water Resources Research Center University of Hawai‘i, Environmental Center University of Hawai‘i, Waikīkī Aquarium <u>City and County of Honolulu</u> Board of Water Supply Department of Emergency Services Department of Environmental Services Department of Facility Maintenance Department of Planning and Permitting Department of Parks and Recreation Department of Transportation Services Honolulu Fire Department Honolulu Police Department Waikīkī Neighborhood Board nos. 5 and 9 <u>Elected Officials</u> U.S. Representative Colleen Hanabusa U.S. Senator Brian Schatz U.S. Senator Mazie Hirono State Representative Bertrand Kobayashi State Senator Brickwood Galuteria CouncilmanTrevor Ozawa

	Utilities Hawaiian Electric Company Community Organizations AIA Honolulu Kaimana Beach Coalition Kapiolani Park Preservation Society Waikīkī Swim Club Waikīkī Roughwater Swim Committee, Inc. The Nature Conservancy Surfrider Foundation, Oahu Chapter Waikīkī Beach Special Improvement District The Outdoor Circle, Greater Waikīkī Branch Waikīkī - Kapahulu Library
Tax Map Key:	(1) 3-1-30:001 to 005, (1) 3-1-31:004 and 005
State Land Use:	Urban District, Preservation 2
County General Plan:	Primary Urban Center
County Zoning:	P-2 General Preservation District
Special Designations	Special Management Area and Shoreline Setback Diamond Head Special District (DHSD) Project site is fronted by Waikīkī Marine Life Conservation District (WMLCD)

1 Introduction

Queen's Surf Beach in Honolulu, Oʻahu is a part of world renowned Waikīkī Beach. This stretch of beach is within Kapiʻolani Regional Park near the Beach Center area of the park. The Beach Center parcel was formerly occupied by a restaurant/bar, restrooms, changing areas and a covered pavilion. An existing seawall of approximately 1,270 lineal feet extends from the area near the Queens Surf groin on the north to the Waikīkī Natatorium on the south. The beach north of the coastal planter box is wide, but narrows considerably as you move in a southerly direction towards the Waikīkī Aquarium. The beach fronting the seawall is composed of a thin layer of carbonate sand, has been modified extensively and is exposed to waves from the south, with good surfing spots offshore. The first encroachment onto the beach with buildings and other works was in the 1880s and 1890s (2008, Weigel). Original segments of this seawall were constructed in the 1920s during the same period the Natatorium (1927), Ala Wai Canal and Ala Wai Yacht Harbor were constructed. The seawall was built to protect structures along the beach from wave-induced erosion. Over the years numerous repairs and modifications have been made to repair damage to the wall. The most recent major repair of the seawall was in 1987.

This Final Environmental Assessment (DEA) was prepared for the City and County of Honolulu Department of Design and Construction to document the environmental impacts of implementing a proposed repair of the seawall. Under this project, a 900 foot section of the 1,270 foot seawall between the area near the Queens Surf Groin and the Aquarium was evaluated for repair or reconstruction. This section shall be refered to as the "Waikīkī Seawall". Based on a comprehensive condition assessment, an approximate 460-foot section of the Waikīkī Seawall shall be subject to major repairs starting from a point north of the coastal planter box to the adjoining wall, fronting the Waikīkī Aquarium on the south end. Minor spot repairs to sections of the seawall north of the planter box and reconstruction of a concrete curb next to ramp are also included in the proposed plan.

Special environmental studies conducted for this EA include: 1) Geotechnical Exploration and Evaluation Reports; 2) Nearshore Survey of Benthic Habitat; 3) Archaeological Monitoring Plan and 4) Cultural Impact Assessment. A summary of these studies are provided in this DEA and a copy of the detailed reports are included in the Appendices.

1.1 Project Purpose

The purpose of the proposed project is to provide mitigative improvements that would correct the deteriorated condition of the existing seawall. During times of high surf, the waves overtop the wall causing damage and erosion problems behind the wall. If the proposed repairs are not implemented continued surface degradation from wave-induced abrasion, undermining, settlement and eventual failure of the wall will occur.

This FEA discloses the foreseeable environmental impacts that would likely result from the proposed project's implementation and commits to the employment of specific measures to avoid, minimize, or mitigate impacts to the environment. Additionally, the FEA contains a record of the consultation activities with appropriate Federal, State, City and County and private organizations that have been conducted to date as part of project planning. The organizations are listed in the General Information Summary. Pursuant to the Hawai'i Environmental Policy Act (HEPA), a Finding of No Significant Impact (FONSI) is anticipated for this proposed project.

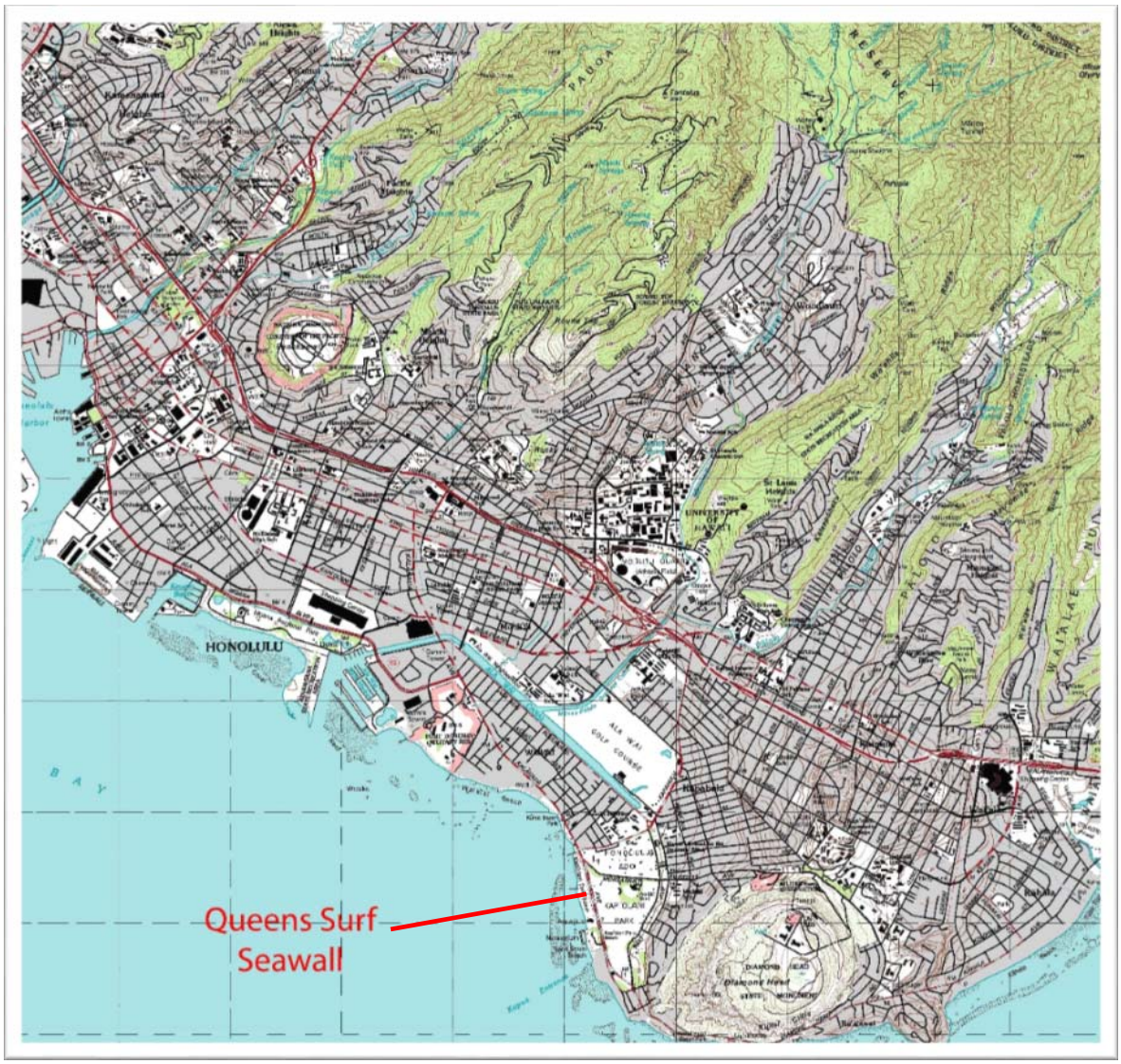


Figure 1-1. Vicinity Map of the Waikīkī Seawall Project

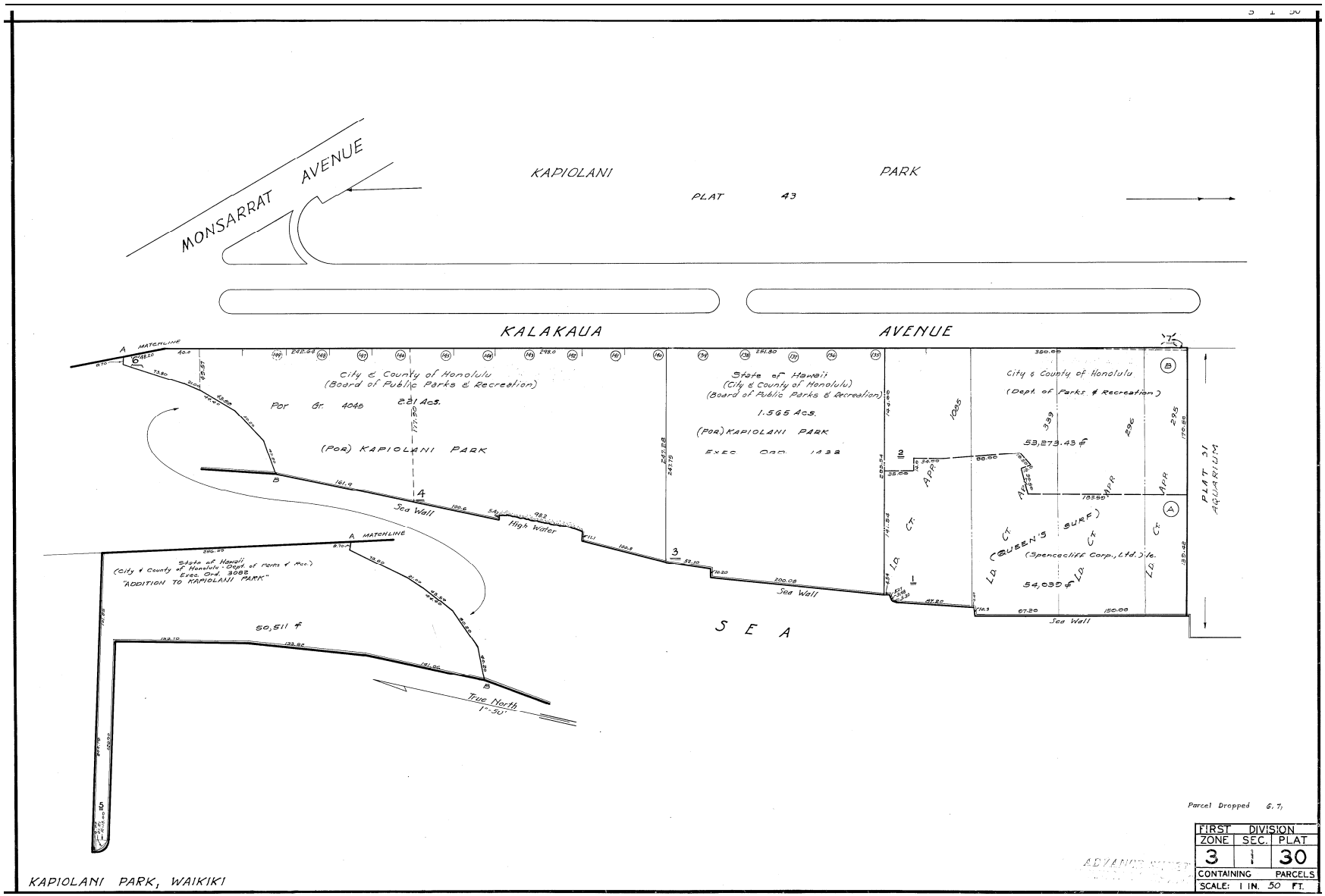


Figure 1-2. Tax Map Key 3-1-30: 1, 2, 3 and 4

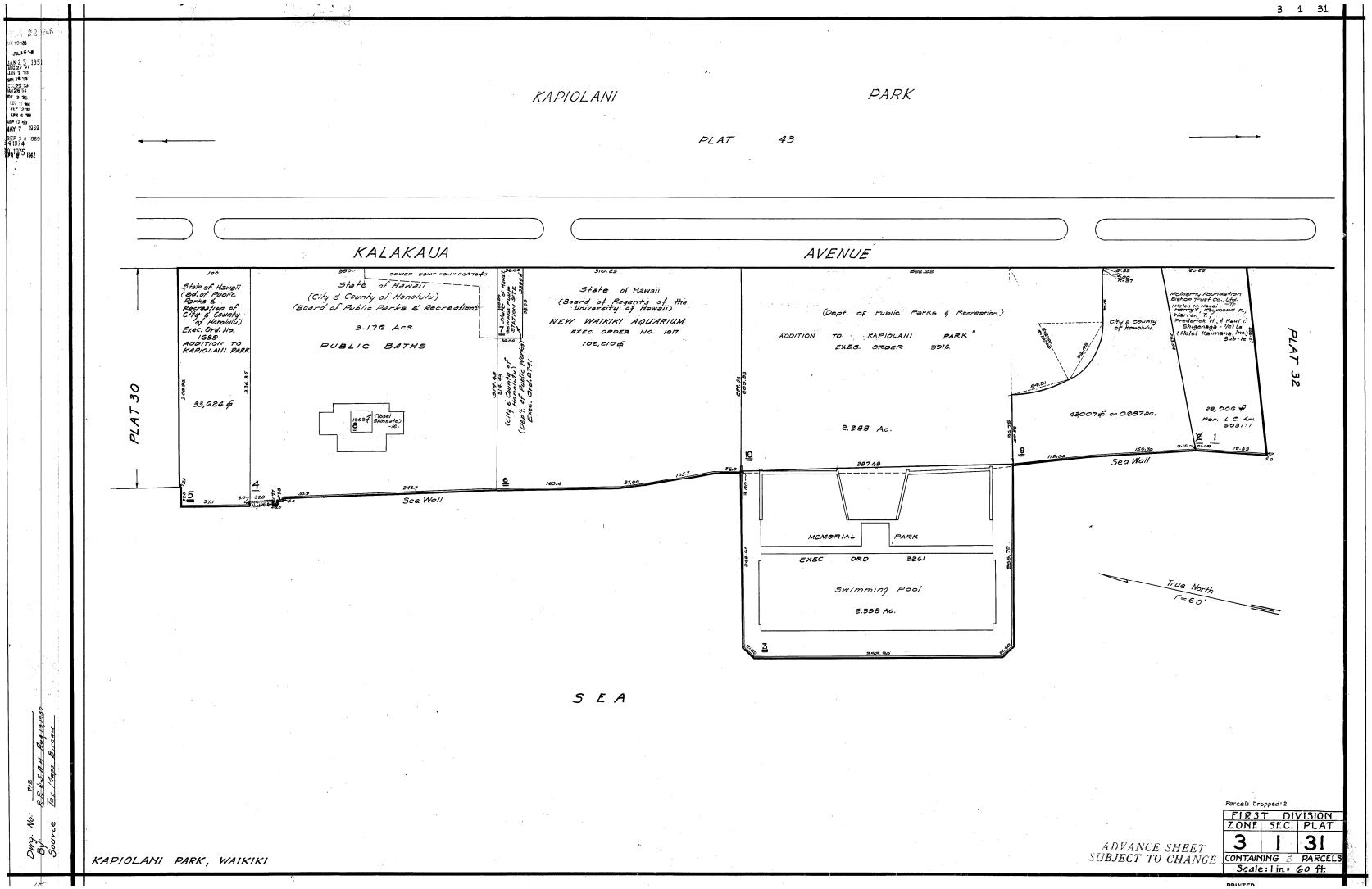


Figure 1-3. Tax Map Key 3-1-31:4 and 5

Figure 1-4. Aerial View of Waikīkī (Queens Surf) Seawall

Figure 1-5. View looking north from ocean side of aquarium wall

Figure 1-6. Condition land side of coastal planter box

Figure 1-7. Void in foundation south of planter box

Figure 1-8. Void in foundation looking toward aquarium

Figure 1-9. Close-up of seawall foundation void

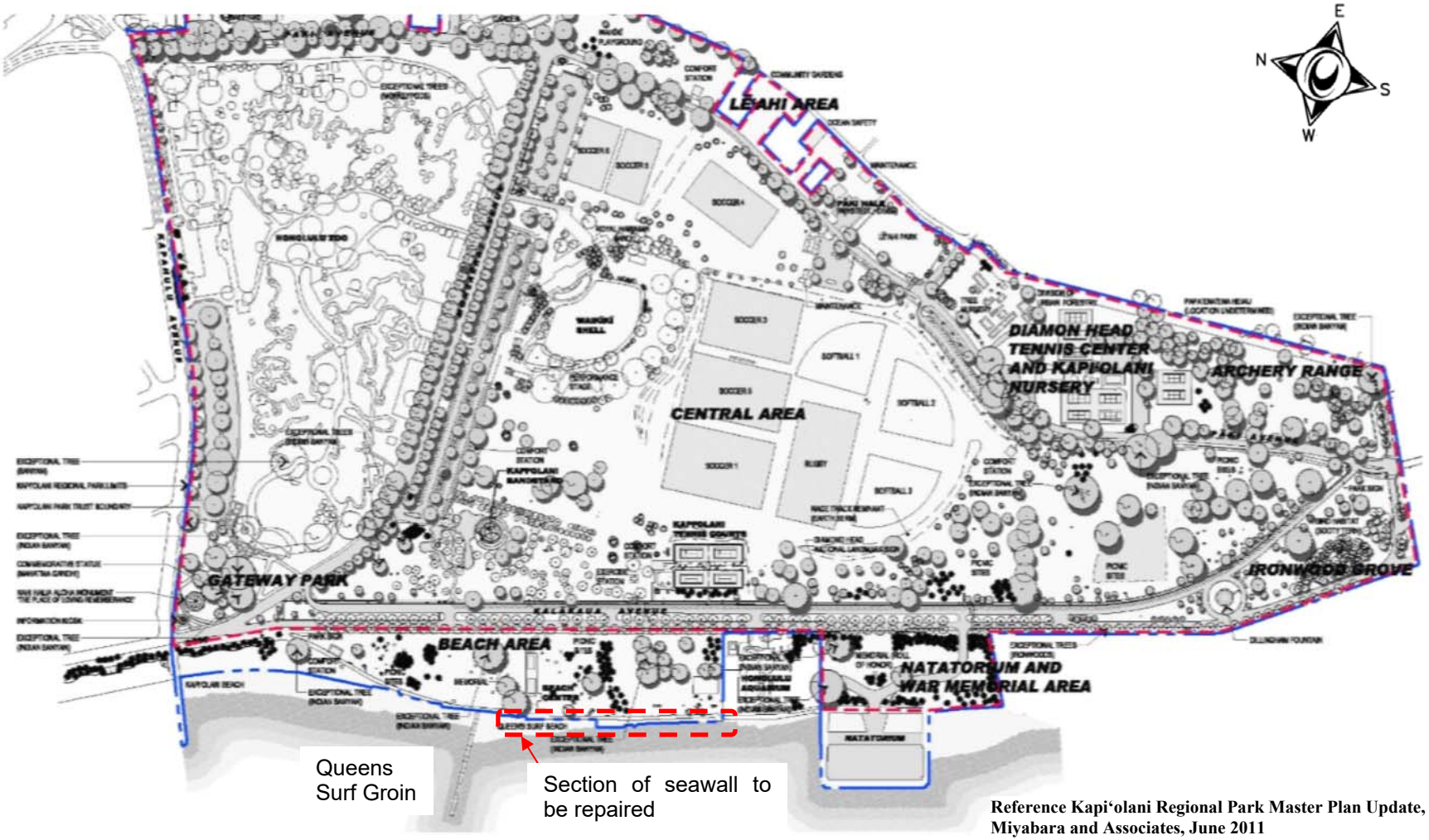
Figure 1-10. Damaged concrete wall cap

2 Project Description

2.1 Location of Project and Description

The portion of the existing seawall that was evaluated for repairs or reconstruction spans approximately 900 lineal feet, extending from the area near the Queens Surf groin on the north end of the project site to the Waikīkī Aquarium on the south end. This 900-foot section along the makai border of TMK parcels 3-1-30:001, 003 and 004, 3-1-31:004 and 005 shall be refered to as the "Waikīkī Seawall". The City and County of Honolulu owns these parcels except for parcel 3-1-30:003, but is obligated by Executive Order to maintain the seawall on its makai border. The 370-foot portion of seawall fronting the aquarium and extending to the natatorium is owned and maintained by the State. The beach fronting the seawall is known by various names; Queens Surf, Kapiolani Park or Kapiolani Beach. An 11 to 12 foot wide, flagstone paved sidewalk promenade was constructed in early 2001 and runs roughly parallel to the seawall. The promenade is installed directly to the edge of the wall along its north end with this condition continuing all the way to the coastal planter box. From the south end of the planter box there is a 11 to 13 foot wide former landscaped area that extends to the wall fronting the Waikīkī Aquarium. This former landscaped area is badly eroded due to wave overtopping and has patches of Naupaka, sand and abandoned irrigation pipes.

Historical accounts (Weigel 2002 and Crane 1972) indicate the original segments of the wall were built in the 1920s using concrete rubble, cast in place (CIP) concrete and cinder blocks. The existing seawall appears to have numerous repairs and modifications over the years. Presently, the seawall is comprised of CIP concrete at its base with one or two horizontal layers of mortared stones (concrete rubble masonry, CRM) on top. According to as-built plans, the wall was found to be in a deteriorated condition in 1987 and repaired by the Department of Parks and Recreation. The shorter north end of the wall is constructed entirely of CIP concrete.



Reference Kapi'olani Regional Park Master Plan Update, Miyabara and Associates, June 2011

Figure 2-1. Seawall to be Repaired - Kapi'olani Regional Park

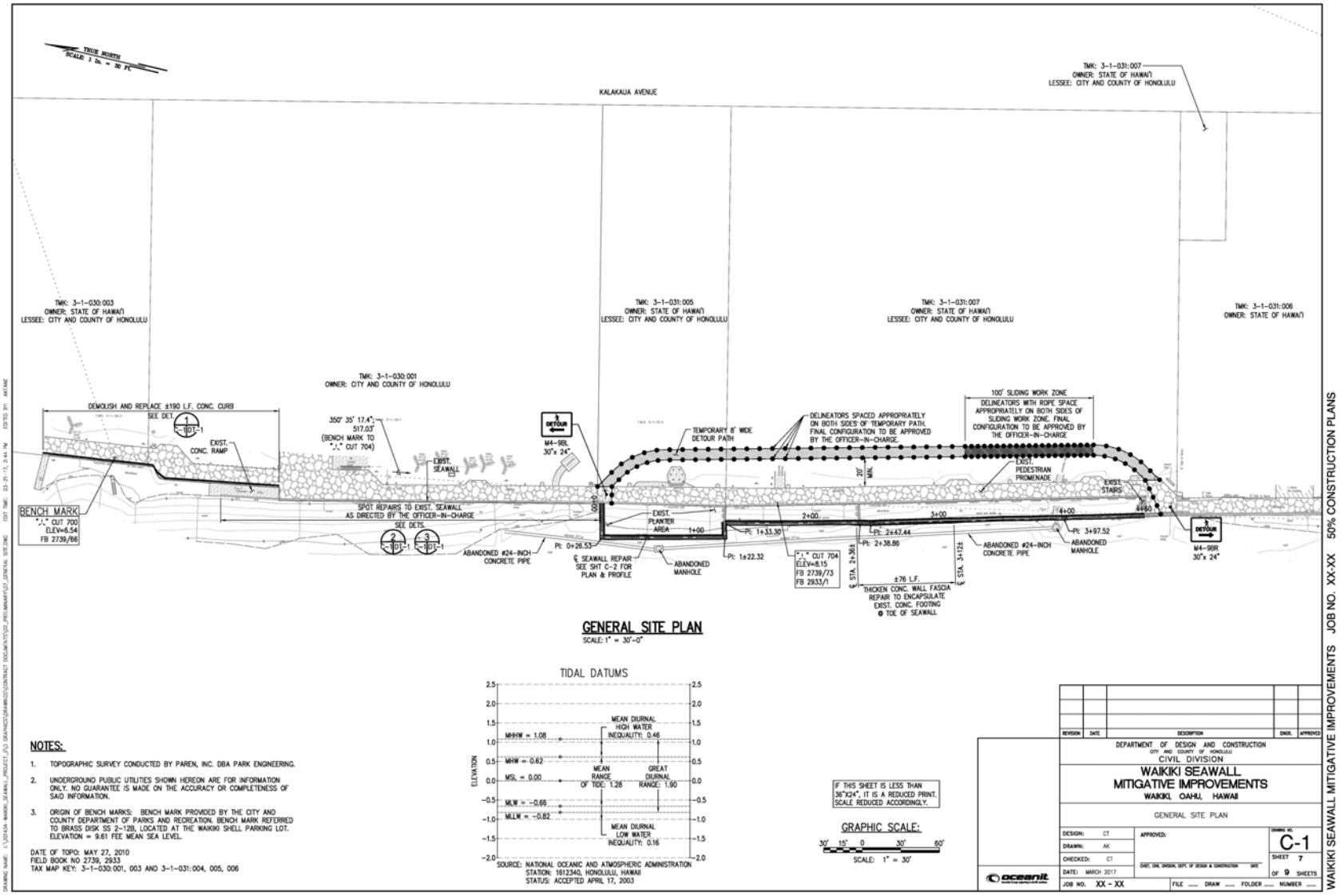


Figure 2-2. General Site Plan for Proposed Repairs

2.2 Existing Land Use Classifications

The project is located within the urbanized areas of Waikīkī, in Honolulu, Hawaii. The State Land Use designation is "U" (Urban) and the County General Plan designation is "Urban Center" with a narrow strip of park space along the shoreline. The City & County of Honolulu zoning designation is a Primary Urban District. Kapiʻolani Regional Park is a large

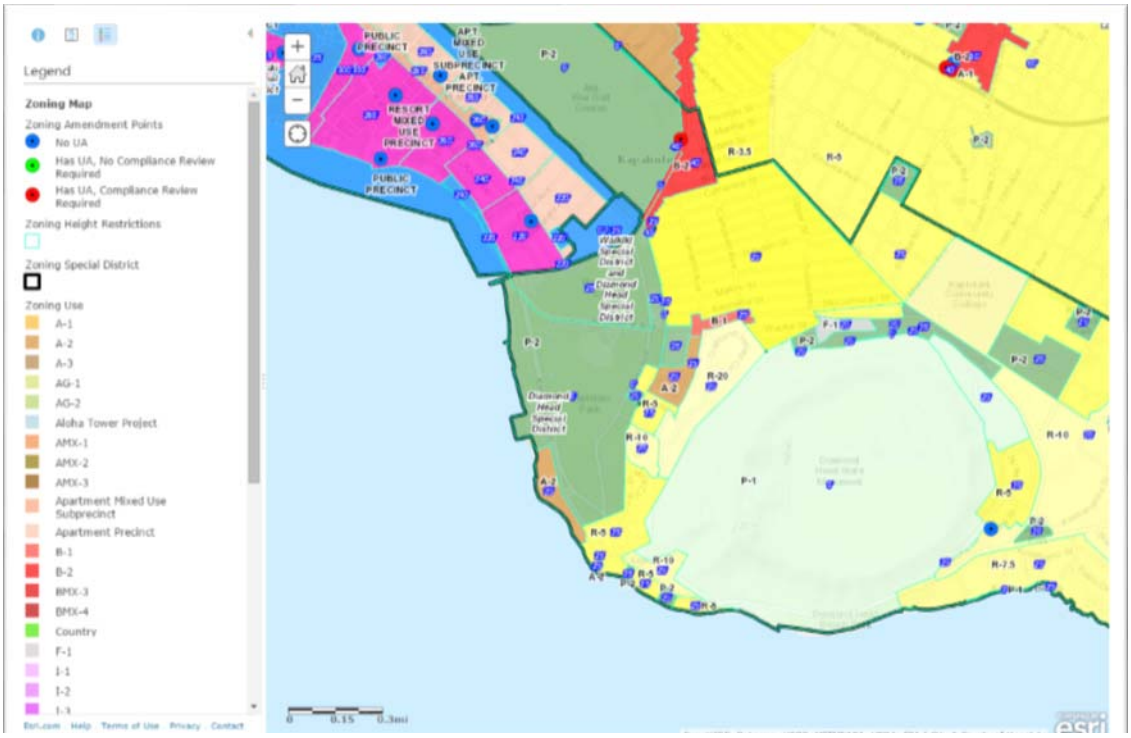


Figure 2-3. County Zoning Map

recreational park with Queens Beach flanking its northwest border. A pedestrian promenade spans along the beach in several sections up and down Waikīkī. The seawall is on the seaward side of the pathway. The Waikīkī Marine Life Conservation District (WMLCD) is seaward of the proposed project site and is comprised of an area of 76 acres. The WMLCD extends from the groin at the end of Kapahulu Avenue to the ewa (west) wall of the Natatorium, from the highwater mark seaward a distance of 500 yards or to the edge of the fringing reef, whichever is greater.

Figure 2-4. State Land Use District Map

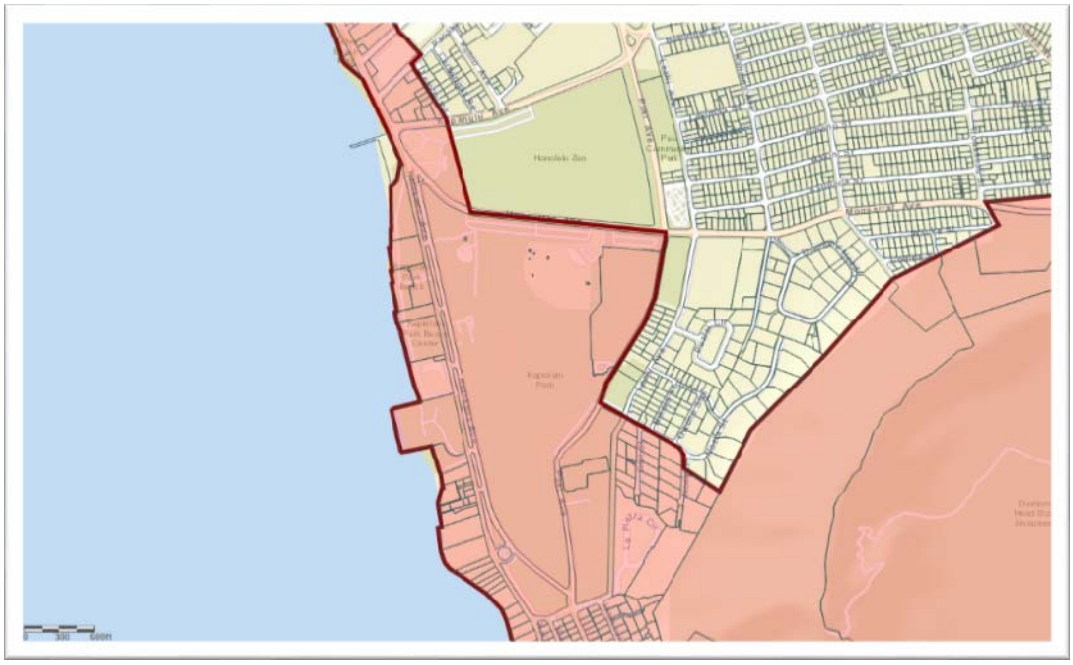


Figure 2-5. Special Management Area Map

3 Alternatives Considered

3.1 No Action Alternative

If no mitigative action is taken to repair the seawall, damage will continue and the level of deterioration of the seawall and eroded landscape area will continue and become a very extreme public safety hazard for residents and visitors. The mass of the seawall and multiple repairs done over the years have kept the wall from collapsing. Failure of the seawall will result in extreme erosion of land side backfill, runoff into the ocean, potential damage to the promenade and increase the likelihood of accidents and injuries.

Figure 3-1. Typical condition of landscaped area

3.2 Required Seawall Repairs

Defects in different parts of the wall were detected during field investigations conducted in 2015 and 2016 and geotechnical explorations conducted in 2011 and 2014. Prior to construction of proposed repairs the contractor shall conduct his own field investigation to document any additional defects in the wall that need to be repaired. Defects presently included in this project have been identified with proposed repairs described.

Voids in the wall's foundation are the most critical defects in the seawall. These voids are in various segments of the seawall, mainly between the area south of the coastal planter box to the wall fronting the aquarium. The methods considered for filling the voids included; drypacking using a cementious material with structural fibers, flowable concrete, shotcreting, marine geotubes filled with mortar or grout bags filled with fiber-reinforced concrete. The repair method recommended is to fill the foundation voids with flowable concrete containing fiber-reinforcement and a washout resistant admixture.

Damage repairs or replacement of the concrete cap. Most of the concrete cap on top of the seawall is in need of repair or replacement. The Contractor will be required to conduct a condition assessment of the concrete cap after completion of repairs of the other parts of the seawall to determine if any of the cap sections are salvageable. Although the concrete cap is more of an aesthetic feature of the wall, repair or replacement of the concrete cap will help stabilize the wall and provides a safer walking surface for the general public.

The need to repair the following defects could automatically be eliminated by constructing the form-lined makai wall. These defects and the proposed repairs that could be eliminated include:

Missing or loose rocks or eroded mortar at CRM portions of the seawall in areas that have been subjected to wave action and sulfate attack can be replaced, reset and repointed using high performance cementitious, sulfate resistant or epoxy mortar.

Vertical cracks at seaward facing corners of retaining walls, such as the corners of the coastal planter box are common and could be repaired a number of different ways. One method involves excavating the backfilled area landward of the cracked wall corner and pouring a reinforced concrete pier to strengthen and reinforce the corner. Epoxy embedded dowels would be used to tie the existing CIP and CRM wall sections to the newly installed concrete. An alternative to correct the vertical cracks would be to drill a shaft to reinforce the corner.

Lower priority, non-mandatory repairs. The following defects in the seawall were identified during the condition assessment but were considered cosmetic and minor in nature and a lower priority compared with the required repairs. The Officer-in-Charge shall make the determination whether these repairs are made, depending on availability of funds.

North of planter box, internal voids between horizontal wall layers were found between the CIP and CRM wall layers, probably caused by wave-induced deterioration of the concrete at the cold joints. These voids between wall layers can be repaired using flowable concrete.

North of planter box, concrete spalls in the CIP wall is probably due to corrosion of the imbedded reinforcing steel, exposed by cracks or weathering of the concrete. Badly deteriorated rebars should be replaced or stainless steel or glass fiber spliced reinforcing can be spliced in. Damaged sections of concrete that are salvageable can be patched with a high performance concrete repair material with a corrosion inhibiting admixture. Fiber could be added to the patching repair material to provide toughness.

North of planter box, cracks and spalling in the decorative bullnose feature. The most likely cause of cracks and spalls in the bullnose is corrosion of the reinforcing steel due to cracks or carbonation. The contractor will be required to follow International Concrete Repair Institute (ICRI) recommendations to conduct these repairs.

3.3 Alternatives considered from planter box to south end of seawall

The alternatives described in this section were initially evaluated as stand-alone measures to reconstruct or repair the seawall. Upon further review it was apparent that a combination of construction methods would be required to satisfy the City's requirements to provide a strong and safe seawall that minimizes erosion on its landward side.

3.3.1 Alternative 1: Reconstruct a new seawall

The existing seawall appears to be constructed on coral formation with the coral bed close to low water. To replace the existing wall with a structurally stable wall in terms of sliding, overturning and bearing capacity would require construction of a new concrete wall 6.5 feet high with a miminum 1-foot thick footing down to the scour level. A keyway constructed at the midpoint of the footing to resist lateral pressure at the base of the wall would also be recommended. This alternative would have the longest construction duration and would be the most expensive of all alternatives considered. A cofferdam structure to provide a dry work area and extensive excavation and shoring would be required to support the excavated trench and prevent damage to the adjacent promenade from settlement. Construction of a new wall would have significant public and environmental impacts.

A design of a new, replacement concrete wall would have to incorporate features that prevent scouring and undermining of its foundation due to wave action. Because of the high cost and environmental impacts, reconstructing the entire section of seawall between the coastal planter box and aquarium was not considered a feasible alternative.

Raise Height of Seawall

During high surf, waves overtop the wall and erosion of the areas behind the seawall are common occurrences. The seawall varies in height at its seaward face, from 1' at its north end to over 10' at its south end and retains up to 8' of earth on the land side. The north end of the wall is fronted by beach sand. Increasing the wall height starting from the north end of the coastal planter box and ending at the wall section fronting the Waikīkī Aquarium; a distance of about 460 linear feet, was considered because of wave damage. See Figures 3-2 and 3-3. Three alternatives for raising the wall by about 3.5 feet to match the height of the adjoining aquarium wall to the south were evaluated. These alternatives included: 1) Pouring a reinforced concrete wall on top of existing wall using a form-liner. Rebar would first be imbedded into the existing wall before pouring the new wall. This would also require constructing a wall footing on the land side for stability and support of the existing wall. 2) Pouring a reinforced concrete "core" wall into a form-liner with rock veneer facing on each side of the wall. This would be a structurally sound alternative but rock veneer facing may come off with high waves. 3) Install Concrete Rubble Masonry (CRM) wall on top of existing wall. This would probably be the least costly of the three, but would provide the least strength of alternatives.

Any alternative to increase the height of the seawall was not considered feasible because of the very real potential of wall failure due to additional dead weight. Visual inspection of the current wall condition reveals the wall to be in a very unstable and unsafe state. Analysis of the existing structure verified that the existing wall is structurally deficient. If the wall were reconstructed and raised, the City has safety concerns and may require railings. There are no railings on the adjoining, higher seawall owned by the State fronting the Waikīkī Aquarium.

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Figure 3-2. Wave Overtopping and Pooling inside Planter Box

Figure 3-3. Wave Crashing and Water Pooling behind Seawall

3.3.3 Alternative 2: Form-lined concrete wall on ocean side and concrete support on land side

Construction of a form-lined concrete wall on the ocean side of the deteriorated seawall would support the existing wall and provide protection from wave erosion. The form-liner would be fabricated to follow the existing shape of the wall, with a slight wave deflector at those sections of the wall where a wave deflector exists, to help reduce wave overtopping and land side erosion. The surface of the new ocean facing wall would also be constructed to match the look and color of the existing seawall as much as practicable. Due to the seawall's poor condition the bond between a new concrete support wall and the existing seawall may present construction problems. During the design phase methods to support the new concrete wall will need to be determined. These may include drilling through the existing seawall in order to install anchors between the new concrete wall and the concrete poured on the land side of seawall, or supporting the new concrete wall with rebars imbedded in the subsurface area makai of the existing seawall. Filling of existing foundation voids and repairs of the seawall would be done prior to placement of the forms for the new concrete wall.

3.3.4 Alternative 3: Permeation Grouting and land side reinforcement

Permeation grout injected into appropriate sections of the existing seawall would allow repairs to be confined to the existing wall envelope and strengthen the wall. Permeation grouting utilizes either a chemical (sodium silicate or polyurethane) or a cementitious (microfine cement) material. Backfill material along the land side of the wall could also be reinforced with grouting. Spacing of the grout injection sites would be determined during the design phase.

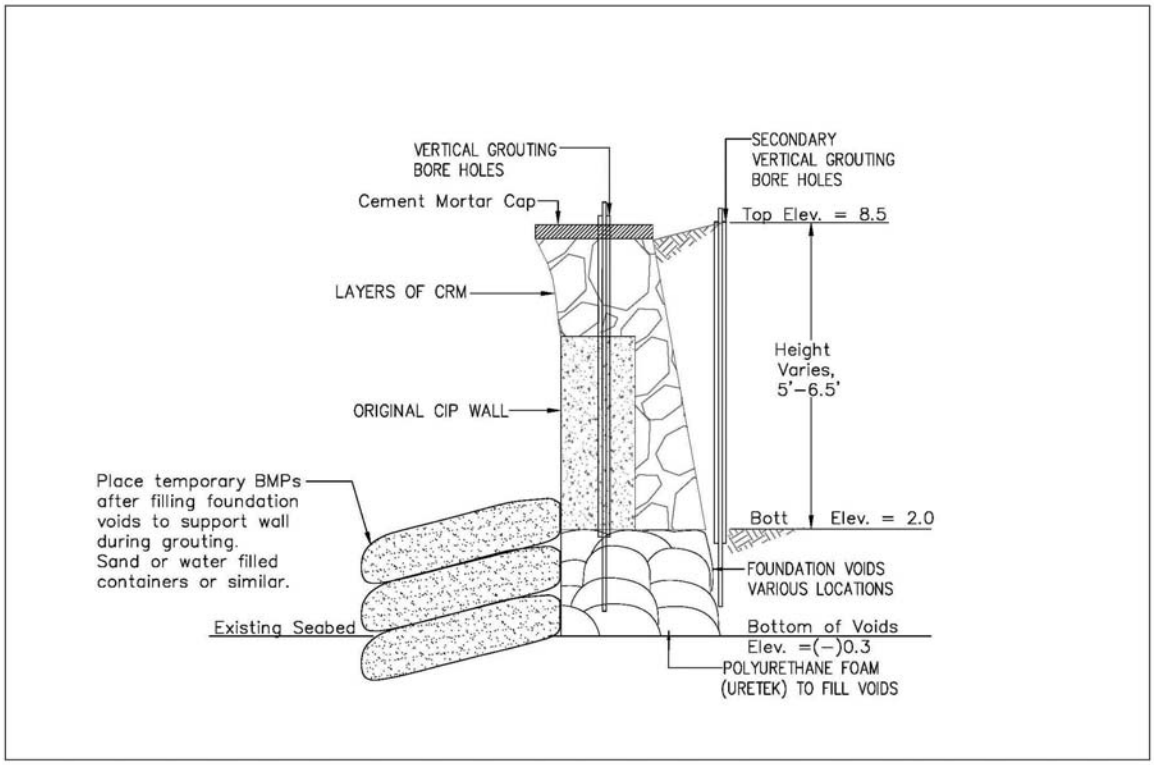

Figure 3-4. Permeation Grouting Schematic

3.3.5 Alternative 4: Rock revetment protection and install concrete support on land side

Once the existing large voids in the wall's foundation are filled, a rock revetment or berm could be placed over geotextile fabric with armor stones placed at the wall's toe to provide protection for the foundation. These structures are capable of dissipating a large fraction of wave energy and reducing wave overtopping and landside erosion. An added benefit of this alternative is the armor stone or rocks would cover up the abandoned stormwater pipes and manholes immediately seaward of the wall (see Figures 1-6 and 1-10). It is also favorable due to its moderate cost and ease of construction. Rock revetments are extremely durable and can last more than 50 years. Rock revetments or berms may initially require maintenance as rocks begin to settle, and periodically rocks may need to be added or moved if they become displaced by wave action.

Figure 3-5. Examples of rock revetments that provide seawall toe protection

The slope of the revetment, size and number of layers of armor stone rocks and height of the revetment relative to the seawall being protected would depend on construction fund constraints and degree of wave run-up protection desired. See Figure 3-6.

A concrete or CLSM support structure to provide land side support of the existing seawall is recommended under this alernative. This mass concrete structure would help brace the seawall against the weight of large armor stones leaning on the existing seawall from the makai side.

Figure 3-6. Kakaako Waterfront Park Seawall and Revetment

3.4 Cost of Alternatives

The construction cost of the alternatives was estimated based on repairing or reconstructing the section of the seawall from the north end of the coastal planter box to the seawall fronting the Waikīkī Aquarium, a distance of approximately 460 lineal feet. A cost summary of the four alternatives considered is shown below. Each alternative and cost below represents a complete design solution. A detailed cost breakdown is contained in the Condition Assessement

Alternative	Description	Total Cost
1	Reconstruct existing seawall and install soil reinforcement	$3,100,000
2	Repair seawall with form-lined makai wall and install concrete support on land side	$2,039,679
3	Repair seawall with permeation grouting and install soil reinforcement	$1,843,825
4	Repair seawall, install rock revetment at toe of seawall and install concrete support on land side	$1,808,885

Table 3-1. Seawall Repair Alternatives – Construction Cost Estimates

3.5 Evaluation of Alternatives

3.5.1 Alternative 1: Construct a new seawall and install soil reinforcement

Replacing a 460 lineal foot section of the existing seawall with a new, reinforced concrete wall with a stronger foundation would provide a structurally sound alternative. This alternative has the highest construction cost of about $3.1 million and would eliminate any of the wall's historical value. Protecting the wall's foundation from undermining and erosion due to wave energy would be a priority for the new seawall design. This alternative would have the longest construction duration, be the most difficult to construct and require significant BMPs to mitigate impacts on the environment and existing improvements, such as the promenade.

An effective soil reinforcement method would also need to be a part of this alternative to provide long-term support of the seawall from the land side and protect the land side improvements behind the wall from wave overtopping.

3.5.2 Alternative 2: Form-lined concrete wall on ocean side and install concrete support on land side

This alternative would provide protection for the seawall's foundation. Initial construction and ongoing maintenance cost would be favorable compared with replacing the entire 460 lineal foot section of wall, but more than Alternatives 3 and 4. Construction of a new form-lined concrete wall would require approval to construct within the Waikīkī Marine Life Conservation District and the Diamond Head Special District. The new form-lined concrete face will be designed to be compatible with the look of the existing seawall, which is a mix of concrete rubble masonry (CRM) using blue rock, aggregate and concrete patches. The proposed form-lined makai concrete wall would also follow the shape of the existing wave deflector near the top of the existing seawall.

The proposed method for supporting the seawall from the land side under this alternative would involve excavating a deep trench behind the seawall and backfilling in controlled thicknesses with concrete or controlled low strength material (CLSM). The mass concrete structure would provide land side support of the seawall and anchoring support for the new makai wall.

3.5.3 Alternative 3: Permeation grouting and soil reinforcement

Permeation grout injected into appropriate sections of the CIP/CRM wall was evaluated as a way to reinforce and consolidate the seawall structure, as well as its foundation, sub-foundation soil, and soils behind the seawall. This method would allow repairs to be confined to the existing wall envelope and maintain its historic appearance. The only in-water construction would be to fill the foundation voids prior to permeation grouting, which is common to all the alternatives being evaluated. Either a chemical (sodium silicate or polyurethane) or a cementitious (microfine cement) grout would be used. Adjustments to grout spacing would depend on the seawall condition. To prevent the seawall from failing or the occurrence of grout leaking into the ocean during construction, BMPs should include structural support of the seawall on the ocean side and injecting only during low tides.

Structural BMPs employed on the ocean side of the seawall could be sandbags or sand filled container berms placed at the seawall toe.

Drilling a secondary row of holes landside of seawall and injecting grout to address inconsistencies in the soil or grouted mass. This grouted mass and subdrain installation land side of the seawall would act to reinforce the soil and help it withstand the erosive wave overtopping and runoff forces. Due to the high level of fines in the silty sand encountered below the base of the seawall it was concluded that permeation grouting may not be effective and be able to penetrate. Other concerns were the inability of BMPs to control grout escape into the ocean.

3.5.4 Alternative 4: Rock revetment and concrete support on the land side

A rock revetment comprised of a top layer of large (average 1,775 pound) armor stones, placed on multiple layers of bedding stones and geotextile fabric would support the existing seawall. The main advantage of the revetment is it would shield the wall's foundation from wave undermining, reduce wave splash and the resulting erosion caused by wave overtopping on the land side. Revetments are relatively much lower in cost than constructing seawalls and are very durable. The Department of Land and Natural Resources Office of Conservation and Coastal Lands informed us that a revetment protecting an existing seawall would be considered coastal hardening and would not be likely be approved by the BLNR. The revetment would also require approvals to construct in the Waikīkī Marine Life Conservation District (WMLCD) and the Diamond Head Special District (DHSD).

A concrete or CLSM support structure to provide land side support of the existing seawall is recommended under this alernative. This mass concrete structure would help brace the seawall against the weight of large armor stones leaning on the existing seawall from the makai side.

3.5.5 Other alternatives considered but rejected

Concrete support wall on the landside. A mass concrete, reinforced or pre-cast concrete support wall was evaluated to improve the existing wall's strength and stability against wave action. Protection of the seawall on the ocean side from wave erosion and undermining would have to be addressed with this alternative. Contructing a large support wall landside of the existing seawall would be difficult to construct, have a lot of environmental impact and could damage the existing wall and promenade. Because of the construction risk this alternative could potentially be more costly than replacing the existing wall, with high costs associated with supporting and repairing the existing seawall, if damaged during construction.

Soil reinforcement on the land side of seawall by itself would only provide minimal structural support for the seawall and no protection from wave forces undermining the foundation. Soil reinforcement will provide a low cost, low environmental impact method that must be combined with the actual seawall structural repairs.

Rock and 'soft' berms. A rock berm built at the seawall toe would provide some added structural strength to the existing seawall. The main advantage of the rock berm is it will protect the wall's foundation and reduce some wave splash and land erosion. The rock berm would be easier to construct, require less rocks and will be lower in cost than the rock revetment. Its historical impact on the seawall would be less than the revetment. The rock berm would also require approval to construct in the Waikīkī Marine Life Conservation District. Softer alternatives to rock berms that provide scour protection of the wall's foundation were also considered. These include sand filled geotextile container berms that are high strength, durable, relatively inexpensive and provide good sand retention capacity. They can be used as a permanent structural component to protect the wall's foundation or a temporary wall support during construction.

SEAWALL REPAIR ALTERNATIVES

Selection Criteria

STAND-ALONE ALTERNATIVES CONSIDERED	*Strength / durability*	*Seawall foundation protection*	*Reduce wave splash & erosion behind seawall*	*Construction duration*	*Environmental impact / Permits/ Approvals*	*Impact on existing improvements*	*Historical / Archaeological impacts*	*Constructability*	*Initial and Maintenance Cost*	*Total*
Reconstruct entire wall with new foundation	1	3	3	5	4	5	5	5	5	36
Construct concrete support wall on land side	3	5	5	4	3	4	4	4	4	36
Permeation grouting	4	4	4	3	1	1	1	3	3	24
Construct form-lined concrete support wall on ocean (makai) side	2	2	2	2	2	3	2	2	2	19
Rock revetment or berm at toe of wall	5	1	1	1	5	2	3	1	1	20

1 = most advantageous or least negative impact 5 = least advantageous or highest negative impact

BLENDED ALTERNATIVES CONSIDERED										
1 - Reconstruct entire wall with new foundation and landside soil reinforcement	1	3	3	4	3	4	4	4	4	30
2 - Form-lined concrete support wall on makai side and concrete support on landside	2	2	2	3	1	2	2	2	3	19
3 - Permeation grouting and landside soil reinforcement	3	4	4	2	2	1	1	3	2	22
4 - Rock revetment or berm and concrete support on landside	4	1	1	1	4	3	3	1	1	19

1 = most advantageous or least negative impact 4 = least advantageous or highest negative impact

Mandatory repairs assumed as part of all repair alternatives include filling all voids detected in the foundation and other parts of the wall, replace or repair concrete cap and repair of cracks at various locations.

Table 3-2. Seawall Repair Alternatives - Evaluation Matrix

3.6 Recommended Repair Alternative

Required repairs of the seawall includes filling all voids detected in the wall's foundation and repair or reconstruction of the concrete cap. The recommended alternative for this project is a form-lined concrete wall on the makai side of the seawall and concrete support on the land side. The makai wall should be designed to provide scour protection of the wall's foundation and shall be constructed to follow the shape and be compatible in appearance with the existing seawall to be repaired and adjacent wall sections. Drainage provisions on the land side would be included with land side improvements to drain water from overtopping waves and stormwater runoff. The new wall will either be anchored to the concrete structure land side of the seawall or supported by vertical reinforcing bars imbedded near the wall's foundation. This will require special care and careful attention to proper construction sequencing. The Contractor shall take measures to protect and minimize damage to the existing promenade during excavation land side of the seawall. The estimated cost of construction for the recommended alternative is $2.04 million.

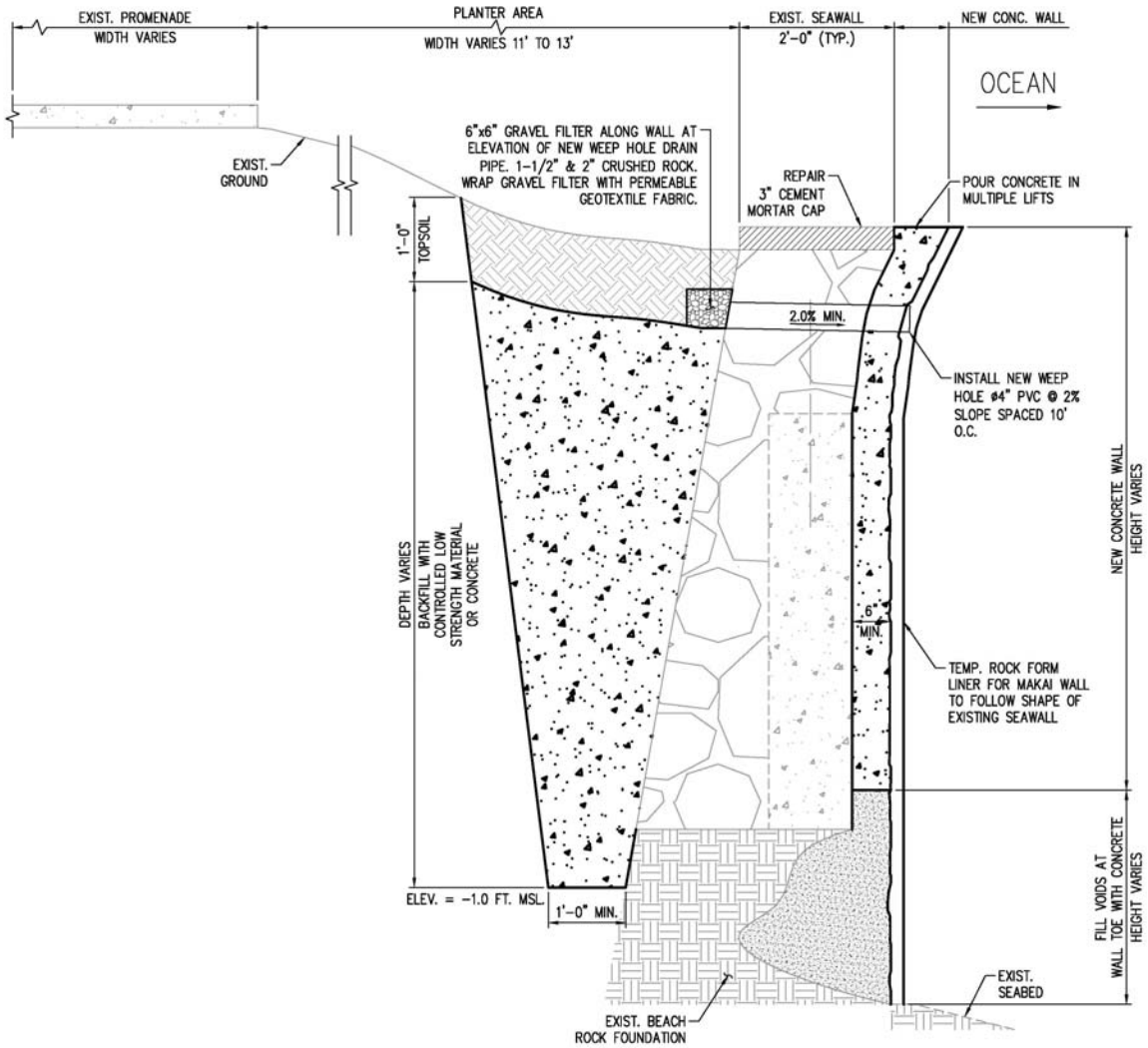

Figure 3-7. Recommended Repair Alternative

4 Physical, Biological and Cultural Environment

4.1 Climate, Topography, and Soils

The island of Oʻahu has a land area of about 596.7 square miles, is the third largest and most populous island in the Hawaiian island chain. Oʻahu, like the other Hawaiian Islands, has a mild semi-tropical climate.. The climate in Waikīkī is characterized by northeast trade winds that blow approximately 80 percent of the time, average annual winds of approximately 10 miles per hour and temperatures between 70 degrees Farenheit in the winter to 84 degrees Farenheit in the summer.

Topography at the seawall site rises from sea level to about 10 feet above mean sea level (MSL). The Waikīkī coastline is shielded by the island mass from North Pacific winter swells and much of the northeast trade wind waves that are present throughout the year. The southern swell predominates during the summer months, while locally-generated wind and Kona storm wave predominate during the winter months.

The island of Oʻahu is made up of 12 soil associations. Soil associations in the vicinity of the project site consist of the Entisol soils. Entisol soils are sandy soils developed from coral limestone, found in low-lying coastal areas, with a surface horizon rich in organic matter, or soils developed from alluvium volcanic ash in dry areas. Soils specific to the project site are Beaches (BS) and Lualualei Fill Land-Ewa Association. Beaches consist mainly of light-colored sands derived from coral and seashells where they are washed and rewashed by ocean waves. The Lualualei Fill Land-Ewa Association soils consist of well-drained soils found along the coastal plains.

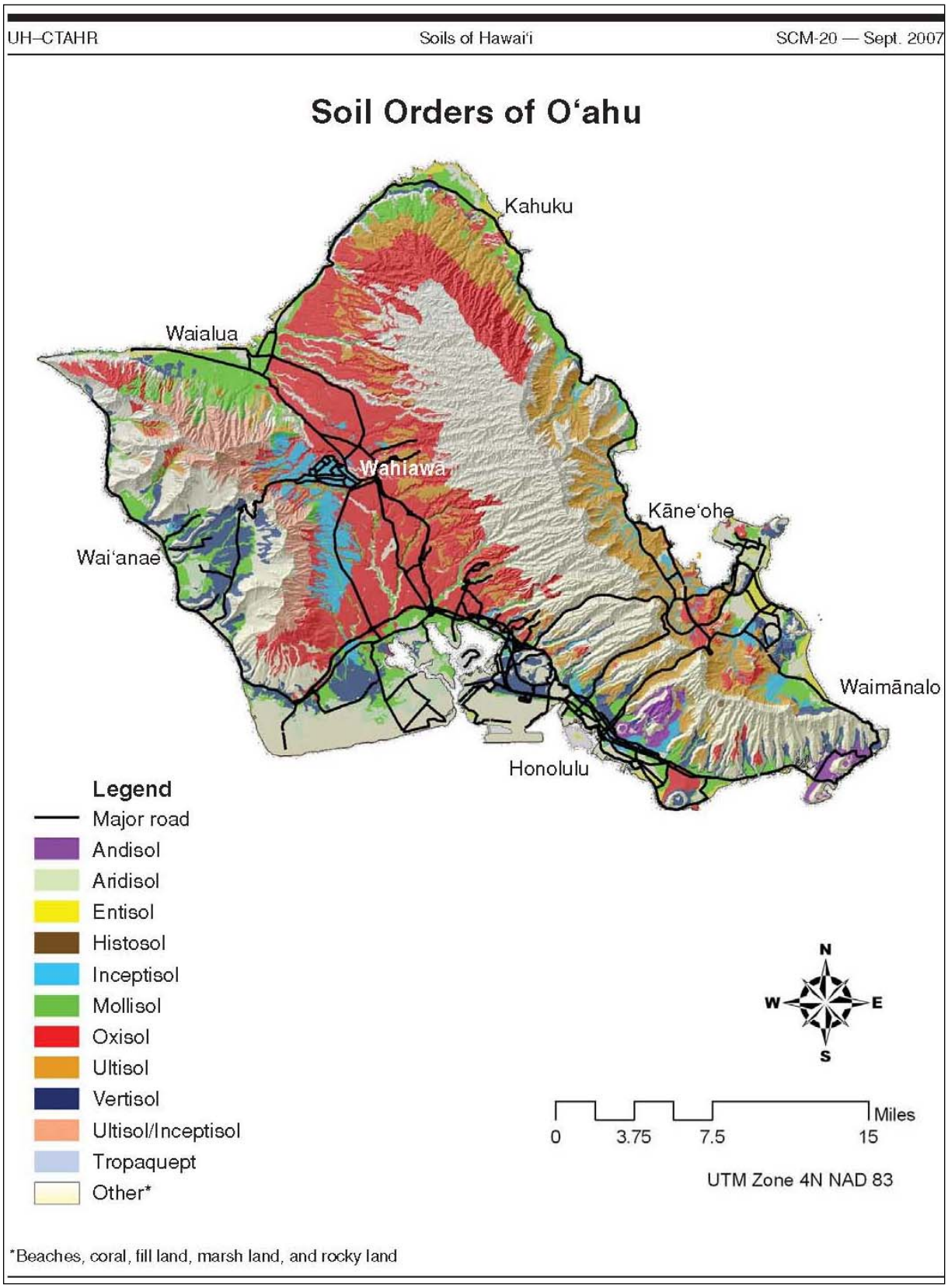

Figure 4-1. Soil Orders of O'ahu Map

4.1.1 Impacts & Mitigation

Original segments of this seawall were constructed in the 1920s with the purpose of protecting structures built along the beach from wave-induced erosion. Today the seawall remains to protect the shore area and the landward improvements from erosion. These improvements include the walkway promenade and Kapiʻolani Regional Park. A structurally sound wall will stabilize the existing topography and allow landscaped areas to thrive. Once repaired the seawall will have no adverse impacts on the environment and by reducing erosion caused by wave action, it will help maintain nearshore water quality.

The seawall will not adversely affect the climate, topography, or soils. Therefore, no mitigation measures are proposed.

4.2 Natural Hazards

Natural hazards in the area consist mainly of hurricanes, tropical or severe storms, flooding, tsunamis, landslides, high wind and earthquakes. Oʻahu is within earthquake zone 1, on a scale of 0 to 4 with 4 having a 10 percent chance of severe shaking in a 50-year interval and 0 having no chance of severe shaking. The seawall lies within a tsunami evacuation zone. Wave heights from the 1952 and 1957 tsunamis were between 2 to 23 feet, respectively. According to the Flood Insurance Rate Map (FIRM), the seawall is in the 100-year flood zone AE, which are areas subject to inundation by the 1 percent annual chance flood event. The designated base flood elevation is 10. See Figure 4-2.

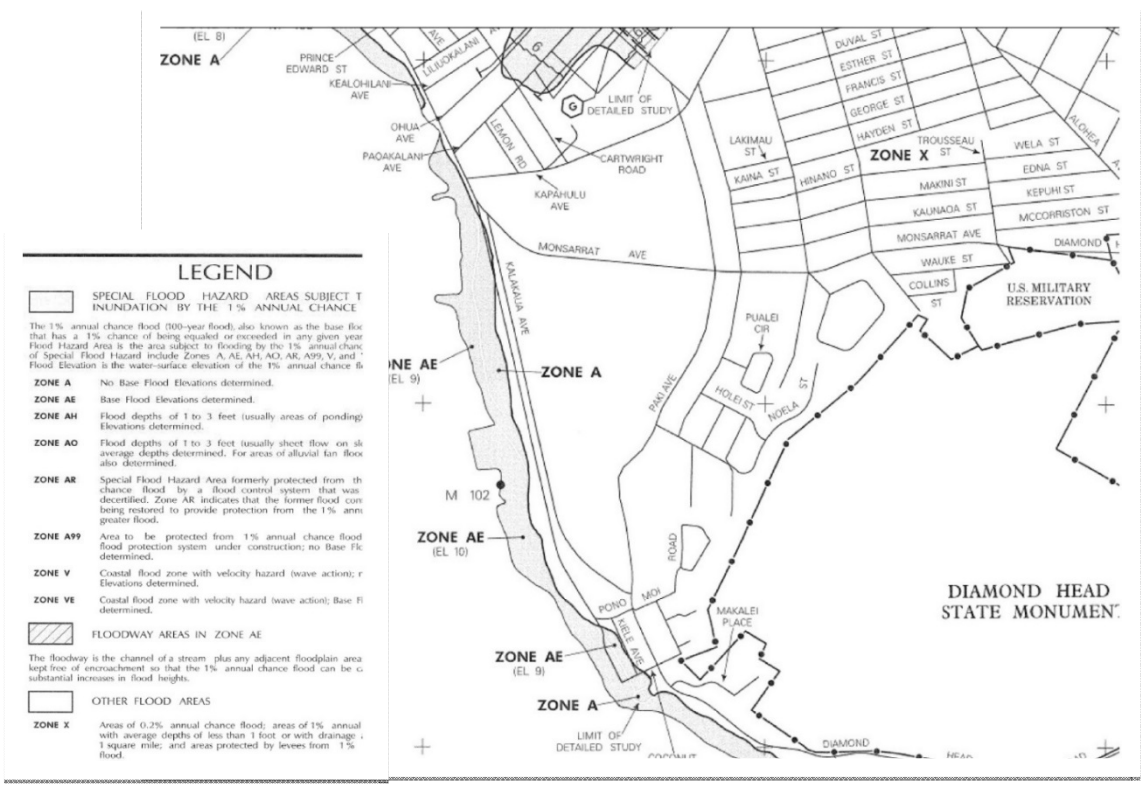

Figure 4-2. Flood Insurance Rate Map

4.2.1 Impacts and Mitigation

Original segments of the seawall were constructed in the 1920s with various repairs over the years. Any of the natural hazards previously mentioned could cause damage to the seawall irregardless of the proposed recommended repairs. Natural hazards associated with this region cannot be controlled, only remediated for after the event occurs.

The seawall proposed to be repaired is located within a tsunami evacuation zone. In the event of a hurricane the project's coastal location increases its potential to be adversely impacted by both high wind and high wave action. Adverse impacts associated with tsunamis and hurricanes include high wave energy, debris over wash, flooding and erosion.

The proposed repair alternative will not increase the severity of any of these natural hazards, but likely lessen the damage to land side improvements (promenade, landscaping) during these natural hazards. The repair alternative will not eliminate the impact of these natural hazards but may decrease wave impacts and resulting erosion of the shoreline.

To ensure the structural integrity of the seawall structure from the impending threat of a natural hazard, the new makai wall and concrete structure landside of the seawall will provide structural protection. Protective measures include lining any unprotected or unvegetated sections landside of the wall with geotextile fabric to prevent soil loss and erosion from occurring behind and underneath the structure. Regular maintenance should involve performing inspections which account for areas of soil loss or failure, particularly after a natural hazard event.

4.3 Geotechnical and Geophysical

Two exploratory borings were drilled and tested during this study. This analysis along with geophysical reconnaissance and available geologic and soil survey maps were studied to evaluate the geotechnical conditions of the proposed project area. The results and analysis from the geotechnical and geophysical investigations were completed by Yogi Kwong Engineers, LLC in November of 2011. Four primary types of soil were encountered in both boring cores: fill material, coralline deposit, alluvium, and basalt lava flows. The first boring was located on the east end of the study area and was drilled to a depth of 30 feet and did not encounter basalt. The second boring was located on the west end of the study area and encountered basalt at 12 feet below grade. Groundwater was encountered in both boring sites at 11.9 to 17.6 feet below grade.

A geophysical investigation was performed using a Multichannel Analysis of Surface Waves (MASW) which determines variations in surface wave velocities. This information can be used to infer rock and soil types, stratigraphy and soil conditions. The results of this survey indicated that the depth to probable basalt lava flows decreases from approximately 40 feet near the east end of the study corridor to approximately 10-15 feet near the west end of the study corridor. The results from the geotechnical borings correlate with the geophysical survey results.

The subsurface conditions encountered during the geotechnical investigation indicate there may be some difficulties in construction and installation of certain shoreline protection structures as follows.

- Cobbles, boulders and cemented zones may obstruct sheet pile driving and caisson drilling.
- Beach and dune sands flowing in and out of unsupported excavation due to the presence of groundwater.
- Over-excavation and increased construction quantities may be encountered due to removal of subsurface obstructions, breaking up rock ledges, cemented zones, cobbles and boulders.

In 2014 Yogi Kwong Engineers was contracted to provide two additional 12-foot deep exploratory borings in support of the design for the wall repairs. In addition, they provided geotechnical recommendations for the foundation support of a repair alternative to the existing seawall or construction of a supplemental wall behind the existing wall.

4.3.1 Impacts & Mitigation

No sheet pile driving or caisson drilling would be conducted for this proposed project. During wall repairs best management practices (BMPs) would be implemented to prevent material from flowing in and out of the seawall and construction area. These BMPs include temporary bulk bag sand barriers or cofferdams placed around the construction area to prevent waves from impacting the wall. In addition, the existing cobbles would be removed and stockpiled, then put back onto the beach after the makai wall is constructed.

4.4 Ocean and Coastal Environment

The Queens Surf seawall is located on the south coast of Oʻahu in Waikīkī. The site is adjacent to the Waikīkī War Memorial Natatorium and the Waikīkī Aquarium. The shoreline is shielded from northwesterly swells and is usually calm in the winter. In the summer, storms from the southern hemisphere bring swells to the south shore beaches of Waikīkī. The largest waves recorded near this site was during the 1957 tsunami when swells produced waves of up to 23 feet.

A beach, park, and pedestrian pathway front the shoreline at the seawall and continues along Waikīkī Beach. The average beach erosion rate as determined by the University of Hawaiʻi Coastal Geology Group from historical aerial photographs is about 2.5 ft. per year at the project site. See Figure 4-5. The beach fronting the seawall is protected by nearshore reefs as is the adjacent shoreline to the north and south along Waikīkī. The nearshore bottom consists of reef flats, aggregate reef, and sand channels.

The beaches at Waikīkī are subjected to increased wave heights typically from south swells between the months of September and October, which often corresponds to beach volume increases. Between November and April, short-period wind waves often correspond to beach volume losses. With Waikīkī being such an important 'economic engine' for the State, short-term and long-term shoreline changes at Waikīkī Beach have been extensively studied. One such study (Waikīkī: Historical Analysis of an Engineered Shoreline. Tara L. Miller and Charles H. Fletcher, 2003) called Queens Surf Beach an erosion hotspot on the Waikīkī shoreline. Between the study period from 1956 to 2001 this beach had retreated at an average rate of 0.6 ± 0.1 meters /yr. The first year of the study, 1956 a beach construction project increased the volume of the beach by 8,847 ± 23 meters^3. However, since 1970 over half of the 8,847 meters^3 of sand placed in 1956 was gone. Between 1970 and 2001 the beach

continued to suffer severe sand loss eventually narrowing the beach by approximately 11 meters. The position of Queens Surf Beach, downdrift of the Natatorium and the naturally nourished Kaimana Beach, is detrimental to sand stability. Today no sandy beach exists from the north end of the planter box to the end of the wall adjoining the aquarium.

Figure 4-3. Looking at north end of planter box toward Diamond Head

Figure 4-4. View along base of seawall at low tide

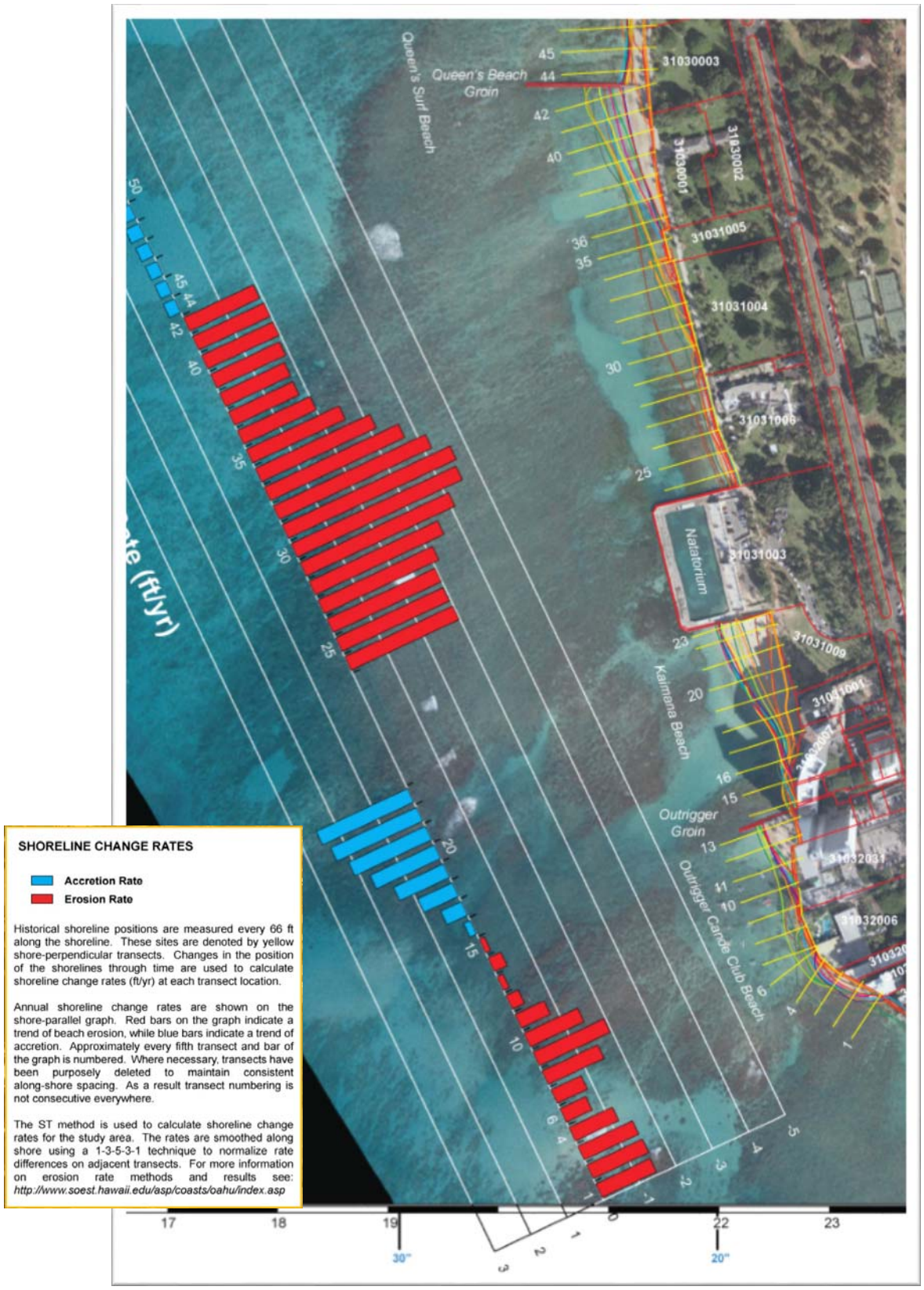

Figure 4-5. Erosion Rate Map

4.4.1 Impacts

The repairs made as part of the recommended alternative would allow the seawall to continue to protect the shoreline and the coastal environment. No adverse effects to the shoreline are anticipated as a result of the repaired seawall. Short-term increases of sediment release into the ocean may occur during construction. The new makai form-lined wall structure would be designed to protect the wall's foundation and land side improvements would decrease erosion behind the wall caused by overtopping waves.

The DLNR-OCCL and Waikīkī Beach Improvement District are currently evaluating various alternatives for beach improvements throughout Waikīkī, including the Queens Surf area in a Feasibility Study and Environmental Impact Statement (EIS). Beach nourishment is a major method being evaluated for restoring and stabilizing the beach. The improved seawall will not hamper efforts to restore the beach, but should provide increased protection of backshore infrastructure and public amenties such as landscaped areas behind the wall and the promenade.

4.4.2 Mitigation

Best Mangement Practices (BMPs) such as silt curtains, sandbag barriers, cofferdams or berms around construction areas would be implemented to contain construction waste and minimize sediment from spreading outside of work areas. The contractor shall monitor and consider weather and tidal conditions in planning for construction in or near the water. Work should be performed during low tides or incoming tides and during low wave and rain conditions. All construction should be halted during storm conditions.

4.5 Aquatic Resources

Marine biota in the coastal waters offshore of the seawall are diverse. The nearshore waters immediately offshore of the seawall are part of the *Waikīkī Marine Life Conservation District*. Marine species such as the threatened green turtle *(Chelonia mydas)* and the endangered Hawaiian monk seal *(Monachus schauinsland)*, occasionally visit waters off Waikīkī. The dominant benthic organisms on the shallow, fringing reef platform are marine macroalgae or limu, which cover virtually all exposed hard surfaces that are not scoured or buried by shifting sand. Algal species observed on the walls of the seawall include; *Dictyosphaeria reticulata, Bryopsis sp., Halimeda discoidea, Neomeris annulata, Ulva reticulata, Lyngbya majuscule, Dictyota sandvicensis, Sargassum polyphyllum, Lobophora variegata, Padina sp., Ralfsia pangoensis, Sphacelaria furcigera, Amansia glomerata, Centroceras clavulatum, Grateloupia filicina, Halymenia Formosa, Plocamium sandvicense, Poroloithon onkodes, and Spyridia filamentosa* (SEA 1992). Macro-invertebrates seen in the general vicinity of the project site, and often on the seawall, include crab, snails, urchins, and various sponges (AECOS 2007, 2008, 2009).

Surveys of the general Waikīkī reef flat have recorded the presence of all the following coral species: *Cyphastrea ocellina* (MRC 2007; AECOS 2007, 2008, 2009), *Montipora capitata*, *M. patula*, *P. evermanni*, *Psammocora stellata*, and *Leptastrea purpurea* (AECOS 2007, 2008, 2009, 2010).

The fish community in the nearshore waters off Waikīkī is largely structured by the local topography and bottom composition on the reef flat; however, fishes are uncommon. Surveys in the vicinity of the Natatorium found the most common species to be wrasses (*Thalassoma duperrey*, *T. trilobatum*, *Stethojulis balteata*), *Acanthurus triostegus* (*manini*), and *Abudefduf abdominalis* (*mamo*). The surveys also found several species of small juvenile fishes inhabiting small holes and spaces in the reef structure (SEA 1992).

Oceanit conducted a marine benthic survey in October 2011 to document the nearshore benthic environment offshore of the seawall to be repaired. The inside reef right off Queen's Surf beach was observed to be mostly sand with rubble and scattered rocks covered with macroalgae and cynobacteria. Within the first 100 to 200 feet section from the beach, only a few small juvenile fish were observed and no corals greater than 6 inches in size were observed. The results of this benthic survey, including the large sand patch located 500 feet from the shore and outside reef beyond the sand patch are contained in Appendix C.

Waters fronting the shoreline in the project area are one of the traditional fisheries of Waikīkī, within the boundaries of the Waikīkī-Diamond Head Shoreline Fisheries Management Area (FMA). Hawaii Administrative Rules 13-48-1 regulates fishing activities within the FMA and mandates that the FMA be completely closed to fishing during odd calendar years.

4.5.1 Impacts

The proposed project may adversely impact threatened green turtles or their terrestrial habitats (beaches where nesting and/or basking is known to occur). Construction activities on or near the green turtle's nesting beach can result in sand/sediment compaction, nest destruction, beach erosion and contaminant or nutrient runoff. Artificial lighting can disorient Green sea turtles and their hatchlings that come ashore to bask on sandy beaches.

Hawaiian monk seals have also used the beach habitat in the project vicinity and may be impacted project construction related activities.

The proposed repair alternative is not anticipated to adversely impact other terrestrial flora and fauna. The primary potential impact to marine biological communities would likely result from in-water construction. There is no designated critical habitats present in the vicinity of the project area. No impacts on other aquatic resources are expected and no mitigation would be required.

Construction of the seawall repairs is anticipated to start in 2018, during which time ocean fishing activities in the area may increase. During construction, portions of the shoreline within the project area will be barricaded temporarily and inaccessible to the public. A 'detour' for the promenade with visible signage will be required for public safety. Access to the shoreline fronting the Waikīkī-Diamond Head Shoreline Fisheries Management Area is not expected to be significantly affected.

4.5.2 Mitigation

Endangering Green turtles and mitigating damage or disturbance to their beach nesting sites can be accomplished by restricting or limiting heavy equipment on the beach areas. If heavy equipment on the beach area makai of the seawall is unavoidable, the equipment travel path and installation site shall be thoroughly inspected by the contractor before deploying onto the beach. Similarly, prior to repair of the wall and installation of the form-lined makai section of the wall the contractor shall thoroughly inspect the makai area for the presence of Green turtles or nesting sites.

The National Marine Fisheries Service (NMFS) has been consulted on potential project impacts on Hawaiian monk seals and Green turtles, both in their on-shore and ocean habitats. NMFS's recommendations will be incorporated into the contract documents.

Recommended Standard Best Management Practices provided by the U.S. Fish and Wildlife Service will be incorporated into the contract documents to protect fish and other wildlife resources.

4.6 Botanical Resources

The Waikīkī Queens Surf area is a heavily developed, landscaped area with little to no remaining pre-development botanical resources. A condition assessment of the area land side of the seawall, including the coastal planter box and a former landscaped area land side of the seawall was conducted. Sand and eroded land was found within these planter areas and behind the seawall.

Very little botanical resources are present on site. All that remains from previous plantings are isolated patches of turfgrass on uneroded land surfaces and one row of *naupaka* (*Scaevola sericea*). Severely eroded land within these planter boxes has exposed underlying sand, abandoned pvc irrigation pipes, and geotextile fabric.

The adjacent park area on the opposite side of the beachwalk contains turfgrass along with many *Coconut Palm* (*Cocos nucifera)*, *Indian Banyan* (*Ficus benghalensis)*, *Chinese Banyon (Ficus microcarpa)* and *Ironwood* (*Casuarina equisetifolia)* trees. Other botanical resources in the park and possibly in the construction area include *Kou* (*Cordia subcordata*), *Hau Hibiscus tiliaceus*, *Rainbow Shower (Cassia X nealiae)*, *weeping fig* (*Ficus benjamina), West Indian Mahogany (Swietania) and Monkeypod (Albizia saman).*

4.6.1 Impacts

There were no botanical species currently listed, candidate or proposed for listing under either the Federal or State of Hawai‘i endangered species statutes were observed within or adjacent to the proposed project site during the course of this survey. Thus no impacts are expected on endangered vegetation and plant species.

The adjacent park land will not be directly involved with the scope of work however the Contractor's equipment will need to traverse the area to gain access to the seawall. Spacing between trees in this area is ample to provide access for light to medium duty equipment without the need to impact any of the trees. Staging and traversing of equipment across the

grass may cause unavoidable damage to the turf in isolated locations. The irrigation system consists of sprinkler heads positioned throughout the lawn.

4.6.2 Mitigation

The Contractor shall have a tree protection plan in order to ensure no landscaped trees are damaged during the proposed project. If required for access, the trees may be trimmed under supervision of a certified arborist. The Contractor shall obtain a Right-of Entry permit from the Department of Parks and Recreation to access the project site and conduct his repairs.

Sprinkler heads should be located and clearly marked prior to mobilizing equipment through the park lawn. Any patches of turfgrass or sprinkler system components that are damaged throughout the project should be reseeded or repaired upon demobilization of equipment.

4.7 Avian, Terrestrial Fauna and Feral Mammals

Wildlife observed on or nearby the seawall was limited primarily to birds including Japanese White-Eye (*Zosterops japonica*), Barred Dove (*Geopelia striata*), Common Mynah (*Acridotheres tristis*), Pigeon, House Sparrow (*Passer domesticus*), and Brazilian Cardinal (*Paroaria cucullata*).

Water and food (either wantonly discarded or placed in trash receptacles) attracts rodents. Feral dogs and cats are also known to roam the grounds. There are no avian or mammalian species currently listed or proposed for listing under the Federal or State of Hawai‘i endangered species statutes known to frequent the area. The proposed project would not impact avian or mammalian species in the proposed project area.

4.7.1 Impacts and Mitigation

No mitigation is planned because no identified avian and mammalian habitats are known to exist in the proposed project area. Although there are are no designated critical habitats in the the vicinity of the project area, the contract documents shall inform the Contractor that Hawaiian hoary bats are known to occur or transit through the project area. The contract documents shall clearly state that threats to the Hawaiian hoary bat such as disturbing, removing or trimming woody plants greater than 15 feet and using barbed wire onsite shall be prohibited.

4.8 Archaeological and Cultural Resources

During construction of the promenade along Queens Surf Beach an archaeological monitor was on-call at all times during all excavation extending 12 inches below the ground surface. Cultural Surveys Hawaii conducted this archaeological monitoring from July 5 through August 1, 2001. Through previous archaeological and background history research and observed subsurface stratigraphy they concluded that this portion of Waikīkī had undergone numerous episodes of filling, grubbing and other land altering activities. The stratigraphy generally observed throughout the project area consisted of well sorted Jaucus sands underlying obvious fill material like loamy landscaping soils.

The project area is located within the ahupuaʻa (traditional Hawaiian land division) of Waikīkī, Honolulu (old Kona) District. This ahupuaʻa was an important agricultural, occupational and political center during much of pre-Contact Hawaiian history, and by the A.D. 1300s it was the ruling center of the Oʻahu chiefs (Beckwith 1940). It continued to be a chiefly residential center through the time of Kamehameha I, after he seized control of Oʻahu from Kalanikupule (ʻĪʻī 1959:17; Tomonari-Tuggle and Blankfein 1998:13).

Despite the density of the modern urban landscape in Waikīkī, remnants of pre-contact and historic occupation have consistently been discovered during subsurface archaeological investigations. Many of these discoveries have been made during archaeological surveys and monitoring associated with urban development and infrastructure upgrades, and they very frequently include pre-Contact (pre-A.D. 1778) Native Hawaiian burials. Previous archaeological investigations and findings include the following:

- Emerson 1902: Burials (pre-Contact; minimum 4 individuals); associated grave goods.
- McAllister 1933: Heiau.
- Bishop Museum: Burials (pre-Contact; minimum 27 individuals).
- Dega and Kennedy 1993: Human remains.
- Winieski et al 2002a.: Burials (minimum 44 individuals).
- Winieski et al 2002b: Burials (minimum 10 individuals).
- Hammatt et al. 2000: N/A.
- McDermott and Chiogioji 2001: No archaeological finds reported.
- Perzinski and Hammatt 2001: Basalt lamp fragment; charcoal concentration.
- Bush et al.2004: No archaeological finds reported.
- Tome and Spear 2005: Historic debris/trash deposit.
- Whitman et al. 2008: Burial (1 individual, Native Hawaiian.

Based on this research, it is likely that subsurface archaeological features and/or human remains may be discovered during any excavations in this area. Therefore, it is recommended that archaeological monitoring be conducted during the repairs of the Queen's Surf seawall at Kapiʻolani Park beach area.

Pacific Consultant Services Inc. (PCSI) has prepared an Archaeological Monitoring Plan (AMP) for the project that includes the locations of ground disturbing activities. The AMP will be used as a guide for the project's designated Archaeological Monitor. PSCI will also conduct a Cultural Impact Assessment (CIA) for the project. This will involve seeking views and comments about potential impacts of the project on cultural sites, practices and

traditional history from individuals, Hawaiian Civic Clubs, the Office of Hawaiian Affairs and the Kapiolani Park Associaton. Any issues related to impacts on cultural resources, traditional cultural practices and properties within the project site will be discussed. See Appendix E for the Preliminary Draft AMP and Appendix F for the Preliminary Draft CIA. These reports will be reviewed by DLNR State Historic Preservation Division.

4.8.1 Impacts

During the archaeological monitoring for the Queen's Surf promenade the only cultural material observed was modern trash. No traditional Hawaiian cultural layers or pre-1950s trash were encountered. Additonally, no known human remains were identified within the Queen's Surf promenade site. The greater ahupuaʻa of Waikīkī has been the location of many archaeological investigations which have resulted in the identification of many buried subsurface archaeological features, sites and human burials (iwi kūpuna).

Based on archaeological monitoring and Cultural Impact Assessment no archaeological or cultural resources are anticipated to be impacted by the proposed seawall repair project.

4.8.2 Mitigation

For this wall repair project, an archaeological monitor will be on-call at all times during all ground disturbing activities extending below 12 inches. If archaeological resources are uncovered, such as burials or significant cultural deposits, construction will cease and the Office of Hawaiian Affairs (OHA), the State Historic Preservation Division (SHPD) and the Burial Council should be contacted.

If any cultural resources are uncovered or identified during the Cultural Impact Assessment recommendations to mitigate these impacts shall be made.

4.9 Visual Resources

According to the Significant Panoramic Views Map of the City and County of Honolulu *Primary Urban Center Development Plan*, the visual resources identified along the proposed project area of Oʻahu's south shore are directed toward Diamond Head. Though not identified in the map, panoramic views of Waikīkī Beach and the ocean may also be experienced from the Queens Surf Beach Seawall. Many of these views will include the site of or be made from the seawall itself and the adjacent land.

4.9.1 Impacts and Mitigation

The proposed repairs will serve to stabilize the seawall and land supported by the wall. The seawall and adjacent promenade provide the public with a scenic vantagepoint of Waikīkī and Diamond Head. During construction, the area will be closed to the public and pedestrian traffic will be rerouted around the work area. Because the project will improve the aesthetic value of the area and the negative impacts from construction will be temporary and unavoidable, no mitigation would be required.

4.10 Air Quality and Noise

The State Department of Health, Clean Air Branch, monitors ambient air in the State of Hawaiʻi via 14 air quality monitoring stations on three islands. Oʻahu has six monitoring stations, Big Island has seven monitoring stations and there is one monitoring station located on Maui. The Environmental Protection Agency has set standards for six pollutants: 1) carbon monoxide; 2) nitrogen dioxide; 3) sulfur dioxide; 4) lead; 5) ozone; and 6) particulate matter ($PM_{2.5}$ and PM_{10}). Particulate matter is measured in microns. The subscript 2.5 and 10 represents microns in aerodynamic diameter. Because of volcanic activity, the State has also set standards for hydrogen sulfide, which is monitored on the Big Island. The monitoring station on Maui is mainly to measure the air quality impacts from agricultural activities where only particulates ($PM_{2.5}$ and PM_{10}) are measured.

The State has set more stringent standards for nitrogen dioxide and carbon monoxide. The Federal standard for nitrogen dioxide is 100 $\mu g/m^3$ (micrograms per cubic meter of air) whereas the State standard is 70 $\mu g/m^3$. For Carbon Monoxide, the 1-hour Federal standard is 40,000 $\mu g/m^3$ and the State standard is 10,000 $\mu g/m^3$.

According to the 2006 annual summary, none of these pollutants exceeded State or Federal standards in the last 3 years from 2006 to 2008. Ambient air quality in the State of Hawaiʻi continues to be one of the best in the nation.

Noise pollution is regulated by the State Department of Health, which has set specific decibel levels into three classes based on land use. Hawaiʻi Administrative Rules Title 11, Chapter 46, Community Noise Control contains the specific sound levels in dBA and is shown in below.

Table 4-1. Maximum Permissible Sound Levels in dBA

Zoning District	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

Class A zoning district are lands zoned residential, conservation, preservation, public space, open space, or similar type. Class B lands are zoned for multi-family dwellings, apartment, business, commercial, hotel, resort, or similar. Class C includes lands zoned agriculture, country, industrial, or similar types. Since the reservoir is located in a conservation zoned area, Class A has been identified as the standard to use for this assessment.

Noise levels cannot exceed the dBA identified above for more than 10 percent of the time within any twenty-minute period, except by permit or variance. Impulsive noise shall be ten dBA above the maximum permissible sound levels. Impulsive noise includes activities such as hammering, pile driving, and explosion. Construction equipment with a motor and/or exhaust system would operate with a muffler, except for pile hammers or pneumatic hand tools weighing less than fifteen pounds.

4.10.1 Impacts

In the immediate vicinity of the construction activities, short-term impacts on air quality are anticipated from the movement and excavation of sand, cobbles, and rocks. Release of particulate matter is not expected to be excessive since there would not be a significant amount of excavation and most of the excavated material that would be moved would probably be wet. Trade winds at the project site are offshore and will lessen the impacts of dust emission on parkgoers.

Short-term noise impacts are also expected with construction activity. Heavy equipment would be used to place and remove rocks and pneumatic hand tools will be used for masonry repairs. The nearest residential unit is located approximately 1,800 feet landward of the construction site on the other side of Kapiolani Park. The nearest hotel is located approximately 1,200 feet to the southeast on the other side of the War Memorial Natatorium.

4.10.2 Mitigation

Air quality can be mitigated during construction by periodic watering of the site where there is a potential for particulate matter to become airborne. Once construction is complete, the air quality would be the same as before construction. Noise impacts would also be generated from construction equipment. Curfew times for construction should be established and mufflers required to be used on equipment to minimize noise from construction equipment. These impacts are short term and would occur only during construction. After construction is completed, no noise impacts would be generated by the proposed project.

4.11 Sea Level Rise

Water level measurements in close proximity to the site are available from the U.S. National Oceanic and Atmospheric Administration (NOAA) tidal station located at Honolulu Harbor, Hawai'i (tide gauge 1612340). The plotted data shows a historic trend of sea level rise at a rate of 1.44 ± 0.21 mm/yr. See Figure 4-6.

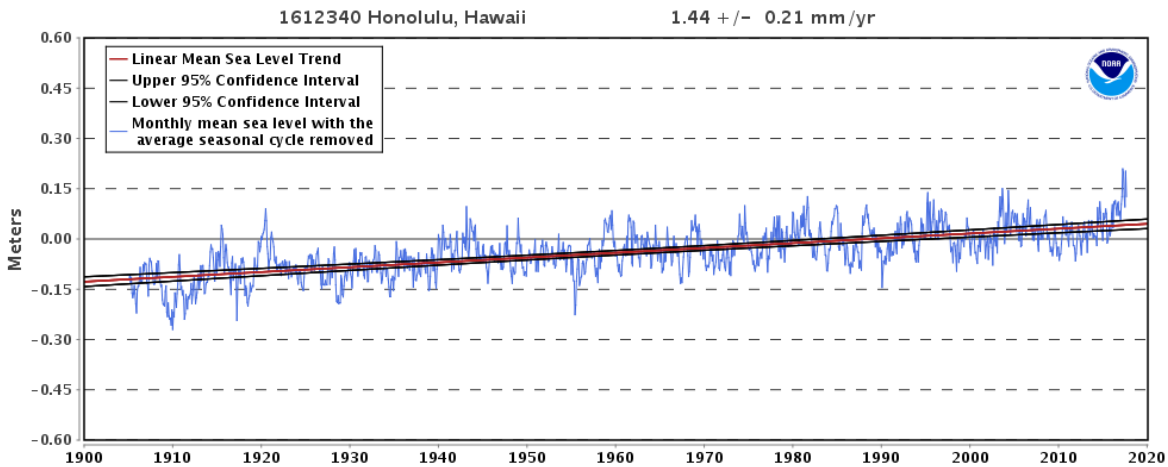

Figure 4-6. Monthly mean sea level trend recorded by the NOAA tide gauge 1612340

The United States Army Corps of Engineers (USACE) Sea-Level Change Curve Calculator applied the data from gauge 1612340 to calculate the expected relative sea level change (RSLC).

Figure 4-7 summarizes the sea level change projections applicable to the site using both NOAA and USACE methods. The data plot starts in 1992, which corresponds to the midpoint of the NOAA National Tidal Datum Epoch of 1983-2001. Based on various rates used by NOAA and USACE, sea level rise (SLR) predictions at the site vary between a low of 0.4 feet and a high of 3.5 feet by 2070 compared to the sea levels in 1992.

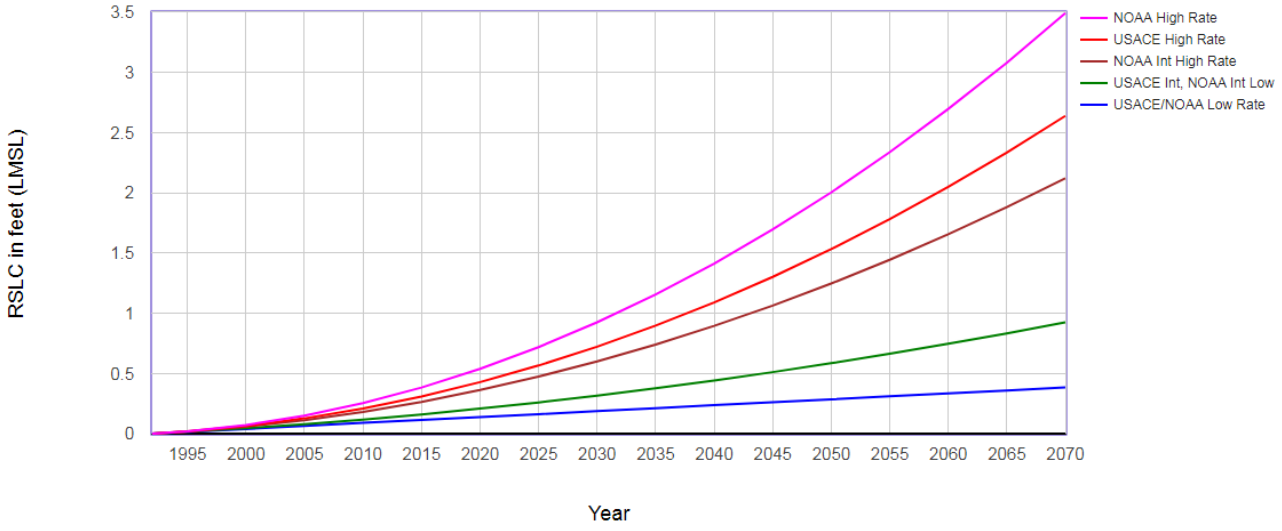

Figure 4-7. Estimated Relative Sea Level Change (RSLC) Projections

According to a recent topographic survey, the elevation of the existing seawall ranges between 8.8 feet and 5 feet above mean sea level (MSL). The existing repair design will not increase the elevation of the existing seawall, but at some time in the future the City may consider raising the wall to meet the required design criteria for potential sea level rise.

5 Social and Economic Factors

This section describes the social and economic environment of the Waikīkī area where the seawall will be repaired. Factors such as demographic characteristics and economic context are described below.

5.1 Social Factors

The combination of a dense population, government, and an industry dedicated to tourism, results in heavy use of Oahu's shorelines. Waikīkī, perhaps one of the best-known shorelines in the nation, and a center of tourist activity, lies at the eastern end of Honolulu. Waikīkī was, until the beginning of the 20th century, a wetland and marsh holding only a narrow sandy strand at the shoreline. Massive efforts to divert the inland waters allowed the city to lay down imported sand to create the famous white sand beaches of Waikīkī that are maintained by periodic sand nourishment projects.

Population of the City & County of Honolulu was 955,000 people according to a 2016 projection (http://worldpopulationreview.com/us-cities/honolulu-population/). This represents about two-thirds of the State population of 1.43 million. A 2015-2016 breakdown of population demographics has the following three groups comprising the majority of the population; asian: 43%, two or more races: 22% and caucasion: 20%.

5.1.1 Impacts and Mitigation

Repairs to the seawall are not expected to have any adverse impacts on the social environment of Waikīkī, but rather a positive and safer environment. Fishing, diving, or shoreline access will not be possible in the vicinity of the seawall section being repaired, but after construction these activities can resume The proposed design for the area land side of the repaired seawall should return some of the functions that formerly existed there. Land side of the wall, sitting and viewing areas with small benches and small native shade trees are proposed. The splash area will be all concrete with the exception of the tree planting areas. Proper drainage provisions will be provided to prevent pooling and erosion of this area caused by wave overtopping.

5.2 Economic and Fiscal Factors

In November 2016 the seasonally adjusted labor force for the State of Hawaii was 696,850 people, with a seasonally adjusted unemployment rate of 3%. The labor force is comprised of persons 16 years of age and over. This same November 2016 projection showed City and County of Honolulu with the largest labor force and the lowest unemployment rate of 2.7% of the four counties. The median household income in 2015 dollars for people residing in the City and County of Honolulu was $74,460.

In 2015, Government (Federal, State, and Local) accounted for the highest total number of jobs statewide with 126,600. A total of 99,100 or 78% of these jobs were in Honolulu. The second highest job sector was Trade, Transportation and Utilities which had 119,100 jobs statewide and 84,200 jobs in Honolulu, or 71% of the state total. The Leisure and Hospitality industry was third highest sector with a total of 114,300 people working statewide, with 67,900, or 59% employed in Honolulu. These jobs involved hotels, arts, entertainment, recreation and food and beverage services.

5.2.1 Impacts

Long-term adverse impacts on the economy are not expected from the repair of the seawall. Short term positive impacts are expected from direct and indirect employment and supplies needed to repair the wall.

5.2.2 Mitigation

No mitigation is required regarding the economic environment associated with the proposed project since the proposed project is not anticipated to have adverse impacts on the economy and would have a short and long-term positive impact on the economy.

6 Infrastructure, Public Services and Utilities

This section describes the existing infrastructure, public services and utilities in the vicinity of the proposed project site. The area is served by a variety of public services and utilities including fire and police services, medical services, schools, water supply, wastewater collection, solid waste disposal, telecommunications systems, electricity, and drainage. Any adverse impacts that the proposed project would incur on these services or utilities will be addressed in this section.

6.1 Public Services

Security and Emergency Services. The Honolulu Police Department (HPD), the Honolulu Fire Department (HFD) and Emergency Medical Services (EMS) provides these services. The nearest fire station is the Waikīkī station, located about a mile away from the project site at 381 Kapahulu Avenue near Paki Avenue. The Waikīkī police station is the nearest station located 0.8 miles away from the project site at 2425 Kalakaua Avenue.

Medical Services are provided by several medical clinics in Waikīkī about 1-2 miles away from the project site. These are the Waikīkī Health Clinic at 277 Ohua Avenue, the Kuhio Walk-In Medical Clinic at 2310 Kuhio Avenue and the Urgent Care Clinic of Waikīkī at 2155 Kalakaua Avenue, Suite 308. The closest hospital 3 miles away; Kapiolani Medical Center at 1319 Punahou Street.

Waikīkī Elementary school is located about 0.7 miles away from the project site.

The nearest solid waste disposal facility is the Kapaa Transfer Station is Kailua, which is about 17 miles away. This facility is open to commercial waste haulers and accepts inert materials (e.g. dirt, rock, sand, gravel, concrete).

6.1.1 Impacts and Mitigation

The proposed seawall repairs are not expected to have any impacts on the public services in the area. The contruction of this project should not affect access to any of these public facilities or services.

6.2 Utilities

The seawall and surrounding areas are situated within the urban and developed Waikīkī area. The City and County of Honolulu and Board of Water Supply provides sewer and water services to nearby facilities in the area. Hawaiian Electric Company provides electrical services through overhead lines and underground conduits, and Hawaiian Telcom has existing telecommunications infrastructure near the project site and surrounding area.

6.2.1 Impacts and Mitigation

The proposed seawall repair is not expected to have an adverse impact on water, wastewater, drainage, or solid waste facilities. In its present condition the seawall poses a health and safety risk to area users. If no action is taken the seawall will continue to deteriorate and erosion land side of the seawall will progress to the point of damaging the promenade.

Because the repaired seawall will have no negative impacts on infrastructure, public facilities or utilities, no mitigation is planned. The Department of Parks and Recreation will provide periodic maintenance of the seawall.

6.3 Traffic and Circulation

The primary road access to the project site is via Kalākaua Avenue, a north-south roadway along the east side of the seawall site. This portion of Kalākaua Avenue is a two-way divided roadway with one travel lane, a bike lane, and parking along each side. The angled parking along the northbound side is metered and the southbound parallel parking is unmetered. U-turns are allowed along the northbound and southbound approaches of Kalākaua Avenue.

6.3.1 Impacts and Mitigation

The proposed seawall repair project is not expected to have an adverse impact on traffic Kalākaua Avenue. The contractor will be required to find his own equipment and staging area and will not be allowed to park his equipment in the onroad parking spaces. No mitigation is required.

7 Relationship with Plans and Policies

This section will describe the relationship of the proposed project to applicable State and County policies. Only those policies related to the proposed seawall repair project will be described.

7.1 Hawai'i 2050 Sustainability Plan (2008)

The *Hawai'i 2050 Sustainability Plan (2008)* is the successor of the *Hawai'i State Plan* and twelve functional plans. The plan lists five goals with associated strategic actions and indicators for each. The five established goals are 1) A way of life; 2) The economy; 3) Environment and natural resources; 4) Community and social well-being; and 5) Kanaka Maoli and island values.

The proposed project would have implications on each of these five goals but primarily will speak to the economy, environment and natural resources, and community and social well-being.

Goal One: A Way of Life

The strategic actions recommended for goal one are to:

- Develop a sustainability ethic;
- Conduct ongoing forums and cross-sector dialogue to promote collaboration and progress on achieving Hawai'i's sustainability goals; and
- Continually monitor trends and conditions in Hawai'i's economy, society and natural systems.

The proposed project addresses both the structural stability and the aesthetic value of the seawall located at Queens Surf Beach. This promenade adjacent to the seawall is a high traffic walkway used by both tourists and residents visiting Waikīkī. Any educational and public exposure opportunities that arise regarding the sustainable design basis for the proposed project would serve to further advance the strategic actions associated with goal one.

Goal Two: The Economy

The strategic actions recommended for goal two are to:

- Develop a more diverse and resilient economy;
- Support the building blocks for economic stability and sustainability;
- Increase the competitiveness of Hawai'i's workforce; and
- Identify, prioritize and fund infrastructure "crisis points" that need fixing.

The proposed project would have a positive short term impact on the economy by creation of direct and indirect jobs. After construction is completed, no additional jobs would be created. The project has been designed to address a "crisis point" in the structural integrity of the shoreline protection infrastructure.

A large portion of the local economy relies on tourism and making sure visitors to the Waikīkī area have an enjoyable experience. The proposed project would have a short term negative impact due to the construction activities. After construction is completed, the area will be safer and much more aesthetically pleasing and the well traveled beachwalk will remain safe from coastal erosion.

Goal Three: Environment and Natural Resources

The strategic actions recommended for goal three are to:

- Reduce reliance on fossil (carbon based) fuels;
- Conserve water and ensure adequate water supply;
- Increase recycling, reuse and waste reduction strategies;
- Provide greater protection for air, and land-, fresh water- and ocean-based habitats;
- Conserve agricultural, open space and conservation lands and resources;
- Research and strengthen management initiatives to respond to rising sea levels, coastal hazards, erosion and other natural hazards; and
- Develop a comprehensive environmental mapping and measurement system to evaluate the overall health and status of Hawai'i's natural ecosystems.

The proposed project has distinct short term and long term impacts to the environment and natural resources. Short term adverse impacts are expected from construction activities while many long term positive impacts are expected after project completion. The following long term impacts all coincide with the strategic actions called for under goal three.

The proposed project specifically addresses the fourth and sixth recommended actions regarding protection of ocean-based habitats and response to erosion. The current seawall has been subject to undermining to the point where it has been structurally jeopardized. This undermining contributes to the addition of concrete and soil into the nearshore aquatic environment. The more undermining that occurs during continual wave action, the more erosion occurs at an accelerated rate. The concrete and sediment that is eroded then becomes suspended in the water column as a pollutant or drops as a bulk solid, where it remains and continues to erode into the water column. These pollutants get washed out into Waikīkī Bay where they interfere with the health of wildlife and coral.

The proposed project area is a part of the Waikīkī Marine Life Conservation District (WMLCD). The goal of the WMLCD program is to allow aquatic life to grow and reproduce as well as create an enhanced environment for snorkeling, diving, and photography. The reduction of pollution input to the area will only benefit the aquatic life present. The proposed project aims to alleviate these adverse impacts by repairing the seawall and preventing further erosion and undermining.

Goal Four: Community and Social Well-Being

The strategic actions recommended for goal four are to:

- Strengthen social safety nets;
- Improve public transportation infrastructure and alternatives;
- Strengthen public education; and

- Provide access to diverse recreational facilities and opportunities.

Potential project impacts that align with goal four are decreasing the addition of pollutants by reducing erosion of the publicly traveled seawall and beachwalk structures.

Goal Five: Kanaka Maoli and Island Values

The strategic actions recommended for goal five are to:

- Honor Kanaka Maoli culture and heritage;
- Celebrate our cultural diversity and island way of life;
- Enable Kanaka Maoli and others to pursue traditional Kanaka Maoli lifestyles and practices; and
- Provide support for subsistence-based business and economics.

The proposed project aims to return the seawall to an attractive visual setting while also structurally reinforcing the seawall and reducing pollution of the local ocean waters. By creating a positive long term environmental impact, the proposed project serves to honor sustainable island values.

7.2 Primary Urban Center Development Plan (2004)

The *Primary Urban Center Development Plan* for the County of Honolulu was adopted June 2004 and is one of eight community-oriented plans on the Island of O‘ahu intended to help guide public policy, investment, and decision making through the 2020 planning horizon. It addresses the areas of development, vision for the future, land use, public facilities and infrastructure, and implementation. The development plan lists a range of specific policy goals including to:

- Develop and implement a plan for a vibrant and livable Waikīkī;
- Improve access to shoreline and mountain areas;
- Improve the pedestrian network; and
- Upgrade the streets and public spaces in Waikīkī.

The proposed project site exists on a narrow strip of land between the ocean and the Waikīkī Beachwalk. The existing seawall is a grouted rock wall with a top layer made of concrete. The top layer is severely deteriorated, with some longer sections broken off and fallen into the water. The top surface is often used as a walking and viewing platform throughout the day for those who want to get a better view of the shoreline and marine life. Repairs to the seawall will not only accomplish increased aesthetic quality of the area but also its practical use.

While shoreline and beachwalk access at the proposed project site can expect to be hindered by construction activities in the short term, access and aesthetic quality after the project is completed will be improved.

The completion of the proposed project will concur with the applicable goals stated in the *Primary Urban Center Development Plan* by preserving the Waikīkī Beachwalk and Queens Surf Beach Seawall as well as upgrading the safety and appearance of the existing seawall.

7.3 City and County of Honolulu General Plan (Amended 2002)

The *General Plan for the City and County of Honolulu* addresses eleven areas of concern: 1) Population; 2) Economic Activity; 3) The Natural Environment; 4) Housing; 5) Transportation and Utilities; 6) Energy; 7) Physical Development and Urban Design; 8) Public Safety; 9) Health and Education; 10) Culture and Recreation; and 11) Government Operations and Fiscal Management. Of those, the applicable areas of concern for the proposed project include Economic Activity, The Natural Environment, Physical Development and Urban Design, and Public Safety.

Each area of concern has applicable objectives listed. The objectives listed for the areas of concern applicable to the proposed project include:

- To maintain the viability of O‘ahu’s visitor industry;
- To make full use of the economic resources of the sea;
- To bring about orderly economic growth on O‘ahu;
- To protect and preserve the natural environment;
- To preserve and enhance the natural monuments and scenic views of O‘ahu for the benefit of both residents and visitors;
- To create and maintain attractive, meaningful, and stimulating environments throughout O‘ahu; and
- To protect the people of O‘ahu and their property against natural disasters and other emergencies, traffic and fire hazards, and unsafe conditions.

The proposed project aims to restore the visual appearance of the seawall and the scenic view of Waikīkī Beach from the beachwalk as well as the structural integrity of the seawall and adjacent land. Any improvements to the visual appearance of the Waikīkī shoreline supports the viability of O‘ahu’s visitor industry and therefore the economic growth. Preventing erosion of the adjacent land and beachwalk structure serves to protect both the natural aquatic and built environments of the area. Replacing the degraded concrete top cap of the wall that is frequently walked upon will serve to protect the public from risk of an unintended fall into shallow water. The completion of the proposed project will therefore be in concurrence with the goals stated in the *General Plan for the City and County of Honolulu*.

7.4 Kapiolani Regional Park Master Plan (2011)

The *Kapiolani Regional Park Master Plan* was adopted in 2011 in order to update the existing park area master plan and recommend specific improvement projects to be made in order to maintain the park and surrounding area. While none of the improvements recommended target the proposed project area, the plan does address the need for wide sidewalks and access ways. The Waikīkī Beachwalk that runs through the proposed project site is a very wide and heavily trafficked walkway. The proposed project will protect this existing walkway by preventing the land underneath it from eroding away.

The *Kapiolani Regional Park Master Plan* also recommends improvements to the War Memorial Natatorium which is located adjacent to the proposed project site seawall. The Natatorium is currently the subject of a separate planning and design study to determine the most appropriate plan of action. Future modifications to the Natatorium may have impacts on the forces felt at the Queens Surf Beach Seawall however, these are yet to be determined and should have no impact on the design basis for the proposed project. The proposed project has no conflict with the recommendations set forth in the *Kapiolani Regional Park Master Pla*n.

7.5 Conservation District Criteria HAR §13-5-30

The proposed project complies with the following criteria of HAR §13-5-30.

(1) The proposed land use is consistent with the purpose of the conservation district. The proposed project will strengthen and stabilize the seawall, protect the promenade and reduce erosion and deterioration of any land side area improvements. The project will provide a stronger, more stable wall, correct existing hazardous conditions and reduce sediment runoff into the ocean, which promotes the public health, safety, and welfare of people who visit the area.

(2) The proposed land use is consistent with the objectives of the protective subzone, P-8 for *Strucures and Land Uses, Existing (D-1)*. The project is major alteration of an existing structure, which is different from what was allowed under the original permit.

(3) The proposed land use complies with provisions and guidelines contained in chapter 205A, HRS, entitled "Coastal Zone Management", where applicable. DDC gave full consideration to the objectives and guidelines of the CZM program in choosing the proposed seawall repair. The CZM program covers the following areas; recreational resources, historic resources, scenic and open space resources, coastal ecosystems, economic uses, coastal hazards, managing development, public participation, beach protection and marine resources.

(4) The proposed land use will not cause substantial adverse impacts to the existing natural resources within the surrounding area, community, or region. The project will strengthen an existing deteriorated wall and will not have any long-term adverse impacts on the natural resources in the surrounding area. Short-term impacts during construction will be mitigated with proper application of BMPs.

(5) The proposed land use, including buildings, structures, and facilities, shall be compatible with the locality and surrounding areas, appropriate to the physical conditions and capabilities of the specific parcel or parcels. The form-lined wall attached to the existing seawall will follow the existing shape of the wall, with a slight wave deflector at those sections of the wall where a wave deflector exists, to help reduce wave overtopping and land side erosion. The surface of the new ocean facing wall would also be constructed to match the look and color of the existing seawall as much as practicable. The proposed pathway and sitting area surface between the promendade and seawall will be constructed of quartzite, the same material as the promenade surface.

(6) The existing physical and environmental aspects of the land, such as natural beauty and open space characteristics, will be preserved or improved upon, whichever is applicable. Many visitors to the area walk on the seawall. The repaired and improved seawall and addition of a pathway and viewing area on the land side of the seawall will enhance the existing physical and environmental aspects of the land.

(7) Subdivision of land will not be utilized to increase the intensity of land uses in the conservation district. The project will not subdivide the land to increase the intensity of land uses.

(8) The proposed land use will not be materially detrimental to the public health, safety, and welfare. By providing a stronger, more stable wall existing hazardous conditions will be corrected. The project will also reduce erosion, deterioration of land side improvements and sediment runoff into the ocean which will positively impact public health, safety, and welfare of people who visit the area.

8 Significance Criteria

To determine whether a proposed action may significantly affect the environment, considerartion of every phase of the action, the expected primary and secondary consequences, and the cumulative as well as the short and long-term effects of the action. Therefore, evaluation of the significance criteria determines if there are any significant impacts on the environment. The following criteria are used to determine significance of the proposed project activities, if any.

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

The proposed project would not result in the irrevocable destruction of a cultural resource; An Archaeological Inventory Survey (AIS) will be submitted to SHPD for review and approval.

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

A stable and repaired Waikīkī seawall would preserve the beneficial uses of the environment by allowing the seawall to continue to protect the shoreline and allow the public to travel along the walkway promenade.

(3) Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;

The proposed project would not conflict with the State's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS. Evaluation of the construction activity described in this EA shows that the proposed project would not have long-term negative impacts. Short-term negative impacts would occur during construction from noise, dust and turbidity in the water. However, these impacts can be mitigated by the use of BMPs, such as mufflers on equipment, frequent watering to keep dust down, and careful containment of construction work areas.

(4) Substantially affects the economic or social welfare of the community or state;

The proposed project would have a short-term positive effect on the economy from jobs and increased revenue during construction. However, after construction the repaired seawall would not directly affect the economy.

(5) Substantially affects public health;

Stabilizing the seawall and the shoreline it protects also protects landside improvements from erosion, undermining and sinkholes.

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

The proposed seawall repair project would have no impact on population and would preserve the promendade which is a public facility.

(7) Involves a substantial degradation of environmental quality;

The stabilization and erosion control measures installed to repair the seawall would not degrade environmental quality but instead would improve environmental quality of the shoreline. The seawall project would also reduce some wave surge from overtopping the wall and onto the landscaped area and promenade.

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

The proposed project is not part of a larger action and would not contribute to cumulative adverse environmental effects on the environment. The seawall would require periodic maintenance to ensure wall undermining and erosion is under control.

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

The construction for the repair of the seawall would not affect any endangered species or their habitat. Of the species observed, none were on the State or Federal endangered species list. Most species observed were invasive species. Therefore, no negative impacts on endangered plants are expected during or after construction.

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

Short-term impacts on air quality and noise levels would occur during construction. However, when the construction is completed, no long-term effects on air quality and noise level are expected.

Constructing the form-lined concrete wall makai of the seawall may temporarily increase turbidity in ocean waters adjacent to the proposed project. Best management practices would be implemented to minimize the effects of turbidity or other pollutants.

(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 project is located in coastal waters, tsunami zones, flood zones, and an erosion prone area. The proposed project aims to stabilize an eroded coastline in order to salvage damage to the roadway, and further loss of shoreline. The attributes from the proposed project would benefit the environmentally sensitive area. In the event of a tsunami, damage to the stabilization and erosion control measures along the coast cannot be predicted.

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

The proposed project would not adversely affect view planes. The proposed structure is a low profile and would not affect any view planes. The proposed project does not conflict with harbor operations or other county or State plans or studies.

(13) Requires substantial energy consumption.

The proposed project would require energy to fuel heavy equipment during construction, but this consumption would be temporary and not substantial.

8.1 Final Determination

A Finding of No Significant Impact (FONSI) determination for the proposed project is based upon the information provided in the Final EA document. The results of the assessments conducted have determined that there would be no "significant" impact in accordance with HRS Chapter 343 from the repair of the Waikīkī Seawall.

9 Permits and Approvals

This section lists the anticipated permits and approvals that will be required to repair the Waikīkī (Queens Surf) Seawall. Although the project is along the coastline, it is not in a Conservation District, but a Marine Life Conservation District; therefore a Conservation District Use Permit may be required if the existing footprint grows seaward of the shoreline.

9.1 Permits Required

Table 9-1 lists the permits that would be required to repair and reinforce the seawall. Other agency approvals are also shown below.

Table 9-1. Permits Required

Permit	Agency Approval
Diamond Head Special District	City & County of Honolulu Planning Department
Shoreline Setback Variance	City & County of Honolulu Planning Department
Conservation District Use (CDUP)	DLNR: Office of Conservation & Coastal Lands (OCCL)
Section 401 Water Quality Certification (WQC) or Waivier	State of Hawaii Department of Health
Coastal Zone Management Federal Consistency Review	Office of Planning, DBEDT
Department of Army Nationwide permit	U.S. Army Corps of Engineers
Archaeological Report Review	DLNR: State Historic Preservation Division
Threatened & Endangered Species Review	US Fish & Wildlife
Approval – Marine Life Conservation District	DLNR: Division of Aquatic Resources
Approval	National Oceanic and Atmospheric Administration (NOAA)

10 References

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Department of Business, Economic Development & Tourism. (1988). *Chapter 226 HRS, Hawai'i State Planning Act*. Office of Planning, State of Hawai'i. Honolulu.

Department of Health (DOH). (2006). *Annual Summary 2006 Hawai'i Air Quality Data*. Clean Air Branch, State of Hawai'i.

Department of Health (DOH). HAR Title 11, Chapter 46, Community Noise Control. State of Hawai'i.

Department of Land and Natural Resources (DLNR). (2007). State of Hawai'i Conservation District Subzones- Islands of Maui & Kahoolawe. State of Hawai'i.

Department of Land and Natural Resources (DLNR). (September 28, 2010). News Release: State Water Commission Decision Balances Competing Demands. State of Hawai'i. Department of Department of Land and Natural Resources. (DLNR). 1989. State of Hawai'i Protected Marine Fisheries Resources. Hawai'i. Administrative Rule §13-92-1 through §13-92-3, dated September 16, 1989.

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Minerbi, Luciano. Coastal Zone Management Program. Technical Supplement No. 8, *Identifying and Managing the Scenic Resources in Hawaii's Coastal Zone*. Pacific Urban Studies and Planning Program, University of Hawaii. 1975.

APPENDIX A

Comment Letters to DEA and Responses

DEPARTMENT OF PLANNING AND PERMITTING
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 7TH FLOOR • HONOLULU, HAWAII 96813
PHONE: (808) 768-8000 • FAX: (808) 768-6041
DEPT. WEB SITE: www.honoluludpp.org • CITY WEB SITE: www.honolulu.gov

KIRK CALDWELL
MAYOR

KATHY K. SOKUGAWA
ACTING DIRECTOR

TIMOTHY F. T. HIU
DEPUTY DIRECTOR

2017/ELOG-1194(EK)

October 4, 2017

Mr. Cris Takushi
Oceanit Center
828 Fort Street Mall, Suite 600
Honolulu, Hawaii 96813

Dear Mr. Takushi:

Subject: Waikiki (Queen's Surf) Seawall Mitigative Improvements
Draft Environmental Assessment (EA)
Tax Map Keys 3-1-030: 001 to 005, and 3-1-031: 004 and 005

This is in response to your request, received June 16, 2017, for comments on the Draft EA for the subject Project. We understand the Project will involve the repair of a 900-linear-foot section of the 1,270-foot-long seawall between the area near the Queens Surf Groin and the Aquarium. According to the Draft EA, about a 460-linear-foot section of the seawall will have major repairs, with minor spot repairs to the remaining 440 feet of the seawall. Reconstruction of a 190-linear-foot concrete curb next to the ramp is also proposed.

We have the following comments:

1. Section 7 should include sections on the Land Use Ordinance (Chapter 21, Revised Ordinances of Honolulu (ROH)), the Shoreline Setback Ordinance (Chapter 23, ROH), and the Special Management Area (SMA) Ordinance (Chapter 25, ROH).

2. The Draft EA contains a shoreline survey that was certified by the State Department of Land and Natural Resources Office of Conservation and Coastal Lands (OCCL) on November 5, 2015. The majority of the proposed work appears to be makai of that certified shoreline. The area makai of the shoreline is not in the SMA. Therefore, no SMA Permit is required for that work. The Final EA should specify whether the work that is mauka of the regulatory shoreline is considered "development" pursuant to Section 25-1.3(2), ROH. If the work is limited to repair and maintenance of an existing structure, it would not be considered development.

Should you have any questions, please contact Elizabeth Krueger, of our Zoning Regulations and Permits Branch, at 768-8017.

Very truly yours,

FOR Kathy K. Sokugawa
Acting Director

November 22, 2017

Ms. Kathy Sokugawa, Acting Director
City and County of Honolulu
Department of Planning and Permitting
650 South King St, 7th Floor
Honolulu, Hawaii 96813
Attention: Ms. Elizabeth Kruger
Zoning Regulations and Permits Branch

Dear Ms. Sokugawa:

Subject: City & County of Honolulu, Department of Design and Construction (DDC)
Waikiki (Queens Surf) Seawall Mitigative Improvements
TMK: 3-1-30:1, 2 & 3 and 3-1-31: 4 & 5
Consultation for Final Environmental Assessment (FEA)
Ref no.: **2017/ELOG-1194(EK)**

This letter is in response to your comment letter dated October 4, 2017, regarding the City and County of Honolulu, Department of Design and Construction's (DDC) Waikiki (Queens Surf) Seawall Mitigative Improvements project. On behalf of the applicant, DDC, thank you for reviewing the Draft EA and your comments. We offer the following information in response to your comments.

1. Section 7 of the FEA will include discussions on the project's conformance with the Land Use Ordinance (Chapter 21, Revised Ordinances of Honolulu, ROH), the Shoreline Setback Ordinance (Chapter 23, ROH), and the Special Management Area (SMA) Ordinance (Chapter 25, ROH).

2. All of the proposed repair work for this project will be makai of the certified shoreline, which was certified by the State Department of Land and Natural Resources Office of Conservation and Coastal Lands (OCCL) on November 5, 2015. We also acknowledge that the area makai of the shoreline is not in the SMA, therefore no SMA Permit is required for that work.

If there are any questions, please contact Cris Takushi at (808) 954-4129 or by email at ctakushi@oceanit.com.

Sincerely,

Cris Takushi

Cris Takushi
Senior Civil Engineer

cc: Department of Design and Construction – Elaine Morisato

DEPARTMENT OF PARKS & RECREATION

CITY AND COUNTY OF HONOLULU

1000 Uluohia Street, Suite 309, Kapolei, Hawaii 96707
Phone: (808) 768-3003 • Fax: (808) 768-3053
Website: www.honolulu.gov

KIRK CALDWELL
MAYOR

MICHELE K. NEKOTA
DIRECTOR

JEANNE C. ISHIKAWA
DEPUTY DIRECTOR

February 23, 2017

SENT VIA EMAIL

Mr. Cris Takushi, Project Manager
www.oceanit.com

Dear Mr. Takushi:

Subject: City &County of Honolulu
Waikiki (Queens Surf) Seawall Mitigative Improvements
TMK: 3-1-30:1, 2 & 3 and 3-1-31: 4 & 5
Consultation for Environmental Assessment

Thank you for your letter dated January 6, 2017, regarding the Queens Surf Seawall project at the Kapiolani Beach Park.

The Department of Parks and Recreation (DPR) has the following comments:

- In regards to the planter area, instead of incorporating green landscape, we would prefer to concrete the entire planter area.

- Another concern at this stage of the project would be that any work done in the future be isolated and secure, allowing the public safe access to the rest of the beach park.

If you have any questions or need further assistance, please contact Jason Woll, Kapiolani Regional Park Manager, at 768-4626.

Sincerely,

Michele K. Nekota
Director

MKN:as
(676844)

November 22, 2017

Ms. Michele K. Nekota, Director
City and County of Honolulu
Department of Parks & Recreation
1000 Uluohia St, Suite 309
Kapolei, Hawaii 96707
Attention: Mr. Jason Woll

Dear Ms. Nekota:

Subject: Consultation for Final Environmental Assessment (FEA)
Waikiki (Queens Surf) Seawall Mitigative Improvements
Waikiki, Oahu, Hawaii
TMK: 3-1-30:1, 2 & 3 and 3-1-31: 4 & 5

This letter is a follow-up response to your e-mail comment letter for the Draft EA, dated February 23, 2017 in which a preference for not incorporating a green landscape and concreting the entire planter area land side of the seawall was expressed.

We are working with our Landscape Designer to develop low maintenance options for the area between the seawall and the promenade. This would serve as an option to completely concreting the entire planter area. One concept being considered is to pave the area, but with a quartzite top that matches the promenade. The concrete surface could have openings for plantings (or large containers) for low maintenance, small native shade trees and shrubs. Provisions for small concrete benches and drainage of water from wave overtopping would be provided. These improvements would allow return of some of the former functions of the area; like sitting and viewing. A concrete ramp and/or steps should be added at some point in the future, depending on availability of funds. See attached Landscape Conceptual Plan.

Please let us know your thoughts on this conceptual plan or if you have other ideas on how to better utilize the planter area. Please contact Cris Takushi at (808) 954-4129 or by email at ctakushi@oceanit.com if you have any questions.

Sincerely,

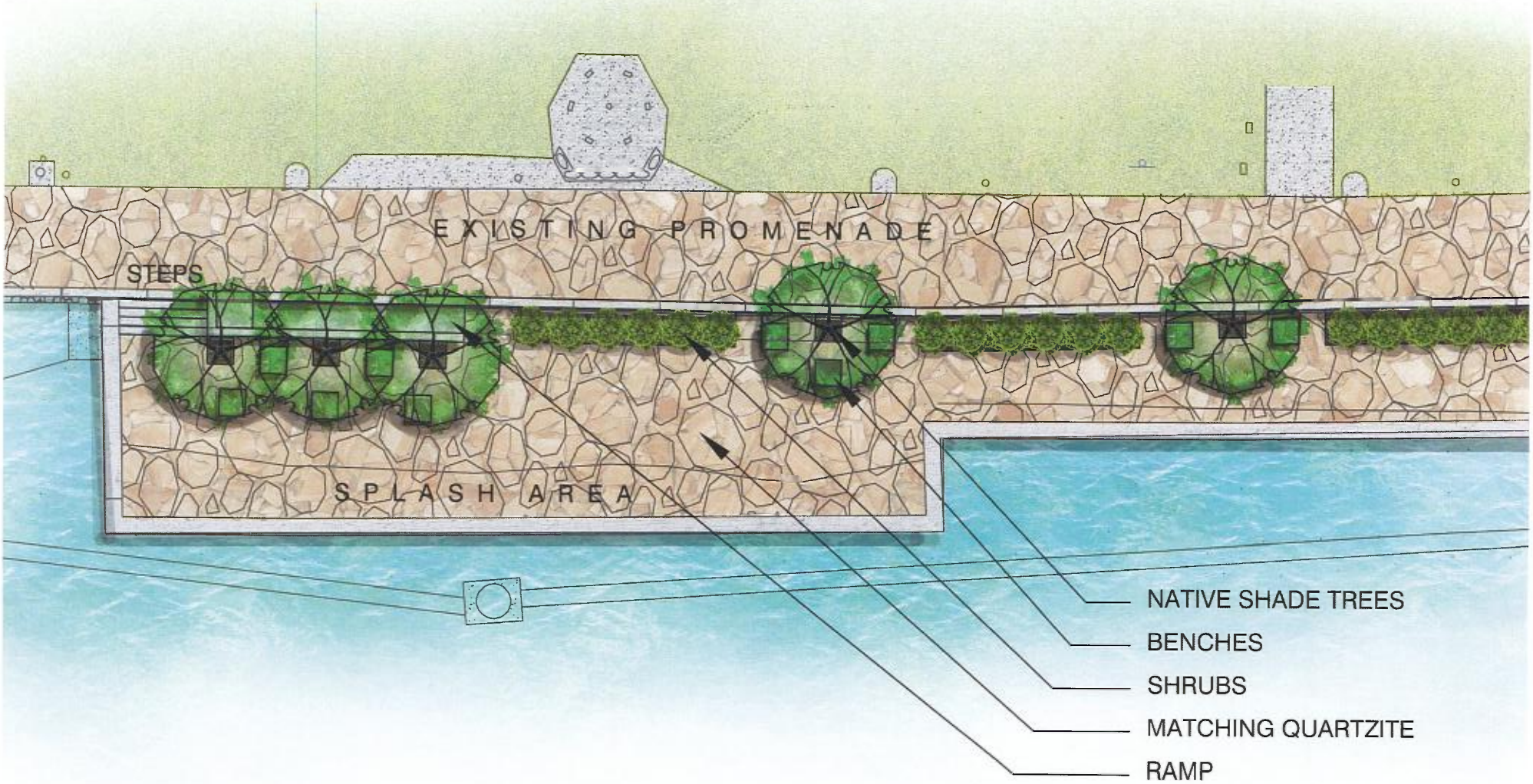
Cris Takushi

Cris Takushi
Project Manager

cc: Department of Design and Construction – Elaine Morisato

QUEEN'S SURF BEACH SEAWALL

LANDSCAPE CONCEPTUAL PLAN



DAVID Y. IGE
GOVERNOR OF
HAWAII

SUZANNE D. CASE
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
FIRST DEPUTY

JEFFREY T. PEARSON, P.E.
DEPUTY DIRECTOR - WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

OFFICE OF CONSERVATION AND COASTAL LANDS
POST OFFICE BOX 621
HONOLULU, HAWAII 96809

DLNR:OCCL:NF

Correspondence OA-18-50

OCT 12 2017

Elaine Morisato
650 South King Street, 9th Floor
Honolulu, HI 96813

SUBJECT: Consultation for Environmental Assessment for the Proposed Waikiki (Queens Surf) Seawall Mitigative Improvements Located in Waikiki, Oahu. Seaward of Tax Map Keys (1) 3-1-030:001, 002, and 003 and (1) 3-1-031:004 and 005

Dear Ms. Morisato,

The Department of Land and Natural Resources, Office of Conservation and Coastal Lands (OCCL) is responding to your September 13, 2017 request for comments on the draft Environmental Assessment (DEA) for the proposed Waikiki Seawall Mitigative Improvements. Oceanit is working on behalf of the City and County of Honolulu, Department of Design and Construction. The DEA was published in the June 8, 2017 edition of the *Environmental Notice*, however a request for comments was not received by the OCCL.

The OCCL has reviewed the DEA for the proposed project and offers the following comments. Under *Section 2.2 Existing Land Use Classifications*, there should be a discussion of the Waikiki Marine Life Conservation District that is located seaward of the shoreline where the proposed project is taking place.

In *Section 3.5 Evaluation of Alternatives*, there is a discussion of four alternatives for the proposed project and additional alternatives that were considered but rejected. Under *Alternative 4: Rock revetment and concrete support on the land side*, you noted the OCCL informed you that a revetment protecting an existing seawall would be considered coastal hardening and would not be approved by the Board of Land and Natural Resources (BLNR). An applicant may apply for a land use, such as a rock revetment, but the decision is ultimately up to the BLNR. It may be unlikely that such a land use would be approved, however it is inaccurate to say it would not be approved.

The preferred alternative includes filling the voids in the existing seawall's foundation, reconstruction of the concrete cap and construction of a form-lined concrete wall on the seaward side of the seawall with concrete support on the land side. This would be considered an identified land use within the Conservation District pursuant to Hawaii Administrative Rules (HAR) §13-5-22 P-8 *Structures and Land Uses, Existing* (D-1) *Major alteration of existing structures, facilities, uses, and equipment, or topographical features which are different from the original use or*

different from what was allowed under the original permit. This proposed land use would require a Board permit. To allow, modify, or deny the land use would be at the discretion of the Board of Land and Natural Resources.

In our pre-consultation letter for the subject DEA dated September 30, 2016, we asked that you provide a discussion in the EA of the potential impacts of rising water levels due to sea level rise over the lifespan of the seawall improvements. Over the coming decades, climate change and sea level rise will increase the vulnerability of the Waikiki shoreline to erosion and overwash from high waves and high-water levels. The DLNR and the Interagency Climate Adaptation Committee are producing a statewide Sea Level Rise Vulnerability Adaptation Report by December 31, 2017 under the Hawaii Climate Adaptation Initiative (Act 83, 2014). Please include a discussion of the potential impacts of sea level rise on the proposed project.

A discussion of recreational resources and impacts should be included in the DEA. Please discuss how the proposed project would or would not affect recreational resources such as fishing, diving, recreation, reflection, surfing and shoreline access and possible mitigation measures for potential impacts.

In *Section 4.5 Aquatic Resources*, you note that marine species such as the green sea turtle and the Hawaiian monk seal visit the waters off Waikiki. Please include a discussion of preparation for endangered species entering the vicinity of the project area including endangered species mitigation, avoidance, stopping construction if endangered species are present, etc. We suggest you include a section in the DEA summarizing best management practices and environmental protection measures that will be used during the proposed project.

The OCCL suggests you include a discussion of the how the proposed project complies with applicable federal acts and legislation in the *Relationship with Plans and Policies* section of the DEA. The section should also include a discussion of how the proposed project complies with the Conservation District criteria, outlined in HAR §13-5-30.

The DLNR and the Waikiki Beach Improvement District association are exploring alternatives for beach improvements throughout Waikiki, including the Queen's Surf area, through the development of a Feasibility Study and Environmental Impact Statement. The Feasibility Study is intended to support coordinate beach improvements in contrast to the practice of ad hoc shoreline engineering and repairs over the past century in Waikiki. We invite the City and County of Honolulu to join in this effort to develop more stable and resilient beach configurations at Waikiki while limiting environmental impacts. We suggest you include a discussion of the proposed projects relationship with future Waikiki Beach development.

The shoreline certification included in the DEA was certified on November 4, 2015. A shoreline certification expires after one year. We suggest you delineate the shoreline on the site plan for the proposed repairs.

Should you have any questions, please feel free to contact Natalie Farinholt in the OCCL at (808) 587-0399 or via email at Natalie.A.Farinholt@Hawaii.gov.

Sincerely,

Samuel J. Lemmo, Administrator
Office of Conservation and Coastal Lands

Cc: Chairperson
LAND
C&C, DPP
Cris Takushi

November 22, 2017

Mr. Samuel Lemmo, Director
Office of Conservation and Coastal Lands
Department of Land and Natural Resources
650 South King St, 7th Floor
Honolulu, Hawaii 96813
Attention: Mr. Alex Roy

Dear Mr. Lemmo:

Subject: City & County of Honolulu, Department of Design and Construction (DDC)
Waikīkī (Queens Surf) Seawall Mitigative Improvements
Seaward of TMK: 3-1-030:001 to 003 and 3-1-031: 004 & 005
Consultation for Final Environmental Assessment (FEA)
Correspondence: **OA-18-50**

This letter is in response to your comment letter dated October 12, 2017, regarding the City and County of Honolulu, Department of Design and Construction's (DDC) Waikiki (Queens Surf) Seawall Mitigative Improvements project. On behalf of the applicant, DDC, thank you for reviewing the Draft EA and your comments. We offer the following information in response to your comments.

1. Section 2.2 of the FEA has been updated to include the Waikīkī Marine Life Conservation District (WMLCD) located seaward of the proposed project site. The project's compatibility with the WMLCD is also discussed in Section 7.1 of the FEA.

2. Section 3.5.4 of the FEA was revised to explain the reason for not recommending a rock revetment for this project. We were informed that the Board of Land and Natural Resources (BLNR) would not likely approve a rock revetment in this portion of Waikīkī.

3. This comment describes the preferred repair alternative; including filling of voids in the existing foundation, construction of a form-lined wall and reconstruction of the concrete cap. We understand this proposed action will require submission of a Conservation District Use Application (CDUA) to DLNR-OCCL in order to obtain approval of a Board Permit.

4. Discussion on rising sea levels has been added to the FEA. The recommended alternative will be structurally designed to support a taller wall if desired at some time in the future to address sea level rise. As mentioned in your letter, the Waikīkī Beach Improvement District and DLNR are developing a comprehensive Feasibility Study encompassing the larger Waikīkī corridor, including the project area. Once the Feasibility Study establishes a standard mitigation method and/or minimum wall height to address sea level rise, the wall can be modified in the future to be in line with the intended purpose of "coordinated beach improvements." See section 4.11 of FEA.

5. Discussion on the project's impacts on recreational resources have been added to the FEA under section 5.1, Social Factors.

6. Discussion on the project's impacts on threatened and endangered species and proposed mitigation measures have been added to the FEA, in section 4.5.

7. A discussion of how the proposed project complies with the Conservation District criteria, outlined in HAR § 13-5-30 was added. See section 7.5 of FEA.

8. This project is in support of a larger comprehensive master plan for overall improvements within the Waikīkī corridor to remove the necessity for ad hoc repair projects such as this one. The project is intended to provide necessary repairs to the existing infrastructure at this time for safety and liability purposes, and prevent further damage and more costly repairs in the immediate future, until time that the Feasibility Study and the coordinated overall beach improvements concept plans are established and can be implemented.

9. Comment noted. The site plans will be revised to show the certified shoreline.

If there are any questions, please contact Cris Takushi at (808) 954-4129 or by email at ctakushi@oceanit.com.

Sincerely,

Cris Takushi

Cris Takushi
Project Manager

cc: Department of Design and Construction – Elaine Morisato

DAVID Y. IGE
GOVERNOR OF HAWAII

VIRGINIA PRESSLER, M.D.
DIRECTOR OF HEALTH

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

In reply, please refer to:
File:

EPO 17-140

June 22, 2017

Mr. Cris Takushi
Oceanit
828 Fort Street Mall, Suite 600
Honolulu, Hawaii 96813
Email: ctakushi@oceanit.com

Dear Mr. Takushi:

SUBJECT: Draft Environmental Assessment (DEA) for Waikiki (Queen's Surf) Seawall Mitigative Improvements
TMK: (1) 3-1-030:001, 003, 004 and 3-1-031:004 and 005

The Department of Health (DOH), Environmental Planning Office (EPO), acknowledges receipt of your DEA to our office via the OEQC link:
http://oeqc2.doh.hawaii.gov/EA_EIS_Library/2017-06-08-OA-DEA-Queens-Surf-Seawall-Repairs.pdf

We understand from the OEQC publication form project summary that *Queens Surf Seawall protects a part of Kapiolani Park from sea erosion. The oceanside area of the seawall is part of the Waikiki Marine Life Conservation District (MLCD). The seawall is badly damaged and being underminined partly by wave attack. The project purpose is to assess the condition of the seawall and provide planning, permitting, design and construction documents to repair the seawall."*

Hawaii's environmental review laws require Environmental Assessments (EAs) and Environmental Impact Statements (EISs) to consider health in the discussion and the mitigation measures to reduce negative impacts. In its definition of 'impacts,' §11-200-2, Hawaii Administrative Rules (HAR) includes health effects, whether primary (direct), secondary (indirect), or cumulative. Further, §11-200-12(b)(5), HAR, lists public health as one of the criteria for determining whether an action may have a significant impact on the environment.

We advocate that you consider health from a broad perspective; one that accounts for the social, economic, and environmental determinants of health and wellbeing. Community well-being can be impacted by access to physical activity, health care, feelings of social connectedness and safety. Design solutions that take these factors into consideration positively contribute to the social determinants of health in a community, improving the well-being of those who live there by influencing health promoting behaviors. Social determinants contribute to preventable chronic diseases such as asthma, diabetes, obesity, and cardiovascular disease.

In the development and implementation of all projects, EPO strongly recommends regular review of State and Federal environmental health land use guidance. State standard comments and available strategies to support sustainable and healthy design are provided at: http://health.hawaii.gov/epo/landuse. Projects are required to adhere to all applicable standard comments. EPO has recently updated the environmental Geographic Information System (GIS) website page. It now compiles various maps and viewers from our environmental health programs. The eGIS website page is continually updated so please visit it regularly at: http://health.hawaii.gov/epo/egis

EPO also encourages you to examine and utilize the Hawaii Environmental Health Portal at: https://eha-cloud.doh.hawaii.gov. This site provides links to our e-Permitting Portal, Environmental Health Warehouse, Groundwater Contamination Viewer, Hawaii Emergency Response Exchange, Hawaii State and Local Emission Inventory System, Water Pollution Control Viewer, Water Quality Data, Warnings, Advisories and Postings.

We suggest you review the requirements of the Clean Water Branch (Hawaii Administrative Rules {HAR}, Chapter 11-54-1.1, -3, 4-8) and/or the National Pollutant Discharge Elimination System (NPDES) permit (HAR, Chapter 11-55) at:

http://health.hawaii.gov/cwb. If you have any questions, please contact the Clean Water Branch (CWB), Engineering Section at (808) 586-4309 or cleanwaterbranch@doh.hawaii.gov. If your project involves waters of the U.S., it is highly recommended that you contact the Army Corps of Engineers, Regulatory Branch at: (808) 835-4303.

Any construction waste generated by the project needs to be disposed of at a solid waste disposal facility that complies with the applicable provisions (HAR, Chapter 11-58.1 "Solid Waste Management Control"). The open burning of any of these wastes, on or off site, is strictly prohibited. You may wish you review the C&D Waste Management Guide at: http://health.hawaii.gov/shwb/files/2016/05/constdem16.pdf Additional information is accessible at: http://health.hawaii.gov/shwb. For specific questions call (808) 586-4226.

You may also wish to review the draft Office of Environmental Quality Control (OEQC) viewer at: http://eha-web.doh.hawaii.gov/oeqc-viewer. This viewer geographically shows where some previous Hawaii Environmental Policy Act (HEPA) {Hawaii Revised Statutes, Chapter 343} documents have been prepared.

To better protect public health and the environment, the U.S. Environmental Protection Agency (EPA) has developed a new environmental justice (EJ) mapping and screening tool called EJSCREEN. It is based on nationally consistent data and combines environmental and demographic indicators in maps and reports. EPO encourages you to explore, launch and utilize this powerful tool in planning your project. The EPA EJSCREEN tool is available at: http://www.epa.gov/ejscreen.

Hawaii's climate is changing. Sea level rise and the associated coastal impacts have the potential to harm an array of natural and built environments in Hawaii. For additional information on projected sea level rise in Hawaii, EPO recommends that you visit the following informative links:

- State of Hawaii Climate Adaptation Portal: http://climateadaptation.hawaii.gov
- University of Hawaii, Manoa, School of Ocean and Earth Sciences and Technology, Coastal Geology Group: http://www.soest.hawaii.edu/coasts/index.html

We request that you utilize all this information on your proposed project to increase sustainable, innovative, inspirational, transparent and healthy design. Thank you for the opportunity to comment.

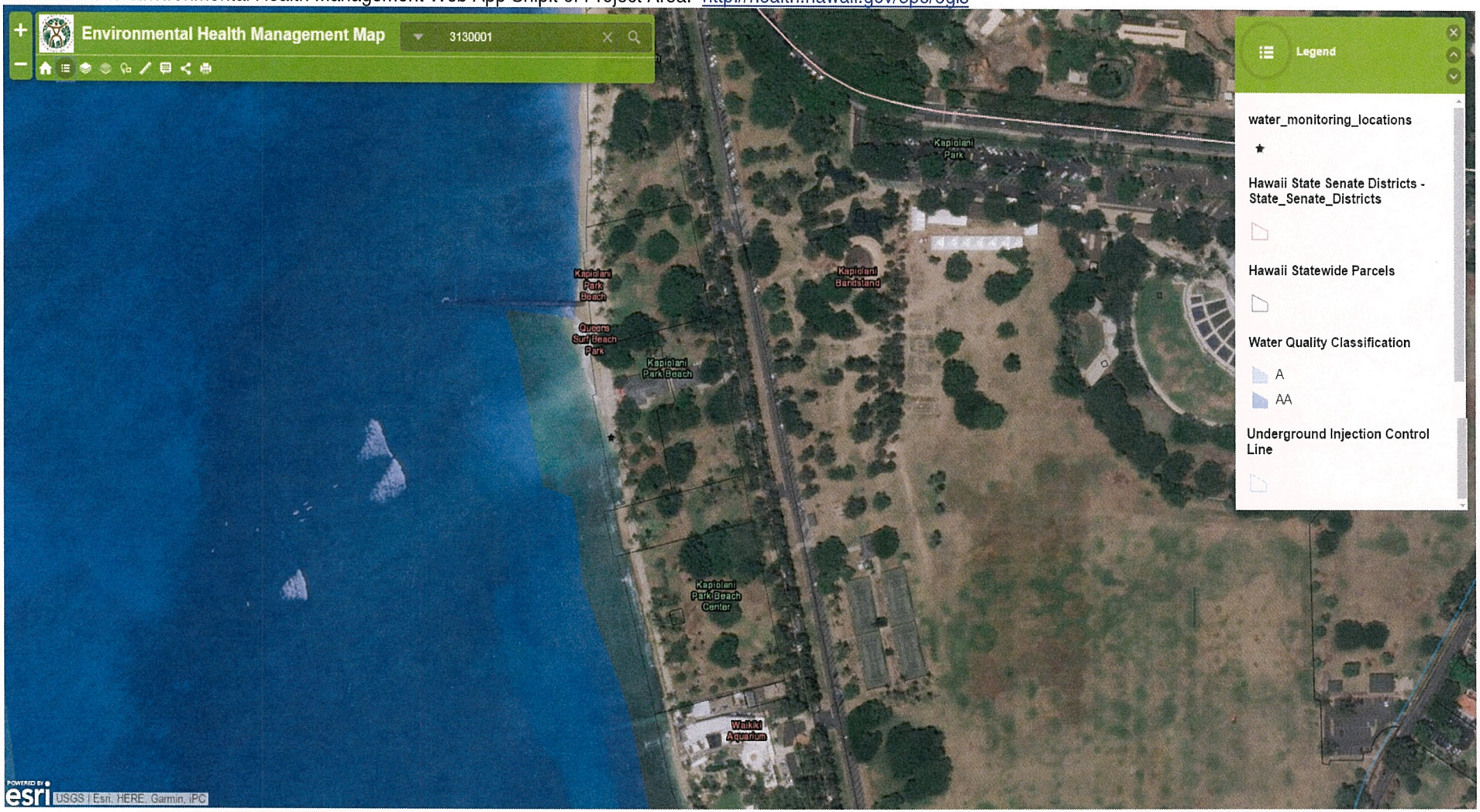
Mahalo nui loa,

Laura Leialoha Phillips McIntyre, AICP
Program Manager, Environmental Planning Office
LM:nn

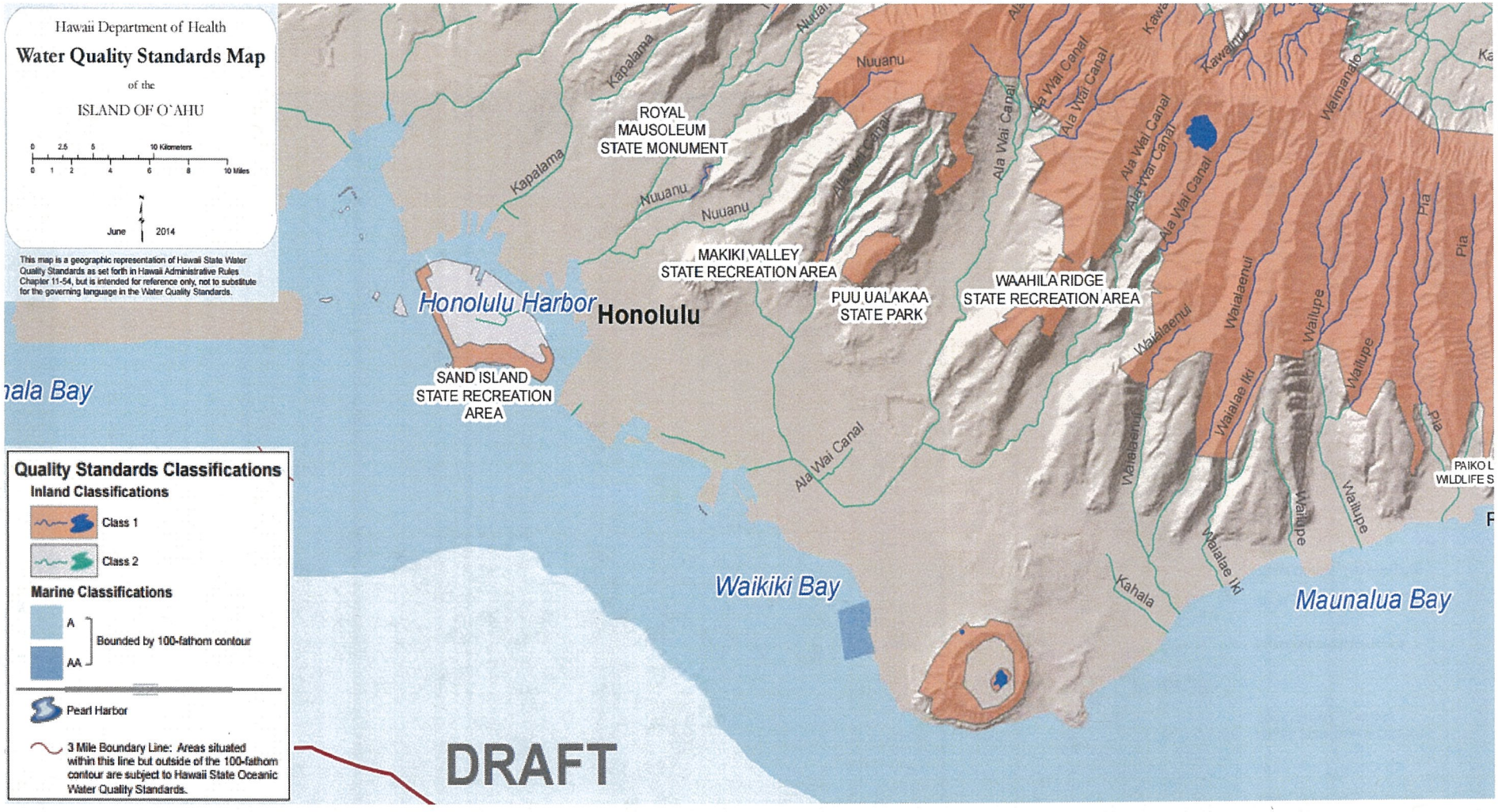
Attachment 1: Environmental Health Management Web App Snipit of Project Area: http://health.hawaii.gov/epo/egis
Attachment 2: Clean Water Branch: Water Quality Standards Map
Attachment 3: OEQC viewer (of some past EA's, EIS's in area)
Attachment 4: U.S. EPA EJSCREEN Report for Project Area

c: Elaine Morisato, Dept. of Design and Construction (via email: emorisato@honolulu.gov)
DOH: CWB, HEER {via email only}

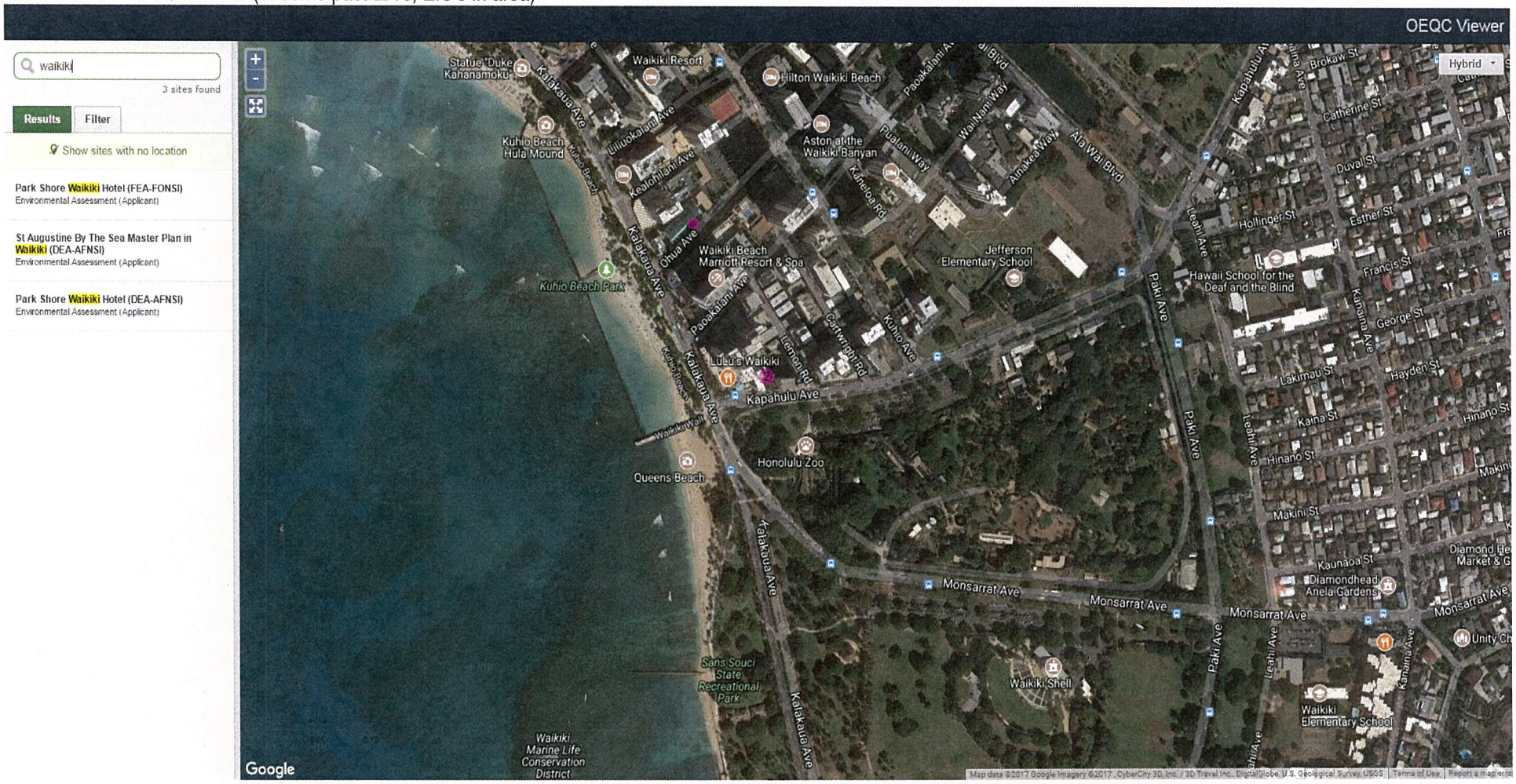
Attachment 1: Environmental Health Management Web App Snipit of Project Area: http://health.hawaii.gov/epo/egis



Attachment 2: Clean Water Branch: Water Quality Standards Map



Attachment 3: OEQC viewer (of some past EA's, EIS's in area)



Attachment 4: U.S. EPA EJSCREEN Report for Project Area

EJSCREEN Report (Version 2016)

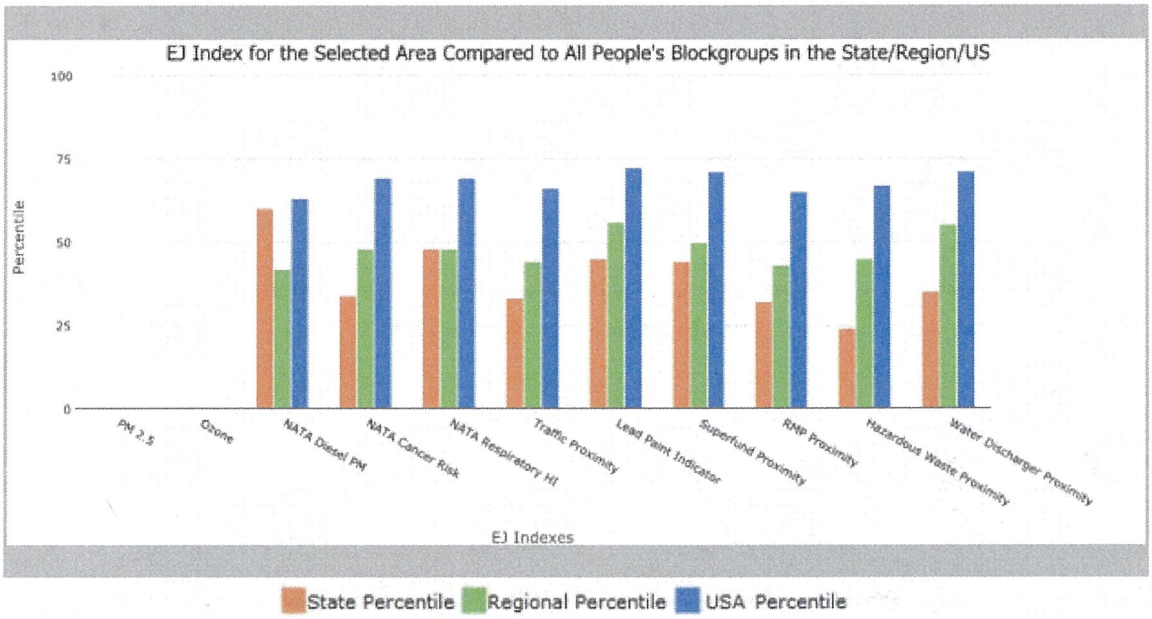
1 mile Ring Centered at 21.267313,-157.822522, HAWAII, EPA Region 9

Approximate Population: 15,980

Input Area (sq. miles): 3.14

(The study area contains 1 blockgroup(s) with zero population.)

Selected Variables	State Percentile	EPA Region Percentile	USA Percentile
EJ Indexes			
EJ Index for PM2.5	N/A	N/A	N/A
EJ Index for Ozone	N/A	N/A	N/A
EJ Index for NATA* Diesel PM	60	42	63
EJ Index for NATA* Air Toxics Cancer Risk	34	48	69
EJ Index for NATA* Respiratory Hazard Index	48	48	69
EJ Index for Traffic Proximity and Volume	33	44	66
EJ Index for Lead Paint Indicator	45	56	72
EJ Index for Superfund Proximity	44	50	71
EJ Index for RMP Proximity	32	43	65
EJ Index for Hazardous Waste Proximity+	24	45	67
EJ Index for Water Discharger Proximity	35	55	71



This report shows the values for environmental and demographic indicators and EJSCREEN indexes. It shows environmental and demographic raw data (e.g., the estimated concentration of ozone in the air), and also shows what percentile each raw data value represents. These percentiles provide perspective on how the selected block group or buffer area compares to the entire state, EPA region, or nation. For example, if a given location is at the 95th percentile nationwide, this means that only 5 percent of the US population has a higher block group value than the average person in the location being analyzed. The years for which the data are available, and the methods used, vary across these indicators. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports.

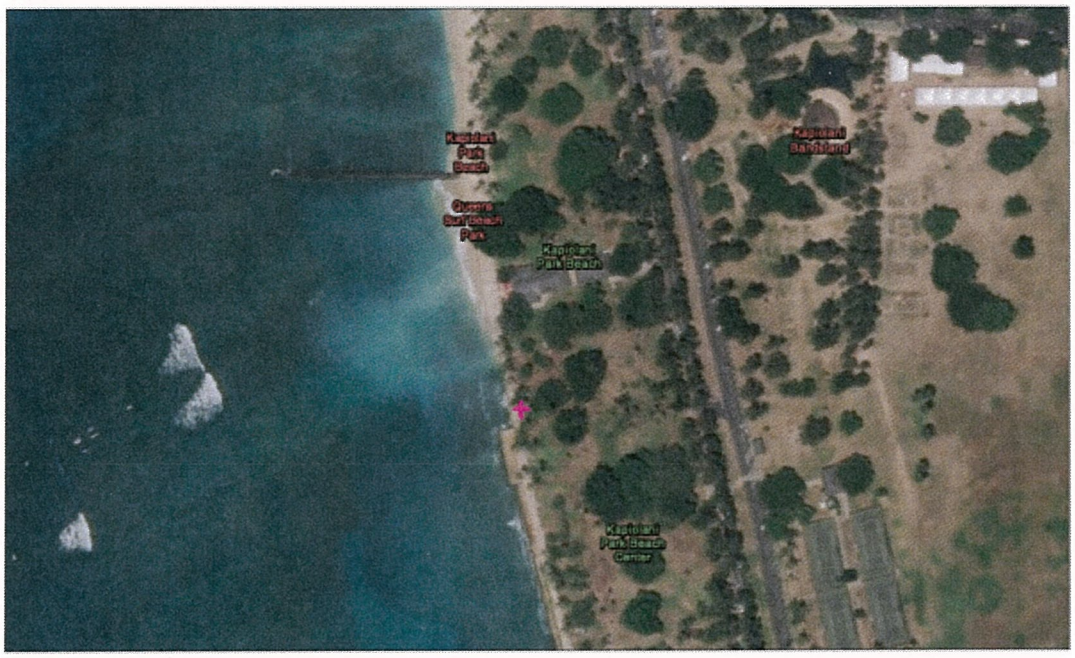
EJSCREEN Report (Version 2016)

1 mile Ring Centered at 21.267313,-157.822522, HAWAII, EPA Region 9

Approximate Population: 15,980

Input Area (sq. miles): 3.14

(The study area contains 1 blockgroup(s) with zero population.)



June 20, 2017

Digitized Point

1:2,257

Sites reporting to EPA	
Superfund NPL	0
Hazardous Waste Treatment, Storage, and Disposal Facilities (TSDF)	0
National Pollutant Discharge Elimination System (NPDES)	0

EJSCREEN Report (Version 2016)

1 mile Ring Centered at 21.267313,-157.822522, HAWAII, EPA Region 9

Approximate Population: 15,980

Input Area (sq. miles): 3.14

(The study area contains 1 blockgroup(s) with zero population.)

Selected Variables	Value	State Avg.	%ile in State	EPA Region Avg.	%ile in EPA Region	USA Avg.	%ile in USA
Environmental Indicators							
Particulate Matter (PM 2.5 in µg/m³)	N/A	N/A	N/A	9.37	N/A	9.32	N/A
Ozone (ppb)	N/A	N/A	N/A	51	N/A	47.4	N/A
NATA* Diesel PM (µg/m³)	0.251	0.149	83	0.978	<50th	0.937	<50th
NATA* Cancer Risk (lifetime risk per million)	44	34	89	43	50-60th	40	60-70th
NATA* Respiratory Hazard Index	1.7	1	90	2	<50th	1.8	50-60th
Traffic Proximity and Volume (daily traffic count/distance to road)	32	990	33	1100	24	590	33
Lead Paint Indicator (% Pre-1960 Housing)	0.22	0.16	70	0.24	58	0.3	53
Superfund Proximity (site count/km distance)	0.047	0.098	42	0.15	33	0.13	41
RMP Proximity (facility count/km distance)	0.086	0.19	43	0.57	15	0.43	22
Hazardous Waste Proximity+ (facility count/km distance)	0.065	0.14	35	0.14	42	0.11	48
Water Discharger Proximity (facility count/km distance)	0.17	0.34	42	0.2	68	0.31	57
Demographic Indicators							
Demographic Index	46%	52%	32	47%	50	36%	70
Minority Population	63%	77%	20	58%	53	37%	75
Low Income Population	29%	26%	60	36%	43	35%	45
Linguistically Isolated Population	10%	6%	79	9%	64	5%	83
Population With Less Than High School Education	7%	9%	44	17%	30	14%	34
Population Under 5 years of age	4%	6%	25	7%	27	6%	29
Population over 64 years of age	18%	15%	63	13%	79	14%	74

* The National-Scale Air Toxics Assessment (NATA) is EPA's ongoing, comprehensive evaluation of air toxics in the United States. EPA developed the NATA to prioritize air toxics, emission sources, and locations of interest for further study. It is important to remember that NATA provides broad estimates of health risks over geographic areas of the country, not definitive risks to specific individuals or locations. More information on the NATA analysis can be found at: https://www.epa.gov/national-air-toxics-assessment.

+ The hazardous waste environmental indicator and the corresponding EJ index will appear as N/A if there are no hazardous waste facilities within 50 km of a selected location.

For additional information, see: www.epa.gov/environmentaljustice

EJSCREEN is a screening tool for pre-decisional use only. It can help identify areas that may warrant additional consideration, analysis, or outreach. It does not provide a basis for decision-making, but it may help identify potential areas of EJ concern. Users should keep in mind that screening tools are subject to substantial uncertainty in their demographic and environmental data, particularly when looking at small geographic areas. Important caveats and uncertainties apply to this screening-level information, so it is essential to understand the limitations on appropriate interpretations and applications of these indicators. Please see EJSCREEN documentation for discussion of these issues before using reports. This screening tool does not provide data on every environmental impact and demographic factor that may be relevant to a particular location. EJSCREEN outputs should be supplemented with additional information and local knowledge before taking any action to address potential EJ concerns.

November 22, 2017

Ms. Laura Leialoha Phillips McIntyre, AICP
Program Manager, Environmental Planning Office
State of Hawaii
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801-3378

Dear Ms. McIntyre:

Subject: City & County of Honolulu, Department of Design and Construction (DDC)
Waikiki (Queens Surf) Seawall Mitigative Improvements
TMK: 3-1-30:1, 2 & 3 and 3-1-31: 4 & 5
Consultation for Final Environmental Assessment (FEA)
Ref. No.: **EPO 17-140**

This letter is in response to your comment letter dated June 22, 2017, regarding the City and County of Honolulu, Department of Design and Construction's (DDC) Waikiki (Queens Surf) Seawall Mitigative Improvements on Oahu. On behalf of the applicant, DDC, thank you for reviewing the DEA and providing comments. We offer the following responses to your comments.

1. The FEA evaluated and discussed the project's impacts on health from a broad perspective; including social, economic and environmental determinants of health and well-being. The main impact the project will have on public health is positive in that it will provide a safe and strong seawall. The area is a well-travelled and popular destination for residents and people visiting the area and the strengthened seawall will better protect the land side areas from erosion and degradation. The project conforms with objectives of the *General Plan for the City and County of Honolulu (2002)* as discussed in Section 7.3 of the FEA.

2. Thank you for providing the environmental planning references. They will be reviewed throughout the design process to provide a sustainable, innovative, inspirational, transparent, and healthy design.

If there are any questions, please contact Cris Takushi at (808) 954-4129 or by email at ctakushi@oceanit.com.

Sincerely,

Cris Takushi

Cris Takushi
Project Manager

cc: Department of Design and Construction – Elaine Morisato

DEPARTMENT OF THE ARMY
HONOLULU DISTRICT, U.S. ARMY CORPS OF ENGINEERS
FORT SHAFTER, HAWAII 96858-5440

April 20, 2017

SUBJECT: Permit Required for the Queens Surf Seawall Repair at TMK 131030001, 003 & 131030004, 005, Waikiki, Island of Oahu, Hawaii, DA File No. POH-2010-00188

Cris Takushi
City and County of Honolulu
Dept of Design and Construction
828 Fort Street Mall, Suite 600
Honolulu, HI 96813

Dear Cris Takushi:

The U.S. Army Corps of Engineers, Honolulu District (Corps), is in receipt of your request dated January 6, 2017 for the proposed Queens Surf Seawall Repair at TMK 131030001, 003 & 131030004, 005, Waikiki, Island of Oahu, Hawaii. Your project has been assigned Department of the Army (DA) file number POH-2010-00188. Please reference this number in all future correspondence with this office concerning your proposed activity.

We have completed a review of your submittal pursuant to Section 404 of the Clean Water Act and Section 10 of the Rivers and Harbors Act of 1899. Section 404 requires authorization prior to the discharge and/or placement of dredged or fill material into waters of the U.S., including adjacent wetlands. Section 10 requires authorization prior to conducting work in, over, under, and affecting navigable waters. Based on our review of your submittal, we have determined the project is in a tidal reach of the Pacific Ocean and is as such a navigable water of the U.S. under the regulatory jurisdiction of the Corps. We have determined the Pacific Ocean is a water of the U.S. under the regulatory jurisdiction of the Corps.

Based on your submittal, the proposed Queens Surf Seawall repair will require placing a structure within, and work in the Pacific Ocean and will result in the discharge of fill material into the Pacific Ocean. Therefore, in accordance with Section 10 and Section 404 you must obtain a DA permit from this office prior to commencing your proposed work.

The proposed Queens Surf Seawall Repair may qualify for authorization under a Nationwide Permit. Please prepare a Pre-Construction Notification (Enclosure 1) and submit to this office via email at: CEPOH-RO@usace.army.mil.

Section 40l(a)(l) of the Clean Water Act requires that you obtain a Water Quality Certification or waiver from the State of Hawaii, Department of Health, Clean Water

Branch. For additional information, please contact the Clean Water Branch at (808) 586-4309 or cleanwaterbranch@doh.hawaii.gov. A final DA permit will not be issued until this office has received a copy of the approved 401 WQC or waiver.

Before authorizing work under our statutory authorities, the Corps must ensure a project complies with applicable Federal laws and regulations, such as the Endangered Species Act (ESA), Magnuson-Stevens Fishery Conservation and Management Act, Section 401 of the Clean Water Act, Coastal Zone Management Act, and the National Historic Preservation Act. In most instances, the Corps will coordinate directly with the appropriate agencies, but we may require additional information from you to complete the coordination and consultation.

Thank you for your cooperation with the Honolulu District Regulatory Program. Should you have any questions related to this determination, please contact Stephen M Willis of my staff at 808-835-4056 or via e-mail at Stephen.m.willis2@usace.army.mil. You are encouraged to provide comments on your experience with the Honolulu District Regulatory Office by accessing our web-based customer survey form at http://corpsmapu.usace.army.mil/cm_apex/f?p=136:4:0.

Sincerely,

Tunis McElwain
Chief, Regulatory Office

Enclosure(s)

cc:
State of Hawaii DBEDT Office of Planning (John Nakagawa)
State of Hawaii DOH-CWB (Darryl Lum)
NOAA-NMFS, Habitat Conservation Division (Dr. Stuart Goldberg)

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Pacific Islands Regional Office
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
(808) 725-5000 · Fax: (808) 725-5215

Oceanit
Attention: Cris Takushi, Project Manager
828 Fort Street Mall, Suite 600
Honolulu, HI 96813

Subject: Waikiki (Queen's Surf) Seawall Mitigative Improvements

October 11, 2017

Dear Mr. Takushi:

This is in response to your letter dated September 12, 2017, addressed to the Regional Administrator, NOAA's National Marine Fisheries Service (NMFS). The letter advised NMFS that the City and County of Honolulu (CCH) is planning on repairing the Queen's Surf seawall in Honolulu, and that Oceanit has been contracted by CCH to develop repair alternatives with the Department of Design and Construction (DOC). Oceanit requested NMFS provide "recommendations to protect and mitigate impacts" to Hawaiian monk seals in the project vicinity. As a species protected by the Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA), the NMFS Pacific Islands Regional Office (PIRO), Protected Resources Division may respond to Oceanit's request separately.

The proposed actions also require the Federal Action Agency (Honolulu District Army Corps of Engineers) to consult on Essential Fish Habitat with NMFS under the Magnuson-Stevens Fishery Conservation and Management Act (section 305(b)) as described by 50 CFR 600.920. This letter intends to inform the Federal Action Agency, the project proponent and project manager. The NMFS PIRO Habitat Conservation Division provides the following comments pursuant to the essential fish habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act (section 305(b)) as described by 50 CFR 600.920.

The Magnuson-Stevens Fishery Conservation and Management Act (MSA) defines EFH as "those waters and substrates necessary to fish for spawning, breeding, feeding or growth to maturity" (16

U.S.C. 1802(10)). Adverse effects on EFH are defined further as "any impact that reduces the quality and/or quantity of EFH," and may include "site-specific or habitat-wide impacts, including individual, cumulative or synergistic consequences of actions" (50 C.F.R. § 600.810(a)).

The proposed project activities include in-water work and the release of material into the navigable waters of the United States, which may adversely affect the quality and/or quantity of EFH in the marine habitats adjacent to the Queen's Surf seawall. In addition, the proposed project will require a permit from the United States Army Corps of Engineers (USACE). As such, NMFS anticipates that the USACE will consult with NMFS for compliance with both the ESA and EFH on behalf of CCH, the permit Applicant. We provide the following comments to assist CCH avoid, minimize, and offset or otherwise mitigate for adverse effects to EFH in the planning phase of the project; which should expedite the EFH consultation between USACE and NMFS.

Coordination with NMFS

NMFS first became aware of the CCH proposed repairs to the Queen's Surf seawall by the USACE on April 20, 2017 when the project reviewer provided a courtesy notification regarding Department of Army Permit # POH-2010-00188. In May 2017, a Draft Environmental Assessment, *Waikiki Seawall Mitigative Improvements Honolulu, Island of Oahu, Hawaii* (hereafter the DEA), was filed by DOC with an anticipated finding of no significant impact. However, NMFS was not notified at that time and did not have an opportunity to provide feedback on project alternatives that have a range of impacts to NOAA trust resources. PIRO is committed to coordinating at the earliest stage feasible, in order to reduce these potential impacts and to deconflict overlapping regulatory mandates where appropriate. In this case, the preferred alternative may have been selected without full consideration of the EFH provisions of the MSA.

NMFS Concerns

Alternative Selection

The preferred repair alternative for the seawall, as described by the DEA, includes: a) filling voids in the seawall foundation with concrete, b) constructing a form-lined concrete wall upland of the seawall, and c) excavating and pouring concrete on the land side to support the seawall. However, other alternatives would provide greater ecological value and reduce adverse effects to EFH, potentially at lower cost.

The preferred alternative does not reduce adverse effects to EFH, especially to coral reefs nearby. Coastal hardening structures, such as the Queen's Surf seawall, redirect wave energy and can increase beach and coastal erosion. Enhanced erosion causes increased sediment transport and deposition which can smother, bury, and scour coral reefs (Fabricus 2005, Rogers 1990). The refractive wave energy from hard structures may degrade or change coral reef habitat (Fletcher 1997). Additionally, the planters will likely continue to be a source of terrigenous sediment when

waves overtop the seawall, which is highly detrimental to coral reefs and the benthic marine organisms that depend on them. Engineering designs that reduce the effects from coastal hardening are greatly needed on the south shore of Oahu.

Although soft-engineering solutions are generally preferable, project alternatives were available that would certainly reduce environmental impact over the long term, potentially increase project longevity, and decrease project cost. Specifically, NMFS believes the rock revetment presents the best ecological and economic analyzed alternative, which was not selected. It was noted that there were two alternatives, not selected, that would require a Conservation District Use Permit from the State of Hawaii, Department of Land and Natural Resources, Board of Land and Natural Resources for changes to the shoreline within a Marine Life Conservation District (MLCD), including the rock revetment alternative. It would be regrettable for the additional administrative burden to preclude the best ecological outcome. The rock revetment alternative could reasonably provide ecological benefit, because it would likely increase fish habitat and provide a diverse array of microhabitats for benthic organisms to colonize; compatible with the purpose of the MLCD," to conserve and replenish marine resources." In similar cases, such as at Iroquois Point, using rock formations to achieve shoreline stabilization has proved to increase coral and fish abundance (AECOS 2014). In addition, removing the planter boxes and replacing it with a rock revetment would increase U.S. waters, potentially offsetting losses from planter-adjacent portions of the footprint that may need revetment.

The preferred alternative does not represent the most durable or cost effective repair solution. As surmised from Appendix D of the DEA, the rock revetment has a lower cost and can last over 50 years. It is not clear what the anticipated life of the preferred alternative is, but more frequent repairs will have increased corresponding impacts to EFH. In addition, it is not clear what rubric was used to evaluate the selection criteria described in the DEA evaluation matrix (Table 3-2). Specifically, the rock revetment was assigned the most disadvantageous score for durability, whereas, in section 3.5.4 the DEA described the rock revetment alternative as "relatively much lower in cost than walls and are very durable." If this was inaccurately presented it would likely make the overall score of the rock revetment alternative more advantageous than any other recommended repair solutions. In addition, the "environmental impact / permits / approvals" selection criteria was also rated as most disadvantageous. It would be unfortunate if the fact that the project was located in a MLCD prevented the most conservation-minded approach executing the necessary repairs to Queen's Surf seawall.

Preferred Alternative

NMFS is unable to completely estimate all potential adverse effects to EFH as a result of project activities of the preferred alternative until more explicit project implementation information is made available. However, generalized adverse effects may include the displacement of fish from the affected areas, disturbance of the seabed, and water quality impacts (e.g., increased turbidity in the water column and the release of sediment, construction materials and/or contaminants).

In order to avoid erosion of soil and discharges/contamination, the worksite and equipment staging area should be isolated from outlets to the ocean. Appropriate work plans with clear best management practices (BMPs) should be developed and made obligatory for the selected contractor. A storm water and erosion control plan will be critical to avoid adverse effects to EFH and NOAA trust resources.

The proposed seawall repair will require excavation and relocation of boulders at the base of the seawall. Heavy machinery should be operated from land only. In-water operation will change the nature of the anticipated impacts substantially. Boulders should be moved to nearby areas devoid of calcifying organisms during repairs, not removed from the water, in order to preserve some value as fish habitat. These boulders should all be returned to a similar orientation as they were before the project was implemented.

Turbidity and sedimentation may adversely affect EFH through any of the following mechanisms: reduction of photosynthesis and/or feeding, abrasion, and smothering. Turbidity curtains can control adverse effects if ocean conditions are relatively calm and/or curtains are securely anchored. Regardless, curtains deployed in areas where there are sensitive and hard-to-replace organisms have the potential to cause more damage than they prevent from abrasion and resuspension of sediments. In addition, turbidity curtains deployed in shallow areas prone to high wave energy will be ineffective. Therefore, the extent of adverse effect to EFH will be dependent upon the control strategy and deployment design. In general, it is best to deploy turbidity curtains on soft sediment only in a manner that does not enclose areas of corals or seagrass. It is best to have a contingency plan to replace losses of EFH in event that avoidance and minimization measures fail.

The project activities are proposed to occur in calm ocean conditions, and it is also best to avoid work during a coral spawning period without a highly effective turbidity control strategy. If a sandbag cofferdam can be used effectively to isolate smaller portions of the seawall at a time, work could proceed sequentially with limited connectivity to the main waterbody and exposure to unexpected ocean conditions. In addition, working in small isolated segments would allow for relocating any mobile invertebrates out of the cofferdam footprint immediately preceding in-water work.

Consultations with PIRO

The preferred method for submitting requests for consultations with NMFS PIRO is via the email address EFHESAconsult@noaa.gov. However, the point of contact for Essential Fish Habitat consultations under the MSA is Gerry Davis, Assistant Regional Administrator (ARA) for the Habitat Conservation Division, gerry.davis@noaa.gov.

The minimum requirements to initiate an EFH consultation are described at 50 CFR 600.920 (e)(3). The information available in the DEA is insufficient to complete an EFH consultation. Additional project details will be required in order to complete an EFH consultation, including specific project information such as how heavy equipment enter the tidal waters, or can they be operated from land. More information is required that describes proposed land-based measures that adequately contain construction materials and contaminants, how excavation will be conducted, and how coffer dams will be deployed, including the planned cofferdam size (e.g, how much area will be isolated at a time), and the sequence of repair operations. More information is required that describes the potential impacts to the seabed from the installation of the vertical reinforcing bars near the seawall foundation if needed, in addition to the associated anticipated acoustic impacts. A description of how the Applicant and their contractor(s) will minimize adverse effects to sensitive and hard-to-replace marine resources that may exist in the project footprint or those nearby subject to indirect impacts, such as corals, will reduce the uncertainty of potential adverse effects to EFH. PIRO accepts marine resource assessments not more than five years old, because benthic conditions may substantially change during that time.

The point of contact at NMFS PIRO for Endangered Species Act consultations is Ann Garrett, ARA for the Protected Resources Division, ann.garrett@noaa.gov. Information regarding the initiation of Section 7 consultation under the ESA should be obtained directly from the PIRO Protected Resources Division.

Conclusions

NMFS is committed to providing continued cooperation and subject matter technical expertise that result in beneficial outcomes for NOAA trust resources and sufficiently comply with relevant mandates, while achieving the project goals effectively and expeditiously. NMFS appreciates having the opportunity to coordinate with Oceanit on behalf of CCH as the future Applicant for Department of the Army Permit POH-2010-00188. Please consider earlier coordination with NMFS in the future, and don't hesitate to contact Shannon Ruseborn at 808-725-5017 and/or Shannon.Ruseborn@noaa.gov with any comments, questions, or to request further technical assistance.

Sincerely,

Gerry Davis
Assistant Regional Administrator
PIRO Habitat Conservation Division

CC via e-mail:
Vera Koskelo, USACE
Elaine Morisato, DOC
Shannon Ruseborn, NMFS

References

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November 22, 2017

Mr. Gerry Davis
Assistant Regional Administrator
PIRO Habitat Conservation Division
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
1845 Wasp Blvd., Bldg 176
Honolulu, Hawaii 96818
Attention: Shannon Ruseborn

Dear Mr. Davis:

Subject: City & County of Honolulu, Department of Design and Construction (DDC)
Waikiki (Queens Surf) Seawall Mitigative Improvements
TMK: 3-1-30:1, 2 & 3 and 3-1-31: 4 & 5
Consultation for Environmental Assessment

On behalf of DDC thank you for reviewing the Draft EA and providing your comment letter dated October 11, 2017. We understand your concern regarding potential project impacts on the Essential Fish Habitat (EFH) and NOAA trust resources. The revetment was considered a favored alternative for repair of the seawall, however because of the following factors was not selected as the recommended alternative.

- DDC contracted Oceanit to provide mitigative repairs to an existing seawall and does not consider adding a revetment makai of the seawall to be a mitigative repair. This alternative was therefore not selected as the recommended alternative.
- We were informed during a pre-application meeting with the Department of Land and Natural Resources (DLNR) Office of Conservation and Coastal Lands (OCCL) that they considered adding the revetment as increasing coastal hardening.
- The revetment was rated low for environmental impact/permits/approvals in the alternatives analysis because we were informed that the Board of Land and Natural Resources (BLNR) would more than likely not approve a Conservation District Use Permit (CDUP) for a revetment in this area.
- Removing the planter boxes and replacing with a rock revetment would require a complete demolition of the seawall and add to the cost of the revetment option.
- Demolishing the existing seawall, which may be considered a historic structure and completely reconstructing it was not considered a feasible option.
- The selected alternative was not the lowest cost or the most durable, but was an alternative that was acceptable to DDC and the agencies reviewing the project.

The proposed measures sited in your letter to reduce adverse impacts on the EFH, water quality, coral reefs, the seabed, fish and other NOAA trust resources will be included in the Final EA and the Best Management Practices (BMP) plan for this project. Some of these include:

- Heavy equipment will not be allowed on beach areas and must be operated on the land side of the seawall only.
- Prior to mobilizing, the contractor shall setup a cofferdam or similar structure makai and around the seawall section to be repaired to keep creatures from entering the work area. The cofferdam will also provide a dry work area and prevent the spread of turbidity, contaminants and sedimentation into the water. The cofferdam shall be properly sized to effectively isolate portions of the seawall to be repaired and allow relocating of any mobile invertebrates out of the cofferdam footprint immediately preceding in-water work.
- Turbidity curtains are not recommended for this project because of the reasons stated in your letter.
- During the filling of voids at the base of the seawall, boulders may be moved in nearby areas devoid of calcifying organisms but should not be removed from the water to preserve some value as a fish habitat.
- Worksite staging and storage areas will be sited away from any outlets to the ocean.
- The BMP plan developed for this project shall be included in the contract documents. The selected contractor shall modify the BMP plan to account for his means and methods and once approved shall be mandatory to follow. The contractor's BMP plan shall also include temporary erosion and sediment control procedures.
- The project design shall include measures to reduce terrigenous sediment transport from the land side planting areas when waves overtop the seawall.
- The selected contractor will be required to provide site-specific and contractor specific information to NMFS to complete the EFH consultation. Some of this information includes; how heavy equipment enters tidal waters, can equipment be operated from land, proposed land-based measures that adequately contain construction materials and contaminants, how excavation will be conducted, how cofferdams will be deployed, planned cofferdam sizes and the sequence of repair operations.

Design details of how the makai wall should be braced, including use of vertical steel reinforcing bars are still being developed. If this is the chosen method for bracing the wall, we will provide those details to your office for review.

If there are any questions, please contact Cris Takushi at (808) 954-4129 or by email at ctakushi@oceanit.com.

Sincerely,

Cris Takushi

Cris Takushi
Project Manager

cc: Department of Design and Construction – Elaine Morisato

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850

In Reply Refer To:
01EPIF00-2017-TA-0300

JUL 05 2017

Ms. Elaine Morisato
Project Manager
City and County of Honolulu
Department of Design and Construction
650 South King Street, 9th Floor
Honolulu, Hawaii 96813

Subject: Technical Assistance for Draft Environmental Assessment for the Proposed Repairs to the Waikiki Seawall, Oahu

Dear Ms. Morisato:

The U.S. Fish and Wildlife Service (Service) received your letter, dated June 16, 2017, requesting our comments on the Draft Environmental Assessment for the proposed repairs to the Waikiki Seawall. The City and County of Honolulu is planning on repairing the Waikiki Seawall on the island of Oahu because it has deteriorated and has been damaged by wave action. The proposed project will repair an approximately 900-foot section of the 1,270-foot wall. The Service offers the following comments to assist you in your planning process so that impacts to trust resources can be avoided. Our comments are provided under the authorities of the Endangered Species Act of 1973 (ESA).

Based on the information in our database and records, including data provided by the Hawaii Biodiversity and Mapping Program, the following are known threatened or endangered species that occur or transit through the vicinity of your proposed project area: the federally endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) and the threatened Green turtle (*Chelonia mydas*). There is no designated critical habitat present in the vicinity of the proposed project area. We offer the following comments for your consideration:

Hawaiian hoary bat

The Hawaiian hoary bat roosts in both exotic and native woody vegetation across all islands and will leave young unattended in trees and shrubs when they forage. If trees or shrubs 15 feet or taller are cleared during the pupping season, there is a risk that young bats could inadvertently be harmed or killed. Additionally, Hawaiian hoary bats forage for insects from as low as three feet to higher than 500 feet above the ground and can become entangled in barbed wire used for fencing.

To minimize impacts to the endangered Hawaiian hoary bat:

- Woody plants greater than 15 feet tall should not be disturbed, removed, or trimmed during the bat birthing and pup rearing season (June 1 through September 15).
- Barbed wire should not be used for fencing.

Green turtles

The Service consults on sea turtles and their use of terrestrial habitats (beaches where nesting and/or basking is known to occur), whereas the National Marine Fisheries Service (NMFS) consults on sea turtles and their use of off-shore and open ocean habitats. We recommend that you consult with NMFS regarding the potential impacts from the proposed project to sea turtles in near-shore and open ocean habitats.

Green turtles may nest on any sandy beach area in the Pacific Islands and exhibit strong nesting site fidelity. Many physical factors such as beach slope, vegetation, nearshore habitat features, oceanographic conditions, temperature, and sand compaction likely influence where a female will lay her eggs. Construction on or in the vicinity of sea turtle nesting beaches can result in sand/sediment compaction, sea turtle nest destruction, beach erosion, contaminant and nutrient runoff, and an increase in direct and ambient light pollution which may disorient hatchlings or deter nesting females. The rate of habitat loss because of erosion and escarpment may be increased when humans attempt to stabilize the shoreline, either through re-nourishment or through placement of hard structures, such as sea walls or pilings. Off-road vehicle traffic also contributes to habitat loss through erosion, especially during high tides or on narrow beaches where driving is often concentrated on the high beach and fore dune. To avoid crushing sea turtle nests or increased erosion, restrict driving and machinery use to existing roads. No hard structures such as seawalls should be constructed and dune vegetation should not be cut or removed. Contaminants including nutrients, silt, and pesticides may increase as a result of proposed actions.

Sea turtles can be disoriented by artificial lighting. Green turtles in Hawaii come ashore to bask on sandy beaches. Sea turtles come ashore to nest on beaches from May through September, peaking in June and July, with hatchlings emerging through November or December. Optimal nesting habitat is a dark beach free of barriers that restrict their movement. Nesting turtles may be deterred from approaching or laying successful nests on lighted or disturbed beaches. If they do come ashore, they may become disoriented by artificial lighting, leading to exhaustion and placement of a nest in an inappropriate locations (such as at or below the high tide line where nests are unlikely to be successful). Hatchlings that emerge from nests may be disoriented by artificial lighting. The areas behind nesting beaches should also be sufficiently dark, with unobstructed nearshore waters directly adjacent to nesting beaches (from the shoreline to oceanic surface currents), to allow for the transit of hatchlings as they orient away from dark silhouettes behind the nesting beach and towards the brighter open horizon. Use of lighting should be minimized and all project-related lights should be shielded so the light is not visible from any sandy beach area. If lights can't be fully shielded or if headlights must be used, light filtering tape or filters should fully enclose the light source such that the frequency of the light reaching the sandy beach is above 580 nanometers. Red light, at 700 nanometers, is optimal, because it is less visible to sea turtles.

Marine Resources

Because the proposed project includes work in or near the aquatic environment, we are attaching the Service's recommended Best Management Practices for conducting work in these areas. We encourage you to incorporate the relevant practices into your project design.

Hawaiian Monk Seal

The endangered Hawaiian monk seal *(Monachus schauinslandi)* may use beach habitat in the vicinity of the proposed project. NMFS is the Federal agency that consults on potential impacts to monk seals, both in their on-shore and ocean habitats. Therefore, we did not review the proposed project for potential impacts to monk seals. We recommend that you contact NMFS regarding the presence of monk seals in the area and potential impacts to the species from the project.

If additional information becomes available, or it is determined that the proposed project may affect federally listed species, we recommend you coordinate with our office early in the planning process so that we may further assist you with Endangered Species Act compliance. We thank you for your efforts to conserve listed species and native habitats. Please contact Stacey Lowe, Fish and Wildlife Biologist (phone: 808-792-9400, email: stacey_lowe@fws.gov) should you have any questions pertaining to this response or require further guidance. When referring to this project, please include this reference number: 01EPIF00-2017-TA-0300.

Sincerely,

Aaron Nadig
Island Team Manager
Oahu, Kauai, Northwestern
Hawaiian Islands and American Samoa

cc: Oceanit

Enclosure: Service BMPs for work in aquatic environments

U.S. Fish and Wildlife Service
Recommended Standard Best Management Practices

The U.S. Fish and Wildlife Service (USFWS) recommends the following measures to be incorporated into project planning to avoid or minimize impacts to fish and wildlife resources. Best Management Practices (BMPs) include the incorporation of procedures or materials that may be used to reduce either direct or indirect negative impacts to aquatic habitats that result from project construction-related activities. These BMPs are recommended in addition to, and do not over-ride any terms, conditions, or other recommendations prepared by the USFWS, other federal, state or local agencies. If you have questions concerning these BMPs, please contact the USFWS Aquatic Ecosystems Conservation Program at 808-792-9400.

1. Authorized dredging and filling-related activities that may result in the temporary or permanent loss of aquatic habitats should be designed to avoid indirect, negative impacts to aquatic habitats beyond the planned project area.

2. Dredging/filling in the marine environment should be scheduled to avoid coral spawning and recruitment periods, and sea turtle nesting and hatching periods. Because these periods are variable throughout the Pacific islands, we recommend contacting the relevant local, state, or federal fish and wildlife resource agency for site specific guidance.

3. Turbidity and siltation from project-related work should be minimized and contained within the project area by silt containment devices and curtailing work during flooding or adverse tidal and weather conditions. BMPs should be maintained for the life of the construction period until turbidity and siltation within the project area is stabilized. All project construction-related debris and sediment containment devices should be removed and disposed of at an approved site.

4. All project construction-related materials and equipment (dredges, vessels, backhoes, silt curtains, etc.) to be placed in an aquatic environment should be inspected for pollutants including, but not limited to; marine fouling organisms, grease, oil, etc., and cleaned to remove pollutants prior to use. Project related activities should not result in any debris disposal, non-native species introductions, or attraction of non-native pests to the affected or adjacent aquatic or terrestrial habitats. Implementing both a litter-control plan and a Hazard Analysis and Critical Control Point plan (HACCP – see http://www.haccp-nrm.org/Wizard/default.asp) can help to prevent attraction and introduction of non-native species.

5. Project construction-related materials (fill, revetment rock, pipe, etc.) should not be stockpiled in, or in close proximity to aquatic habitats and should be protected from erosion (*e.g.*, with filter fabric, etc.), to prevent materials from being carried into waters by wind, rain, or high surf.

6. Fueling of project-related vehicles and equipment should take place away from the aquatic environment and a contingency plan to control petroleum products accidentally spilled during the project should be developed. The plan should be retained on site with the person responsible for compliance with the plan. Absorbent pads and containment booms should be stored on-site to facilitate the clean-up of accidental petroleum releases.

7. All deliberately exposed soil or under-layer materials used in the project near water should be protected from erosion and stabilized as soon as possible with geotextile, filter fabric or native or non-invasive vegetation matting, hydro-seeding, etc.

November 22, 2017

Director
U.S. Fish and Wildlife Service
Pacific Islands Fish and Wildlife Office
300 Ala Moana Boulevard, Room 3-122
Honolulu, Hawaii 96850
Attention: Mr. Aaron Nadig
Island Team Manager

Dear Mr. Nadig:

Subject: City & County of Honolulu, Department of Design and Construction (DDC)
Waikiki (Queens Surf) Seawall Mitigative Improvements
TMK: 3-1-30:1, 2 & 3 and 3-1-31: 4 & 5
Consultation for Environmental Assessment
Ref No.: 01EP1F00-2017-TA-0300

On behalf of DDC thank you for reviewing the Draft EA and providing your comment letter dated July 5, 2017. Responses to your comments are provided below.

We acknowledge your concern for the endangered Hawaiian hoary bat and threatened Green turtle that may occur or transit through the vicinity of the project area. The measures suggested for minimizing impacts to these species will be incorporated into the project contract documents.

For the Hawaiian hoary bat these include not disturbing woody plants greater than 15 feet tall at or near the project site and not using barbed wire. See FEA, section 4.7.1.

Mitigating damage or disturbance to Green turtle's beach nesting sites can be accomplished by restricting or limiting heavy equipment on the beach areas. Prior to repair of the wall and installation of the form-lined makai section of wall the contractor shall thoroughly inspect the makai area for presence of Green turtles or nesting sites. See FEA, section 4.5.2.

Recommended Standard Best Management Practices provided by the U.S. Fish and Wildlife Service will be incorporated into the contract documents to protect fish and other wildlife resources.

We have consulted with National Marine Fisheries Service (NMFS) and have received their comments regarding potential project impacts on Hawaiian monk seals and Green turtles, both in their on-shore and ocean habitats. NMFS's recommendations will be incorporated into the contract documents. See FEA, section 4.5.2.

If there are any questions, please contact Cris Takushi at (808) 954-4129 or by email at ctakushi@oceanit.com.

Sincerely,

Cris Takushi

Cris Takushi
Project Manager

cc: Department of Design and Construction – Elaine Morisato

693242

RECEIVED dtf
DEPT OF DESIGN & CONSTR
C & C OF HONOLULU
17 JUN 14 AM 9:40

City and County of Honolulu
Department of Design and Construction - Director
650 South King Street, 11th floor
Honolulu, Hawai`i 96813

6/13/2017

RE: Comments concerning environmental assessment for Queens' surf sea wall repair

Report fails to note that, historically, much of this site was a restaurant/bar that was removed during the Fasi era. The existing beach café and restrooms was a replacement to restrooms & changing area that were demolished (early 80s ?). A covered pavilion that was south of the Chinese banyan and left over from the restaurant was removed later and grassed over and coconut palms installed.

There is an abandoned outflow drain mentioned in Ross Sasamura's response in which he states it provides drainage from Kalakaua Ave. to the beach. It is not at all apparent that this drain is still functional. Additionally, a portion of the concrete at the top of the outfall under the promenade collapsed and fell into the drain this past winter. Such is not noted in the report. While your response makes note of this drain (and it is shown in various photos and diagrams), I believe it is necessary to clarify with the City whether this storm drain is still in active use or whether it can be closed up in the course of the project. If it is actively discharging stormwater from Kalakaua Ave., there is a whole different issue with respect to pollution from run-off from the street.

The report mentions the abandoned pipe and manhole just off the protruding planter. Since neither is in current use, consideration should be given to their removal or, as suggested in one of the appendices, covered with large rock revetment. There used to be a stair on the north side of the planter that allowed access to the promenade from the beach area. It was removed during one of the renovations as there was little beach left at that side of the planter. There is also an old wall that extends out perpendicularly to the seawall about 30-40 feet north of the planter. This consists of blocks of aggregate, now mostly covered in algae. Although entirely underwater, it modifies the wash of the waves and removal and redeposition of sand to the beach near the planter. It provides a favored entry into the ocean where there is little coral or rock and seawall repair should not eliminate it.

I disagree with Ms. Nekota's proposal that the existing planter be covered over with concrete. When the City did a renewal of the makai Kapiolani Park area some years ago, a saltwater-tolerant grass (*Paspalum distichum* -seashore paspalum) was installed. Before it was washed out by waves overtopping the sea wall, people used that area to sun bathe. If the area that sticks out and is most referenced (north wall, southwall) is to be paved over, then some benches and perhaps a small covered pergola could be installed to make the site useful as a viewing area. The other narrower planters toward the south side could be refurbished with salt-tolerant plants once the sea wall has been restored/improved/raised with an outward curvature to reduce wave action.

This also reminds me that the contractor must restore the grass area on which construction vehicles and storage units are placed during the project. I was pleased to note that a tree protection plan is required.

The proposal that a new capstone for the wall be installed, reminds me that the existing one is subject to damage from skateboarders. The new capping should embrace a design that minimizes such use (see photo, next page).

As one who swims regularly in the waters off the Queens Surf beach, I note that there is little viable coral left due to warm waters during the past couple summers.

4.6 Botanical Resources: Add: Cordia subcordata (kou), Hibiscus tiliaceus ((hau), Cassia X nealiae (Rainbow Shower 'Lunalilo Yellow'), Ficus microcarpa (Chinese banyan) Ficus benjamina (weeping fig), Swietania mahogany (West Indian Mahogany), and Albizia saman (Monkeypod) to the list of trees inland of the sea wall and possibly in the construction zone. There are also single trees of Bombax ceiba (Red silk cotton), Delonix regia (royal poinciana), Ficus rubinginosa (Port Jackson fig), and Clusia rosea (autograph tree) to the north side of the women's restroom, which may be out of the construction area.

Thank you for the opportunity to review the environmental assessment documents. It is fascinating to learn of the multiple permits and reviewing agencies involved in this project. I hope that all permits can be secured and the improvements to the seawall completed for the protection of this park area.

Sincerely,

Richard Criley

Richard Criley
725 Piikoi St., #801
Honolulu, HI 96814

Top of wall has a wave effect that is fine for Seating but not for skateboarding.

November 22, 2017

Mr. Richard Criley
725 Piikoi Street, #801
Honolulu, Hawaii 96814

Dear Mr. Criley:

Subject: City & County of Honolulu, Department of Design and Construction (DDC)
Waikiki (Queens Surf) Seawall Mitigative Improvements
TMK: 3-1-30:1, 2 & 3 and 3-1-31: 4 & 5
Consultation for Final Environmental Assessment (FEA)

On behalf of DDC thank you for reviewing the Draft EA and providing your comment letter dated June 13, 2017. In response to your comments we offer the following responses.

- The information provided about the former use of the Beach Center parcel was included in FEA.
- Department of Facilities Maintenance (DFM) informed us the existing storm drain that outlets through the seawall is active and if damaged during the seawall repair must be repaired to City standards. We also inquired about the damage of the top of the outfall under the promenade and if that has since been repaired.
- The advantages of removing the abandoned storm drain pipes and manholes has been discussed with multiple departments of the City, and is still under consideration.
- The plans do not include removal of the submerged aggregate wall 30 - 40 feet north of the coastal planter box.
- We are working with DDC, DFM and the Department of Parks and Recreation (DPR) and a landscape architect to come up with an acceptable concept for the area land side of the seawall. The amount of maintenance required for any vegetation or improvements like benches and sitting areas, reduction of sediment runoff and gouging of the land from wave overtopping and drainage are all considerations for the proposed improvements on the area land side of the seawall. The City has decided to repair, but not raise the wall and include an outward curvature on the seaward face to deflect waves. Wave overtopping will undoubtedly occur even after repairs have been made so these improvements must be appropriately chosen and durable.
- The contract documents will include provisions requiring the Contractor to repair any damage to the existing grounds, including the grassed area crossed by his vehicles or used for staging or storage to equal or better conditions.

- The decision to install a "scalloped" concrete cap on top of the repaired seawall will be evaluated by the City.
- The botanical resources you provided will be included in section 4.6 of the FEA.

If there are any questions, please contact Cris Takushi at (808) 954-4129 or by email at ctakushi@oceanit.com.

Sincerely,

Cris Takushi

Cris Takushi
Project Manager

cc: Department of Design and Construction – Elaine Morisato

Cris Takushi

From: David Gentry JET Filter System LLC <dgentry@jetfiltersystem.com>
Sent: Thursday, June 15, 2017 7:55 AM
To: Cris Takushi
Cc: gwest.kap@gmail.com
Subject: Waikiki (Queens Surf) Seawall Mitigative Improvements
Attachments: Product Manual.pdf; Concrete Seawall Installation Detail.pdf; Concrete Seawall Installation Detail.png; Backflow preventer flyer.pdf

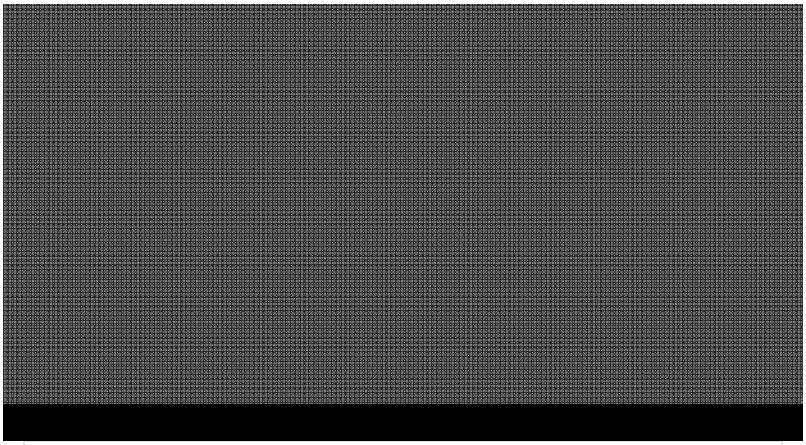
Hello Cris,
I just left you a voice mail.

In regards to your project. We would like to inform you on a practical and simple dewatering solution for (ERS) Earth Retaining Structures, an important accessory to a wall design. The Jet Filter System will facilitate drainage and reduce water pressure while still preventing the loss of soil materials through the structure thus preventing sink holes and wall failure.

We also have an closed-end option one-way backflow preventer 4"dia. units that will reduce any water flow through the front of the concrete seawall that you may have an interest.

We would be more than happy to send samples for your review.

Please visit our website for more information at Geotextile Weep Hole Dewatering Solutions - JET Filter System



Geotextile Weep Hole Dewatering Solutions - JET Filter System

The JET Filter System is a unique weep hole dewatering solution which enables filtration & erosion control u...

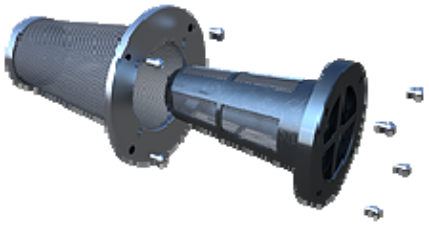
Also included is our product manual below
[Product Manual Revised | FlipHTML5]

Product Manual Revised | FlipHTML5

By fliphtml5.com
Product Manual Revised

Thank you for your time and consideration

David Gentry



Introduction JET Filter video- https://youtu.be/vWUHTUwatM0

United States Patent Number 7,615,148
Geocomposite Wick Drainage System
Geotextile Filtration and Erosion Control

David Gentry
President | JET Filter System L.L.C.
800-475-2029| dgentry@jetfiltersystem.com | http://www.jetfiltersystem.com
LinkedIn: http://linkedin.com/in/jetfilter
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Twitter: http://twitter.com/jetfilter1
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November 22, 2017

Mr. David Gentry
Jet Filter System, LLC
14 N Central Ave #101
Casey, IL 62420

Dear Mr. Gentry:

Subject: City & County of Honolulu, Department of Design and Construction (DDC)
Waikiki (Queens Surf) Seawall Mitigative Improvements
TMK: 3-1-30:1, 2 & 3 and 3-1-31: 4 & 5
Consultation for Final Environmental Assessment (FEA)

This letter is in response to your phone call and email on June 15, 2017, regarding the City and County of Honolulu, Department of Design and Construction's (DDC) Waikiki (Queens Surf) Seawall Mitigative Improvements on Oahu. On behalf of the applicant, DDC, thank you for providing the information on the Jet Filter system for relieving hydrostatic pressure and dewatering. We forwarded the information to DDC and are helping them evaluate the Jet Filter system for this project.

If there are any questions, please contact Cris Takushi at (808) 954-4129 or by email at ctakushi@oceanit.com.

Sincerely,

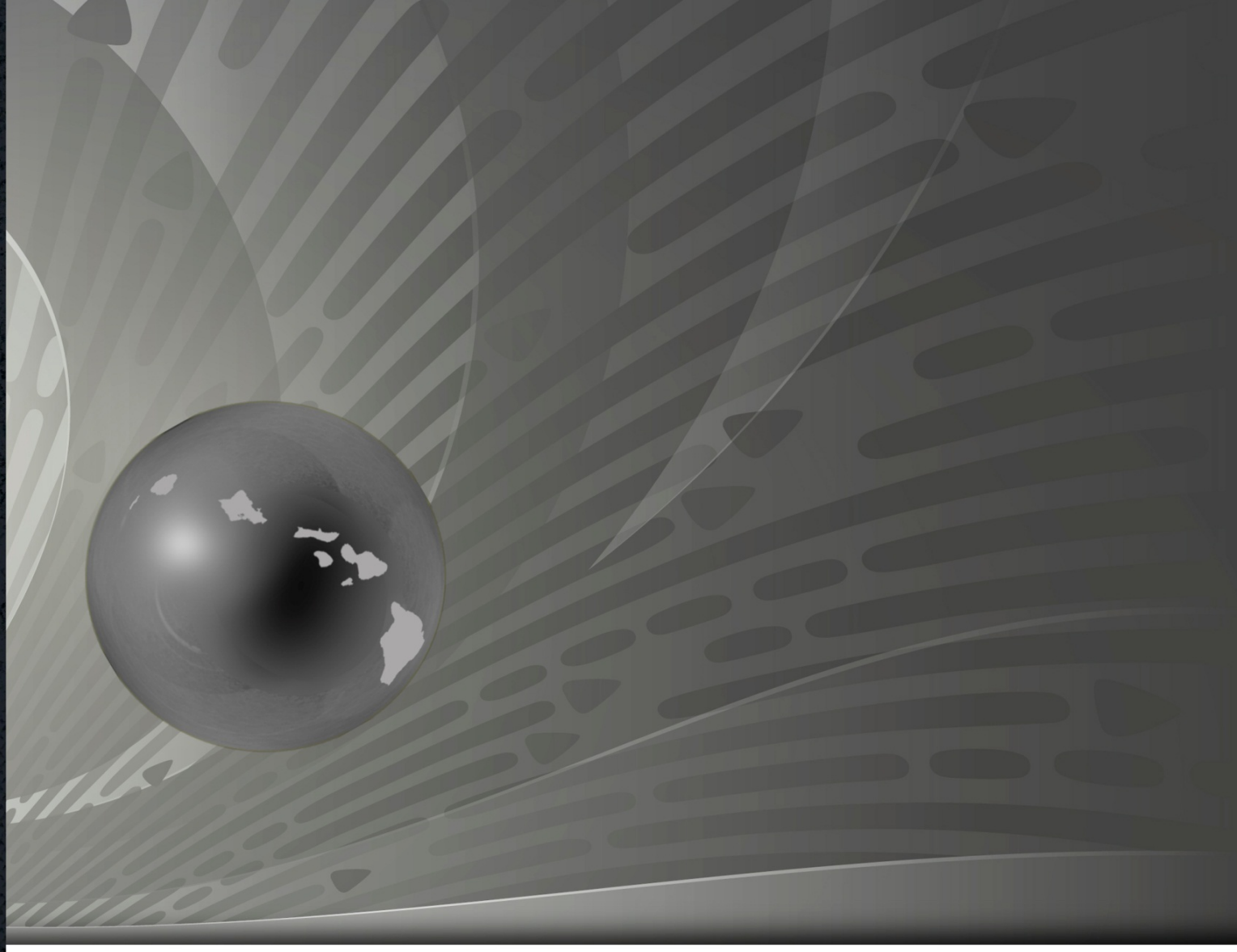
Cris Takushi

Cris Takushi
Project Manager

cc: Department of Design and Construction – Elaine Morisato

APPENDIX B

Geotechnical Exploration and Evaluation Reports



DRAFT SUBMITTAL

GEOTECHNICAL EXPLORATION AND EVALUATION REPORT

Prepared for:

Oceanit, Inc.
828 Fort Street Mall, Suite 600
Honolulu, Hawaii 96813

Queen's Surf – Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

January 2015
YKE Project No. 11027

Prepared by

Yogi Kwong Engineers, LLC
1357 Kapiolani Blvd., Suite 1450
Honolulu, Hawaii 96814

January 30, 2015

Mr. Cris Takushi, P.E.
Oceanit, Inc.
828 Fort Street Mall, Suite 600
Honolulu, Hawaii 96813

Subject: **Draft Submittal**
Geotechnical Exploration and Evaluation Report In Support of Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Dear Mr. Takushi:

Yogi Kwong Engineers, LLC is pleased to submit this draft Geotechnical Exploration and Evaluation Report (henceforth referred to as the Geotechnical Report) in support of the Queen's Surf - Waikiki Beach Seawall Repair project on the island of Oahu, Hawaii, for your review and use. Our geotechnical engineering services were performed in general accordance with our fee proposals dated August 29, 2011 and April 4, 2013, respectively.

We appreciate the opportunity to provide these services to Oceanit, Inc and the City and County of Honolulu. If you have any questions regarding this letter and the attached draft Geotechnical Exploration and Evaluation Report, please do not hesitate to contact us.

Yours truly,

Yogi Kwong Engineers, LLC

Reyn Hashiro, P.E.
Project Manager

James Kwong, Ph.D., P.E.
Principal

Yogi Kwong Engineers, LLC
1357 Kapiolani Blvd., Suite 1450
Honolulu, Hawaii 96814
Tel: 808.942.0001
Fax: 808.942.0004

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APPENDIX

Appendix A Field Exploration
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Appendix E Draft Geotechnical Exploration and Evaluation Report dated January 26, 2012

1.0 INTRODUCTION

This draft submittal of the Geotechnical Report presents the results of a geotechnical exploration and evaluation performed in two (2) phases by Yogi Kwong Engineers, LLC (YKE) in support of the Queen's Surf – Waikiki Beach Seawall Repair project on the island of Oahu, Hawaii. The approximately 1,030 linear foot long Waikiki beach seawall is located within the City & County of Honolulu's Kapiolani Regional Park – Kapiolani Beach Center and is deteriorating severely along its eastern section.

The approximate project location and its general vicinity are shown on the Project Location Map, Figure 1, and the Aerial Photograph of Project Location, Figure 2, respectively.

1.1 PROJECT DESCRIPTION

It was our original understanding that the subject project was to involve the repair of an approximately 430 feet long section at the southern end of the existing, deteriorating Waikiki beach seawall from Sta. 4+60 to Sta. 8+90, as shown in Figure 4.

Based on a draft structural assessment and recommendations for repairs and modifications report prepared by KSF Inc., (KSF) dated September 29, 2011, it appeared that the existing seawall was generally comprised of a cast in place concrete (CIP) wall at the base, topped with one (1) or two (2) layers of concrete rubble masonry (CRM). Based on our visual observations made during field work and a review of as-built drawings obtained from the City and County of Honolulu (CCH), it also appeared that the seawall had been subjected to numerous repairs and modifications since its original construction sometime in the 1920's.

The proposed repairs were to include permeation grouting of the upper CRM portion of the seawall and spall repairs of the lower reinforced concrete base. Drypak or shotcrete was proposed for use to fill the voids in the seawall. Additionally, the coastal planter box segment located between Sta. 4+60 and Sta. 5+80 was to be raised in height by 18 inches.

A preliminary geotechnical exploration and evaluation was performed by YKE in 2011 in support of the originally proposed repair concepts. Based on our initial findings, we indicated that the use of flowable concrete, viscous cement, or masonry grout was preferred over the proposed use of permeation grout, drypak or shotcrete to fill the voids on both the sea and land sides of the existing seawall and to form a mass concrete wall behind the patched existing seawall from a geotechnical point of view.

Currently, the project design team proposes to construct a reinforced concrete retaining wall instead of a mass concrete wall behind the existing seawall to reinforce the seawall. YKE is tasked to perform this additional exploration and evaluation to provide foundation recommendations for the new wall behind the existing seawall.

Based on our recent communication with Oceanit, Inc. (Oceanit), CCH is also requesting the project design team to consider alternates from increasing the existing seawall height, modifying the existing seawall or its foundation, to building a new lower wall behind to prevent erosion. It is our understanding that Oceanit is also considering to place a rock revetment on the seaward side to prevent erosion and undermining of the existing wall, or to excavate behind the existing seawall to install a filter structure to prevent loss of materials through the existing seawall as shown in Figures 5 and 6.

It is also our understanding that Oceanit may consider applying permeation grouting to repair the seawall at selected locations.

1.2 Purpose and Scope of Work

The purpose of this geotechnical exploration was to explore and evaluate the subsurface conditions within the project area provided by Oceanit in support of the proposed repair of the existing Waikiki beach seawall section by developing preliminary geotechnical foundation recommendations for the new wall.

Our initial exploration and evaluation was performed in general accordance with our fee proposal dated August 29, 2011. The preliminary field exploration included the following field work:

- Hand excavated a total of two (2) test pits to approximately 3 feet below the existing ground surface behind the existing seawall.
- Performed a total of eight (8) dynamic cone penetration (DCP) tests to practical refusal or a maximum depth of 3 feet at the tests pits and additional locations behind and in front of the existing seawall.
- Subcontracted Global Geophysics to conduct a geophysical survey by using Ground Penetration Radar (GPR) along the top of the existing seawall approximately from Sta. 4+60 to Sta. 9+00.

Our preliminary findings of the geotechnical field exploration, laboratory testing, engineering analyses and evaluations conducted, and our preliminary geotechnical recommendations for the repair of the subject Waikiki beach seawall section were summarized and presented in a draft submittal geotechnical exploration and evaluation report dated January 26, 2012.

The following additional scope of services was performed during the current supplemental geotechnical exploration and evaluation in general accordance with our fee proposal dated April 4, 2013:

- Performed a geotechnical site reconnaissance, selected and staked out two (2) exploratory boring locations, contacted Hawaii One Call Center to identify probable

subsurface utilities, and applied and received approval of a City and County of Honolulu Department of Parks (CCH Parks) Permit and Right-of-Entry.

- Verified probable underground utility locations at field work areas with utility agency personnel and CCH Parks personnel based on available as-built and topographic plans prior to drilling of the two (2) exploratory borings.
- Drilled two (2) exploratory borings to approximately 26.0 and 26.5 feet below the existing ground surface at the selected locations within the project area provided by Oceanit, Inc..
- Performed soil sampling and classification during the supplemental field exploration, and preserved soil samples for subsequent laboratory testing.
- Performed geotechnical laboratory tests on selected soil samples to determine pertinent geotechnical properties.
- Analyzed the supplemental field exploration and laboratory test data with data obtained from the initial exploration and evaluation, for the development of our geotechnical engineering evaluation findings and preliminary foundation design recommendations.
- Prepared this draft Geotechnical Report summarizing our preliminary findings of the supplemental geotechnical field exploration, laboratory testing, engineering analyses and evaluations conducted along with findings of the initial supplementary geotechnical explorations and evaluations, and presenting our preliminary geotechnical foundation recommendations for the proposed new wall behind the subject Waikiki beach seawall section to be repaired.

The scope of our services presented herein was limited to a geotechnical exploration and evaluation and did not include any civil, structural, hydrological, environmental, hazardous waste assessment and/or evaluations, utility verification for design and construction, detail design, permit applications, and/or topographic survey of the site. The scope of our services also excluded any meetings, submittal review, and geotechnical monitoring services during construction.

2.0 FIELD EXPLORATIONS AND LABORATORY TESTING

2.1 FIELD EXPLORATIONS

The initial field exploration for this project was performed between October 17 and 21, 2011 while the current supplemental field exploration was performed on November 24, 2014 under the supervision of our engineering personnel in general accordance with the scope of work in our fee proposals dated August 11, 2011 and April 4, 2013, respectively. The current field exploration included drilling and sampling a total of two (2) exploratory borings to the approximate depths of 26 and 26.5 feet below the ground surface.

The approximate locations of the exploratory borings are shown on the Approximate Boring Location Plan, Figure 4. A detailed description of the procedures used to perform the exploratory borings along with the logs of these borings, is presented in Appendix A.

2.2 LABORATORY TESTING

Laboratory testing was performed to verify our visual field classifications and to determine pertinent geotechnical engineering properties of selected soil samples retrieved from the exploratory borings. The geotechnical laboratory testing was performed at YKE's laboratory in Honolulu, Hawaii.

A description of the laboratory testing procedures is presented in Appendix B. The geotechnical laboratory tests performed include moisture content, dry density, gradation, and direct shear tests.

3.0 SITE CONDITIONS

3.1 SURFACE CONDITIONS

The project site is located in Kapiolani Park, and is bordered on the North by the Queen's Surf groin, on the South by the Waikiki Aquarium, on the East by Sans Souci State Recreational Park, and on the West by the Pacific Ocean, as shown in Figure 1.

The area along the shore line of Kapiolani Park west of the Waikiki Aquarium was previously known as "Public Baths" that were constructed in 1907 and renovated in 1930's. The baths were small children wading pools protected from the waves by 5-foot tall walls. It is speculated that the seawall section YKE has been tasked to study may have been part of the original Public Bath pool walls.

Based on a topographic survey performed by ParEn, Inc. dated May 27, 2011, the surface topography of Kapiolani Beach Center near the project area is generally flat with an average ground surface elevation of 7 feet above Mean Sea Level (MSL). Ground surface elevations behind the Waikiki beach seawall section considered for repairs appear to range between 4.3 and 7.8 feet MSL. Top elevations of the seawall section appear to range between 4.8 and 5.5 feet MSL.

The existing ground cover behind the seawall section considered for repairs included grass, small vegetation, topsoil and beach sand. Erosion of the topsoil and beach sand was evident as the seawall was susceptible to overtopping during high surf. No utility lines were observed within the project site. A 4-inch perforated PVC drain pipe was spotted along the seawall during YKE's previous field reconnaissance visit, along with 1 to 2-inch PVC irrigation lines.

An exposed 24-inch diameter Reinforced Concrete Pipe (RCP) drainage line with two (2) manholes was observed traversing approximately 10 feet in front of the seawall, between approximately Sta. 3+70 and Sta. 8+40. The drainage line appeared to have been abandoned and several major pieces were missing with overall growth of coral and deposit of sand inside the pipe.

3.2 EXISTING WALL CONDITIONS

The Waikiki beach seawall extends from the Queen's surf groin on the North to the Waikiki Aquarium on the South, with an approximately 430-foot long section between Sta. 4+60 and Sta. 8+90 currently in various forms of distresses or disrepairs. Based on the draft structural assessment and recommendations by KSF, Inc. dated September 29, 2010, several structural and non-structural damages along the seawall section were identified.

The seawall varies in height between 5 and 6 feet along the studied section. As previously mentioned, the seawall appears to be built on a cast in place concrete (CIP) wall at the base, topped with one (1) or two (2) layers of concrete rubble masonry (CRM). The seawall was constructed on the beach rock formation located at the low water elevation. An extension of what appears to be a concrete wall footing past the seawall face was observed at the base of the seawall from Sta. 6+85 to Sta. 7+70. Large boulders and concrete debris were observed between the seawall and the exposed 24-inch diameter drainage pipe.

Due to aging effects, reinforcing steel corrosion, repetitive wetting and drying of concrete, and wave scouring forces, the seawalls is in a structurally deficient condition. The most significant damages observed at the seawall included large voids at the base of the wall, voids between the CIP wall base and the overlying CRM layers, vertical cracks, missing stones, and eroded mortar at the CRM sections. The locations of selected site condition photographs are presented in Appendix D of the initial draft report.

Based on the draft structural assessment by KSF and our observation during YKE's previous field reconnaissance visit, the horizontal voids at the base of the seawall were likely very deep and extensive at numerous locations along the studied section of the seawall. Voids of up to 4 feet in size were observed under the wall structure. Based on the structural assessment by KSF, Inc., wave actions and runoff from behind the seawall may have eroded the coral reef under the seawall and undermined the wall. Other distresses such as vertical cracks were observed in the south corner of the coastal planter box at approximate Sta. 5+70.

Based on the available as-built plans (Reconstruction and Repairs to Existing Seawall dated February 1987), the seawall may have been built in two (2) different configurations. 'Type A' section is located at the southern portion of the studied wall section (Sta. 6+90 to Sta. 8+90) that consists of a CIP wall approximately 2 feet in thickness topped by a CRM layer, with a sloped CRM wall behind the original CIP wall. Backfill behind the structure probably consisted of 18 inches of sand underlain by 18 inches of crushed rock fill over a geotextile fabric. A surface slope of about 5.5V:1H was previously measured on the back face of the wall. Large boulders and cobbles of concrete debris and coral were encountered from approximately 1 to 3 feet below the existing ground surface. Based on the reviewed as-built plans, 'Type B' section is located at the northern portion of the studied seawall section and is consisting of the original vertical CIP wall topped with a CRM layer.

3.3 Regional Geology

The project area is located along the existing shoreline in lower Waikiki, on the island of Oahu. The fluctuations of the sea level resulted in migrating shorelines and the formation of deep erosion channels. These erosion channels dissected upland or deeper basaltic lava flows

and earlier coral and alluvial deposits. During periods of low sea level, these alluvial channels (valleys) and erosion surfaces developed well below the current mean sea level.

Sea level fluctuations also contributed to the consolidation or over-consolidation of some alluvial silts and clays. Basaltic cobbles and boulders are typically anticipated in these alluvial sediments, due to the proximity of the project site to lava flows and erosion channels and gullies. Most of these erosion channels in the project area were later filled in by the alluvial and tuffaceous deposits.

Ancient back-reef sedimentation basins in the area were infilled by lagoonal and estuarine deposits and swamps while the sea level rose and fell during glacial and interglacial periods. Substantial man-made fills were placed to raise the ground surface of much of the lower Waikiki when the area was originally developed. Due to the past complex depositional environment in the area, variations in stratigraphy, complex interbedding and intercalations of the above deposits within short distances, in both vertical and horizontal directions, should be expected.

Coralline deposits were formed primarily as a result of wave actions on coralline reefs during different stands of the sea level. Wave actions caused breakage of reef formation to form rubblestone to coralline detritus. Subsequent re-cementation of coralline debris and beach sand deposits formed rock like structures from cemented calcareous sandstone to “beach rock” limestone ledges. Rises in sea level introduced an influx of fine sediments in a matrix with coarse coralline detritus. Due to the wave actions dominating the depositional environment, coralline deposits and coral reef limestone are often highly variable in all directions.

Historically, there were fresh water ponds back of the shoreline. Geologically, a lithified calcareous formation known as beach rock was formed over the lagoonal and beach sand and gravel deposits as a natural shoreline protection from the waves. The beach rock was interbedded with the algal coral formation which is shown on the Aerial Photograph of Project Location, Figure 2. Typically, the beach rock formation is relatively thin in the order of 6 to 12 inches thick and is not noted in Boring B-1.

The regional geology map of the project area and its vicinity is presented in Figure 3. The project site is primarily covered or underlain by beach deposits (Qbd) that were formed by the erosion of paleo coral reefs which had been re-worked by waves and deposited as beach deposits. To the east of the project area lies alluvium (Qa) and Honolulu Volcanics tuff cone deposits (Qot).

3.4 SUBSURFACE CONDITIONS

Interpretations of the subsurface conditions presented in this report are based on the subsoil data obtained from the previous test pit excavation and DCP testing, and the current drilling and sampling of the supplemental exploratory borings and the field and laboratory testing performed for this project, which are supplemented by available published geologic and soil survey maps and YKE's general experience in this area. Detailed descriptions of the subsurface conditions encountered in the YKE borings are presented on the boring logs in Appendix A. Selected photographs of the soil samples are shown in Appendix C.

The subsoil conditions can be generalized into three (3) geologic units: Fill, Beach and Coralline Deposits, and Lagoonal Deposits.

Fill – Fill was encountered in Boring B-2 located east of the sea wall to approximately 2.5 feet below the existing ground surface (bgs). The fill unit primarily consisted of brown sandy silt with gravel.

Beach and Coralline Deposits – Beach deposits were encountered in Borings B-1 and B-2 at the existing ground surface and 2.5 feet bgs, respectively. The beach deposits generally consisted of very loose to dense, brown, light brown, tan and off-white poorly graded coralline sand with silt, trace gravel and shells. In Boring B-1, the beach deposits graded with pockets of gray clay, and became weakly to moderately cemented or probably embedded with cobble sized fragments . In Boring B-2, the beach deposits graded with coralline cobbles at approximately 12 feet bgs.

Coralline deposits were encountered underlying the beach deposits in Boring B-1 but was not encountered in Boring B-2. The coralline deposits primarily consisted of medium dense, tan to off-white silty sand with gravel and loose, tan silty gravel with sand.

A summary of the field sampling blow counts and selected laboratory test results of the beach and coralline deposits is listed below:

Table 3.4-3
Beach and Coralline Deposits: Summary of Blow Counts and Laboratory Test Results

	No. of samples or tests	Range	Average
SPT sampler blow counts per foot	8	5 to 35	18
D&M sampler blow counts per foot (excluding refusal)	5	4 to 29	17
D&M sampler refusal blow counts	1 out of 6 total samples		
Moisture Content (%)	8	7 to 26	15
Dry Density (pcf)	5	90 to 109	97

Lagoonal Deposits – Lagoonal deposits were encountered in Borings B-1 and B-2 at approximately 15 feet bgs and 12.5 feet bgs, respectively. The lagoonal deposits consisted generally of very loose to medium dense, gray silty coralline gravel with sand.

A summary of the field sampling blow counts and selected laboratory test results of the lagoonal deposits is listed below:

Table 3.4-3
Lagoonal Deposits: Summary of Blow Counts and Laboratory Test Results

	No. of samples or tests	Range	Average
SPT sampler blow counts per foot	8	2 to 25	10
D&M sampler blow counts per foot	4	6 to 23	16
Moisture Content (%)	5	24 to 49	36
Dry Density (pcf)	1	105	-

During the field exploration, groundwater was encountered at approximately 5.7 and 6.9 feet below the existing ground surface at the time of drilling of the exploratory Borings B-1 and B-2, respectively. Due to the proximity of the project site to the shoreline, the effect of ocean tides should be taken into account during design and construction of the new wall under the subject project.

4.0 DISCUSSION AND GEOTECHNICAL RECOMMENDATIONS

4.1 DESIGN AND CONSTRUCTION CONSIDERATIONS

Based on the draft structural assessment by KSF, sulfate attack of seawater and wave action have caused severe erosion and undermining of the Queen's Surf – Waikiki beach seawall along its southern portion, leading to the development of large voids at the base of the wall, and loose or missing stones at its face. As a result, the preliminary repair measures considered by the project's structural and civil engineers involved the following repair alternatives to be performed at low tide:

- Permeation grouting to fill voids in the CRM wall sections,
- Spall repairs at the reinforced concrete section and dry pack or shotcrete to fill voids along the CRM section of seawall.
- Excavated the land side of the seawall and poured flowable concrete to fill voids accessible from the land side of the wall.

Due to the close proximity of the Pacific Ocean, it was anticipated that daily tidal change along the seawall would significantly affect the progress of repair work using the proposed repair measures. While this restriction could be overcome by performing the repair work during low tides, wave action was also observed at the base of the seawall during low tides.

It was therefore also anticipated that a suitable cofferdam or bulkhead would be necessary to facilitate repair of the makai side of the seawall and to prevent any discharge of construction water, debris and/or contaminants into the adjacent ocean and/or State water.

4.2 EVALUATION OF PREVIOUSLY PROPOSED REPAIR MEASURES

In evaluating the above proposed repair measures during our initial exploration, we agreed with the assessment in KSF 's draft structural assessment report (dated September 29, 2010) that the use of shotcrete to fill the exposed voids on the existing seawall would generate rebound of the sprayed concrete and could become an environmental concern. If permeation grouting was to be used to grout the voids in the existing seawall, we believed that a large number of closely spaced drill or grout holes would be required, and that the permeation grout would likely leak and spill outside of the existing seawall.

Based on the available geotechnical data and GPR information and because of the above environmental concerns, we indicated that from a geotechnical standpoint, the use of flowable concrete or masonry grout, both with a washout resistant admixture, to fill the voids on both the sea and land sides of the existing seawall and to form a mass concrete wall behind the patched existing seawall could be preferable. Building of the mass concrete wall would require a trench to be excavated on the land side behind the existing seawall to the

base of the wall until the underlying beach rock formation was encountered. The trench excavation would have to be properly supported and shoring of the temporary excavation would be the responsibility of the Contractor.

The subsurface materials likely to be encountered behind the existing seawall, based on our test pit excavations, could generally be excavated by conventional methods, however, the generally loose beach sand, gravel and basalt cobbles & boulders are anticipated to run or flow into the supported excavation. After excavation, the bottom should be sealed by placement of flowable concrete or masonry grout. The concrete or grout should be placed in maximum 8-inch lifts and allowed to adequately set prior to placement of the next lift to reduce the lateral loading on the existing seawall which is currently in a distressed condition.

We recommended that the Contractor retain an experienced Professional Civil and/or Structural Engineer licensed in the State of Hawaii to evaluate and design the cofferdams or bulkheads required for the proposed seawall repair concept and any temporary excavation support systems necessary to complete the proposed seawall repair. All work should comply with all applicable City, State, and Federal government regulations and associated permit conditions.

4.3 Current Design Concepts Proposed by CCH and Oceanit

Based on the currently available boring data and the previous geotechnical and GPR information, we also believe that from a geotechnical standpoint, a conventional reinforced concrete wall, possibly lower than the existing seawall, may be constructed instead of a mass concrete wall to support the existing seawall from behind as currently proposed by the design team and CCH.

It is our opinion that similar construction methods and sequences as discussed above in Subsection 4.2 for the previously recommended mass concrete wall are generally applicable to the new reinforced concrete wall construction. However, sea water could penetrate the construction joints which may occur during successive lifts during the concrete pour and the use of special (or coated) reinforcing bars not susceptible to corrosion may be required at the discretion of the projects structural engineer.

The excavated onsite sand and gravel free of cobbles and boulders may be used as the wall backfill. Imported backfill should consist of No 2 or No. 3 gravel with little or no fines and should be wrapped in a non-woven filter fabric (Mirafi 180N or equivalent) to minimize the migrations of fines and beach sand into the imported backfill material.

It appears effective sub-drainage behind the proposed reinforced concrete wall will not be available. The new reinforced concrete retaining wall should be designed to resist a horizontal force of 75 pounds per square feet per foot of depth from the existing fills during draw down of the sea level, e.g. during low tides and in extreme cases, after a tsunami

inundation. The lateral earth pressure could be reduced to the active earth pressure of 35 pounds per square foot per foot of depth, by capping the backfill with another layer of concrete and elevating the wall to above the wave splash height to prevent water infiltration. This design concept is similar to the alternate design of increasing the wall height currently proposed by CCH presumably to avoid wave topping that could lead to future erosion.

The new reinforced concrete wall footing may be designed for a maximum allowable bearing capacity of up to 1,500 pounds per square foot with a potential total settlement of 1 inch and a potential differential settlement of ½ inch. The allowable bearing capacity may also be used to evaluate the proposed alternate designs from increasing the height of the existing seawall to modifying the existing seawall or its foundation as currently proposed by CCH.

On the other hand, Oceanit has proposed an alternate design concept to construct a filter structure behind the existing seawall to prevent migration of fines and materials from washing out during overtopping will require a trench to be excavated on the land side of the existing seawall. The trench excavation will need to extend to the base of the existing seawall wall similarly as discussed above in Subsection 4.2. The trench excavation must be properly supported and shoring of the temporary excavation should be the responsibility of the Contractor.

The other proposed alternate design concept presented by Oceanit involves constructing a rock rubble revetment in front of the existing seawall also appears to be conceptually feasible from a geotechnical standpoint. However, this alternate design concept cannot be properly evaluated in detail at this time due to limited available subsoil data with only two (2) DCPs performed on the seaward side of the approximately 430-foot long seawall section in concern.

We recommended that the Contractor retain an experienced Professional Civil and/or Structural Engineer licensed in the State of Hawaii to evaluate and design the cofferdams or bulkheads required for the proposed seawall repair concept and any temporary excavation support systems necessary to complete the proposed seawall repair. All work should comply with all applicable City, State, and Federal government regulations and associated permit conditions.

5.0 REFERENCES

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Stern, H.T. and Vaksvik, K.N., 1935. *Geology and Groundwater Resources of the Island of Oahu, Hawaii*. Division of Hydrography Bulletin 1.

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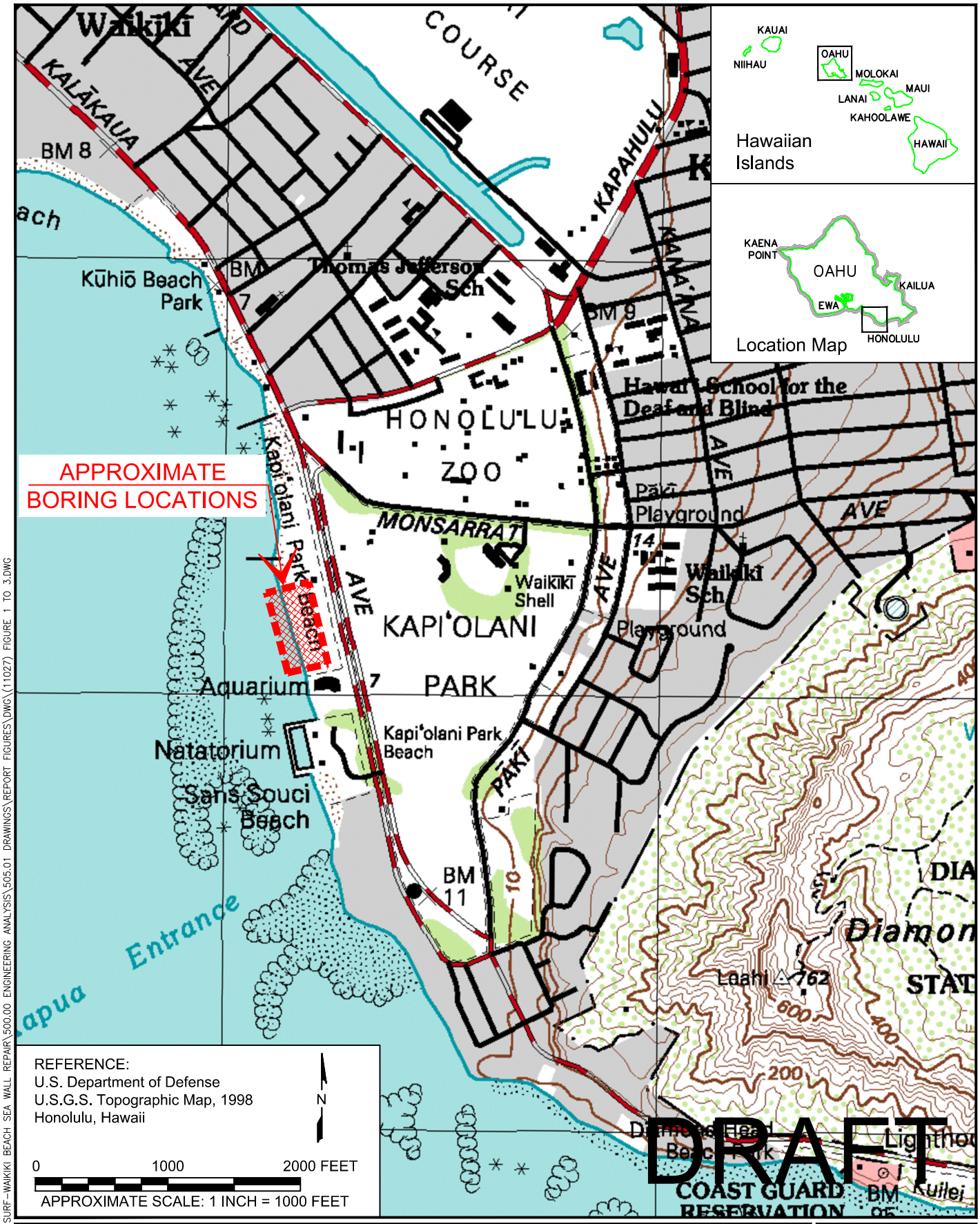
6.0 LIMITATIONS

The geotechnical recommendations and conclusions presented in this report are based on the assumption that the scope of the construction project, as described, does not change appreciably and that significant variations in soil properties from those encountered in our field explorations do not occur. The exploratory borings and various field test locations are widely spaced; therefore, some variations in soil properties between these locations are likely. If any conditions notably different from those described herein are encountered during construction, we should be immediately notified. The geotechnical recommendations presented in this report were developed assuming the Geotechnical Engineer-of-Record will be retained to observe actual field conditions encountered during construction to verify the applicability of the recommendation presented in this report, and to recommend appropriate changes in design or construction procedures, if conditions differ from those described herein.

This report was prepared for use by Oceanit, Inc. in accordance with generally accepted geotechnical engineering principles and practices. The geotechnical opinions and recommendations given in this report are based on our analysis of the data collected for this project. Additional conclusions and/or recommendations made from the data by others are solely their own responsibility.

Our analysis is based on the data obtained from the exploratory borings, test pits, DCP probing, and GPR survey at the locations indicated in the initial draft exploration and evaluation report dated January 26, 2012, and on the Approximate Boring Location Plan, Figure 4. If project plans or requirements change, the conclusions and recommendations provided herein by YKE may need to be revised. The nature and extent of variations between the borings and the various field test locations may become evident during construction and will likely differ from those discussed in this report. No warranty is included, either expressed or implied, that the actual conditions encountered will conform exactly to the conditions described herein. Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended or implied.

Note that the scope of service associated with this report was designed solely to achieve the objectives, schedule, budget ,and risk-management preferences Oceanit established for this project. No one except Oceanit should use or rely on this report. No one - not even Oceanit should use or rely on this report for any extension of this project, for any other project, or for any other purpose. Unless YKE verifies in writing that it has reviewed the report and that the proposed use reuse or reliance is acceptable, any such use, reuse, or reliance is prohibited and shall be at the user's, reuser's, or relier's sole risk.



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PROJECT LOCATION MAP

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC

FIGURE 1

P:\11027.01 QUEEN'S SURF-WAIKIKI BEACH SEA WALL REPAIR\500.00 ENGINEERING ANALYSIS\505.01 DRAWINGS\REPORT FIGURES\DWG\(11027) FIGURE 1 TO 3.DWG

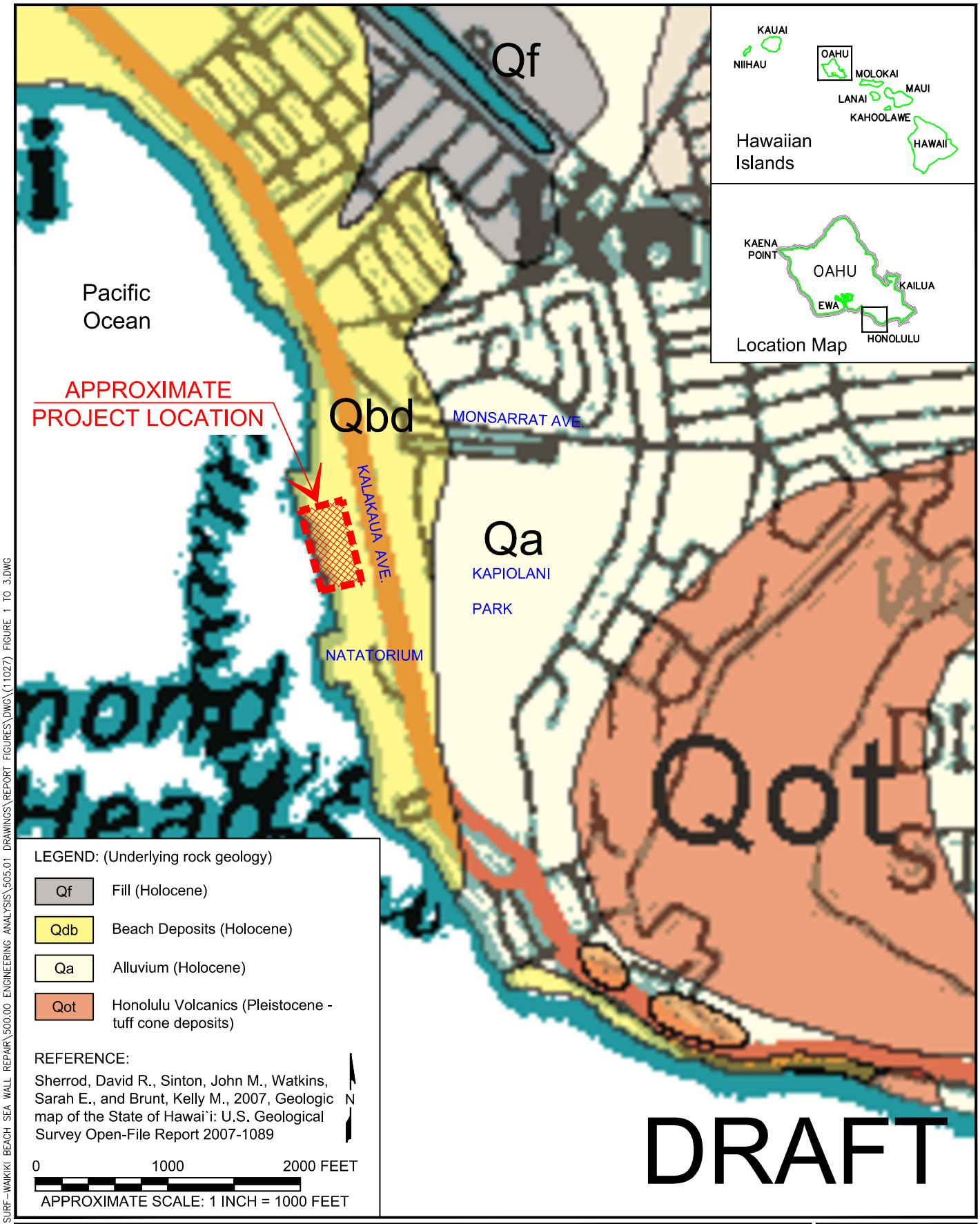
AERIAL PHOTOGRAPH OF PROJECT LOCATION

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC

FIGURE 2



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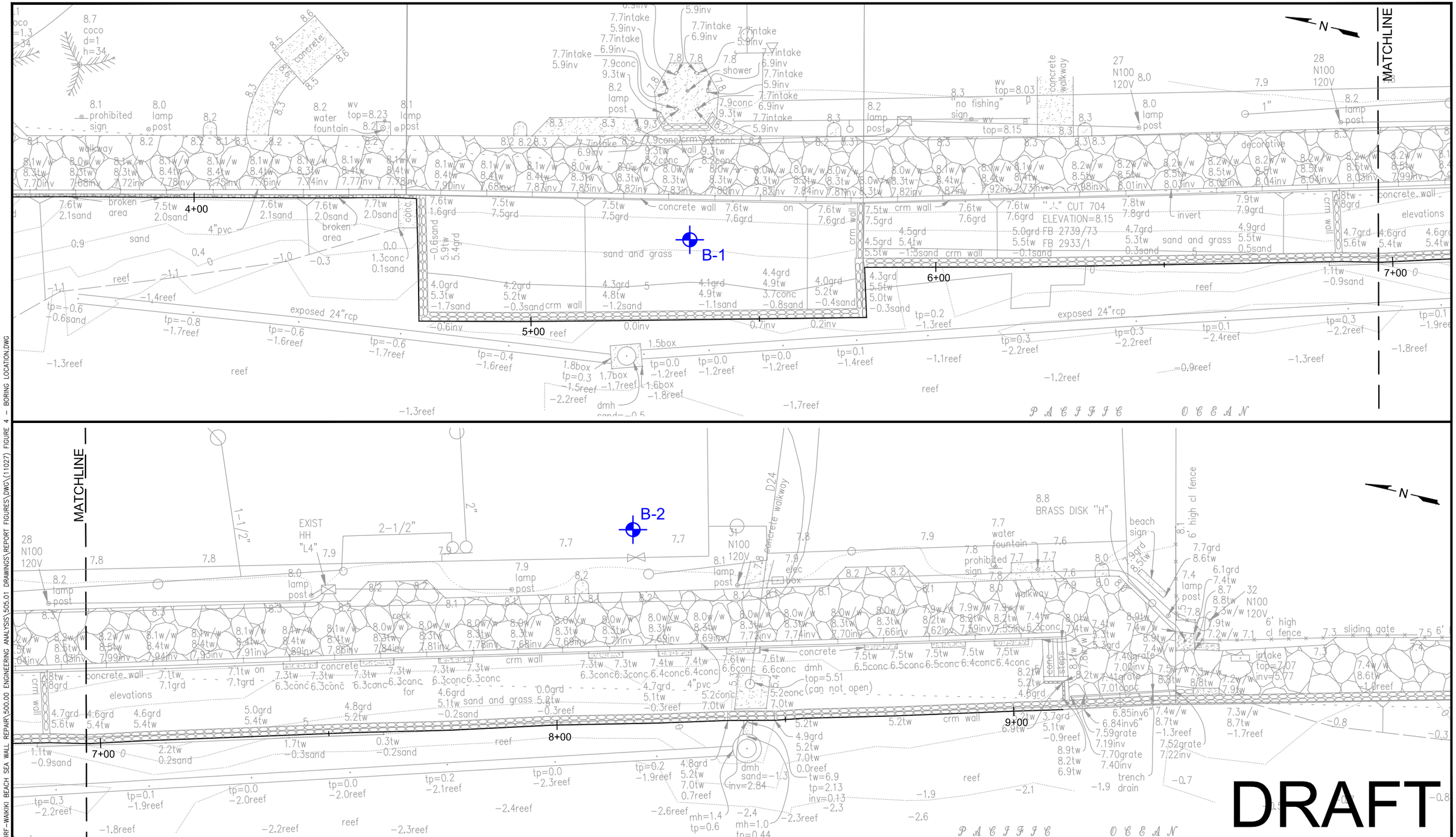
REGIONAL GEOLOGY MAP

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC

FIGURE 3



APPROXIMATE BORING LOCATION PLAN

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

Reference:
Topographic Survey Map
Provided by Oceanit
on September 23, 2011

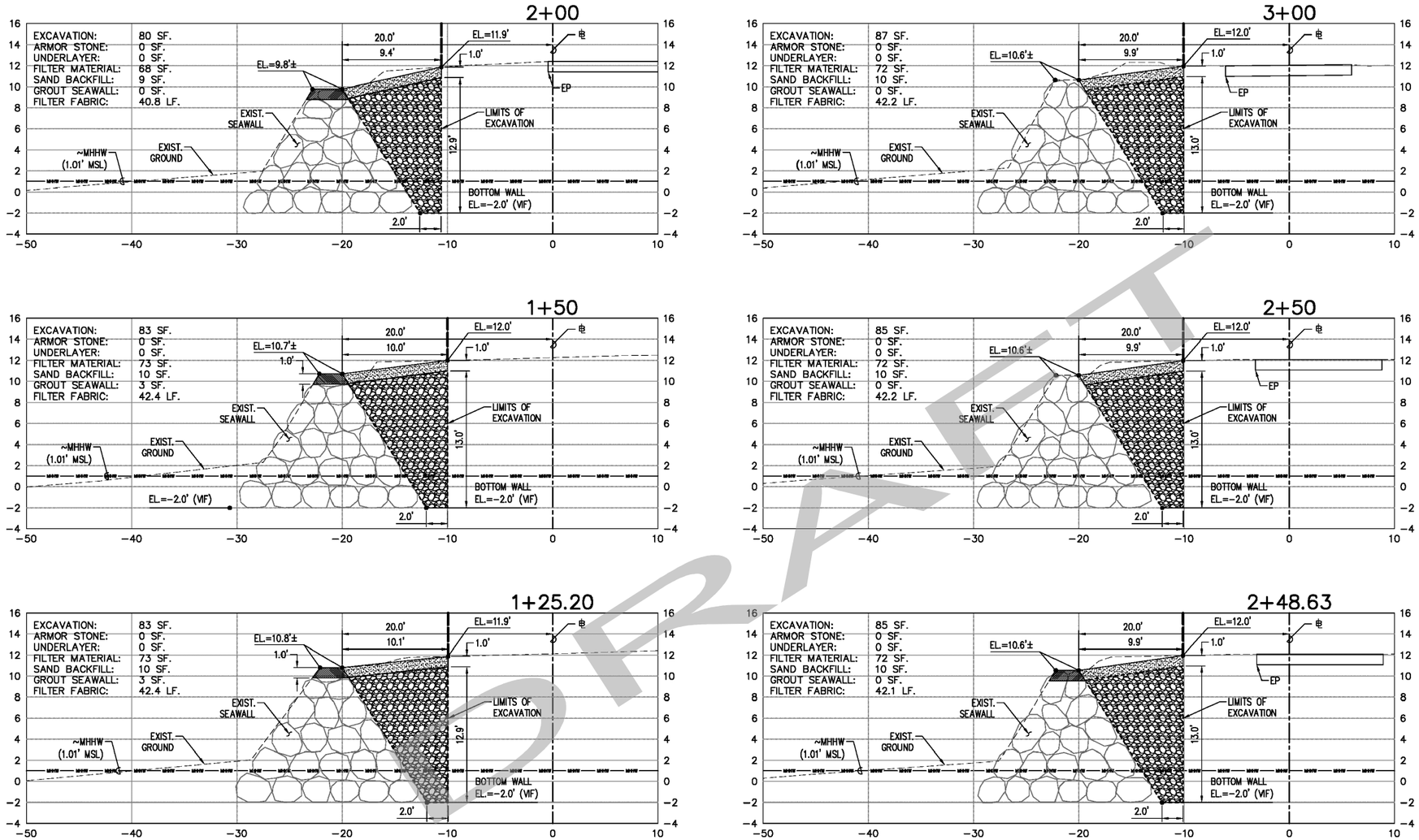
Legend:
APPROXIMATE BORING LOCATION
5+00 WAIKIKI BEACH SEAWALL ALIGNMENT AND STATIONS

Scale:
0 20 40 FEET
APPROXIMATE SCALE: 1 INCH = 20 FEET

YOGI KWONG ENGINEERS, LLC

FIGURE 4

P:\11027.01 QUEEN'S SURF-WAIKIKI BEACH SEA WALL REPAIR\500.00 ENGINEERING ANALYSIS\505.01 DRAWINGS\REPORT FIGURES\DWG\(11027) FIGURE 4 - BORING LOCATION.DWG



CROSS SECTION – 2
STA 1+25.2 TO 3+00

SCALE: HOR.: 1" = 5'-0"
VER.: 1" = 5'-0"

NOTES:

1. EXISTING SEAWALL TOE DEPTH IS ASSUMED FOR CIVIL DESIGN PURPOSES. CONTRACTOR SHALL VERIFY ACTUAL FIELD CONDITIONS AND ADJUST MATERIAL PLACEMENT AS NECESSARY.

GRAPHIC SCALE
5' 0 5' 10'
SCALE: 1" = 5'

DWG. NO. C-6
SHEET NO. 9 OF 11

REVISION	DATE	BRIEF	MADE BY	APPROVED

DEPARTMENT OF PUBLIC WORKS
COUNTY OF KAUA'I

PONO KAI SEAWALL REPAIR
KAPA'A, KAUA'I, HAWAI'I

CROSS SECTIONS 2
STA 1+25.20 TO 3+00

DESIGNED BY: MM DRAWN BY: MM CHECKED BY: DV

FINAL

AUGUST 2014

PONO KAI SEAWALL REPAIR

DRAWING NAME: I:\20737 - PONO KAI SEAWALL REPAIR\0 GRAPHICS\DRAWINGS\CONTRACT DOCUMENTS\03_FINAL\09_CROSS-SEC-2_C-6.DWG EDIT TIME: 09-26-14, 8:47 AM EDITED BY: CTAKUSHI

P:\11027.01 QUEEN'S SURF-WAIKIKI BEACH SEA WALL REPAIR\500.00 ENGINEERING ANALYSIS\505.01 DRAWINGS\REPORT FIGURES\DWG\(11027.01) FIGURE 5 - OCEANIT PROPOSED FILTER STRUCTURE BEHIND SEAWALL.DWG

OCEANIT PROPOSED FILTER STRUCTURE BEHIND SEAWALL
Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii
Project No. 11027

Reference:
Pono Kai Seawall Repair Plan
Drawing, Drawing C-6, Provided
by Oceanit on January 16, 2015.

DRAFT

NOT TO SCALE

YOGI KWONG ENGINEERS, LLC

FIGURE 5

Reference:
Photographs Provided by Oceanit
on January 16, 2015.

DRAFT

OCEANIT PROPOSED SEAWARD ROCK REVETMENT

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC

FIGURE 6

P:\11027.01 QUEEN'S SURF-WAIKIKI BEACH SEA WALL REPAIR\500.00 ENGINEERING ANALYSIS\505.01 DRAWINGS\REPORT FIGURES\DWG\(11027) FIGURE 6 - OCEANIT PROPOSED SEAWARD ROCK REVETMENT.DWG

APPENDIX A FIELD EXPLORATION

A.1 Exploratory Borings
A.2 Soil Sampling

APPENDIX B LABORATORY TESTING

B.1 Moisture Content and Density Tests
B.2 Gradation Tests
B.3 Direct Shear Test

APPENDIX C SELECTED PHOTOGRAPHS OF SOIL SAMPLES

APPENDIX D SELECTED SITE CONDITION PHOTOGRAPHS

LIST OF APPENDIX FIGURES

Figure A-1	Unified Soil Classification
Figure A-2	Log of Boring Key
Figures A-3 and A-4	Log of Borings
Figure B-1	Grain Size Distribution Curves
Figure B-2	Direct Shear Test
Figures C-1 through C-17	Selected Photographs of Soil Samples
Figures D-1 through D-5	Selected Site Condition Photographs

APPENDIX A FIELD EXPLORATION

A.1 EXPLORATORY BORINGS

The field exploration consisted of the drilling and sampling of total two (2) borings, B-1 and B-2, between February 2 and March 6 of 2014. The approximate location of the project site is indicated on Figure 1. The approximate locations of the borings are shown on Figure 4.

The borings were drilled by YK Drilling, LLC using an EXPLO 220MPR drill rig with 4-inch solid stem continuous flight augers and NX wash boring and coring drilling method and a SIMCO 2400 SK-1 drill rig with 4-inch solid-stem, continuous flight augers. The drilling method used is noted on the Logs of Borings, which are presented on Figures A-3 and A-4.

After drilling, Boring B-1 was backfilled with bentonite and sand and Boring B-2 was backfilled with gravel and Quikrete.

A.2 SOIL SAMPLING

Soil sampling was conducted under the observation of a YKE field engineering technician, who logged the materials encountered in the borings and obtained samples for further examination and laboratory tests.

Disturbed soil samples were obtained using a Standard Penetration Test (SPT) sampler (outside diameter (OD) of 2.0-inch and inside diameter (ID) of 1.5-inch), and relatively undisturbed soil samples were obtained using a Dames & Moore type "U" sampler (OD of 3.25-inch and ID of 2.5-inch). The SPT, or Dames & Moore sampler was driven into the ground by successive blows of a 140-pound hammer falling 30 inches. The sampler was driven for a total distance of 18 inches, and blow counts for each 6 inches of penetration were recorded. Where the SPT sampler was used, this procedure followed the American Society of Testing and Materials (ASTM) D1586 standard for determining the standard penetration resistance of soil. Where the Dames & Moore type "U" sampler was used, this procedure followed ASTM D3550 standard practice for thick wall, ring lined, split barrel, drive sampling of soils. Blow counts for the last 12 inches of penetration are noted on the Logs of Borings at the respective sample depths.

Core samples were obtained using NX (approximately 2.1-inch diameter cores) coring in maximum 5-foot lengths. Percentages of recovery were recorded for each core run.

Soil samples were initially classified in the field according to ASTM D2488 and the Unified Soil Classification System shown on Figure A-1. The field classifications were later verified and/or refined according to ASTM D2487 based on the results of laboratory tests performed on selected samples.

Samples recovered during the field exploration program were transported to our office in Honolulu for further examination and laboratory testing.

SOIL CLASSIFICATION CHART

	Major Divisions		Symbol	Typical Names	Other Criteria
COARSE GRAINED SOILS More than 50% of material larger than No. 200 sieve size	**Gravels** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravel** Little or no fines (<5%)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Cu>4 and 1<=Cc=3
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting Cu and Cc criteria for GW
		Gravels with Fines Appreciable amount of fines (>12%)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limit below A-line or PI<4
			GC	Clayey gravels, gravel-sand-silt mixtures	Atterberg limit above A-line with PI>7
	Sands More than 50% of coarse fraction passing No. 4 sieve	**Clean Sands** Little or no fines (<5%)	SW	Well-graded sands, gravelly sands, little or no fines	Cu>6 and 1<=Cc=3
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting Cu and Cc criteria for SW
		Sands with Fines Appreciable amount of fines (>12%)	SM	Silty sands, sand-silt mixture	Atterberg limit below A-line or PI<4
			SC	Clayey sands, sand-clay mixture	Atterberg limit above A-line with PI>7
FINE GRAINED SOILS More than 50% of material smaller than No. 200 sieve size	**Silts and Clays** Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Atterberg limit below A-line
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clay	Atterberg limit above A-line
			OL	Organic silts and organic silty clays flow plasticity	Atterberg limit below A-line
	Silts and Clays Liquid limit larger than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Atterberg limit below A-line
			CH	Inorganic clays of high plasticity, fat clays	Atterberg limit above A-line
			OH	Organic clays of high plasticity, organic silts	Atterberg limit below A-line
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils	

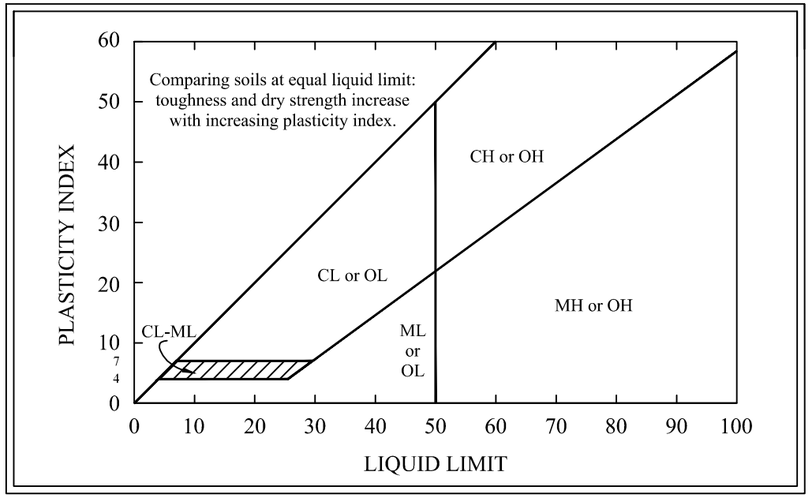
Notes: 1. Cu = D60/D10, Cc = (D30)^2/(D60 x D10) where D60, D30 and D10 are diameters associated with 60%, 30% and 10% smaller in gradation curves.
2. Dual symbols are used to indicate borderline classifications such as GP/SP.

GRADATION CHART

Soil Fraction		Size Range			
		Lower Limit		Upper Limit	
		Millimeters	Sieve	Millimeters	Sieve
Boulders		304.8	12*	914.4	36*
Cobbles		76.2	3*	304.8	12*
Gravel		4.76	4**	76.2	3*
Sand	Coarse	2	10**	4.76	4**
	Medium	0.42	40**	2	10**
	Fine	0.074	200**	0.42	40**
Fines				0.074	200**

* U.S. standard sieve opening in inches
** U.S. standard sieve number

PLASTICITY CHART



UNIFIED SOIL CLASSIFICATION

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

YOGI KWONG ENGINEERS, LLC
PROJECT NO. 11027

FIGURE A-1

QUEEN'S SURF WAIKIKI BEACH SEA WALL REPAIR

LOG OF BORING Key

LOCATION: Honolulu, Oahu, Hawaii
PROJECT NO.: 11027
DATE(S) DRILLED:
LOGGED BY:
CHECKED BY:
CONTRACTOR: YK Drilling, LLC
HAMMER TYPE:
HAMMER WT./DROP:
DRILL EQUIPMENT:
DRILLING METHOD:
GROUND ELEVATION:
BOREHOLE BACKFILL:

DEPTH, FT	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	REC, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, PCF	POCKET PEN., TSF	TORVANE, TSF	OTHER TESTS & REMARKS
0							STRATA SYMBOLS					
							Poorly graded sand (SP)					
							Silty sand (SM)					
							Silt (ML)					
							Clayey gravel (GC)					
5							Poorly graded gravel (GP)					
							Silty gravel (GM)					
							Poorly graded sand / Silty sand (SP/SM)					
							SAMPLE SYMBOLS					
10							Hand Augered sample					
							Standard Penetration Test (SPT) sample					
							Dames and Moore (D&M) ring sample					
			10				Number of blows to advance sampler the last 12 inches, or distance indicated					
15				85			Percent recovery is the length of core recovered divided by the total length of core run					
							Core sample					
			0/18"				Sampler advanced on weight of hammer with no blow count					
20												

SUMMARY OF GROUNDWATER LEVELS

DATE	TIME	DEPTH, FT	DATE	TIME	DEPTH, FT

This Log of Boring was prepared by Yogi Kwong Engineers, LLC (YKE) for the exclusive use by YKE and its client, and within the scope of YKE's contract agreement with the client on the subject project. No other persons, entities, or projects may rely on or use any information or statements contained in this Log of Boring. Inferences made by anyone that are based, in whole or part, on any information included in (or omitted from) this Log of Boring are their own responsibility.

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FIGURE A-2

QUEEN'S SURF WAIKIKI BEACH SEA WALL REPAIR

LOG OF BORING Key

LOCATION: Honolulu, Oahu, Hawaii
PROJECT NO.: 11027
DATE(S) DRILLED:
LOGGED BY:
CHECKED BY:
CONTRACTOR: YK Drilling, LLC
HAMMER TYPE:
HAMMER WT./DROP:
DRILL EQUIPMENT:
DRILLING METHOD:
GROUND ELEVATION:
BOREHOLE BACKFILL:

DEPTH, FT	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	REC, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, PCF	POCKET PEN., TSF	TORVANE, TSF	OTHER TESTS & REMARKS
20							ABBREVIATIONS FOR TESTS AND RESULTS					
							Gravel = % of sample passing through 76.2 mm sieve and retained on #4 sieve					
							Sand = % of sample passing through #4 sieve and retained on #200 sieve					
25							Fines = % of sample passing through #200 sieve					
							DS = Direct Shear Test					
30												
35												
40												
44												

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QUEEN'S SURF WAIKIKI BEACH SEA WALL REPAIR

LOG OF BORING B-1

LOCATION: Honolulu, Oahu, Hawaii
PROJECT NO.: 11027
DATE(S) DRILLED: 11/24/2014
LOGGED BY: J. Heine
CHECKED BY: E. Ng
CONTRACTOR: YK Drilling, LLC
HAMMER TYPE: Safety
HAMMER WT./DROP: 140 lb / 30 in
DRILL EQUIPMENT: Explo 220 MPR
DRILLING METHOD: 4" Solid Stem Augers, NX Coring, and HQ Wash Boring
GROUND ELEVATION: 5.4 FT MSL
BOREHOLE BACKFILL: Bentonite, Sand

DEPTH, FT	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	REC, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, PCF	POCKET PEN., TSF	TORVANE, TSF	OTHER TESTS & REMARKS
0							**BEACH DEPOSITS**	10	90			
		1	9	67			Brown poorly graded coralline sand (SP), very loose, dry					
		2	6	72			becomes tan, with trace gravel and shell fragments, loose	7				Gravel=2% Sand=97% Fines=1%
		3	29	72			becomes medium dense	26	93			
5		4	35	89			becomes dense grades to brown with pockets of gray clay becomes weakly to moderately cemented, probable cobbles					
		5	50/6"	100				23	109			
		6	27	100			becomes medium dense					
							CORALLINE DEPOSITS Tan to off-white silty sand with gravel (SM), medium dense, moist					Tan partial water return
		NX-1		0								
10												
		7	5	50			Tan silty gravel with sand (GM), loose, wet					Installed casing at 12.5' bgs Off-white partial water return
15		8	6	61			**LAGOONAL DEPOSITS** Gray silty coralline gravel with sand (GM), loose, wet	44				Gravel=43% Sand=38% Fines=19% Grayish off-white partial water retun
20												

SUMMARY OF GROUNDWATER LEVELS

DATE	TIME	DEPTH, FT	DATE	TIME	DEPTH, FT
11/24/2014	12:40 pm	5.7			

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FIGURE A-3

YKE

QUEEN'S SURF WAIKIKI BEACH SEA WALL REPAIR

LOG OF BORING B-1

LOCATION: Honolulu, Oahu, Hawaii
PROJECT NO.: 11027
DATE(S) DRILLED: 11/24/2014
LOGGED BY: J. Heine
CHECKED BY: E. Ng
CONTRACTOR: YK Drilling, LLC
HAMMER TYPE: Safety
HAMMER WT./DROP: 140 lb / 30 in
DRILL EQUIPMENT: Explo 220 MPR
DRILLING METHOD: 4" Solid Stem Augers, NX Coring, and HQ Wash Boring
GROUND ELEVATION: 5.4 FT MSL
BOREHOLE BACKFILL: Bentonite, Sand

DEPTH, FT	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	REC, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, PCF	POCKET PEN., TSF	TORVANE, TSF	OTHER TESTS & REMARKS
20		9	2	22			Gray and off-white silty coralline gravel with sand (GM), very loose, wet					Off-white partial water return
25		10	6	61			becomes loose	35				
							Boring completed at 26.5 feet below existing ground surface on 11/24/2014.					
30												
35												
40												
44												

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FIGURE A-3

QUEEN'S SURF WAIKIKI BEACH SEA WALL REPAIR

LOG OF BORING B-2

LOCATION: Honolulu, Oahu, Hawaii
PROJECT NO.: 11027
DATE(S) DRILLED: 11/24/2014
LOGGED BY: J. Heine
CHECKED BY: E. Ng
CONTRACTOR: YK Drilling, LLC
HAMMER TYPE: Safety
HAMMER WT./DROP: 140 lb / 30 in
DRILL EQUIPMENT: Simco 2400 SK-1
DRILLING METHOD: 4" SSolid Stem Augers, PQ Wash Boring
GROUND ELEVATION: 7.7 FT MSL
BOREHOLE BACKFILL: Gravel, Quikrete

DEPTH, FT	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	REC, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, PCF	POCKET PEN., TSF	TORVANE, TSF	OTHER TESTS & REMARKS
0							**FILL**					
		1					Brown sandy silt with gravel (ML)	10				
								8				
		2	20	83			**BEACH DEPOSITS** Tan poorly graded coralline sand with silt (SP-SM), medium dense, dry					
		3	23	83			becomes brown					
5							becomes tan	9				Gravel=8%
		4	19	83			becomes light brown, with gravel, loose	10	92			Sand=87% Fines=5% DS
		5	16	94			becomes off-white, with trace coralline gravel, medium dense					
		6	24	100			becomes loose, with more coralline gravel, wet	26	99			
10		7	14	72			becomes medium dense					
		8	4	17			grades with coralline cobbles, very loose					Install casing at 11' bgs Gray partial water return
		9	5	100			**LAGOONAL DEPOSITS** Gray silty coralline gravel with sand (GM), loose, wet	49				Gravel=42% Sand=32% Fines=26%
15		10	6	67			becomes very loose					
		11	6	72			becomes loose					Gray partial water return
		12	23	72			grades with more sand	24	105			
		13	9	78								Gray partial water return
20												

SUMMARY OF GROUNDWATER LEVELS

DATE	TIME	DEPTH, FT	DATE	TIME	DEPTH, FT
11/24/2014	9:55 am	6.9			

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FIGURE A-4

YKE

QUEEN'S SURF WAIKIKI BEACH SEA WALL REPAIR

LOG OF BORING B-2

LOCATION: Honolulu, Oahu, Hawaii
PROJECT NO.: 11027
DATE(S) DRILLED: 11/24/2014
LOGGED BY: J. Heine
CHECKED BY: E. Ng
CONTRACTOR: YK Drilling, LLC
HAMMER TYPE: Safety
HAMMER WT./DROP: 140 lb / 30 in
DRILL EQUIPMENT: Simco 2400 SK-1
DRILLING METHOD: 4" SSolid Stem Augers, PQ Wash Boring
GROUND ELEVATION: 7.7 FT MSL
BOREHOLE BACKFILL: Gravel, Quikrete

DEPTH, FT	SAMPLE TYPE	SAMPLE NO.	SAMPLING RESISTANCE	REC, %	RQD, %	GRAPHIC LOG	DESCRIPTION	WATER CONTENT, %	DRY UNIT WEIGHT, PCF	POCKET PEN., TSF	TORVANE, TSF	OTHER TESTS & REMARKS
20												
		14	18	67								Gray partial water return
		15	22	100			becomes medium dense	29				
		16	15	28			grades with more silt, loose					Gray partial water return
25		17	25	100			becomes medium dense					
							Boring completed at 26.0 feet below existing ground surface on 11/24/2014.					
30												
35												
40												
44												

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FIGURE A-4

APPENDIX B LABORATORY TESTING

To verify field classifications, selected soil samples obtained during the field exploration were laboratory tested for moisture contents, dry densities, gradation, and direct shear test. The tests and results are described in the following paragraphs.

B.1 MOISTURE CONTENT AND DENSITY TEST

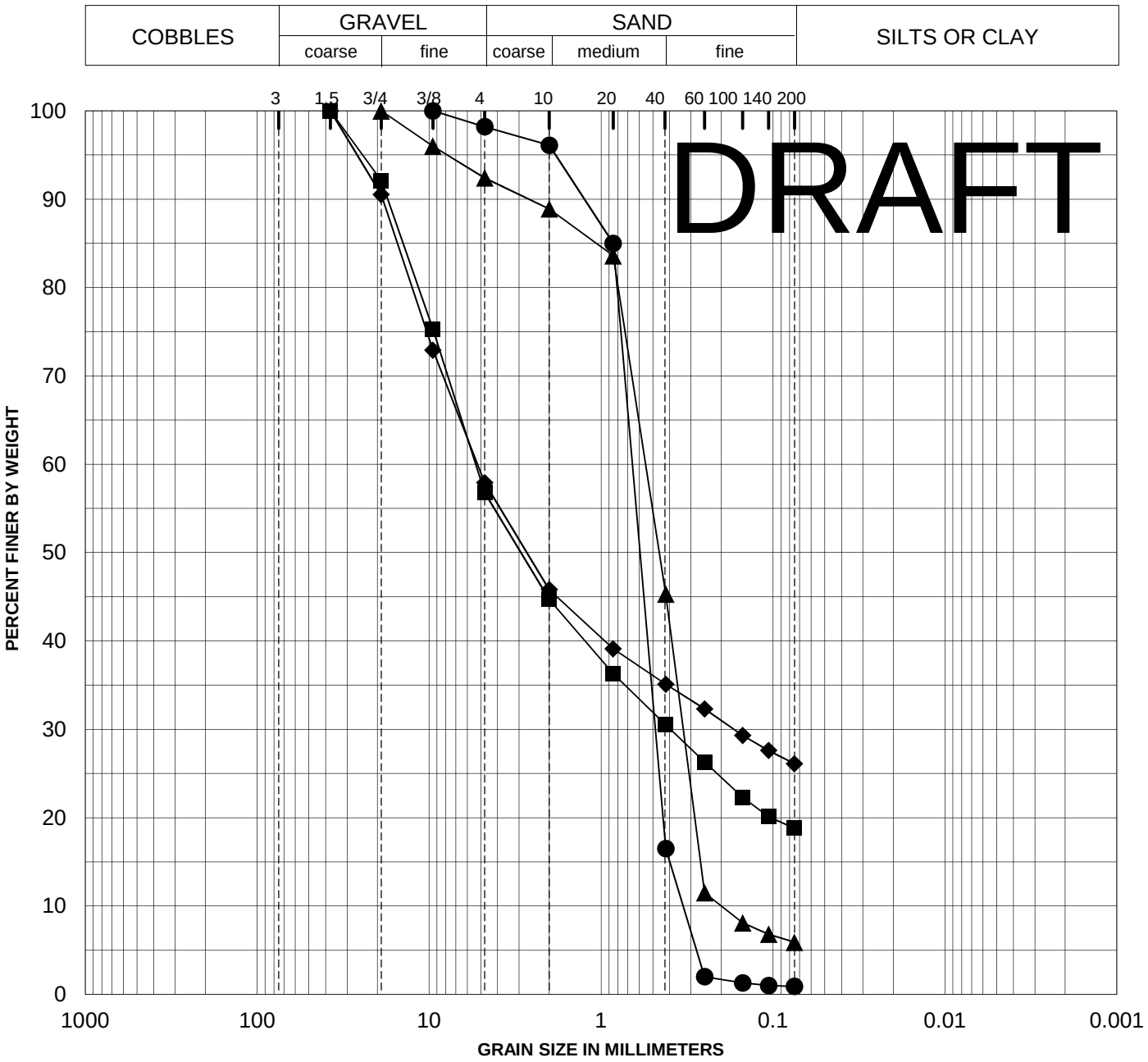
Selected soil samples were tested to measure their moisture contents and their wet and dry densities. The tests were performed in accordance with American Society for Testing and Materials (ASTM) Test Method D2216 and D2937. The moisture contents and wet and dry densities are presented on the Log of Borings at the appropriate sample depths.

B.3 GRADATION TEST

Gradation analyses (ASTM D6913 and D422) were performed on selected samples using the wash sieve method to evaluate grain size distribution. Results of the gradation analyses are presented in Figure B-1 and included on the Log of Borings at the appropriate sample depths.

B.3 DIRECT SHEAR TEST

This test was performed to determine the consolidated drained shear strength of a soil material in general accordance with ASTM D3080. The test was performed by deforming a specimen at a controlled strain rate on or near a single shear plane determined by the configuration of the apparatus. Three (3) specimens were tested for each sample, each under a different normal load, to determine the corresponding shear resistance and displacement. The test results are presented in Figure B-2.



Boring		Depth (ft)	Description	Gravel %	Sand %	Fines %
●	B-1	1.5	Tan poorly graded sand with trace gravel and shells (SP)	2	97	1
■	B-1	15.0	Gray clayey coralline gravel with sand (GC)	43	38	19
▲	B-2	5.0	Light brown poorly graded coralline sand with silt and gravel (SP-SM)	8	86	6
◆	B-2	12.5	Gray clayey coralline gravel with sand (GC)	42	32	26

Project: Queen's Surf Waikiki Beach Sea Wall Repair

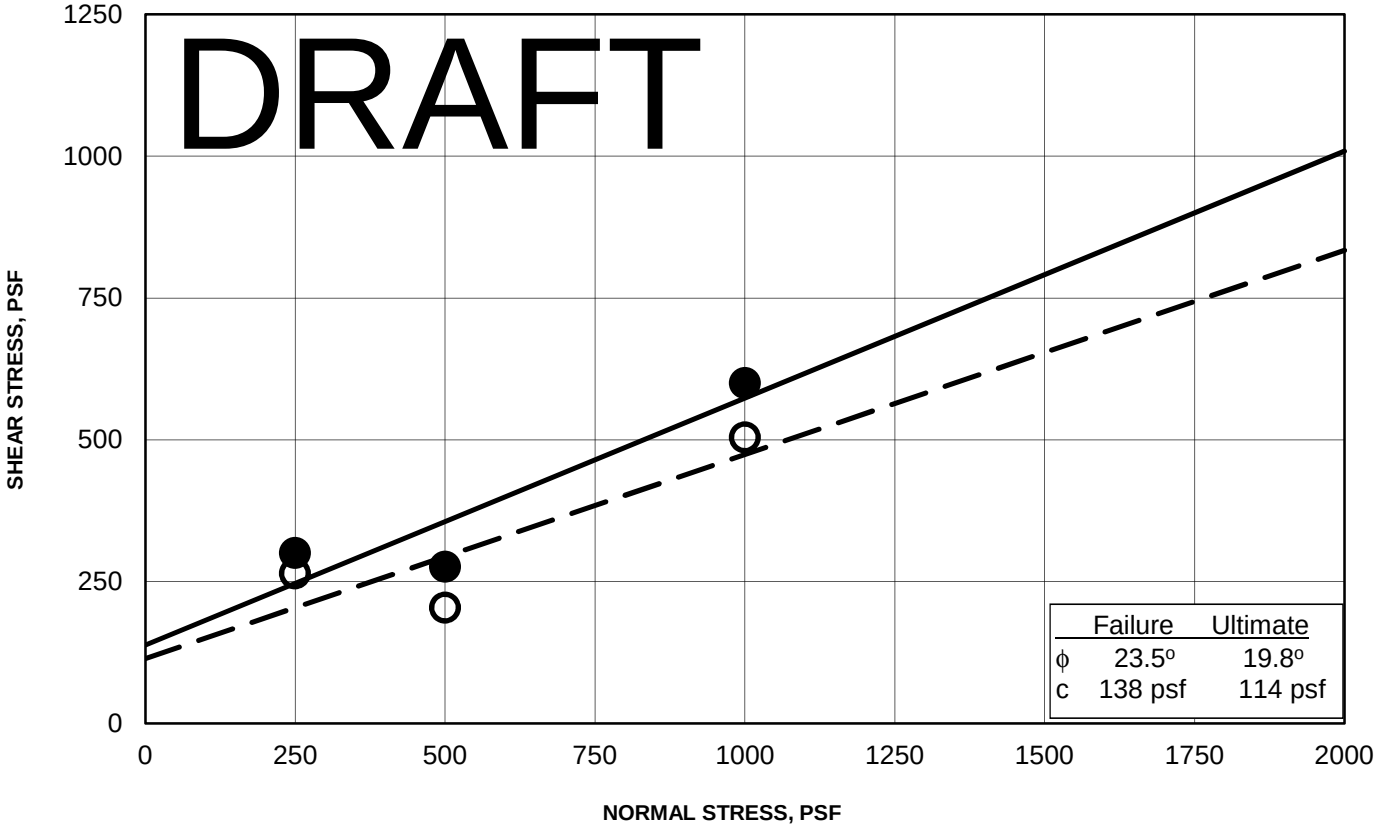
Honolulu, Oahu, Hawaii

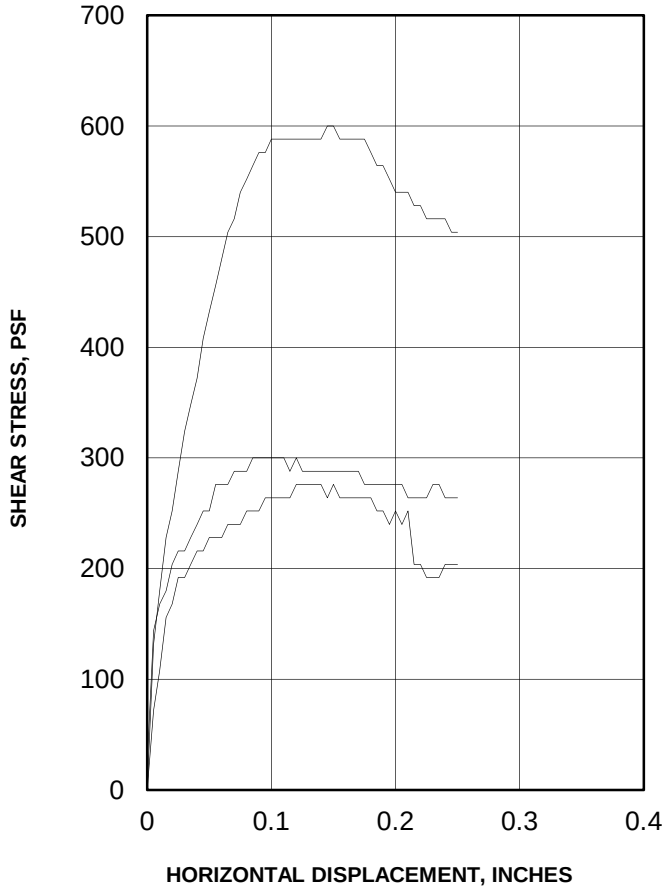
GRAIN SIZE DISTRIBUTION CURVES

Project Number: 11027

FIGURE B-1

Yogi Kwong Engineers, LLC





Boring	B-2	**Depth, ft**	5.0'-6.5'
Description	Light brown poorly graded coralline sand with silt and gravel (SP-SM)		

Sample No.		1	2	3
Initial	Water Content, %	9.5	9.8	10.8
	Dry Density, pcf	90.7	92.7	92.4
	Diameter, inches	2.416	2.416	2.416
	Height, inches	1.0	1.0	1.0
Final	Water Content, %	30.5	29.4	31.0
	Dry Density, pcf	91.6	93.6	95.7
	Diameter, inches	2.416	2.416	2.416
	Height, inches	0.991	0.991	0.966
Strain Rate, in./minute		0.001	0.001	0.001
Normal Stress, psf		**250**	**500**	**1000**
Failure Stress, psf		**300**	**276**	**600**
Displacement, in.		0.0850	0.1200	0.1450
Ultimate Stress, psf		**264**	**204**	**504**
Displacement, in.		0.250	0.250	0.250

Project: Queen's Surf Waikiki Beach Sea Wall Repair

Honolulu, Oahu, Hawaii

Project Number: 11027

DIRECT SHEAR TEST

FIGURE B-2

Yogi Kwong Engineers, LLC

APPENDIX C

Selected Photographs of Soil Samples

Boring B-1, Sample 1, Depth 0' to 1.5'

Boring B-1, Sample 1, Depth 0' to 1.5'

Boring B-1, Sample 1, Depth 0' to 1.5'

Boring B-1, Sample 1, Depth 0' to 1.5'

Boring B-1, Sample 1, Depth 0' to 1.5'

Boring B-1, Sample 1, Depth 0' to 1.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

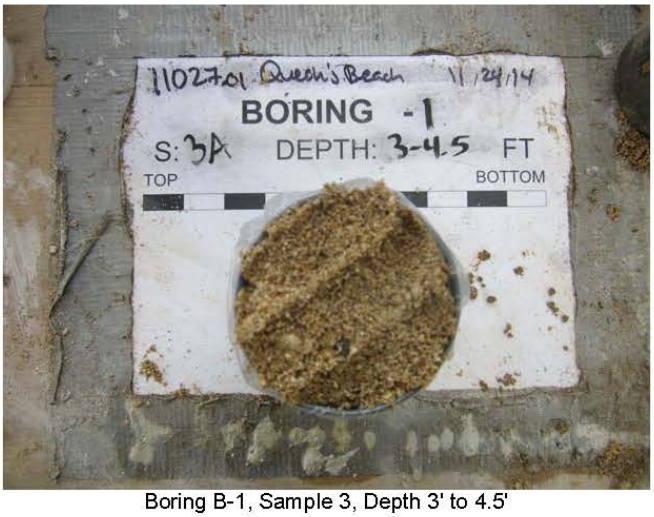
YOGI KWONG ENGINEERS, LLC.

FIGURE C-1

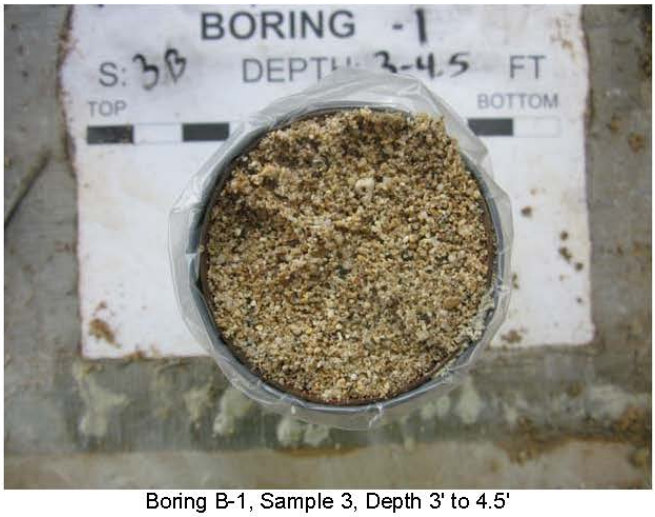
Boring B-1, Sample 2, Depth 1.5' to 3'

Boring B-1, Sample 2, Depth 1.5' to 3'

Boring B-1, Sample 2, Depth 1.5' to 3'



Boring B-1, Sample 3, Depth 3' to 4.5'



Boring B-1, Sample 3, Depth 3' to 4.5'

Boring B-1, Sample 4, Depth 4.5' to 6'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-2

Boring B-1, Sample 4, Depth 4.5' to 6'

Boring B-1, Sample 4, Depth 4.5' to 6'

Boring B-1, Sample 4, Depth 4.5' to 6'

Boring B-1, Sample 5, Depth 6' to 6.5'

Boring B-1, Sample 5, Depth 6' to 6.5'

Boring B-1, Sample 5, Depth 6' to 6.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

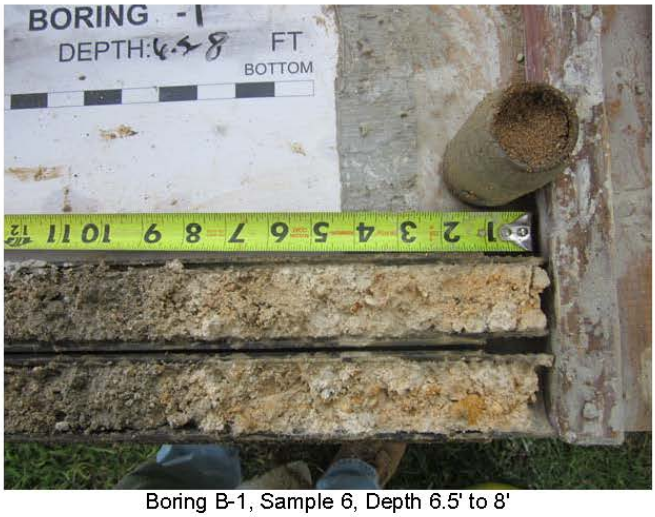
Project No. 11027

YOGI KWONG ENGINEERS, LLC.

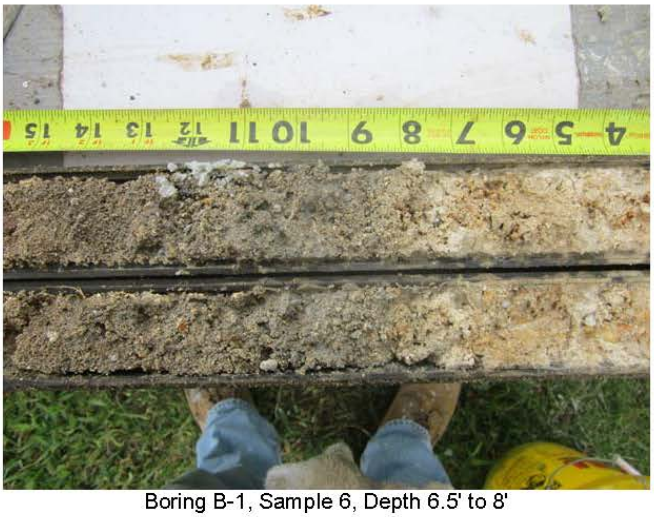
FIGURE C-3

Boring B-1, Sample 5, Depth 6' to 6.5'

Boring B-1, Sample 6, Depth 6.5' to 8'



Boring B-1, Sample 6, Depth 6.5' to 8'


Boring B-1, Sample 6, Depth 6.5' to 8'

Boring B-1, Sample 6, Depth 6.5' to 8'

Boring B-1, Sample 6, Depth 6.5' to 8'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

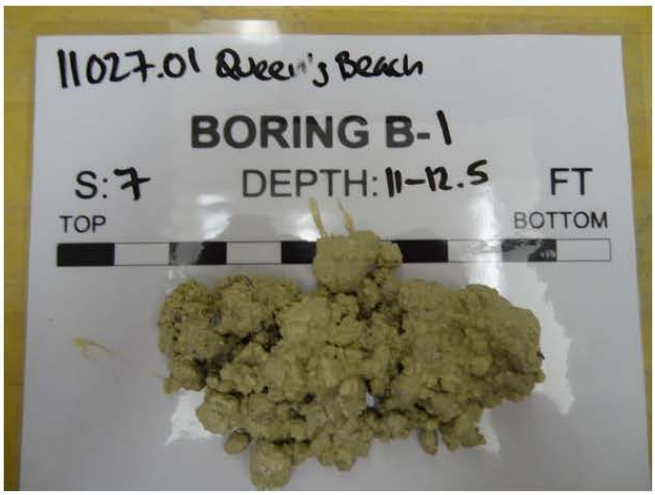
Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

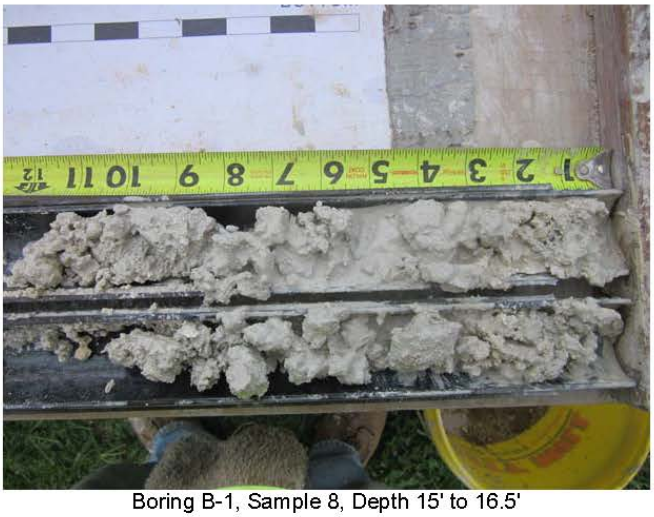
FIGURE C-4

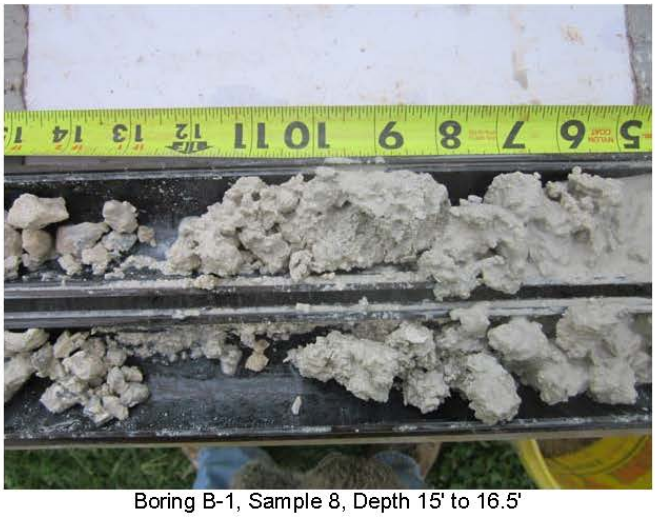


Boring B-1, Sample 7, Depth 11' to 12.5'

Boring B-1, Sample 7, Depth 11' to 12.5'

Boring B-1, Sample 8, Depth 15' to 16.5'


Boring B-1, Sample 8, Depth 15' to 16.5'


Boring B-1, Sample 8, Depth 15' to 16.5'

Boring B-1, Sample 9, Depth 20' to 21.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

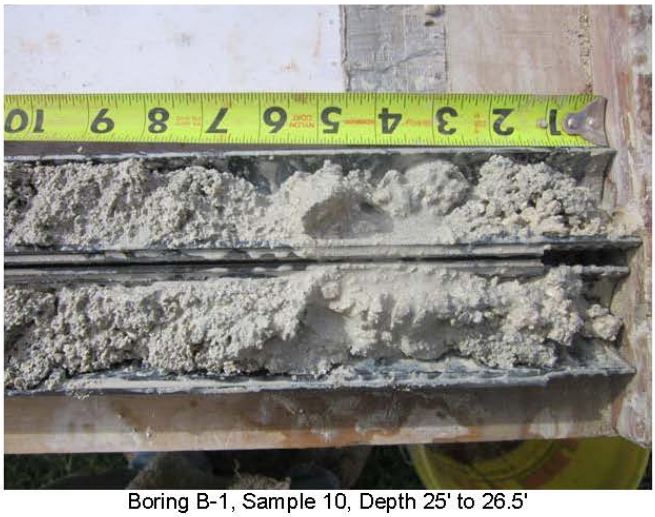
Project No. 11027

YOGI KWONG ENGINEERS, LLC.

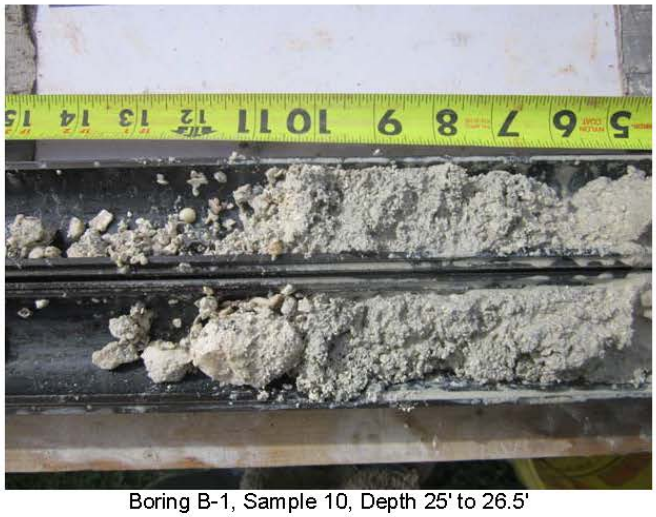
FIGURE C-5

Boring B-1, Sample 9, Depth 20' to 21.5'

Boring B-1, Sample 10, Depth 25' to 26.5'



Boring B-1, Sample 10, Depth 25' to 26.5'



Boring B-1, Sample 10, Depth 25' to 26.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

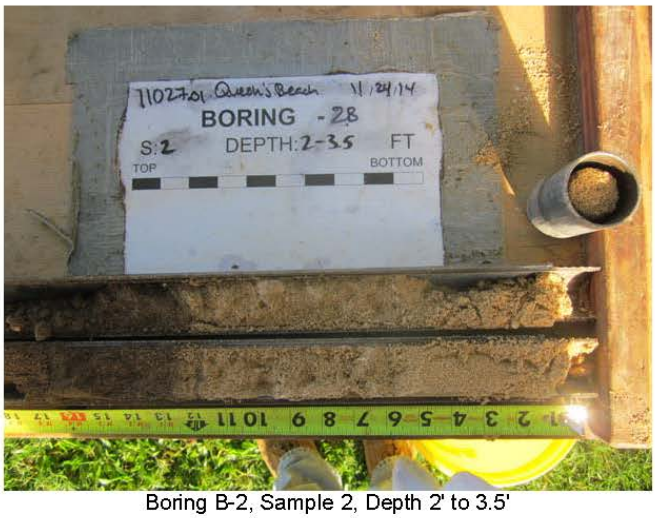
Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-6

Boring B-2, Sample 1, Depth 6"

Boring B-2, Sample 1, Depth 6"



Boring B-2, Sample 2, Depth 2' to 3.5'

Boring B-2, Sample 2, Depth 2' to 3.5'

Boring B-2, Sample 2, Depth 2' to 3.5'

Boring B-2, Sample 2, Depth 2' to 3.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

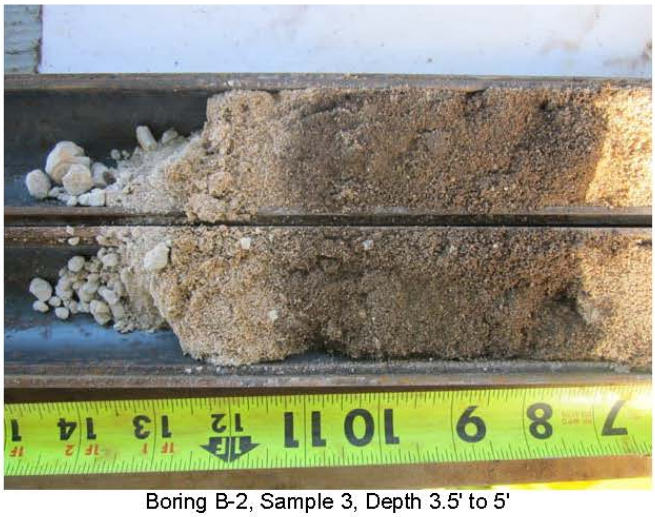
Project No. 11027

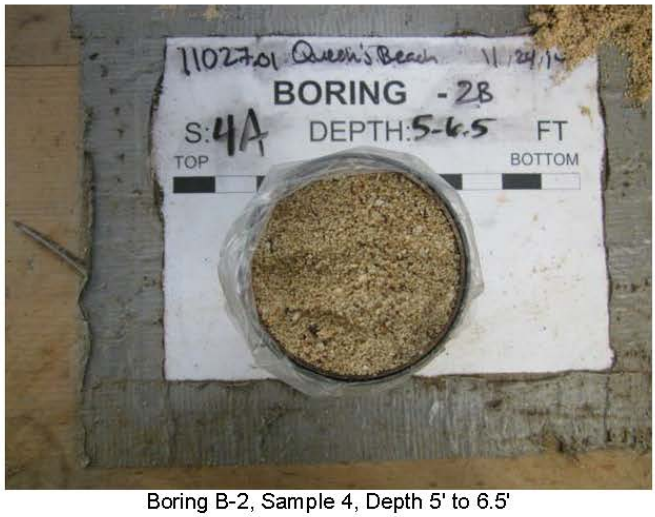
YOGI KWONG ENGINEERS, LLC.

FIGURE C-7

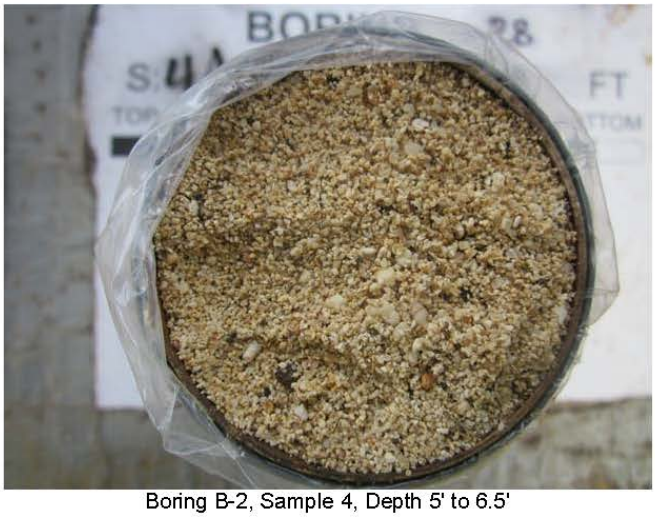
Boring B-2, Sample 3, Depth 3.5' to 5'

Boring B-2, Sample 3, Depth 3.5' to 5'


Boring B-2, Sample 3, Depth 3.5' to 5'



Boring B-2, Sample 4, Depth 5' to 6.5'


Boring B-2, Sample 4, Depth 5' to 6.5'

Boring B-2, Sample 4, Depth 5' to 6.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

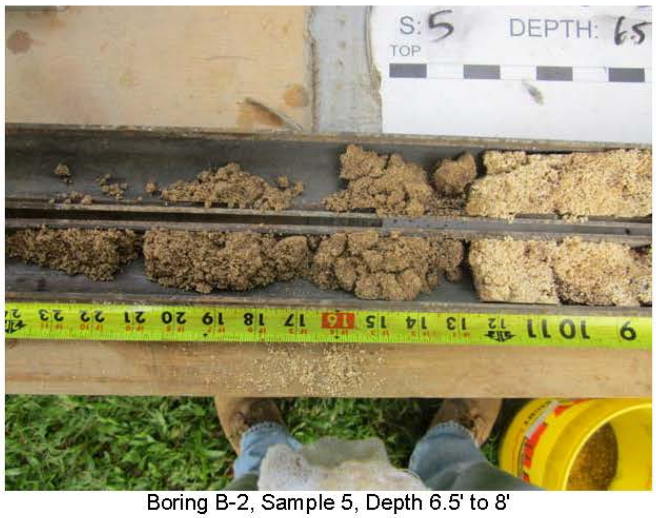
YOGI KWONG ENGINEERS, LLC.

FIGURE C-8

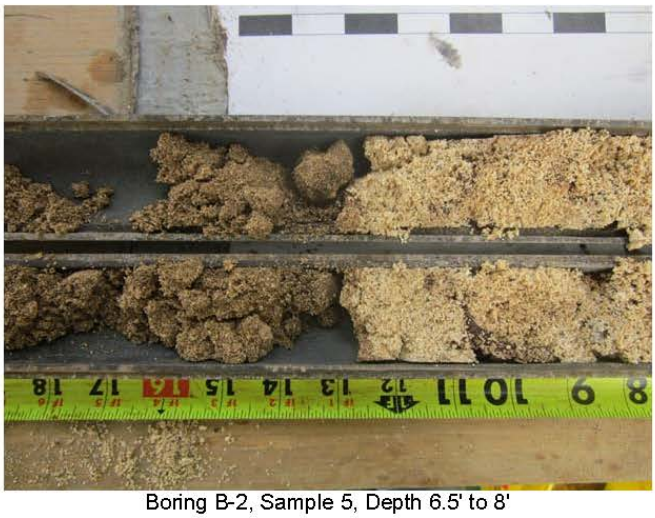
Boring B-2, Sample 4, Depth 5' to 6.5'

Boring B-2, Sample 5, Depth 6.5' to 8'

Boring B-2, Sample 5, Depth 6.5' to 8'



Boring B-2, Sample 5, Depth 6.5' to 8'


Boring B-2, Sample 5, Depth 6.5' to 8'

Boring B-2, Sample 5, Depth 6.5' to 8'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-9

Boring B-2, Sample 6, Depth 8' to 9.5'

Boring B-2, Sample 6, Depth 8' to 9.5'

Boring B-2, Sample 6, Depth 8' to 9.5'

Boring B-2, Sample 6, Depth 8' to 9.5'

Boring B-2, Sample 6, Depth 8' to 9.5'

Boring B-2, Sample 6, Depth 8' to 9.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

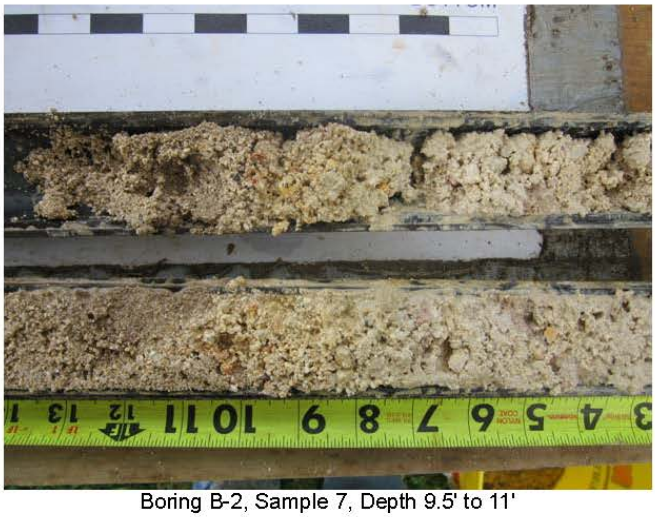
Project No. 11027

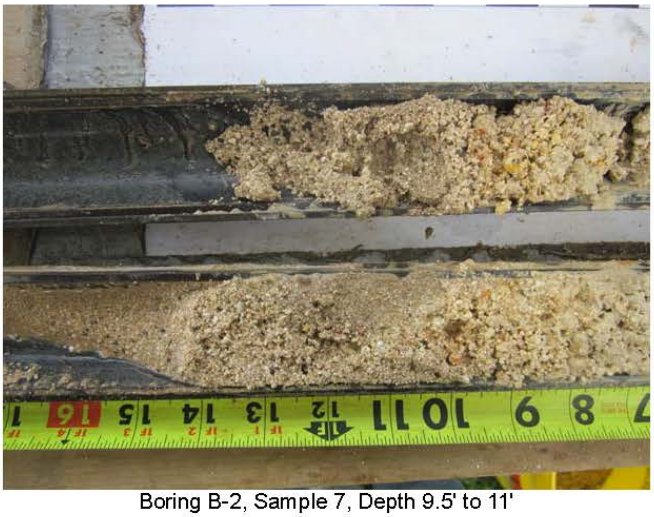
YOGI KWONG ENGINEERS, LLC.

FIGURE C-10

Boring B-2, Sample 7, Depth 9.5' to 11'

Boring B-2, Sample 7, Depth 9.5' to 11'


Boring B-2, Sample 7, Depth 9.5' to 11'


Boring B-2, Sample 7, Depth 9.5' to 11'

Boring B-2, Sample 8, Depth 11' to 12.5'

Boring B-2, Sample 8, Depth 11' to 12.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

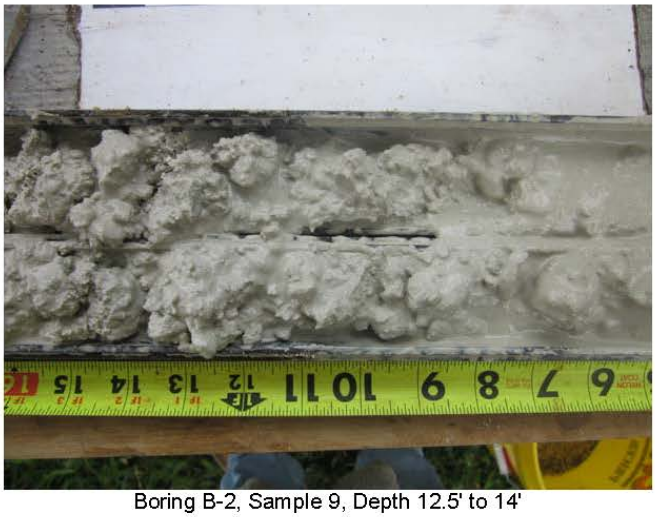
Project No. 11027

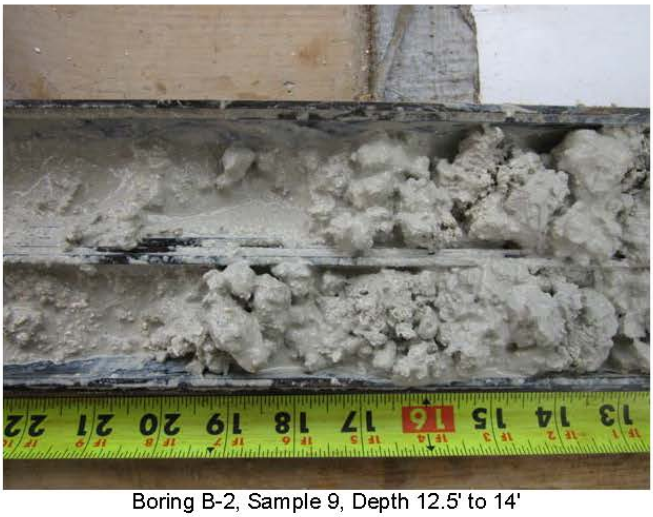
YOGI KWONG ENGINEERS, LLC.

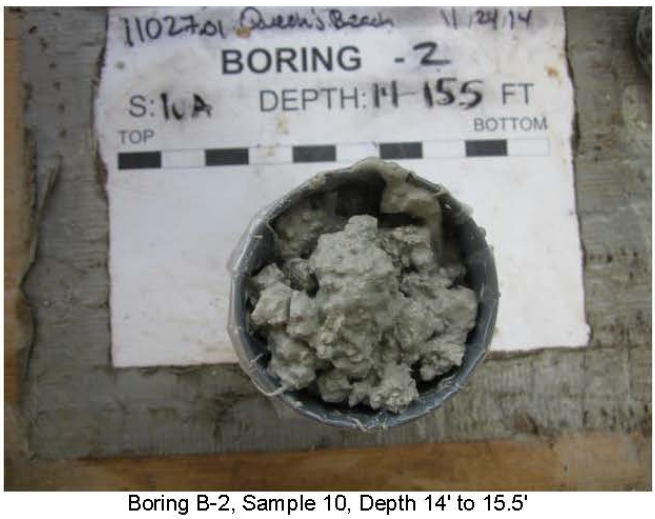
FIGURE C-11

Boring B-2, Sample 9, Depth 12.5' to 14'

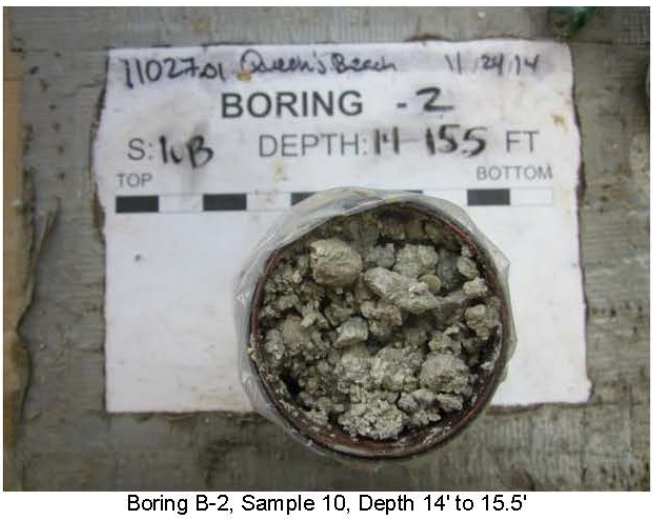
Boring B-2, Sample 9, Depth 12.5' to 14'


Boring B-2, Sample 9, Depth 12.5' to 14'


Boring B-2, Sample 9, Depth 12.5' to 14'



Boring B-2, Sample 10, Depth 14' to 15.5'



Boring B-2, Sample 10, Depth 14' to 15.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

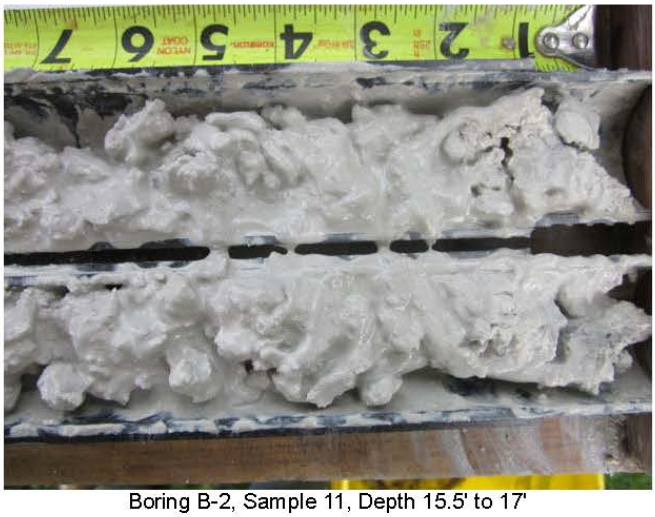
Project No. 11027

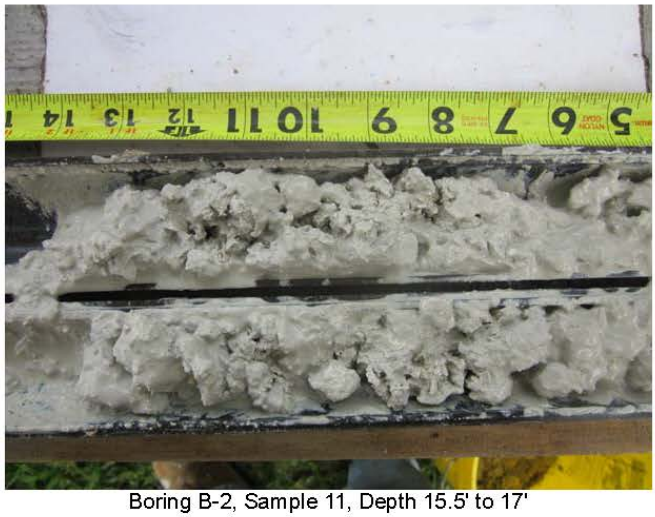
YOGI KWONG ENGINEERS, LLC.

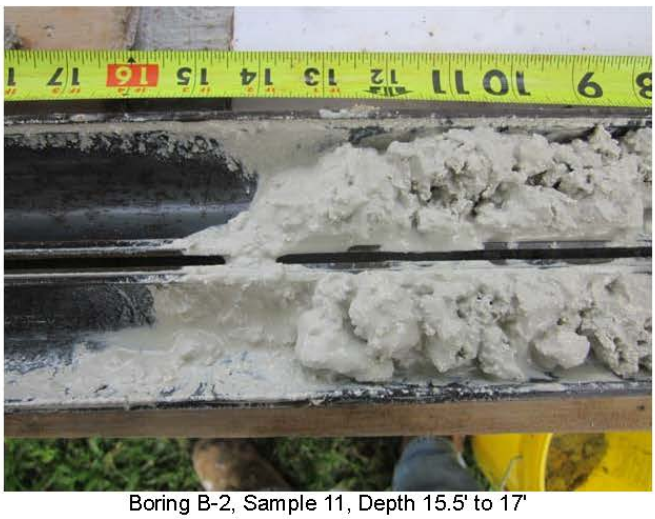
FIGURE C-12

Boring B-2, Sample 10, Depth 14' to 15.5'

Boring B-2, Sample 11, Depth 15.5' to 17'


Boring B-2, Sample 11, Depth 15.5' to 17'


Boring B-2, Sample 11, Depth 15.5' to 17'


Boring B-2, Sample 11, Depth 15.5' to 17'

Boring B-2, Sample 12, Depth 17' to 18.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-13

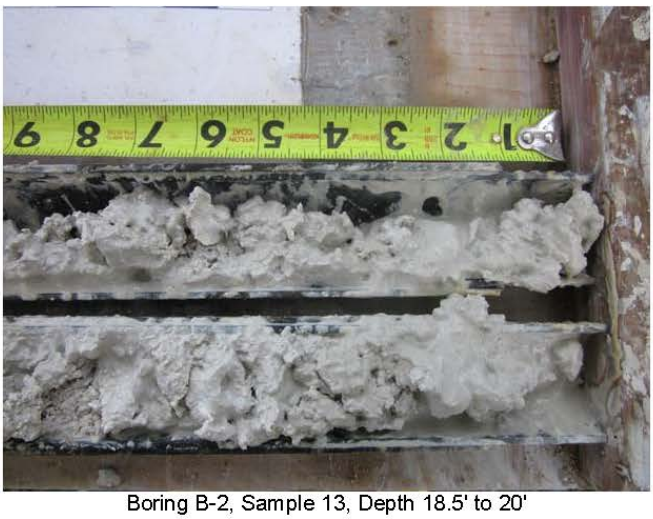
Boring B-2, Sample 12, Depth 17' to 18.5'

Boring B-2, Sample 12, Depth 17' to 18.5'

Boring B-2, Sample 12, Depth 17' to 18.5'

Boring B-2, Sample 12, Depth 17' to 18.5'

Boring B-2, Sample 13, Depth 18.5' to 20'


Boring B-2, Sample 13, Depth 18.5' to 20'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-14

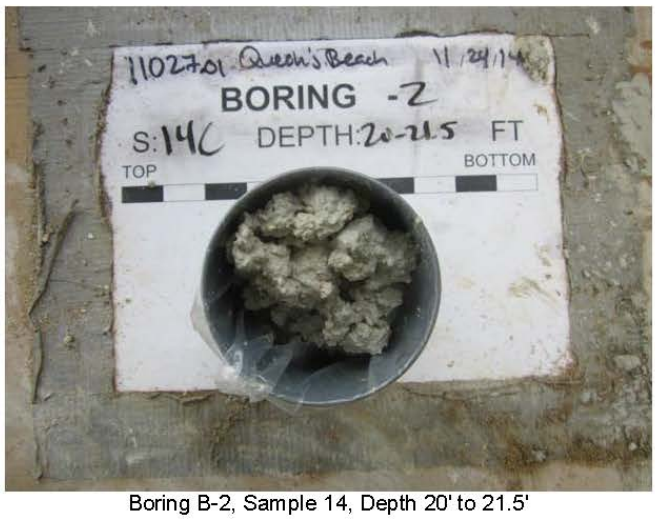
Boring B-2, Sample 13, Depth 18.5' to 20'

Boring B-2, Sample 14, Depth 20' to 21.5'

Boring B-2, Sample 14, Depth 20' to 21.5'

Boring B-2, Sample 14, Depth 20' to 21.5'

Boring B-2, Sample 14, Depth 20' to 21.5'



Boring B-2, Sample 14, Depth 20' to 21.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

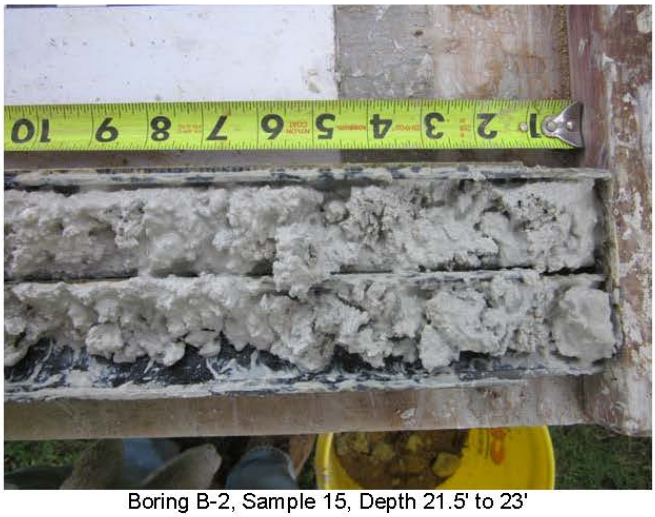
Project No. 11027

YOGI KWONG ENGINEERS, LLC.

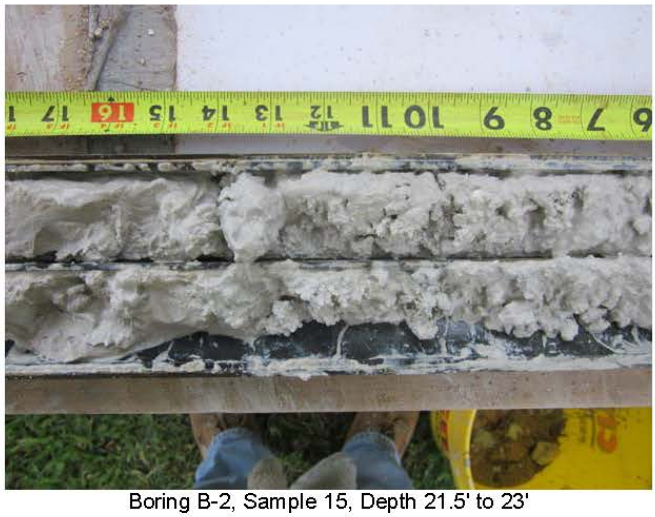
FIGURE C-15

Boring B-2, Sample 14, Depth 20' to 21.5'

Boring B-2, Sample 15, Depth 21.5' to 23'



Boring B-2, Sample 15, Depth 21.5' to 23'



Boring B-2, Sample 15, Depth 21.5' to 23'

Boring B-2, Sample 15, Depth 21.5' to 23'

Boring B-2, Sample 16, Depth 23' to 24.5'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

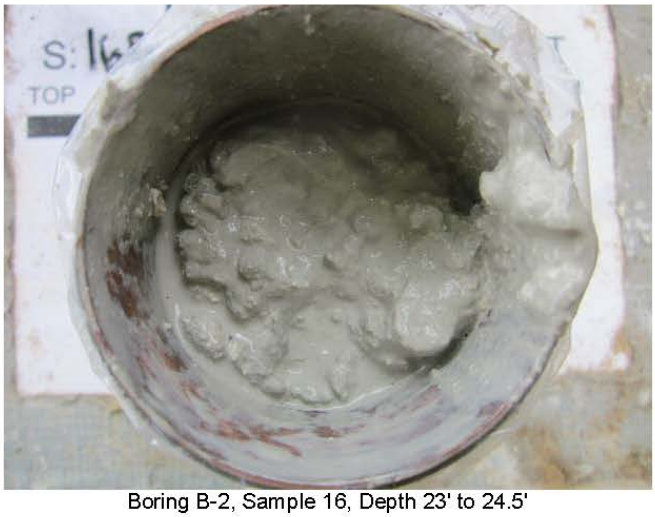
Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-16

Boring B-2, Sample 16, Depth 23' to 24.5'

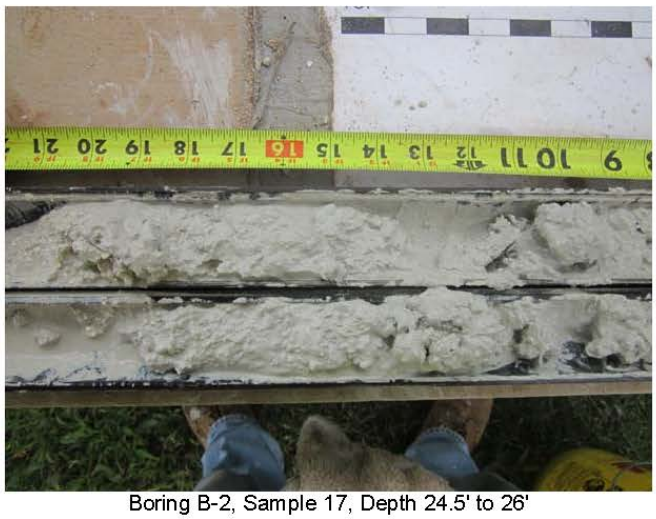
Boring B-2, Sample 16, Depth 23' to 24.5'



Boring B-2, Sample 16, Depth 23' to 24.5'

Boring B-2, Sample 17, Depth 24.5' to 26'

Boring B-2, Sample 17, Depth 24.5' to 26'



Boring B-2, Sample 17, Depth 24.5' to 26'

SELECTED PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-17

APPENDIX D

Selected Site Condition Photographs

View of General Site Condition of B-1

View of General Site Condition of B-1

View of General Site Condition of B-1

View of General Site Condition of B-1

View of General Site Condition of B-1

View of General Site Condition of B-1

SELECTED SITE CONDITION PHOTOGRAPHS

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE D-1

View of General Site Condition of B-2

View of General Site Condition of B-2

View of General Site Condition of B-2

View of General Site Condition of B-2

View of General Site Condition of B-2

View of General Site Condition of B-2

SELECTED SITE CONDITION PHOTOGRAPHS

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE D-2

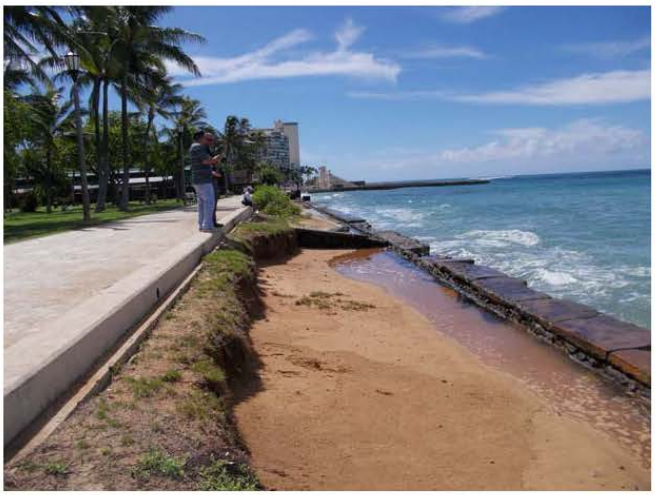
View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall



View of General Site Condition of Existing Sea Wall

SELECTED SITE CONDITION PHOTOGRAPHS

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE D-3

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

SELECTED SITE CONDITION PHOTOGRAPHS

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC.

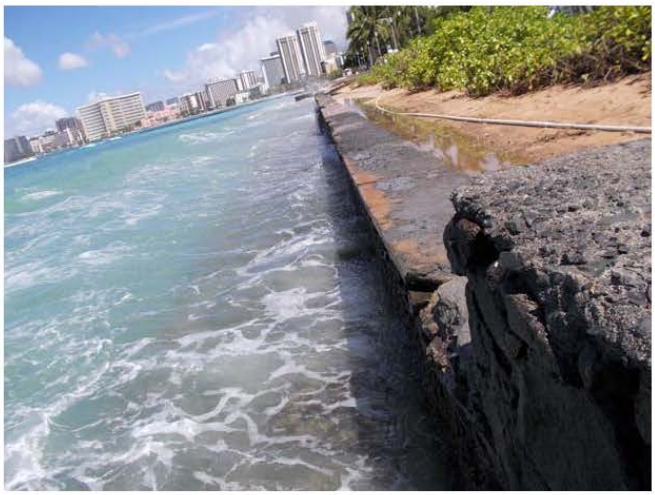
FIGURE D-4

View of General Site Condition of Existing Sea Wall

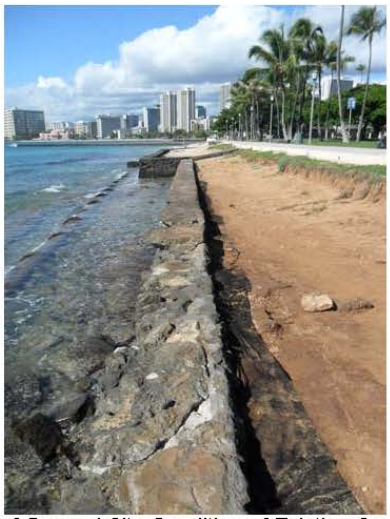
View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall

View of General Site Condition of Existing Sea Wall



View of General Site Condition of Existing Sea Wall



View of General Site Condition of Existing Sea Wall

SELECTED SITE CONDITION PHOTOGRAPHS

Queen's Surf – Waikiki Beach Seawall Repair

Honolulu, Oahu, Hawaii

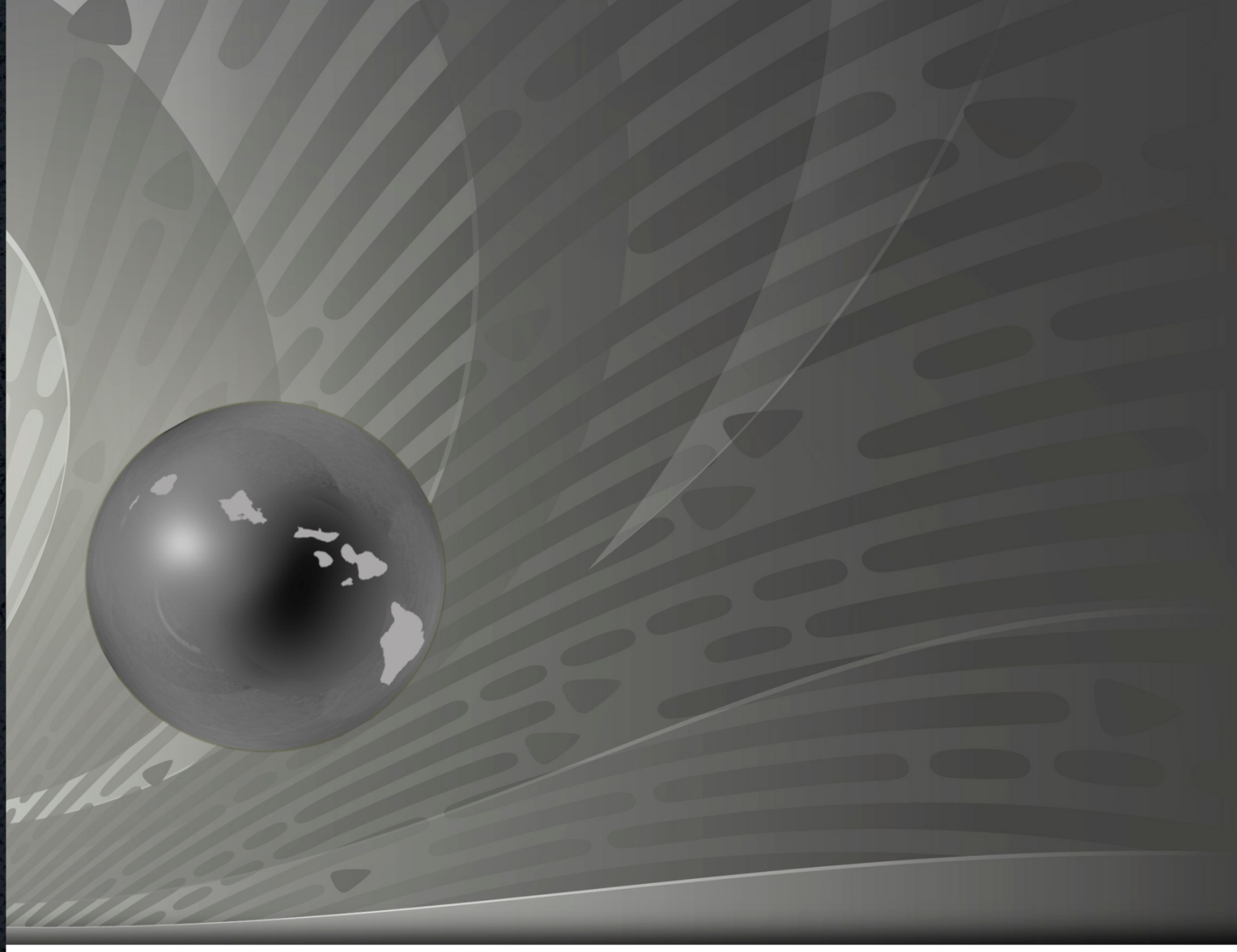
Project No. 11027

YOGI KWONG ENGINEERS, LLC.

FIGURE D-5

APPENDIX E

Previous Exploration and Evaluation Draft Report By YKE



DRAFT SUBMITTAL

GEOTECHNICAL EXPLORATION AND EVALUATION REPORT

Prepared for:

Oceanit, Inc.
828 Fort Street Mall, Suite 600
Honolulu, Hawaii 96813

Queen's Surf – Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

January 2012
YKE Project No. 11027

Prepared by

Yogi Kwong Engineers, LLC
1357 Kapiolani Blvd., Suite 1450
Honolulu, Hawaii 96814

February 7, 2012

Mr. Cris Takushi, P.E.
Oceanit, Inc.
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Honolulu, Hawaii 96813

Subject: **Draft Submittal**
Geotechnical Exploration and Evaluation Report In Support of Queen's Surf – Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Dear Mr. Takushi:

Yogi Kwong Engineers, LLC (YKE) is pleased to submit this draft Geotechnical Exploration and Evaluation Report in support of the Queen's Surf – Waikiki Beach Seawall Repair project on the island of Oahu, Hawaii, for your review and use. Our geotechnical engineering services were performed in general accordance with our revised fee proposal dated August 29, 2011.

We appreciate the opportunity to provide these services to Oceanit, Inc. If you have any questions regarding this letter and the attached draft Geotechnical Exploration and Evaluation Report, please do not hesitate to contact us.

Yours truly,

Yogi Kwong Engineers, LLC

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1.0 INTRODUCTION

This draft report presents the results of a geotechnical exploration and evaluation performed by Yogi Kwong Engineers, LLC (YKE) in support of the Queen's Surf – Waikiki Beach Seawall Repair Project on the island of Oahu, Hawaii. The approximately 1,030 linear foot long Waikiki beach seawall is located within the City & County of Honolulu's Kapiolani Regional Park – Kapiolani Beach Center. The approximate project location and its general vicinity are shown on the Project Location Map, Figure 1, and the Aerial Photograph of Project Location, Figure 2, respectively.

1.1 PROJECT DESCRIPTION

It is our current understanding that the subject project will involve the repair of selected segments within a 460-foot section of the deteriorating Waikiki beach seawall between Sta. No. 4+60 and Sta. No. 9+20, as shown in Figure 3.

Based on a draft structural assessment and recommendations for repairs and modifications report prepared by KSF Inc., dated September 29, 2011, it is our understanding that the existing seawall is generally comprised of cast in place concrete (CIP) wall at the base, topped with one or two layers of concrete rubble masonry (CRM). Based on visual observations made during our field work and review of as-built drawings obtained from the C&C, it appears that the seawall has been subjected to numerous repairs and modifications since its original construction sometime in the 1920's.

It is our understanding that the proposed repairs include permeation grouting of the upper CRM portion of the seawall and spall repairs of the lower reinforced concrete base. Drypak or shotcrete is currently proposed to fill the voids in the seawall. Additionally, the coastal planter box segment which is located between Sta. No. 4+60 and Sta. No. 5+80 will be raised in height by 18 inches.

1.2 PURPOSE AND SCOPE OF WORK

The purpose of this geotechnical exploration was to explore and evaluate the subsurface conditions at the site of the deteriorating Waikiki beach seawall section for developing preliminary geotechnical recommendations for the repair of the existing seawall structure section.

The following scope of services was performed in general accordance with our revised fee proposal dated August 29, 2011:

- Reviewed available geotechnical information pertaining to the project site, including as-built drawings, geologic maps, and soil survey maps.

- Performed a geotechnical site reconnaissance, selected and marked out the test pit locations, contacted Hawaii One Call Center to identify probable subsurface utilities, and applied and received approval of a City and County of Honolulu Department of Parks (C&C Parks) Permit and Right-of-Entry.
- Verified probable underground utility locations at field work areas with utility agency personnel and C&C Parks personnel based on available as-built and topographic plans prior to test pit excavation.
- Hand excavated a total of two (2) test pits to three (3) feet below the existing ground surface behind the existing seawall.
- Performed dynamic cone penetration (DCP) tests to practical refusal or a maximum depth of three (3) feet at each tests pit location and at additional locations behind and in front of the existing seawall.
- Performed soil sampling and classification during the field exploration, and preserved soil samples for subsequent laboratory testing.
- Performed geotechnical laboratory tests on selected soil samples to determine pertinent geotechnical properties.
- Conducted a geophysical survey (performed by Global Geophysics) to explore subsurface conditions.
- Analyzed field exploration and laboratory test data for the development of our geotechnical engineering evaluation findings and preliminary recommendations.
- Prepared this draft Geotechnical Report summarizing our preliminary findings of the geotechnical field exploration, laboratory testing, engineering analyses and evaluations conducted, and presenting our preliminary geotechnical recommendations for the repair of the subject Waikiki beach seawall section.
- Conducted an in-house quality assurance review of the geotechnical evaluation findings and recommendations by a principal engineer of our firm.

The scope of our services presented herein was limited to a geotechnical exploration and evaluation and did not include any archeological, civil, structural, hydrological, environmental, and hazardous waste assessments or evaluations; permit applications; and/or topographic survey of the project site.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 FIELD EXPLORATION

The field exploration for this project was performed between October 17 and October 21, 2011 under the supervision of our engineering personnel in general accordance with the scope of work in our revised fee proposal dated August 29, 2011. The field exploration included hand excavating and sampling a total of two (2) test pits to a maximum depth of three (3) feet below the ground surface, driving seven (7) dynamic cone penetrometer (DCP) probes, and conducting a geophysical survey using the ground penetrating radar (GPR) method.

The approximate locations of the test pits, DCP probes, and geophysical survey are shown on the Approximate Field Work Location Plan, Figure 3. A detailed description of the procedures used to perform the test pits and DCP tests, along with the logs of these explorations, is presented in Appendix A. A copy of the geophysical survey report is presented in Appendix E.

2.2 LABORATORY TESTING

Laboratory testing was performed to verify our visual field classifications and to determine pertinent geotechnical engineering properties of selected soil samples retrieved from the text pits and DCP probes. The geotechnical laboratory testing was performed at YKE's laboratory in Honolulu, Hawaii.

A description of the laboratory testing procedures is presented in Appendix B. The geotechnical laboratory tests performed include moisture content, Atterberg limits, and gradation tests.

3.0 SITE CONDITIONS

3.1 SURFACE CONDITIONS

The project site is bordered on the North by the Queen's Surf groin, on the South by the Waikiki Aquarium, on the East by Sans Souci State Recreational Park, and on the West by the Pacific Ocean, as shown in Figure 1.

Based on a topographic survey performed by ParEn, Inc. dated May 27, 2011, the surface topography of Kapiolani Beach Center near the project area is generally flat with an average ground surface elevation of seven (7) feet above Mean Sea Level (MSL). Ground surface elevations behind the Waikiki beach seawall section considered for repairs range between 4.3 and 7.8 feet above Mean Sea Level (MSL). Top elevations of the seawall range between 4.8 and 5.5 feet above Mean Sea Level (MSL).

The existing ground cover behind the seawall section considered for repairs included grass, small vegetation and topsoil. Erosion of the topsoil was evident as the seawall was susceptible to overtopping during high surf. No utility lines were observed within the project site. A 4-inch perforated PVC drain pipe was spotted along the seawall, along with 1 to 2-inch PVC irrigation lines.

An exposed 24-inch diameter Reinforced Concrete Pipe (RCP) drainage pipe with two (2) manholes was observed traversing approximately ten (10) feet in front of the seawall, between approximately Sta. No. 3+70 and Sta. No. 8+40. The drainage pipe appeared to be abandoned and several major pieces were missing with overall growth of coral and sand inside the pipe.

3.2 EXISTING WALL CONDITIONS

The Waikiki beach seawall extends from the Queen's surf groin on the North to the Waikiki Aquarium on the South, with a 460-foot section between Sta. No. 4+60 and Sta. No. 9+20 currently in various forms of distresses or disrepairs. Based on the draft structural assessment and recommendations by KSF, Inc. dated September 29, 2010, several structural and non-structural damages along the seawall section were identified.

The seawall varies in height between 5 and 6 feet along the studied section. As previously mentioned, the seawall appears to be built on a cast in place concrete (CIP) wall at the base, topped with one or two layers of concrete rubble masonry (CRM). An extension of what appears to be a concrete wall footing past the seawall face was observed at the base of the seawall from Sta. No. 6+85 to Sta. No. 7+70. Large boulders and concrete debris were observed between the seawall and the exposed 24-inch diameter drainage pipe.

The most significant damages observed at the seawall included large voids at the base of the wall, voids between the CIP wall base and the overlying CRM layers, vertical cracks, missing stones, and eroded mortar at the CRM sections. A brief photographic survey was performed along the seawall section of interest as presented in Figure 4. The locations of selected photos are also presented in Figure 4. More site conditions photographs are presented in Appendix D.

Based on the draft structural assessment, and YKE's field reconnaissance visit, the horizontal voids at the base of the seawall are deep and extensive in numerous locations along the studied section of the seawall. Voids of up to 4 feet in size were observed under the wall structure. Based on the structural assessment by KSF, Inc., we understand that wave action and runoff from behind the seawall may account for the erosion of coral reef under the seawall and therefore undermining the wall. Other distresses such as vertical cracks were observed in the south corner of the coastal planter box at approximate Sta. No. 5+70.

The seawall dimensions and as-built details were explored to a depth of up to 3 feet during the test pits excavation. Based on the available as-built plans (Reconstruction and Repairs to Existing Seawall dated February 1987), the seawall may have been built in two different configurations. 'Type A' section is located at the southern portion of the studied wall section (Sta. No. 6+90 to Sta. No. 9+20) that consists of a CIP wall approximately two (2) feet in thickness topped by a CRM layer, with a sloped CRM wall behind the original CIP wall. Backfill behind the structure probably consisted of 18 inches of sand underlain by 18 inches of crushed rock fill over a geotextile fabric. Test pit TP-2 was excavated at approximately Sta. No. 8+30 behind the existing seawall. A slope of about 5.5V:1H was measured on the back face of the wall. Large boulders and cobbles of concrete debris and coral were found from approximately 1 to 3 feet below the existing ground surface, making the excavation very difficult.

Based on the reviewed as-built plans, 'Type B' section is located at the northern portion of the studied seawall section and is consisting of the original vertical CIP wall topped with a CRM layer. A vertical back wall face was confirmed during the excavation of TP-1. In addition, a 4-inch thick vertical layer of gray and brown fat clay was observed covering the back wall face below the PVC drain pipe. Similar to TP-2, large boulders of concrete debris and coral were encountered from 1.5 to 3 feet below the existing ground surface. In order to verify any runoff flowing through the large voids observed at the base of the seawall at TP-1, a few buckets of water were dumped into the test pit. After a few seconds, runoff seepage was observed flowing from the bottom of the seawall. A similar test was performed at TP-2 but no apparent seepage was observed. A more detailed description of the subsurface conditions found during the exploration is presented in the following subsections of the report and also in Figure 5 and Appendix A.

3.3 REGIONAL GEOLOGY

The project area is located in lower Waikiki on the island of Oahu. The fluctuations of the sea level, that took place at the same time that the rejuvenated stage of Hawaiian volcanism, the Honolulu Volcanic Series, were deposited (about 50,000 years ago to present), resulted in migrating shorelines and the formation of deep erosion channels. These erosion channels dissected upland or deeper basaltic lava flows and earlier coral and alluvial deposits. During periods of low sea level, these alluvial channels (valleys) and erosion surfaces developed well below the current mean sea level.

Sea level fluctuations also contributed to the consolidation or over-consolidation of some alluvial silts and clays, resulting in very stiff to hard consistency. Basaltic cobbles and boulders are anticipated in these alluvial sediments, due to the proximity of the project site to lava flows and erosion channels and gullies. Most of these erosion channels in the project area were later filled in by the alluvial and tuffaceous deposits.

Ancient back-reef sedimentation basins in the area were infilled by lagoonal and estuarine deposits and swamps while the sea level rose and fell during glacial and interglacial periods. Substantial man-made fills were placed to raise the ground surface of much of the lower Waikiki when the area was originally developed. Due to the past complex depositional environment in the area, variations in stratigraphy, complex interbedding and intercalations of the above deposits within short distances, in both vertical and horizontal directions, should be expected.

Coralline deposits were formed primarily as a result of wave actions on coralline reefs during different stands of the sea level. Wave actions caused breakage of reef formation to form rubblestone to coralline detritus. Subsequent re-cementation of coralline debris and beach sand deposits formed cemented calcareous sandstone to “beach rock” limestone ledges. Rises in sea level introduced an influx of fine sediments in a matrix with coarse coralline detritus. Due to the wave actions dominating the depositional environment, coralline deposits and coral reef limestone are often highly variable in all directions.

The regional geology map of the project area and its vicinity is presented in Figure 6. The geology of the project site consists of beach deposits (Qbd) that were formed by the erosion of paleo coral reefs which have been re-worked by waves and deposited as beach deposits. To the east of the project area lies alluvium (Qa) and Honolulu Volcanics tuff cone deposits (Qot).

3.4 SUBSURFACE CONDITIONS

The subsurface conditions presented in this report are based on our interpretation of the subsoil data obtained from the exploratory test pits and DCP test probes, the geophysical survey, and the laboratory testing performed for this project, which are supplemented by

available geologic and soil survey maps and YKE's general experience in this area. More detailed descriptions of the subsurface conditions encountered are presented on the DCP and Test pit logs in Appendix A. Photographs of the soil and rock samples are shown in Appendix C.

Excavation of the test pits was difficult due to the presence of numerous cobbles and boulders. Therefore, additional on-land DCP tests advanced using hand auger probes were necessary in order to help identify the subsurface conditions behind the existing seawall along the section of interest. The field exploration and testing data show that the subsoil profile consists of upper fill underlain by beach deposits. Lagoonal deposits underlying beach deposits were observed in the northern area of the project site.

The subsoil conditions can be generalized into three (3) predominant soil or geologic units as discussed below:

- FILL – Variable fill materials were encountered in Test pits TP-1 and TP-2, and in DCP probes DCP-5 to DCP-8. The fill unit primarily consisted of loose to very loose light brown to reddish brown coralline sand and silty sand to approximately 4.5 feet below ground surface (bgs). Silty sand at TP-2 location consisted of higher silt content than at TP-1. At both test pits and DCP-7, large boulders of concrete debris and coral of up to 1.5 feet in diameter were encountered under an existing woven geotextile fabric at depths ranging between 1.5 and 2.5 feet below ground surface. Dark gray fat clay was encountered above the boulder layer at approximately 1.5 to 2.0 feet below ground surface at DCP-7.
- BEACH DEPOSITS – Beach deposits were encountered in DCP-6 and DCP-8 approximately at 4.5 and 5.5 feet bgs respectively. The beach deposits primarily consisted of very loose to medium dense, tan to off-white coralline sand and silty coralline sand.
- LAGOONAL DEPOSITS – Lagoonal deposits were encountered at DCP-8 from approximately 6.0 feet to the maximum DCP test depth at 6.5 feet bgs. The lagoonal deposits primarily consisted of very loose, dark gray and brown clayey coralline gravel and sand with abundant shell fragments.

Groundwater was encountered at approximately 4.5 and 5.5 feet below the existing ground surface at the time of performing DCP-6 and DCP-8 tests respectively. Due to the proximity of the project site to the shoreline, the effect of ocean tides should be taken into account during design and construction of the subject project.

3.4.1 Geophysical Survey Results

A geophysical survey was also performed by Global Geophysics during the field exploration. Two (2) transecs were explored along the existing seawall between Sta. No. 4+60 and Sta. No. 9+20 using the Ground Penetrating Radar (GPR) method, as shown in Figure 3.

The first GPR profile was made along the top of the seawall. In general, the geophysical data in this profile appears to confirm the presence of voids at the base of the seawall from Sta. No. 5+70 to Sta. No. 6+00, from Sta. No. 6+10 to Sta. No. 6+35, from Sta. No. 6+60 to Sta. No. 7+00, from Sta. No. 7+50 to Sta. No. 7+60, and from Sta. No. 8+00 to Sta. No. 8+15 approximately.

In the second GPR profile, performed along the backside of the seawall, two (2) locations appear to have near surface voids, at approximately Sta. No. 6+10 and Sta. No. 6+30. Other changes in signal intensity may have been caused by the presence of boulders and surface features such as gaps and uneven surface. More detailed results from the geophysical survey are presented in Appendix E.

4.0 PRELIMINARY GEOTECHNICAL CONSIDERATIONS AND RECOMMENDATIONS

It is our understanding that sulfate attack of seawater and wave action at the beach has caused severe erosion and undermining of the Queen's Surf – Waikiki beach seawall along its southern portion, leading to the development of large voids at the base of the wall, and loose or missing stones at its face. We also understand that the preliminary repair measures being considered by the project's structural and civil engineers may involve the following repair alternatives to be performed at low tide:

- Permeation grouting to fill voids in the CRM wall sections,
- Spall repairs at the reinforced concrete sections and dry pack or shotcrete to fill voids along the CRM section of wall.
- Excavate the land side of the wall and pour flowable concrete to fill voids accessible from the land side of the wall.

Due to the close proximity of the Pacific Ocean, it is anticipated that daily tidal changes along the seawall will significantly affect the progress of repair work using the proposed repair measures. While this restriction can be overcome by performing the repair work during low tides, wave action was also observed at the base of the seawall during low tides.

We anticipate that a suitable cofferdam or bulkhead will be necessary to facilitate repair of the makai side of the wall and to prevent any discharge of construction water, debris and/or contaminants into the adjacent ocean and/or State water.

In evaluating the proposed repair measures, we agree with the assessment in KSF, Inc.'s draft structural assessment report (dated September 29, 2010) that the use of shotcrete to fill the exposed voids on the existing seawall will generate rebound of the sprayed concrete and can be an environmental concern. If permeation grouting is used to attempt to grout the voids in the existing sea wall, we anticipate that a large number of closely spaced drill or grout holes will be required, and that the permeation grout will likely leak and spill outside of the existing sea wall.

Based on the available geotechnical and GPR information, from a geotechnical standpoint, the use of flowable concrete or viscous cement or masonry grout to fill the voids on both the sea and land sides of the existing sea wall and to form a mass concrete wall behind the patched existing sea wall may be preferable. This will require a trench to be excavated on the land side behind the existing seawall to the base of the existing wall. The trench excavation must be properly supported and shoring of the temporary excavation is the responsibility of the Contractor.

The subsurface materials behind the existing seawall can generally be excavated by hand and the generally loose sand and gravels are anticipated to run or flow into the supported excavation. After excavation, placement of flowable concrete, viscous cement or masonry grout should be performed in maximum 8-inch lifts and allowed to adequately set prior to placement of the next lift in order to reduce the lateral loading on the existing seawall in a distressed condition. . The geophysical survey performed along the back face of the seawall on land has identified two (2) locations, approximately at Sta. No. 5+90 and 6+40, where near surface voids are likely present in the fills behind the existing wall. We believe that the on-site fill material can be used to fill the near surface voids or the voids can be filled during the concrete or masonry grout placement. The fill material should be placed in maximum 10-inch loose lifts, and compacted to a minimum of 85% to 90% maximum dry density per the latest procedure of ASTM D-1557 Test Method. Over-compaction of the fill material should be avoided.

The Contractor should retain a suitably experienced Hawaii licensed professional civil/structural engineer to design and evaluate cofferdams or bulkheads and any excavation supports necessary to complete the sea wall repair without any discharge into the adjacent ocean and/or State water. All work must comply with all applicable government regulations and permit conditions.

5.0 REFERENCES

MacDonald, G.A., Abbott, A.T., and Peterson. F.L., 1983. *Volcanoes in the Sea: The Geology of Hawaii*, 2nd Edition, University of Hawaii Press, Honolulu, Hawaii.

Sherrod, David R., Sinton, John M., Watkins, Sarah E., & Brunt, Kelly M., 2007. *Geologic Map of the State of Hawai`i: U.S. Geological Survey Open-File Report 2007-1089.*

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Stern, H.T. and Vaksvik, K.N., 1935. *Geology and Groundwater Resources of the Island of Oahu, Hawaii*. Division of Hydrography Bulletin 1.

U.S. Geologic Survey Topographic Map, *Honolulu Quadrangle*, 1998. U.S. Department of Defense.

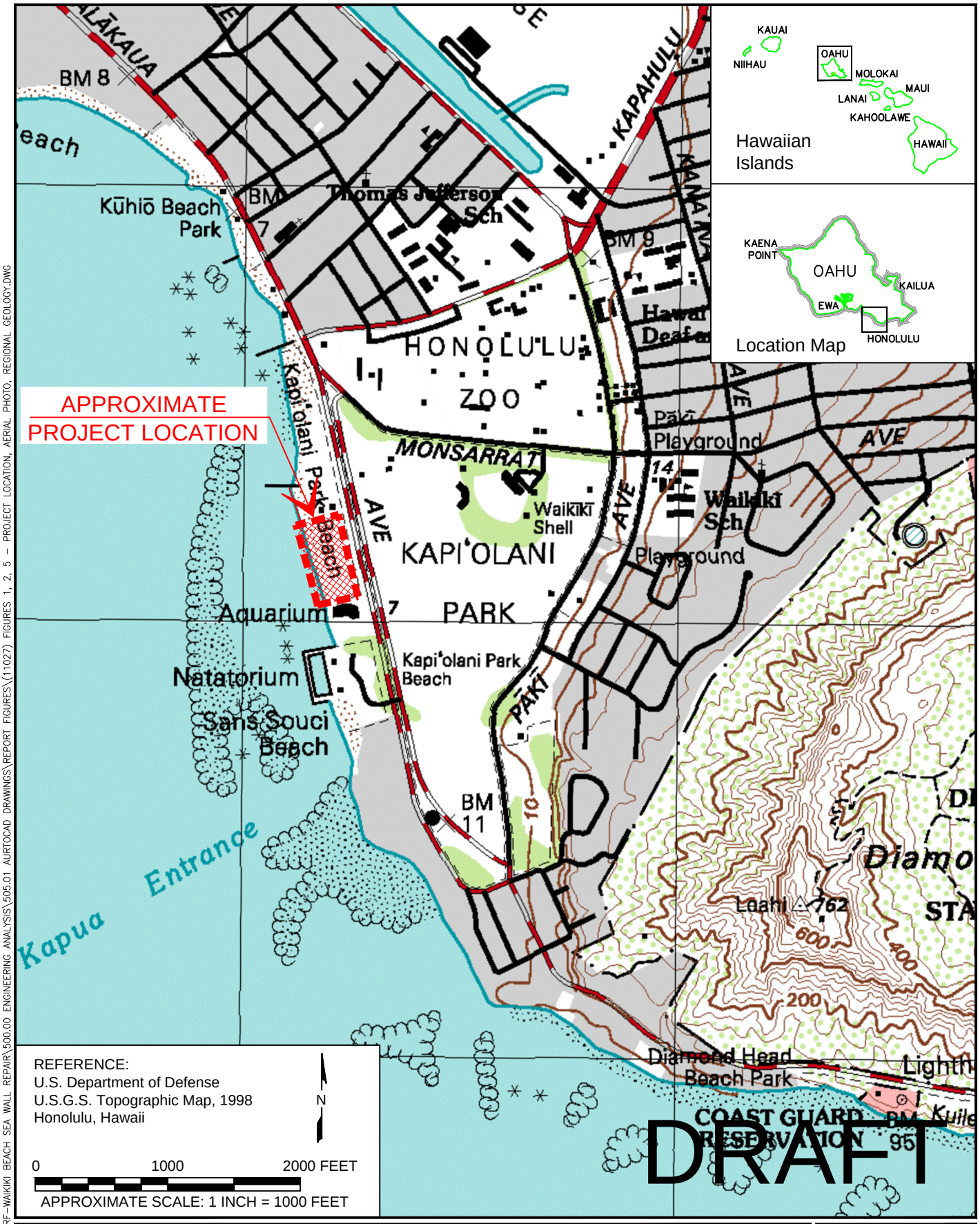
6.0 LIMITATIONS

The geotechnical recommendations and conclusions presented in this report are based on the assumption that the scope of the construction project, as described, does not change appreciably and that significant variations in soil properties from those encountered by our field exploration do not occur. The test pits and DCP probes are widely spaced; therefore, some variation in soil properties between the probes is likely. If any conditions notably different from those described herein are encountered during construction, we should be immediately notified. The geotechnical recommendations presented in this report were developed assuming the Geotechnical Engineer-of-Record will be retained to observe actual field conditions encountered during construction to verify the applicability of the recommendation presented in this report, and to recommend appropriate changes in design or construction procedures, if conditions differ from those described herein.

This report was prepared for use by Oceanit, Inc. in accordance with generally accepted geotechnical engineering principles and practices. The geotechnical opinions and recommendations given in this report are based on our analysis of the data collected for this project. Additional conclusions and/or recommendations made from the data by others are solely their own responsibility.

Our analysis is based on the data obtained from the test pits and DCP probes at the locations indicated on the Approximate Field Work Locations. If project plans or requirements change, the conclusions and recommendations provided herein by YKE may need to be revised. The nature and extent of variations between the borings may become evident during construction and will likely differ from those discussed in this report. No warranty is included, either expressed or implied, that the actual conditions encountered will conform exactly to the conditions described herein.

Our services were provided in a manner consistent with the level of care and skill ordinarily exercised by other professional consultants under similar circumstances. No other representation is intended or implied.



P:\11027 QUEEN'S SURF-WAIKIKI BEACH SEA WALL REPAIR\500.00 ENGINEERING ANALYSIS\505.01 AUTOCAD DRAWINGS\REPORT FIGURES\(11027) FIGURES 1, 2, 5 - PROJECT LOCATION, AERIAL PHOTO, REGIONAL GEOLOGY.DWG

PROJECT LOCATION MAP

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC

FIGURE 1

P:\11027 QUEEN'S SURF-WAIKIKI BEACH SEA WALL REPAIR\500.00 ENGINEERING ANALYSIS\505.01 AURTOCAD DRAWINGS\REPORT FIGURES\(11027) FIGURES 1, 2, 5 - PROJECT LOCATION, AERIAL PHOTO, REGIONAL GEOLOGY.DWG

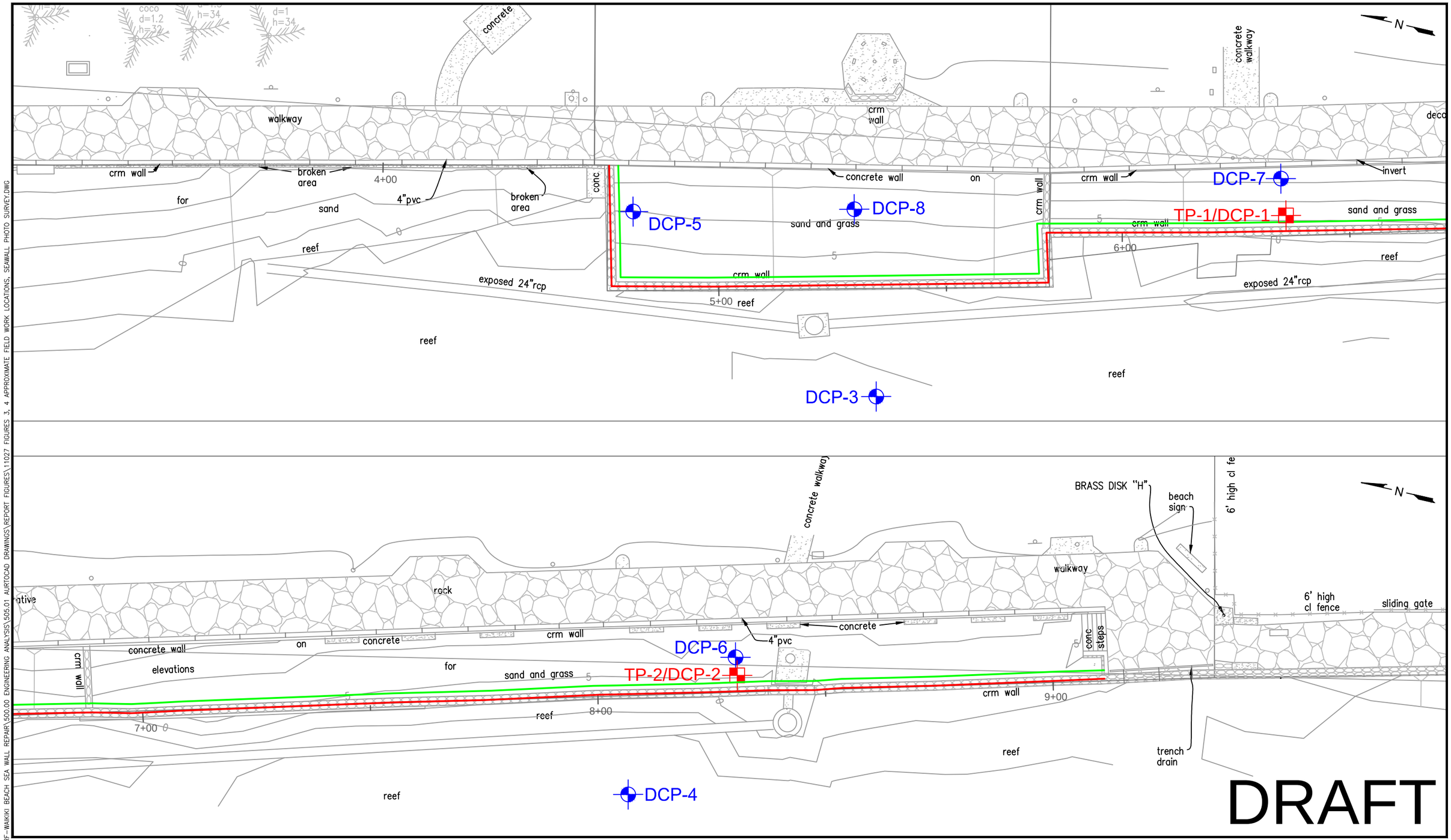
AERIAL PHOTOGRAPH OF PROJECT LOCATION

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC

FIGURE 2



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APPROXIMATE FIELD WORK LOCATIONS

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

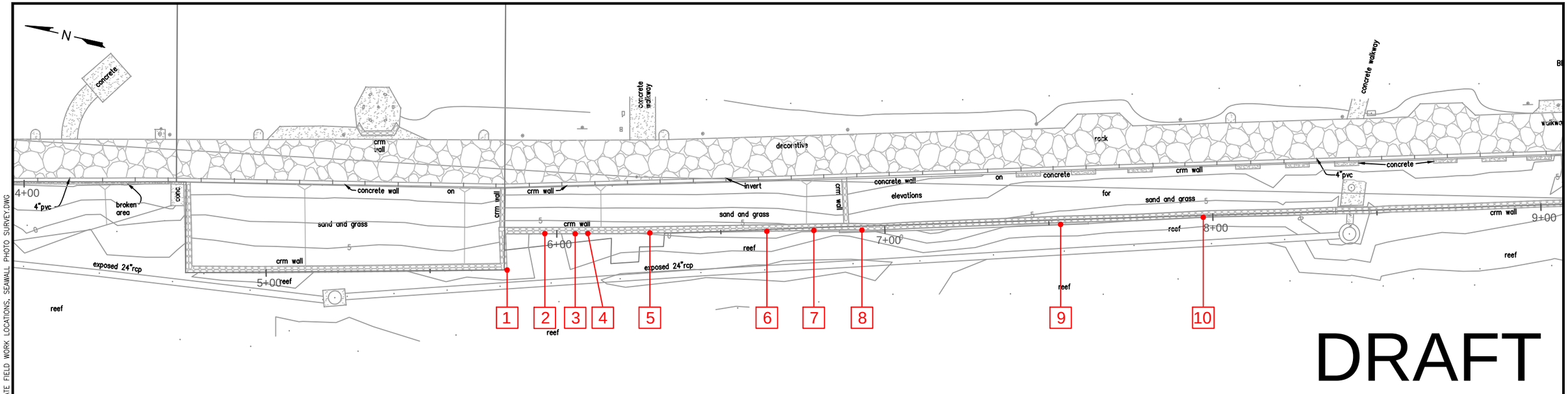
Reference:
Topographic Survey Map
Provided by Oceanit
on Septmber 23, 2011

Legend:
- YKE DCP Test Location
- YKE Test Pit Location
- Geophysical Survey (GPR) Transec on Top of Seawall
- Geophysical Survey (GPR) Transec Behind Seawall

Scale:
0 20 40 FEET
APPROXIMATE SCALE: 1 INCH = 20 FEET

YKE
YOGI KWONG ENGINEERS, LLC

FIGURE 3



SEAWALL PHOTO SURVEY
Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

Reference:
Topographic Survey Map
Provided by Oceanit
on Septmber 23, 2011

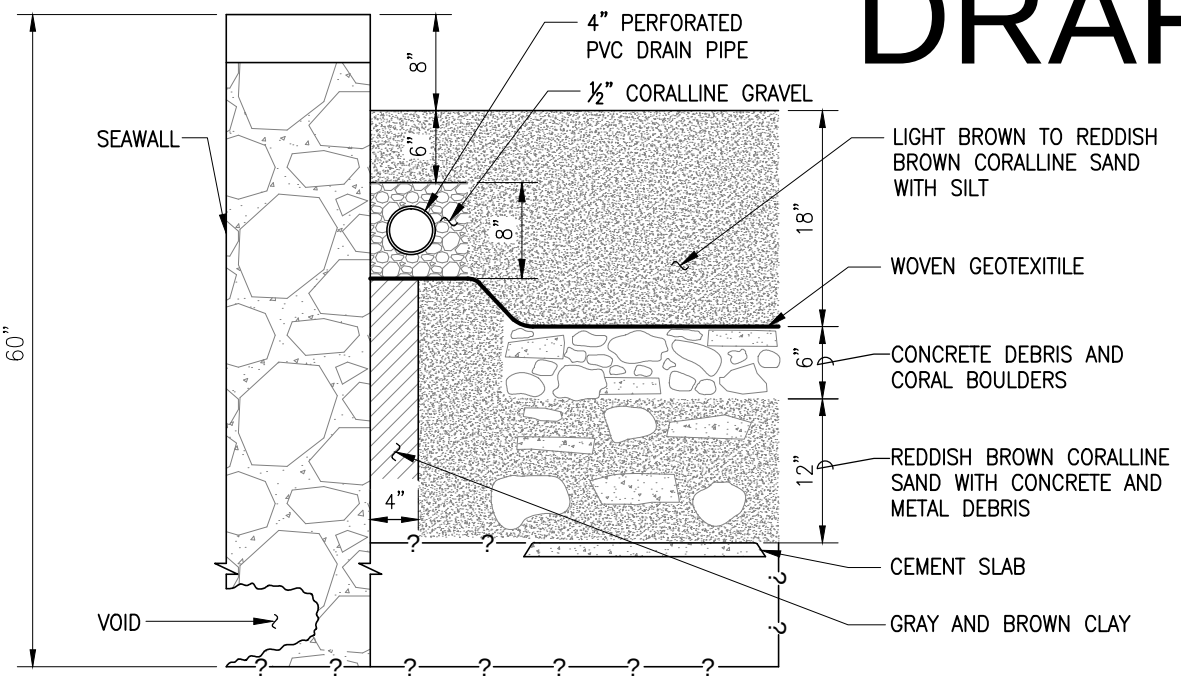
Scale:
0 30 60 FEET
APPROXIMATE SCALE: 1 INCH = 30 FEET

YOGI KWONG ENGINEERS, LLC

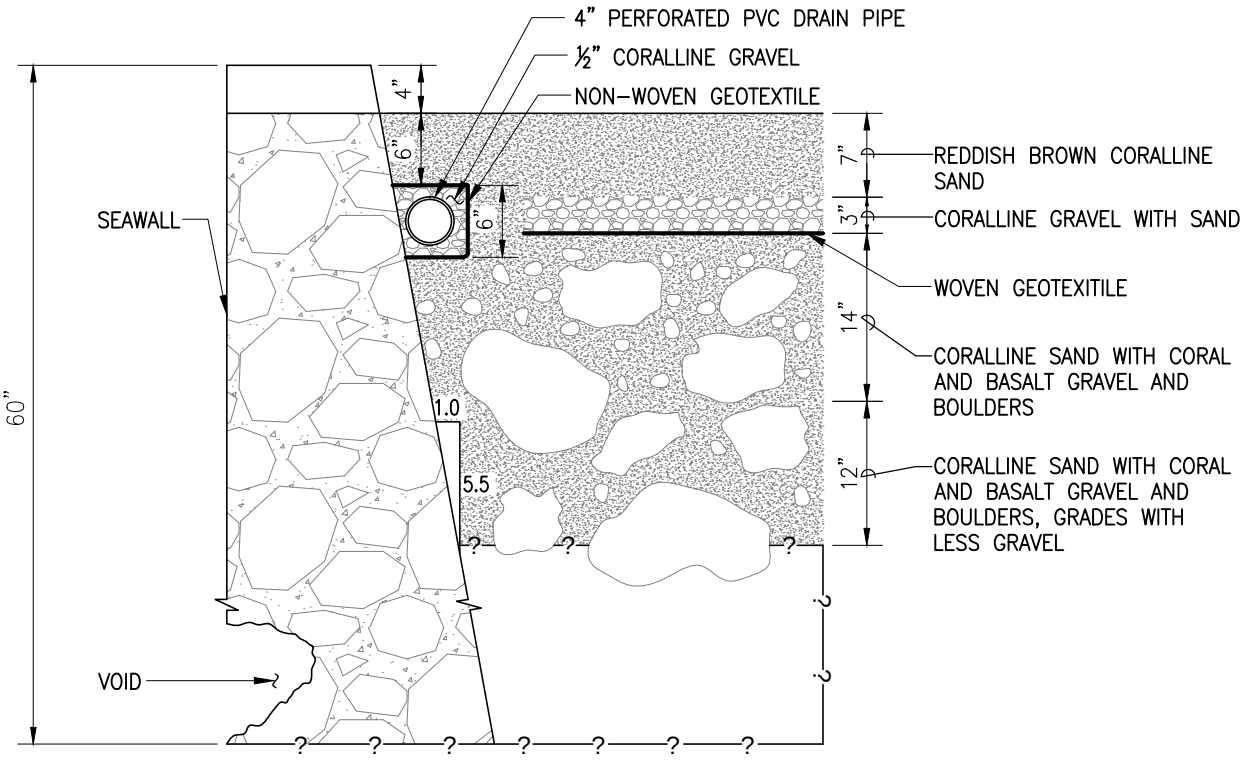
FIGURE 4

P:\11027 QUEEN'S SURF-WAIKIKI BEACH SEA WALL REPAIR\500.00 ENGINEERING ANALYSIS\505.01 AURTOCAD DRAWINGS\REPORT FIGURES\11027 FIGURES 3, 4 APPROXIMATE FIELD WORK LOCATIONS, SEAWALL PHOTO SURVEY.DWG

DRAFT



TEST PIT TP-1
NOT TO SCALE

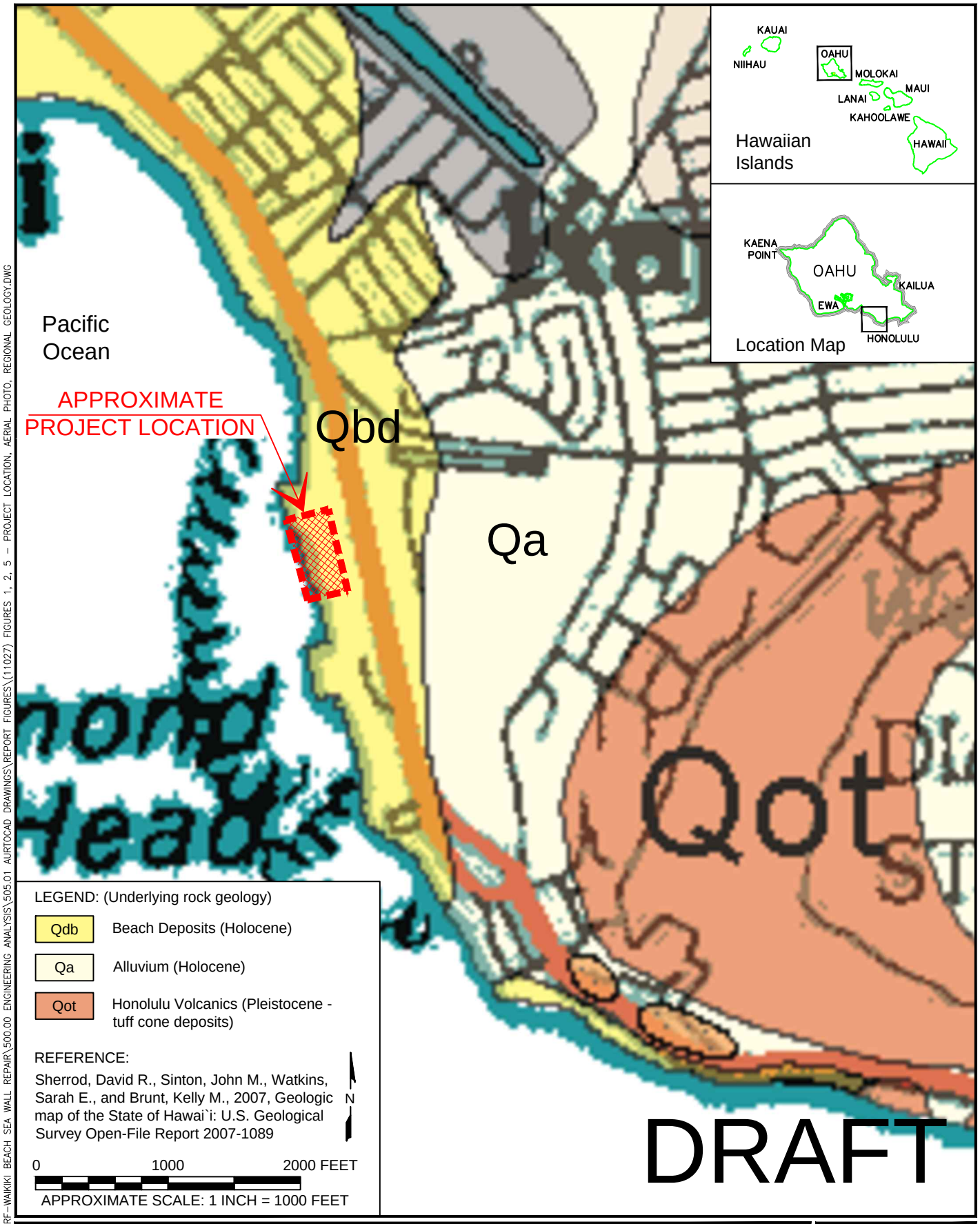


TEST PIT TP-2
NOT TO SCALE

P:\11027 QUEEN'S SURF-WAIKIKI BEACH SEA WALL REPAIR\500.00 ENGINEERING ANALYSIS\505.01 AURTOCAD DRAWINGS\REPORT FIGURES\11027 FIGURE 5, TEST PITS TP-1 AND TP-2 SOIL PROFILE.DWG

TEST PITS TP-1 AND TP-2 ENCOUNTERED CONDITIONS
Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii
Project No. 11027

YOGI KWONG ENGINEERS, LLC
FIGURE 5



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REGIONAL GEOLOGY MAP

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No. 11027

YOGI KWONG ENGINEERS, LLC

FIGURE 6

APPENDIX A FIELD EXPLORATION & TESTING

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A.2 Soil Sampling
A.3 Dynamic Cone Penetrometer (DCP) Test

APPENDIX B LABORATORY TESTING

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B.2 Atterberg Limits (Plasticity Index)
B.3 Gradation Analysis

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APPENDIX A FIELD EXPLORATION & TESTING

This appendix summarizes the results of our field exploration and testing, and soil sampling performed in support of Queen's Surf – Waikiki Beach Seawall Repair Project. Refer to Section 3.4 of report for anticipated subsurface conditions for this project. The location of the study corridor is presented in Figure 1 and the approximate test pit and DCP test locations are presented in Figure 3.

A.1 TEST PITS

The test pits were excavated by Yogi Kwong Enginners, LLC (YKE) engineering personnel using hand tools. After excavation, the borings were backfilled with the excavated material and compacted with a hand tamper. Removed sections of geotextile fabric were restored with a new piece of fabric.

A.2 SOIL SAMPLING

Soil sampling was conducted under the observation of YKE personnel, who logged the materials encountered in the test pits and DCP probes advanced by hand auger, and obtained bag samples for further examination and laboratory tests.

Soil samples were initially classified in the field according to ASTM D2488 and the Unified Soil Classification System shown on Figure A-1. The field classifications were later refined according to ASTM D2487 based on the results of laboratory tests performed on selected samples. Samples recovered during the field exploration program were transported to our office in Honolulu for further examination and laboratory testing.

A.3 DYNAMIC CONE PENETROMETER (DCP) TEST

A total of eight (8) Dynamic Cone Penetrometer (DCP) tests were completed by YKE personnel. Two (2) DCP tests were performed over water in front of the seawall. Six (6) DCP tests were executed on the landside of the wall to a maximum of 6.5 feet below the existing ground surface. The tests were performed in accordance with ASTM Special Technical Publication #399. The DCP test consists of driving a cone tip 1.75 inches into the ground by successive blows of a 15 pound hammer falling 20 inches. The number of blows and penetration were recorded, and the resulting penetration rate can be related to the N-values derived from Standard Penetration Tests. Hand auger probes were conducted along the on-land DCP tests after four (4) consecutive 1.75-inch increments, in order to minimize the effect of side friction of the shaft and record descriptions of the encountered soils. Approximate locations of the DCP tests are shown on Figure 3. The DCP and hand auger probe logs are presented on Figures A-2 and A-9.

SOIL CLASSIFICATION CHART

	Major Divisions		Symbol	Typical Names	Other Criteria
COARSE GRAINED SOILS More than 50% of material larger than No. 200 sieve size	**Gravels** More than 50% of coarse fraction retained on No. 4 sieve	**Clean Gravel** Little or no fines (<5%)	GW	Well-graded gravels, gravel-sand mixtures, little or no fines	Cu>4 and 1<=Cc=3
			GP	Poorly graded gravels, gravel-sand mixtures, little or no fines	Not meeting Cu and Cc criteria for GW
		Gravels with Fines Appreciable amount of fines (>12%)	GM	Silty gravels, gravel-sand-silt mixtures	Atterberg limit below A-line or PI<4
			GC	Clayey gravels, gravel-sand-silt mixtures	Atterberg limit above A-line with PI>7
	Sands More than 50% of coarse fraction passing No. 4 sieve	**Clean Sands** Little or no fines (<5%)	SW	Well-graded sands, gravelly sands, little or no fines	Cu>6 and 1<=Cc=3
			SP	Poorly graded sands, gravelly sands, little or no fines	Not meeting Cu and Cc criteria for SW
		Sands with Fines Appreciable amount of fines (>12%)	SM	Silty sands, sand-silt mixture	Atterberg limit below A-line or PI<4
			SC	Clayey sands, sand-clay mixture	Atterberg limit above A-line with PI>7
FINE GRAINED SOILS More than 50% of material smaller than No. 200 sieve size	**Silts and Clays** Liquid limit less than 50%		ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands or clayey silts with slight plasticity	Atterberg limit below A-line
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, lean clay	Atterberg limit above A-line
			OL	Organic silts and organic silty clays flow plasticity	Atterberg limit below A-line
	Silts and Clays Liquid limit larger than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	Atterberg limit below A-line
			CH	Inorganic clays of high plasticity, fat clays	Atterberg limit above A-line
			OH	Organic clays of high plasticity, organic silts	Atterberg limit below A-line
HIGHLY ORGANIC SOILS			Pt	Peat and other highly organic soils	

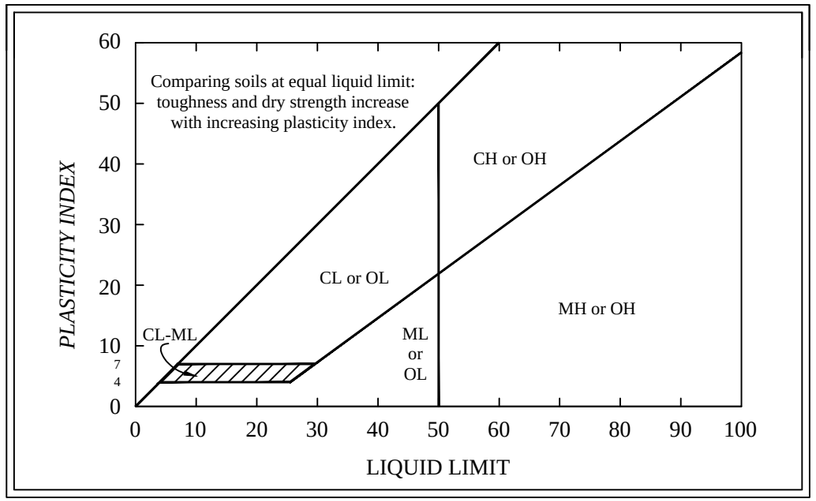
Notes: 1. Cu = D60/D10, Cc = (D30)^2/(D60 x D10) where D60, D30 and D10 are diameters associated with 60%, 30% and 10% smaller in gradation curves.
2. Dual symbols are used to indicate borderline classifications such as GP/SP.

GRADATION CHART

Soil Fraction		Size Range			
		Lower Limit		Upper Limit	
		Millimeters	Sieve	Millimeters	Sieve
Boulders		304.8	12*	914.4	36*
Cobbles		76.2	3*	304.8	12*
Gravel		4.76	4**	76.2	3*
Sand	Coarse	2	10**	4.76	4**
	Medium	0.42	40**	2	10**
	Fine	0.074	200**	0.42	40**
Fines				0.074	200**

* U.S. standard sieve opening in inches
** U.S. standard sieve number

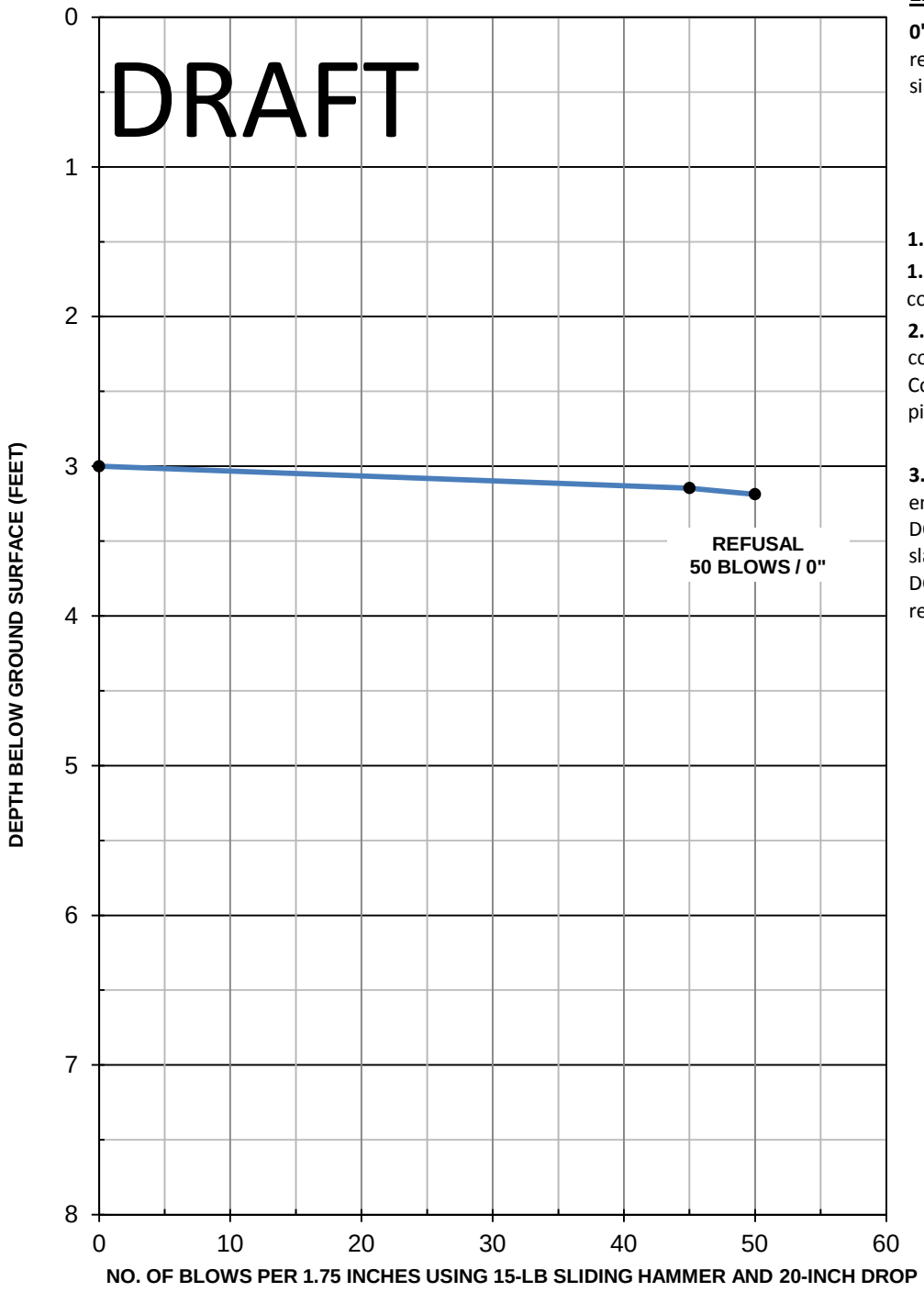
PLASTICITY CHART



UNIFIED SOIL CLASSIFICATION
Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii
Project No. 11027

YOGI KWONG ENGINEERS, LLC
PROJECT NO. 11027

FIGURE A-1



Exploration Log - Test Pit 1

0' to 1.5' bgs - Ligth brown to reddish brown coralline sand with silt, moist

1.5' bgs - Geotextile fabric encountered

1.5' to 2.0' bgs - Concrete debris and coral boulders

2.0' to 3.0' bgs - Reddish brown coraline sand with trace clay
Concrete slab debris and metal pieces encountered

3.0' bgs - Concrete slab debris encountered at bottom of excavation
DCP performed at one side of concrete slab
DCP-1 completed at 3.2' bgs with refusal (50 blows/ 0")

Location	Date	Test Elevation (feet bgs)	Notes
DCP 1	10/18/11	3.0	DCP Test performed in Test Pit TP-1, Low Tide

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DCP TEST & TEST PIT

FIGURE A-2

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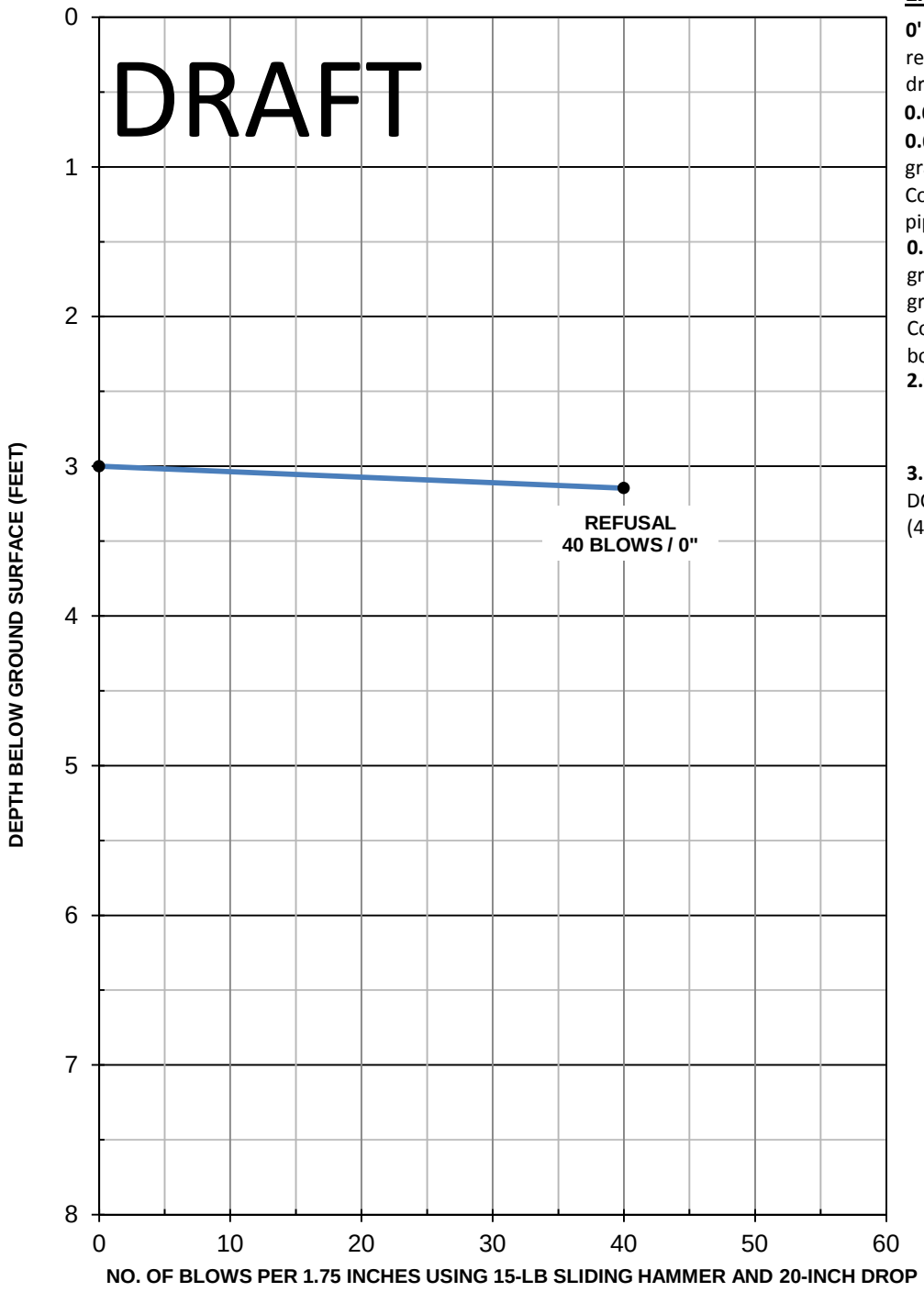

Exploration Log - Test Pit 2

0' to 0.6' bgs - Ligth brown to reddish brown coralline silty sand, dry

0.6' bgs - Geotextile Fabric encountered

0.6' to 0.8' bgs - Tan to off-white well-graded angular coralline gravel, dry
Covering a 4" perforated PVC drain pipe

0.8' to 2.0' bgs - Tan and black poorly graded coralline sand with basalt gravel, moist
Concrete debris and coral cobbles and boulders encountered at 2.0' bgs

2.0' to 3.0' bgs - grades with less gravel

3.0' bgs - DCP-2 performed at 3.0' bgs
DCP completed with refusal
(40 blows/ 0")

Location	Date	Test Elevation (feet bgs)	Notes
DCP 2	10/17/11	3.0	DCP Test performed in Test Pit TP-2, Low Tide

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DCP TEST & TEST PIT

FIGURE A-3

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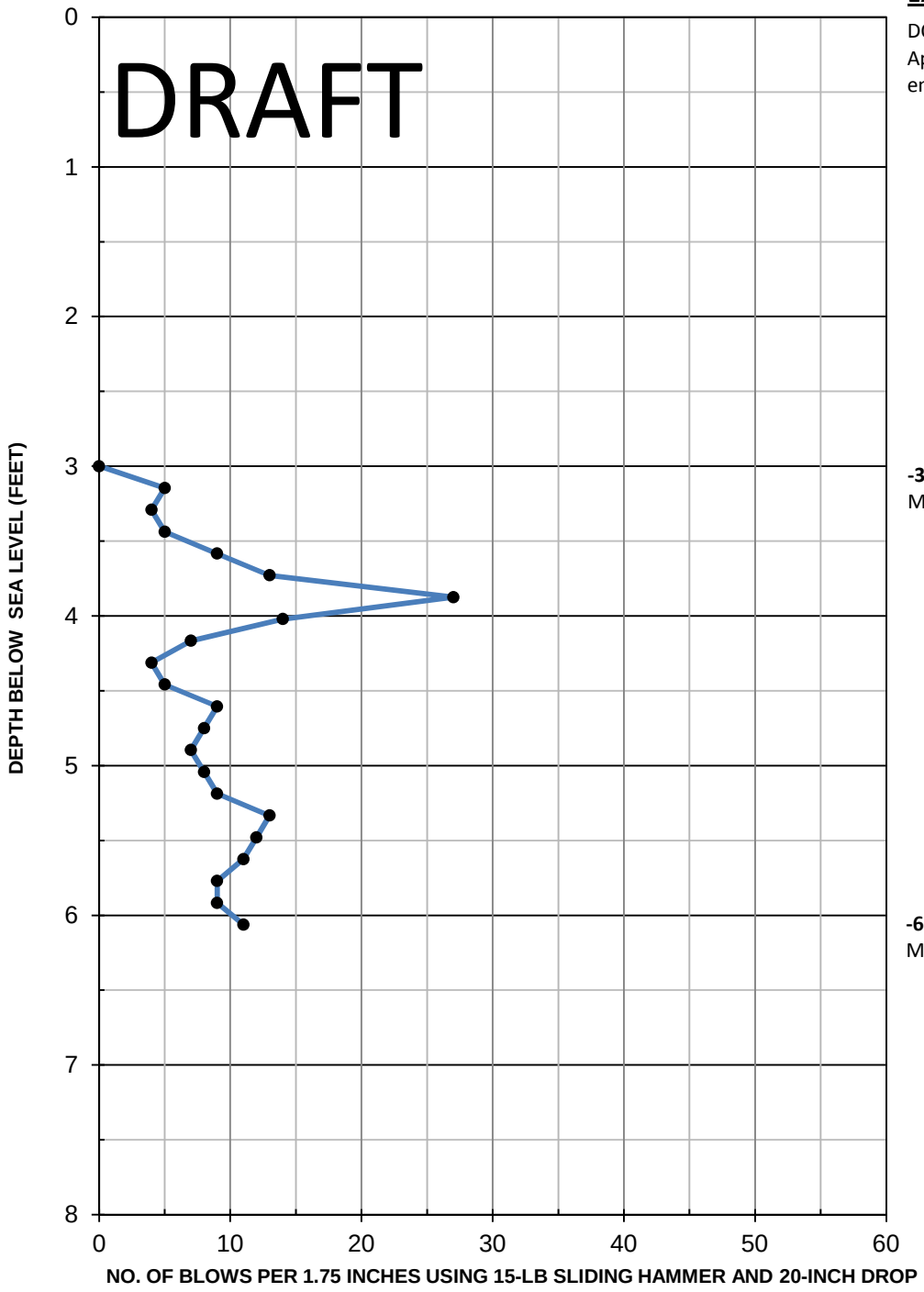

Exploration Log

DCP-3 performed over water
Approximate elevation of sea floor encountered at -3.0 ft MSL

-3.0' MSL - DCP-3 performed at -3.0' MSL

-6.1' MSL - DCP-3 completed at -6.1' MSL

Location	Date	Test Elevation (feet MSL)	Notes
DCP 3	10/17/11	-3.0	DCP Test performed approx. 23.5 ft west of seawall at STA 5+80, Low Tide

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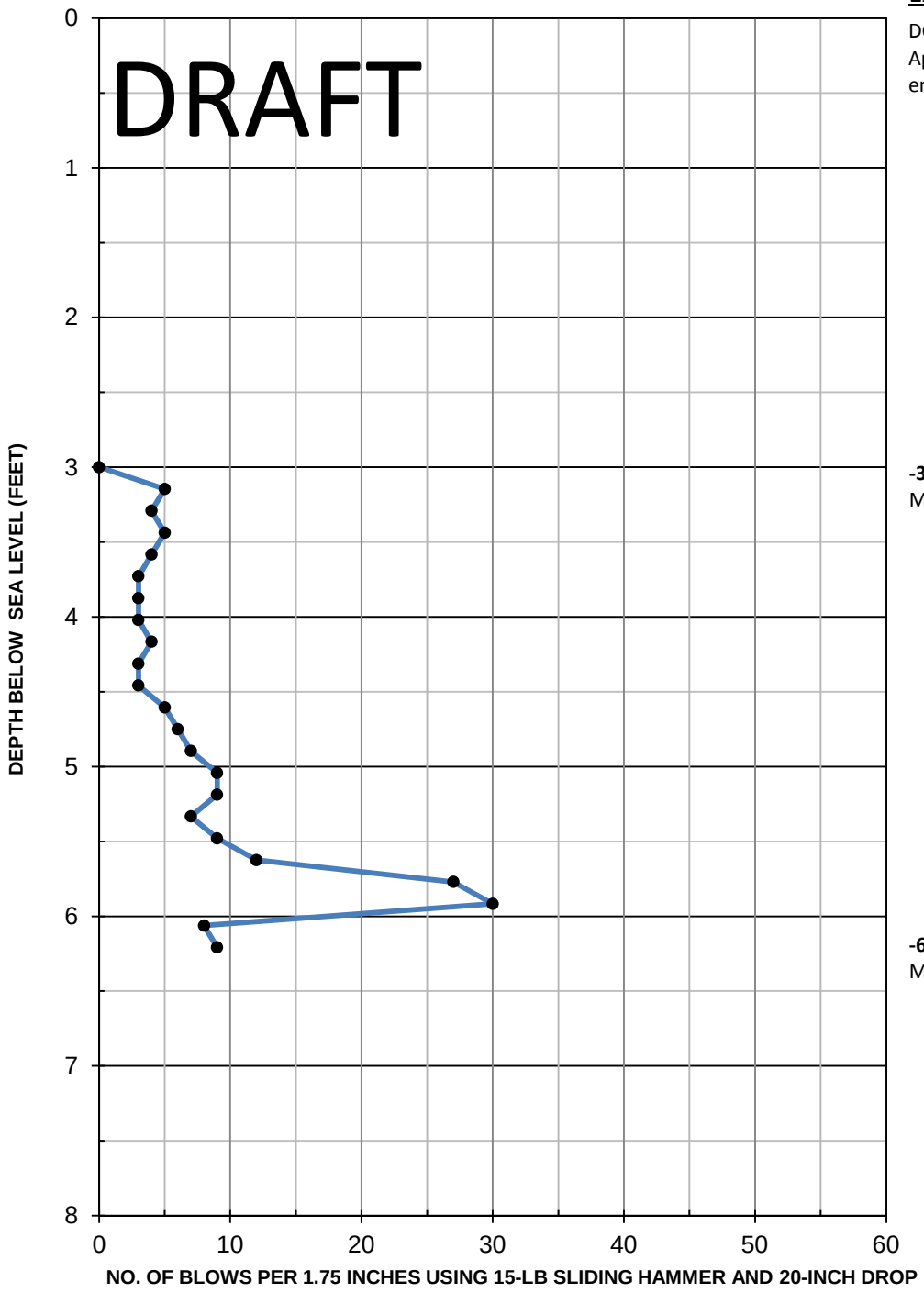
OVER-WATER DCP TEST

FIGURE A-4

Yogi Kwong Engineers, LLC



Exploration Log

DCP-4 performed over water
Approximate elevation of sea floor encountered at -3.0 ft MSL

-3.0' MSL - DCP-4 performed at -3.0' MSL

-6.2' MSL - DCP-4 completed at -6.2' MSL

Location	Date	Test Elevation (feet MSL)	Notes
DCP 4	10/17/11	-3.0	DCP Test performed approx. 21 ft west of seawall at STA 8+05, Low Tide

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OVER-WATER DCP TEST

FIGURE A-5

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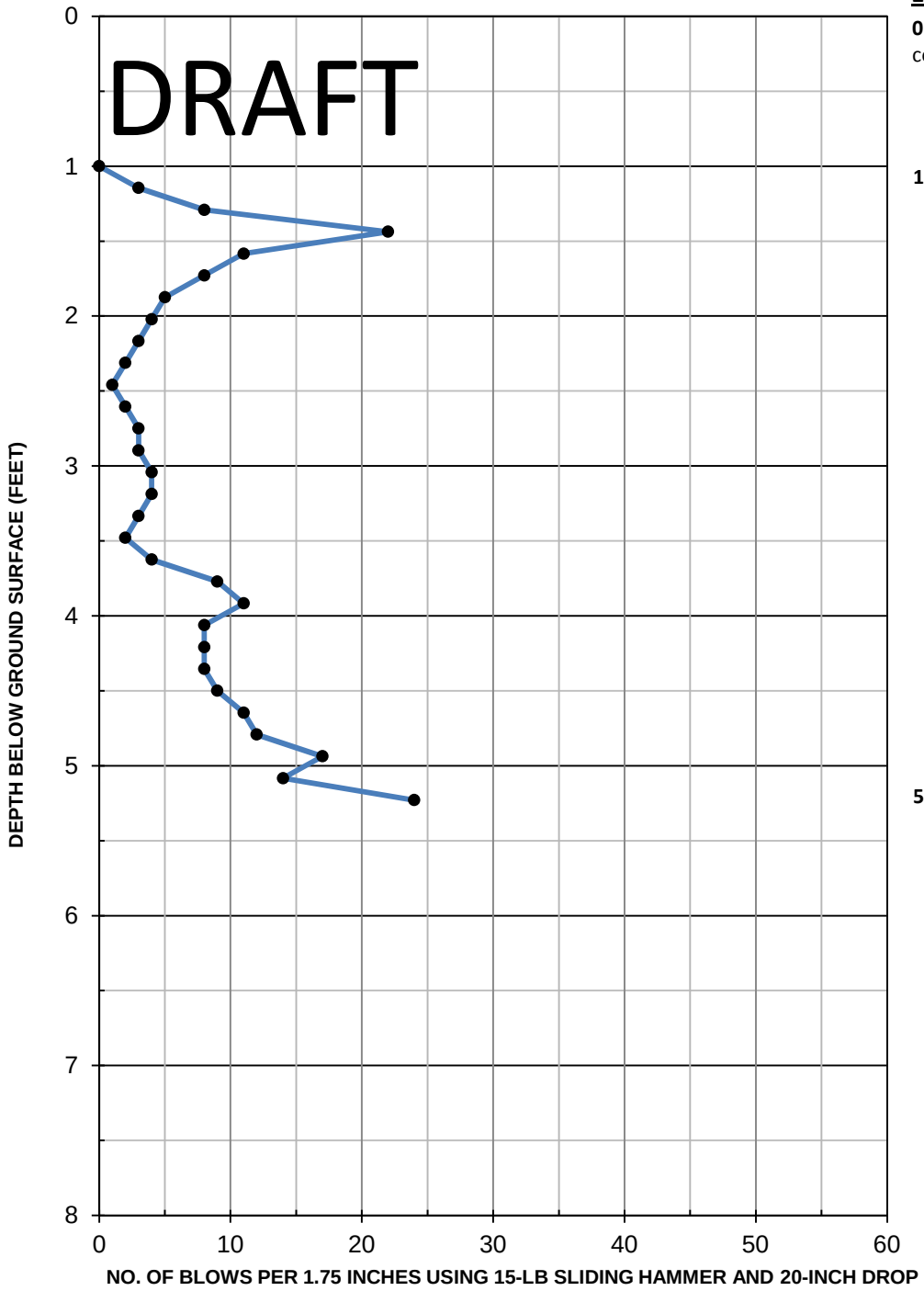

Exploration Log

0' to 1.0' bgs - Ligth brown to tan coralline silty sand, dry

1.0' bgs - DCP-5 performed at 1.0' bgs

5.2' bgs - DCP-5 completed at 5.2' bgs

Location	Date	Test Elevation (feet bgs)	Notes
DCP 5	10/18/11	1.0	DCP Test performed approx. 4 ft east of seawall at STA 4+60, Low Tide

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DCP TEST & HAND AUGER PROBE

FIGURE A-6

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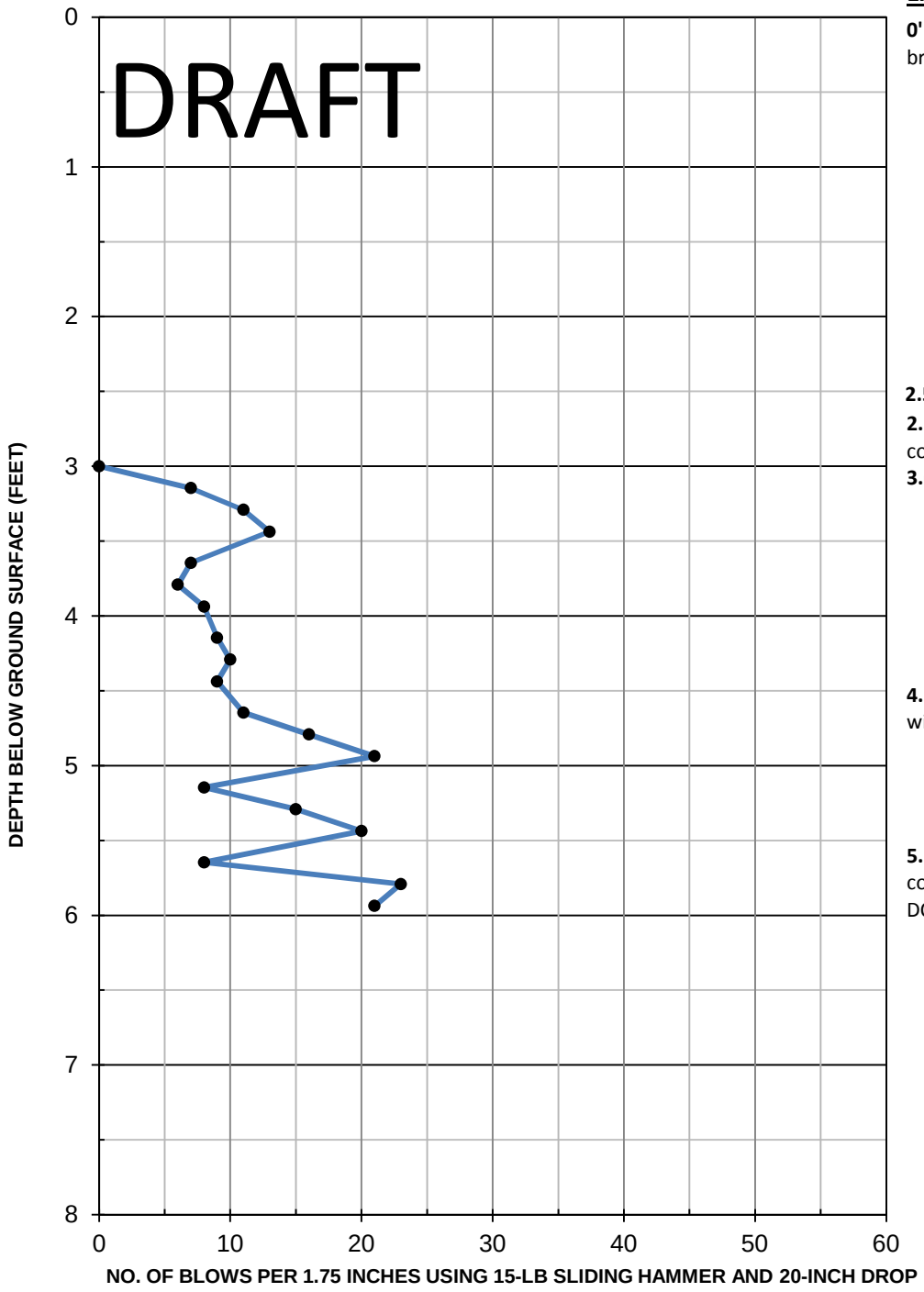

Exploration Log

0' to 2.5' bgs - Ligth brown to reddish brown coralline silty sand, moist

2.5' bgs - Geotextile Fabric encountered
2.5' to 4.5' bgs - Tan to light brown coralline silty sand, moist
3.0' bgs - DCP-6 performed at 3.0' bgs

4.5' to 5.5' bgs - Tan coralline silty sand with gravel, wet

5.5' to 5.9' bgs - Tan to off-white silty coralline sand with gravel, wet
DCP-6 completed at 5.9' bgs

Location	Date	Test Elevation (feet bgs)	Notes
DCP 6	10/21/11	3.0	DCP Test performed approx. 16 ft east of seawall at STA 8+30, Low Tide

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DCP TEST & HAND AUGER PROBE

FIGURE A-7

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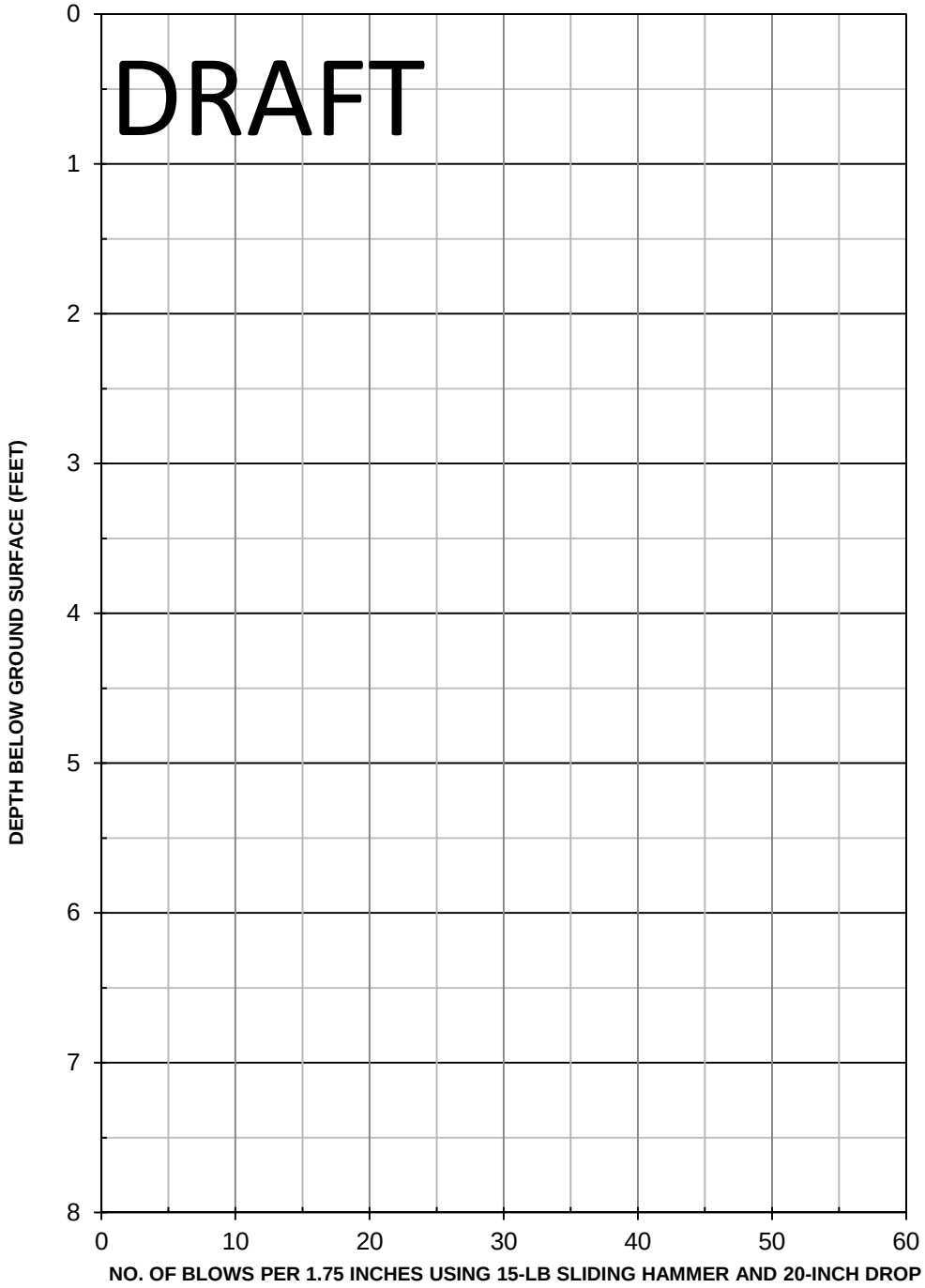

Exploration Log

0' to 1.5' bgs - Ligth brown to reddish brown coralline silty sand, moist

1.5' to 2.0' bgs - Gray to dark gray fat clay with sand, moist

2.0' bgs - Boulders encountered Unable to advance with hand auger
DCP-7 refusal; DCP bouncing

Location	Date	Test Elevation (feet bgs)	Notes
DCP 7	10/21/11	N/A	DCP Test located approx. 15 ft east of seawall at STA 6+30, Low Tide

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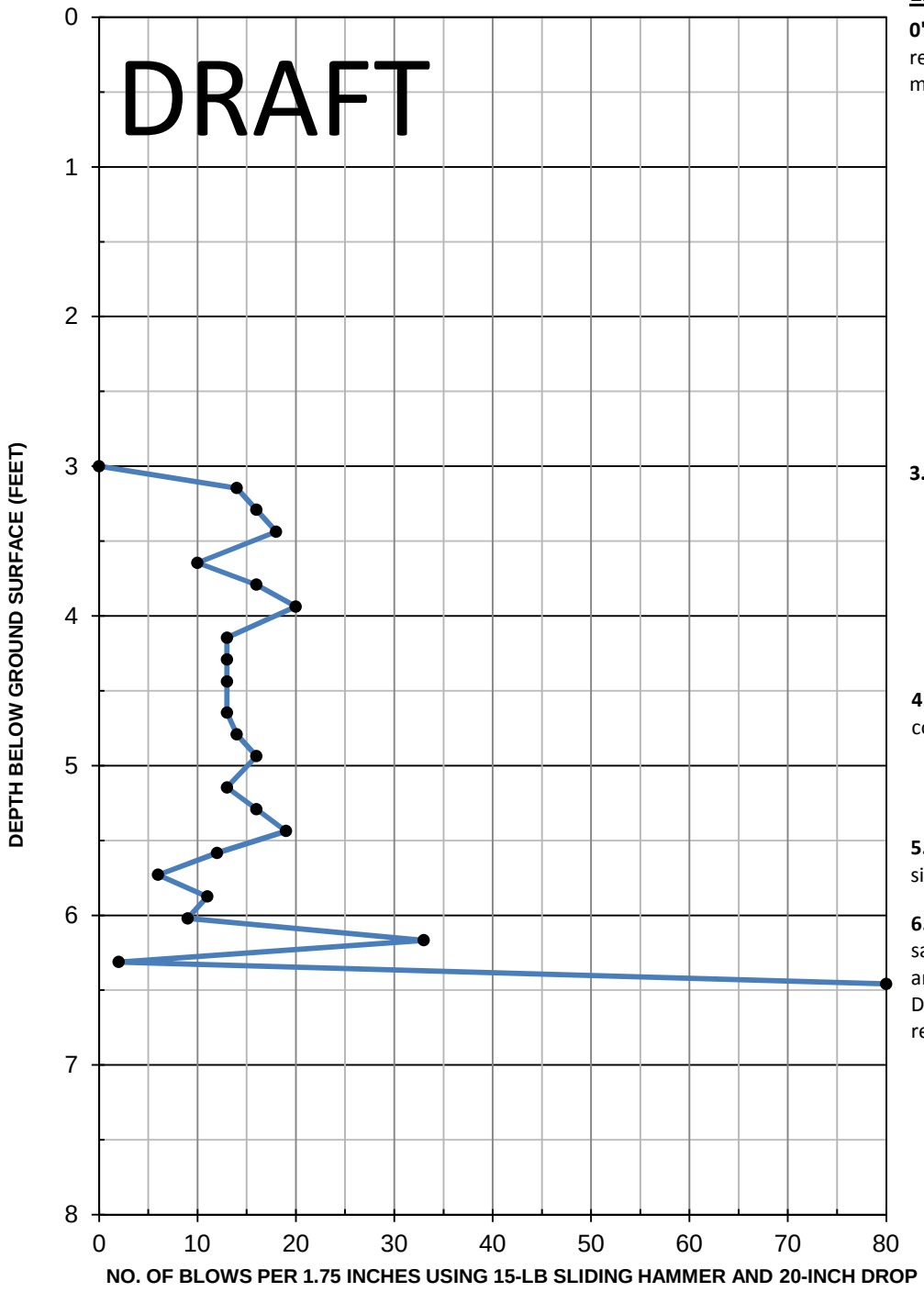
DCP TEST & HAND AUGER PROBE

FIGURE A-8

Yogi Kwong Engineers, LLC



Exploration Log

0' to 4.5' bgs - Ligth brown to reddish brown coralline silty sand, moist

3.0' bgs - DCP-8 performed at 3.0' bgs

4.5' to 5.5' bgs - Tan to off-white coralline silty sand, moist

5.5' to 6.0' bgs - Dark brown coralline silty sand , wet

6.0' to 6.5' bgs - Dark gray to brown sandy lean clay with traces of gravel and organics, wet
DCP-8 completed at 6.5' bgs with refusal (80 blows/1.75")

Location	Date	Test Elevation (feet bgs)	Notes
DCP 8	10/21/11	3.0	DCP Test performed approx. 16 ft east of seawall at STA 5+30, Low Tide

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DCP TEST & HAND AUGER PROBE

FIGURE A-9

Yogi Kwong Engineers, LLC

APPENDIX B LABORATORY TESTING

To verify field classifications, selected soil samples obtained during the field exploration were laboratory tested for moisture contents, Atterberg limits (plasticity index), and gradation analysis. The tests and results are described in the following paragraphs.

B.1 MOISTURE CONTENT

Selected soil samples were tested to measure their moisture contents and dry densities. The tests were performed in accordance with American Society for Testing and Materials (ASTM) Test Method D2216 and D2937. When measuring the moisture content, each sample had a minimum mass of 20 grams and was dried in a draft oven at 110°C for at least 12 hours. Moisture content results are presented in the Table B.1.1 below.

Table B.1.1 Moisture Content Test Results

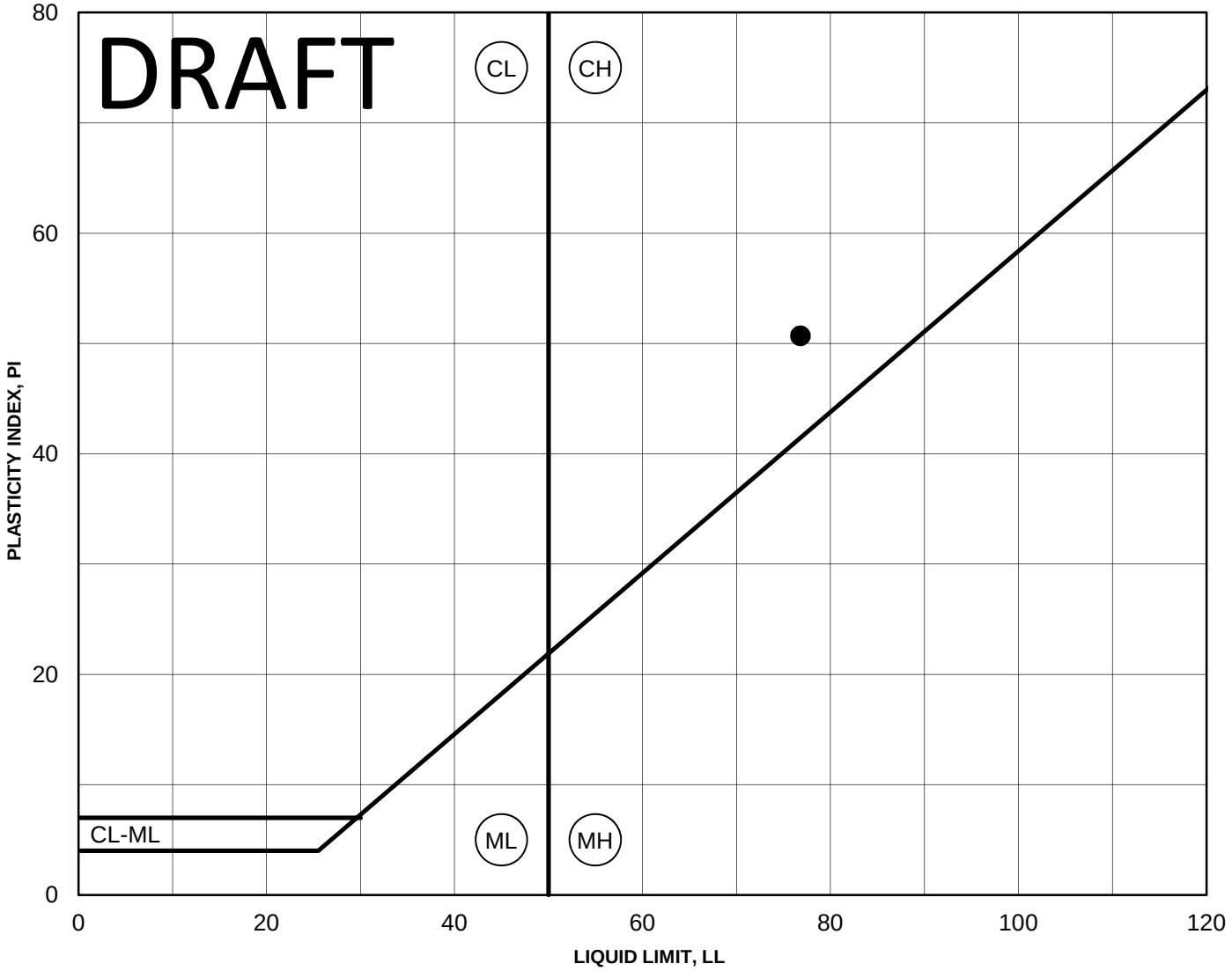
Test Pit	Depth* (feet)	Sample Description	Moisture Content (%)
TP-1	1	Multicolor Olive Brown Clayey Sand with Gravel	40.4
TP-2	2-3	Brownish Tan Poorly Graded Sand with Gravel	9.6

B.2 ATTERBERG LIMITS (PLASTICITY INDEX)

To assist in soil classification, the liquid limit and plastic limit tests were performed on select samples. The tests were performed in accordance with ASTM D4318. This test is useful for determining the plasticity of a soil and whether the fines behave more like a clay or silt. After passing the sample through a No. 40 sieve and mixing it thoroughly with water, the soil was put into a liquid limit device where blows were counted to close a 2 mm groove. The procedure was repeated with varying moisture contents. After plotting the data, the liquid limit was taken as the moisture content needed to close the 2 mm groove at 25 blows. The plastic limit was the moisture content of the soil when it was able to be rolled into 3.2 mm diameter threads. The plasticity index is the difference between the liquid limit and plastic limit. Preliminary results are presented in Figure B-1.

B.3 GRADATION ANALYSIS

Gradation analyses (ASTM D422) were performed on selected samples using the wash sieve method to evaluate grain size distribution. The soil was passed through various sieves with decreasing opening sizes. The dry weights retained on each sieve were used to calculate the percent passing for each grain size. Results of gradation analyses are presented on Figure B-2.



Boring		Depth (ft)	LL %	PL %	PI %	Classification
●	TP-1	1.0	76.8	26.1	50.7	Fat clay (CH)

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PLASTICITY CHART

FIGURE B-1

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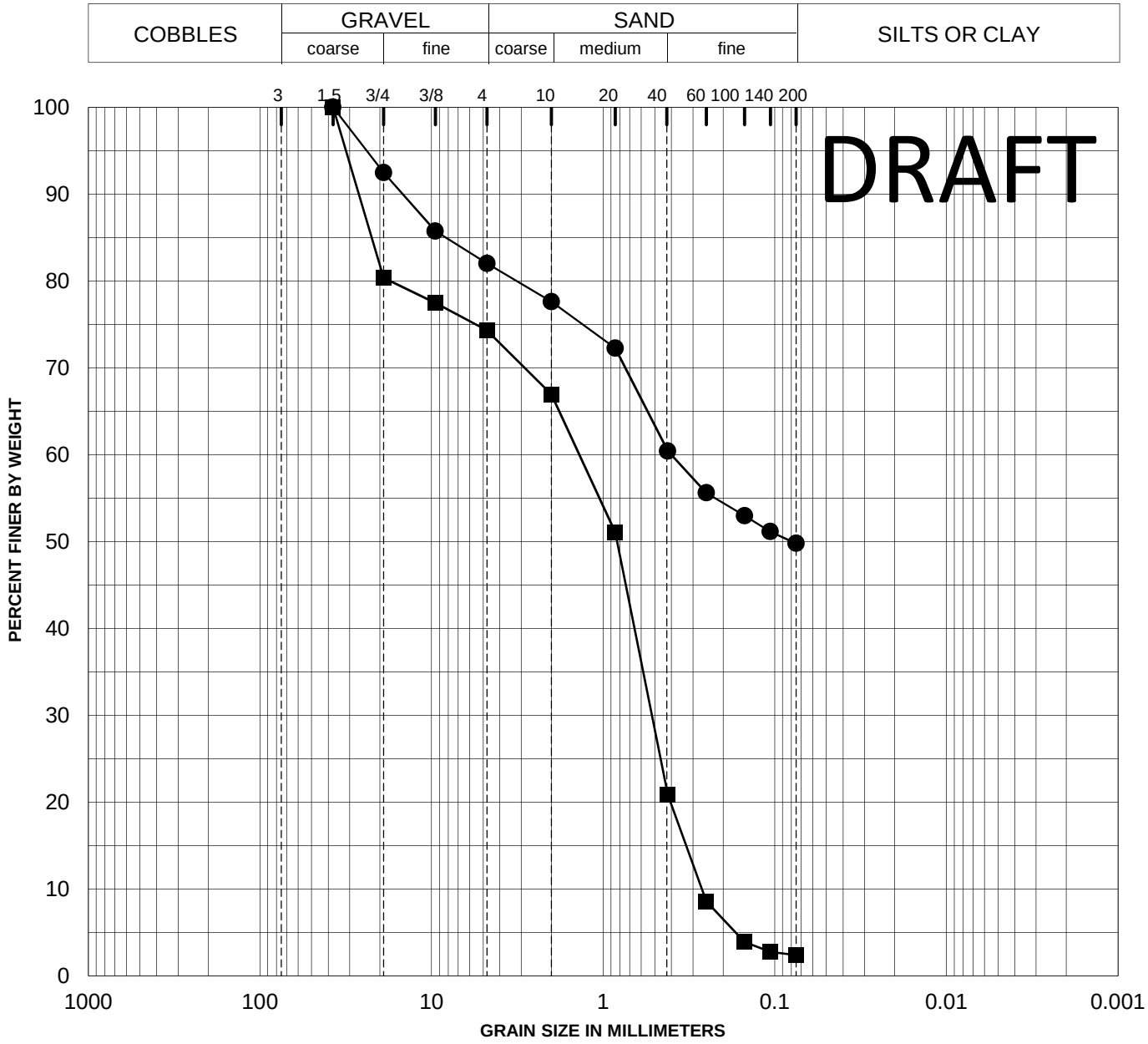

Boring		Depth (ft)	Description	Gravel %	Sand %	Fines %
●	TP-1	1.0	Multicolor Olive Brown Clayey Sand with Gravel	18	32	50
■	TP-2	2.0-3.0	Brownish Tan Poorly Graded Sand with Gravel	26	72	2

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GRAIN SIZE DISTRIBUTION CURVES

FIGURE B-2

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APPENDIX C

Photographs of Field Work

TP-1, View of Work Area

TP-1, View of Test Pit Side Wall 0" to 16" bgs

TP-1, View of Test Pit Side Wall 0" to 10" bgs

TP-1, View of Test Pit Side Wall 0" to 10" bgs

TP-1, View of Test Pit Side Wall 0" to 18" bgs

TP-1, View of Test Pit - Boulders below geotextile at 18" bgs

PHOTOGRAPHS OF TEST PIT EXCAVATION

Queen's Surf - Waikiki Beach Seawall Repair
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FIGURE C-1

TP-1, View of Test Pit - Boulders below geotextile at 18" bgs

TP-1, View of Test Pit Side Wall 0" to 23" bgs

TP-1, Metal plate and pieces encountered during excavation

TP-1, View of Test Pit Side Wall 13" to 34" bgs

TP-1, View of Test Pit Side Wall 0" to 36" bgs - concrete slab at 36"

TP-1, Excavation under filter - clay layer on seawall face

PHOTOGRAPHS OF TEST PIT EXCAVATION

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

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FIGURE C-2

TP-1, View of Test Pit - Boulders encountered during excavation

TP-1, 12"-Boulders encountered from 18" to 36" bgs

TP-1, 12"-Boulders encountered from 18" to 36" bgs

TP-1, View of Backfill

TP-1, View of Backfill

TP-1, View of Backfill

PHOTOGRAPHS OF TEST PIT EXCAVATION

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Honolulu, Oahu, Hawaii

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FIGURE C-3

TP-2, View of Work Area

TP-2, View of Test Pit Side Wall - 0" to 12" bgs

TP-2, View of Test Pit Side Wall - 0" to 7" bgs

TP-2, View of Test Pit Side Wall - 4" to 10" bgs

TP-2, View of Test Pit Side Wall - 8" to 12" bgs

TP-2, View of Test Pit Side Wall - 0" to 10" bgs

PHOTOGRAPHS OF TEST PIT EXCAVATION

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

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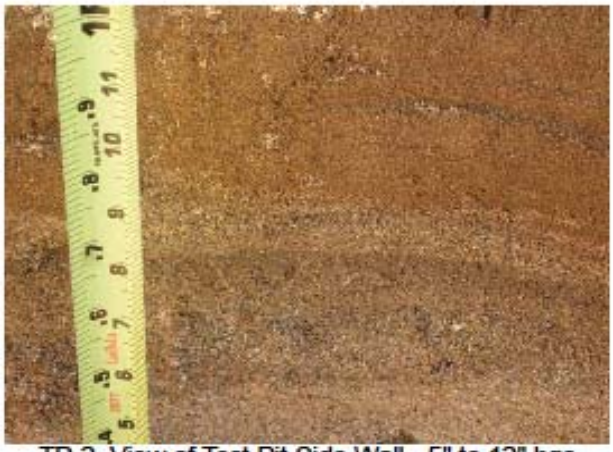
FIGURE C-4

TP-2, View of Test Pit Side Wall - 0" to 12" bgs

TP-2, View of Test Pit Side Wall - 1" to 7" bgs



TP-2, View of Test Pit Side Wall - 5" to 12" bgs

TP-2, View of Test Pit

TP-2, View of Test Pit

TP-2, View of Test Pit

PHOTOGRAPHS OF TEST PIT EXCAVATION

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Honolulu, Oahu, Hawaii

Project No.11027

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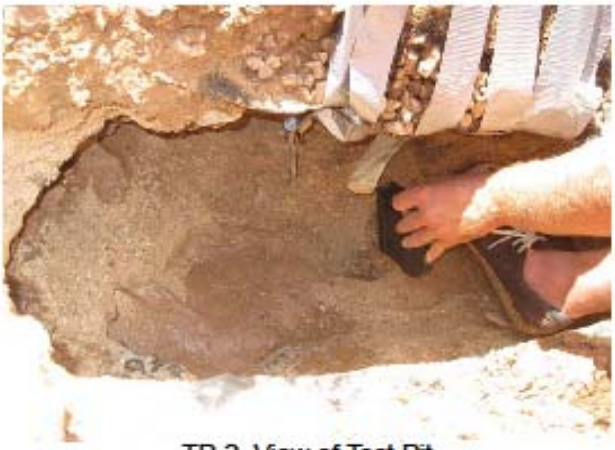
FIGURE C-5

TP-2, View of Test Pit



TP-2, View of Test Pit

TP-2, View of Test Pit

TP-2, View of Backfill

TP-2, View of Backfill

PHOTOGRAPHS OF TEST PIT EXCAVATION

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

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FIGURE C-6

Boring TP-1, Sample 1, Depth 1.5'

Boring TP-1, Sample 2, Depth 2.0' to 2.5'

Boring TP-1, Sample 2, Depth 2.0' to 2.5'

Boring TP-2, Depth 0.8' to 3.0'

Boring TP-2, Sample 1, Depth 0' to 0.6'

Boring TP-2, Sample 2A, Depth 0.6' to 0.8'

PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

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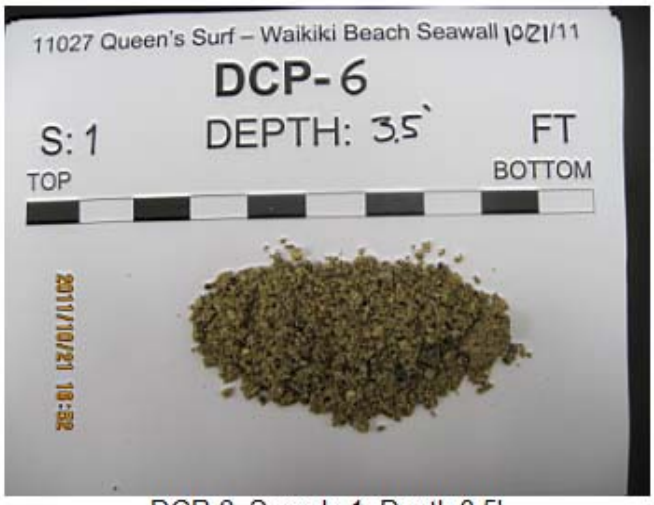
FIGURE C-7

Boring TP-2, Sample 3, Depth 0.8' to 2.0'

Boring TP-2, Sample 4, Depth 2.0' to 3.0'

Boring TP-2, Sample 4, Depth 2.0' to 3.0'



DCP-6, Sample 1, Depth 3.5'

DCP-6, Sample 2, Depth 4.5'

DCP-6, Sample 2, Depth 4.5'

PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-8

DCP-6, Sample 3, Depth 5.5'

DCP-6, Sample 3, Depth 5.5'

DCP-7, Sample 1, Depth 1.5'

DCP-7, Sample 1, Depth 1.5'

DCP-7, Sample 1, Depth 1.5'

DCP-7, Sample 1, Depth 1.5'

PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-9

DCP-8, Sample 1, Depth 5.5'

DCP-8, Sample 2, Depth 6.0'

PHOTOGRAPHS OF SOIL SAMPLES

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

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YOGI KWONG ENGINEERS, LLC.

FIGURE C-10

View of DCP-1 Test

View of DCP-1 Test

View of DCP-1 Test

View of DCP-2 Test

View of DCP-2 Test

View of DCP-2 Test

PHOTOGRAPHS OF DCP TESTS

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-11

View of DCP-6 Test

View of DCP-6 Test

View of DCP-6 Test

View of DCP-7 Test

View of DCP-7 Test

View of DCP-7 Test

PHOTOGRAPHS OF DCP TESTS

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

YOGI KWONG ENGINEERS, LLC.

FIGURE C-12

APPENDIX D

Selected Site Condition Photographs

Face of seawall near STA 6+00

Face of seawall STA 5+72 to 5+85

Face of seawall STA 5+90 to 6+00

Face of seawall STA 6+00 to 6+10

Face of seawall STA 6+10 to 6+20

Face of seawall STA 6+14 to 6+25

SELECTED SITE CONDITION PHOTOGRAPHS

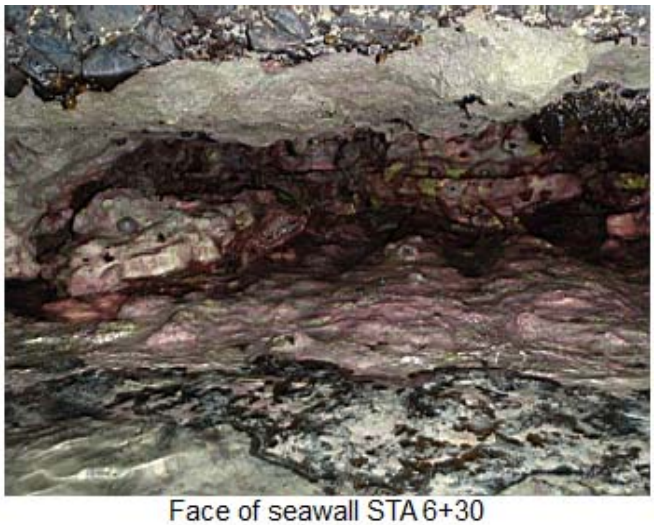
Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

YOGI KWONG ENGINEERS, LLC.

FIGURE D-1

Face of seawall STA 6+25 to 6+32



Face of seawall STA 6+30

Face of seawall STA 6+64 to 6+75

Face of seawall STA 6+85 to 6+93

Face of seawall STA 7+50 to 7+57

Face of seawall STA 7+95 to 8+00

SELECTED SITE CONDITION PHOTOGRAPHS

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

YOGI KWONG ENGINEERS, LLC.

FIGURE D-2

Top of seawall near STA 5+50

Top of seawall STA 6+50 to 7+00

Top of seawall STA 6+50 to 6+00

Top of seawall STA 7+00 to 7+50

General view of seawall STA 6+50 to 7+00

General view of seawall near STA 9+00

SELECTED SITE CONDITION PHOTOGRAPHS

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

YOGI KWONG ENGINEERS, LLC.

FIGURE D-3

General view of seawall STA 7+50 to 8+00

General view of seawall STA 9+00 to 8+50

General view of seawall STA 4+00 to 9+00

General view of seawall STA 9+00 to 4+00

SELECTED SITE CONDITION PHOTOGRAPHS

Queen's Surf - Waikiki Beach Seawall Repair
Honolulu, Oahu, Hawaii

Project No.11027

YOGI KWONG ENGINEERS, LLC.

FIGURE D-4

APPENDIX E

Geophysical Survey Report by Global Geophysics

APPENDIX E

E.1 GROUND PENETRATING RADAR

GPR toning is based upon the measurement of high frequency electromagnetic wave pulses which are transmitted into the subsurface and then recorded when they reflect back to the receiver. The different types of materials reflect energy differently and as a result can create a cross-section. The depth is determined by the amount of time it takes for the pulse to return to the transmitter. GPR survey was conducted by Dr. John Liu of Global Geophysics. The data collected from the survey is presented in Appendix E.

Global Geophysics
16651 White Mountain Road SE
Monroe, WA 98272
Tel: 425-890-4321
Fax: 360-805-0259

October 30, 2011 Our ref: 101-0723.000

Yogi Kwong Engineers, LLC
1357 Kapiolani Blvd., Suite 1450
Honolulu, Hawaii 96814

Attention: Mr. Reyn Hashiro

RE: REPORT FOR GROUND PENETRATING RADAR SURVEY AT QUEEN SURF SEAWALL, HONOLULU, HAWAII

This letter report presents the results of the geophysical surveys performed by Global Geophysics on October 22nd, 2011. The survey was carried out on the Queen Surf Seawall, Honolulu, Hawaii. The objective of the survey was to detect voids in the seawall and behind the seawall.

GEOPHYSICAL METHOD AND FIELD PROCEDURE

Ground Penetrating Radar

The GPR method uses electromagnetic pulses, emitted at regular intervals by an antenna to map subsurface features. The electromagnetic pulses are reflected where changes in electrical properties of materials occur such as changes in lithology or where underground utilities are present. The reflected electromagnetic energy is received by an antenna, converted into an electrical signal, and recorded on the GPR unit. The data is recorded and viewed in real time on a graphical display that depicts a continuous profile or cross-section image of the subsurface directly beneath the path of the antenna.

The depth of penetration of the GPR signal varies according to antenna frequency and the conductivity of the subsurface material. The depth of subsurface penetration with GPR decreases with an increase in the frequency of the antenna and an increase in soil conductivity. Low frequency antennas (50 to 500 MHz) provide the best compromise between obtaining good subsurface penetration and resolution.

The data at this site were collected using Geophysical Survey Systems, Inc. (GSSI) SIR 2000 GPR system with an antenna having center frequency of 200 MHz. The data were digitally recorded for post processing.

RESULTS

The GPR profiles are presented in Figure 1. The GPR scan was conducted on the top of the seawall and behind the seawall.

Top of the seawall: There are a few areas identified as voids due to local signal intensity increase. Surface features, such as gaps and uneven surface, created strong amplitude from top to bottom of the profile.

Behind the seawall: Two small inverted hyperbolic curves are observed, which may indicate the presence of voids in the soil. Other signal intensity increases are probably due to the soil condition variations.

CLOSURE

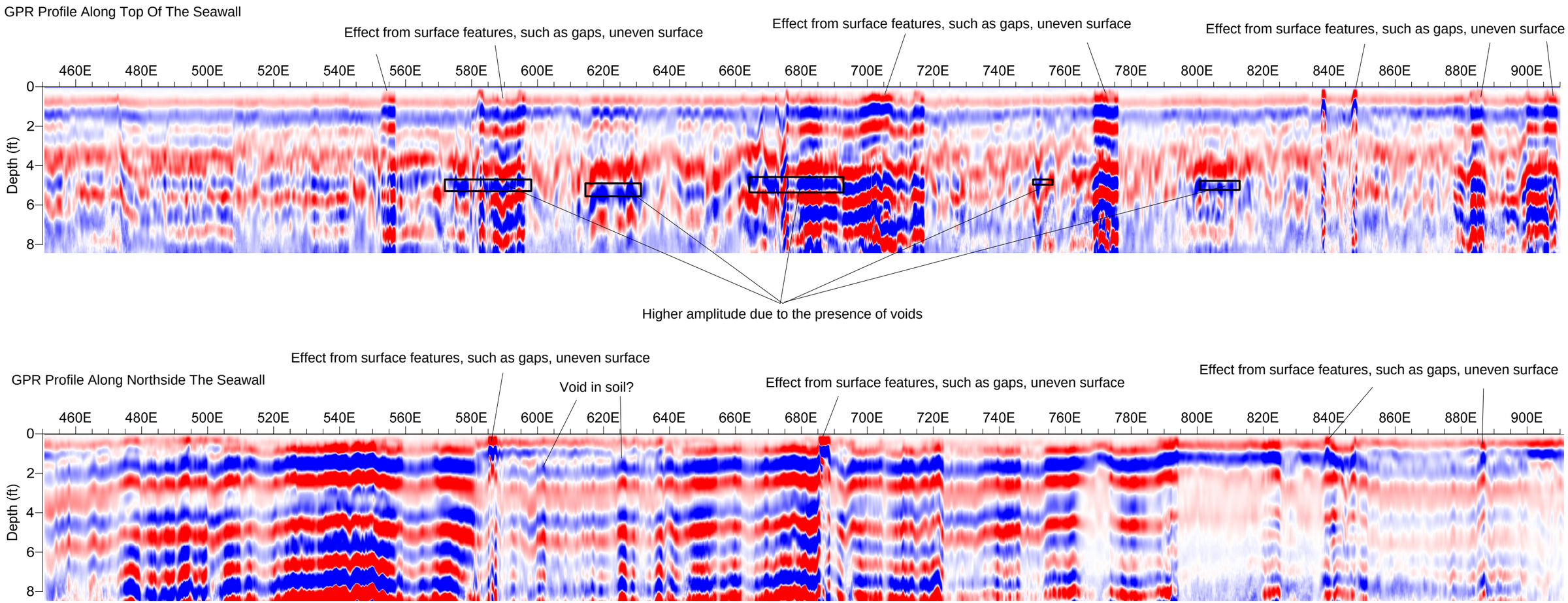
Global Geophysics services will be conducted in a manner consistent with the level of care and skill ordinarily exercised by other members of the geophysical community currently practicing under similar conditions subject to the time limits and financial and physical constraints applicable to the services.

We appreciate the opportunity to work with you on this project, and we hope that you find the results of the geophysical survey useful to your investigation. If you have any questions regarding this report, please call the undersigned at 425-890-4321. We look forward to providing you with additional geophysical services in the future.

Sincerely,

Global Geophysics.

John Liu, Ph.D., R.G.
Principal Geophysicist



0ft 30ft 60ft

Horizontal Scale

0ft 5ft 10ft

Vertical Scale

PROJECT

Queen's Surf Seawall
Honolulu, Hawaii

TITLE

GPR PROFILES

Global Geophysics
16651 White Mountain Road SE
Monroe, WA, 98272
Tel: 425-890-4321

PROJECT NO.: 101-0723.000		FILE No.
DESIGN	--	SCALE AS SHOWN REV.
CADD	JL	**FIGURE 1**
CHECK	JL	
REVIEW	--	

APPENDIX C

Nearshore Survey of Benthic Habitat

Inside reef:

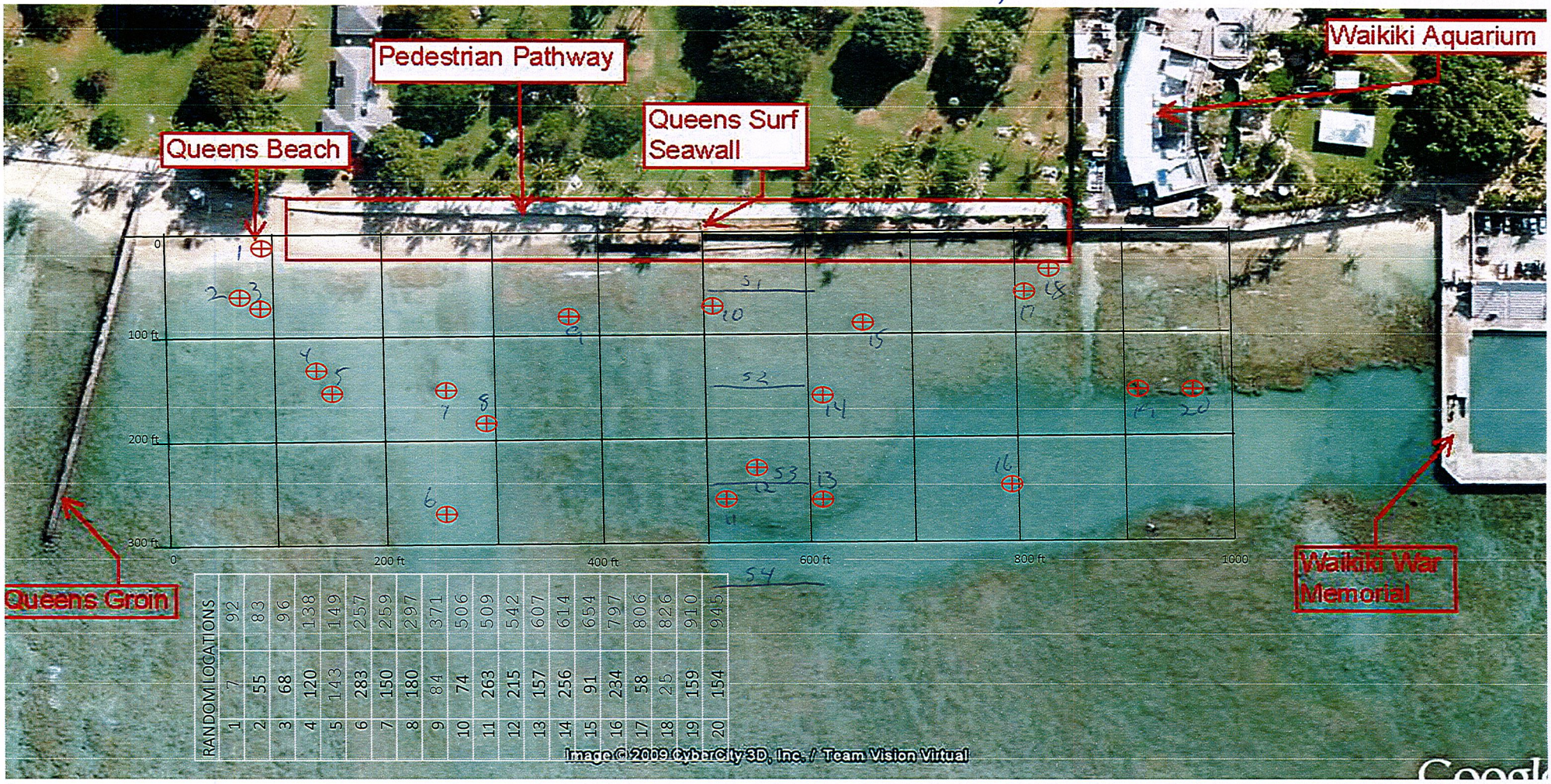
The inside reef right off of Queen's beach was mostly sand with rubble and rocks scattered throughout. Settled on the rubble and rocks were macroalgae, mainly *Acanthophora spicifera, Dictyota sp.* and various species of cyanobacteria. Very few fish were seen in the first 100-200 ft off Queen's beach, only small juveniles. No coral was observed until about 200 ft off Queen's Surf Beach. The inside reef towards the natatorium was more of a reef flat and mostly covered with algae mats. The algae mats were diverse but only a few species made up the majority, *Acanthophora spicifera, Padina sp., Dictyota sp.* and *Turbinaria ornata.* Again, few fish were seen on the inside reef and most of them were juveniles. There were only a few coral colonies observed and they were less than 6 inches, *Porites evermanni* and *Pocillopora meandrina.* Overall, the inside reef coral cover is significantly less than 1%.

Sand patch:

There is a large sand patch that extends 500 ft from the natatorium parallel to shore. Along the west edge of the sand patch there is a distinct 8-10 ft cut in the reef. There was a gathering of fish along this cut edge including, *Naso unicornis, Plectroglyphidodon imparipennis, Myripristis sp., Chaetodon auriga, Chaetodon lunula, Ostracion meleagris* and *Synodus sp.* The south edge of the sand patch is a gradual slope up from the sand to the reef flat that consists of rubble. Surrounding the sand patch were thick algae mats of *Gracilaria salicornia, Acanthophora spicifera, Padina sp.* and *Turbinaria ornata.* Throughout the sand patch there were also loose bunches of *Gracilaria salicornia*. There were a few colonies of coral including *Porites evermanni, Porites lobata, Pocillopora meandrina, Leptastraea purpurea* and *Psammocora stellata.* Coral cover of the sand patch was significantly less than 1%.

Outside-reef:

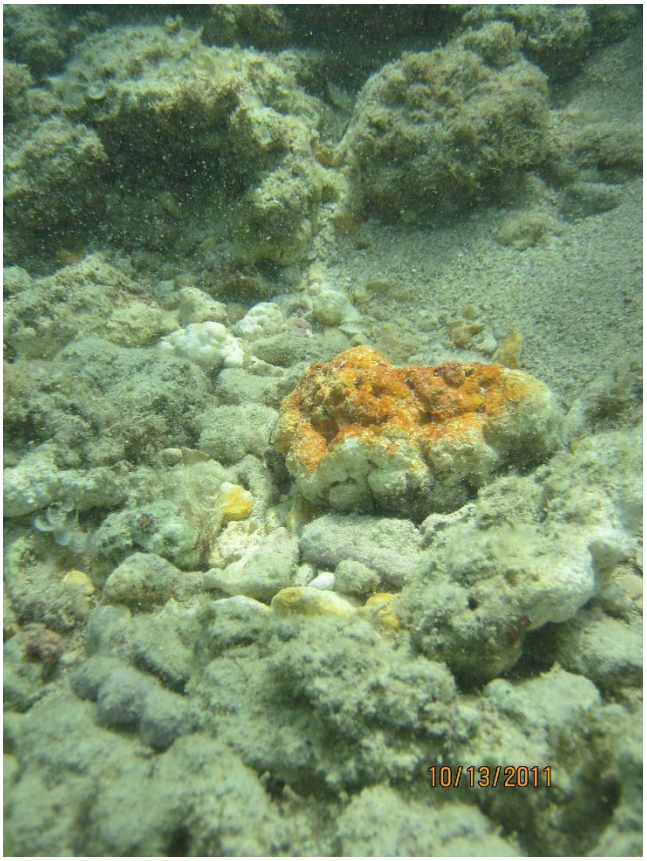
The outside reef was reef flat that gradually shifted into carved out rock at the surf break. The reef flat was covered in algae mats composed of mostly *Padina sp, Gracilaria salicornia* and *Acanthophora spicifera.* There were also high numbers of *Echinometra mathaei* and various species of *Holothurids*. There were more coral species on the outside reef, *Porites lobata, Porites evermanni, Porites compressa, Pocillopora meandrina, Pocillopora damicornis* and *Leptastrea purpurea.* The coral colonies were also significantly larger than those on the inside reef. In the high wave area of the outside reef there was almost no macroalgae and the predominate coral species was *Pocillopora meandrina.* The coral cover of the outside reef was less than 5%. There was a significant increase in fish diversity from the inside to the outside reef. Among the fish observed were, Acanthurus *triostegus, Acanthurus leucopareius, Acanthurus nigroris, Naso unicornis, Naso lituratus, Chlorurus perspicillatus, Gomphosus varius, Thalassoma duperrey, Thalassoma trilobatum, Parupeneus cyclostomus,* and *Parupeneus multifasciatus.* The inside reef was dominated by juvenile fish while the outside reef hosted large adults. The topography was more rugous on the outside reef, which can support larger populations of fish.



RANDOM LOCATIONS																				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
7	55	68	120	143	283	150	180	84	74	263	215	157	256	91	234	58	25	159	154
92	83	96	138	149	257	259	297	371	506	509	542	607	614	654	797	806	826	910	945

Queen's Surf Seawall Project - Nearshore Survey of Benthic Habitat - Random Point Notes		
Point #	fish present	notes
1	0	entire quadrat on sand above water
2	0	rubble covered with sand fair amount of ulva
3	0	rock rubble with lots of sand covering it, large rock in center of quadrat, pedina and A. specifera present
4	0	rubble with sand, more algae (A. specifera and G. saliornia mat)
5	0	small rubble with sand, small clumps of A. specifera, small 10cm P. meandrina colony just outside of quad
6	0	mostly sand with larger grain size, a few pieces of rubble
7	0	sand patch with large wave ripples (15-20cm from crest to crest)
8	0	rubble area covered with marcoalgae, lots of A specifera, dictyota and turbinaria, 1 E. mathaei
9	0	shallow inside site, rubble covered almost entirely by G. salicornia mat, also pedina present, 15cm P. stellata and 5cm P. meandrina colony near quad
10	Mulloiditchthys flavolineatus	shallow rubble and sand mized with larger rocks, algae present - dictyota, halameda, pedina and trubinaria, 15cm P. meandrina colony near quad
11	Thalassoma duperrey	Med-Small rubble with some larger rocks, G. salicornia mats, 1 Holothuria difficilis, 1 5cm P meandrina colony in 4th pic
12	0	Rubble and sand with sparce algae (pedina and turbinaria), 10cm P. compressa colony near quad
13	0	Some rubble and sand but more large rocks covered in macroalgae (pedina and G. salicornia mats, this site is on the edge of the sand patch
14	0	small rubble covered with sand, very sparce algae
15	0	med rubble with tuffs of algae (mostly A. specifera, neomeris, turbinaria), site shallow and murky, 1 large Holothuria difficilis in 4th pic
16	Cymolutes lecluse	sand patch with small pieces of rubble with small pieces of A. specifera on them
17	0	shallow, rubble covered with marcroalgae (dictyota, turbinaria, G. salicornia and pedina) with larger rocks, 25cm P meandrina colony near by
18	0	very shallow, rock bench covered with macroalgae (mostly A. specifera and G. salicornia), murkey, right next to aquarium outflow channel
19	Naso unicornis, Acanthurus triostegus, Zanclus Cornutus, Acanthurus nigrofuscus, Chaetodon lunula, Thalassoma trilobatum	on the egde of dropoff of large rock bench covered with marcoalgae (turbinaria, microdictyon, A. specifera, and Dasya iridescens), 15cm P meandrina colony near by
20	Mulloiditchthys flavolineatus, Acanthurus triostegus, Acanthurus xanthopterus, Acanthurus nirgrofuscus, Scarus sp	in sand right in front of rock bench, 2 15cm P meandrina colonies and 8 <5cm C. ocellina colonies near by on wall of bench dropoff

Queen's Surf Seawall Project - Nearshore Survey of Benthic Habitat - Transect Notes		
Transect (feet from shore)	Fish Present	Notes
50'	Cheilio inermis	mixed rubble and sand, lots of A. specifera and dictyota, only 2-3 E. mathaei
150'	Arothron meleagris	rubble coverd with sand, algae very sparce (turbinaria, A. specifera, pedina and G. salicronia, only a few larger rocks in area
250'	Dascyllus albisella, Thalassoma duperrey	rubble with sand and more larger rocks which are all covered with algae
350'	Thalassoma duperrey, Thalassoma purpureum, Thalassoma trilobatum, Rhinecanthus rectangulus, Acanthurus triostegus, Zanclus cornutus, Naso unicornis, Plectroglyphidodon imparipennis, Chaetodon lunula	right off reef after sand patch, lots of algae (G. salicornia, mircodictyon, and turbinaria), 40cm M. capitata and 25cm P. evermanni near end of transect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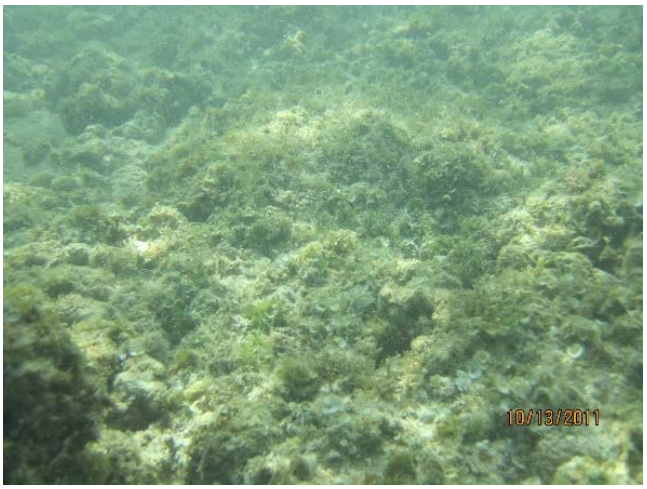
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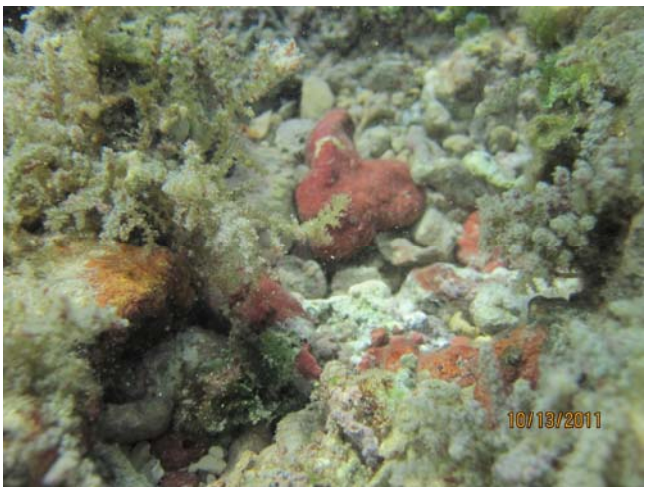
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APPENDIX D

Condition Assessment Report

CONDITION ASSESSMENT AND RECOMMENDATIONS FOR REPAIRS AND MODIFICATIONS FOR THE QUEENS SURF SEAWALL AT KAPIOLANI REGIONAL PARK TMK: 3-1-30:001, 002, 003, 004 & 005, 3-1-31:004 & 005

I. Overview

The Queen's Surf seawall extends approximately 1,270 linear feet from its northern end near the Queen's Surf Groin to its southern end close to the Waikiki Natatorium. See FIGURE 2. The State of Hawaii owns 3 of the 5 parcels landward of the existing seawall and the City and County of Honolulu (CCH) owns the remaining 2 parcels. See FIGURE 1. CCH leases the State parcels and is required to maintain the seawall under Executive Orders 1438, 1689 and 1817.

The existing seawall is eligible for the Hawaii Register of Historic Places under Criteria A (Events – development of private homes within Kapiolani Park) and Criteria C (Architecture – wall development design to protect private homes. The Queen's Surf property (including the seawall) was once the home of C. R Holmes, heir to the Fleischmann yeast fortune and owner of Hawaiian Tuna Packers and Coconut Island. The portion of the seawall proposed for repair is bounded on the north by the Queen's Surf Groin and on the south by the Waikiki Aquarium, an approximate length of 936 linear feet. Station references have been established starting from the north end of the project. Appendix A contains the approved Certified Shoreline Map and referenced photos.

Historical accounts (Robert Weigel 2002 and Crane 1972) indicate that original segments of the seawall were constructed in the 1920's using concreted rubble, cast in place concrete, and cinder blocks. According to available as-built plans, the wall was found to be in a deteriorated condition in 1987 and repaired by the Department of Parks and Recreation. These repairs covered a length of approximately 460 linear feet between the north end of the planter box to the area near the steps, adjacent to the Waikiki Aquarium. Deteriorated concrete rubble masonry (CRM) sections of the wall that had been built onto the original 1-1/2 foot wide concrete cast in place (CIP) wall were removed and replaced. The reconstructed wall is now comprised of 1 or 2 layers of CRM, using blue rock around the original CIP wall. The reconstructed sections were dowelled into the original concrete wall with 1-inch diameter galvanized steel dowels spaced at 24- to 36-inches on center. The resulting wall averages 30 inches in width and ranges in height from 5-feet to 6 1/2-feet and is topped with a 3-inch thick cement mortar cap. The plans show in some areas existing concrete benches landward of the wall have been installed previously to provide additional support.

FIGURE 1. OWNERSHIP OF PARCELS FRONTING QUEEN'S SURF SEAWALL

This report develops alternative conceptual proposals to repair and/or reconstruct damaged areas. As requested by the City, Oceanit looked into raising portions of the wall to mitigate the effects of wave splash on the land side of the seawall. Other alternatives considered were: a) constructing a supporting concrete wall mauka of the existing seawall, b) building a supporting and protective structure at the wall's seaward face and c) using permeation grouting. The ideal design would prevent the reoccurrence of voids at the bottom of the wall, slow down the undermining of the foundation, and reduce wave splash and resulting soil erosion behind the wall.

II. Condition Assessment

<u>North end of existing seawall, between station 0+00 and 1+96</u> is comprised of a 12-inch wide by 8-inch high, cast- in-place (CIP) concrete curb on top of one or two horizontal layers of concrete rubble masonry (CRM). There is a sloping concrete ramp on the landside of the wall from 1+50 to 1+96. Portions of the concrete curb have longitudinal cracks due to corrosion of the reinforcing and should be repaired.

Station 1+96 and 4+46. Seawall has a decorative bullnose cast near top of the wall. There is evidence that a finish coating of concrete or plaster over a steel mesh was originally used. Some minor cosmetic repairs to the wall face will be required in this section.

Between station 0+00 and 4+46 the seawall is fronted by a sandy beach to a height of roughly 1 foot above mean sea level (msl). The base of the remaining length of wall is below msl. The seawall appears to have been constructed on a coral formation foundation at low water (Crane 1972 and Noda 1991). This was noted during the geotechnical investigation and verified by Boring B-1.

There is a CRM coastal planter box approximately 98 feet wide between stations 4+46 and 5+82. On its north end the planter box protrudes into the ocean approximately 27 feet from the main seawall alignment. On its south end the planter box protrudes 12 feet from the main seawall alignment. The wall of the planter box is 2 to 2-1/2 feet thick and appears to have numerous increments of construction and repairs. This is evidenced by the different stone sizes, lay patterns and distinctive layers of CRM installations and cold joints in the CIP concrete.

At the base of the seawall between stations 6+85 and 7+70 is an extension of what appears to be a concrete wall footing past the seaward face of the wall.

Most of the CIP wall faces have been eroded to the extent that the cement between the aggregate has been eroded away leaving only the exposed aggregate.

Recent visual inspections of the wall revealed no signs of overturning or sliding. However sections of the wall show signs of damage from wave action, aging effects, corrosion of reinforcement and undermining. Numerous areas of localized damage were noted.

Voids at Base of Wall. Of greatest concern are the large voids at the base of the wall in multiple areas, where wave action has eroded the coral on which the wall is founded. The geophysical survey conducted in October 2011 found at least 5 voids at the base of the seawall at multiple places. These voids were found along the entire south portion of the seawall between stations 5+70 and 8+15 and ranged in length between 10 and 40 feet. The total length of observed voids was 245 feet. The Contractor will need to estimate the extent of these foundation voids relative to the wall's width prior to filling.

Near surface voids at the back (land side) of the wall were also detected during the geophysical survey between station 6+10 and 6+30.

Horizontal voids were observed between the CIP and CRM wall layers. These voids were probably caused by erosion or deterioration of the concrete at its cold joints.

Other damages observed were vertical cracks in the south corner of the coastal planter box at approximate station 5+70, loose or missing stones and eroded mortar in the CRM construction. . Wave action and abrasion combined with sulfate attack from the seawater and exposure to low pH groundwater has eroded the mortar between the stones.

Water from wave surge and tidal action is currently flowing back and forth through the recesses of the wall removing the finer materials and contributing to further undermining. Depending on the amount of fines remaining behind the wall, this continual back and forth of flows will continue to undermine the foundation and cause settlement behind the wall.

Appendix B shows the plans and elevations of the existing wall and also provides descriptions of conditions observed during field inspections conducted in January 2015 and August 2015 and detected during the geophysical survey.

FIGURE 2. SECTION OF WAIKIKI QUEENS SURF SEAWALL TO BE REPAIRED

III. Analysis of Existing Seawall

A. General

State Historic Preservation Division (SHPD) of the Department of Land and Natural Resources (DLNR) has stated their preference that repairs emulate the existing wall design. The Office of Conservation and Coastal Lands (OCCL) has also stated their preference that seawall repair options not include additional hardening of the coastline. Staying within the existing dimensions and footprint of the wall would probably avoid triggering of permits from OCCL. However, preserving the historical significance of the wall by using similar repair materials is only a secondary project goal, overridden by wall strength and public safety concerns.

The Department of Design and Construction of the City and County of Honolulu (DDC) advised that the repaired seawall will not need to be designed to withstand hurricane or worse case tsunami forces.

The seawall repair design will be done in accordance with the Shore Protection Manual. This manual provides guidance for the application of techniques for coastal design solutions.

B. Geotechnical Exploration and Evaluation - Yogi-Kwong Engineers (YKE)
[See Appendix D]

Two geotechnical field explorations were performed to evaluate the subsurface conditions within the project area. The first exploration was done in October 2011 and included 2 test pits 3 feet below the ground surface, 8 dynamic cone penetration (DCP) tests to a maximum depth of 3 feet and a geophysical survey along the top of the seawall approximately from stations 4+46 to 9+00. The geophysical survey confirmed the presence of numerous voids at the base of the seawall between stations 5+70 and 8+15.

A supplemental geotechnical exploration was performed in November 2014 and consisted of 2 exploratory borings to depths of 26 feet and 26.5 feet. YKE's geotechnical findings and foundation recommendations were used in support of the proposed repair of the existing seawall, including an alternative to build another wall behind (landside) the seawall for additional support. Refer to Geotechnical Exploration and Evaluation Report, January 2015.

Three (3) predominant soil or geologic units were encountered during the 2 borings; Fill, Beach and Coralline Deposits, and Lagoonal Deposits.

Fill was encountered in Boring B-2 located east of the seawall near station 8+15 down to approximately 2.5 feet below ground surface (bgs) and consisted primarily of brown sandy silt with gravel.

Beach and Coralline Deposits were encountered in Borings B-1 and B-2 at the existing ground surface and from 2.5 feet bgs, respectively. The beach deposits generally consisted of very loose to dense, brown, light brown, tan and off-white, poorly graded coralline sand with silt, trace gravel and shells.

Lagoonal Deposits were encountered in both borings at depths of 12.5 and 15 feet bgs. These deposits consisted of very loose to medium dense silty coralline gravel and sand.

C. As-built Conditions

Based on available as-built plans (DDC File No. 87/DH-15, *Reconstruction and Repairs to Existing Seawall* dated February 1987), the seawall was built in two (2) different configurations. The 'Type A' section which is the main portion of the seawall parallel to the shoreline and the coastal planter box protruding into the ocean consists of the original CIP wall approximately 1 foot thick, topped by a CRM layer. The existing composite seawall varies in thickness between 2 feet and 2-1/2 feet. Refer to FIGURE 3 and Appendix E.

Two 'Type B' walls intersect the 'Type A' wall; one at the south end of planter box and the other at about station 6+75. They are constructed of CRM, about 1-1/2 feet wide and are less than 1 feet in height.

Backfill behind the structure consists of 18 inches of sand underlain by 18 inches of crushed rock fill over geotextile fabric. Several sections of slopes along the back face of the wall were measured at 5.5V:1H during YKE's Geotechnical Exploration. These slopes vary along the wall's length.

During excavation for the test pits on the land side of the seawall, large boulders and cobbles of concrete debris and coral were encountered from approximately 1 to 3 feet below the existing ground surface.

D. Design Capacity

The design soil retaining capacity of the composite wall repaired in 1987 has been reduced by erosion and weathering. The following design values and capacities are for worst case scenarios. Quantifying the composite wall's design capacity and the reduction in design capacity is not possible without knowing the full extent of the spalling, corrosion and voids in the structure.

<u>Sliding failure</u>. The calculated factor of safety for sliding is 0.61, which is below the acceptable value of 1.5.

<u>Overturning failure</u>. The calculated factor of safety for overturning is 1.72, above the acceptable value of 1.5. This value is considered borderline but acceptable.

Foundation Bearing Capacity. The calculated foundation bearing capacity of the wall 7,016 lb/ft^2 exceeds the maximum allowable bearing capacity of 1,500 lb/ft^2. The wall's poor overall condition and structural deficiencies makes repair of the wall a high priority. For unknown reasons the wall has not failed. This could be because maximum loading has not been reached and/or loads have been redistributed to other areas of the wall that have higher bearing capacity or stronger foundations. Adjacent areas of the wall may be carrying more load than other areas. The structural analysis does not take into account the reinforcing bars along the wall between the original CIP section and the CRM layers and the unknown extent of concrete benches installed in 1987 to support portions of the wall from the land side.

Strength of Joints. Significant amounts of cement mortar have washed away from the wall, leaving exposed aggregates and voids. This condition makes the strength of the wall both at the base and internally questionable. Exactly how weak the joints are throughout the wall is unknown and would require determining the locations and extent of all the voids.

See FIGURE 4 for structural analysis calculations.

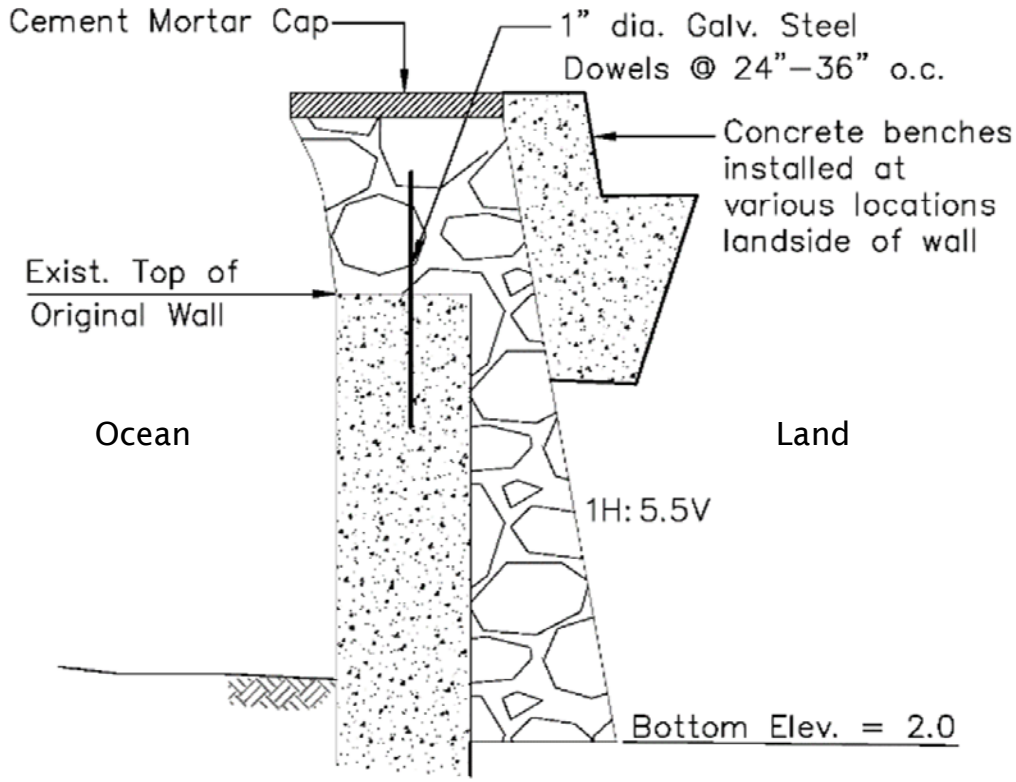


FIGURE 3. TYPICAL TYPE 'A' WALLSECTION

STRUCTURAL ANALYSIS OF WAIKIKI CRM SEAWALL

WALL HEIGHT = 6.0' **TOTAL HEIGHT = 6.5'** Bottom of foundation varies

			Wall Section	Section Height	Section Thickness		Force	Height	Moment
Bearing	1500.00	lb/ft^2	H1	1.0	2.00	Fsoil	1584.38	2.17	3432.81
Friction coeff., μ	0.40		H2	1.0	2.27	Feq	0	3.9	0
Horiz. active pressure, Kactive (h)	75.00	lb/ft^3	H3	1.0	2.53	Fwind	0	6.5	0
Passive pressure, Kpassive	300.00	lb/ft^3	H4	1.5	2.80	Fsursoil	487.5	3.25	1584.38
Soil density, γ_{soil}	120.00	lb/ft^3	H5	1.5	3.20		2071.88		5017.19
Footing density, γ_{ftg}	0.00	lb/ft^3							
Rock wall density, γ_{Stem}	140.00	lb/ft^3	Toe	0.54		Slope H	0.00		
Permanent cover, toe covered	yes		Heel	1.19		Ffriction	1228.40		
Vertical active pressure, Kactive (v)	0.00		Footing	0.00		Fpassive	37.50		
Cohesion bet. wall and subgrade	0.00		Surcharge	1.00		Cohesion	0.00		
Wind Velocity	N/A		Cover	0.50	3.73	Footing L	3.73		
Wind variable, Exp	N/A		Key	0.00		e	1.57	outside kern	
Wind variable, Ce	N/A		Hextra	0.00	2.00				
Wind variable, Cq	N/A		Slope	100000000: 1.00(V)					
Wind variable, EQ	N/A								
Seismic loads	N/A								

FSoverturning	1.72	>	1.5	OK, but borderline
FSsliding	0.61	<	1.5	Sliding is a problem
	7015.94	>	1500.00	Bearing is a problem

	Weight	Horiz. Distance	Moment
Soil 1	464.75	3.34	1550.46
Soil 2	16.25	0.18	2.93
Slope	0.00	3.34	0.00
Surcharge	0.00	3.14	0.00
Kactive	0.00	3.73	0.00
Stem 1	280.00	1.54	431.67
Stem 2	336.00	1.59	534.80
Stem 3	373.33	1.64	612.89
Stem 4	630.00	1.69	1065.75
Stem 5	970.67	1.77	1714.84
Ftg	0.00	1.87	0.00
	3071.00		5913.34

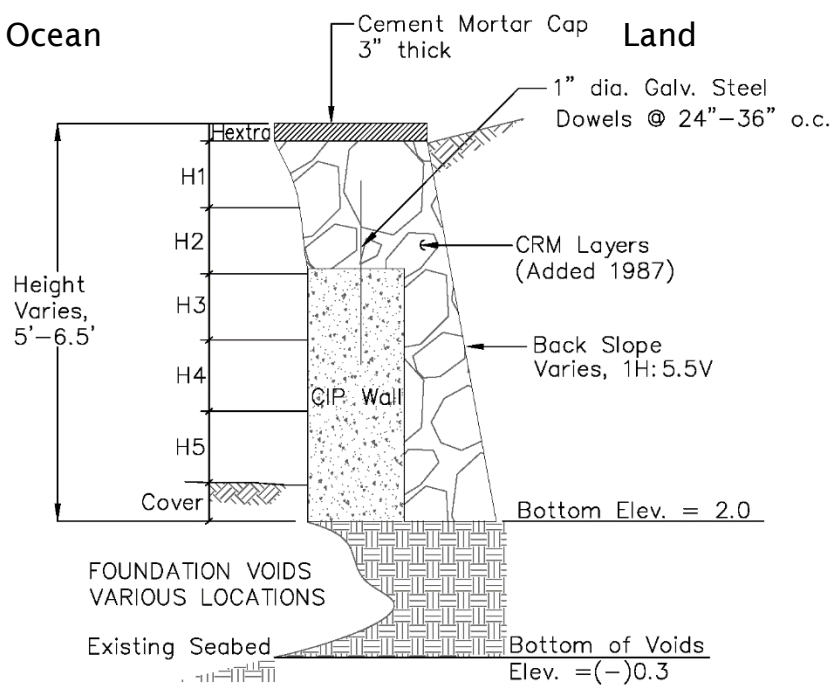


FIGURE 4. STRUCTURAL ANALYSIS OF EXISTING COMPOSITE SEAWALL

IV. Repair Alternatives Considered

Reconstruct failed sections of wall with special concrete. Due to the seawall's fragile condition, extreme care needs to be taken to prevent collapse of the seawall during repair work. The construction plans shall include details for complete reconstruction of sections of the wall, should that be required. The collapsed sections would be constructed with special concrete (Class "B" or better) in accordance with the Standard Specifications for Public Works Construction, of the Department of Public Works, City and County of Honolulu. Reconstructing the entire length of seawall is not anticipated, but if portions of the seawall do require reconstruction, the new wall should emulate the existing wall shape. See FIGURE 5.

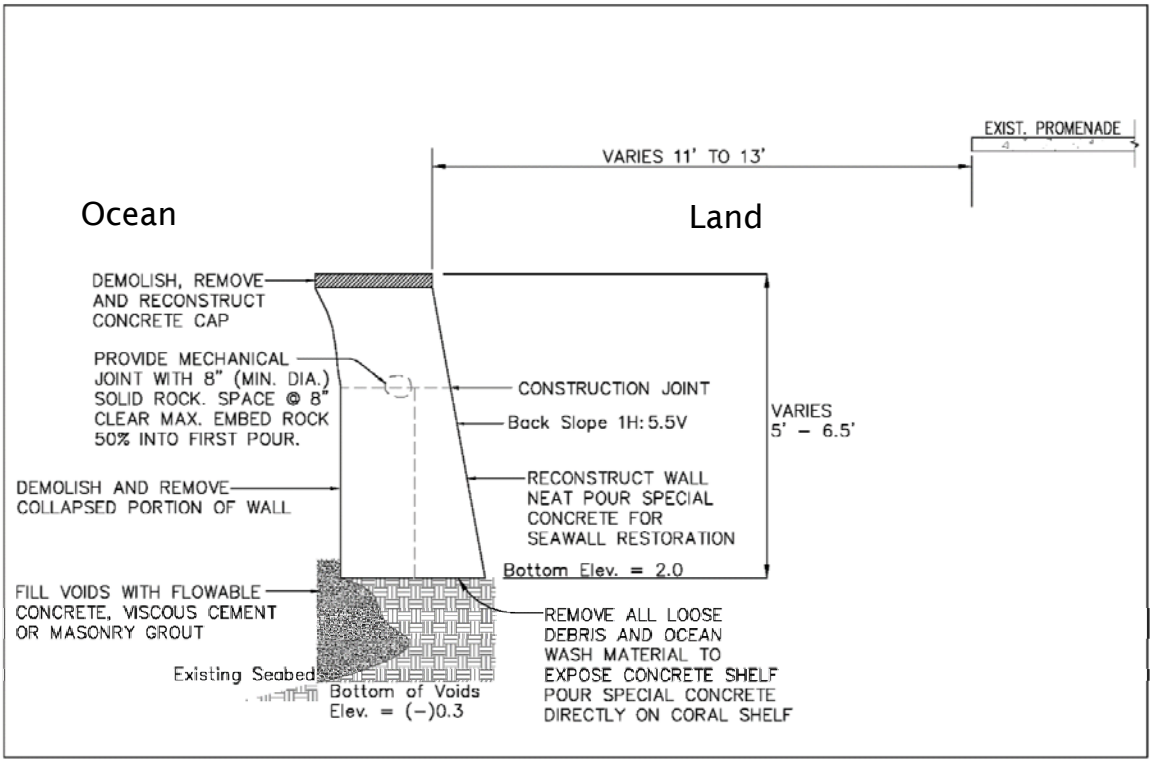


FIGURE 5. RECONSTRUCTED SEAWALL TYPICAL SECTION

Filling of Wall and Foundation Voids. All repair work to fill voids should be done at low tide. This is especially critical for the foundation voids. Prior to void filling, remove algae and seaweed (limu) from existing surfaces. There are many methods that can be used for filling the foundation voids of the seawall. Some of these methods include:

- Drypacking using a rapid setting cementitious material. Utilize structural fibers for added toughness to the patch material. This would be the least costly but may not completely fill the void cavity.

- Shotcreting the voids to assure a denser installation of the concrete. The main disadvantage is the likelihood of rebound into the ocean.

- Geotextile systems comprised of high strength synthetic fabric (marine geotubes) filled with mortar. An appropriately sized geotube could be placed in the void and then pumped with mortar until the cavity was filled. Careful monitoring of pumping rates and filling of the geotube would prevent excessive stress on the seawall during repairs.

- Grout or concrete bags filled with fiber-reinforced concrete can also be used to fill the foundation voids.

- Flowable concrete, viscous cement or masonry grout can also be used for filling the voids in the seawall foundation. Fiber reinforcement material for added strength and a washout resistant admixture could be added to the concrete.

Permeation Grouting.
Permeation grouting is the recommended method for filling wall foundation voids and strengthening the wall. This method would allow repairs to be confined to the existing composite CIP/CRM wall envelope.

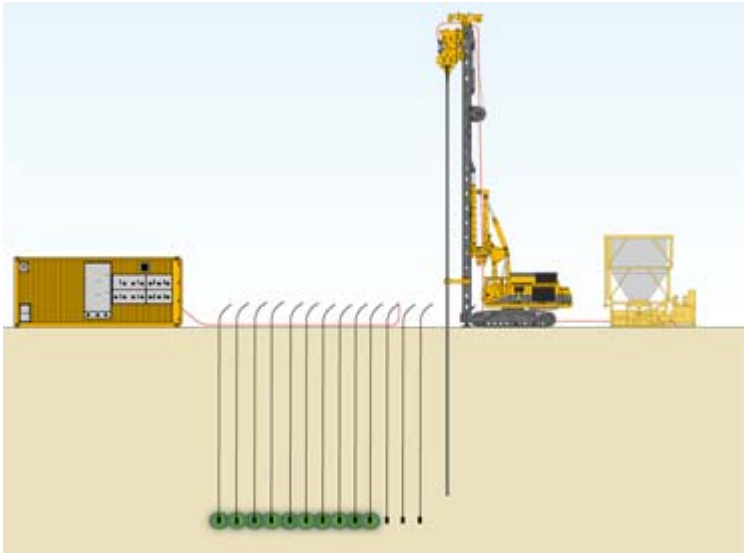


FIGURE 6. TYPICAL PERMEATION GROUTING ALONG A HORIZONTAL STRUCTURE

Large foundation voids detected in various segments of the seawall between the area south of the planter box to the wall fronting the aquarium will be filled. During geophysical surveys conducted for this project in October 2011 these large foundation voids were found in more than half (245 feet) of this segment of the seawall.

Initial filling of the voids would be done during low tide with rock fill. Approved best management practices would be required to be in place prior to wall repairs. The rock-filled void could then be supported with plywood, steel sheet, stone, sandbags or other approved containment. Because of the existing poor condition of the seawall the Contractor may also be required to brace the wall during drilling and permeation grouting.

The methodology for permeation grouting operations is as follows:

- Approximately 185 3-inch diameter holes would be drilled vertically through the top of the seawall to the wall's foundation depth.

- Polyurethane foam would be injected into the holes to fill voids down to the wall's foundation depth. A polyurethane foam similar or equal to Uretek is recommended because it is structural-grade, long-lasting, hydro-insensitive and environmentally inert (drinking water safe, ANSF-61).
- After the polyurethane foam has cured, a below grade curtain wall would be installed. The 3-inch diameter holes are drilled down to an elevation below that of the seawall foundation.
- The 3-inch diameter holes filled with the polyurethane foam shall be re-drilled to a level past the foundation void and sleeve ports or grout tubes shall be inserted into the holes.
- A chemical polyurethane permeation grout would then be injected to create a below grade permanent curtain wall. A high-strength permeation grout (similar or equal to De Neef Soil PURe) that penetrates well into fine sands and finely cracked rock, is hydrophobic, has excellent durability in seawater, is drinking water safe, and is designed to increase the bearing capacity of the underlying soil is recommended.
- Once the grout curtain wall has cured, a grouted mass of microfine cement would be pumped into the holes at low pressures to minimize fracturing and allow for proper consolidation of the subgrade.
- After completion of the grouted mass, a secondary cycle of grouting may need to be performed landside of the wall to address inconsistencies in the soil or grouted mass due to variations in the density or porosity of the subsurface soil or other subsurface conditions.
- The proposed permeation grout work in the wall shall be designed to cement and stabilize the wall foundation and soils within the subgrade at the points of injection. This work may cause an increase in undermining in other "hot spot" areas. If required, the holes for a secondary row of grout injection shall be drilled vertically on the land side of the wall and staggered horizontally from the primary row.
- The structural engineer has determined that the existing seawall has an issue with foundation bearing. The seawall is currently unstable due to erosion at the wall foundation. It is recommended that a project allowance be made for rebuilding of a failed wall section approximately 50 feet long. Cost estimates for permeation grouting work are provided with the use of impact drilling of grout holes vertically through the top surface of the wall. Care will be taken to observe the seawall for signs of imminent failure as the drilling progresses. Signs of imminent failure could include major cracking, wall cap separation, or slumping. If any of these conditions are observed, drilling will be halted and the engineer immediately notified. Options should that occur would be switching from drilling to coring, shoring of the seawall, or reconstruction of the wall section.

The curtain wall and microfine cement create a grouted, water impermeable mass that cements the existing underlying soils in place and prevents future undermining. A permeation grout (similar or equal to De Neef MC-500 Microfine cement) that is unaffected by acids, gasses, or microorganisms in the soil or surrounding environment is recommended.

Construction Best Management Practices (BMPs). A comprehensive BMP plan shall be prepared for the project to prevent pollution of state waters from all construction activities. Prior to construction activities, appropriate in-water BMPs shall be set up on the seaside of the seawall. BMPs for wall and foundation repairs include filling the foundation voids with rocks and grout only during low tide. Possible methods to support the makai surface of the filled-in void cavity to minimize any spillage of polyurethane foam or grout into the ocean include plywood, steel plate, stacked rocks, sandbags, bulkbags or geobladders filled with seawater.

The recommended method for repair of voids between wall layers is flowable concrete. Filling these voids will help extend the service life of the seawall.

Near surface voids at the back (land side) of the wall at station 6+10 and 6+30 can be filled with geotextile fabric and on-site fill material.

Repair of Wall Mortar. Attack from the seawater has eroded the mortar between the stones. Many stones are loose or missing. Eroded wall mortar sections should be repaired using either high performance cementitious mortar or epoxy mortar.

Repointing the joints with a high performance cementitious mortar which is resistant to sulfate attack from the seawater. Epoxy mortar may be used as an alternative to cementitious mortar.

Subsurface Drain system including Wall Weepholes. The seawall is regularly overtopped by waves and results in the pooling of water on the land side. Regular overtopping has caused damage to the wall structure. See FIGURE 9 and FIGURE 10. Although an existing subsurface drainage system comprised of 4-inch perforated pipes at about 10 inches below ground surface was found in the test pits at two locations land side of the wall (Yogi-Kwong Engineers January 2012) no weepholes were found in the seawall between the planter box and aquarium. The need for a subsurface drainage system comprised of perforated drain pipe, geotextile fabric, gravel and weepholes in the wall will be evaluated. Drain pipe sizes, spacing and locations of weepholes along the wall's height, and how this drainage system will be installed relative to land side construction shall be determined during the design phase.

Repair of Vertical Crack at outside south corner of Planter Box Wall.
Vertical cracks near the outside corner of retaining walls are common. Any movement of the perpendicular wall sections will “tear” the corner. After probing the retaining side of the walls to assess the backfill and the foundation material the following alternatives were considered:

- Excavating backfill at the corner and pouring a reinforced concrete pier to strengthen and reinforce the corner. Installing epoxy embedded dowels to the existing CRM and CIP walls to tie the existing to the new. Extreme care needs to be taken and/or shoring installed during repair of this corner to prevent wall collapse. See FIGURE 7.

- Installing a drilled shaft to reinforce the corner. This alternative also warrants extreme care to prevent collapse during repairs.

- The recommended method to repair other sections of the wall may work at this corner of the planter box. Fill any voids in the wall’s foundation with polyurethane foam, construct the curtain wall and the grouted mass by injecting through the wall and surrounding areas. A secondary row of holes should be bored behind the wall to stabilize the subsurface soil behind the wall.

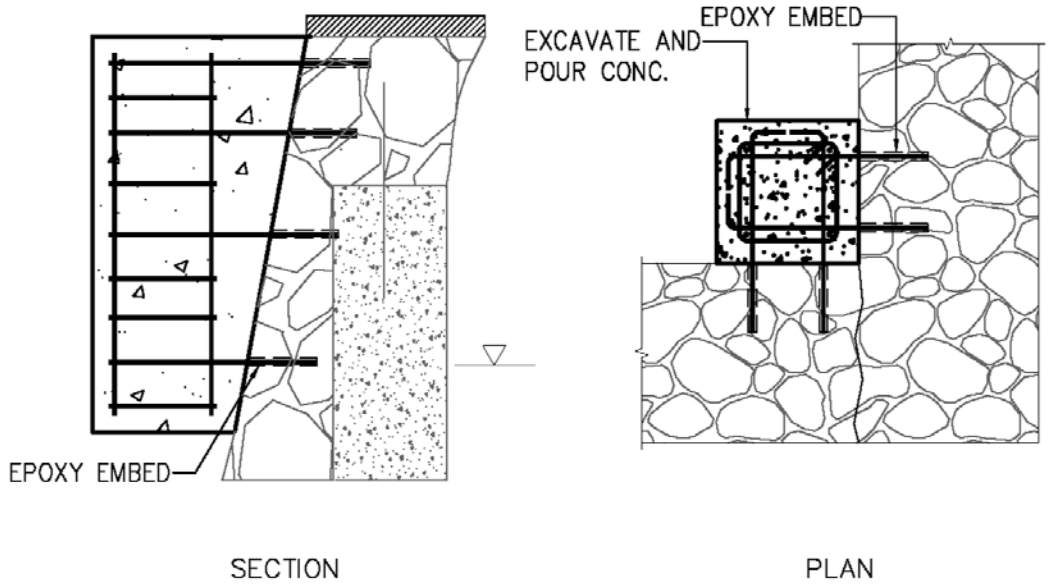


FIGURE 7. REINFORCED CONCRETE PIER TO SUPPORT PLANTER BOX CORNER

Concrete Spalls in Wall. Spalling of concrete may be caused by embedded reinforcing steel which has corroded due to exposure to seawater through cracks or by carbonation of the surrounding concrete. These areas of the seawall are north of the coastal planter box. These repairs will have no impacts on the promenade.

Check the chloride content and carbonation of the existing concrete.

Utilize repair procedures recommended by the International Concrete Repair Institute (ICRI) as described below:

- Where the cross section of existing reinforcing bars has lost more than 25% of its original cross sectional area, replace or splice the bars with stainless steel or glass fiber reinforcing.

- Utilize a high performance concrete repair material with a corrosion inhibiting admixture.

- Add fiber reinforcement to the patching material to increase the cohesiveness and toughness of the patch material.

Corrosion of Reinforcing Steel at Exterior Face of Wall. Corrosion "stains" are remnants of vertical reinforcing bars. The recommended repair is to install replacement vertical steel in accordance with ICRI recommendations.

Non-Structural Damage.

Wall concrete cap spalling. Most of the concrete cap on top of the seawall is in need of repair or replacement. The Contractor should conduct a condition assessment of the concrete cap after completion land side and ocean side construction to determine if any sections are salvageable. Although the cap is more of an aesthetic feature of the wall with minimal structural value, repair or replacement of the concrete cap will help stabilize the wall. A solid cap provides a safer walking surface for the general public and will lessen the City's liability.

Sidewalk curb cracks and spalls. A 12-inch wide by 8-inch high concrete curb between station 0+00 and 2+00 has longitudinal cracks due to corrosion of the reinforcing steel. The recommended repair for badly cracked and spalled sections is to demolish and replace the curb. Utilize GFR longitudinal and epoxy embedded dowels to mechanically attach the curb to the existing sidewalk and provide construction joints at 8-feet spacing.

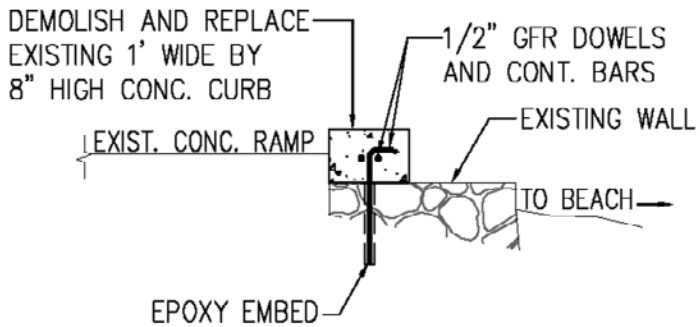


FIGURE 8. CONCRETE CURB REPLACEMENT

Decorative bullnose feature cracks and spalling. This decorative feature is located between station 2+00 and 4+60. The most likely cause of these cracks and spalls is corrosion of the reinforcing steel due to cracks or carbonation. Several attempts to repair and reconstruct this feature are evident. The recommended repair is to repair the bullnose in accordance with ICRI recommendations.

Planter Box Surface Erosion

The sand fill in the planter box is not level. This may be due to sand going over the low point of the wall as waves wash over the wall, or sand leaking through the cracks in the wall. A feasible repair for the planter box needs to be further investigated, including the need for a subsurface drainage system with weepholes in the wall to drain pooled water.

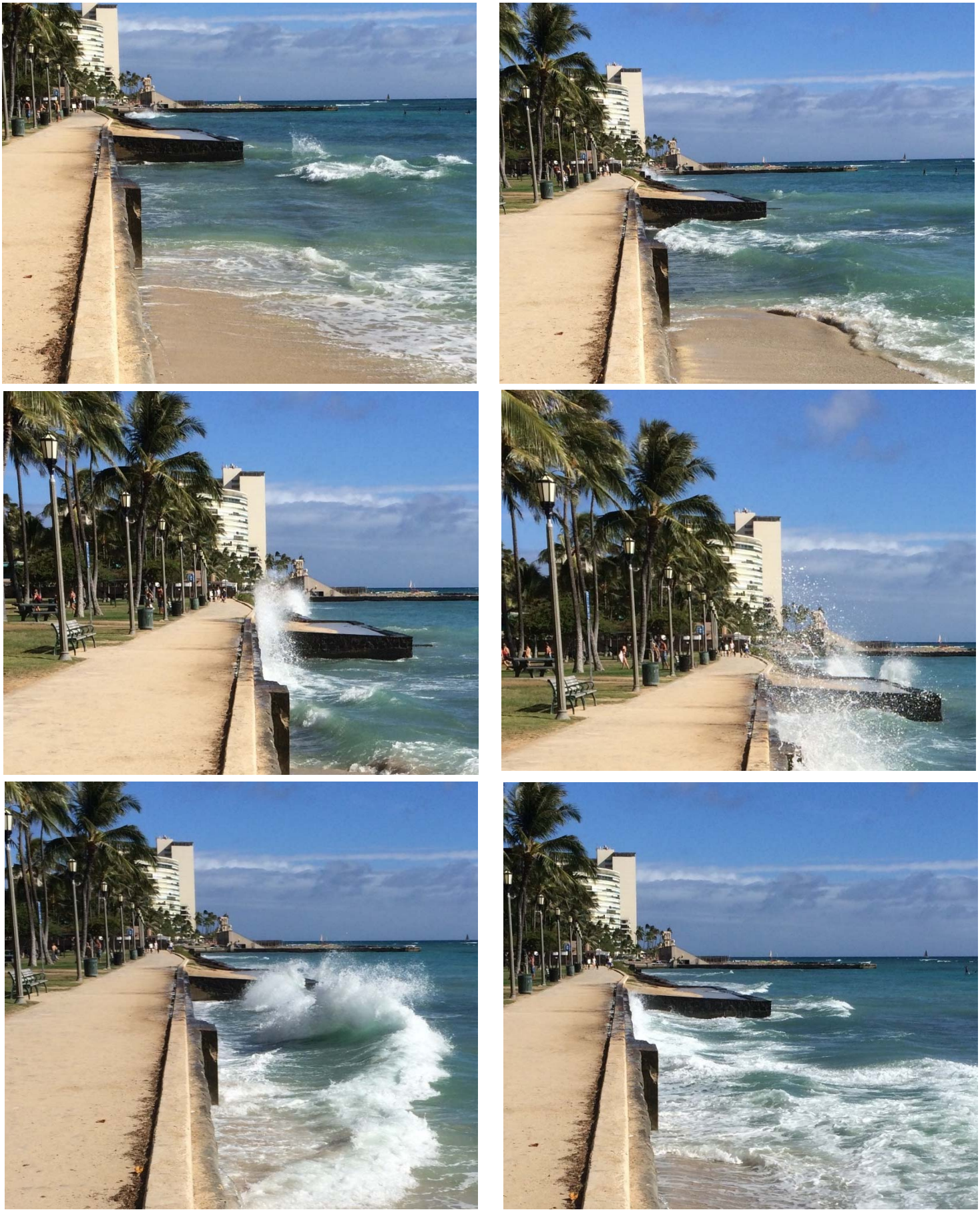


FIGURE 9. WAVES HITTING SEAWALL AT HIGH TIDE JULY 30, 2015

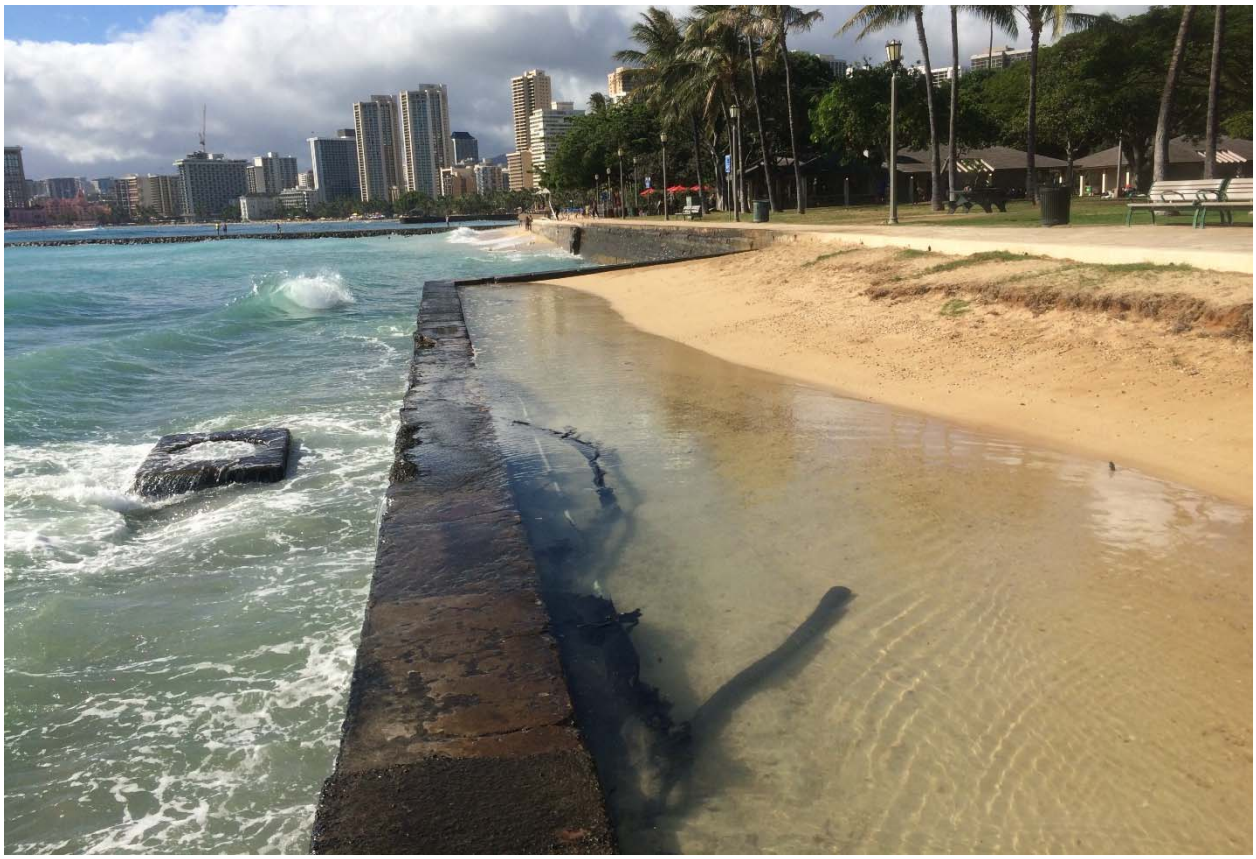


FIGURE 10. OVERTOPPING OF THE SEAWALL PLANTER BOX CAUSING POOLING AND EROSION

V. Alternatives Considered for Seawall between station 4+46 and 9+08

Reconstruct Entire Wall with a New Foundation

The existing seawall appears to be constructed on a coral formation with the coral bed close to the low water elevation. To replace the existing wall with a structurally stable wall in terms of sliding, overturning and bearing capacity, a new concrete wall 6.5 feet high with a 1-foot thick footing down to the scour elevation would be required. A keyway constructed at the midpoint of the footing to resist lateral pressure at the base of the wall is also recommended. A new wall foundation entails reconstructing the entire wall from the south end of the planter box to the wall fronting the aquarium. This alternative would have the longest construction duration and would be the most expensive of all alternatives considered. Extensive excavation and shoring would be required to support the excavated trench and minimize damage to the promenade from settlement. The reconstruction effort would also have severe public safety and environmental impacts.

Even with a new, redesigned replacement concrete wall, the wall's footing would continue to be vulnerable to foundation scouring and undermining due to wave action. Because of this, reconstructing the entire section of wall between the planter box and aquarium was not considered an acceptable alternative.

Raise Height of Seawall

During high surf conditions waves break upon and overtop the wall causing water to pool and erosion of the areas behind the seawall to occur. Wave erosion is the main contributing cause of damage to the wall. During high tide the overtopping becomes more severe. FIGURE 9 shows a typical sequence of waves crashing on the seawall during high tide. FIGURE 10 shows the resulting pooling behind the seawall that contributes to the wall's deterioration.

The seawall varies in height at its seaward face, from 1.5 feet at its north end, where it is fronted by beach sand to about 6.5 feet at the north end of the planter box. The average height of the seawall from the planter box to the seawall's southern end connecting to the wall fronting the Waikīkī Aquarium is 6 feet.

Increasing the height of the existing seawall was considered because of the wave overtopping and resulting erosion on the land behind the seawall. Various alternatives for raising the wall by about 3.5 feet to match the height of the adjoining aquarium wall to the south were evaluated. However, because the seawall's existing structural condition indicated that repairing or reconstruction of the wall would first be required if the wall is raised. It was therefore decided that raising the height of the existing seawall should not be considered unless the existing wall's structural condition was improved to allow it to carry additional dead load.

Rock Revetment on Seaward Side of Seawall.

Filling the voids at the seaward side of the wall's foundation and other parts of the seawall would be a critical and necessary first task for all wall repair alternatives. A structure designed to support the wall on its seaward side, such as a rock revetment structure would significantly dissipate wave energy and reduce wave overtopping,

pooling of water and the resulting erosion of the seawall and landward areas. Most important, the revetment would protect the wall's foundation from wave-induced erosion and the overall life of the wall would be prolonged. An added benefit would be to cover up the abandoned storm water pipes and manholes immediately seaward of the wall, hiding them from public view.

Preliminary design included a single layer of 2.1 foot nominal diameter armor stones, averaging 1,775 pounds. The armor stones would be placed on top of layers of 1 foot diameter bedding stones, 3 inch filter rock, pea gravel, and geotextile fabric. The revetment would provide protection from wave energy to the foundation as well as the lower 2 feet of the seawall.

The seaward face of the revetment would extend from the existing seawall towards the ocean about 16 feet, 9 inches and would be about 4.5 feet thick from the bottom of the void to the top of the armor stone layer.

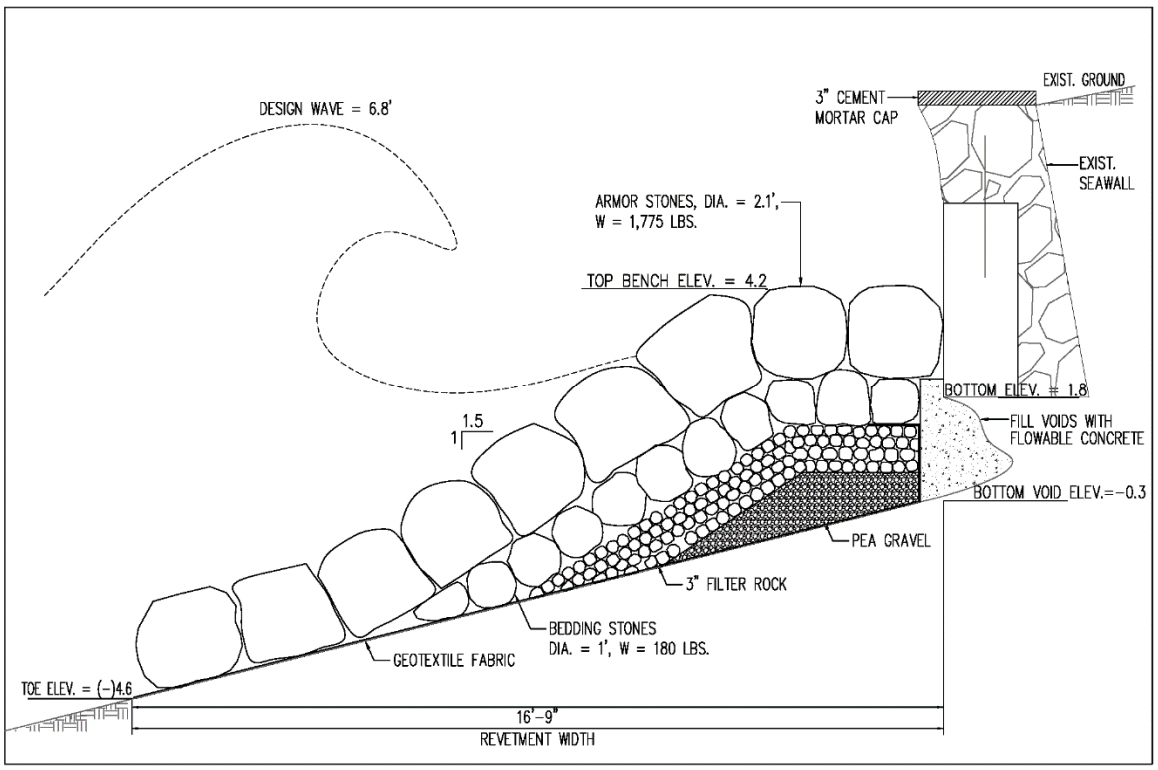


FIGURE 11. ROCK REVETMENT

Rock revetments are moderately priced compared to seawalls, are relatively easy to construct and are extremely durable. Properly designed and constructed structures can last well over 50 years and don't require a lot of maintenance. After installation there may be a short period of time where some maintenance is required as rocks begin to settle, and rocks may need to be added or moved if they become displaced by wave action during large storm events.

Rock Berm at Toe of Seawall.
Filling the voids at the seaward side of the wall's foundation and other parts of the seawall would be a critical and necessary first task for all wall repair alternatives. Once the voids are filled, a rock berm on the sea side of the wall could be installed at the toe of the seawall.

The main function of the rock berm would be to protect the seawall foundation from scour and undermining and reduce wave overtopping. The berm would dissipate wave energy and wave overtopping and erosion, but to a lesser degree than the larger rock revetment.

The rock berm would be about 3 feet thick at the seaward edge of the existing wall and would have a smaller footprint than the revetment, extending 9 feet from wall. The structure would be comprised of one or two layers of 900 pound armor stones with 1,300 pound stones at the toe laid directly on the sea floor.

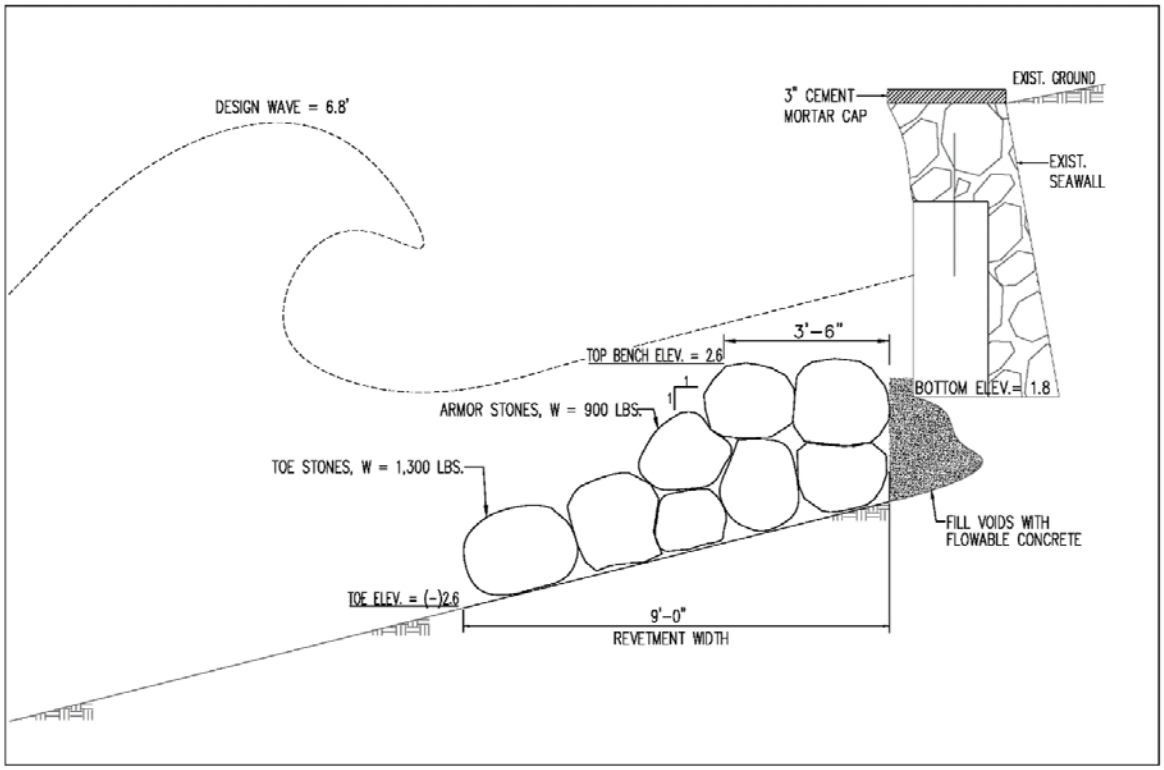


FIGURE 12. ROCK BERM AT TOE OF WALL

Alternate Rock Berm at Toe of Seawall. An alternate configuration for the rock berm was considered and is shown below. Like the previously described rock berm this configuration would also protect the seawall foundation, but with a smaller footprint into the ocean. The berm is comprised of a single layer of 560 pound armor stones laid on two to three layers of 30-pound bedding stones and would extend 2 feet – 6 inch out from the seawall and 2 feet – 6 inch from bottom of the void.

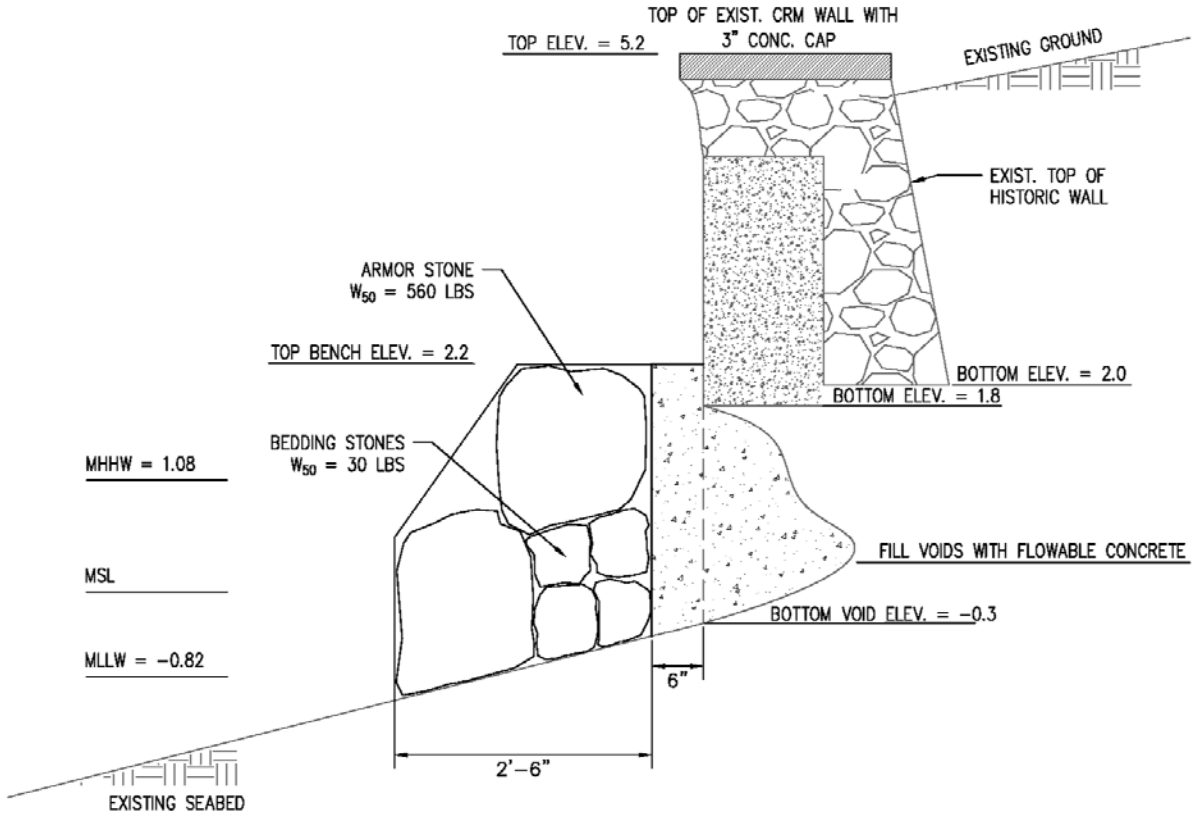


FIGURE 13. ALTERNATIVE ROCK BERM AT TOE OF WALL

Sand filled Container Berm at Toe of Seawall. These containers should be considered as they have been used successfully for coastal protection projects since the 1970s. Sand filled geotextile containers are designed primarily as a user friendly, 'soft' alternative to traditional rock rubble structures such as revetments and berms. They have a proven record of stability over long periods of time; standing up well to wave forces in tests and project sites around the world. They also provide excellent scour protection at the toe of structures and sand retention capacity with a proven record of damage resistance in both accidental damage (due to hazards in the coastal environment) and vandalism.

Major advantages of these containers are their low cost, ability to be rapidly deployed over large areas with the woven geotextile providing relatively high strength at a reasonably lower cost compared to rock berms or revetments. Disadvantages include their manmade appearance and the uncertainty of their effective life span. This

geosynthetic application is still considered to be in its infancy and the long-term life of these structures has been studied, but is not yet known. FIGURE 14 and FIGURE 15 show two berms comprised of sand filled geotextile containers of standard, readily available sizes.

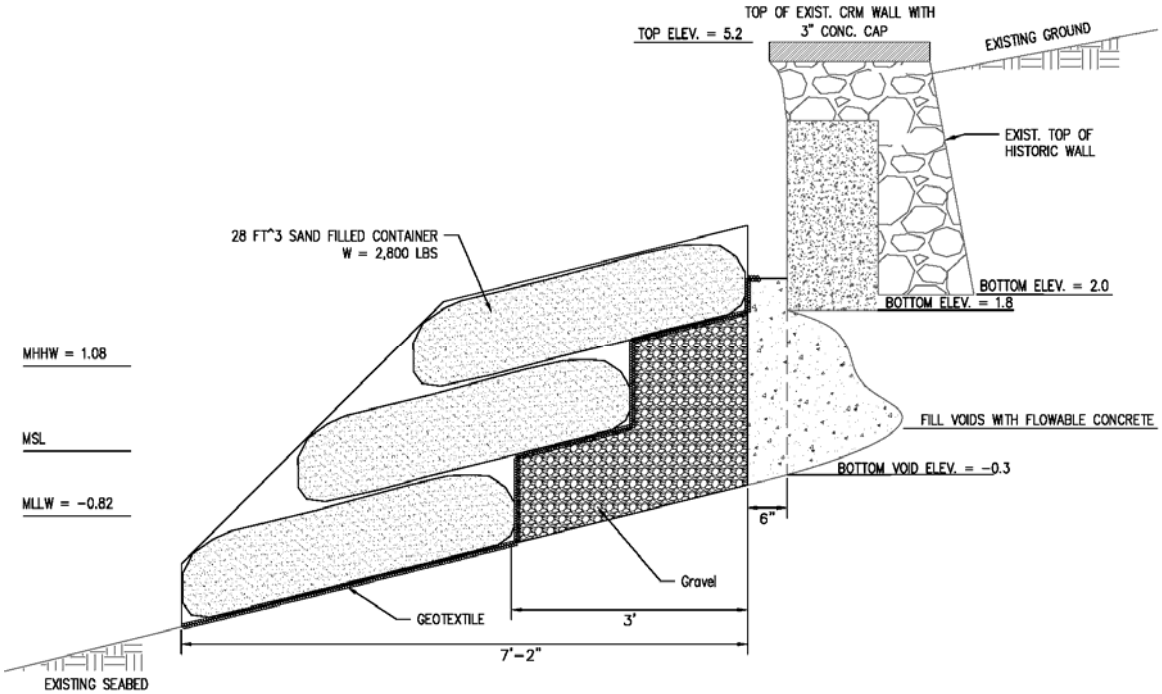


FIGURE 14. LAYERS OF SAND FILLED GEOTEXTILE CONTAINERS

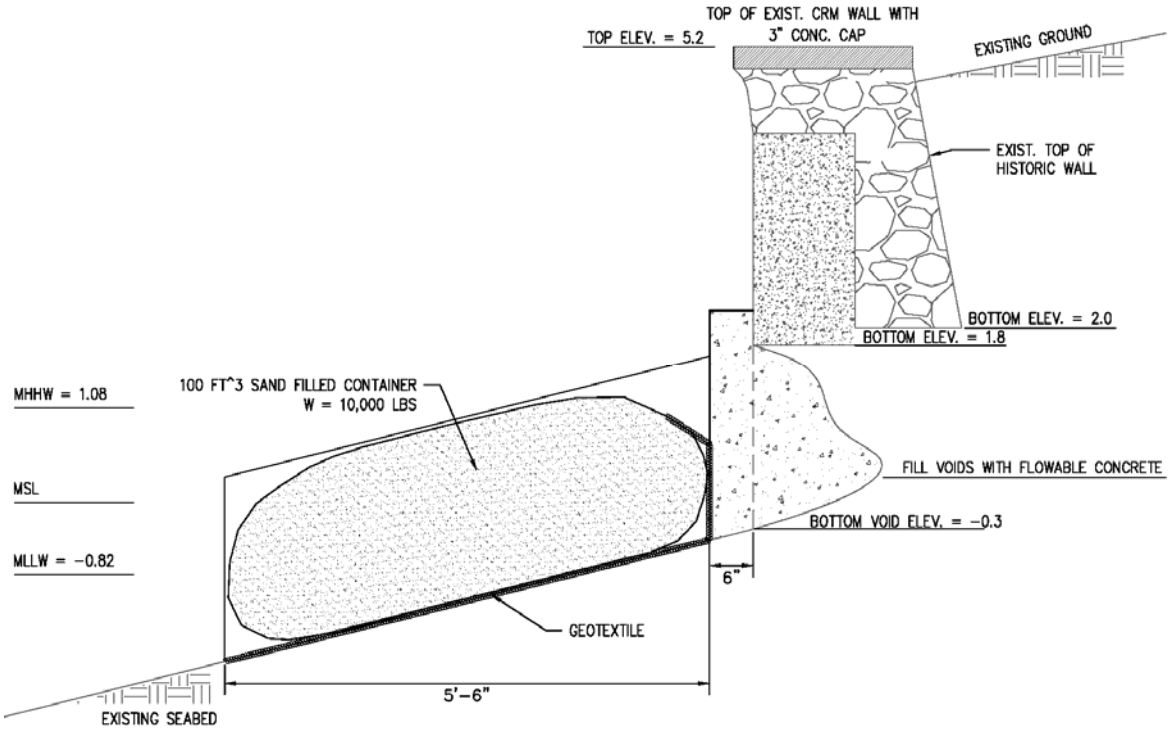


FIGURE 15. LARGE SAND FILLED GEOTEXTILE CONTAINER

Supporting Concrete Wall Behind (landside) Existing Seawall. Filling of seawall voids and placement of a structure to support the wall from the seaside would precede any excavation and proposed structural work on the land side of the seawall.

A suitable cofferdam or bulkhead designed by an experienced Professional Civil or Structural Engineer will be required to prevent any discharge of construction water, debris and/or contaminants into the adjacent State waters.

A Mass Concrete, Reinforced Concrete or Precast Concrete Wall could provide support of the existing seawall on the land side. A reinforced concrete wall would provide greater support for the seawall than the mass concrete wall but would require the use of special or coated corrosion resistant reinforcing bar.

Reduction of lateral earth pressure behind the wall could be achieved by capping the backfill with another layer of concrete. This action would reduce lateral earth pressure to active earth pressure of 35 pounds per square foot per foot of depth.

Based on the YKE's test pit excavations, excavated materials likely to be encountered behind the existing seawall are loose beach sand, gravel, basalt cobbles and boulders. After excavation, the trench bottom shall be sealed by placement of flowable concrete or masonry grout.

Because the existing seawall is in a distressed condition concrete or grout will need to be placed at predetermined maximum lifts and allowed to be adequately set prior to placement of the next lift to reduce lateral loading.

Excavated onsite sand and gravel free of cobbles and boulders may be used as the wall backfill. Appropriate imported backfill with little or no fines should be wrapped in a non-woven filter fabric to minimize the migration of fines and beach sand into the imported backfill material.

YKE's geotechnical exploration also revealed effective sub-drainage behind the proposed reinforced concrete wall does not exist. If a new concrete retaining wall is built, it needs to be designed to resist a horizontal force of 75 pounds per square foot per foot of depth from the existing fills during draw down of the sea level, e.g. during low tides and in extreme cases.

The new reinforced concrete wall footing may be designed for a maximum allowable bearing capacity of up to 1,500 pounds per square foot with a potential total settlement of 1 inch and a potential differential settlement of ½ inch.

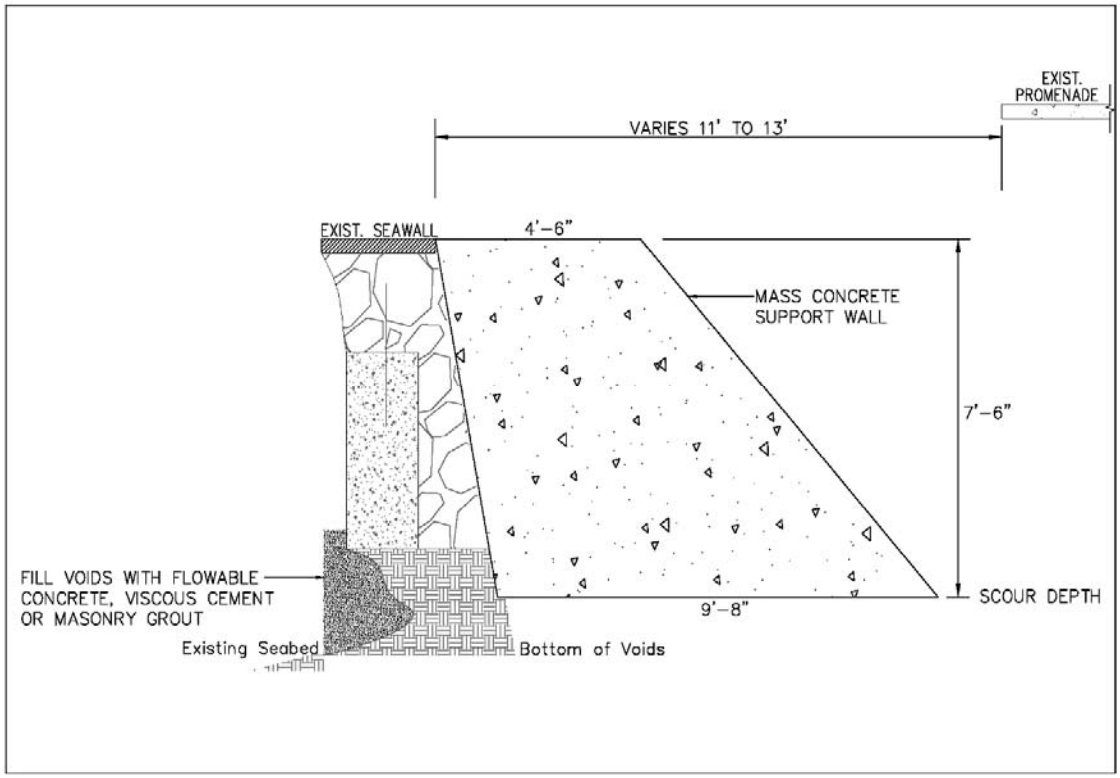


FIGURE 16. MASS CONCRETE SUPPORT WALL

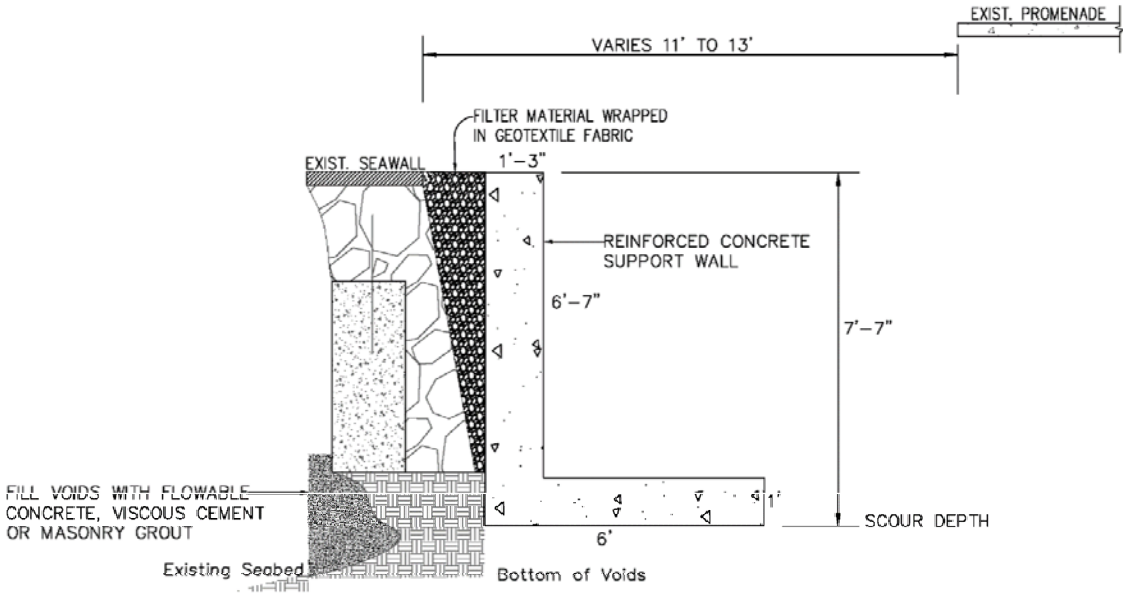


FIGURE 17. REINFORCED CONCRETE SUPPORT WALL

The concrete mixture of the mass concrete wall will have high cementitious material content, which results in high temperatures within the concrete and attendant volume change after hydration. To avoid cracking and other temperature related damage to the concrete, the Contractor must control the maximum temperature and temperature differences between the interior and the surface of the concrete. Construction of a mass concrete wall would be extremely time-consuming, disruptive and expensive.
A supporting concrete wall built landside of the existing seawall could also be constructed of pre-cast concrete wall sections that interlock into place. The pre-cast concrete units could be manufactured off-site, transported to the site and dropped into place. A wall made of pre-cast units will be less likely to crack than a cast-in-place wall.

Permeation Grouting

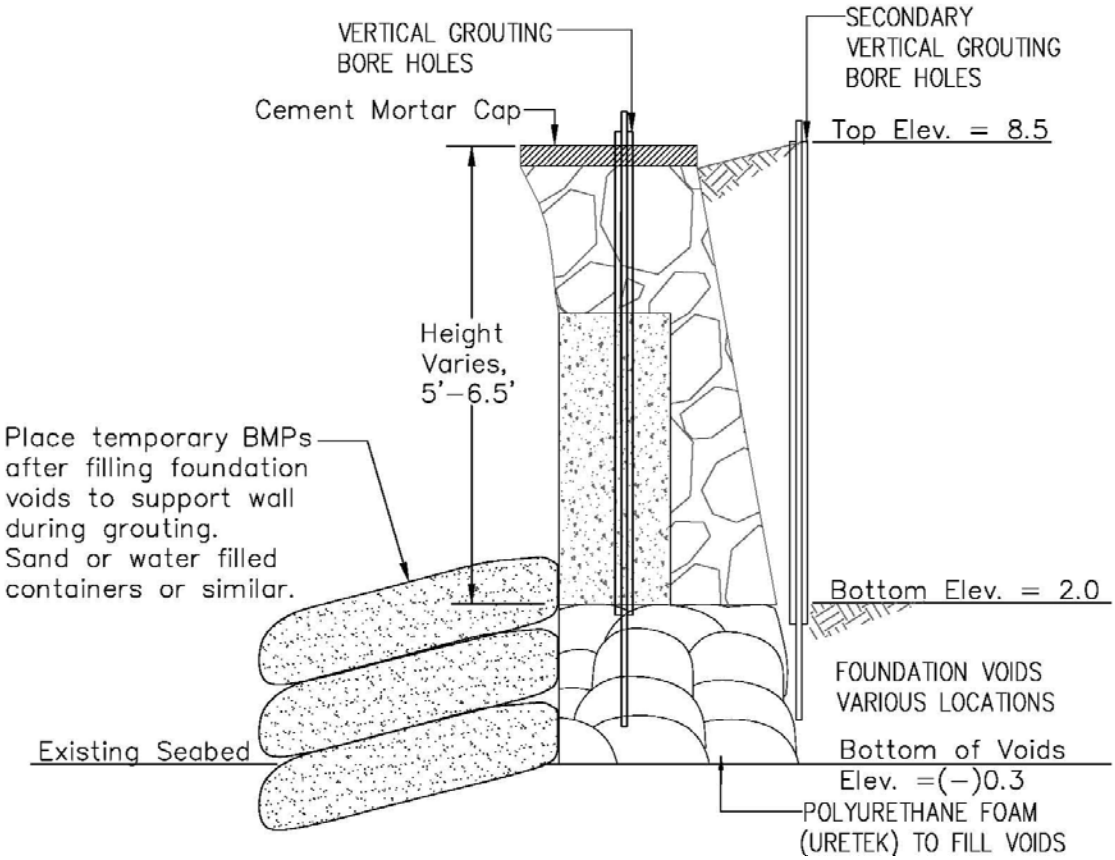


FIGURE 18. PERMEATION GROUTING

Permeation grout injected into the existing composite CIP/CRM wall would allow repairs to be confined to the existing wall envelope and would strengthen the wall. A combination of chemical (polyurethane) and a cementitious (microfine cement) grout is recommended to construct a grouted mass that will minimize and prevent future undermining. Section 4 of this report contains a detailed description of the proposed grouting procedure for this seawall.

To prevent the seawall from failing or the occurrence of grout leaking into the ocean during construction, BMPs could include structural support of the seawall on the ocean side and injecting only during low tides (FIGURE 18). Structural BMPs employed on the ocean side of the seawall could be sandbags, sand filled or water filled container berms placed at the seawall toe. Structural BMPs would serve to both provide structural support to the wall as well as prevent seawater from coming in contact with repair grout.

Alternatively, non-structural BMPs would consist of short skirted silt curtain held in place by small anchors and/or chain. The silt curtain would contain any contaminated seawater from spreading further into the marine conservation district. Final design BMPs must be approved by the permitting regulatory agencies.

Form-lined concrete support wall on ocean side

Filling of the wall foundation voids should be done prior to placement of the forms for the new concrete support wall. The forms are intended to construct a concrete support wall that will strengthen the existing wall and provide scour protection from wave erosion. The form could include a wave deflector at the top of wall to help reduce wave overtopping and land side erosion. The surface of the new ocean facing wall could be made to match the existing look and color of the seawall. Due to the existing seawall's poor condition it cannot be depended on to support the new concrete wall. Drilling through the existing seawall in order to anchor the new concrete ocean side support wall to a structure on the land side of seawall is recommended. See FIGURES 19 and 20.

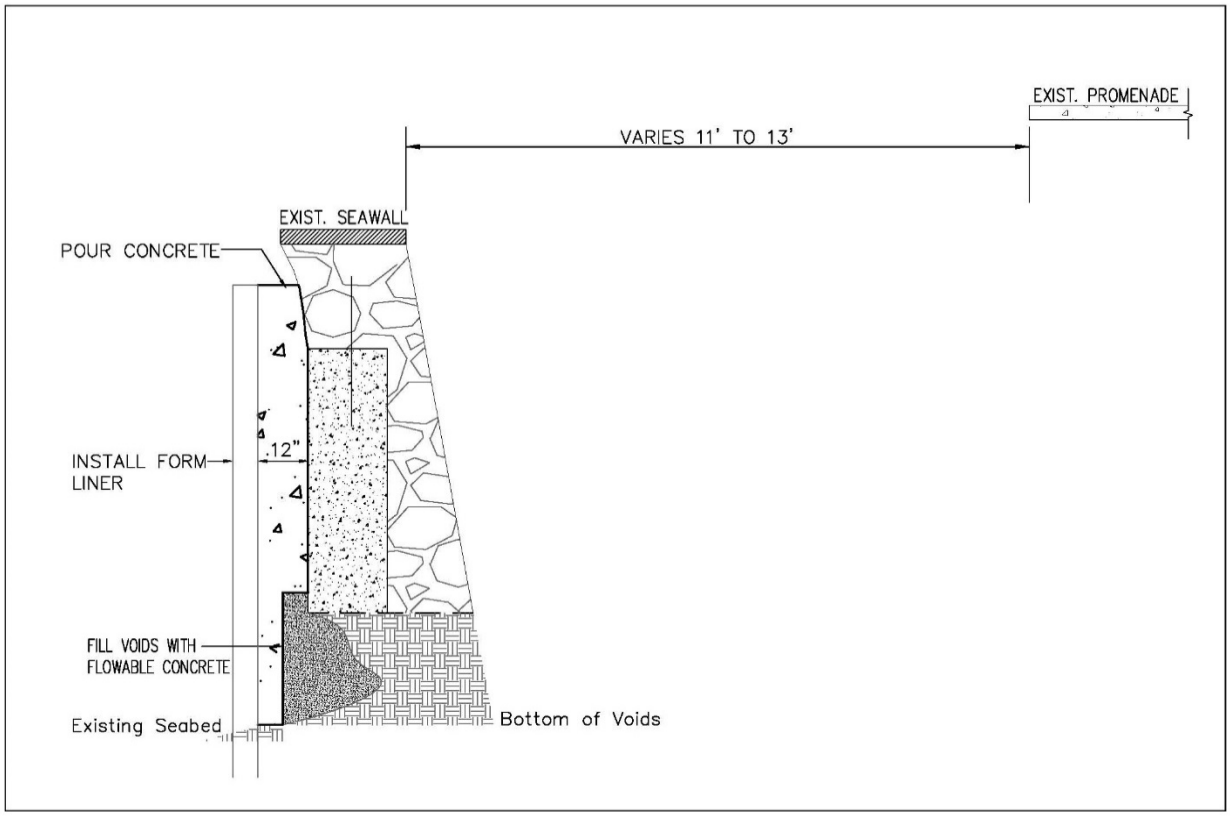


FIGURE 19. FORM-LINED CONCRETE SUPPORT WALL

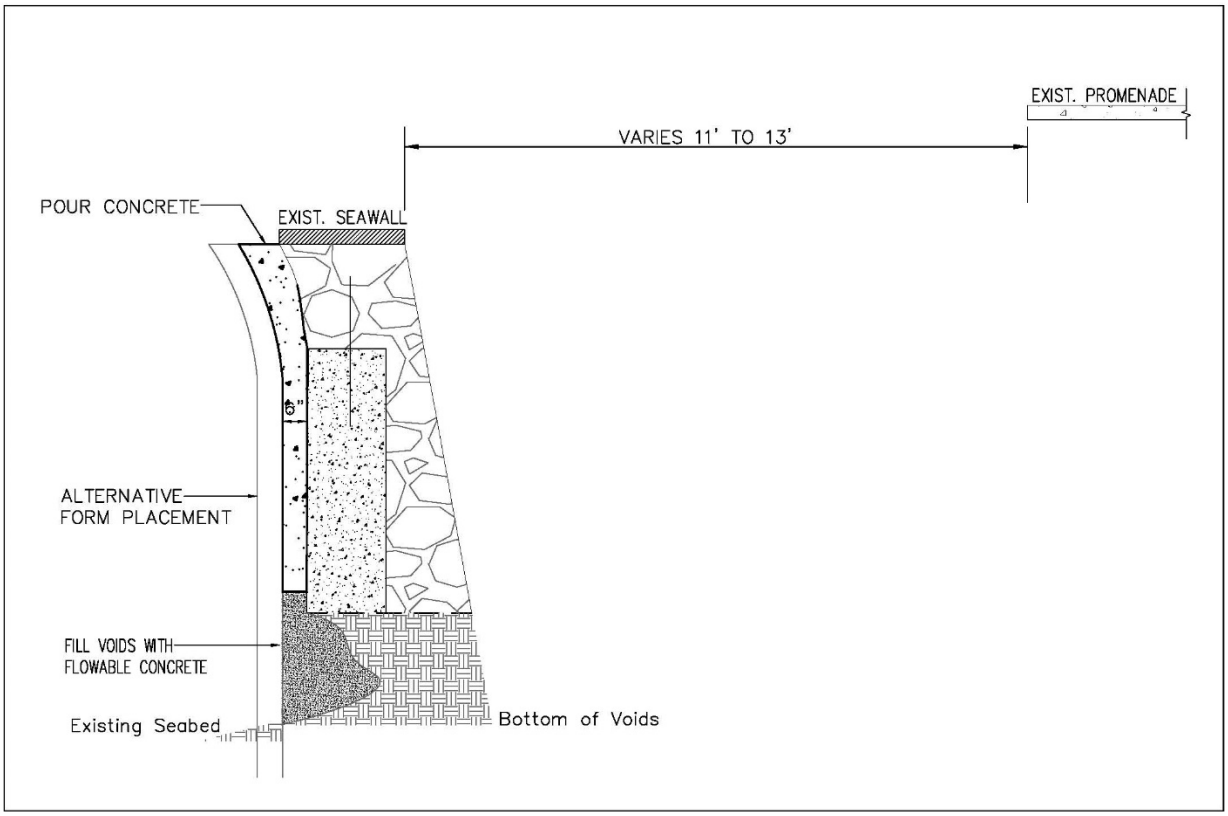


FIGURE 20. FORM-LINED CONCRETE SUPPORT WALL WITH WAVE DEFLECTOR

Soil Reinforcement. A number of soil reinforcement methods to provide temporary support of the seawall during repairs and long-term support of the seawall from the land side were evaluated. Generally reinforcing the backfill is achieved by placing reinforcing elements in the soil mass to improve its stability and control deformation.

To be effective, the selected reinforcing material would be placed to intersect potential failure surfaces in the backfill mass. Strains in the soil mass will generate tensile loads in the reinforcing material, which will restrict soils movements and give the soil mass additional shear strength.

The recommended long-term soil reinforcement method involves the use of vertical sheetpiling and concrete beams to form a bulkhead support structure. Material considered for the sheetpiles are precast concrete, steel, timber or vinyl and will be determined during the design phase. Precast concrete beams attached horizontally to the sheetpiles to retain the backfill are recommended. The bulkhead shall be installed after the seawall's foundation has been repaired and with appropriate land and ocean side BMPs and a support structure for the wall section to be repaired on the ocean side in place. An area behind the existing seawall will be excavated and sheetpiles shall be installed. Adequate imbedment depth of the sheetpiles sufficient to prevent overturning at points along the seawall's length will also be determined during the design phase. The excavated area on the ocean side of the bulkhead can be backfilled with controlled low strength material (CLSM) to create a mass concrete structure with the existing wall. Anchors to tie in the new ocean side support wall through the existing wall to the CLSM mass on the land side of the seawall are recommended. On the land side of the bulkhead on-site fill can be used to backfill the excavation. A typical bulkhead support structure comprised of precast concrete King Piles (H-shape cross section) and precast concrete T&G beams is shown in FIGURE 21. Impacts to the existing promenade during construction of the bulkhead structure would be less likely than the concrete support walls.

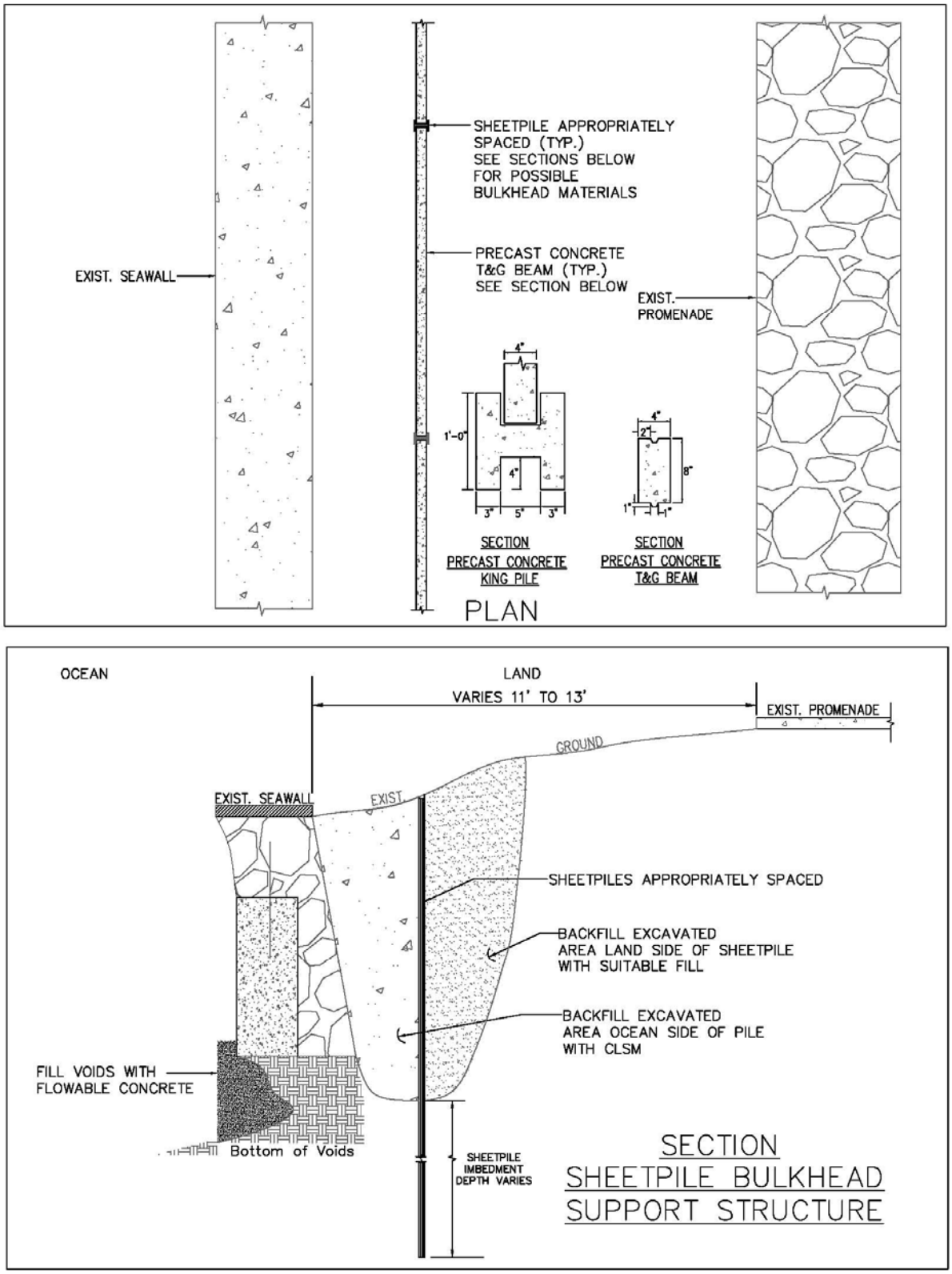


FIGURE 21. SHEETPILE BULKHEAD SUPPORT STRUCTURE

TABLE 1. SEAWALL REPAIR SELECTION CRITERIA

Selection Criteria

	Strength / durability	*Foundation protection*	*Reduce wave splash & erosion behind seawall*	*Construction duration*	*Environmental impact/ Permits*	*Impact on existing improvements*	*Historical / Archaeological impacts*	*Constructability*	*Initial and Maintenance Cost*	*Total*
STAND-ALONE ALTERNATIVES										
Reconstruct entire wall w/ new foundation	1	4	4	5	4	5	5	5	5	38
Construct concrete support wall on land side	3	5	5	4	2	4	2	3	3	31
Permeation grouting	4	3	3	2	1	1	1	1	2	18
Construct form-lined concrete support wall on ocean side	2	2	2	3	3	3	4	4	4	27
Rock revetment or berm at toe of wall	5	1	1	1	5	2	3	2	1	21

1 = most advantageous or least negative impact 5 = least advantageous or highest negative impact

BLENDED ALTERNATIVES										
Permeation grouting and soil reinforcement	3	4	4	2	1	1	1	1	3	20
Form-lined concrete support wall on ocean side, concrete support wall on land side	1	2	3	4	3	4	4	4	4	29
Form-lined concrete support wall on ocean side and soil reinforcement	2	3	2	3	2	2	3	2	1	20
Rock revetment or berm and soil reinforcement	4	1	1	1	4	4	2	3	2	22

1 = most advantageous or least negative impact 4 = least advantageous or highest negative impact

Mandatory repairs assumed as part of the chosen repair alternative include filling all voids detected in the foundation and other parts of the wall, replace or repair concrete cap and repair of cracks at various locations.

V. Seawall Repair Alternatives Analysis

As a stand-alone alternative, a reconstructed wall with a thicker foundation would provide a safe and the most structurally sound alternative. However, this condition would be temporary, as deterioration problems that plague the existing seawall would continue. These problems include undermining of the foundation, wave splash and erosion behind the wall. This alternative would also have the longest construction duration, be the most difficult to construct and have the highest impact on the environment and existing improvements, such as the promenade. In addition to having the highest construction cost, this alternative would also eliminate any of the wall's historical value.

Constructing a form-lined concrete wall on the ocean side of the existing seawall is proposed. Placement of the forms would be after the seawall foundation voids are filled. The concrete support wall would strengthen the existing wall and provide scour protection from wave erosion. The form could include a wave deflector at the top of wall to help reduce wave overtopping and land side erosion. The surface of the new ocean facing wall could be made to match the existing look and color of the seawall. Due to the existing seawall's poor condition it cannot be depended on to support the new concrete wall. Therefore, the new wall should be anchored through the existing seawall to the new concrete support structure on the land side of seawall.

Constructing a concrete support wall on the land side; whether mass concrete, reinforced or pre-cast concrete sections would improve the existing wall's strength and its stability against the wave forces and soil pressure. By itself, a land side support wall will do little to reduce wave splash, scour and erosion of the foundation and other parts of the seawall. The new support wall should be anchored to the existing wall. Impacts on the environment and to existing improvements would also be very high. Support of the existing deteriorated seawall during construction of the land side wall will prevent the seawall from collapse. For this reason support from the ocean side of the seawall is required prior to construction of a land side concrete wall.

A less expensive and lower impact alternative to a concrete support wall on the land side involves the use of vertical sheetpiling and concrete beams to form a bulkhead support structure. The bulkhead structure shall be installed after the seawall's foundation voids have been filled and with appropriate land and ocean side BMPs in place. Anchors to tie in the new ocean side support wall through the existing wall to the CLSM mass on the land side of the seawall are recommended.

A rock revetment comprised of 1,775 pound armor stones, placed on multiple layers of stone bedding and geotextile fabric would give the existing seawall added structural strength. The main advantages of the revetment are protection the wall's foundation, reduced wave splash, and the resulting erosion caused by wave overtopping on the land side. Revetments have relatively lower cost than walls and are very durable. The revetment would cover part of the seawall and therefore have some historical impact. A

disadvantage of the rock revetment is it would require approval to construct near the Waikiki Marine Life Conservation District by the Board of Land and Natural Resources.

Permeation grouting could serve to reinforce and consolidate the seawall structure as well as the foundation, sub-foundation soil, and soils behind the seawall. It would allow the majority of the wall to stay intact and maintain its historic appearance. The only in-water construction would be to fill the foundation voids which is common to all the alternatives being evaluated. Permeation grouting will not address wave overtopping of the seawall. Soil reinforcement and subdrain installation would complement this alternative providing land side support and erosion protection.

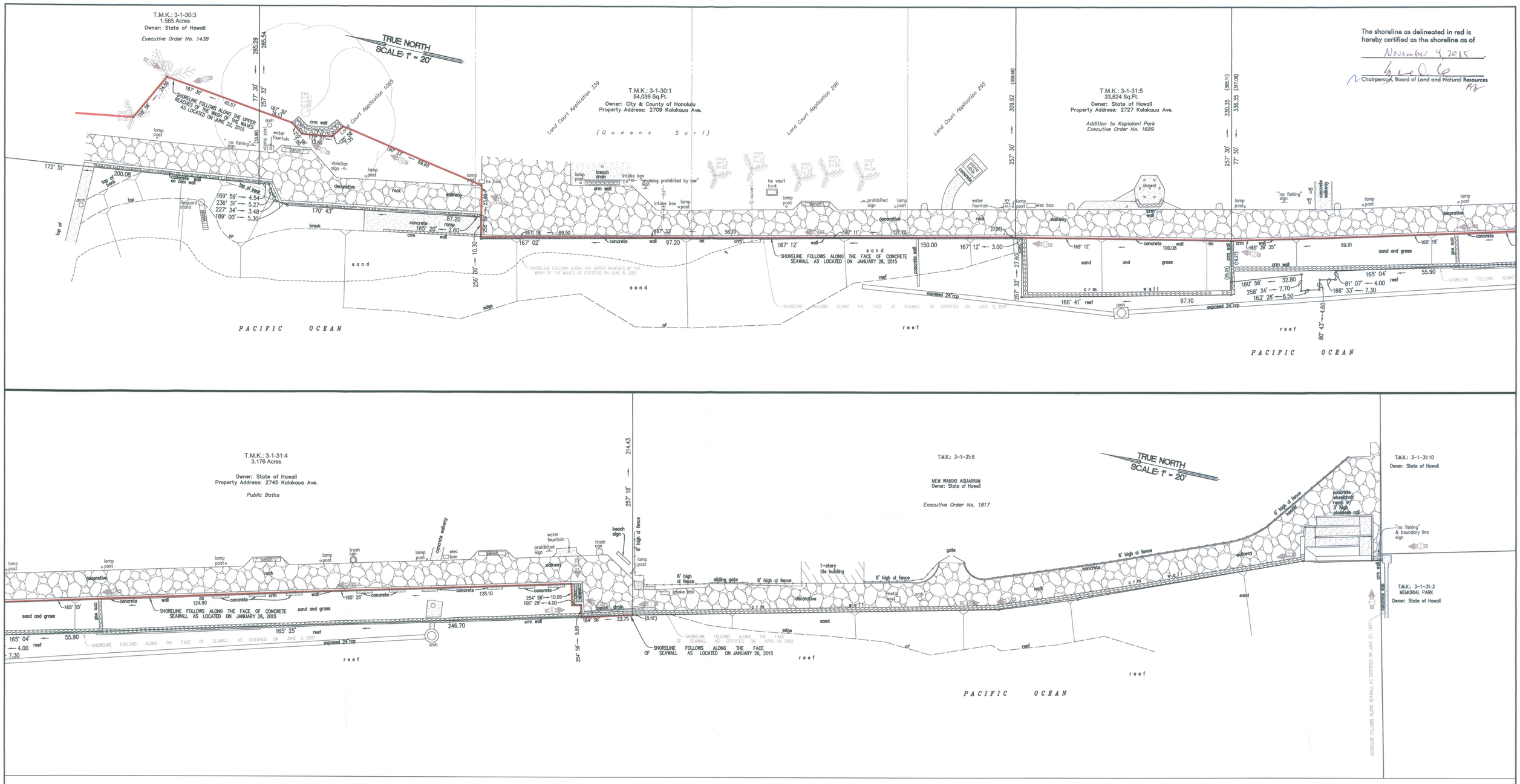
Mandatory repairs of the seawall, regardless of the chosen alternative include filling all voids detected in the wall's foundation and other parts, repair or reconstruction of the concrete cap, and repair of cracks at various locations.

See Preliminary Cost Estimates in Appendix C.

APPENDIX A

CERTIFIED SHORELINE MAP

AND REFERENCED PHOTOS



NOTE:

INDICATES PICTURE NUMBER AND DIRECTION TAKEN.

SEPTEMBER 21, 2015
JUNE 23, 2015
DATE: MARCH 3, 2015
FIELD BOOK NO. 2739, 2933, 3168

LEGEND

cl	chain link
coco	coconut tree
conc	concrete
crm	concrete rubble masonry
d	diameter
dmh	drain manhole
h	height
he	hawaiian electric
rcp	reinforced concrete pipe
s	spread
w/	with
wv	water valve

MAP SHOWING SHORELINE
FRONTING A PORTION OF KAPIOLANI REGIONAL PARK
AT WAIKIKI, HONOLULU, OAHU, HAWAII

OWNER: CITY AND COUNTY OF HONOLULU – DEPARTMENT OF PARKS AND RECREATION
ADDRESS: 1000 ULUOHIA STREET, SUITE 309
KAPOLEI, HAWAII 96707

GRAPHIC SCALE : 1"=20'

WAYNE M. TERUYA
LICENSED PROFESSIONAL LAND SURVEYOR
No. 6297
HAWAII, U.S.A.

THIS WORK WAS PREPARED BY ME OR UNDER MY SUPERVISION
ParEn, Inc.
dba PARK ENGINEERING

LICENSED PROFESSIONAL SURVEYOR
CERTIFICATE NUMBER 6297
LICENSE EXPIRES APRIL 2016

TAX MAP KEY: 3–1–30:1,3 AND 3–1–31:4,5

ParEn, Inc. dba Park Engineering
Pacific Park Plaza Suite 1600 711 Kapiolani Blvd Honolulu, Hawaii 96813
808-593-1876

IMAGE 1 of 19

IMAGE 2 of 19

T.M.K.: 3–1–30, 3–1–31
JANUARY 26, 2015
2:45 pm to 3:30 pm

ParEn, Inc.
dba PARK ENGINEERING
Pacific Park Plaza Suite 1500
711 Kapiolani Blvd. Honolulu, Hawaii

IMAGE 3 of 19

IMAGE 4 of 19

IMAGE 5 of 19

T.M.K.: 3–1–30, 3–1–31
JANUARY 26, 2015
2:45 pm to 3:30 pm

ParEn, Inc.
dba PARK ENGINEERING
Pacific Park Plaza Suite 1500
711 Kapiolani Blvd. Honolulu, Hawaii

IMAGE 6 of 19

IMAGE 7 of 19

IMAGE 8 of 19

T.M.K.: 3–1–30, 3–1–31
JUNE 22, 2015
8:30 am to 9:30 am

ParEn, Inc.
dba PARK ENGINEERING
Pacific Park Plaza Suite 1500
711 Kapiolani Blvd. Honolulu, Hawaii

IMAGE 9 of 19

IMAGE 10 of 19

IMAGE 11 of 19

T.M.K.: 3–1–30, 3–1–31
JUNE 22, 2015
8:30 am to 9:30 am

ParEn, Inc.
dba PARK ENGINEERING
Pacific Park Plaza Suite 1500
711 Kapiolani Blvd. Honolulu, Hawaii

IMAGE 12 of 19

IMAGE 13 of 19

IMAGE 14 of 19

T.M.K.: 3–1–30, 3–1–31
JUNE 22, 2015
8:30 am to 9:30 am

ParEn, Inc.
dba PARK ENGINEERING
Pacific Park Plaza Suite 1500
711 Kapiolani Blvd. Honolulu, Hawaii

IMAGE 15 of 19

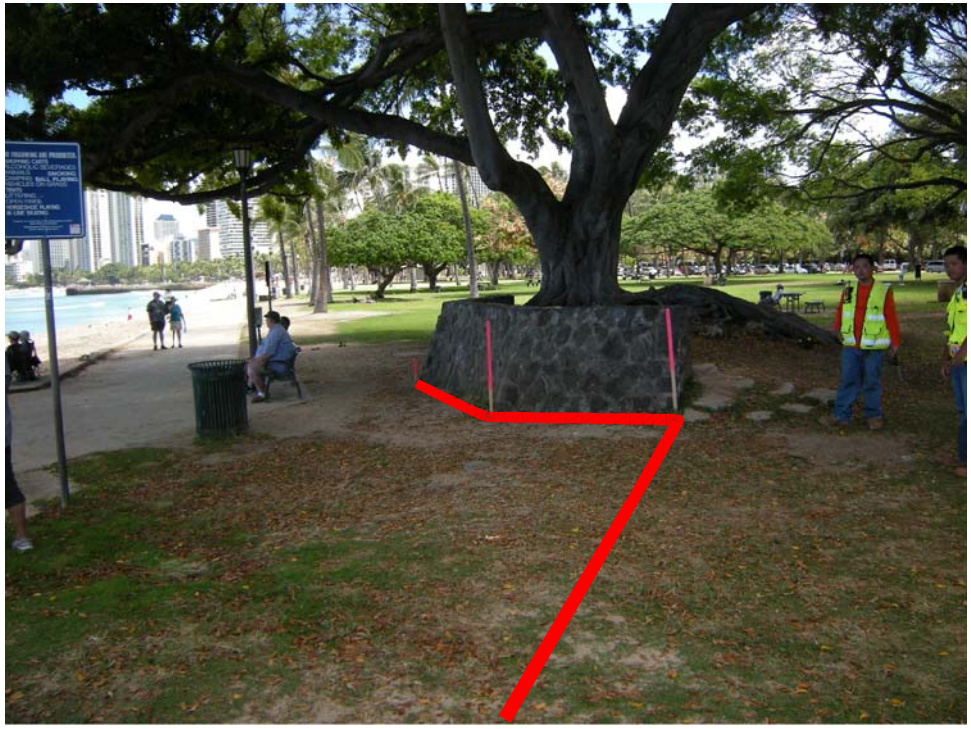


IMAGE 16 of 19

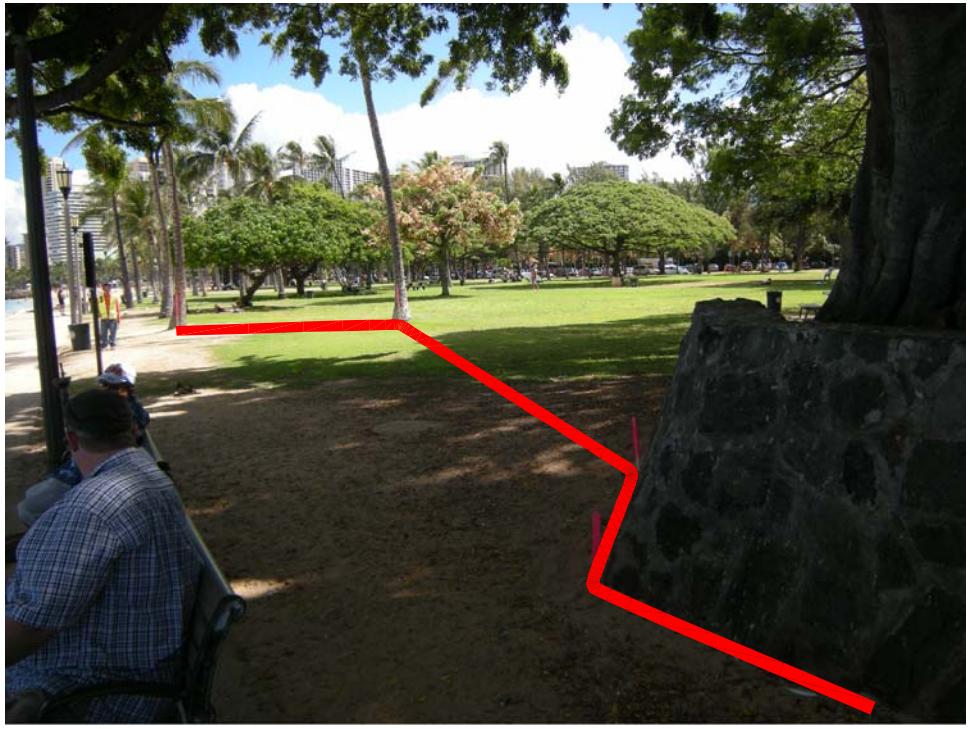


IMAGE 17 of 19

T.M.K.: 3–1–30, 3–1–31
JUNE 22, 2015
8:30 am to 9:30 am

ParEn, Inc.
dba PARK ENGINEERING
Pacific Park Plaza Suite 1500
711 Kapiolani Blvd. Honolulu, Hawaii

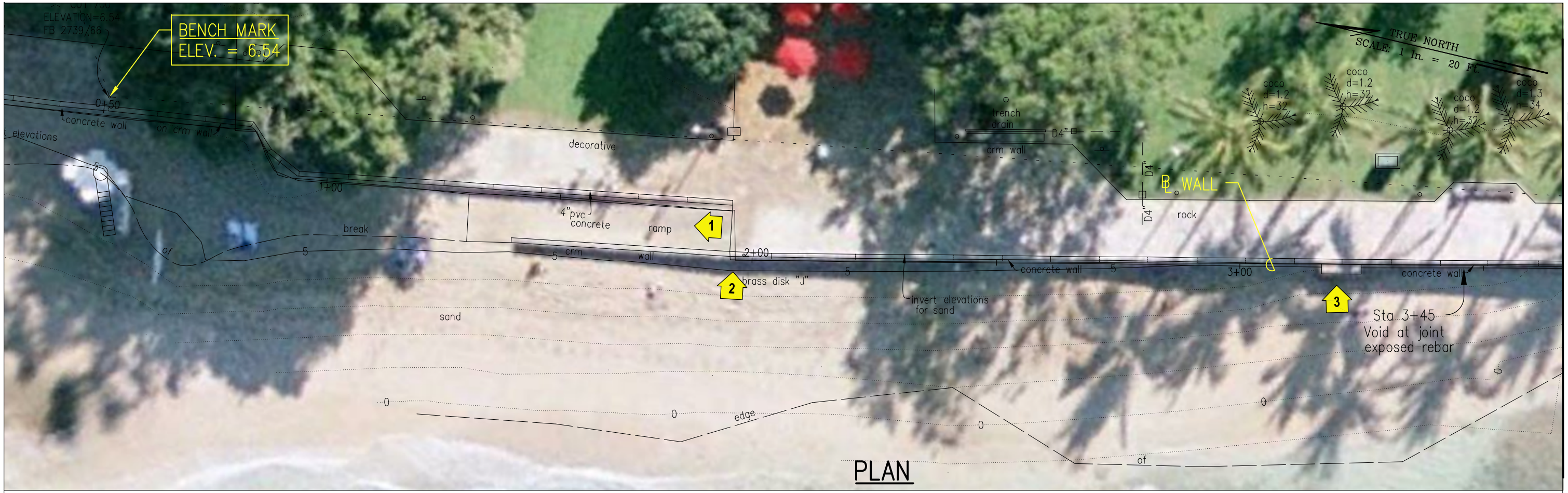
IMAGE 18 of 19

IMAGE 19 of 19

T.M.K.: 3–1–30, 3–1–31
JUNE 22, 2015
8:30 am to 9:30 am

ParEn, Inc.
dba PARK ENGINEERING
Pacific Park Plaza Suite 1500
711 Kapiolani Blvd. Honolulu, Hawaii

APPENDIX B
PLAN AND ELEVATION VIEWS OF SEAWALL AND DEFECTS



PLAN

X = PHOTO LOCATION

20' 10' 0 20' 40'

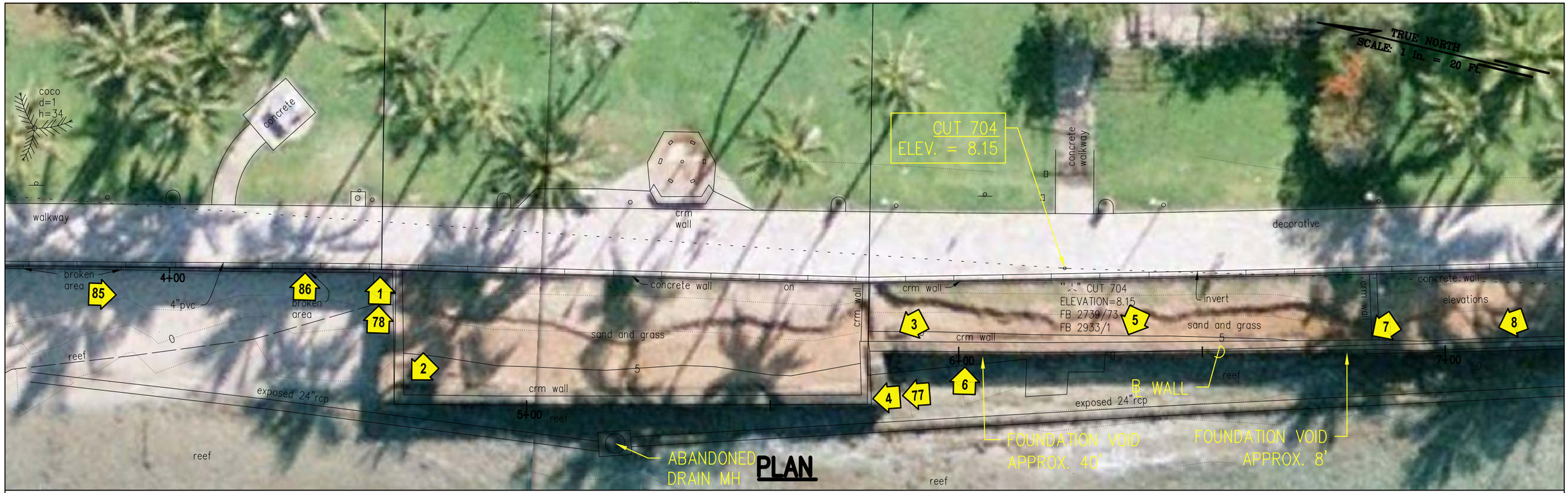
SCALE: 1" = 20'

ELEVATION

WALL BASELINE – STA. 0+00 TO 3+70

SCALE: 1" = 20'-0"

STATION	WALL MATERIAL	WALL HEIGHT (ft)	CONDITION ASSESSMENT	REMARKS
0+00 to 1+96	Top: CIP conc. curb Bot: 1, 2 layers CRM	0.5 to 1.0	Portions of concrete curb bordering ramp have longitudinal cracks	Repair cracks in curb
1+96 to 4+46	CIP conc. with bullnose at top	2.3 to 5.7	Some minor surface defects	Repair surface defects
3+45 to 3+51	CIP conc. with bullnose at top	4.0	Seaward face of wall has 1-1/2" void and exposed rebar	Fill and/or patch void. Replace or splice rebars where more than 25% of rebar cross-section area lost



ELEVATION

WALL BASELINE – STA. 3+70 TO 7+15

SCALE: 1" = 20'–0"

XX P91800XX
= PHOTO LOCATION (SEP. 2015, HIGH TIDE)

X = PHOTO LOCATION (JAN. 2015, LOW TIDE)

20' 10' 0 20' 40'

SCALE: 1" = 20'

20' 10' 0 20' 40'

SCALE: 1" = 20'

WALL BASELINE – STA. 7+15 TO 9+12

SCALE: 1" = 20'-0"

X = PHOTO LOCATION

STATION	WALL MATERIAL	WALL HEIGHT (ft)	CONDITION ASSESSMENT	REMARKS
7+15 to 9+12	CRM w/different size stones and lay patterns on top with CIP conc. on bottom with cold joints	5.0 to 5.5, connects to 8' high wall fronting Aquarium	Top concrete cap broken	Repair or reconstruct concrete cap

SITE PHOTOS

01. Concrete curb bordering ramp has cracks. 09/18/2015 09:33 AM

02. Station 1+96 minor cosmetic repairs on wall surface. 09/18/2015 09:34 AM

03. Station 3+20 exposed rebar, minor surface defects in concret 01/20/2016 01:59 PM

04. Station 4+20 minor concrete surface defects, exposed rebar. 01/20/2016 02:09 PM

05. Surface defects in concrete patch area north of planter box. 01/20/2016 02:15 PM

06. Cracked concrete cap planter box. 01/20/2016 02:17 PM

SITE PHOTOS

07. Station 5+70 missing stones in planter box. 01/20/2016 02:28 PM

08. Closeup of foundation void. 01/27/2016 03:54 PM

08. Closeup view of foundation void south of planter box. 01/27/2016 03:55 PM

08. Large foundation void south of planter box. 01/20/2016 02:42 PM

09. Foundation void station 6+75. 01/20/2016 02:43 PM

10. Station 6+85 typical condition of concrete cap. 09/18/2015 09:20 AM

SITE PHOTOS

11. Station 7+80 typical condition of concrete cap; cracked displa 09/18/2015 09:13 AM

12. Station 9+10 concrete steps and bordering wall needs minor 09/18/2015 09:04 AM

APPENDIX C
PRELIMINARY COST ESTIMATES

Preliminary Cost Estimate	Permeation Grouting Alternative				
		Qty	**Unit**	**Unit Price**	**Sub Total**
1*	Seawall Rehabilitation to Include Mobilizatior Drilling, Uretek Installation, Soil PURe Installation, and Microfine Cement Installation for Two Rows	1	LS	$1,412,724.00	$1,412,724.00
2	Project Fencing with Dust Cloth	1	LS	$35,000.00	$35,000.00
3	Above Ground Drill Cutting Containment System	1	LS	$19,500.00	$19,500.00
4	Project Utility Toning	1	LS	$6,000.00	$6,000.00
5	Wall Face Repairs with Cementitious Mortar	1	LS	$16,424.00	$16,424.00
6	Repair Vertical Crack at South Corner Planter	1	LS	$6,450.00	$6,450.00
7*	Reconstruct Failed Wall Sections	1	Allowance	$50,000.00	$50,000.00
8*	Demolish & Replace 3" thick Concrete Cap	13	CY	$3,510.00	$45,630.00
9*	Temporary Pollution Control Measures	1	LS	$68,690.00	$68,690.00
10	Traffic Control	1	Allowance	$20,000.00	$20,000.00
11	Soil Reinforcement & Subdrain	1	LS	$127,237.00	$127,237.00
12	Surface Restoration	1	LS	$24,690.00	$24,690.00
13	Landscaping	1	LS	$11,480.00	$11,480.00
				Sum Items 1-13	**$1,843,825.00**
14*	Deductive Alternate: Replace Soil PURe w/DeNeef Micro-fine cement for Makai Row	1	LS	($274,500.00)	($274,500.00)
15*	Deductive Alternate: Delete Secondary Row of Injection Locations	1	LS	($386,224.00)	($386,224.00)
				Sum Items 1-15	**$1,183,101.00**

PRELIMINARY COST ESTIMATE – PERMEATION GROUTING

Notes:

*1. Estimate includes up to 5,000 total pounds of Uretek, 35 gallons MC-500 Microfine grout per hole, and 35 gallons Soil PURe per hole injections.

*7. Assumes 25’ of existing wall, 6’ high, 3’ wide will fail during repair operations.

*8. Assumes 460’ long, 2.5’ wide, 3” thick will be repaired or replaced.

*9. Assumes 4 man crew will take 5 working days to setup, maintain and remove temporary BMPs through project duration.

*14. A deductive alternative for replacing the recommended polyurethane grout with a cementitious grout has been provided. The deductive alternative is less resistant to chemical degradation by seawater.

*15. A deductive alternative for deleting the secondary row of grout injection has been provided. The deductive alternative will not provide structural reinforcement of the soils backing the seawall.

Preliminary Cost Estimate	Rock Revetment Construction				
		Qty	**Unit**	**Unit Price**	**Sub Total**
1	Mobilization & Demobilization	1	LS	$60,100.00	$60,100.00
2*	Temporary Erosion Control BMPs	1	LS	$217,170.00	$217,170.00
3	Repair Concrete Wall, Sidewalk, Curb, Bullnose Cracks, and Spalls	1	LS	$16,950.00	$16,950.00
4*	Grout Foundation Voids	31	CY	$3,150.00	$97,650.00
5	Wall Face Repairs with Cementitious Mortar	1	LS	$15,595.00	$15,595.00
6	Repair Vertical Crack at South Corner Planter	1	LS	$6,120.00	$6,120.00
7*	Reconstruct Failed Wall Sections	1	Allowance	$50,000.00	$50,000.00
8*	Demolish & Replace 3" thick Concrete Cap	13	CY	$3,330.00	$43,290.00
9	Furnish and Install Armor Stones, 2.1' Nom Dia, 1775 lbs	1433	CY	$640.00	$917,120.00
10	Furnish and Install Bedding Stones, 1' Nom Dia, 180 lbs	190	CY	$800.00	$152,000.00
11	Furnish and Install Filter Rock, 3 in.	138	CY	$400.00	$55,200.00
12	Furnish and Install Pea Gravel	73	CY	$540.00	$39,420.00
13	Geotextile Fabric Underlayment	1032	SY	$30.00	$30,960.00
14	Soil Reinforcement	1	LS	$72,960.00	$72,960.00
15	Surface Restoration	1	LS	$23,450.00	$23,450.00
16	Landscaping	1	LS	$10,900.00	$10,900.00
				Sum Above Items	**$1,808,885.00**

PRELIMINARY COST ESTIMATE – ROCK REVETMENT

Notes:

*2. Assumes 4 man crew will take 25 working days to setup, maintain and remove temporary BMPs through project duration.

*4. Assumes an estimated 120 feet of foundation voids, full wall thickness need to be filled.

*7. Assumes 25’ of existing wall, 6’ high, 3’ wide will fail during repair operations.

*8. Assumes 460’ long, 2.5’ wide, 3” thick will be repaired or replaced.

Preliminary Cost Estimate	Rock Berm Construction				
		Qty	**Unit**	**Unit Price**	**Sub Total**
1	Mobilization & Demobilization	1	LS	$45,190.00	$45,190.00
2*	Temporary Erosion Control BMPs	1	LS	$180,820.00	$180,820.00
3	Repair Concrete Wall, Sidewalk Curb, and Bullnose Cracks and Spalls	1	LS	$17,100.00	$17,100.00
4*	Grout Foundation Voids	31	CY	$3,170.00	$98,270.00
5	Wall Face Repairs with Cementitious Mortar	1	LS	$15,740.00	$15,740.00
6	Repair Vertical Crack at South Corner Planter	1	LS	$6,175.00	$6,175.00
7*	Reconstruct Failed Wall Sections	1	Allowance	$50,000.00	$50,000.00
8*	Demolish & Replace 3" Thick Concrete Cap	13	CY	$3,360.00	$43,680.00
9	Furnish and Install Armor Stones, 1.67' Nom Dia, 900 lbs	721	CY	$700.00	$504,700.00
10	Soil Reinforcement	1	LS	$73,630.00	$73,630.00
11	Surface Restoration	1	LS	$23,660.00	$23,660.00
12	Landscaping	1	LS	$9,430.00	$9,430.00
				Sum Above Items	**$1,068,395.00**

PRELIMINARY COST ESTIMATE – ROCK BERM AT TOE OF WALL

Notes:

*2. Assumes 4 man crew will take 20 working days to setup, maintain and remove temporary BMPs through project duration.

*4. Assumes an estimated 120 feet of foundation voids, full wall thickness need to be filled.

*7. Assumes 25’ of existing wall, 6’ high, 3’ wide will fail during repair operations.

*8. Assumes 460’ long, 2.5’ wide, 3” thick will be repaired or replaced.

APPENDIX D
GEOTECHNICAL EXPLORATION AND EVALUATION REPORT
Yogi Kwong Engineers, January 2015
(excluded)

APPENDIX E
AS-BUILT PLANS
Queen Kapiolani Park
Reconstruction and Repairs to Existing Seawall
February 1987

CONSTRUCTION NOTES:

Construction of Cement Rubble Masonry Wall shall conform to Section 44 of the Standard Specifications of the Dept. of Public Works, City & County of Honolulu.

All stones to be used shall be blue rock having a specific gravity no less than 2.5. No moss rock or porous rock will be accepted.

Steel dowels shall be galvanized as called for in the plans.

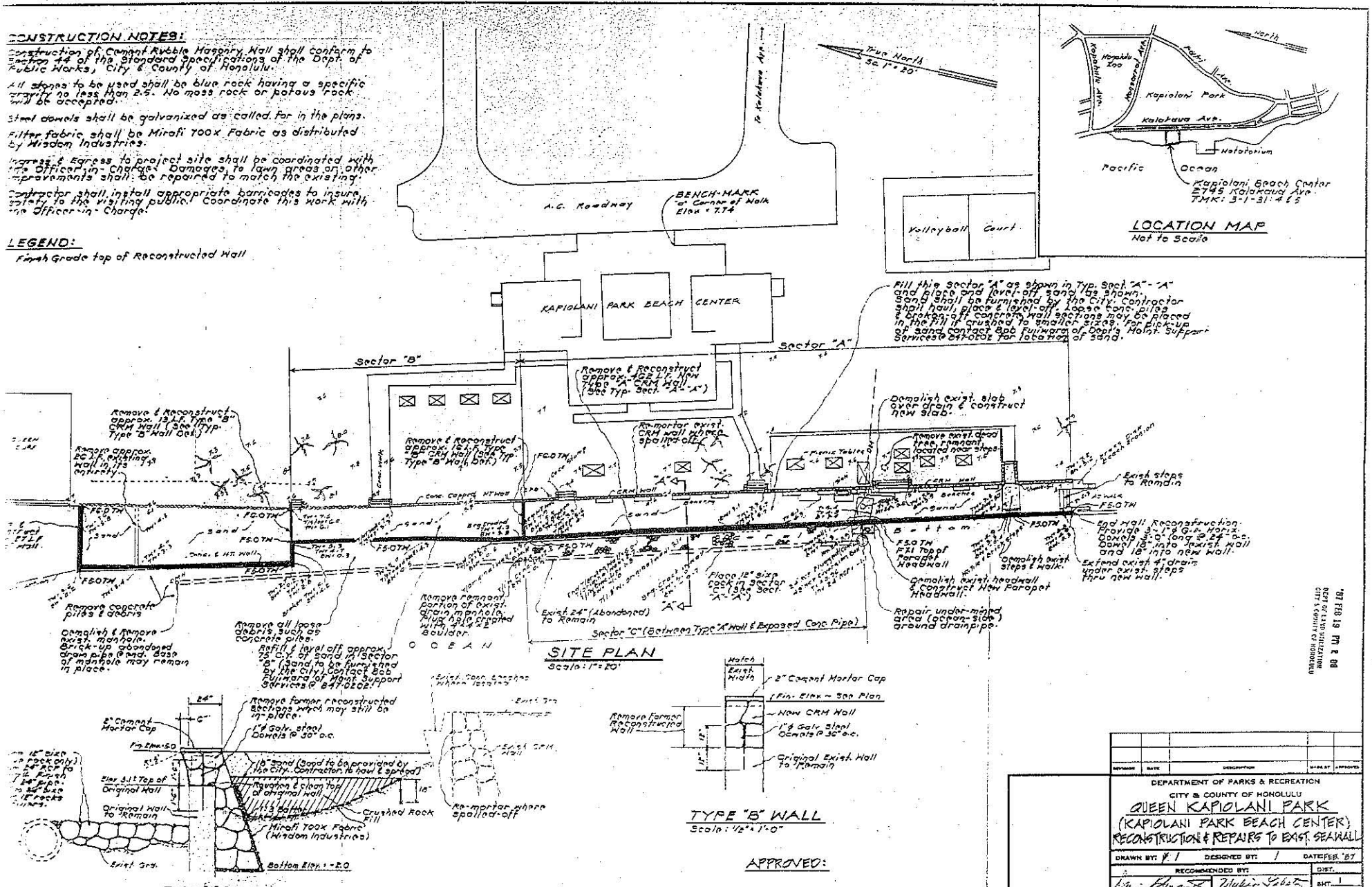
Filter fabric shall be Mirafi 700x Fabric as distributed by Hisdom Industries.

Ingress & Egress to project site shall be coordinated with the Officer-in-Charge. Damages to lawn areas or other improvements shall be repaired to match the existing.

Contractor shall install appropriate barricades to insure safety to the visiting public. Coordinate this work with the Officer-in-Charge.

LEGEND:

Finish Grade top of Reconstructed Wall


True North
Sc 1" = 20'
To Kalakaua Ave.
A.C. Roadway
BENCH-MARK
"a" Corner of Walk
Elev = 7.74
Volleyball Court
KAPIOLANI PARK BEACH CENTER
Sector "B"
Sector "A"
Sector "C" (Between Type "A" Wall & Exposed Conc Pipe)
Remove & Reconstruct approx. 19 L.F. Type "B" CRM Wall (See Typ. Type "B" Wall Sect.)
Remove approx. 20 L.F. existing wall in its entirety
Remove & Reconstruct approx. 16 L.F. Type "B" CRM Wall (See Typ. Type "B" Wall Sect.)
Remove & Reconstruct approx. 46 L.F. New Type "A" CRM Wall (See Typ. Sect. "A"-"A")
Re-mortar exist. CRM wall where spalled-off
Demolish exist. slab over drain & construct new slab.
Remove exist. dead tree, remnant, located near steps.
Fill this sector "A" as shown in Typ. Sect. "A"-"A" and place and level-off sand as shown. Sand shall be furnished by the City. Contractor shall haul, place & level-off. Loose conc. piles & broken-off concrete wall sections may be placed in the fill if crushed to smaller sizes. For pick-up of sand, contact Bob Fujimoto of Dept's. Maint. Support Services @ 847-0202 for location of sand.
Exist steps to Remain
End Wall Reconstruction: Provide 3-1/2" G.I. Horiz. Dowels 3'-0" long @ 24" o.c. Dowel 18" into exist. wall and 18" into new wall.
Extend exist. 4" drain under exist. steps thru new wall.
Demolish exist. steps & walk.
Demolish exist. headwall & construct New Parapet Headwall.
Repair under-mined area (ocean-side) around drainpipe.
Place 12" size rock in sector "A"-"A" Sect.
Exist 24" (Abandoned) to Remain
Remove remnant portion of exist. drain manhole. Plug hole created with 24" x 2' Boulder.
Remove all loose debris such as concrete piles.
Refill & level off approx. 75 C.Y. of sand in Sector "B" (Sand to be furnished by the City). Contact Bob Fujimoto of Maint. Support Services @ 847-0202.
Remove concrete piles & debris
Demolish & remove exist. manhole. Brick-up abandoned drain pipe @ end. Base of manhole may remain in place.
OCEAN
Remove former reconstructed sections which may still be in-place.
2" Cement Mortar Cap
1" ϕ Galv. steel Dowels @ 30" o.c.
Fin. Elev. = 5.0
Elev. 3.1 ± Top of Original Wall
Original Wall to Remain
Exist. Grd.
Bottom Elev. = -2.0
Hisdom & clean top of original wall
Crushed Rock Fill
Mirafi 700X Fabric (Hisdom Industries)
Re-mortar where spalled-off
Exist. Conc. Anchors where located
Exist. Grd.
Exist. CRM Wall
Hatch Exist. Width
2" Cement Mortar Cap
1 Fin. Elev. - See Plan
New CRM Wall
1" ϕ Galv. Steel Dowels @ 30" o.c.
Original Exist. Wall to Remain
Remove former Reconstructed Wall
Kapiolani Park Beach Center
Kapiolani Park
Kalakaua Ave.
Honolulu Zoo
Monsarrat Ave.
Paki Ave.
Waikiki Aquarium
Pacific Ocean
Kapiolani Beach Center
2795 Kalakaua Ave.
TMK: 3-1-31: 4 & 5
North
Sector "B"
Sector "A"
Sector "C"
Bottom
Sand
Conc. Capping
Conc. & Mt. Wall
CRM Wall
Benches
Walk
Picnic Tables
Bldg. Entrance
Exist. Grass Beach Erosion
Exist. Conc. Walk
Exist. Grass
Exist. Tree
Exist. Bldg.
Exist. Pole
Exist. Light Pole
Exist. Sign
Exist. Bldg. Entrance
Exist. Grass
Exist. Tree

APPENDIX F
PERMEATION GROUTING INFORMATION

URETEK POLYMER

PRODUCT DESIGN

URETEK polymer is inherently hydro-insensitive and is capable of being directly injected into water. Due to the hydro-insensitive nature, this product is excellent for lifting and/or stabilizing in areas with a high level of moisture content. The low viscosity of the system allows for easy penetration into soil and displaces water without losing product integrity as it stabilizes and lifts.

PRODUCT TYPE

URETEK polymer is a two component polyurethane rigid foam. Designed specifically for URETEK, this product is excellent for lifting settled pavement, stabilizing weak soil, and the filling or encapsulating of various voids. URETEK polymer utilizes a fully EPA approved, non-CFC, non-HFC, zero ozone depleting blowing agent.

STORAGE AND HANDLING

URETEK polymer has a shelf life of 1 yr when stored in the original, sealed container at a temperature of 60F-90F with humidity levels not greater than 85% and also not in direct sunlight. The "A" component is very sensitive to moisture and caution must be taken to insure moisture is not introduced.

Prolonged storage at temps below 60F can affect both the "A" and "B" components. The "B" component may separate slightly but can be heated and mixed to regain product integrity. The "A" component may crystallize. Once crystallization occurs the product cannot be reheated or mixed thus rendering it un-useable. Please consult your URETEK representative if such conditions arise for proper guidance.

SAFETY PRECAUTIONS

Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling URETEK polymer components. Before working with these products, you must read and become familiar with the available information on their hazards, proper use, and handling. Information is available in several forms, e.g., material safety data sheets and product labels.

CREDENTIALS

URETEK polymer utilizes a fully EPA approved, non-CFC, non-HFC, zero ozone depleting blowing agent. URETEK polymer is NSF 61 certified.

DISCLAIMER: Physical properties generated under controlled laboratory conditions per URETEK polymer sampling guidelines. For sampling guidelines contact URETEK, 281-351-7800. Actual properties may vary under real world conditions. No warranty expressed or implied is given as individual results will vary.

TECHNICAL DATA SHEET

LIQUID PROPERTIES

COMPONENTS SUPPLIED	A (ISO)	B (RESIN)
LIQUID COMPONENTS AS SUPPLIED:	A (ISO)	B (RESIN)
Specific Gravity@74°F (23°C)	1.22	1.04
Viscosity (Brookfield)@74°F (23°C), cps	220-250	400-500
Mixing Ratio by volume	1	1

TECHNICAL DATA

	ASTM TEST	3LB	4LB
Compressive Strength	D-1621	33 psi	63 psi
Compressive Modulus	D-1621	1785 psi	2100 psi
Dimensional Stability	D-2126	<2%	<2%
Tensile Strength	D-1623	63 psi	95 psi
Tensile Modulus	D-1623	1775 psi	2100 psi
Shear Strength	C-273	37 psi	47 psi
Shear Modulus	C-273	525 psi	945 psi
Flexural Strength	D-790	53 psi	95 psi
Flexural Modulus	D-790	998 psi	2100 psi
Water Absorption	D-2842	<2%	<2%
Closed Cell Content	D-6226	>85%	>85%

COMMON CHEMICAL RESISTANCE

CHEMICAL	RESISTANCE
Water	Excellent
Toluene	Good
Gasoline	Excellent
Sulfuric Acid 10%	Excellent
Hydrochloric Acid 10%	Excellent
Isopropanol	Excellent
Benzene	Excellent
Motor Oil	Excellent
Acetone	Poor
Ethyl Alcohol	Poor
Methyl Alcohol	Poor

The information herein is to assist customers in determining whether our products are suitable for their applications. Customer assumes full responsibility for quality control, testing and determination of suitability of product for its intended use or application. URETEK ICR/StarLift Services, Inc. warrants only that the material shall meet its specifications; this warranty is in lieu of all other written, expressed or implied warranties and URETEK ICR/StarLift Services, Inc. expressly disclaims any warranty of merchantability, fitness for a particular purpose, or freedom from patent infringement. Accordingly, buyer assumes all risks whatsoever as to the use of the material. Buyer's exclusive remedy as to any breach of warranty, negligence or other claim shall be limited to the purchase price of the material. Failure to adhere to any recommended procedures shall relieve URETEK ICR/StarLift Services, Inc.. of all liability with respect to the material or the use thereof.

URETEK Products are trademarks of URETEK ICR

TECHNICAL DATA SHEET

URETEK POLYMER

PRODUCT DESIGN

URETEK polymer is a two component high density expanding thermoset polymer system formulated for the under sealing, void filling & lifting of settled pavement/concrete, the stabilizing & stiffening of weak soils, and for the encapsulation & sealing of buried infrastructure. polymer coupled with minimally invasive injection techniques achieves permanent repairs without the necessity of excavation or demolition.

STORAGE AND HANDLING

URETEK polymer components have a shelf life of 1 year when stored at 60 - 80ºF out of direct sunlight and extreme humidity, >80% RH. Polymer "A" component is water sensitive and caution must be taken to ensure "A" component is not exposed to moisture. If material remains in a receptacle be sure to tightly seal lid to minimize moisture exposure.

The "A" and "B" components should not be stored in temperatures less than 50ºF for prolonged periods. Some phase separation in the "B" component may be noticed at these temperatures. If there is phase separation the material must be warmed and thoroughly mixed prior to use. Consult URETEK for proper warming and mixing guidelines. If the "A" component is allowed to crystallize or separate from exposure to cold temperatures, it is not useable and must be replaced.

PRODUCT TYPE

URETEK polymer is capable of expanding up to 25 times its original starting volume in unconfined conditions. Fully cured polymer material is inert and non-toxic URETEK polymer are formulated in various densities and expansive coefficients for specific project applications. The low viscosity & lubricity of the polymer allows for easy penetration into soils while compacting surrounding soils and displacing water without detrimental dilution or loss of dimensional stability to the resin system.

URETEK polymer has a patented chemical composition that allows for direct application into water or very damp regions while still maintaining good physical properties. The patented chemical nature of polymer goes beyond available hydro-insensitive technologies currently available. Polymer will form proper linkages even while being injected directly into water. This property makes it ideal for lifting and stabilizing in areas with elevated soil moisture. The monolithic and hydro-insensitive nature of polymer the grout will resist under ground water erosion or weakening.

PROCESSING PARAMETER

URETEK polymer is a two component system that must be applied with a proportioning unit designed to allow 1 to 1, by volume, metering of materials. The proportioning equipment must be capable of maintaining recommended injection temperatures and pressures.

SAFETY PRECAUTIONS

Appropriate literature has been assembled which provides information concerning the health and safety precautions that must be observed when handling polymer components. Before working with these products, you must read and become familiar with the available information on their hazards, proper use, and handling. Information is available in several forms, e.g., material safety data sheets and product labels.

CREDENTIALS

URETEK Polymer utilizes a fully EPA approved, non-CFC, non-HFC, zero ozone depleting blowing agent. URETEK Polymer is NSF 61 certified.

TECHNICAL DATA

PHYSICAL PROPERTY	TEST METHOD	684EXP	486STAR	486STAR-4BD	486STAR-4	486STAR-4GD	486STAR-6	486STAR-8	3F	3R	4F	4R
Grout Density, min	*ASTM D 1622*	2lbs/ft^3	3lbs/ft^3	4lbs/ft^3	4lbs/ft^3	4lbs/ft^3	6lbs/ft^3	8lbs/ft^3	3lbs/ft^3	3lbs/ft^3	4lbs/ft^3	4lbs/ft^3
Compressive Strength	*ASTM D 1621*	20psi	30psi	60psi	60lb/in^2	60psi	100psi	175psi	33psi	33psi	63psi	63psi
Compressive Modulus	*ASTM D 1621*	500psi	1700psi	2000psi	2000psi	2000psi	3000psi	4000psi	1785psi	1785psi	2100psi	2100psi
Dimensional Stability	*ASTM D 2126*											
-40F	*ASTM D 2126*	< 2%	< 2%	< 2%	< 2%	< 2%	< 1%	< 1%	< 2%	< 2%	< 2%	< 2%
200F	*ASTM D 2126*	< 15%	< 2%	< 2%	< 2%	< 2%	< 1%	< 1%	< 2%	< 2%	< 2%	< 2%
Tensile Strength	*ASTM D 1623*	50psi	60psi	90psi	90psi	90psi	120psi	150psi	63psi	63psi	95psi	95psi
Tensile Modulus	*ASTM D 1623*	700psi	1700psi	2000psi	2000psi	2000psi	3000psi	4000psi	1775psi	1775psi	2100psi	2100psi
Shear Strength	*ASTM C 273*	30psi	35psi	45psi	45psi	45psi	70psi	100psi	37psi	37psi	47psi	47psi
Shear Modulus	*ASTM C 273*	350psi	500psi	900psi	900psi	900psi	1100psi	1400psi	525psi	525psi	945psi	945psi
Flexural Strength	*ASTM C 790*	30psi	50psi	90psi	90psi	90psi	170psi	280psi	53psi	53psi	95psi	95psi
Flexural Modulus	*ASTM C 790*	700psi	950psi	2000psi	2000psi	2000psi	4000psi	7000psi	998psi	998psi	2100psi	2100psi
Water Absorption	*ASTM D 2842*	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%	< 2%
Elongation	*ASTM D 1623*	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%	< 1%
Closed Cell Content	*ASTM D 6226*	90%	90%	90%	90%	90%	90%	90%	> 85%	> 85%	> 85%	> 85%

COMMON CHEMICAL RESISTANCE

CHEMICAL	RESISTANCE
Water	Excellent
Toluene	Excellent
Gasoline	Excellent
Sulfuric Acid	Excellent
Hydrochloric Acid	Good
Isopropanol	Excellent
Benzene	Excellent
Motor Oil	Excellent
Kerosene	Excellent
Acetic Acid	Good
Formaldehyde	Good

DISCLAIMER

The information herein is to assist customers in determining whether our products are suitable for their applications. Customer assumes full responsibility for quality control, testing and determination of suitability of product for its intended use or application. URETEK ICR warrants only that the material shall meet its specifications; this warranty is in lieu of all other written, expressed or implied warranties and URETEK ICR. expressly disclaims any warranty of merchantability, fitness for a particular purpose, or freedom from patent infringement. Accordingly, buyer assumes all risks whatsoever as to the use of the material. Buyer's exclusive remedy as to any breach of warranty, negligence or other claim shall be limited to the purchase price of the material. Failure to adhere to any recommended procedures shall relieve URETEK ICR of all liability with respect to the material or the use thereof.

URETEK ICR

Construction Products

United States

Soil PURe

De Neef Soil PURe is a hydrophobic polyurethane that, when used alone or with Soil Cat PURe, is designed to increase the bearing capacity of permeable soil. In its uncured form, Soil PURe is a blackish-brown nonflammable liquid. When it comes in contact with water, the grout slightly expands and, depending on temperature and amount of accelerator (Soil Cat PURe) used, quickly cures to a very dense open cell foam that is essentially unaffected by corrosive environments and micro organisms.

Product Documents

Document Name	Document Type	Download
Soil PURe (Data Sheet)	Data Sheet	PDF
Soil PURe (SDS)	SDS	PDF
Soil Cat (SDS)	SDS	PDF

Features/Benefits

- Free Foam Expansion up to 3 times
- Contains no volatile solvents
- Very high strength with no creep
- Very low viscosity for permeation into tight soils
- Controlled reaction time

de neef

SOIL PURe

Product Description

Soil PURe is a hydrophobic polyurethane that, when used alone or with Soil Cat PURe, is designed to increase the bearing capacity of permeable soil. In its uncured form, Soil PURe is a blackish-brown nonflammable liquid. When it comes in contact with water, the grout slightly expands and, depending on temperature and amount of accelerator (Soil Cat PURe) used, quickly cures to a very dense open cell foam that is essentially unaffected by corrosive environments and micro organisms.

Phthalate free- no phthalate-based plasticizers

Unregulated for transport- no hazmat shipping

Reformulated TDI free-all MDI based technology.

environmentally friendly-NSF/ANSI 61 approved.

C USA

SOIL PURe when combined with SOIL CAT PURe is certified by WQA to NSF/ANSI 61 for materials safety only, as verified and substantiated by test data. Please refer to WQA website(www.wqa.org) for use ratios and limitations

Product Advantages

Free Foam Expansion up to 3 times

Contains no volatile solvents

Very high strength with no creep

Very low viscosity for permeation into tight soils

Controlled reaction time

Applications

•Stabilizing soil beneath slabs and roadways

•Confinement of hazardous materials in soil

•Creating below grade cut-off curtain wall

Properties

Soil PURe Resin		
Solids	100%	ASTM D2369
Viscosity	50 cp at 77°F	ASTM D2196
Color	Black-brown liquid	
Density	1.12 g/cm^3	ASTM D4659
Flashpoint	284°F	ASTM D93
Corrosiveness	Non-corrosive	
Soil Cat PURe		
Viscosity	15 cp at 77°F	ASTM D2196
Color	Clear Liquid	
Flashpoint	221°F	ASTM D93
Soil PURe Cured		
Density confined	1.00 g/cm^3	ASTM D3574
Compressive	1813 psi	confined w/ sand
Flexural	290 psi	confined w/ sand

Packaging & Handling

Soil PURe: 5 gallon metal pail
50 gallon metal drum
Soil Cat PURe: 25 oz. metal cans

Soil PURe is sealed under dry nitrogen because it is sensitive to moisture, and should be stored in original containers in a dry area. Storage temperature must be between 40°F and 90°F. Once the packaging has been opened, the useful life of the material is greatly reduced and should be used as soon as possible. Shelf life: 2 years.

de neef

MC-500® MICROFINE® CEMENT

Product Description

MC-500®MICROFINE® Cement is a blast furnace slag based cement composed of ultrafine particles, designed for injection into loose soils, rock, concrete, and down-hole applications. MC-500 has a grain size of d_{95} equal to 9.5 microns and a d_{50} of 3.5 microns. The composition is comparable to high sulfate – resistant cements. It is suited for stabilizing or sealing all earthen foundations; especially for permanent structures such as tunnels, dams, deep foundations and oil storage tanks. Because MC-500 cures into a hardened concrete, it causes no pollution to underground soils or water supplies.

MC-500 is used with NS-200, a super plasticizer, to prevent clumping of microfine cements. It is generally used at 1-2 wt. % of the dry cement weight.

Product Advantages

Excellent penetration into fine sands and finely cracked rock

High cured strength- chemically activated to produce rapid curing to high strength

Excellent durability- impermeable to ground water and seawater

Low permeability- 10^{-9} cm/s permeability for neat grout.

Properties

Dry Properties		
Grain Size	9.5 d_{95}	ASTM C204
Grain Size	3.5 d_{50}	ASTM C204
Bulk Specific Gravity	0.7 g/cm^3	ASTM C150
Absolute Density	2.9 g/cm^3	ASTM C150
Volume	0.041 gal/lb	ASTM C150
Surface Area	1.6 x 10^4 cm^2/g	BET Method
Mixed Properties Water:Cement = 2:1. NS-200= 2% by weight . T=20°C		
Marsh Funnel	Mix Time*	Run Out
	0 min	29 s/dm^3
	30 min	30 s/dm^3
	60 min	30 s/dm^3
	90 min	30 s/dm^3
Sedimentation	Mix Time*	By Volume
	30 min	0 %
	60 min	3 %
	90 min	5 %
Compressive Strength (neat grout 2:1)**		
3 d	3.0 N/mm^2	435 psi
7 d	4.0 N/mm^2	580 psi
14 d	4.5 N/mm^2	653 psi
28 d	4.5 N/mm^2	653 psi

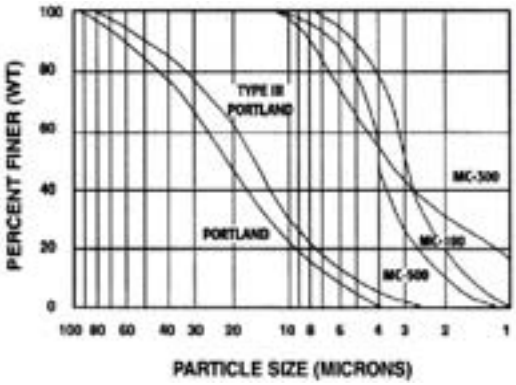
* Suspension mixed continuously at 350 rpm until tested.
** Measured on 4 cm x 4 cm x 16 cm prisms.

Note: The data shown above reflects typical results based on laboratory testing under controlled conditions. Reasonable variations from the above data may be expected.

Applications

- Geotechnical grouting
- Oil well remedial cementing
- Seal off underground streams
- Create cut off walls for dam construction
- Reinforce foundations in dams and buildings
- Reinforce and waterproof tunnel walls and roofs
- Create waterproof basins for reservoirs
- Facilitate all types of excavation
- Stabilize hazardous waste.
- Provide secondary containment for nuclear waste

Particle Size



Installation

A colloidal mixer is necessary for mixing MC-500. The order of addition to the tank is: water, NS-200, mix, then add MC-500.

Contact a DeNeef technical services representative for application specific installation procedures.

One Component Grout Mix

MC-500 Grout Mix (55 lb bag)			
Batch Size	5 Bags (275 lb)	4 Bags (220 lbs)	3 Bags (165 lbs)
Water: Cement	1:1	2:1	3:1
Water	33 gal.	53 gal.	60 gal.
NS-200	0.28 gal	0.22 gal	0.16 gal
MC-500	275 lbs	220 lbs	165 lbs
TOTAL	44 gal.	62 gal.	67 gal.
TOTAL	555 lbs	668 lbs	672 lbs

Set time for above mixes is 3-5 hours

Packaging & Handling

MC-500 : 55 lb bags
40 bags per pallet.
Store on pallets in dry and cool location.

NS-200 : 3.5 gallon pails (35 lb).
Store in original containers at or above 60°F.

Health and Safety

Freshly mixed cement grout may cause skin injury. Avoid contact with skin where possible and wash exposed skin promptly with water. Use dust mask when breaking bags and mixing. Avoid eye contact, if exposed, rinse immediately with water and seek prompt medical attention. Always use protective clothing, gloves, and goggles during use. Do not ingest. Refer to MSDS for detailed safety precautions.

In the event of an EMERGENCY call: CHEMTREC 800-424-9300.

We hope the information here will be helpful. It is based on data and knowledge considered to be true and accurate and is offered for the users' consideration, investigation and verification, but we do not warrant the results to be obtained. Please read all statements, recommendations or suggestions in conjunction with our conditions of sale, which apply to all goods supplied by us. No statement, recommendation or suggestion is intended for any use which would infringe any patent or copyright. W. R. Grace & Co.–Conn., 62 Whittemore Avenue, Cambridge, MA 02140.

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Reaction Times

T	% Cat	End Reaction	Foam Factor
40°F	0.5	14′30″	1V
	1.0	6′30″	2V
	1.5	5′00″	3V
	2.0	4′10″	3V
	2.5	2′46″	3V
50°F	0.5	12′06″	1V
	1.0	5′30″	2V
	1.5	4′30″	3V
	2.0	3′40″	3V
	2.5	2′40″	3V
60°F	0.5	11′30″	1V
	1.0	5′00″	2V
	1.5	4′00″	3V
	2.0	3′10″	3V
	2.5	2′30″	3V
68°F	0.5	10′50″	1V
	1.0	4′50″	2V
	1.5	3′50″	3V
	2.0	2′50″	3V
	2.5	2′20″	3V
77°F	0.5	8′46″	3V
	1.0	4′30″	3V
	1.5	3′25″	3V
	2.0	2′30″	3V
	2.5	2′06″	3V
86°F	0.5	8′00″	3V
	1.0	4′20″	3V
	1.5	3′05″	3V
	2.0	2′20″	3V
	2.5	2′00″	3V
95°F	0.5	7′35″	3V
	1.0	3′50″	3V
	1.5	3′05″	3V
	2.0	2′10″	3V
	2.5	1′56″	3V

CAUTION: pH NOTICE. Water used to activate PURe Grouts must be in the pH range of 3-10 for optimum foam quality.

www.deneef.com

Installation Guidelines

Warning: Consult the Technical Data Sheets and MSDS before using.

Installation Instructions: For detailed installation instructions refer to the DeNeef technical bulletin for your application.

Catalyst: Shake catalyst can 2-3 minutes. Pour the desired amount of Soil PURe into a clean dry pail. Measure the appropriate amount of Soil Cat PURe (refer to the **Reaction Times** section of this data sheet for the desired set time) and pour it into the pail. Stir until adequately mixed.

Injection: During injection the grout will follow the path of least resistance. When the material has stopped penetrating it will continue to expand against the limits of the confined space.

Extreme conditions: For application procedures in extreme temperatures and specific environments or equipment recommendations call DeNeef Technical Service.

Cleaning: Clean all tools and equipment which have been in contact with the resin with DeNeef Washing Agent before resin has cured. Products should be disposed of according to local, state, and federal laws.

Health and Safety

Always use protective clothing, gloves and goggles consistent with OSHA regulations. Avoid eye and skin contact. Do not ingest. Refer to MSDS. For emergencies, call CHEMTREC 1-800-424-9300.

Limitations

Low temperatures will significantly affect viscosity. If site temperatures are extremely low, heat bands or heated water baths may be used on the pails before and during installation to maintain the product's temperature. Avoid splashing water into open containers, as the material is water activated. Avoid exceeding 90°F when warming.

Rev. 02/2013

Technical Service 1-800-732-0166

We hope the information here will be helpful. It is based on data and knowledge considered to be true and accurate and is offered for the users' consideration, investigation and verification, but we do not warrant the results to be obtained. Please read all statements, recommendations or suggestions in conjunction with our conditions of sale, which apply to all goods supplied by us. No statement, recommendation or suggestion is intended for any use which would infringe any patent or copyright. W. R. Grace & Co.–Conn., 62 Whittemore Avenue, Cambridge, MA 02140.

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STRUCTURAL SYSTEMS, INC.
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Email: STRUCTURS001@hawaii.rr.com
www.SSIHAWAII.com
Licence No. AC-13555

April 26, 2016

Oceanit
828 Fort Street Mall, Ste 600
Honolulu, Hawaii 96813

Attention: Cris Takushi

Subject: Queens Surf Seawall at Kapiolani Regional Park -
Rough Order of Magnitude for Sea Wall Rehabilitation

Dear Cris:

We hereby submit the following proposal for the seawall remediation. We believe the attached addresses the repairs discussed in our recent meeting at our office, to remediate selected elements of this structure with appropriate consideration given to cost implications.

Scope of Work:
Supply all labor, materials and equipment to perform void filling with Uretek Polyurethane Foam and permeation grouting with Soil PURe and microfine cement at the proposed seawall structure as follows.

The microfine cement material to be installed would be the DeNeef MC-500 Micro-fine Cement and the chemical permiation grout to be used will be the DeNeef Soil PURe:

Containment & Void Filling:
I-Drill 185 each 3" diameter holes vertically down through the top of the sea wall.

II - Inject Uretek polyurethane foam directly beneath the wall in order to fill any existing voids and provide containment for future permeation grouting. Uretek polyurethane foam is NSF-61 (drinking water) safe.

Curtain Wall Installation:
III - Drill out 185 each, 3" diameter holes vertically through the void filling hole, down past the Uretek material and down to an elevation of -11.5 feet from grade, to receive permanent initial curtain wall material, DeNeef Soil PURe. DeNeef Soil PURe is NSF-61 (drinking water) safe.

IV - Drill 185 holes vertically behind the wall and through the subgrade to a depth of -11.5 feet from grade. These holes will be staggered between the vertical holes in item #3.

V- Place sleeve port/grout tubes down through the drill holes and down to a depth of -11.5 feet from grade.

VI - Pump DeNeef MC-500 Microfine Cement into the soils at an elevation of -5 feet below the existing wall, at low pressures to minimize any fracturing and allow for proper consolidation of the subgrade (see grouting notes below).

The existing soils will be grouted with microfine and polyurethane grout to construct a grouted mass in order to minimize and attempt to prevent future undermining. This is a highly specialized grouting application where we have the unique capability to "cement" the existing soils "in-place". The grout to be employed is unaffected by acids, gasses, or microorganisms in the soil or surrounding environment. The proposed polyurethane resin contains no volatile organic compounds (VOC's), is nonflammable, non-carcinogenic, and non-corrosive. At catalysis, the grout bonds to the surrounding soils creating a water impermeable mass. A secondary cycle of grouting may need to be performed to address inconsistencies in the soils or grouted mass due to variations in the density or porosity of the subsurface soil or other subsurface conditions. Where necessary, a tertiary round of grouting can be performed if inconsistencies remain in the grouted area.

Value Engineering/Quality Assurance:
The practices and methods to be employed follow generally accepted construction practices. Water erosion and/or the instability of soils at the shoreline are problems with a difficult and not always clearly definable solution. It is both our experience and that of other grouting professionals we consult with, that grouting with microfine cements and/or polyurethane grouts present one of the most economical and viable solutions to the problems typified at this project site. Polyurethane seals are not affected by water in the areas to be grouted. The polyurethane resins will permeate and fill voids and irregularities in the grouted soils.

Exclusions:
While we have a few options for our BMP method for containing the void filling material and future permeation grout, we are currently excluding it from our proposal. All traffic control provisions are excluded from this proposal and must be completed by others. This proposal assumes existing construction conforms with or is generally recognized as standard in accordance with applicable building codes or industry standards. If this is not the case, or if previous reinforced underpinnings/piers are discovered an additional charge will be assessed. Any testing, field monitoring, permitting or engineering services, if required, will be at your expense. *Any concealed, "as-found" or unanticipated conditions, and any landscaping repair, tree removal and replacement, irrigation or other utility lines that may require removal and reinstallation are not included in this proposal.* Unionized labor and/or davis-back labor rates are also excluded from this work. Any and all sidewalk repair, flagstone repair, seawall and/or top cap repair, concrete curb repair, adjacent masonry repair and buttress wall repair. Structural Systems, Inc. is not responsible for any concealed, "as-found," or unforeseen conditions. Any failure due to Acts of God, current or future construction, or other waterproofing efforts is excluded. All remedial work not integral to the drilling, Uretek system and curtain wall system is excluded.

Additional Notes:
Due to the nature of the work being addressed, successful grouting and stabilization of subsurface soils may cause an increase in undermining in other "hot spot" areas. These other areas may then demonstrate new or additional symptoms of erosion or undermining. It is important to realize that this is a physical law of nature over which we have no control. These or other additional "hot spot", isolated symptoms of erosion/undermining which become apparent after the primary grouting work is completed, can be addressed in succeeding phases of grouting for an additional fee.

Fee Schedule:
The above scope of work will be completed for a fee of $1,473,224, tax included. Our quote includes a minimum fee for 5,000 pounds of Uretek injection, 11 pallets of MC-500 Microfine grouting (35 gallons per hole) and 6,475 gallons of Soil PURe (35 gallons per hole). Additional Uretek foam (beyond the estimated 5,000 pounds) if necessary will be priced out at $20.95 per pound of urethane grout in place. Additional Permeation Grouting will be priced at unit prices listed below.

Queens Surf - Rough Order of Magnitude

Item I -	Base Bid for Sea Wall Rehabilitation (See above Notes) Includes Drilling, Uretek Installation, Soil PURe Installation Microfine Cement Installation, Mobilization	$1,412,724.00
Item II -	Project Fencing with Dust Cloth	$ 35,000.00
Item III -	Above Ground Drill Cutting Containment System	$ 19,500.00
Item VI -	Project Utility Toning	$ 6,000.00
	Project Subtotal:	$1,473,224.00

Deductive Alternate Options:

Replace Soil PURE w/ DeNeef Micro-fine cement for Makai Row:	($274,500.00)
Delete Secondary Row of Injection Locations:	($386,224.00)

APPENDIX E

Archaeological Monitoring Report

PRELIMINARY DRAFT REPORT
Archaeological Monitoring Plan
in Support of Proposed Repairs to the Queen's Surf Seawall in Waikīkī,
Waikīkī Ahupuaʻa, Honolulu District, Island of Oʻahu
TMK: (1) 3-1-030:001 and (1) 3-1-031:004 and 005

By:
Jackie Walden, B.A.

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Principal Investigator

Prepared for:
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July 2017

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INTRODUCTION

At the request of the Oceanit, Pacific Consulting Services, Inc. (PCSI) has prepared this Archaeological Monitoring Plan (AMP) in support of proposed Repairs to the Queen's Surf Seawall in Waikiki at Kapiʻolani Beach Park, Honolulu, Oʻahu (Figure 1). The seawall project will consist of restoring the structural integrity of the seawall and the adjacent land, preventing erosion of the adjacent land and the beach walk structure, and replacing the degraded concrete top cap of the wall.

This AMP has been prepared in compliance with Hawaii Revised Statutes (HRS), Chapter 6E, and Title 13 of the Hawaii Administrative Rules (HAR), Subtitle 13 (State Historic Preservation Division Rules), Chapter 279 (*Rules Governing Standards for Archaeological Monitoring Studies and Reports*), and Chapter 275 (*Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-8, HRS*). The City and County of Honolulu (CCH), Department of Design and Construction (DDC) is the project proponent.

PROJECT AREA LOCATION

The entire project area is located within the boundaries of Kapiʻolani Park in the Kapiʻolani Beach / Queen's Surf Beach recreational area. The proposed seawall project area location is owned by the State of Hawaii and the City and County of Honolulu. The TMKs associated with this project include (1) 3-1-030:001 and (1) 3-1-031:004 and 005 (see inset on Figure 1). The primary project area parcel, TMK: (1) 3-1-031:004, has been leased to the CCH and is under the administration of the Department of Parks and Recreation. The project area is located along the shore on the ʻ*ewa* (north) side of the Waikīkī Aquarium (Figure 2). The project area borders the ocean and the ground surface currently consists of beach sand. The project area measures 0.2 acres (817 sq m). Staging areas will likely be on adjacent lands owned by CCH.

Required repairs of the seawall include filling all voids detected in the wall's foundation and repair or reconstruction of the concrete cap. The recommended construction for this project consists of a form-lined concrete wall on the *makai* (ocean) side of the seawall and concrete support on the land side. Drainage provisions on the land side would be included with land side improvements to drain water from overtopping waves and storm water runoff. The new wall will either be anchored to the concrete structure land side of the seawall or supported by vertical reinforcing bars imbedded near the wall's foundation (Figure 3).

The project area is situated in the Diamond Head Special District and a Special Management Area. Kapiʻolani Park was listed on the State of Hawaiʻi Register of Historic Places (HRHP) in July 17, 1992, and was assigned Statewide Inventory of Historic Places (SIHP) Site No. 50-80-14-9758 (Site 9758).

ENVIRONMENTAL BACKGROUND

RAINFALL AND HYDROLOGY

According to Giambelluca et al. (2011) annual rainfall in this part of leeward Oʻahu averages less than 636.0 mm (25.4 in) per year, with most rain falling in the winter months between November and March.

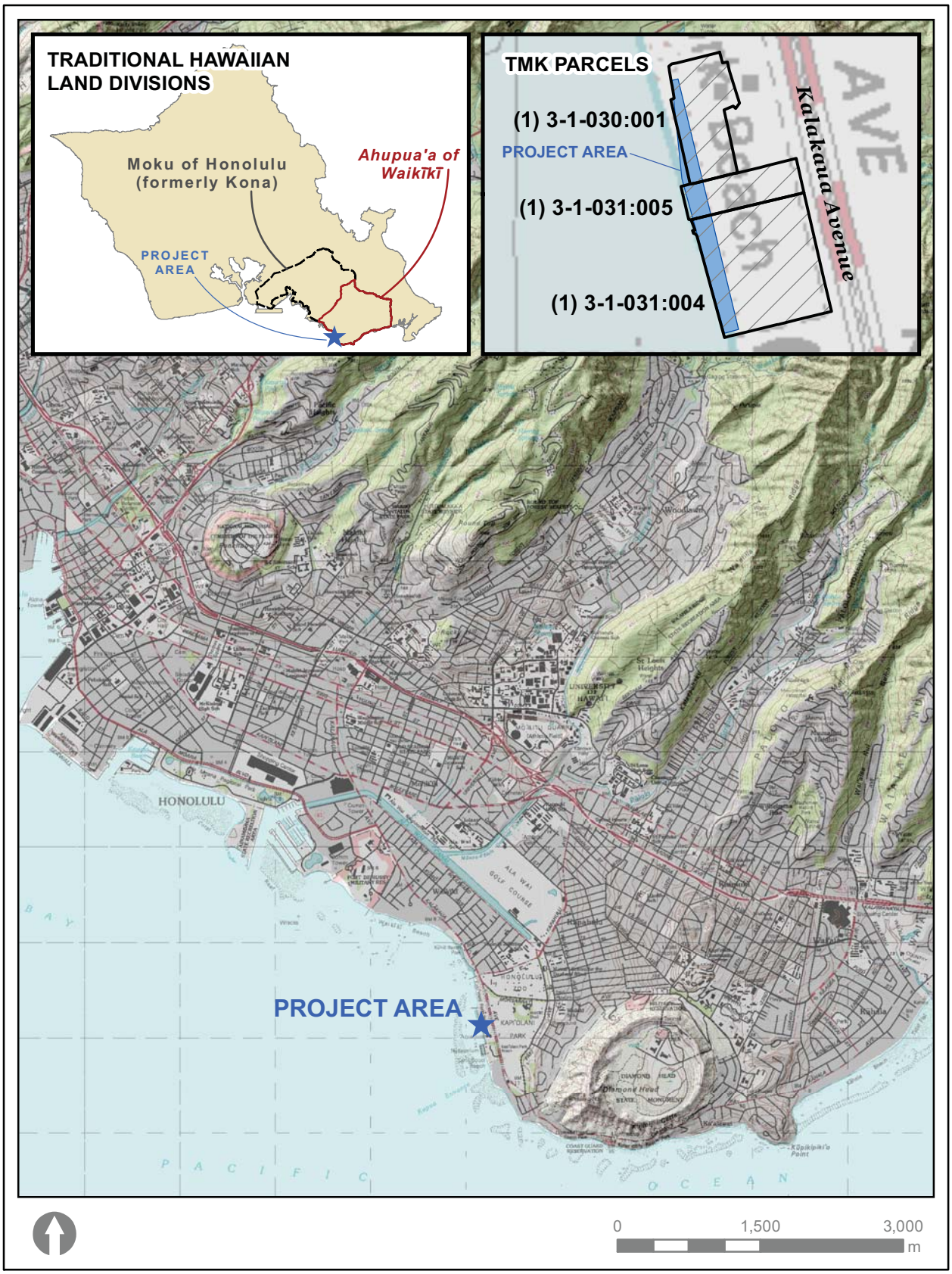

Figure 1. Location of the Queen's Surf Seawall Repair Project Area on an Enlarged 1:24,000 U.S.G.S. Quadrangle Map, Honolulu (2012).

Figure 2. Aerial view of Project Area (Google Earth 2008, Adapted from Oceanit).

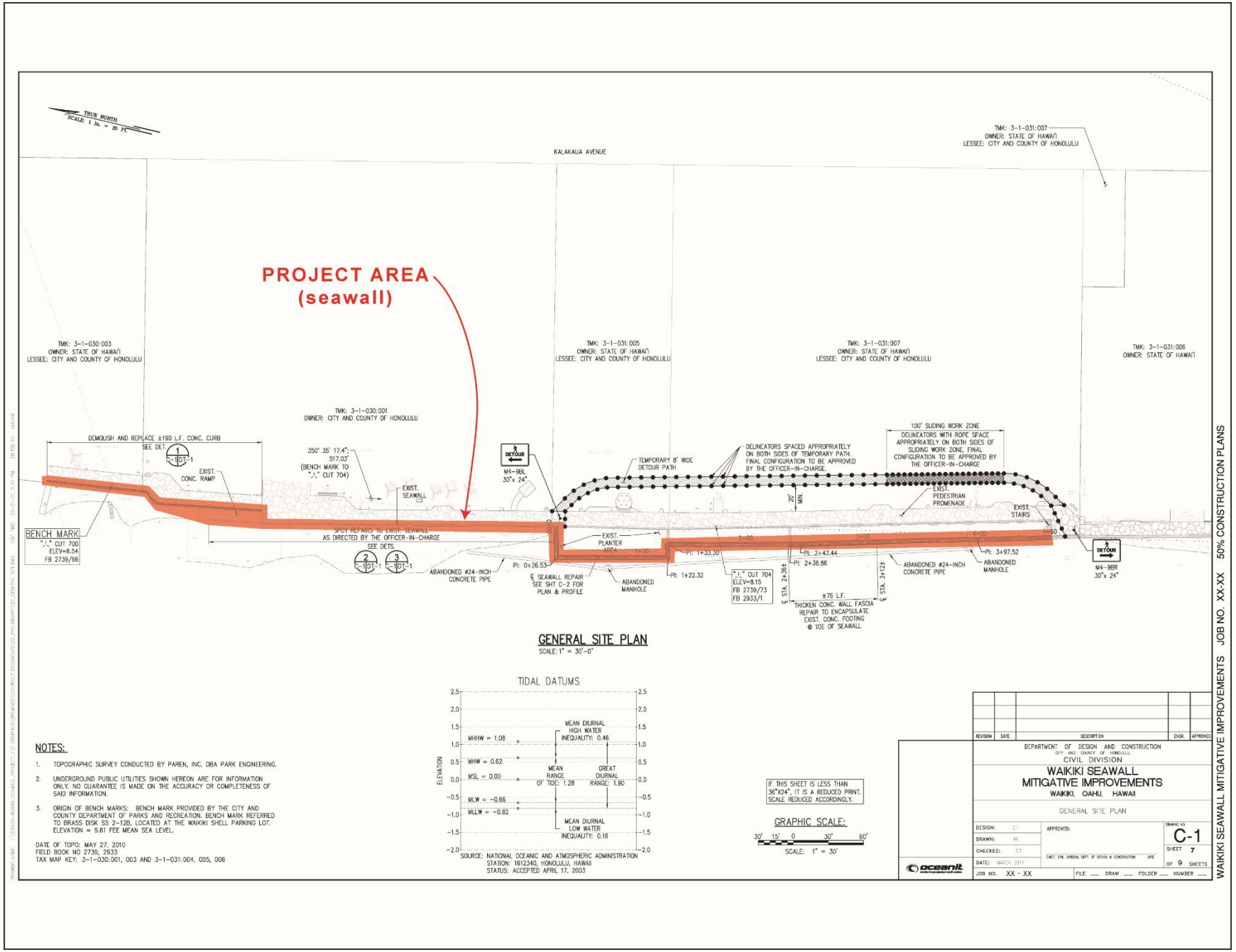

Figure 3. Project Design Plans for the Seawall Repair Project.

VEGETATION

The current vegetation in the vicinity of the project area consists of *kukui* trees (*Aleurutes moluccanna*), coco palms (*Cocos nucifera*) and unidentified exotic grasses (Wagner et al. 1990).

TOPOGRAPHY AND SOILS

The project area is situated in the southwestern end of Waikīkī on a relatively flat coastal plain. The elevation within the project area ranges between 1.2 and 2.0 meters (m) (4.0 and 6.5 feet [ft]) above mean sea level. The underlying geology of Waikīkī consists of late-Pleistocene coral reef substrate overlaid with calcareous marine beach sand or terrigenous sediments, as well as stream-fed alluvial deposits (Macdonald and Abbott 1970).

The naturally-deposited soils within the project area are classified as Beaches (BS) along the shoreline at 0 to 5 percent slopes (Figure 4). Outside the project area are Jaucas Sands (JaC) which cover a majority of the inland portion of the area which occur on 0 to 15 percent slopes, and Kawaihapai clay loam (KIA) in the northern most section at 0 to 2 percent slopes (Soil Survey Staff 2013).

Three primary factors influenced what is now the modern Hawaiian shoreline near the Queen's Surf seawall project area (Bush et al. 2004:2-3):

1) Sea level rise at the end of the Pleistocene.

2) The approximately 1.5 to 2.0 m high-stand of the sea during the mid to late Holocene.

3) Landscape modification by prehistoric and historic human activity.

Prior to a 100.0 m rise in sea level at the end of the Pleistocene, the coastal regions were erosional environments. After this remarkable sea-level rise these environments changed into low-energy estuaries or lagoons, and became depositional environments, which led to the accumulation of soft and relatively loose sediments.

A high-stand of approximately 1.5 to 2.0 m above present sea level has been documented between 4500 and 2000 years ago. During this time, coral reef formation (and concomitant detrital reef sediments) increased. Specific to the project area, Waikīkī became a marshy wetland environment (both brackish and fresh water) because of its many stream estuaries. While some erosion would have taken place due to the subsequent decrease to present-day sea level, the results of these depositional processes would have largely created the Waikīkī environment first encountered by early Hawaiians.

Urbanization of Waikīkī and parts of Honolulu resulted in many land reclamation projects, with the excavation of the Ala Wai Canal in the 1920s being one of the largest and most environmentally significant. The canal replaced the natural streams as the primary means of draining water coming down from the Koʻolau Mountains, and the wetlands were buried below layers of sediment and coral fill, including the area of Kapiʻolani Park (Bush et al. 2004: 2-3).

HISTORICAL BACKGROUND

This section presents a brief summary of the historical background literature available for the project area. The type of literature reviewed includes accounts of early Europeans (e.g., explorers, traders, missionaries), ethno-historic studies by historians, ethnographers, and other scholars, government records (e.g., Land Commission Awards [LCA]), and old photographs and maps. To provide the necessary comprehensive historical context, the area under review

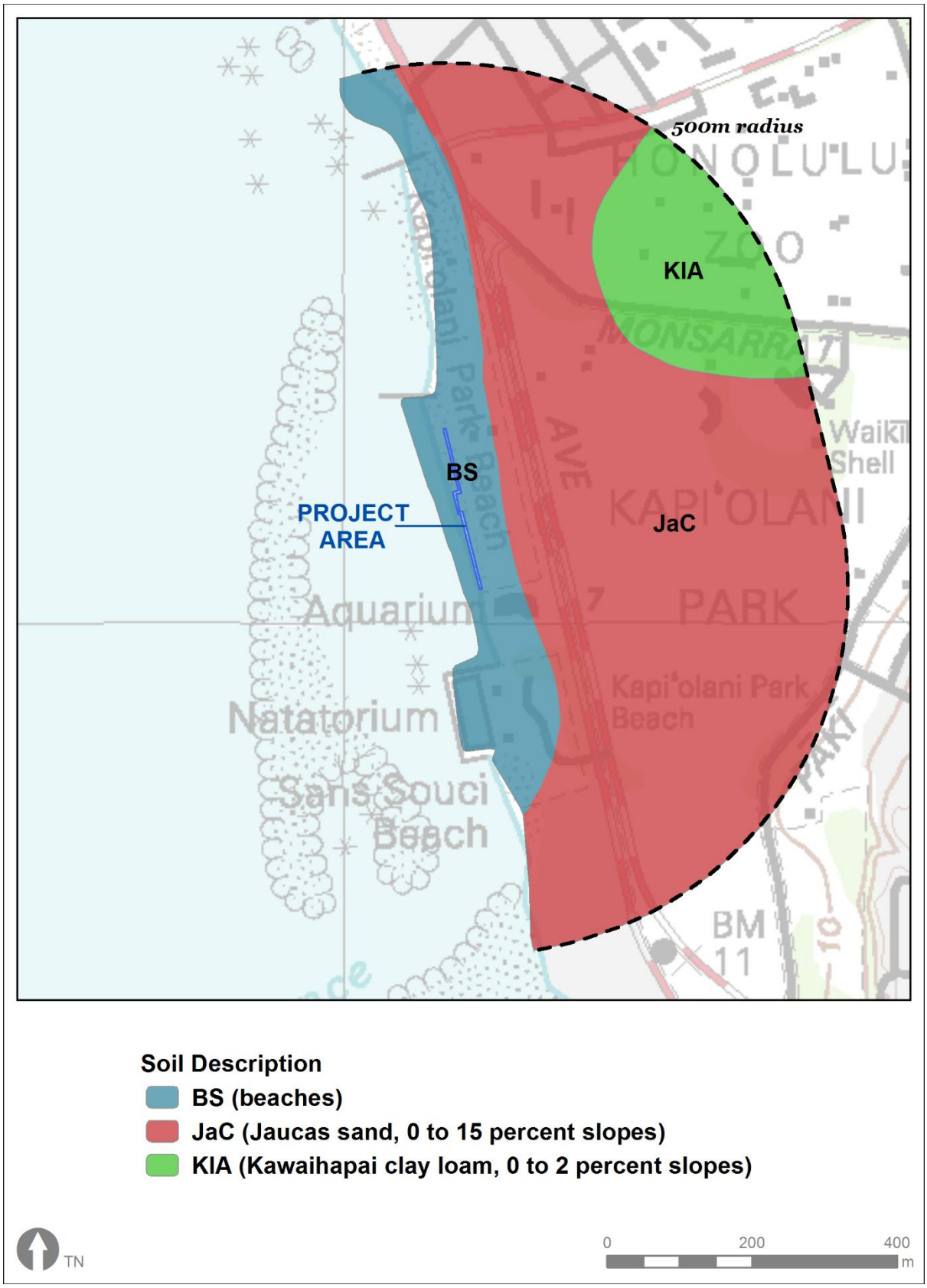

Figure 4. Soil Survey Map for the Queen's Surf Seawall Repair Project Area (Soil Survey Staff 2017; USGS 2012).

includes much of the Waikīkī Ahupuaʻa, as well as the area adjacent to the Queen's Surf seawall project area.

WAIKĪKĪ AHUPUAʻA

The project area is located within the *ahupuaʻa* (traditional land division) of Waikīkī, in the Honolulu (old Kona) District. This *ahupuaʻa* was an important occupational and political center during much of pre-Contact Hawaiian history, and by the A.D. 1300s it was the ruling center of the Oʻahu chiefs (Beckwith 1940). It continued to be a chiefly residential center through the time of Kamehameha I, after he seized control of Oʻahu from Kalanikupule (ʻĪʻī 1959:17; Tomonari-Tuggle and Blankfein 1998:13). Historian Lilikālā Kameʻeleihiwa (1992: Kindle Locations 1406-1409) describes in detail how and to whom Kamehameha I conveyed *ʻāina* in Waikīkī and other desirable areas of Oʻahu:

> Thirteen years later, in 1795, after Kamehameha had defeated the other Hawaiʻi island Aliʻi and taken all the islands from Māui to Oʻahu as well, the four Kona Uncles were given the highest positions on his council. They were also given extensive *ʻĀina* throughout the islands; these *ʻĀina* were known as *panalāʻau*, or conquered Lands.

Along with the residential complexes of the pre-Contact Hawaiian chiefs, a thriving populace lived here as well, with an abundant food production system that included extensive *loʻi* (wetland taro fields), *ʻauwai* (irrigation ditches) and fishponds. Accounts of traditional Hawaiian life in Waikīkī can be found in the journals of several early European explorers (Menzies 1920:23-24; Vancouver 1798: I, 161-164).

Waikīkī was a vastly populated and favored land of the chiefs, rich with agricultural and aquacultural resources. Oral history describes Kalamakua, a chief who reigned around the sixteenth century (based on Stoke's 20 year-count - Kelly 1989), as being the first to build an extensive irrigation system in Waikīkī. Kamakau (1991:45) describes Kalamakua as:

> …a good chief. He was noted for cultivating, and it was he who constructed the large pond fields Keʻokea, Kūalulua, Kalāmanamana, and other *loʻi* in Waikiki. He traveled about his chiefdom with his chiefs and household companions to cultivate the land and gave the produce to the commoners, the *makaʻāinana*.

Hawaiian historian John Papa ʻĪʻī (1959:17) described Kamehameha's residence in Waikīkī:

> Kamehameha's houses were at Puaaliilii, makai of the old road, and extended as far as the west side of the sands of Apuakehau. Within it was Helumoa, where Kaahumanu *ma* went to while away the time. The king built a stone house there, enclosed by a fence; and Kamalo, Wawae, and their relatives were in charge of the royal residence. Kamalo and Wawae were the children of Luluka and Keaka, the childhood guardians of Kamehameha.
>
> This place has long been a residence of chiefs. It is said that it had been Kekuapoi's home, through her husband Kahahana, since the time of Kahekili. Haalou, a *makuahine* of Kamehameha, lived there with her younger daughter Kekuapoi while en route from Hawaii to Kauai to consult Kapoukahi, a seer of Kauai, for means whereby Kamehameha would gain victory over Keoua Kuahuula.

Additional accounts of traditional Hawaiian life in Waikīkī were described by several early European explorers as rich and bountiful. In 1792, Captain George Vancouver (1798:162-164) described the southern shoreline of Oʻahu in the following manner:

> On the shores, the villages appeared numerous, large, and in good repair; and the surrounding country pleasingly interspersed with deep, though not extensive valleys; which, with the plains near the sea-side, presented a high degree of cultivation and fertility.
>
> This opened to our view a spacious plain, which, in the immediate vicinity of the village, had the appearance of the open common fields in England; but, on advancing, the major part appeared divided into fields of irregular shape and figure, which were separated from each other by low stone walls, and were in a very high state of cultivation. These several portions of land were planted with the eddo or taro root, in different stages of inundation; none being perfectly dry, and some from three to six or seven inches under water. The causeway led us near a mile from the beach, at the end of which was the water we were in quest of.
>
> The gentleness and civility of the natives tempted us to extend our walk through the plantations, which we found very pleasant. A fine refreshing breeze prevailed, and the Indians kept at a sufficient distance to prevent their company being incommodious. In this excursion we found the land in a high state of cultivation, mostly under immediate crops of taro; and abounding with a variety of wild fowl, chiefly of the duck kind, some of which our sportsmen shot, and they were very fine eating. The sides of the hills, which were at some distance, seemed rocky and barren; the intermediate vallies [sic], which were all inhabited, produced some large trees, and made a pleasing appearance. The plains, however, if we may judge from the labour bestowed on their cultivation, seem to afford the principal proportion of the different vegetable productions on which the inhabitants depend for the subsistence.

Archibald Menzies (1920:23-24), a surgeon and naturalist who accompanied Vancouver aboard the H.M.S. Discovery described the land around Waikīkī:

> We pursued a pleasing path back into the plantation, which was nearly level and very extensive, and laid out with great neatness into little fields planted with taro, yams, sweet potatoes and the cloth plant. These, in many cases, were divided by little banks on which grew the sugar cane and a species of Draecena without the aid of much cultivation, and the whole was watered in a most ingenious manner by dividing the general stream into little aqueducts leading in various directions so as to be able to supply the most distant fields at pleasure, and the soil seemed to repay the labor and industry of these people by the luxuriancy (*sic*) of its productions. Here and there we met with ponds of considerable size, and besides being well stocked with fish, they swarmed with water fowl of various kinds such as ducks, coots, water hens, bitterns, plovers, and curlews.

During 1813-1818, the islands were visited by Peter Corney (1965:193) who described Waikīkī in the following manner:

> On rounding Diamond hill the village of Wyteetee (Waikiki) appears through large groves of cocoanut and bread-fruit trees; it has a most beautiful appearance, the land all round in the highest state of cultivation, and the hills covered with wood; a beautiful plain extending as far as the eye can reach. A reef of coral runs along the whole course of this shore, within a quarter of a mile of the beach, on which the sea breaks high; inside this reef there is a passage for canoes.

Russian explorer Otto Von Kotzebue (1821:320) visited the islands in 1816. During this voyage, Kotzebue described the landscape of Waikīkī:

> ...but you have scarcely sailed round the Yellow Diamond Hill, when you are surprised by the most beautiful landscape. Close to the shore you see verdant vallies [*sic*] adorned with palm and banana-trees, under which the habitations of the savages lie scattered; behind

> this, the land gradually rises, all the hills are covered with a smiling verdure, and bear the stamp of industry.

In 1824-1825, Andrew Bloxam (1925:35-36), a naturalist on the *H.M.S. Blonde,* described Honolulu and Waikīkī in the following manner:

> I walked along shore towards the bay of Whyteete [Waiki - ki-, from Honolulu] to see if I could procure any shells, but I found none worth picking up. The whole distance to the village of Whyteete is taken up with innumerable artificial fishponds extending a mile inland from the shore, in these the fish taken by nets in the sea are put, and though most of the ponds are fresh water, yet the fish seem to thrive and fatten. Most of these fish belong to the chiefs, and are caught as wanted. The ponds are several hundred in number and are the resort of wild ducks and other water fowl. I found it very difficult to get out of the labyrinth of paths which lead among them. Whyteete is about four miles east of Honoruru [Honolulu]. It is pleasantly situated and built along the shore among numerous groves of coconut and other trees, and in this respect far better than Honoruru, as scarcely any trees are to be found there.

However, when Honolulu became the center of trade with foreigners, many Hawaiians, including Kamehameha I himself, shifted residences from Waikīkī. Additionally, introduced European diseases decimated Native Hawaiian populations, including that of Waikīkī. Later, the people who remained replaced the *lo'i* with rice fields, and continued farming up until the construction of the Ala Wai Canal in the 1920s, which succeeded in draining the wetlands. Construction on the Canal began in 1921 and was completed in 1929, as a major part of the Waikīkī Reclamation Project (Stephenson 2008: 28). This land reclamation allowed for the rapid urbanization of Waikīkī, including the present-day Kapiʻolani Park, and was likely the most significant event with regard to land use in this area.

KAPIʻOLANI PARK

Historic documents suggest that the southern end of Waikīkī, where Kapiʻolani Park is presently located, was somewhat removed from the dense populations and intensive food production activities that characterized the rest of the *ahupuaʻa* (Figure 5). Figure 6, a historic map made in 1876 by surveyor Curtis J. Lyons records five *heiau* (temple) in the area of Kapiʻolani Park and Diamond Head as having been present: Papaʻenaʻena, Kupalaha, Kapua, Kamauakapu, and Makahuna, though none of them remain today.

Thrum (1907:44) compiled a preliminary list of *heiau* sites in the Hawaiian Islands, and descriptions of the *heiau* listed above are presented below:

> Papaenaena: At the foot of Diamond Head slope, rear of Douglas' premise. Heiau pookanaka, 130x70 feet in size; a walled and paved structure of open terraced front, destroyed by Kanaina about 1856, the stones used to enclose Queen Emma's premises and for road work. This heiau is the supposed place of a number of sacrifices by Kam. I at the opening of the last century, as mentioned in "Tales from the Temples" in this issue.
>
> Kupalaha: Kapiolani Park, near Cunha's. – Entirely obliterated. Class unknown, but said to have had connection in its working with Papaenaena.
>
> Kapua: Near Kapiolani Park, Opposite Camp McKinley. Heiau pookanaka. Fragments of its walls, torn down in 1860, show it to have been about 240 feet square; said to be the place of sacrifice of Kaolohaka, a chief from Hawaii, on suspicion of being a spy.
>
> Kamauakapu: Kapahulu, Diamond Head, 11x15.8 feet in size: erected by Kalakaua in 1888; of husbandry class for "Naua Society" workings. Already in partial ruins.
>
> Makahuna: Diamond Head, overlooking "Aqua Marine." – A large heiau enclosure dedicated to Kane and Kanekoa, of Kuula character, so said.

Figure 5. Portion of 1825 Map by Lt. C.R. Malden Showing Southeast Portion of Waikiki.

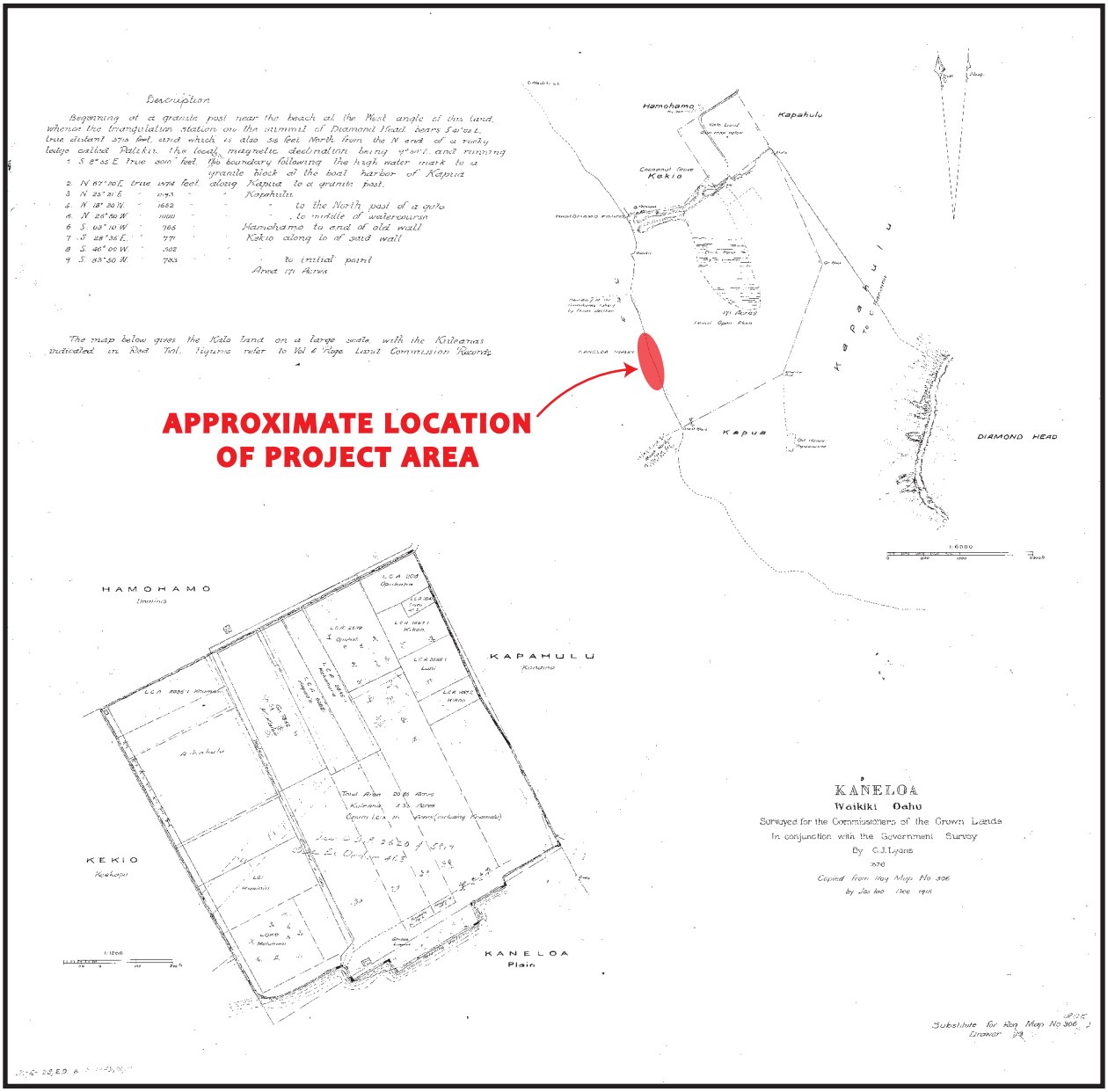

Figure 6. Portion of 1876 Map by C.J. Lyons Showing Kaneloa.

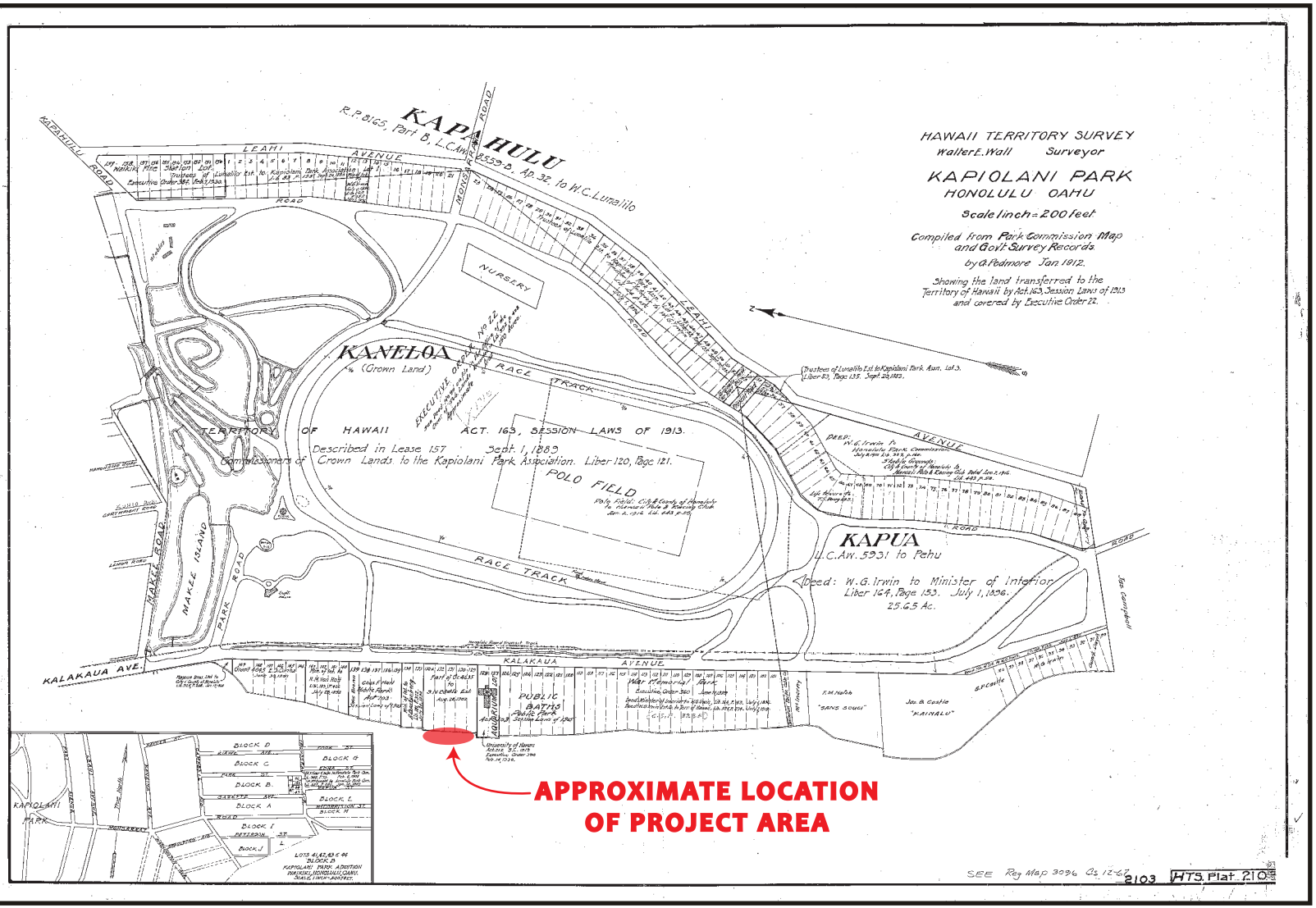

Figure 7. 1912 Map of the Southern Portion of Waikiki.

Act 103 declared that certain lands ought to be developed as public parks. This act ensured that Kapiʻolani Park would acquire beachfront for public use (Weyeneth 1991:24). In the early 20th Century, during the Waikīkī Reclamation Project, the stagnant ponds in Kapiʻolani Park became a health concern to the general population. As a result these ponds were drained and filled with imported materials and sediments dredged from the Ala Wai Canal. On the southern end of Waikīkī the Waikīkī Aquarium opened in 1904, and a public bath park was established in 1905 on the Diamond Head side of the aquarium property. The War Memorial Park was established on June 17, 1929 by Executive Order (EO) 360 (see Figure 5). In 1952 Governor Long's EO 1536 withdrew 2.3 acres from the War Memorial Park land to use as the new Waikīkī Aquarium site.

Kapiʻolani Park is listed on the HRHP (Site 9758), and the park is eligible for placement on the National Register of Historic Places (NRHP). However for reasons unknown Kapiʻolani Park has not been added the NRHP. The significance statement for Kapiʻolani Park as summarized in the NRHP nomination form is listed below:

> Kapiolani Park is historically significant for its past association with indigenous Hawaiian culture and royalty. Hawaiian King Kalakaua envisioned the park as a place of recreation for all and named it after his famous Queen, Kapiolani. Since its dedication in 1877 it has been in continuous use as a location for recreational activities valued by local residents and visitors alike. It provides a sense of place to a special part of Honolulu and is indentified with the world famous image of Hawaii as a recreational resort. Over the years it has been the scene of a variety of sports and leisure time activities that reflects the recreational development of Honolulu and Hawaii into the modern world (Abel 1992:3).

Based on these documentary sources alone, it is very likely that evidence of both pre-Contact Native Hawaiian and historic use of the parcel may be present underlying the ground surface within the project area.

PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

Despite the density of the modern urban landscape in Waikīkī, remnants of pre-Contact and historic occupation have consistently been discovered during subsurface archaeological investigations. Many of these discoveries have been made during archaeological surveys and monitoring associated with urban development and infrastructure upgrades, and they very frequently include pre-Contact (pre-A.D. 1778) Native Hawaiian burials. Table 1 summarizes key archaeological studies near the project area. Figure 8 illustrates the locations of these previous archaeological studies.

Numerous human burials have been discovered in Waikīkī, despite the considerable quantity of fill that was placed here during the Waikīkī Reclamation Project. Pockets of undisturbed beach and dune sands (i.e., Jaucas Sands, see Foote et al. 1972) have been observed below the historic fill layers making the possibility of discovering human burials and other cultural materials in this area high. A number of archaeological discoveries have been reported (Table 1), a brief outline of previous archaeological studies in / near the vicinity of the project area is provided here to aid in understanding the area's archeological context.

The first human burials were reported by Emerson (1902:18-202) in 1901 during excavation of trenches for the installation of sewer pipes on the site of the present-day Elks Club. Emerson collected the remains of four individuals, all presumably pre-Contact Native Hawaiians. Along with the burials, grave goods were found, including whale-tooth beads, glass

beads, and a carved sperm-whale tooth. The presence of glass beads does suggest an historic-period context should, at least in part, be assigned to this discovery.

Table 1. Previous Archaeological Studies in the Vicinity of the Project Area.

Reference	TMK/Location	Nature of Study	SIHP# 50-80-14-	Summary of Results
Emerson 1902	**3-1-032:006** Waikīkī Elks Club	Inadvertent Discovery	None	Burials (pre-Contact; minimum 4 individuals); associated grave goods
McAllister 1933*	Waikīkī (general)	Survey	[all of Waikīkī Site #60 in McAllister]	*Heiau*
Bishop Museum	**3-1-032:031** Outrigger Canoe Club	Inadvertent Discovery	None	Burials (pre-Contact; Min of 31 individuals with MNI of 96)
Dega and Kennedy 1993	**3-1-031/** Waikīkī Aquarium	Inadvertent Discovery	4729	Human remains (scattered)
Lovington 1996	**Offshore**	Underwater Survey	None	Mapping of isolated artifact finds
Winieski et al. 2002a	**2-6-001:023,026-027 & 3-1-043**/ Kuhio Beach	Monitoring	5846-5862, 5940, 5942-5943	Burials (minimum 44 individuals)
Winieski et al. 2002b	**2-6-001:022-024,026-027 & 3-1-043**/ Kuhio Beach	Monitoring	5858, 5862-5863, 5940, 5948	Burials (minimum 10 individuals)
Hammatt et al. 2000	**3-1-043/** Honolulu Zoo	Assessment	N/A	N/A
McDermott and Chiogioji 2001	**3-1-043/** Honolulu Zoo	Survey (Inventory); Test Excavation	None	No archaeological finds reported
Perzinski and Hammatt 2001	**3-1-031,032,043/** Kalakaua Ave: Natatorium to Poni Moi Rd	Monitoring	None	Adze fragment; cowry shell octopus lure component; historic glass and ceramics
Bush et al. 2002	**3-1-030,031/** Queen's Surf Promenade	Monitoring	None	No archaeological finds reported
Perzinski and Hammatt 2002	**3-1-043/** Kapiʻolani Park (bandstand)	Monitoring	None	Basalt lamp fragment; charcoal concentration
Bush et al. 2004	**3-1-043/** Honolulu Zoo	Monitoring	None	No archaeological finds reported
Cultural Surveys Hawaiʻi 2004	**3-1-031:008/** Kalakaua Ave	Monitoring	6704	Historic trash deposit

Table 1. Previous Archaeological Studies in the Vicinity of the Project Area.

Reference	TMK/Location	Nature of Study	SIHP# 50-80-14-	Summary of Results
Tome and Spear 2005	**3-1-031/** Kalakaua Ave	Monitoring	6702	Historic debris/trash deposit
Liebhardt and Kennnedy 2008	**3-1-031:006/** Waikīkī Aquarium	Monitoring	None	No archaeological finds reported
Whitman et al. 2008*	**3-1-032, 043/** Kalakaua Ave and Poni Moi Rd	Monitoring	6946	Burial (1 individual, Native Hawaiian)
Moser et al 2012	**3-1-032:031 Outrigger Canoe Club**	Monitoring	None	
Walden et al. 2012	**3-1-043/** Honolulu Zoo	Monitoring	7208	Subsurface features in dune sand layer; possibly Makee Island
Mintmier et al. 2013	**3-1-043/** Honolulu Zoo	Monitoring	N/A	Recent and historic features associated with Zoo and Kapiʻolani Park
Clark et al. 2014	**3-1-043/** Honolulu Zoo	Monitoring	7208	Subsurface feature; possibly Makee Island

*Reference not listed on Figure 6.

In the 1920s and 1930s, the first major archaeological survey of Oʻahu was conducted by McAllister (1933), he recorded four *heiau* (Hawaiian ritual structure) in the Waikīkī area. Not until the 1960s do reports of archaeological materials surface again. Human remains were found in 1963 during construction at the Outrigger Canoe Club, at the end of Kalakaua Ave (Bush et al. 2004:24). Bush et al. (2004) cite the 1963 Honolulu Star Bulletin:

> The Outrigger Canoe Club yesterday dedicated its new site [on land adjacent to and leased from the Elks Clubs], an ancient Hawaiian burial ground in Waikīkī…Robert Bowen of the Bishop Museum has been working closely with Ernest Souza, Hawaiian Dredging superintendent, on the removal of skeletons unearthed on the site, between the Colony Surf and the Elks Club…Most of the bodies were buried in the traditional *hoʻolewa* position, with legs bound tightly against the chest.

In 1993, during construction activities at the Waikīkī Aquarium fragmentary human remains were discovered (Dega and Kennedy 1993).

In 1996, Lovington conducted a pilot study in an area just offshore of the Waikīkī Natatorium, in an attempt to locate submerged cultural resources associated with a koʻa (fishing shrine) formerly thought to be on the nearby shoreline. Lovington's underwater survey was conducted as a class project through the Marine Options Program at the University of Hawaiʻi at Mānoa; several isolated artifacts were recorded (Lovington 1996).

The early 2000s yielded a sizable quantity of human burials in the Waikīkī area (Winieski et al. 2002a, 2002b). A minimum of 54 individuals were discovered in burials recorded along Kalakaua Ave. near Kuhio Beach.

Specifically in the Kapiʻolani Park area, several survey, monitoring, and test excavation projects were completed (Bush et al. 2002; Bush et al. 2004; Hammatt et al. 2000; McDermott

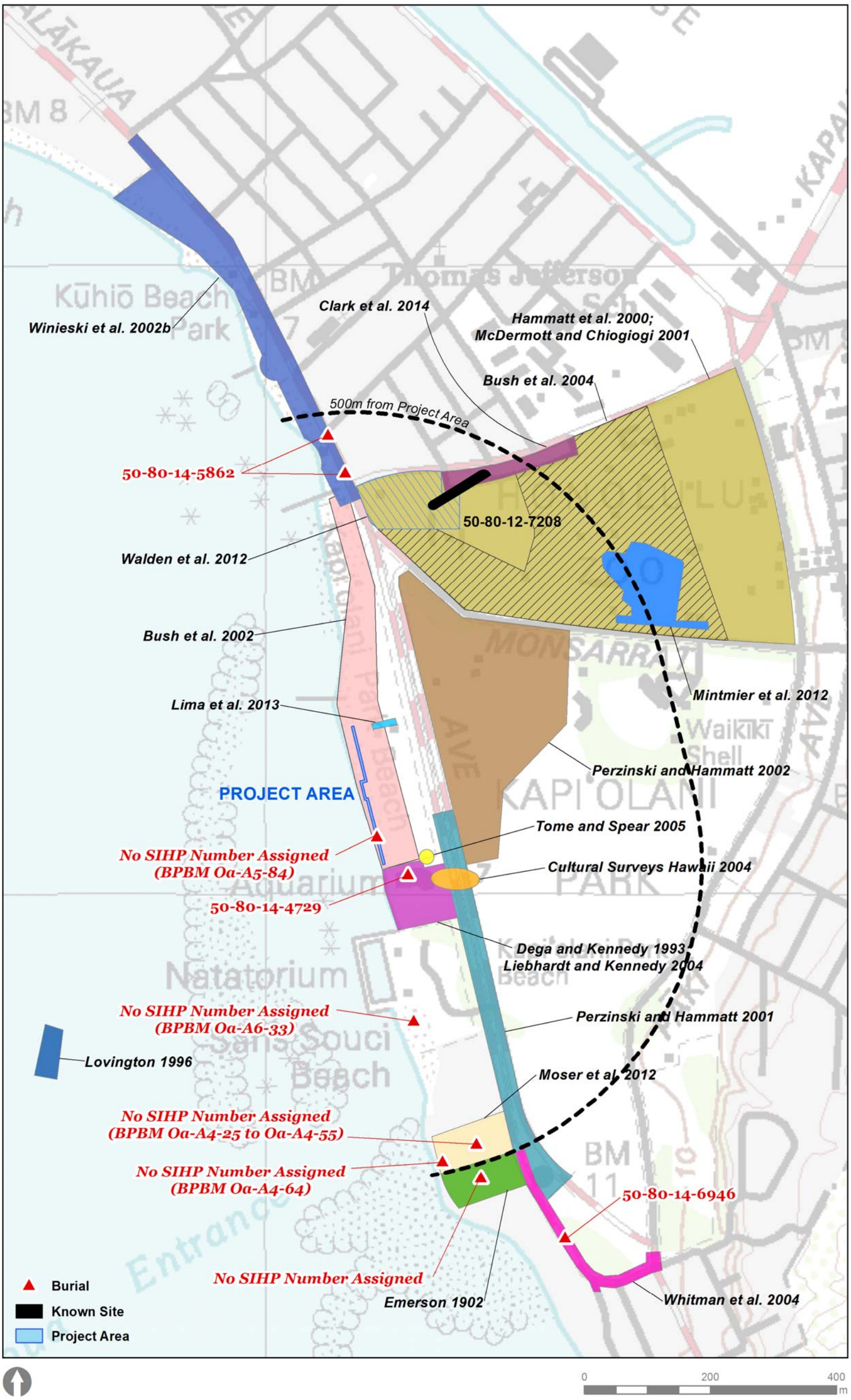

Figure 8. Locations of Previous Archaeological Studies.

and Chiogioji 2001; Perzinski and Hammatt 2002; Tome and Spear 2005; Whitman et al. 2008; Walden et al. 2012; Mintmier et al. 2013; Clark et al. 2014).

Perzinski and Hammatt (2002) conducted archaeological monitoring near the Kapiʻolani Bandstand. During this project a basalt lamp fragment and a charcoal concentration was recorded.

In 2004 Cultural Surveys Hawaiʻi conducted archaeological monitoring for an electrical trench located just *ʻewa* of the Waikiki Aquarium. The 80 m trench ran across Kalakaua to the sidewalk fronting the aquarium and continued on for 25 m towards the ocean. A historic trash pit (site 6704) was recorded. The trash pit included bottles ranging in date from the 1880's to the 1920's, broken ceramic and saw-cut animal bone.

Tome and Spear (2005) conducted archaeological monitoring along Kalakaua Ave. During this project historic debris / trash pit was observed and recorded as site 6702.

One burial was reported directly in front of 2957 Kalakaua Avenue (Whitman et al. 2008). This burial was of one individual, fully-articulated, who was most likely Native Hawaiian. The burial was located in Jaucas sand deposits, and no artifacts were associated the remains. In addition to this burial, charcoal concentrations, an adze fragment, a basalt lamp fragment, a cowry shell octopus lure component, and historic trash/debris deposits were reported, suggesting that sub-surface archaeological deposits may be discovered during the proposed ground-disturbing activities.

In 2012 archaeological monitoring was conducted by CSH (Moser et al 2012:ii). During the monitoring project no historic properties were observed. A small stone artifact (awl or cutting tool), fire-cracked rock, and charcoal flecking were recorded in back dirt piles. Due to the lack of integrity these items were not designated as a historic property. The recorded stratigraphic sequence consisted of imported fill layers over Jaucas Sands.

ARCHAEOLOGICAL MONITORING PROCEDURES

EXTENT OF MONITORING

The archaeological monitor will conduct on-site monitoring of all ground-disturbing activities that may impact subsurface proveniences greater than 20.3 centimeters below surface (cmbs) (8 inches) within the project area. These activities include the following:

1. Filling all voids detected in the wall's foundation and repair or reconstruction of the concrete cap
2. Land side improvements to drain water from overtopping waves and storm water runoff
3. Anchoring to the concrete structure land side of the seawall or supported by vertical reinforcing bars imbedded near the new wall's foundation

Figure 3 above presents the design plan for the project.

PRE-CONSTRUCTION CONFERENCE

Before work begins on the project, the on-site archaeologist will explain to the entire construction crew what materials may be encountered and the procedures to follow if archaeological materials are found, as well as the role of the archaeological monitor. At this time it will be made clear that the archaeological monitor must be on-site for all ground-disturbing activities, and that the archaeologist has the authority to stop work ***immediately***, if necessary.

HALTING OF EXCAVATION ACTIVITY

The monitoring archaeologist has the authority to halt construction in the vicinity of a potential/actual cultural resource discovery, so that the provisions of this AMP can be carried out. The consulting archaeological firm will make it clear to the construction personnel that the monitoring archaeologist has the authority to halt work.

MONITORING METHODS

The archaeological monitor will closely observe excavations and other ground disturbing activities, and examine soils as they are removed. After excavations, trench faces will be examined for cultural material and subsurface features. If any archaeological materials are encountered during the monitoring of ground-disturbing activities, work will be stopped immediately in that area and the monitoring archaeologist will investigate the nature of the discovery. Photographs of excavations and the stratigraphic sequences will be documented and included in the report even if no historically significant sites are documented during the field work.

The archaeological monitor will compile daily monitoring logs. These logs will minimally include a description of daily activities, sites or features recorded, personnel on-site, and problems encountered and corrective action taken. If necessary and appropriate, monthly reports will be filed with the SHPD detailing any new sites or features identified.

TREATMENT OF HUMAN REMAINS

If human remains are identified, work will immediately stop in that locale, and the SHPD/Department of Land and Natural Resources (DLNR) will be notified immediately of the find. No further work will take place in that locale—including screening of back dirt, cleaning and/or excavation of the burial area, or exploratory work of any kind—unless explicitly requested by the SHPD.

Any human skeletal remains identified during monitoring shall be treated as an inadvertent discovery and be dealt with in accordance with HAR § 13-300-40. The SHPD/DLNR, in consultation with the land owner and the O‘ahu Island Burial Council (OIBC), will determine whether to preserve in place or relocate. If SHPD makes a determination for removal of the human remains, the consulting archaeologist will remove and treat the human remains in accordance with HAR § 13-300-40.

LABORATORY WORK

Artifacts will be catalogued and analyzed, along with any samples of midden materials that have been collected. Charcoal and other datable materials will be submitted for dating analysis, provided samples were collected in situ from prehistoric contexts that show no signs of intermixing with historic materials, e.g., charcoal obtained from distinct fire features in solely pre-contact deposits.

REPORT PREPARATION

Following completion of fieldwork, an end of field report and a draft archaeological monitoring report will be prepared and submitted to SHPD for review. The consulting archaeological firm will submit a final archaeological monitoring report after receiving any comments on the draft report. Should burials and/or human remains be identified, other letters, memos, and/or reports may be requested by SHPD, and will be provided in accordance with applicable statutes and regulations, and as contractual obligations permit.

COLLECTIONS ARCHIVING

All burial remains and associated materials will be stored temporarily at the consulting archaeologist's firm or with the landowner for curation until re-interment plans are finalized. Non-burial materials will be stored temporarily at the consulting archaeologist's firm until an appropriate curation facility is selected in consultation with SHPD.

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APPENDIX F

Cultural Impact Assessment

PRELIMINARY DRAFT REPORT
Cultural Impact Assessment
in Support of Proposed Repairs to the Queen's Surf Seawall in Waikīkī, Waikīkī Ahupuaʻa,
Honolulu (old Kona) District, Island of Oʻahu.
TMKs: (1) 3-1-030: portions of 001 and (1) 3-1-031: portions of 004 and 005

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INTRODUCTION

At the request of the Oceanit, Pacific Consulting Services, Inc. (PCSI) has prepared this Cultural Impact Assessment (CIA) in support of proposed Repairs to the Queen's Surf Seawall in Waikiki at Kapiʻolani Beach Park, Honolulu, Oʻahu (Figure 1). The seawall project will consist of restoring the structural integrity of the seawall and the adjacent land, preventing erosion of the adjacent land and the beach walk structure, and replacing the degraded concrete top cap of the wall.

This CIA has been prepared in compliance with Hawaii Revised Statutes Chapter 343, Act 50 (HRS), Chapter 6E, and Title13 of the Hawaii Administrative Rules (HAR), Subtitle 13 (State Historic Preservation Division Rules), Chapter 275 (Rules Governing Procedures for Historic Preservation Review for Governmental Projects Covered Under Sections 6E-8, HRS), and Chapter 276 (Rules Governing Standards for Archaeological Inventory Surveys and Reports).

PROJECT AREA LOCATION AND DESCRIPTION

The entire project area is located within the boundaries of Kapiʻolani Park in the Kapiʻolani Beach / Queen's Surf Beach recreational area. The proposed seawall project area location is owned by the State of Hawaii and the City and County of Honolulu. The parcel, TMK: (1) 3-1-031:004, has been leased to the CCH and is under the administration of the Department of Parks and Recreation. The project area is located along the shore on the ʻ*ewa* (north) side of the Waikīkī Aquarium (Figure 2). The project area borders the ocean and the ground surface currently consists of beach sand. The project area measures 0.2 acres (817 sq m).

Required repairs of the seawall include filling all voids detected in the wall's foundation and repair or reconstruction of the concrete cap. The recommended construction for this project consists of a form-lined concrete wall on the *makai* (ocean) side of the seawall and concrete support on the land side. Drainage provisions on the land side would be included with land side improvements to drain water from overtopping waves and storm water runoff. The new wall will either be anchored to the concrete structure land side of the seawall or supported by vertical reinforcing bars imbedded near the wall's foundation (Figure 3).

The project area is situated in the Diamond Head Special District and a Special Management Area. Kapiʻolani Park was listed on the State of Hawaiʻi Register of Historic Places (HRHP) in July 17, 1992, and was assigned Statewide Inventory of Historic Places (SIHP) Site No. 50-80-14-9758 (Site 9758).

ENVIRONMENTAL BACKGROUND

RAINFALL AND HYDROLOGY

According to Giambelluca et al. (2013) annual rainfall in this part of leeward Oʻahu averages less than 636.0 mm (25.4 in) per year, with most rain falling in the winter months between November and March.

VEGETATION

The current vegetation in the vicinity of the project area consists of *kukui* trees (*Aleurutes moluccanna*), coco palms (*Cocos nucifera*) and unidentified exotic grasses (Wagner et al. 1990).

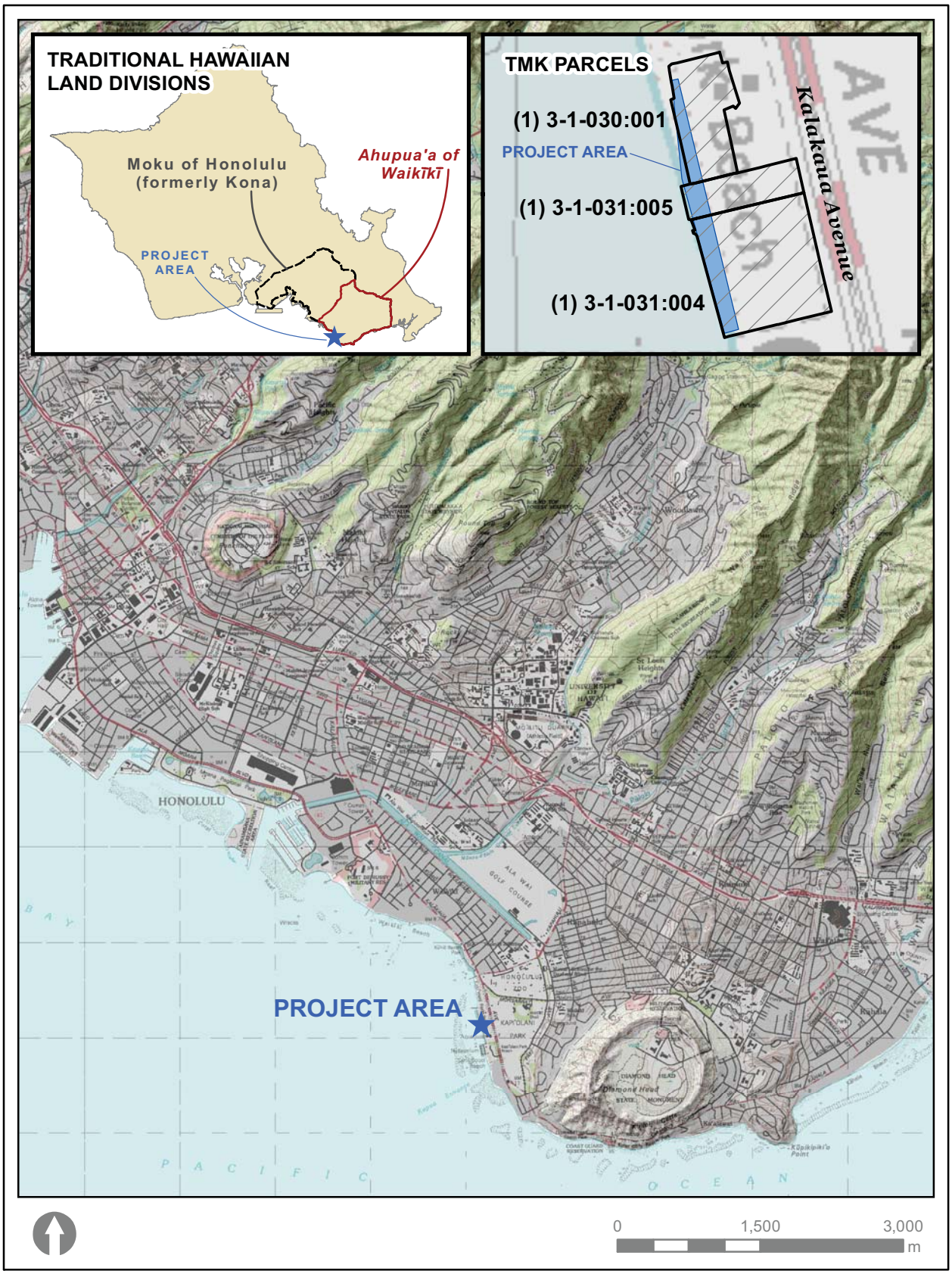


Figure 1. Location of the Queen's Surf Seawall Repair Project Area on an Enlarged 1:24,000 U.S.G.S. Quadrangle Map, Honolulu (2012).

Figure 2. Aerial view of Project Area (Google Earth 2008, Adapted from Oceanit).

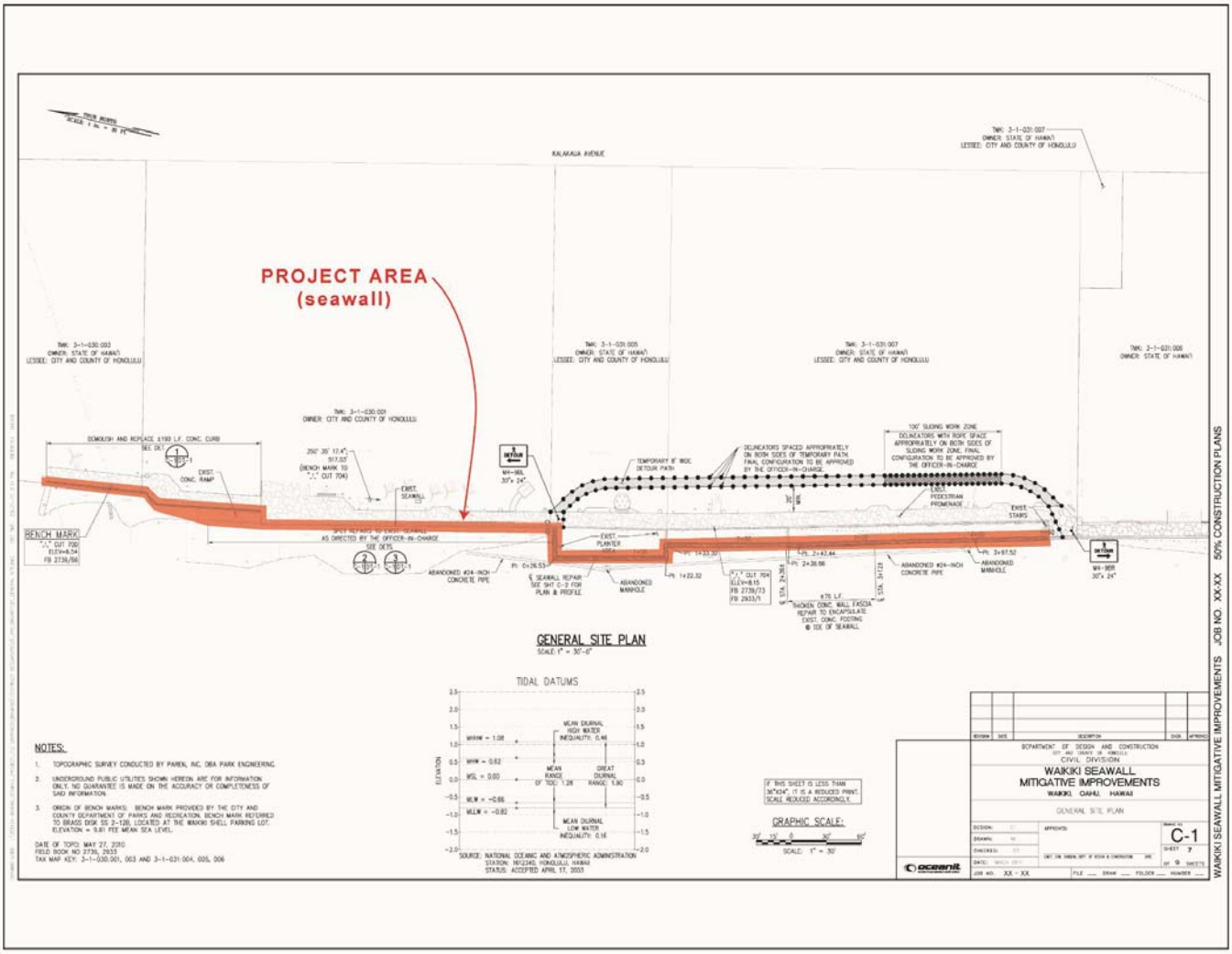


Figure 3. Project Design Plans for the Seawall Repair Project.

TOPOGRAPHY AND SOILS

The project area is situated in the southwestern end of Waikīkī on a relatively flat coastal plain. The elevation within the project area ranges between 1.2 and 2.0 meters (m) (4.0 and 6.5 feet [ft]) above mean sea level. The underlying geology of Waikīkī consists of late-Pleistocene coral reef substrate overlaid with calcareous marine beach sand or terrigenous sediments, as well as stream-fed alluvial deposits (Macdonald and Abbott 1970).

The naturally-deposited soils within the project area are classified as Beaches (BS) along the shoreline at 0 to 5 percent slopes (Figure 4). Outside the project area are Jaucas Sands (JaC) which cover a majority of the inland portion of the area which occur on 0 to 15 percent slopes, and Kawaihapai clay loam (KIA) in the northern most section at 0 to 2 percent slopes (Soil Survey Staff 2013).

Three primary factors influenced what is now the modern Hawaiian shoreline near the Queen's Surf seawall project area (Bush et al. 2004:2-3):

1) Sea level rise at the end of the Pleistocene.

2) The approximately 1.5 to 2.0 m high-stand of the sea during the mid to late Holocene.

3) Landscape modification by prehistoric and historic human activity.

Prior to a 100.0 m rise in sea level at the end of the Pleistocene, the coastal regions were erosional environments. After this remarkable sea-level rise these environments changed into low-energy estuaries or lagoons, and became depositional environments, which led to the accumulation of soft and relatively loose sediments.

A high-stand of approximately 1.5 to 2.0 m above present sea level has been documented between 4500 and 2000 years ago. During this time, coral reef formation (and concomitant detrital reef sediments) increased. Specific to the project area, Waikīkī became a marshy wetland environment (both brackish and fresh water) because of its many stream estuaries. While some erosion would have taken place due to the subsequent decrease to present-day sea level, the results of these depositional processes would have largely created the Waikīkī environment first encountered by early Hawaiians.

Urbanization of Waikīkī and parts of Honolulu resulted in many land reclamation projects, with the excavation of the Ala Wai Canal in the 1920s being one of the largest and most environmentally significant. The canal replaced the natural streams as the primary means of draining water coming down from the Koʻolau Mountains, and the wetlands were buried below layers of sediment and coral fill, including the area of Kapiʻolani Regional Park (Bush et al. 2004: 2-3).

HISTORICAL BACKGROUND

This section presents a brief summary of the historical background literature available for the project area. The type of literature reviewed includes accounts of early Europeans (e.g., explorers, traders, missionaries), ethno-historic studies by historians, ethnographers, and other scholars, government records (e.g., Land Commission Awards [LCA]), and old photographs and maps. To provide the necessary comprehensive historical context, the area under review includes much of the Waikīkī Ahupuaʻa, as well as the area adjacent to the Queen's Surf seawall project area.

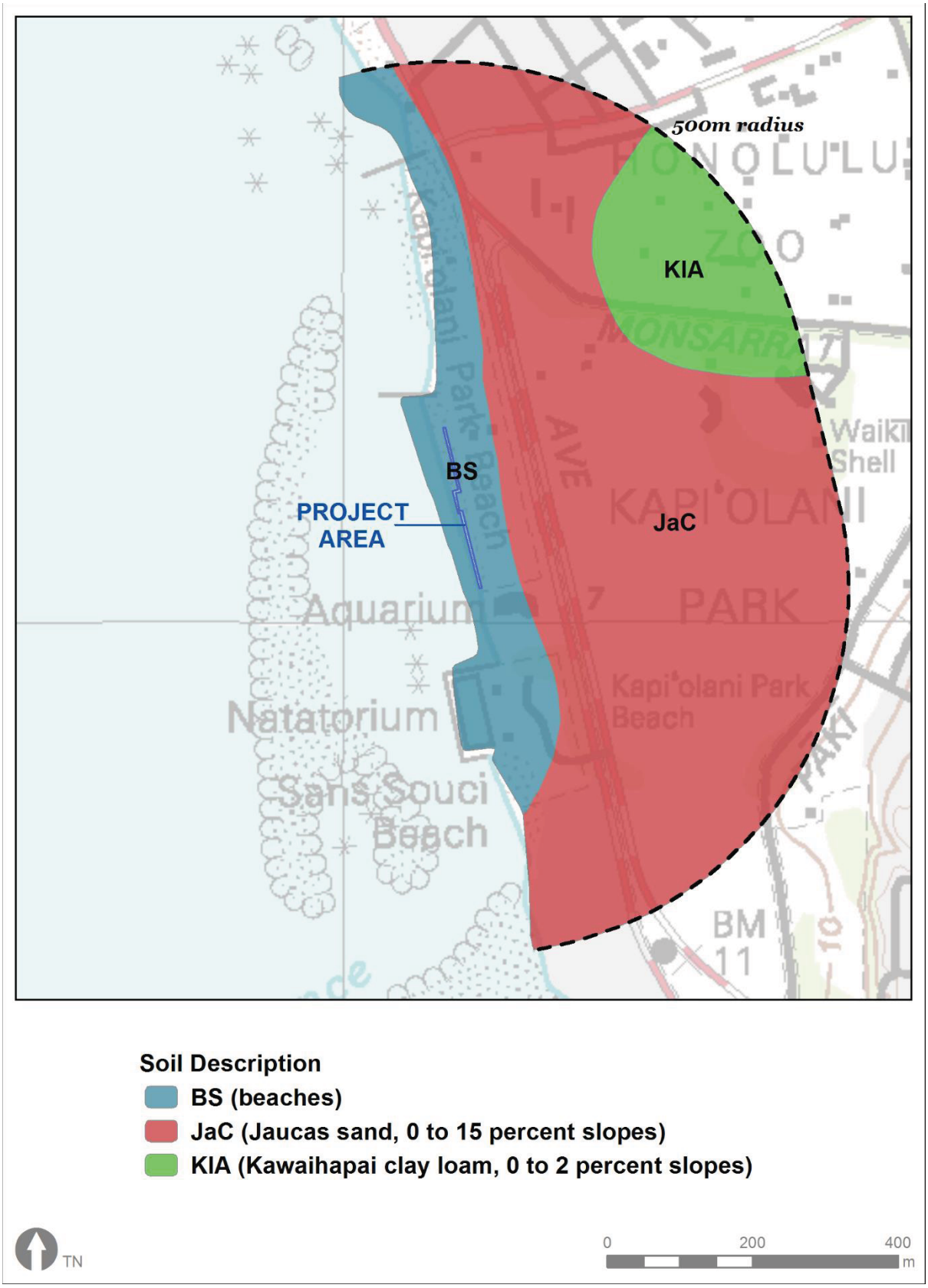


Figure 4. Soil Survey Map for the Queen's Surf Seawall Repair Project Area (Soil Survey Staff 2017; USGS 2012).

WAIKĪKĪ AHUPUA‘A

The project area is located within the *ahupua‘a* (traditional land division) of Waikīkī, in the Honolulu (old Kona) District. This *ahupua‘a* was an important occupational and political center during much of pre-Contact Hawaiian history, and by the A.D. 1300s it was the ruling center of the O‘ahu chiefs (Beckwith 1940). It continued to be a chiefly residential center through the time of Kamehameha I, after he seized control of O‘ahu from Kalanikupule (‘Ī‘ī 1959:17; Tomonari-Tuggle and Blankfein 1998:13). Historian Lilikālā Kame‘eleihiwa (1992: Kindle Locations 1406-1409) describes in detail how and to whom Kamehameha I conveyed *‘āina* in Waikīkī and other desirable areas of O‘ahu:

> Thirteen years later, in 1795, after Kamehameha had defeated the other Hawai‘i island Ali‘i and taken all the islands from Māui to O‘ahu as well, the four Kona Uncles were given the highest positions on his council. They were also given extensive *‘Āina* throughout the islands; these ‘*Āina* were known as *panalā‘au*, or conquered Lands.

Along with the residential complexes of the pre-Contact Hawaiian chiefs, a thriving populace lived here as well, with an abundant food production system that included extensive *lo‘i* (wetland taro fields), *‘auwai* (irrigation ditches) and fishponds. Accounts of traditional Hawaiian life in Waikīkī can be found in the journals of several early European explorers (Menzies 1920:23-24; Vancouver 1798: I, 161-164).

Waikīkī was a vastly populated and favored land of the chiefs, rich with agricultural and aquacultural resources. Oral history describes Kalamakua, a chief who reigned around the sixteenth century (based on Stoke’s 20 year-count - Kelly 1989), as being the first to build an extensive irrigation system in Waikīkī. Kamakau (1991:45) describes Kalamakua as:

> …a good chief. He was noted for cultivating, and it was he who constructed the large pond fields Ke‘okea, Kūalulua, Kalāmanamana, and other *lo‘i* in Waikiki. He traveled about his chiefdom with his chiefs and household companions to cultivate the land and gave the produce to the commoners, the *maka‘āinana*.

Hawaiian historian John Papa ‘Ī‘ī (1959:17) described Kamehameha’s residence in Waikīkī:

> Kamehameha’s houses were at Puaaliilii, makai of the old road, and extended as far as the west side of the sands of Apuakehau. Within it was Helumoa, where Kaahumanu *ma* went to while away the time. The king built a stone house there, enclosed by a fence; and Kamalo, Wawae, and their relatives were in charge of the royal residence. Kamalo and Wawae were the children of Luluka and Keaka, the childhood guardians of Kamehameha.
>
> This place has long been a residence of chiefs. It is said that it had been Kekuapoi’s home, through her husband Kahahana, since the time of Kahekili. Haalou, a *makuahine* of Kamehameha, lived there with her younger daughter Kekuapoi while en route from Hawaii to Kauai to consult Kapoukahi, a seer of Kauai, for means whereby Kamehameha would gain victory over Keoua Kuahuula.

Additional accounts of traditional Hawaiian life in Waikīkī were described by several early European explorers as rich and bountiful. In 1792, Captain George Vancouver (1798:162-164) described the southern shoreline of O‘ahu in the following manner:

> On the shores, the villages appeared numerous, large, and in good repair; and the surrounding country pleasingly interspersed with deep, though not extensive valleys; which, with the plains near the sea-side, presented a high degree of cultivation and fertility.
>
> This opened to our view a spacious plain, which, in the immediate vicinity of the village, had the appearance of the open common fields in England; but, on advancing, the major

> part appeared divided into fields of irregular shape and figure, which were separated from each other by low stone walls, and were in a very high state of cultivation. These several portions of land were planted with the eddo or taro root, in different stages of inundation; none being perfectly dry, and some from three to six or seven inches under water. The causeway led us near a mile from the beach, at the end of which was the water we were in quest of.
>
> The gentleness and civility of the natives tempted us to extend our walk through the plantations, which we found very pleasant. A fine refreshing breeze prevailed, and the Indians kept at a sufficient distance to prevent their company being incommodious. In this excursion we found the land in a high state of cultivation, mostly under immediate crops of taro; and abounding with a variety of wild fowl, chiefly of the duck kind, some of which our sportsmen shot, and they were very fine eating. The sides of the hills, which were at some distance, seemed rocky and barren; the intermediate vallies [sic], which were all inhabited, produced some large trees, and made a pleasing appearance. The plains, however, if we may judge from the labour bestowed on their cultivation, seem to afford the principal proportion of the different vegetable productions on which the inhabitants depend for the subsistence.

Archibald Menzies (1920:23-24), a surgeon and naturalist who accompanied Vancouver aboard the H.M.S. Discovery described the land around Waikīkī:

> We pursued a pleasing path back into the plantation, which was nearly level and very extensive, and laid out with great neatness into little fields planted with taro, yams, sweet potatoes and the cloth plant. These, in many cases, were divided by little banks on which grew the sugar cane and a species of Draecena without the aid of much cultivation, and the whole was watered in a most ingenious manner by dividing the general stream into little aqueducts leading in various directions so as to be able to supply the most distant fields at pleasure, and the soil seemed to repay the labor and industry of these people by the luxuriancy (*sic*) of its productions. Here and there we met with ponds of considerable size, and besides being well stocked with fish, they swarmed with water fowl of various kinds such as ducks, coots, water hens, bitterns, plovers, and curlews.

During 1813-1818, the islands were visited by Peter Corney (1965:193) who described Waikīkī in the following manner:

> On rounding Diamond hill the village of Wyteetee (Waikiki) appears through large groves of cocoanut and bread-fruit trees; it has a most beautiful appearance, the land all round in the highest state of cultivation, and the hills covered with wood; a beautiful plain extending as far as the eye can reach. A reef of coral runs along the whole course of this shore, within a quarter of a mile of the beach, on which the sea breaks high; inside this reef there is a passage for canoes.

Russian explorer Otto Von Kotzebue (1821:320) visited the islands in 1816. During this voyage, Kotzebue described the landscape of Waikīkī:

> ...but you have scarcely sailed round the Yellow Diamond Hill, when you are surprised by the most beautiful landscape. Close to the shore you see verdant vallies [*sic*] adorned with palm and banana-trees, under which the habitations of the savages lie scattered; behind this, the land gradually rises, all the hills are covered with a smiling verdure, and bear the stamp of industry.

In 1824-1825, Andrew Bloxam (1925:35-36), a naturalist on the *H.M.S. Blonde,* described Honolulu and Waikīkī in the following manner:

> I walked along shore towards the bay of Whyteete [Waiki - ki-, from Honolulu] to see if I could procure any shells, but I found none worth picking up. The whole distance to the

> village of Whyteete is taken up with innumerable artificial fishponds extending a mile inland from the shore, in these the fish taken by nets in the sea are put, and though most of the ponds are fresh water, yet the fish seem to thrive and fatten. Most of these fish belong to the chiefs, and are caught as wanted. The ponds are several hundred in number and are the resort of wild ducks and other water fowl. I found it very difficult to get out of the labyrinth of paths which lead among them. Whyteete is about four miles east of Honoruru [Honolulu]. It is pleasantly situated and built along the shore among numerous groves of coconut and other trees, and in this respect far better than Honoruru, as scarcely any trees are to be found there.

However, when Honolulu became the center of trade with foreigners, many Hawaiians, including Kamehameha I himself, shifted residences from Waikīkī. Additionally, introduced European diseases decimated Native Hawaiian populations, including that of Waikīkī. Later, the people who remained replaced the *lo‘i* with rice fields, and continued farming up until the construction of the Ala Wai Canal in the 1920s, which succeeded in draining the wetlands. Construction on the Canal began in 1921 and was completed in 1929, as a major part of the Waikīkī Reclamation Project (Stephenson 2008: 28). This land reclamation allowed for the rapid urbanization of Waikīkī, including the present-day Kapi‘olani Park, and was likely the most significant event with regard to land use in this area.

KAPI‘OLANI PARK

Historic documents suggest that the southern end of Waikīkī, where Kapi‘olani Park is presently located, was somewhat removed from the dense populations and intensive food production activities that characterized the rest of the *ahupua‘a* (Figure 5). Figure 6, a historic map made in 1876 by surveyor Curtis J. Lyons records five *heiau* (temple) in the area of Kapi‘olani Park and Diamond Head as having been present: Papa‘ena‘ena, Kupalaha, Kapua, Kamauakapu, and Makahuna, though none of them remain today.

Thrum (1907:44) compiled a preliminary list of *heiau* sites in the Hawaiian Islands, and descriptions of the *heiau* listed above are presented below:

> Papaenaena: At the foot of Diamond Head slope, rear of Douglas' premise. Heiau pookanaka, 130x70 feet in size; a walled and paved structure of open terraced front, destroyed by Kanaina about 1856, the stones used to enclose Queen Emma's premises and for road work. This heiau is the supposed place of a number of sacrifices by Kam. I at the opening of the last century, as mentioned in "Tales from the Temples" in this issue.
>
> Kupalaha: Kapiolani Park, near Cunha's. – Entirely obliterated. Class unknown, but said to have had connection in its working with Papaenaena.
>
> Kapua: Near Kapiolani Park, Opposite Camp McKinley. Heiau pookanaka. Fragments of its walls, torn down in 1860, show it to have been about 240 feet square; said to be the place of sacrifice of Kaolohaka, a chief from Hawaii, on suspicion of being a spy.
>
> Kamauakapu: Kapahulu, Diamond Head, 11x15.8 feet in size: erected by Kalakaua in 1888; of husbandry class for "Naua Society" workings. Already in partial ruins.
>
> Makahuna: Diamond Head, overlooking "Aqua Marine." – A large heiau enclosure dedicated to Kane and Kanekoa, of Kuula character, so said.

In 1877 a group of prominent businessmen, belonging to the Kapi‘olani Park Association, created Kapi‘olani Park for the purpose of establishing a "residential retreat". The park included a "first-class horse-racing track" and private estates (Weyeneth 1991:4) (Figure 7). This same group also created several water features, bridges, and islands in the vicinity of today's Honolulu Zoo. Figure 7 shows that the project area lies within Lot 120 on a portion of land that was part of the Public Baths created under Public Park Act 103 in 1905 (Savidge:183).

Figure 5. Portion of 1825 Map by Lt. C.R. Malden Showing Southeast Portion of Waikiki.

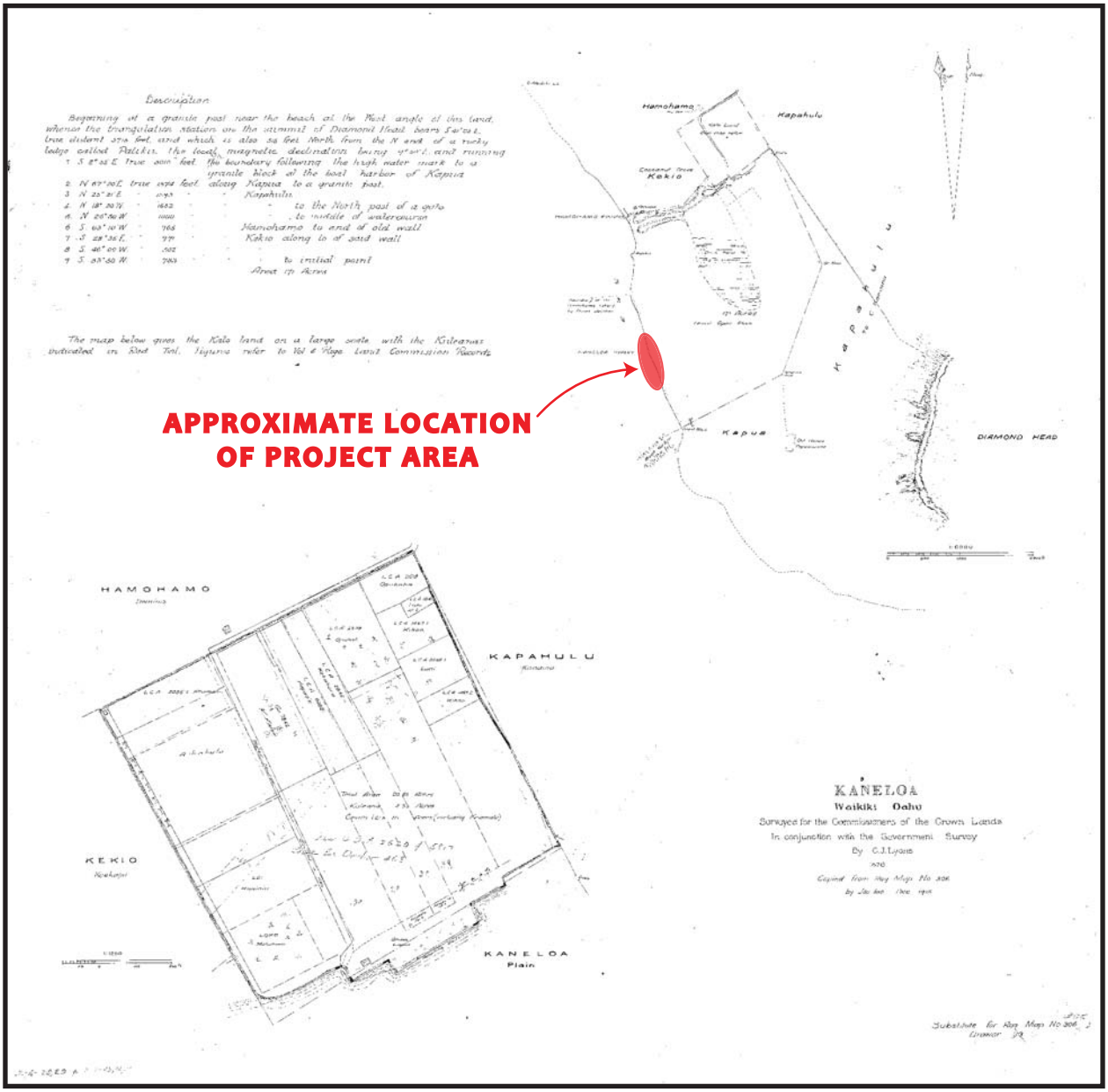


Figure 6. Portion of 1876 Map by C.J. Lyons Showing Kaneloa.

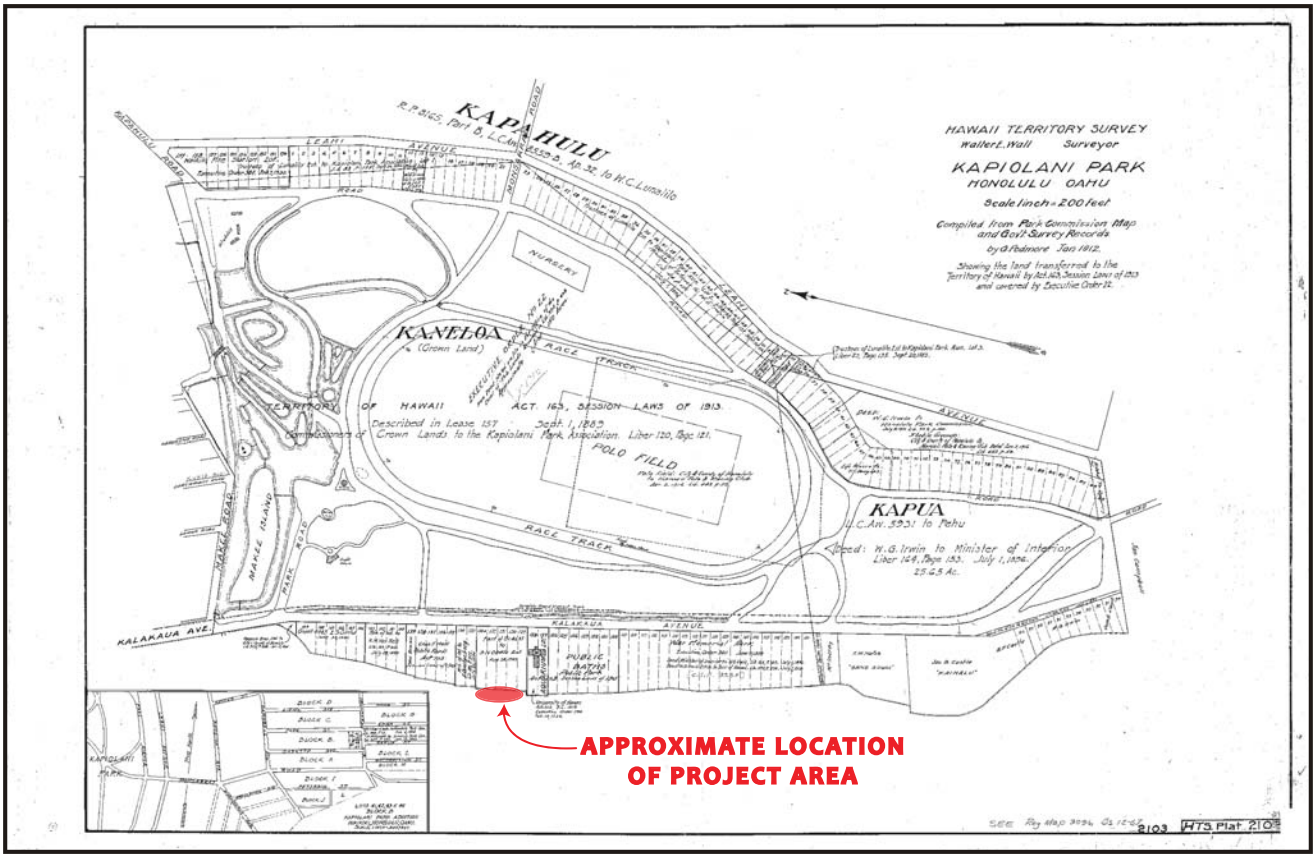


Figure 7. 1912 Map of the Southern Portion of Waikiki.

Act 103 declared that certain lands ought to be developed as public parks. This act ensured that Kapiʻolani Park would acquire beachfront for public use (Weyeneth 1991:24). In the early 20th Century, during the Waikīkī Reclamation Project, the stagnant ponds in Kapiʻolani Park became a health concern to the general population. As a result these ponds were drained and filled with imported materials and sediments dredged from the Ala Wai Canal. On the southern end of Waikīkī the Waikīkī Aquarium opened in 1904, and a public bath park was established in 1905 on the Diamond Head side of the aquarium property. The War Memorial Park was established on June 17, 1929 by Executive Order (EO) 360 (see Figure 5). In 1952 Governor Long's EO 1536 withdrew 2.3 acres from the War Memorial Park land to use as the new Waikīkī Aquarium site.

Kapiʻolani Park is listed on the HRHP (Site 9758), and the park is eligible for placement on the National Register of Historic Places (NRHP). However for reasons unknown Kapiʻolani Park has not been added the NRHP. The significance statement for Kapiʻolani Park as summarized in the NRHP nomination form is listed below:

> Kapiolani Park is historically significant for its past association with indigenous Hawaiian culture and royalty. Hawaiian King Kalakaua envisioned the park as a place of recreation for all and named it after his famous Queen, Kapiolani. Since its dedication in 1877 it has been in continuous use as a location for recreational activities valued by local residents and visitors alike. It provides a sense of place to a special part of Honolulu and is indentified with the world famous image of Hawaii as a recreational resort. Over the years it has been the scene of a variety of sports and leisure time activities that reflects the recreational development of Honolulu and Hawaii into the modern world (Abel 1992:3).

Based on these documentary sources alone, it is very likely that evidence of both pre-Contact Native Hawaiian and historic use of the parcel may be present underlying the ground surface within the project area.

PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

Despite the density of the modern urban landscape in Waikīkī, remnants of pre-Contact and historic occupation have consistently been discovered during subsurface archaeological investigations. Many of these discoveries have been made during archaeological surveys and monitoring associated with urban development and infrastructure upgrades, and they very frequently include pre-Contact (pre-A.D. 1778) Native Hawaiian burials. Table 1 summarizes key archaeological studies near the project area. Figure 8 illustrates the locations of these previous archaeological studies.

Numerous human burials have been discovered in Waikīkī, despite the considerable quantity of fill that was placed here during the Waikīkī Reclamation Project. Pockets of undisturbed beach and dune sands (i.e., Jaucas Sands, see Foote et al. 1972) have been observed below the historic fill layers making the possibility of discovering human burials and other cultural materials in this area high. A number of archaeological discoveries have been reported (Table 1), a brief outline of previous archaeological studies in / near the vicinity of the project area is provided here to aid in understanding the area's archeological context.

The first human burials were reported by Emerson (1902:18-202) in 1901 during excavation of trenches for the installation of sewer pipes on the site of the present-day Elks Club. Emerson collected the remains of four individuals, all presumably pre-Contact Native Hawaiians. Along with the burials, grave goods were found, including whale-tooth beads, glass beads, and a carved sperm-whale tooth. The presence of glass beads does suggest an historic-period context should, at least in part, be assigned to this discovery.

Table 1. Previous Archaeological Studies in the Vicinity of the Project Area.

Reference	TMK/Location	Nature of Study	SIHP# 50-80-14-	Summary of Results
Emerson 1902	**3-1-032:006** Waikīkī Elks Club	Inadvertent Discovery	None	Burials (pre-Contact; minimum 4 individuals); associated grave goods
McAllister 1933*	Waikīkī (general)	Survey	[all of Waikīkī Site #60 in McAllister]	*Heiau*
Bishop Museum	**3-1-032:031** Outrigger Canoe Club	Inadvertent Discovery	None	Burials (pre-Contact; Min of 31 individuals with MNI of 96)
Dega and Kennedy 1993	**3-1-031/** Waikīkī Aquarium	Inadvertent Discovery	4729	Human remains (scattered)
Lovington 1996	**Offshore**	Underwater Survey	None	Mapping of isolated artifact finds
Winieski et al. 2002a	**2-6-001:023,026-027 & 3-1-043**/ Kuhio Beach	Monitoring	5846-5862, 5940, 5942-5943	Burials (minimum 44 individuals)
Winieski et al. 2002b	**2-6-001:022-024,026-027 & 3-1-043**/ Kuhio Beach	Monitoring	5858, 5862-5863, 5940, 5948	Burials (minimum 10 individuals)
Hammatt et al. 2000	**3-1-043/** Honolulu Zoo	Assessment	N/A	N/A
McDermott and Chiogioji 2001	**3-1-043/** Honolulu Zoo	Survey (Inventory); Test Excavation	None	No archaeological finds reported
Perzinski and Hammatt 2001	**3-1-031,032,043/** Kalakaua Ave: Natatorium to Poni Moi Rd	Monitoring	None	Adze fragment; cowry shell octopus lure component; historic glass and ceramics
Bush et al. 2002	**3-1-030,031/** Queen's Surf Promenade	Monitoring	None	No archaeological finds reported
Perzinski and Hammatt 2002	**3-1-043/** Kapiʻolani Park (bandstand)	Monitoring	None	Basalt lamp fragment; charcoal concentration
Bush et al. 2004	**3-1-043/** Honolulu Zoo	Monitoring	None	No archaeological finds reported
Cultural Surveys Hawaiʻi 2004	**3-1-031:008/** Kalakaua Ave	Monitoring	6704	Historic trash deposit
Tome and Spear 2005	**3-1-031/** Kalakaua Ave	Monitoring	6702	Historic debris/trash deposit

Table 1. Previous Archaeological Studies in the Vicinity of the Project Area.

Reference	TMK/Location	Nature of Study	SIHP# 50-80-14-	Summary of Results
Liebhardt and Kennnedy 2008	**3-1-031:006/** Waikīkī Aquarium	Monitoring	None	No archaeological finds reported
Whitman et al. 2008*	**3-1-032, 043/** Kalakaua Ave and Poni Moi Rd	Monitoring	6946	Burial (1 individual, Native Hawaiian)
Moser et al 2012	**3-1-032:031 Outrigger Canoe Club**	Monitoring	None	
Walden et al. 2012	**3-1-043/** Honolulu Zoo	Monitoring	7208	Subsurface features in dune sand layer; possibly Makee Island
Mintmier et al. 2013	**3-1-043/** Honolulu Zoo	Monitoring	N/A	Recent and historic features associated with Zoo and Kapiʻolani Park
Clark et al. 2014	**3-1-043/** Honolulu Zoo	Monitoring	7208	Subsurface feature; possibly Makee Island

*Reference not listed on Figure 6.

In the 1920s and 1930s, the first major archaeological survey of Oʻahu was conducted by McAllister (1933), he recorded four *heiau* (Hawaiian ritual structure) in the Waikīkī area. Not until the 1960s do reports of archaeological materials surface again. Human remains were found in 1963 during construction at the Outrigger Canoe Club, at the end of Kalakaua Ave (Bush et al. 2004:24). Bush et al. (2004) cite the 1963 Honolulu Star Bulletin:

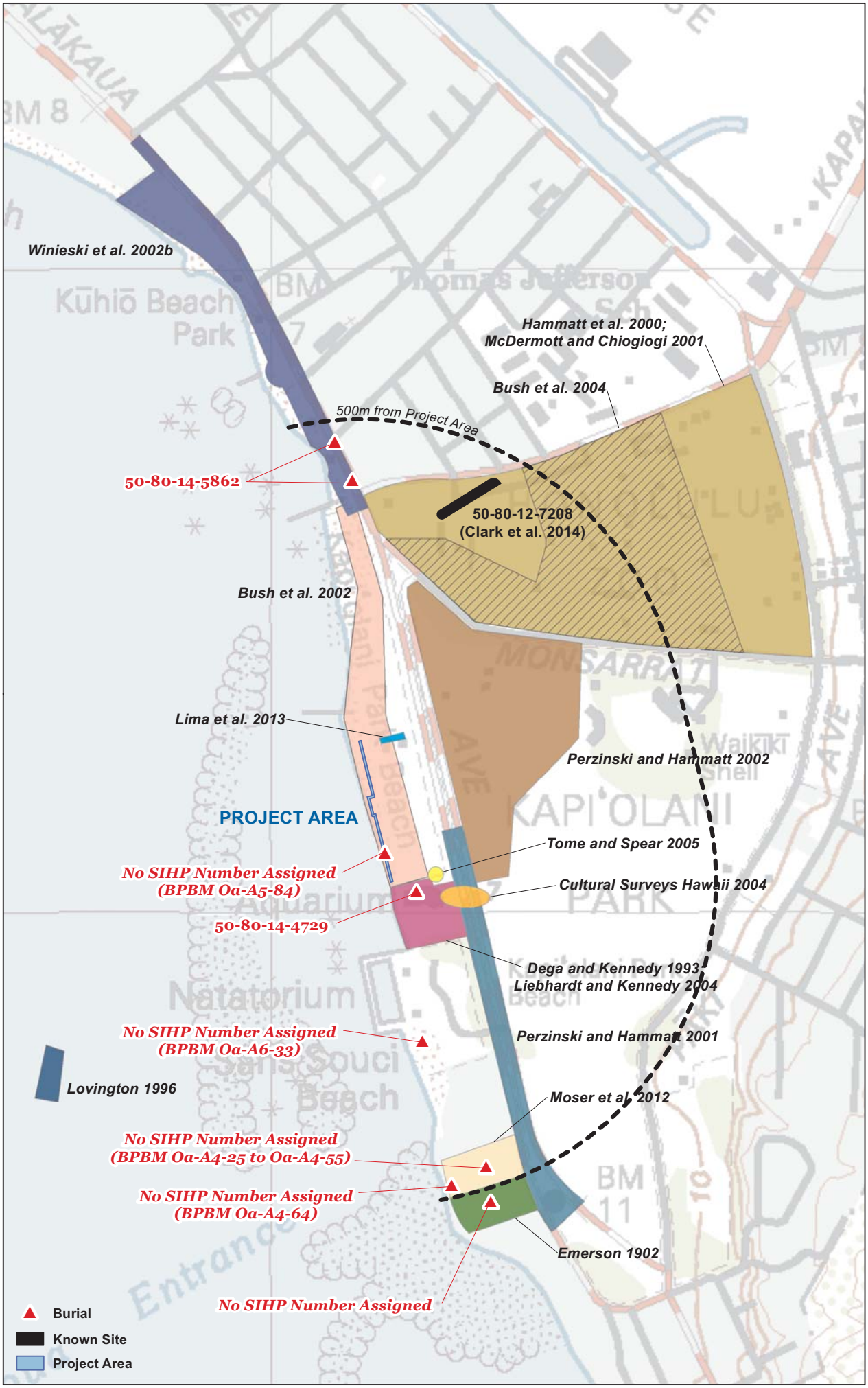
> The Outrigger Canoe Club yesterday dedicated its new site [on land adjacent to and leased from the Elks Clubs], an ancient Hawaiian burial ground in Waikīkī…Robert Bowen of the Bishop Museum has been working closely with Ernest Souza, Hawaiian Dredging superintendent, on the removal of skeletons unearthed on the site, between the Colony Surf and the Elks Club…Most of the bodies were buried in the traditional *hoʻolewa* position, with legs bound tightly against the chest.

In 1993, during construction activities at the Waikīkī Aquarium fragmentary human remains were discovered (Dega and Kennedy 1993).

In 1996, Lovington conducted a pilot study in an area just offshore of the Waikīkī Natatorium, in an attempt to locate submerged cultural resources associated with a koʻa (fishing shrine) formerly thought to be on the nearby shoreline. Lovington's underwater survey was conducted as a class project through the Marine Options Program at the University of Hawaiʻi at Mānoa; several isolated artifacts were recorded (Lovington 1996).

The early 2000s yielded a sizable quantity of human burials in the Waikīkī area (Winieski et al. 2002a, 2002b). A minimum of 54 individuals were discovered in burials recorded along Kalakaua Ave. near Kuhio Beach.

Specifically in the Kapiʻolani Park area, several survey, monitoring, and test excavation projects were completed (Bush et al. 2002; Bush et al. 2004; Hammatt et al. 2000; McDermott and Chiogioji 2001; Perzinski and Hammatt 2002; Tome and Spear 2005; Whitman et al. 2008; Walden et al. 2012; Mintmier et al. 2013; Clark et al. 2014).


Winieski et al. 2002b
Hammatt et al. 2000;
McDermott and Chiogiogi 2001
Bush et al. 2004
500m from Project Area
50-80-14-5862
50-80-12-7208
(Clark et al. 2014)
Bush et al. 2002
Lima et al. 2013
Perzinski and Hammatt 2002
PROJECT AREA
Tome and Spear 2005
No SIHP Number Assigned
(BPBM Oa-A5-84)
Cultural Surveys Hawaii 2004
50-80-14-4729
Dega and Kennedy 1993
Liebhardt and Kennedy 2004
No SIHP Number Assigned
(BPBM Oa-A6-33)
Perzinski and Hammatt 2001
Lovington 1996
Moser et al. 2012
No SIHP Number Assigned
(BPBM Oa-A4-25 to Oa-A4-55)
No SIHP Number Assigned
(BPBM Oa-A4-64)
Emerson 1902
No SIHP Number Assigned
Burial
Known Site
Project Area
0
200
400
m

Perzinski and Hammatt (2002) conducted archaeological monitoring near the Kapiʻolani Bandstand. During this project a basalt lamp fragment and a charcoal concentration was recorded.

In 2004 Cultural Surveys Hawaiʻi conducted archaeological monitoring for an electrical trench located just *ʻewa* of the Waikiki Aquarium. The 80 m trench ran across Kalakaua to the sidewalk fronting the aquarium and continued on for 25 m towards the ocean. A historic trash pit (site 6704) was recorded. The trash pit included bottles ranging in date from the 1880's to the 1920's, broken ceramic and saw-cut animal bone.

Tome and Spear (2005) conducted archaeological monitoring along Kalakaua Ave. During this project historic debris / trash pit was observed and recorded as site 6702.

One burial was reported directly in front of 2957 Kalakaua Avenue (Whitman et al. 2008). This burial was of one individual, fully-articulated, who was most likely Native Hawaiian. The burial was located in Jaucas sand deposits, and no artifacts were associated the remains. In addition to this burial, charcoal concentrations, an adze fragment, a basalt lamp fragment, a cowry shell octopus lure component, and historic trash/debris deposits were reported, suggesting that sub-surface archaeological deposits may be discovered during the proposed ground-disturbing activities.

In 2012 archaeological monitoring was conducted by CSH (Moser et al 2012:ii). During the monitoring project no historic properties were observed. A small stone artifact (awl or cutting tool), fire-cracked rock, and charcoal flecking were recorded in back dirt piles. Due to the lack of integrity these items were not designated as a historic property. The recorded stratigraphic sequence consisted of imported fill layers over Jaucus Sands.

CULTURAL IMPACT ASSESSMENT

This cultural impact assessment presents a detailed description of the proposed development project, the methods used for consultation, the results of the consultation, and the results of the assessment. The scope of work (SOW) for this cultural impact assessment included the following tasks:

- Archival background research on the cultural history and previous land uses of the project area.
- Reconnaissance Survey
- Literature review of previous archaeological studies within the project area and in areas near the current project area.
- Written consultation with the following interested parties:
    - Office of Hawaiian Affairs (OHA); Dr. Kamanaʻopono Crabbe, CEO
    - Kapiolani Park Preservation Society (KPPS); Ms. Althea K. Rebman, President
    - State Historic Preservation Division (SHPD); Dr. Alan Downer, Administrator
    - Waikīkī Neighborhood Board (WNB); Mr. Robert J. Finley, President
    - Waikīkī Hawaiian Civic Club (WHCC); Ms.Piʻikea Tomczyk, President

Description of the Project

The Queen's seawall project site is located in portions of TMKs: (1) 3-1-030:001 and 3-1-031:004, 005 along the beach on the '*ewa* side of the Waikīkī Aquarium (Figures 2 and 7). The seawall project will consist of restoring the structural integrity of the seawall and the adjacent land, preventing erosion of the adjacent land and the beach walk structure, and replacing the degraded concrete top cap of the wall (see Figure 3).

Required repairs of the seawall include filling all voids detected in the wall's foundation and repair or reconstruction of the concrete cap. The recommended construction for this project consists of a form-lined concrete wall on the *makai* side of the seawall and concrete support on the land side. Drainage provisions on the land side would be included with land side improvements to drain water from overtopping waves and storm water runoff. The new wall will either be anchored to the concrete structure land side of the seawall or supported by vertical reinforcing bars imbedded near the wall's foundation (City and County of Honolulu: Department of Design and Construction 2017:27).

Methods

An archaeological reconnaissance survey was conducted in the project area parcel on December 2, 2011 and June 23, 2017. It was conducted by PCSI archaeologist Jackie Walden, M.A. Ms. Walden walked transects back and forth over the project area and the adjacent green space to determine the presence and/or absence of surface archaeological sites and cultural material scatters (Figures 9 and 10).

Prior to contacting the interested parties for the consultation, a literature review was conducted on the land use history and previous archaeological studies completed in this area. Based on this research, it was noted that there is a reasonable likelihood that subsurface archaeological features and/or human remains may be discovered during any excavations in this area. During research efforts associated with this project, there were no indications that specific traditional and customary practices are being carried in the vicinity of the project area, with the exception of general public use of the inshore area for swimming, surfing, fishing, canoeing, and other related recreational activities.

The Office of Hawaiian Affairs, the Kapiolani Park Preservation Society, State Historic Preservation Division, and Waikīkī Neighborhood Board were all contacted by letter. Formal letters were sent out to these organizations/agencies on March 28, 2017. We contacted the Waikīkī Hawaiian Civic Club via email on April 10, 2017. Correspondence included requesting information concerning their views on this project, in addition any effects it might have on historic or cultural sites that they might know about in the area. Likewise, they were asked to share any information about legends, cultural properties, or traditional and customary practices associated with the project area.

Results

Reconnaissance Survey

No surface archaeological sites were encountered during the reconnaissance survey of the project area.

North portion of seawall; view NW

Close-up of damaged cement cap on seawall

Oceanside of seawall; view NE

South portion of seawall; view SE

Figure 9. Reconnaissance Photos of the Proposed Project Area.

Green Space adjacent to Waikiki Aquarium; View SE

Green Space adjacent to Waikiki Aquarium; View E

Overall View of Green Space; View SW

Green Space adjacent to Waikiki Aquarium; view W

Figure 10. Reconnaissance Photos of Green Space East of Project Area.

Consultation

The responses from those consulted by letter are summarized as follows:

Office of Hawaiian Affairs: They had not responded as of June 22, 2017

Kapiʻolani Park Preservation Society: They had not responded as of June 22, 2017

SHPD: They had not responded as of June 22, 2017

Waikīkī Neighborhood Board: Mr. Robert Finley responded "No" on April 10, 2017

Waikīkī Hawaiian Civic Club: Ms. Lori Tomczyk responded via email on May 18, 2017, saying that she did consult with a few of the members and at this time they would like to defer their participation.

RECOMMENDATIONS

The project area, consisting of the Beach sands and Jaucas Sands, located in Kapiʻolani Park adjacent to Kalakaua Avenue, TMKs: (1) 3-1-030:001 and 3-1-031:004, 005, is within the Waikīkī Ahupuaʻa, where there have been numerous discoveries of archaeological sites and human burials. Previous archaeological work adjacent to the project area (see Table 1) has recorded the discovery numerous human burials.

Because of the nature of the seawall repairs scheduled, it is recommended that a archaeological monitoring be conducted during repairs to the Queens Surf Seawall. A report of findings of the archaeological monitoring should be submitted to the State Historic Preservation Division for review and approval.

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