PUBLIC NOTICE

Public Notice No. **POH-2006-338** Date: September 10, 2008

U.S. Army Corps of Engineers
Honolulu District

Reply to:
District Engineer
U.S. Army Corps of Engineers
Building 230
Fort Shafter, Hawaii 96858-5440

Respond by: October 10, 2008

WATERWAY NAME: Kuhio and Hilo Bays, Hilo Commercial Harbor, Hawaii Island

Interested parties are hereby notified that an application has been received for authorization of a Department of the Army Standard Permit for construction dredging of a new commercial Pier 4 basin, installation of its associated shoreline revetment and the disposal of suitable dredged material at the Hilo Dredged Material Ocean Disposal Site (HDMODS) as described below and shown on the attached sheets.

1. **APPLICANT:** Harbors Division, Department of Transportation, State of Hawaii, Hale Awa Ku Moku Building, 79 South Nimitz Highway, Honolulu HI 96813-4898

2. **AGENT:** Mitsunaga and Associates, Inc., 747 Amana Street, Suite 216, Honolulu, HI 96814

3. **APPLICABLE STATUTORY AUTHORITIES:** Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403); Section 404 of the Clean Water Act (33 U.S.C. 1344), and Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413and 40 CFR 220-227); and with due consideration of the public interest and potential environmental effects following the issuance of this Public Notice.

4. **LOCATION OF THE PROPOSED ACTIVITY:** Hilo Commercial Harbor, Hilo Bay, Hawaii Island and Hilo Dredged Material Ocean Disposal Site (HDMODS)

5. **PURPOSE AND PROJECT DESCRIPTION:**

The purpose is to authorize the Harbors Division, Department of Transportation to construction dredge a basin for a future Pier 4 structure, install shoreline revetment, and dispose suitable dredged spoils at the Hilo Dredged Material Ocean Disposal Site (HDDMODS)) by transit through Hilo Bay. The proposed activity to remove accumulated sediments, gravels and boulders from jurisdictional waters of the United States is to expand the capacity of the Hilo Interisland Cargo Terminal facility to accommodate a projected increase in commercial activities (see attached sheets).

The proposed construction dredging project consists of 3 major activities: 1) the removal by conventional means of about 162,000 cubic yards of sand and coral material from about 39,400 square yards (or 8.14 acres) of the existing Hilo Commercial Harbor basin, 2) the construction of about 600 linear feet of shoreline revetment, and 3) the transport to, and disposal of about 155,000 cubic yards suitable dredge spoils at the Hilo Dredged Material Ocean Disposal Site (HDMODS/USEPA Site OD0914).

Activity 1 will involve removal of bottom sediments and substrate by conventional mechanized excavation dredging methods to minus-25 feet MLLW (Mean Lower Low Water). The extent of finished depths by plan view and cross-section are shown in Figure 3.

Activity 2 will involve the discharge of about 2,000 cubic yards of articulated concrete block (ACB) mat which will function as a shoreline revetment 600 feet long by 100 feet wide. The shoreside segment will be anchored and buried in a trench 3 feet below grade and extend atop a dredged and sculpted slope and geotextile filter cloth layer to minus-25 feet below Mean Low Low Water level. The location of this revetment is indicated in Figures 2, 3 and 4.

Activity 3 will involve the transport to the HDMODS of about 155,000 cubic yards of dredged material.

These in-water activities are expected to take 12 months to complete.

6. The following information is pertinent to the Applicant's proposed project for Section 103 (ocean dumping) activities which include the transport of dredged material to, and disposal at, the EPA designated Hilo Dredged Material Ocean Disposal Site (HDMODS).

(i) The proposed disposal site is the HDMODS located about 10 miles northeast of the proposed project area, the center point of which is at latitude 19° 48'30" North and longitude 154° 58'30" West,

(ii) The HDMODS has been designated for use by the Administrator, EPA, pursuant to section 102(c) of the Act. The EIS for Hawaii Dredged Material Disposal Sites Designation was published by EPA in September 1980. The Site Management Plan (SMP) for all the Hawaii Ocean Dredged Material Disposal Sites was developed by the Corps, Honolulu Engineer District, and EPA, Region IX and became effective on April 7, 1997;

(iii) The applicant has provided no estimates of the total days which would be required for the transport and disposal of about 155, 000 cubic yards of dredged material at the HDMODS; and

(iv) Available geotechnical data indicate sediments in the proposed dredge area is composed of a relatively uniform substrate, consisting of a thin mud/silt layer over a thick layer of coral detritus and lagoonal deposits extending beyond the proposed dredge depth. The mud layer is more pronounced closer to shore. At the corner of the proposed dredge site, closest to shore and the existing container yard, a basalt (rock) bench measuring two feet thick was encountered at one geotechnical boring. This rock material is to be disposed at an approved upland disposal site.

7. <u>IMPACTS OF PROPOSED ACTIVITIES IF AUTHORIZED</u>:

The proposed activity would permanently remove approximately 162,000 cubic yards of accumulated sediments, gravels, cobbles and boulders from the basin bottom; and establish water depths to -25 feet MLLW. Use of this area by the general public would be restricted during construction through the placement of appropriate safety devices, structures, and signage. Water quality within the basin is expected to remain the same after construction. The water quality of the receiving Kuhio Bay and Hilo Bay waters that are accessible to the public is not expected to be significantly degraded during project dredging. Water quality monitoring during dredging operations of the proposed project will be required in compliance with the State Department of Health, Clean Water Branch's administrative rules. A Construction Contractor's Site-Specific Best Management Practices Plan (BMPP) will be required to minimize turbidity and the proper handling and disposal of excavated material. In addition, the BMPP will also contain measures to avoid, minimize or mitigate potential pollution events from equipment maintenance, leaks, and spills. The transport to, and disposal of dredged sediments at the HDMODS shall also be in compliance with an approved dredging and disposal operation plan.

Short term impacts include temporary disruption to upland activities adjacent to the basin from construction equipment, material staging, and de-watering areas, increased noise and traffic, and temporary degradation to Kuhio Bay water quality during dredging operations.

Sessile, slow-moving, and fish biota inhabiting the Kuhio Harbor basin, or attached to the existing shoreline substrates will be destroyed or displaced. Noise-producing activities during construction (i.e. equipment operation) will be minimized by distance from residential areas and daylight hours of operation.

8. IMPACT ON HISTORIC PROPERTIES:

The areas of direct and indirect impact from construction activities and subsequent improvements will not adversely impact any Historic District, or any other adjacent historic properties listed, or eligible for listing, on the Hawaii and National Registers of Historic Places. Existing bottom surfaces within the project area are unlikely to contain *in situ* Native Hawaiian cultural properties and burial remains.

This notice has been sent to the State Historic Preservation Officer, the State Office of Hawaiian Affairs, Hui Malama I Na Kupuna and the Aha Kiole Advisory Council. Any comments they have regarding historic properties and cultural resources will be considered before a final decision is made on the DA permit.

9. IMPACT ON ENDANGERED SPECIES, ESSENTIAL FISH HABITAT:

Green sea turtles, a federally listed threatened species, are known to forage within the nearshore areas of Hilo Bay. There is no indication that the maintenance dredging of sediments from marine waters will result in inadvertent entrapment of turtles or other larger biota. The receiving marine environment around the areas of proposed disturbance consists primarily of sediments, gravels, cobbles, and existing harbor structures which supports minimal growth of marine algal species preferred by turtles. The threatened green sea turtle *(Chelonia mydas)*, endangered hawksbill turtle *(Eretmochelys imbricata)*, humpback whale *(Megaptera novaengliae)*, and Hawaiian monk seal *(Monachus schauinslandi)* may transit in the vicinity of and/or within the boundaries of Hilo Bay. Also, the proposed project's dredge disposal route is located within the boundaries of the Humpback Whale National Marine Sanctuary. Pursuant to Section 7 of the Endangered Species Act (ESA), the Corps has determined that the proposed project may affect, but is not likely to adversely affect any Federally-listed species since all proposed harbor dredging and ocean disposal activities will comply with plans and specifications which will avoid and minimize potential harm to Protected Marine Species.

This notice has been sent to the U.S. Fish and Wildlife Service, National Marine Fisheries Service and Hawaii Division of Aquatic Resources. Any comments they have on endangered or threatened species, designated critical habitat or essential fish habitat, will be considered before a final decision is made on the permit.

10. OTHER GOVERNMENT AUTHORIZATIONS/CERTIFICATIONS:

Prior to the issuance of a valid Department of Army permit, the applicant is required to obtain a Section 401 Water Quality Certification, or waiver from the Clean Water Branch, Hawaii Department of Health and a Coastal Zone Management (CZM) Program consistency determination, or waiver from the Office of Planning. The requirements for a CZM consistency statement and accompanying information are available for public review at the Department of Business, Economic Development & Tourism, Office of Planning, CZM Program Office, 235 S. Beretania Street, 6th Floor, Honolulu, HI. 96813. Comments on the consistency statement should be submitted in writing to the Department of Business, Economic Development & Tourism, Office of Planning, CZM Program Office, P.O. Box 2359, Honolulu, HI 96804 no later than 30 days from the date of this notice.

The dredging area is located within the Hilo Commercial Harbor, an area maintained by the Harbors Division, Hawaii Department of Transportation. The presence of dredging machinery and scow barges, including the routes and frequency of passage to and from the HDMODS for the transport of dredged material is proposed in, and through, Kuhio and Hilo Bays. The Commander, U.S. Coast Guard District Honolulu, shall be consulted to determine the conditions under which the proposed work shall, or shall not take place, in navigable waters subject to their control and security.

The U.S. Environmental Protection Agency (USEPA) has reviewed and commented on the suitability of dredged spoils for disposal at their HDMODS. Dredged gravels, cobbles and boulders larger than 10cm (4in) in any dimension are restricted from disposal into the SOODMDS and will be disposed at an authorized upland location. Further, any de-watered sediments are prohibited from transport to, and disposal at, the HDMODS. This restriction shall be a special condition of the DA permit authorization.

Other State and local approvals required may may require a National Pollution Discharge Elimination System (NPDES) permit, NPDES Stormwater Construction Permit and Community Noise Control Permit from the State Department of Health, and a Special Management Area Use Permit, Grading, Grubbing, Excavation & Stockpiling Permit, and Building Permit from the County of Hawaii Department of Planning.

11. EVALUATION FACTORS:

The decision whether to issue a permit will be based on an evaluation of the probable impacts, including cumulative impacts, of the proposed activity on the public interest. That decision will reflect the national concern for both protection and utilization of important resources. The benefit which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered, including the cumulative effects thereof. Among these are conservation, economics, aesthetics, general environmental concerns, wetlands, historic values, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shoreline erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership and, in general, the needs and welfare of the people.

12. COMMENTS AND INQUIRIES:

The U.S. Army Corps of Engineers (USACE) is soliciting comments from the public, Federal, State and local agencies and officials, native Hawaiian organizations and individuals and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the USACE to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

Interested parties may submit in writing any comments that they have on issuance of a permit for the proposed activity. Comments on the described work, with the reference number, should reach this office no later than the expiration date of this Public Notice to become part of the record and be considered in the decision. Please contact Farley K. Watanabe at 808-438-7701 if further information is desired concerning this notice. Electronic comments by e-mail can be posted at CEPOH-EC-R@usace.army.mil. Facsimile comments can be sent to 808-438-4060.

It is Corps of Engineers policy that any objections will be forwarded to the applicant for comment or rebuttal before the objection is resolved. If the objecting party so requests, all personal information will be deleted from the forwarded letter, or the objections will be sent in paraphrased, summary form.

13. REQUEST FOR PUBLIC HEARING:

Any person may request, in writing, within 30 days from the date of this notice that a public hearing be held to consider issuance of a permit for the proposed project. Requests for public hearing must specifically state the reasons for holding a public hearing.

14. Attachments:

Figure 1. General Location Map
Figure 2. Proposed Revetment Plan View
Figure 3. Proposed Dredging Limits
Figure 4. Conceptual Profile of Shoreline Revetment
Figure 5. Existing Condition of Project Shoreline
Figure 6. General Location Map. Hilo Dredged Materials Ocean Disposal Site OD0914

15. Additional references relevant to this proposed project can be found on our website at: http://www.poh.usace.army.mil/PA/PublicNotices/PN20080912POH2006-338.pdf

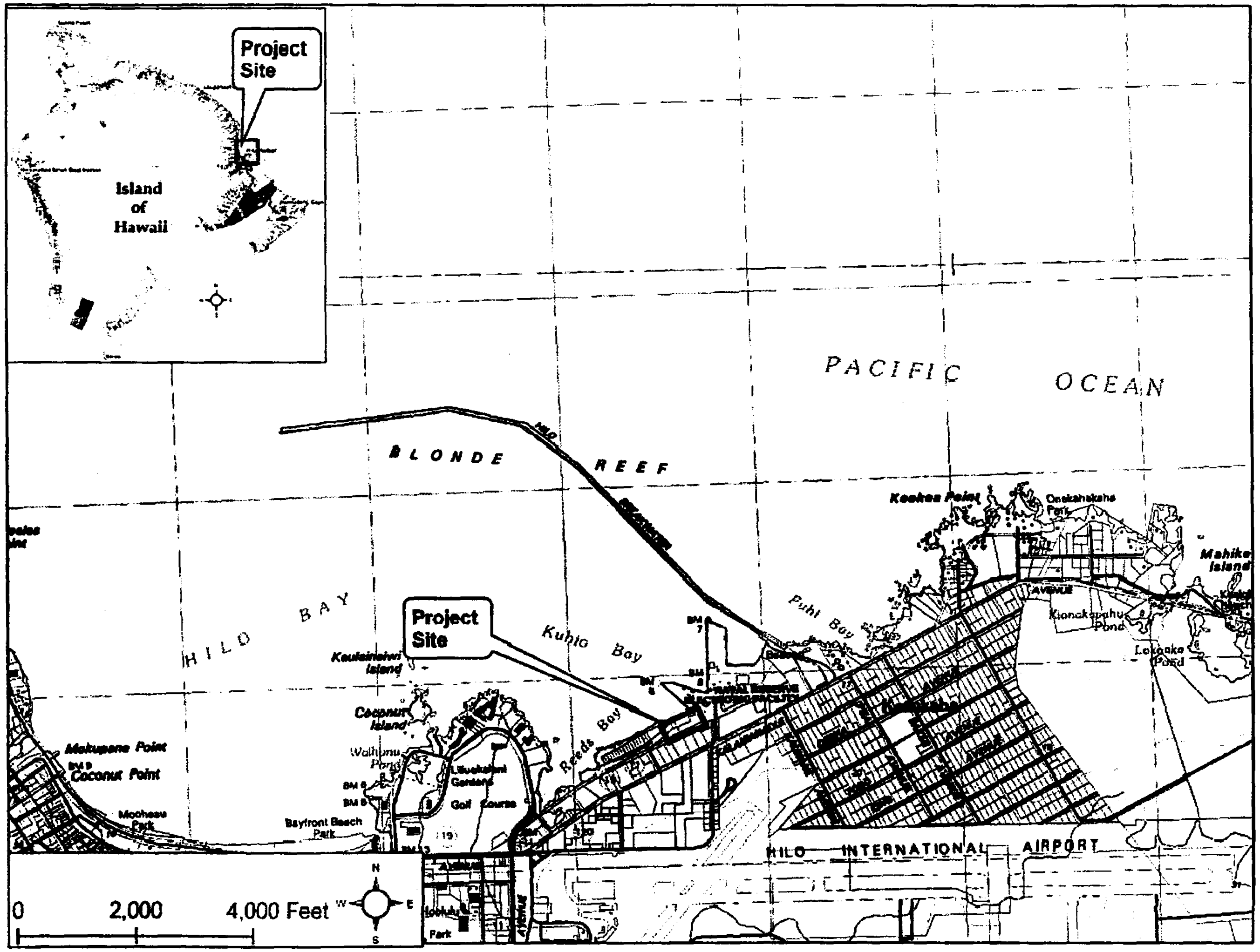

Figure 1. Vicinity Map of Hilo Harbor

REVISIONS				
ZONE	REV	DESCRIPTION	DATE	APPROVED

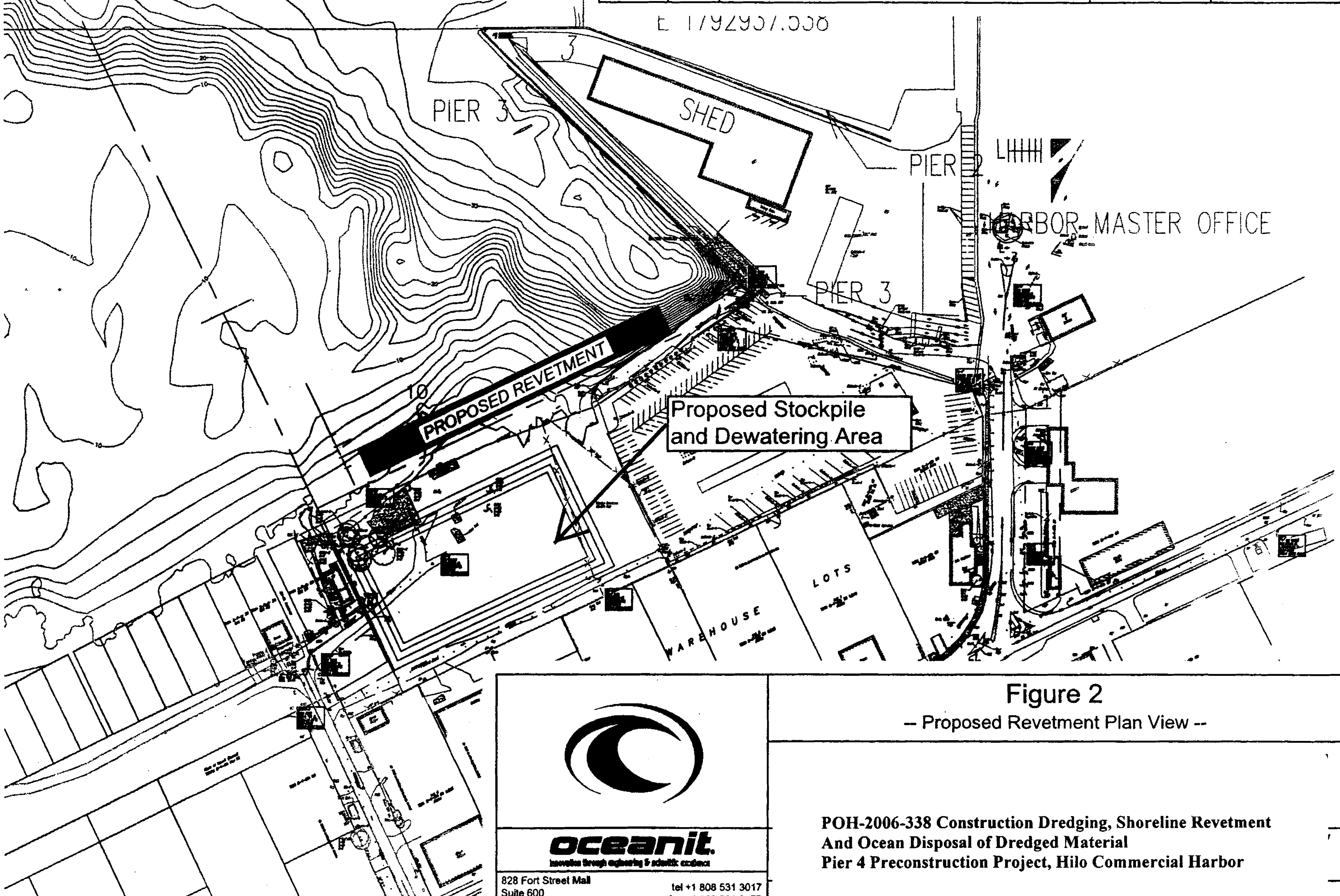

Figure 2
-- Proposed Revetment Plan View --

oceanit.
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828 Fort Street Mall
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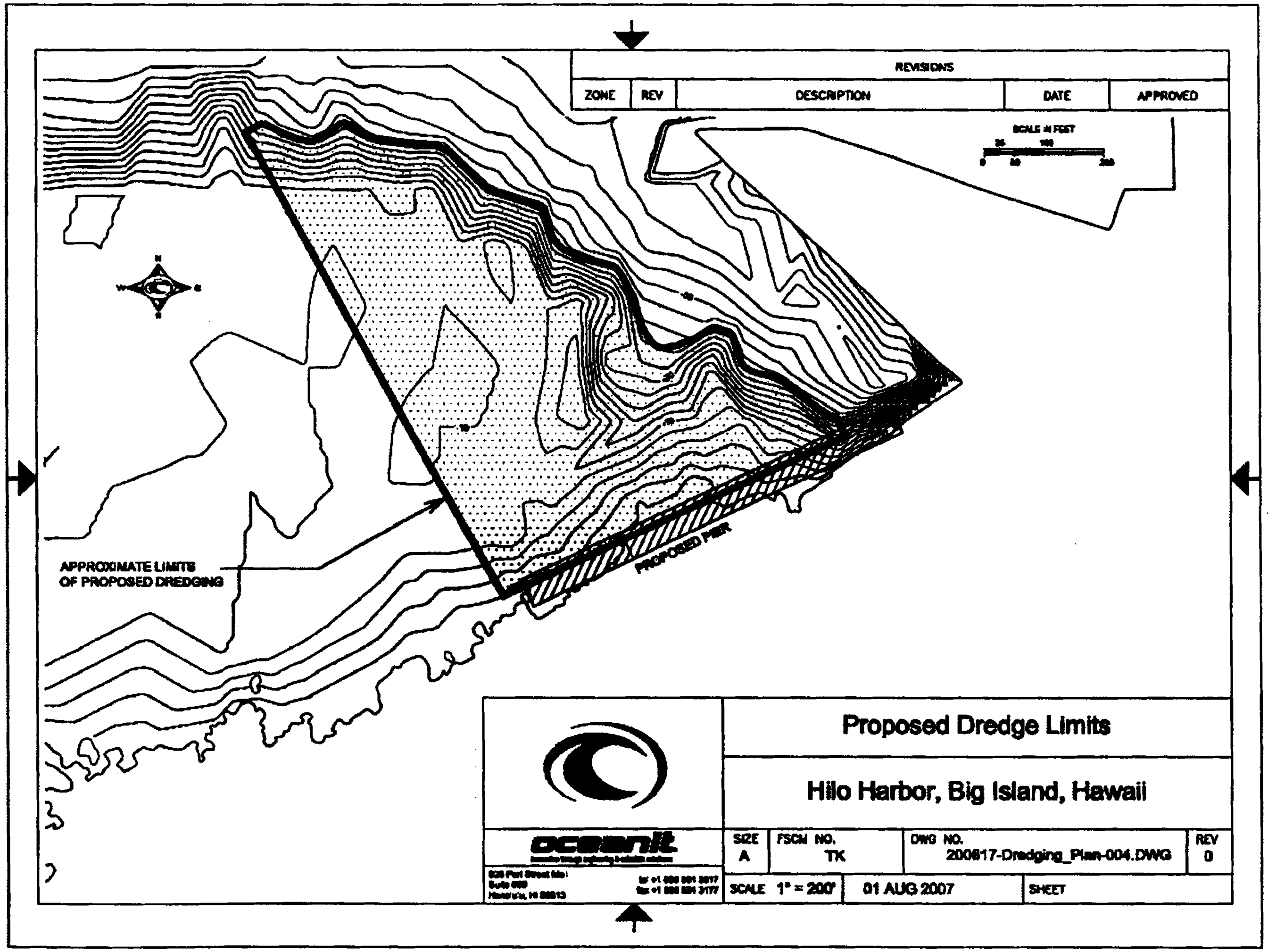
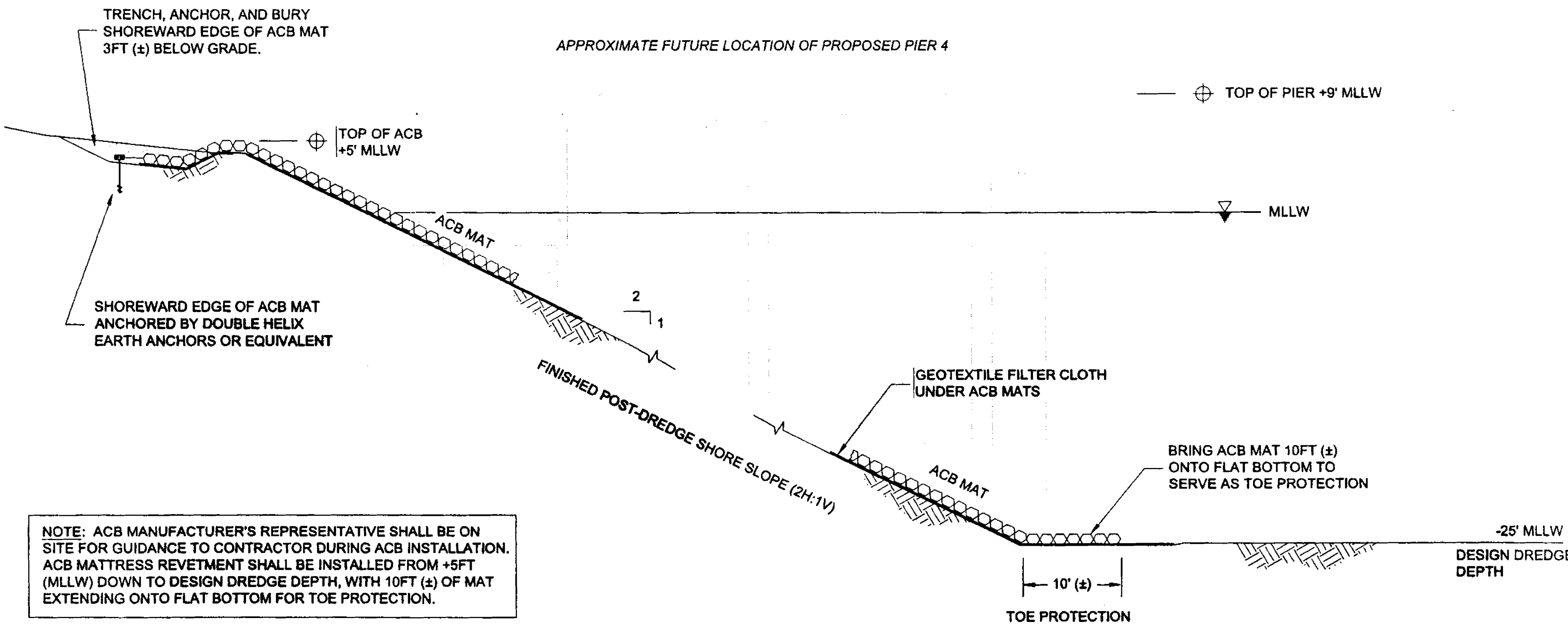
fax +1 808 531 3177

POH-2006-338 Construction Dredging, Shoreline Revetment And Ocean Disposal of Dredged Material Pier 4 Preconstruction Project, Hilo Commercial Harbor



POH-2006-338 Construction Dredging, Shoreline Revetment
And Ocean Disposal of Dredged Material
Pier 4 Preconstruction Project, Hilo Commercial Harbor

Figure 3. Plan View of Dredging Site



NOTE: ACB MANUFACTURER'S REPRESENTATIVE SHALL BE ON SITE FOR GUIDANCE TO CONTRACTOR DURING ACB INSTALLATION. ACB MATTRESS REVETMENT SHALL BE INSTALLED FROM +5FT (MLLW) DOWN TO DESIGN DREDGE DEPTH, WITH 10FT (±) OF MAT EXTENDING ONTO FLAT BOTTOM FOR TOE PROTECTION.

ARTICULATED CONCRETE BLOCK MATTRESS SPECIFICATIONS:

* SPECIFICATIONS MAY VARY BETWEEN MANUFACTURERS, CHECK WITH ENGINEER BEFORE FINALIZING ACB SOURCE
* MATTRESS DIMENSIONS: 8' X (16' TO 20') X (9" TO 12")
* MATTRESS WEIGHT IN AIR: APPROX. 10,500 LBS.
* MATTRESS WEIGHT SUBMERGED: APPROX. 6,000 LBS.
* CONCRETE DENSITY: 145 LBS. PER CU. FT., 4,000 PSI
* 128 TO 160 ELEMENTS: 5/8" STAINLESS STEEL OR ULTRA VIOLET STABILIZED COPOLYMER EXTRUDED FIBER ROPE, MINIMUM TENSILE STRENGTH 9,500 LBS
* BLOCK UNITS SHALL BE MECHANICALLY CONNECTED OR BONDED TO INTERNAL CABLES WHICH SHALL RUN THROUGH EACH BLOCK BOTH TRANSVERSELY AND LATERALLY.

EXAMPLE OF TYPICAL INSTALLATION OF ACB MATS FOLLOWING DREDGE COMPLETION AND PRIOR TO CONSTRUCTION OF PROPOSED PIER

- CONCEPTUAL DRAWING -

NOT TO SCALE

POH-2006-338 Construction Dredging, Shoreline Revetment And Ocean Disposal of Dredged Material Pier 4 Preconstruction Project, Hilo Commercial Harbor

Figure 4. Conceptual Profile of Shoreline Revetment

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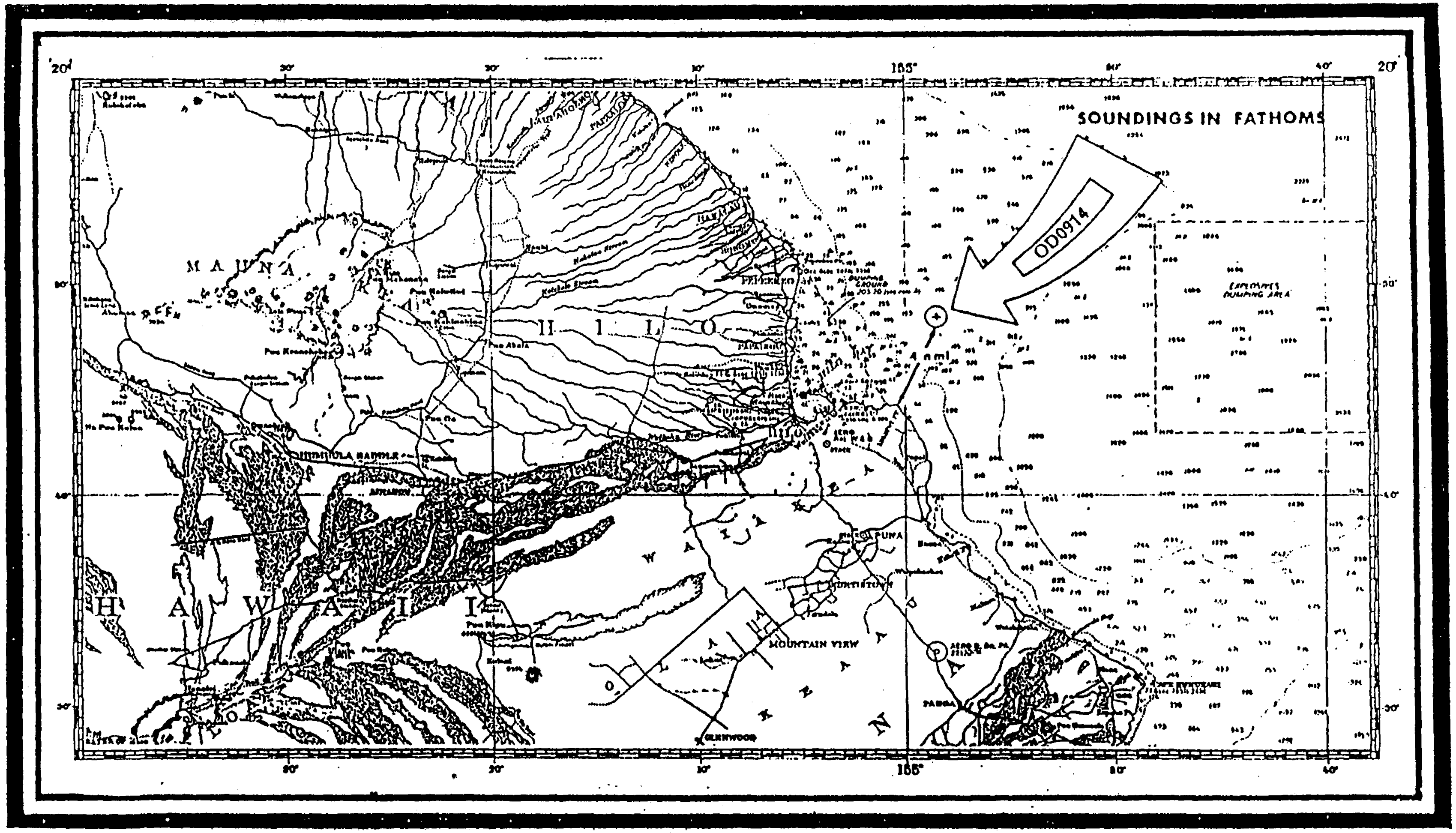
And Ocean Disposal of Dredged Material
Pier 4 Preconstruction Project, Hilo Commercial Harbor

Figure 5. Existing Condition of Project Shoreline



Boundary Coordinates	1,000-Yard Radius
Center Coordinates	19°48'30"N., 154°58'30"W.

Navigation Chart No.	NOS 19320
Area	0.76 Square Nautical Mile
Local Navigational Aids	Loran C, Omega, RDF, Radar
Material Type	Dredged Material

September 1980

POH-2006-338 Construction Dredging, Shoreline Revetment And Ocean Disposal of Dredged Material Pier 4 Preconstruction Project, Hilo Commercial Harbor

Figure 6. Location of Hilo Dredged Material Ocean Disposal Site

Appendix B: Pre-Final Report of Findings

Dredge Material Evaluation for Ocean Disposal: Construction of Inter-Island Cargo Terminal Facility at Hilo Harbor, Hawaii

Final Report of Findings

Dredge Material Evaluation for Ocean Disposal: Construction of Inter-Island Cargo Terminal Facility at Hilo Harbor, Hawaii

United States Environmental Protection Agency
Region IX
Water Division
75 Hawthorne
San Francisco, CA 94105

By:

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

January 2008

Executive Summary

Hilo Bay is located on the North East coast of the island of Hawaii. Hilo Harbor, an active commercial harbor, is sheltered by a 10,000 foot breakwater. As part of the implementation of the Hawaii Commercial Harbors 2020 Master Plan, the State of Hawaii Department of Transportation proposes dredging in the area adjacent to the existing Pier 3 facilities, to eventually accommodate a Pier 4 and container yard. The proposed dredge depth is -25 feet below Mean Low Lower Water, dredge area is 355,000 ft^2 and the estimated dredge volume is 162,300 cubic feet. The dredged material is being proposed for ocean disposal at the Hilo Ocean Dredged Material Disposal Site. In accordance with EPA and United States Army Corps of Engineers policies, the material is being evaluated for suitability for ocean disposal. Suitability of the dredge material is determined through a series of physical, chemical, and bioassay investigations, also referred to as a Tier III investigation. Lack of previous investigations in the vicinity also warranted the intensive Tier III investigation.

As part of the overall project, jet-probing and borings beyond the dredge depth were used to examine sediment in the proposed dredge area. These investigations showed a relatively uniform substrate, consisting of a thin mud/silt layer over a thick layer of coral detritus and lagoonal deposits extending beyond the proposed dredge depth. The mud layer is more pronounced closer to shore. At the corner of the proposed dredge site, closest to shore and the existing container yard, a basalt (rock) bench measuring two feet thick was encountered at one geotechnical boring, and possibly by subsequent vibracoring attempts. The laboratory tests expected to show elevated levels of arsenic due to previous sugar mill activities and subsequent investigations.

Seventeen sampling locations were laid out in a 100-foot grid fashion and divided into two subsections sections: nearshore and seaward. Two of the predetermined sampling points were shifted to shallower waters due to an underwater obstruction that prevented the boat from maneuvering across the sites. Reference sediment was collected from a point approximately 1.5 miles from the breakwater opening. Samples were collected from each of the seventeen sites within the proposed dredging area using a vibracore, and using a stainless steel bucket for sediments at the reference site. Samples from the nearshore points were composited into one sample at the laboratory, as were samples from the seaward points. Sediment from the reference point was analyzed separately.

The vibracore was not able to penetrate to the proposed dredge depth at many of the sampling points. Physical characterization of the sediments concurred with the jet probe and boring analyses, however, confirming a mixture of coral detritus (dead coral pieces) and sand making up most of the proposed dredge volume. A 1–3 foot layer of silt was found at sampling points close to shore, as well as along the drop-off to the existing active shipping channel. The plateau had a much thinner layer of mud/silt. Ultimately, compacted coral detritus cemented together by sand particles caused vibracore refusal at all but one of the points. At point E1, both vibracore attempts ended with refusal against a solid substrate, presumably the basalt bench encountered during the geotechnical borings.

Each of the three sample composites underwent grain size, chemistry, and bioassay analyses. Chemistry tests included Semi-volatile Organic Compounds (SVOC), Polynuclear Aromatic Hydrocarbons (PAHs), Chlorinated Pesticides, Polychlorinated Biphenyls (PCB), Dioxins, Chlorinated Herbicides, numerous metals, organotins, total recoverable hydrocarbons (TRPH), and total petroleum hydrocarbons (TPH [oil and diesel fractals]). Bioassay tests included suspended–particle testing, solid phase acute toxicity testing, and solid phase bioaccumulation potential tests.

For the grain size analyses, the inshore composite had 23% gravel, 36% sand, 24% silt, and 17.5% clay and the seaward composite consisted of 35% gravel, 44% sand, 12% silt, and 10% clay. The reference sediment consisted mainly of silt (72%).

Lab results for the inshore composite showed elevated arsenic levels, with a mean value of 14.36 mg/kg. Arsenic levels in the seaward composite had a mean value of 7.46 mg/kg. Background arsenic levels, up to 5 mg/kg, are common in Hawaii, with naturally occurring levels of as high as 20 mg/kg having been reported. No other metals were found at elevated levels in the project sediments. Arsenic, Chromium, Copper, Iron, Nickel, and Vanadium were elevated in reference sediments.

Extremely low levels of PAHs were detected in both project composites, with a total detectable PAH value of 173 μg/kg for the inshore composite and 158 μg/kg for the seaward composite. PCBs, pesticides, herbicides, organotins, dioxins, TRPH and TPH were all absent or present in trace or very low concentrations in the project sediments and were not expected to play a role in toxicity experiments.

Suspended Particulate Phase (SPP) testing using *Mytilus galloprovincialis, Mysidopsis bahia* and *Menidia beryllina* did not show any effects of the project sediments on the water column. Brine (hypersaline) solution was added to site water to boost salinity to acceptable levels. Test conditions, including test organism sensitivity, were normal.

Solid Phase (SP) testing using *Neanthes arenaceodentata* and *Ampelisca abdita* also proceeded normally. Survivorship in the reference sediment was very low, at 49%, thus comparisons were made to the survivorship of the organism in the laboratory sediments. For the *Ampelisca abdita* test with the inshore sediments, survivorship did not meet the criterion for suitability for ocean disposal. The reduced survivorship could not be attributed to organism hypersensitivity, nor were there any indicators that physical or chemical attributes of the sediment played a significant role.

The bioaccumulation potential tests proceeded normally. Tissue chemistry analyses did not show significant uptake of contaminants, with the exception of selenium. Closer examination, however, revealed that the Day 0 selenium tissue concentrations were higher than the mean tissue concentration in each of the project composites. In effect, the organisms lost selenium to their surroundings.

Based on the physical, chemical, and bioassay studies, the material being proposed is suitable for ocean disposal, with two exceptions. First, the solid basalt ledge, detected at the corner of the of the project area closest to shore and existing container yard during borings and vibracoring, will not likely meet the physical standards for ocean disposal, as only unconsolidated material is permitted. Second, the *Ampelisca abdita* solid phase test showed decreased survivorship in the inshore sediments. A well justified cause for this reduced survivorship is lacking.

Alternatives for ocean disposal were considered. Landfill disposal on the Hilo side of the Island of Hawaii is not possible, as the facility is nearing capacity and has previously stated it will not accept the dredged material. Transport costs alone make disposal at the Kona landfill unfeasible (90 miles one-way). No significant development projects are planned for the Hilo area, and the pier and associated facilities will not be requiring substantial amounts of fill, making reuse of the material or storage unfeasible as well.

Dredging is a prerequisite for later pier and container yard construction, as well as implementation of the Hawaii Commercial Harbors 2020 Master Plan. The no action alternative will prevent planned upgrades from proceeding. Ocean disposal remains as the most environmentally, technically, and economically feasible alternative.

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List of Acronyms

AECOS	Aecos Laboratories, Inc.
ASTM	American Society for Testing and Materials
BP	Bioaccumulation Potential
°C	Degree Celsius
CFR	Code of Federal Regulations
COC	Contaminant of Concern
Corps	United States Army Corps of Engineers
CRG	CRG Marine Laboratories, Inc., Torrance, California
CY	Cubic yards
DDT	dichlorodiphenyltrichloroethane
DGPS	Differential Global Positioning System
EC_{50}	Median Effective Concentration
EPA	United States Environmental Protection Agency
ERL	Effects Range Low
ERM	Effects Range Median
ft	feet or foot
g	gram
GC-MS	gas chromatography – mass spectroscopy
HEER	Office of Hazard Evaluation and Emergency Response
HIDOH	State of Hawaii Department of Health
HIDOT	State of Hawaii Department of Transportation, Harbors Division
HODMDS	Hilo Ocean Dredged Material Disposal Site
L	liter
LC_{50}	Lethal Concentration 50
LPC	Limiting Permissible Concentration
m	meter
MDL	Method Detection Limit
mg/kg	milligram per kilogram
µg/kg	microgram per kilogram
mg/L	milligram per liter
MLLW	Mean Lower Low Water
mm	millimeter
MPRSA	Marine Protection, Research, and Sanctuaries Act
MRL	Method Reporting Limit
NAD83	North American Datum, 1983
ng	nanogram
ng/g	nanogram per gram
ng/kg	nanogram per kilogram
Oceanit	Oceanit Laboratories, Inc.
OTM	Ocean Testing Manual
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pg	picogram

pg/g	picogram per gram
pH	hydrogen ion concentration
ppm	parts per million
ppt	parts per trillion
PRG	Preliminary Remediation Goal
QA	quality assurance
QAP	quality assurance plan
QC	quality control
SAP	sampling and analysis plan
SOP	standard operating procedure
SP	solid phase
SPP	suspended particulate phase
SVOC	semi-volatile organic compounds
TBP	Theoretical Bioaccumulation Potential
TBT	tributyltin
TCLP	toxicity characteristic leaching procedure
TEF	toxic equivalency factors
TEQ	toxic equivalency quotient
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TRPH	total recoverable petroleum hydrocarbons
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
Weston	Weston Solutions, Inc., Carlsbad, California
WHO	World Health Organization
WQC	Water Quality Criteria

1.0 INTRODUCTION

Hilo Bay is located on the North East coast of the island of Hawaii. Hilo Harbor, located on the Big Island (Hawaii County), Hawaii, is an active commercial harbor serving cargo carrier, cruise ship, and military clients. A 10,000-foot breakwater constructed in 1930 shelters the harbor. Pier 3 is located immediately to the east of the project site. To the west, residences with addresses on Ocean View Drive face the waterfront.

As part of the Hawaii Commercial Harbors 2020 Master Plan (2001) development activities, the State of Hawaii Department of Transportation proposes dredging the area adjacent to the proposed Pier 4 to a depth of -25 feet below Mean Lower Low Water (MLLW) at Hilo Harbor, Hawaii County, Hawaii (Figure 1). Based on a dredge depth of 25 feet and dredge area of 355,000 ft^2, approximately 162,300 cubic yards (CY) of dredge material is planned. This dredged material is being considered for ocean disposal at the U.S. Environmental Protection Agency's designated Hilo Ocean Dredged Material Disposal Site (HODMDS). Prior to dredging and disposal activities, this material must be determined acceptable for ocean disposal in accordance with the EPA and U.S. Army Corps of Engineers Ocean Testing Manual (OTM, USEPA/USACE 1991).

Proposed Pier 4 is located in Hilo, on the northeast coast of the Island of Hawaii. The

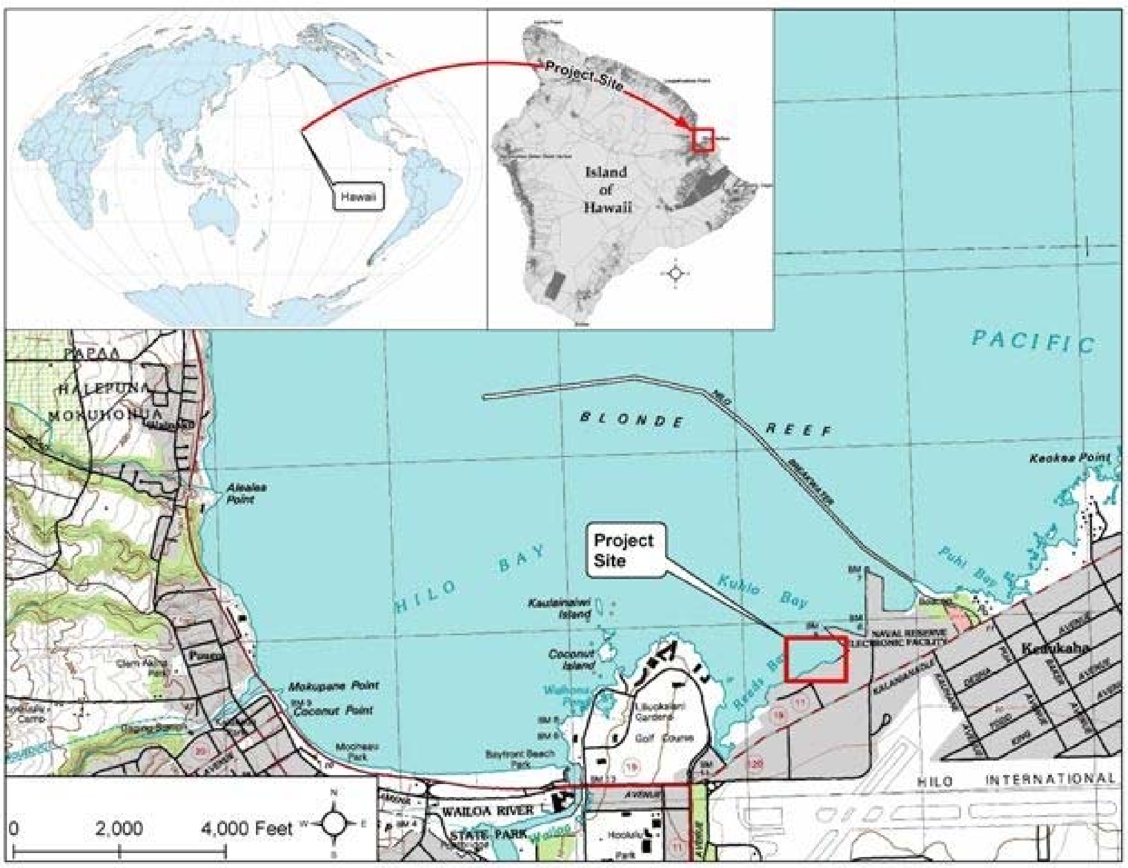

Figure 1. Map illustrating Project Location

present shoreline consists mainly of basalt rock. Existing water depth across a majority of the project site is between -5 feet and -20 feet below MLLW.

Acceptability for ocean disposal is to be determined through physical, chemical, and bioassay testing of sample materials collected from the proposed dredging site.

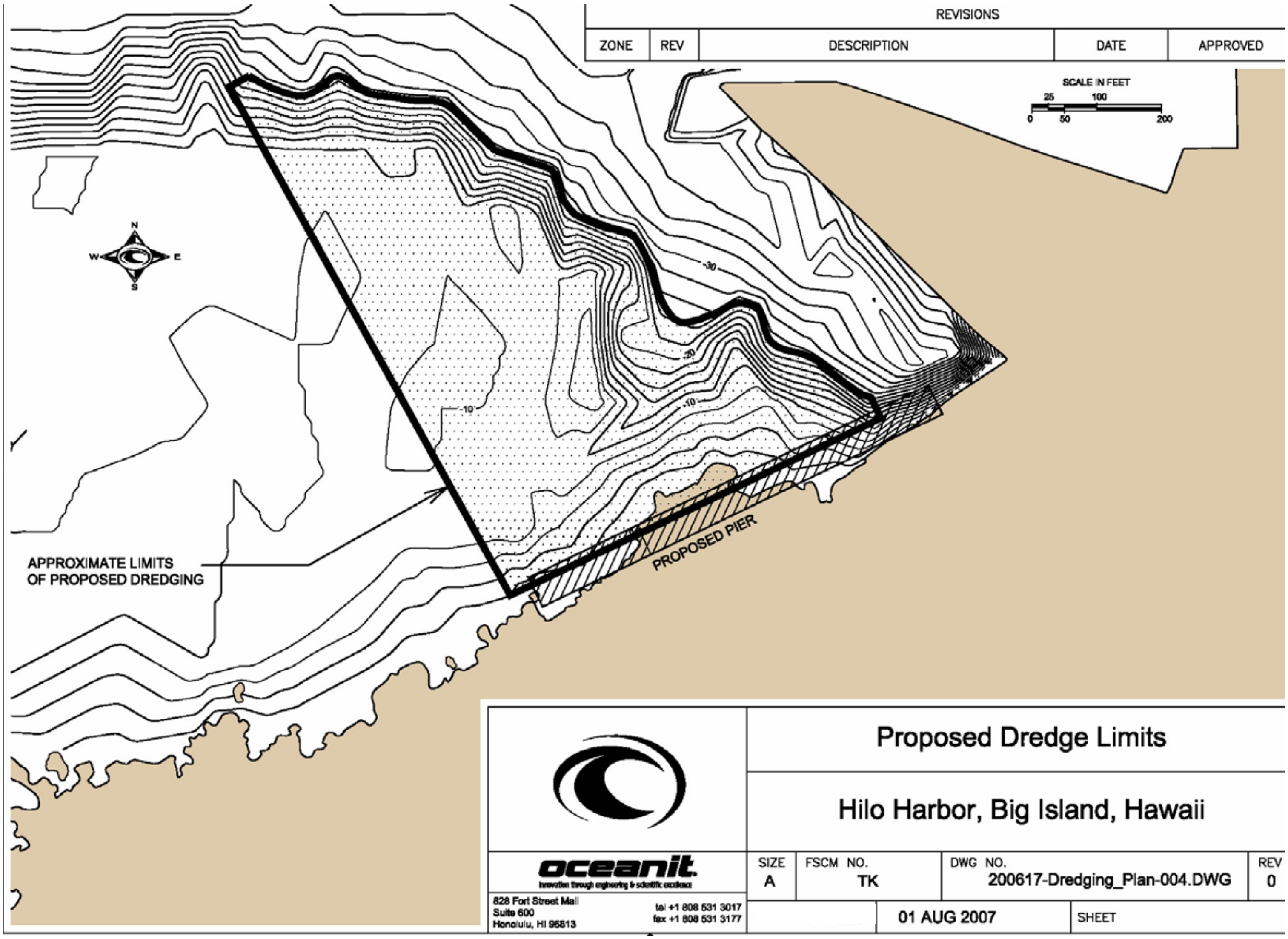

Figure 2. General Site Map illustrating proposed dredge area. Contours are based on an August 2005 Army Corps survey.

2.0 BACKGROUND

2.1 Physical Characterization and Identification of Contaminants of Concern in Materials Proposed to be Disposed

2.1.1 Previous Activities

Dredging records of Hilo Bay are sparse. A major dredging project was completed in 1927 by Hawaii Dredging Co., Ltd. for the construction of Pier 1 (~97,000 CY) and Pier 3 (~87,000 CY).

According to verbal information from the USEPA and the U.S. Army Corps of Engineers (USACE), Honolulu District, maintenance dredging has not taken place in the past decade at Hilo Harbor. One exception was the maintenance dredging in 2005 of Radio Bay at the easternmost end of the harbor, where the breakwater meets land. This dredging operation was performed to allow adequate depth for a Coast Guard cutter regularly moored at the site.

An investigation of the suitability of dredge material for ocean disposal was conducted in 2005 for the deepening of neighboring Radio Bay. Chemical and physical analyses were conducted however the quality of the data and different collection methods meant the data were not directly comparable. The findings, however, assisted in identifying potential Contaminants of Concern (COC).

2.1.2 Summary of Jet Probing Results

Sea Engineering conducted a jet probing investigation across the proposed dredge site in July 2006. A complete copy of the report can be found in Appendix G. The study found a mix of coralline gravel across the project site. Probes 22 and 23 (Figure 3), in the area closest to the present pier 3, encountered hard rock within the planned dredge depths.

Five additional probes were conducted at the edge of where the existing reef plateau slopes down into the harbor channel and turning basin. Probe 17, in 20 feet of water, penetrated through 10 feet of soft sediment. Probes 1, 2, and 16 showed gravel over a more consolidated bottom, and probe 5 showed soft material beyond the dredge depth. Probes closest to shore (18, 19, 21, and 24) had a thicker accumulation of sand, silt, or gravel than those across the plateau. The shallow reef platform consisted of mud or gravel ranging from 0-5 feet thick over consolidated material.

2.1.3 Geotechnical Engineering Exploration

In preparation for this project, Geolabs, Inc. of Honolulu conducted exploratory borings in August 2006 throughout the proposed dredge site (Figure 4). The full report can be found in Appendix H. The report details the geological history of the site, noting the presence of lagoonal/coralline deposits on top of older basalt (lava). Younger, less weathered lava flows can be found in the area, on the present shoreline, for example.

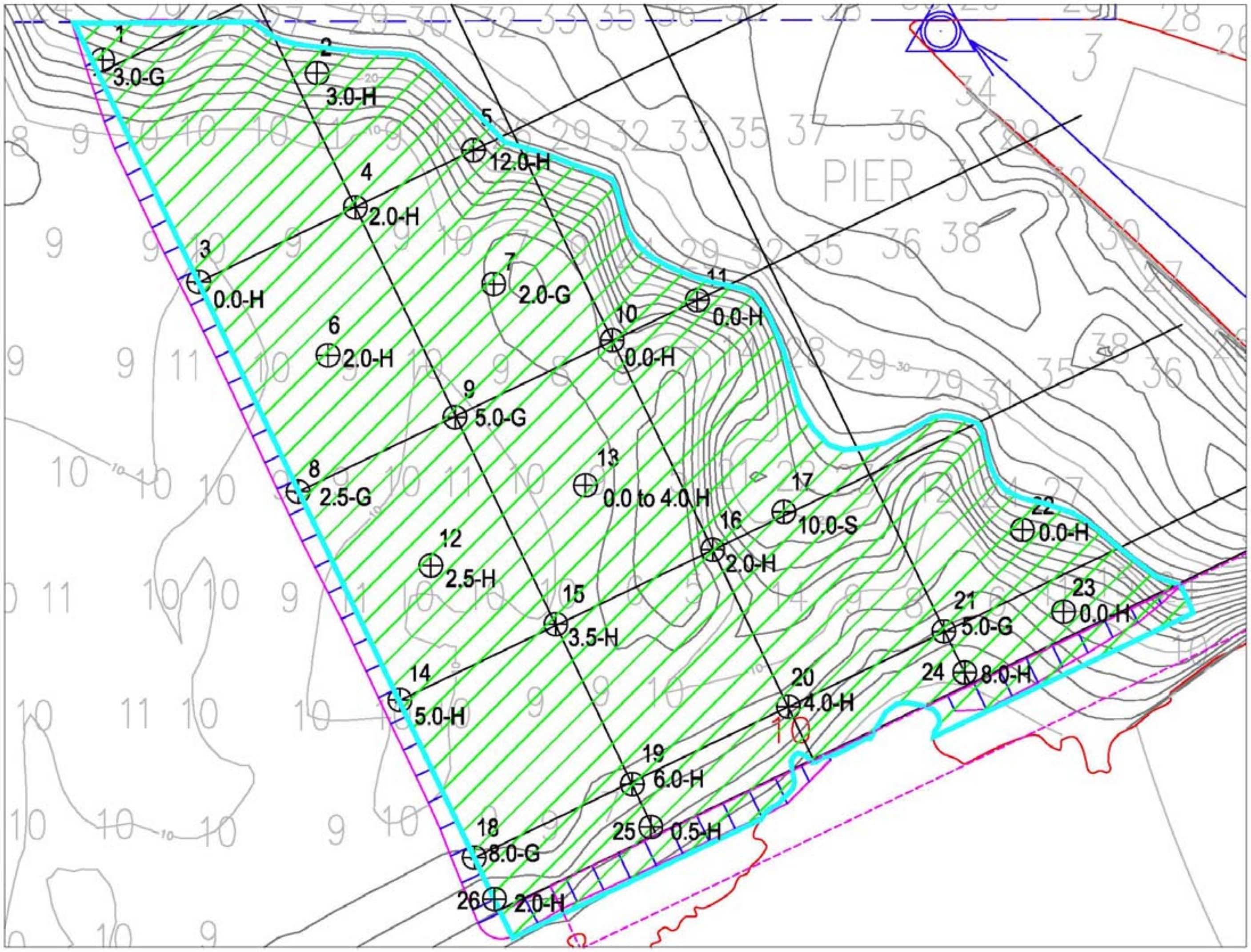

Figure 3. Map detailing jet probe locations at Hilo Harbor (Sea Engineering 2006). Numerical values indicate depth to refusal and type of refusal (S-Soft, G-Gravel, H-Hard, See Appendix G for details).

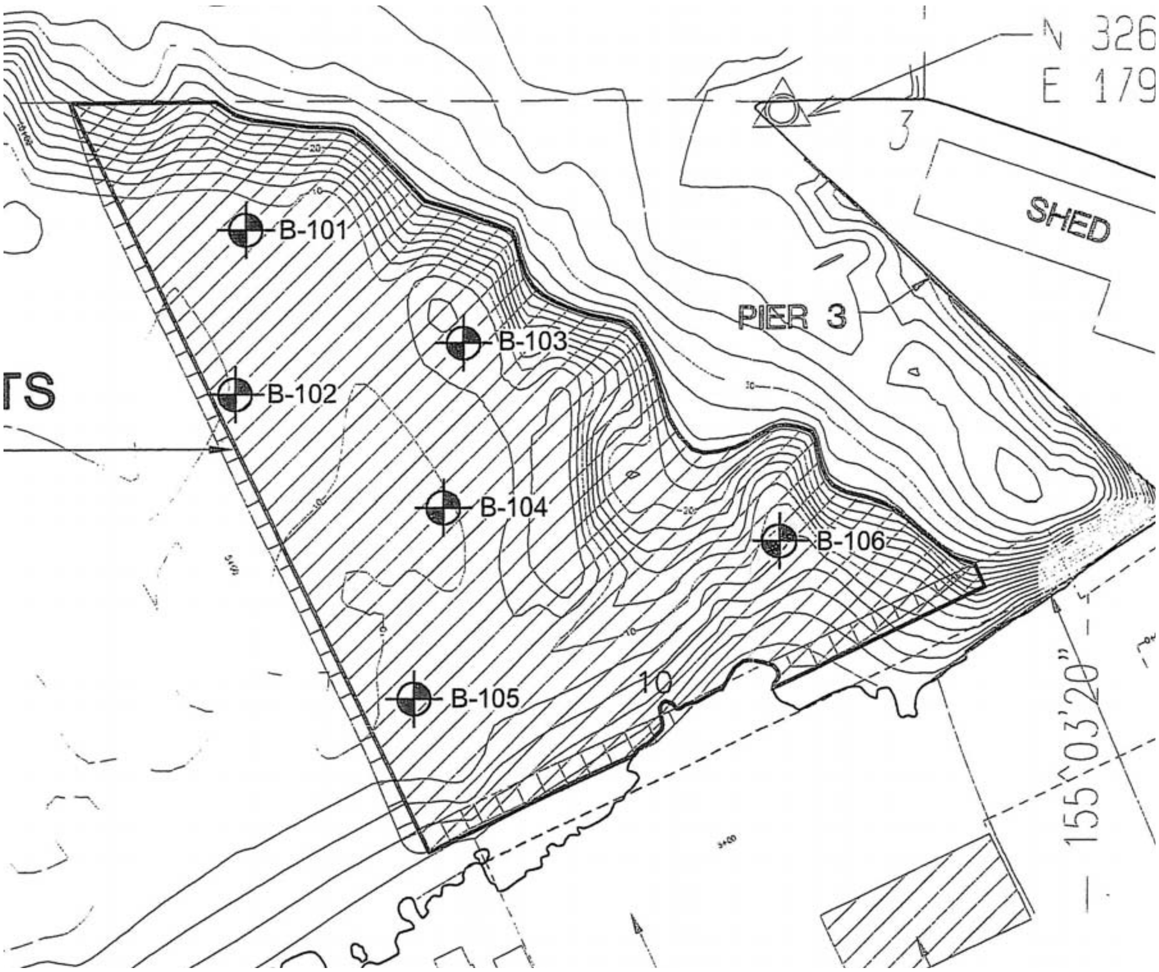

Figure 4. Boring locations for geotechnical investigation at Hilo, Hawaii (Geolabs 2006)

The borings were conducted from a truck-mounted drilling rig (parked on the *Huki Pau*, a landing craft) that used a combination of rotary drilling equipment and split barrel direct push (hammer driven) sampling.

Six exploratory borings were conducted to -43 feet below the existing ground surface. The subsurface conditions were characterized in the field by a geologist. Samples collected from the field were analyzed for grain size in the laboratory. Core logs and grain size analysis results are found at the end of the appended report (Appendix H).

The report notes that the mudline was encountered at between 10 to 13.5 feet below the water level. A 1-2.5 foot thick layer of harbor deposits was encountered below the mudline. The harbor deposits consisted of very soft sandy silt and loose silty sand. Lagoonal deposits mixed with coralline detritus (loose to medium dense silty gravel and sand) were found beyond this layer to the maximum depths explored.

Along the areas sloping to the existing harbor basin to the east (borings 101, 103, and 106), Geolabs encountered severely fractured coral ledges ranging from 1 to 5.5 feet thick, encountered at between 12.5 and 16.5 feet and 23.5 and 31 feet below water level. The hardness of the coral ranged from soft to medium hard.

Basalt rock was encountered during the boring at site 106, closest to shore and the existing harbor basin, and a depth of 23 to 25.5 feet below the water level. The basalt was severely fractured and hard.

Grain size analysis results are summarized in Table 1 below. Results are presented for two samples: the first value for each site falls within the proposed dredge depth. The second value is included for comparison.

2.1.4 Records of Previous Activities, Accidents and Spills

Possible contributors to contamination aside from urban runoff include a Canec wallboard factory (ceased operation in 1963), a landfill, aboveground fuel and oil storage bunkers, and sugarcane fields, all found within the watershed above the project site. The project site receives runoff indirectly from the adjacent Pier 3.

An investigation in July 2006 at the Hawaii Department of Health (HIDOH) Office of Hazard Evaluation and Emergency Response (HEER), which maintains hard copies of reported hazardous materials spill incidents[1], did not reveal any significant spills. Records for all street addresses within a 1.15-mile radius of the project site were requested and reviewed for relevance to the project. Twelve incidents were reported spanning 1989-present. Three reports were for Polychlorinated Biphenyl (PCB)-containing insulating oil for electrical transformers. Power poles sheared by automobile accidents were cited as the cause, and site cleanups were completed. Two reports documented hydraulic fluid spills: a 15-gallon roadside spill in 1995 and a 1-gallon spill in 1998 at a service station. Cleanups were undertaken for both incidents. The largest single spill reported was the loss of 400-500 gallons of Unitek 146 Solvent (a petroleum-based degreaser) on 30 May 2003. Affected areas were covered in absorbent material and soils beneath excavated by 5 June 2003. The HEER files also contain an extensive monitoring report from 1989 documenting the presence of Hazardous Materials (Hazmat)

Table 1. Grain size analysis results from Hilo harbor exploratory borings August 2006 (Geolabs).

Sample	Depth (ft)	Description	% Gravel	% Sand	% Fine
B101	21-23	Tannish white sand w/ some silt & traces of gravel	41.1	48.8	10.1
B101	31-33	Light gray gravel w/ sand and some silt	57.7	35.1	7.2
B102	21-23	Light gray sand w/ gravel and some silt	43.5	46.2	10.3
B102	31-33	Light gray gravel w/ sand and some silt	54.6	38.4	6.9
B103	26-28	Tan gravel w/ sand and some silt	51.8	41.9	6.3
B103	31-33	Tan gravel w/ sand and some silt	57.7	36.4	5.9
B104	21-23	Tannish white silty sand w/ traces of gravel	23.7	63.1	13.2
B104	26-28	Tannish white gravel w/ sand and some silt	50.2	41.1	8.7
B105	18-20	Tannish white sand w/ some silt & traces of gravel	22.9	67.7	9.4
B105	31-33	Light gray silty gravel	54.6	29.3	16.1
B106	16-18	Tannish white gravel w/ silt and sand	66.9	25.6	7.5
B106	21-23	Grayish white sand w/ some silt	25.5	63.2	11.3
B106	31-33	White gravel w/ silt and sand	52.7	37.8	9.5

[1] The HIDOH HEER office maintains records of all *reported* hazmat spill incidents and attempts, via site visit, records, and interviews, to verify whether an incident actually occurred. HEER maintains a records even if upon further investigation, the report turns out to be false.

at the Hilo Landfill. Various hazmat was accepted for disposal at the facility, including 500 tons of wood treating waste. Water samples collected from monitoring wells around the property did not detect movement of contamination, despite reports of arsenic and other heavy metal presence in Hilo Bay. There is no direct connection between the landfill (approximately 1 mile inland) and the project site, and the Hilo Airport lies in-between. The presence of elevated arsenic in Hilo Bay can be attributed to arsenic treatment of sugarcane processing by-products at Waiakea Sugar Mill in the production of Canec wallboard and its release into the environment.

2.2 Tier III Evaluation

The OTM (USEPA/USACE 1991) sets forth a tiered approach for the evaluation of potential environmental impacts of dredged material, which is designed to aid in gathering of contamination and toxicity data, but not beyond what is necessary. Data gathering mechanisms increase in intensity with each tier. Tiers 1 and 2 rely heavily on existing data, where sampling and analyses reports generated prior to regular or maintenance dredging are readily available and substantially comparable to the proposed dredging. While contamination was not expected to be present in the materials being proposed for disposal, the dearth of dredging data for past work in Hilo Harbor prompted, in consultation with EPA Region IX officials, a Tier III evaluation. In addition to investigating past dredging events, a Tier III evaluation calls for physical, chemical, toxicity, and bioaccumulation studies of the materials being proposed for disposal. A Tier IV evaluation is only necessary where detection of contamination and/or toxicity warrants further, very detailed examination.

3.0 DATA GENERATION/METHODS

Sampling and analyses were conducted in accordance with the EPA-approved sampling analysis plan. The following sections detail procedures followed in the field.

3.1 Sampling Locations

Following the EPA approved sampling plan, sediment sampling locations were selected with the goal of collecting sufficient representative samples for compositing into two samples. A 100-foot by 100-foot grid was laid over the proposed dredging area, and divided in two: grouping by sites closest to shore, hereafter “inshore” (HH1 in Weston’s lab results), and area further from shore, hereafter “seaward” (also HH2 in Weston’s lab results). Nine locations were selected within the closer-to-shore group and eight locations in the outer area for a total of 17 locations (Figure 6). Locations planned for sampling were laid out in a grid fashion and are as follows:

Inshore: A-1, C-1, E-1, B-2, D-2, F-2, A-3, C-3, E-3
Seaward: B-4, D-4, A-5, C-5, B-6, A-7, C-7, B-8

Figure 7 offers a close-up view of the sampling locations (those inshore and those seaward). These points were selected such that they were representative of the area being sampled. The inshore (HH1) composite sample represents 100,800 cubic yards and the seaward (HH2) composite sample represents 61,500 cubic yards, totaling 162,300 cubic yards.

A review of topographic maps and the State of Hawaii’s streams database did not show any outfalls into the vicinity of the project area. Shifting sampling locations due to the presence of stormwater or similar outfalls was not necessary, as none were determined to be present.

Locations D-3 and E-2 were sampled instead of locations E-3 and F-2 (respectively) due to an underwater obstruction that prevented the boat from maneuvering across those locations. Moving the locations into shallower water increased the likelihood of successfully obtaining a representative sample.

Pre-selected locations were determined in the field using two differential Global Positioning System (DGPS) units with accuracy to 10 feet.

In addition, sediments from a reference location, selected in consultation with USEPA Region IX representatives, were collected from a location outside the Hilo Harbor breakwater in approximately 165 feet of water (See Figure 8).

3.2 Sampling Methods

3.2.1 Core Collection

Sediment cores were collected from the RV *Huki Pau*, a landing craft. The *Huki Pau* is equipped with four anchors and winch systems which allowed precise maneuvering of the vessel over the selected sampling points. The bow of the vessel, designed for beach landing, has a very shallow draft, allowing the boat to maneuver very close to shore. A vibracore with a four-inch outer diameter aluminum pipe was suspended from the onboard hydraulic crane, and swung over the side of the ship. A GPS reading of the actual sampling point was taken at the side of the ship during coring. All cores were expected to encounter refusal prior to reaching the planned dredging depth of 25 feet. The vibracore was allowed to advance to two feet past dredging depth or until it met refusal. Refusal was defined as the vibracore advancing less than 2 inches per minute. Most of the stations required coring twice to ensure sufficient sediment volume for all analyses.

Sediment cores were deposited into a sampling tray freshly lined with plastic, where strata were identified and samples collected. In the field, sediment subsamples were collected from along the length of the core and deposited into a stainless steel bowl where they were homogenized. Multiple jars were then filled with the homogenized sample material for archiving, physical analyses, and chemical analyses. Sediment remaining in the sampling trays was deposited into bags for bioassay analyses. All sediment collected for analysis was placed in closed coolers on ice. The laboratories were given instructions for compositing the samples into two groups (inshore, seaward) proportionally by sampling depth and volume.

Figure 5. Sampling activities. Left: Positioning of vibracoring equipment. Upper-right: Extraction of the core contents into lined sampling tray. Bottom-right: Sub-sampling the core contents, homogenization, filling sample jars.

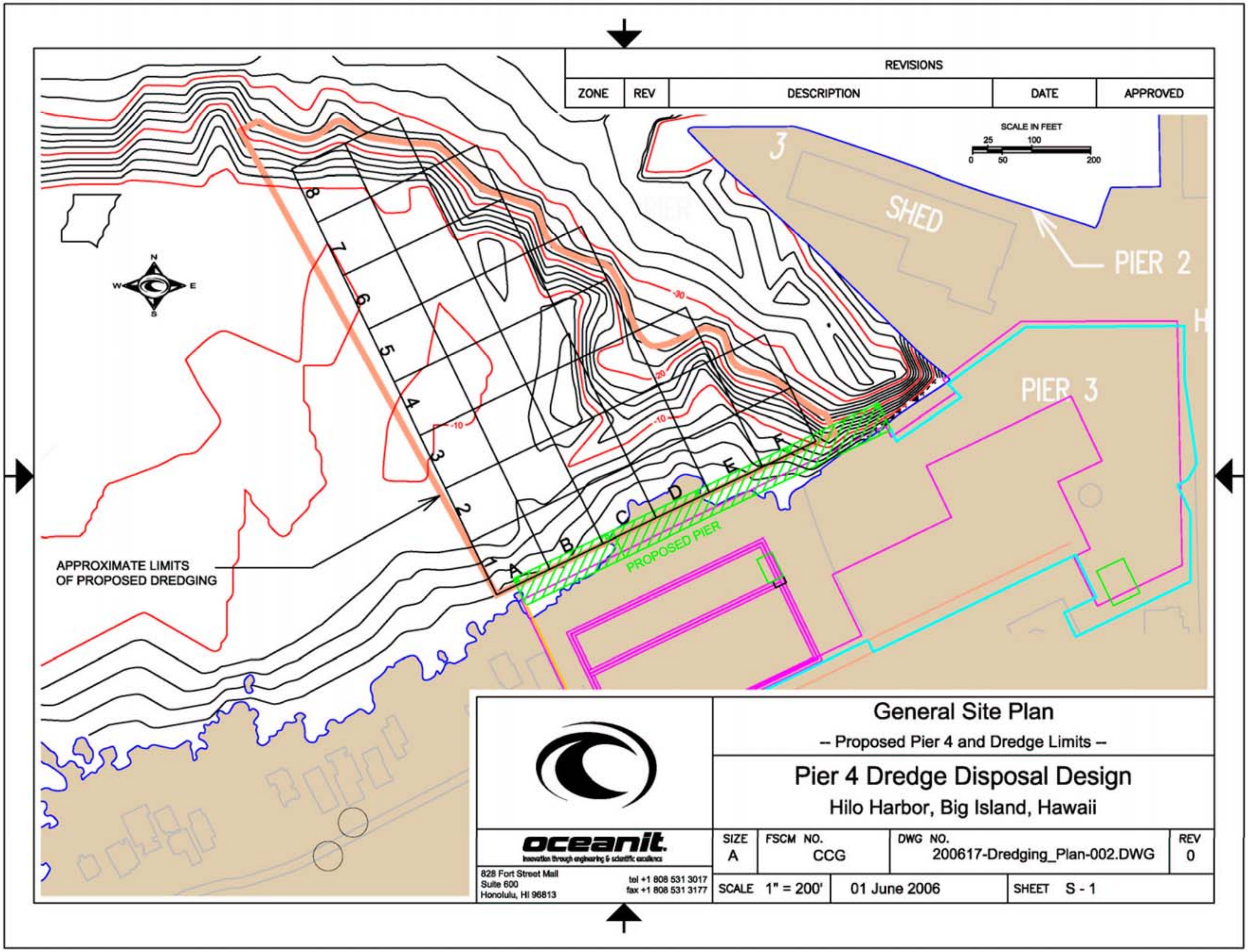

Figure 6. Map of project site and 100 foot grid used to locate sampling locations. Sediment was sampled at the center of a square. Contours based on August 2005 USACE survey data.

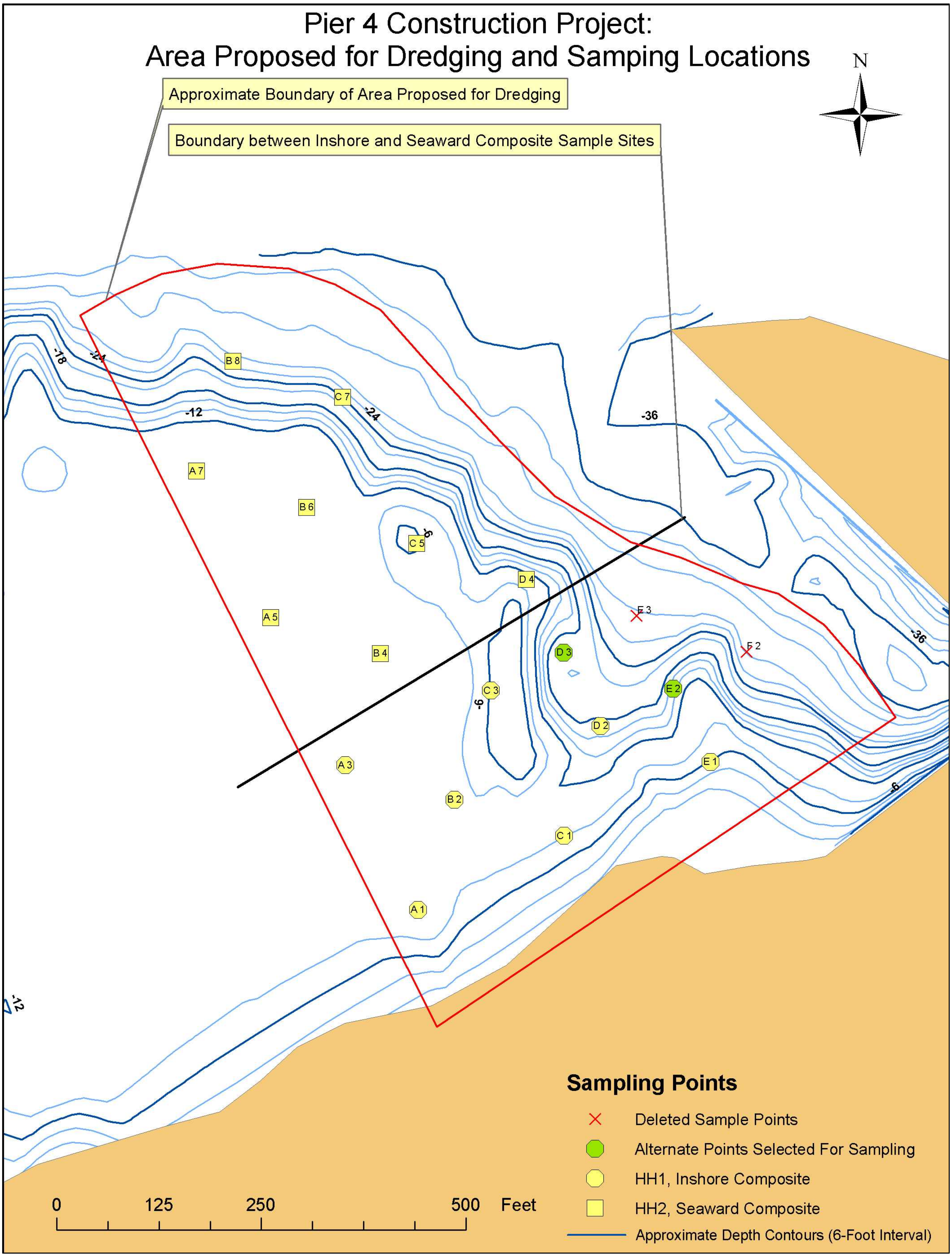

Figure 7. Map illustrating the locations where sediment samples were collected for compositing and analysis. Dredging project boundary and depth contours are approximates. Black line divides the sample area into the Inshore and Seaward compositing groups. Alternate sampling locations used are indicated.

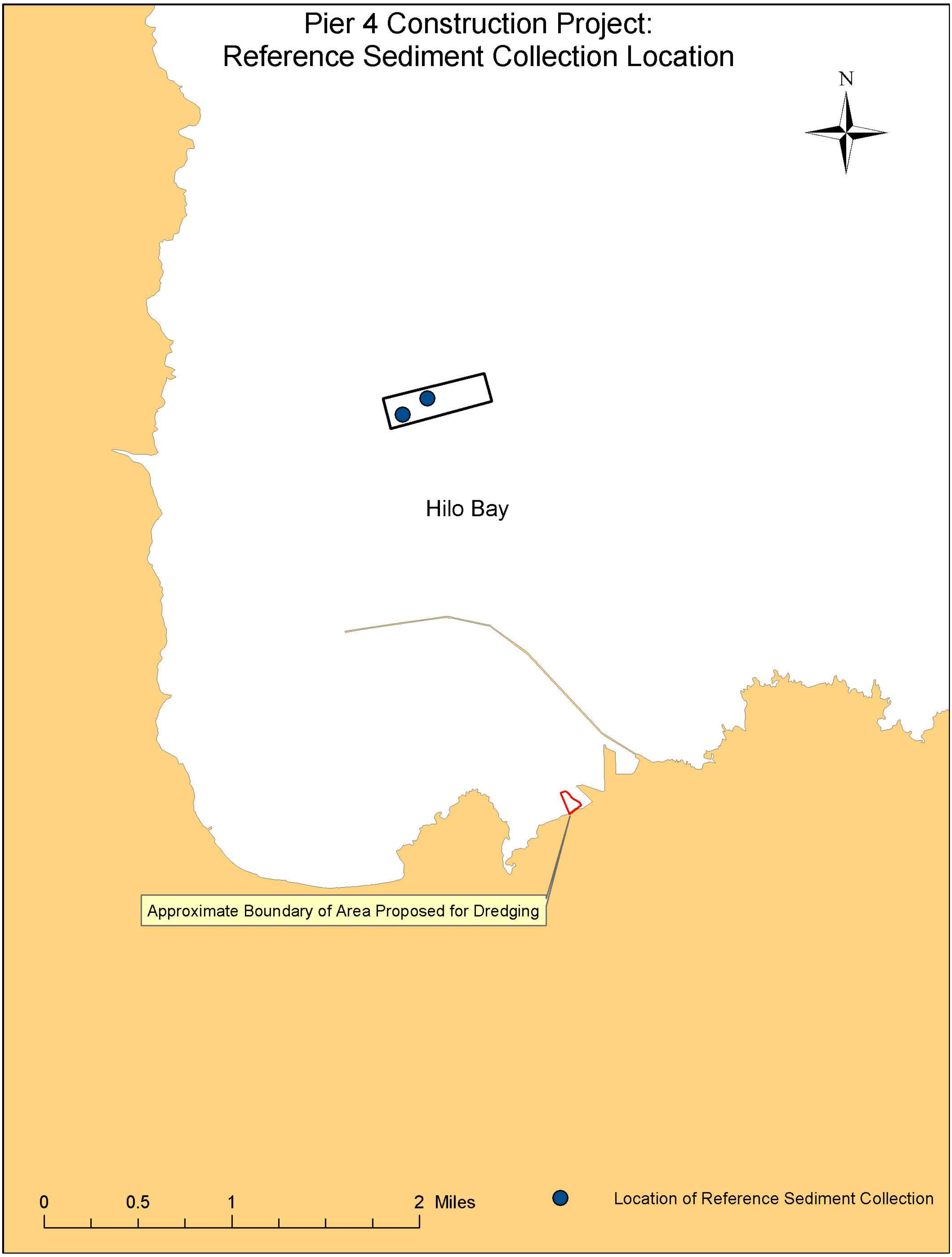

Figure 8. Reference Sediment Sampling Location. Points indicate retrieval location of sampling bucket. Bucket was deployed to the northeast.

3.3 Sample Handling, Preservation, and Storage

3.3.1 Physical Analyses and Sediment Chemistry

Sediment samples collected for the primary phase of chemical analyses along with chain-of-custody documentation were shipped via overnight courier to CRG Marine Laboratories (CRG), Torrance, California, care of AECOS Labs (AECOS), Inc., Kaneohe, Hawaii. Samples were packaged in coolers and chilled to 4°C for shipment. Jars shipped for analyses were composited at the laboratory based on group (inshore vs. seaward) for the primary set of analyses.

3.3.2 Bioassay Analyses

Coolers containing sediments samples for bioassay testing and their respective chain-of-custody forms were shipped via overnight freight to the Weston laboratory in California for analyses.

3.3.3 Archive Sample Storage

The set of jars designated for archiving is being kept frozen at AECOS should the need arise for further analyses to determine more specifically which location and depth contamination is present.

3.4 Sample Analyses

3.4.1 Physical Analyses

Physical analyses of the sediments were conducted to better understand their behavior after disposal. Grain size analysis down to 100 microns was conducted on each composite sample to establish the physical characteristics of the sediments, relative to those at the reference site and those reported from the disposal site. These data are in addition to grain size data available from the Geotechnical Investigation Borings discussed in Section 2.1.3 above.

3.4.2 Sediment Chemistry Analysis

Sediment samples were tested for those compounds listed in Table 2. The list is modified from the one found in the OTM (USEPA/USACE 1991) and was compiled in cooperation with representatives of EPA Region IX. Selected analysis methods and procedures addressed the presence of salt water in the samples and provided for detection limits set forth in "Guidelines for Implementing the Inland Testing Manual in the San Francisco Bay Region" (EPA Region IX 2001). For those compounds listed, USEPA Effects Range Low (ERL) and Effects Range Median (ERM) will be used as screening guidelines to determine if further analyses or disposal alternatives should be considered. USEPA Preliminary Remediation Goals (PRG) will be consulted where an ERL and ERM does not exist.

Following collection of the last core, field rinsate blanks were prepared to control for effects of the sediment being handled once removed from the vibracoring instrument. Distilled water was added to a clean stainless steel bowl and agitated with a clean stainless steel spoon for a two-minute period. The rinsate was then poured into sample bottles, chilled, and shipped along with project sediment samples to the respective analytical labs for analysis.

3.4.3 Bioassay Testing

Sediments being considered for ocean disposal were analyzed according to procedures set forth in the OTM (USEPA and USACE 1991) and modified as appropriate to follow

Table 2. List of chemical parameters analyze on samples collected from Hilo Harbor and reference sediments near the proposed Pier 4 construction site.

Priority Pollutants*:	Method	MRL
Semi-Volatile Organic Compounds	8270Cm	1 µg/kg**
PAHs	8270Cm	20 µg/kg
Chlorinated Pesticides	8270Cm	2 µg/kg***
PCBs	8270Cm	20 µg/kg†
Dioxins	8290	5 ng/kg
Chlorinated Herbicides	8151A	10 µg/kg
Metals		
Arsenic	6020m	2 mg/kg
Cadmium	6020m	0.3 mg/kg
Chromium	6020m	5 mg/kg
Copper	6020m	5 mg/kg
Iron	6020m	5 mg/kg
Lead	6020m	5 mg/kg
Mercury	245.7m	0.02 mg/kg
Nickel	6020m	5 mg/kg
Selenium	6020m	0.1 mg/kg
Silver	6020m	0.2 mg/kg
Zinc	6020m	1 mg/kg
Other:		
Organotins	Krone et al. (1989)	10 µg/kg
TRPH	SM 5520 E	0.1%
TPH Oil range	SW8015C	100 mg/kg
TPH Diesel range	SW8015C	100 mg/kg
301(h) Chlorinated Pesticides††		
mirex	8270Cm	2 µg/kg
methoxychlor	8270Cm	2 µg/kg
malathion	8270Cm	200 µg/kg
demeton	8270Cm	200 µg/kg

* After consulting with EPA Region IX officials; VOC, cyanide, and asbestos analyses will be omitted

** Compounds with phenol groups will have higher detection limits: 50 µg/kg and in some cases 100 µg/kg

*** A reporting limit of 20 µg/kg is acceptable for Chlordane and Toxaphene

† for each arochlor

†† Not on Priority Pollutants List

more recent procedures outlined in the Inland Testing Manual (ITM, USEPA/USACE 1998). Analyses were conducted on two sampling composites for the proposed dredging area and one for the reference point. In addition, laboratory controls were run parallel to the analyses. The project plan called for toxicity testing and bioaccumulation testing. The following sections provide a summary of the analyses that were conducted.

3.4.3.1 Suspended-Particle Testing

Suspended Particulate Phase (SPP) bioassay tests were performed to determine the effects of the dredged materials on organisms in the water column. Procedures followed those outlined in the OTM (USEPA/USACE 1991) and ITM (USEPA/USACE 1998). Sediments were agitated in seawater and allowed to settle. Test organisms were exposed to various concentrations/dilutions of the decanted water, and survivorship compared to that of controls.

3.4.3.2 Solid Phase Acute Toxicity Testing

Solid Phase (SP) Acute Toxicity testing was performed to determine the suitability of the dredged material for colonization post disposal using two species (amphipods and worms). Procedures followed those outlined in the OTM (USEPA/USACE 1991) and ITM (USEPA/USACE 1998). Sieved sediments were placed in tanks which were stocked with burrowing organisms and survivorship recorded. Appropriate control tests were conducted simultaneously.

3.4.3.3 Solid Phase Bioaccumulation Potential Testing

Similar to the SP Acute Toxicity testing, for the SP Bioaccumulation Potential testing, two species of test organisms (worms and clams) were stocked into tanks with sediment, though for a much longer period. Organisms were removed, cleaned, and sent to the laboratory for tissue analysis. Tests for bioaccumulation were analyzed by comparing results with those of the reference sediments collected from the field and appropriate laboratory control sediments.

3.5 Quality Assurance/Quality Control

Every effort was made to have the sampled sediment only come into contact with new, clean surfaces. The vibracoring tube was rinsed with freshwater between sampling events. Gloved hands were used in handling sample collection and storage equipment. The plastic liner on the sampling trays was replaced between each sampling attempt. A new clean stainless steel spoon was used to subsample the core. A new clean stainless steel bowl was used for homogenizing the subsamples. Contents of the bowl were placed in new laboratory certified clean labeled sampling jars. Sampling jars were individually placed in ziplock bags before being put on ice in new coolers. Sediment collected for the bioassay experiments was transferred directly from the lined sample trays into double lined plastic bags before being placed directly on ice in coolers. Chain-of-custody forms were completed on the ship prior to coolers being transferred to the airport for shipment.

Laboratories conducting the analyses maintain QA/QC manuals detailing methods, QC procedures, calibration procedures, data validation, and preventative maintenance to ensure accurate and complete reporting. Full copies of laboratory reports are included in the appendices of this report.

4.0 RESULTS

4.1 Sampling Area & Sampling Depths

Target sampling depths and actual sampling depths are summarized in Table 3. Actual sampling depths are relative to MLLW, and based on a combination of water depth at MLLW and actual penetration of the vibracore. Target sampling depths were reached at two of 17 stations, and to within three feet at an additional three stations. For stations that did not reaching the target sampling depth, refusal due to consolidated sand and coral rubble or lava rock was encountered.

4.2 Physical Analyses & Characterization

The physical makeup of sediments across the proposed dredge area are relatively uniform. Consistent with findings of the geotechnical investigation borings, sediment in samples collected during vibracoring across the proposed dredge area consisted mostly of coral detritus cemented together with coralline sand, covered by a mud/sand layer. The photo in Figure 9 illustrates a typical view of an extracted core.

Rubble of volcanic origin mixed with coral detritus was encountered in core samples. This was most evident in the grayer coloration of the cored sediments visible in Figure 9. Layers of fine silt 1-3 feet thick, were encountered at stations closest to shore (Locations A-1, C-1, and E-1) and on the slopes into deeper waters (Locations C-7 and D-3).

Table 3. List of sampling locations, target sampling depths, and actual sampling depths at the Hilo Harbor project site. Alternate sampling points D-3 and E-2 were selected instead of points E-3 and F-2 due to an underwater obstruction that did not permit maneuvering the boat over the points.

Station	Composite Area	Target Sampling Depth (ft)	Actual Sampling Depth (ft)	Station	Composite Area	Target Sampling Depth (ft)	Actual Sampling Depth (ft)
A-1	HH1	25	16.4	A-5	HH2	25	20.4
A-1	HH1	25	16.5	A-5	HH2	25	20.4
A-3	HH1	25	24.3	A-7	HH2	25	20.7
A-3	HH1	25	17.2	A-7	HH2	25	15.8
B-2	HH1	25	21.7	B-4	HH2	25	17.0
B-2	HH1	25	22.3	B-4	HH2	25	14.3
C-1	HH1	25	15.7	B-4	HH2	25	20.9
C-1	HH1	25	14.0	B-6	HH2	25	19.4
C-3	HH1	25	17.3	B-6	HH2	25	17.9
C-3	HH1	25	15.2	B-8	HH2	25	19.3
D-2	HH1	25	14.6	B-8	HH2	25	22.2
D-2	HH1	25	17.5	B-8	HH2	25	18.6
D-3	HH1	25	27.7	C-5	HH2	25	15.5
D-3	HH1	25	26.7	C-5	HH2	25	21.9
E-1	HH1	25	18.9	C-7	HH2	25	24.7
E-1	HH1	25	16.9	C-7	HH2	25	27.4
E-2	HH1	25	15.9	D-4	HH2	25	25.5
E-2	HH1	25	15.4	D-4	HH2	25	31.5

Figure 9. View of typical core, laid out in sampling trays. Coral detritus in sand matrix (left). Coral detritus in a silt/sand/basalt matrix (right).

Evidence of a submerged solid basalt ledge was detected close to shore, closest to the existing container handling facility. Geotechnical boring number 106 encountered this ledge at -23ft to -25ft below MLLW. No other borings encountered a solid substrate. Vibracore refusal due to suspected solid substrate also occurred in the vicinity of boring number 106. Hard refusal occurred at Station E1, inshore of boring 106, at –18.9 ft (Attempt 1) and –16.9 ft (Attempt 2) below MLLW.

Table 4 summarizes grain size analyses results conducted by Weston Solutions on each composite sample and the reference sample. Detailed results can be found in Appendix A. The results indicate that the sediments are relatively coarse.

Table 4. Summary of grain size analysis results.

	HH1 Composite	HH2 Composite	Reference Composite
% < 4 phi	41.159	21.587	92.631
% > 1 phi	32.955	48.453	0.650
% gravel	23.328	34.908	0.000
% sand	35.513	43.505	7.369
% silt	23.680	11.953	72.117
% clay	17.479	9.634	20.515
*Median**	*636.86*	*120.07*	*26.90*
*Mean**	*407.39*	*114.85*	*9.97*
*Dispersion**	*4.376*	*5.250*	*2.424*
*Skewness**	*0.147*	*0.012*	*0.591*

* microns

4.3 Chemical Analyses

4.3.1 Project Sediments

Chemical contamination was largely absent from the project sediments collected at Hilo Harbor. Only those compounds detected in the project sediments are reported in this section. The complete data set can be found in Appendix B.

Table 5 and Table 6 list those compounds detected in the two composite samples of the project area sediments. Included in the table are detection limits and corresponding reference sediment and field blank analysis results.

4.3.1.1 Metals

All metals of concern were detected in project sediments. However, in project sediments, only arsenic values exceed an EPA PRG, ERL, or ERM. Arsenic values in the seaward composite (7.322 mg/kg and 7.589 mg/kg) were below the 8.2 mg/kg ERL. At 13.112 mg/kg and 15.612 mg/kg. The inshore sediments exceed the ERL, but are still below the 70 mg/kg ERM.

In reference sediments, Arsenic, Chromium, Copper, Iron, Nickel, and Vanadium exceeded an ERL, ERM, or a PRG. This indirectly affects evaluation of suitability for ocean disposal, by making comparisons between project sediments and reference sediments more difficult in the bioassay experiments.

4.3.1.2 Other Compounds

The Aroclor-based PCB analyses did not detect the presence of contamination in any of the project site samples, nor in the reference materials. The EPA 8270Cm analysis method detection limit (MDL) and method reporting limit (MRL) were 10 µg/kg and 20 µg/kg, respectively.

Using EPA method 8270Cm, no chlorinated or organophosphate pesticides were detected in the project sediments. MDLs and MRLs for chlorinated pesticides were 1 µg/kg and 5 µg/kg respectively (except for Dacthal Perthane, where they were 5 µg/kg and 10 µg/kg; and 10 µg/kg and 50 µg/kg for Toxaphene). MDLs and MRLs for organophosphate pesticides were 10 µg/kg and 20 µg/kg respectively for a majority of the compounds. MDLs and MRLs were 5 µg/kg and 10 µg/kg for Chorphyrifos, Diazinon, Dimethoate, and Merphos; and 50 µg/kg and 100 µg/kg for Azinphos Methyl.

Organotins were not detected in project sediments using the Krone et al 1989 method. MDL and MRL were 1 µg/kg and 2 µg/kg, respectively.

Analyses using EPA method 8270Cm also did not detect PCBs in the project sediments. MDL and MRL for the procedure were 1 µg/kg and 5 µg/kg respectively.

Low levels of 13 PAHs were detected above the MRL in the near-shore project sediments using EPA method 8270Cm, for a Total Detectable PAH level of 173 µg/kg. An additional three compounds were reported as estimates because they fall above the MDL but below the MRL.

Analysis of the seaward composite sample showed a Total Detectable PAH level of 158 µg/kg. Eleven compounds were detected above the MRL of 5 µg/kg. Five additional compounds were reported as estimates because they fall above the MDL but below the MRL.

Fifteen PAHs were detected in the reference sediments. Total Detectable PAH levels of 478.8 µg/kg were found in the reference material. An additional eight compounds were reported as estimates, above the MDL, but below the MRL.

TRPH levels, using analysis method SM 5520 E, for the inshore composite was 0.02% of the dry weight, which is equal to the MRL. Levels for the seaward composite were estimated at 0.01% of the dry weight, equal to the MDL.

Total Petroleum Hydrocarbon (TPH) analyses (Extraction Method SW3550C, Analysis Method SW 8015C) for diesel range hydrocarbons yielded levels of 3.3 mg/kg and 1.3 mg/kg for the inshore and seaward composites, respectively. Motor oil range hydrocarbons at 6.3 mg/kg were detected in the inshore composite. The detection limits for the diesel range hydrocarbons was 1 mg/kg and 5 mg/kg for the motor oil. Diesel range hydrocarbons were also detected in the reference sediment at 2.0 mg/kg.

Dioxin analysis (method EPA SW846-8290) showed very low levels of dioxins in the project sediments, all below the United States sediment background dioxin Toxic equivalency quotient (TEQ) of 5.3 ng/kg and the PRG of 3.9 ng/kg. Total Toxic Equivalency values (based on World Health Organization (WHO) Toxic Equivalency Factors (TEF)) for the inshore and seaward samplers were 3.27 pg/g and 2.74 pg/g. Reference sediment sample showed 21.2 pg/g, exceeding the EPA PRG. Reporting limits for the various Dioxin compounds ranged from 0.12 pg/g to 29 pg/g.

4.3.2 Field Blanks

Rinsate collected for use as a field blank was analyzed for a subset of contaminants listed in Table 7. Corresponding results for those compounds detected in the project sediment composite samples are included in Table 5 for comparison and do not suggest that sampling methods or equipment contributed to contamination of the samples. The full set of results can be found in Appendix C.

Table 5. Chemistry analysis results: Summary of compounds detected in project sediment composite samples collected from Hilo Harbor. HH1 = inshore composite sample, HH2 = Seaward composite sample, Reference = Reference site sediments, Field Blank = Rinsate from field equipment. See Appendix B for a complete set of results.

Compound	EPA PRG (mg/kg)	ERL (mg/kg)	ERM (mg/kg)	HH1 Replicate 1	HH1 Replicate 2	MDL	MRL	HH2 Replicate 1	HH2 Replicate 2	MDL	MRL	Reference Replicate 1	Reference Replicate 2	MDL	MRL	Field Blank	MDL	MRL
Trace Metals (mg/kg)																		
Aluminum	76000	-	-	**7094**	**8047**	1	5	**3485**	**3638**	1	5	**49979**	**51049**	1	5			
Antimony	31	-	-	**0.434**	**0.525**	0.025	0.05	**0.277**	**0.265**	0.025	0.05	**0.95**	**0.977**	0.025	0.05			
Arsenic	0.39	8.2	70	**13.112**	**15.612**	0.025	0.05	**7.322**	**7.589**	0.025	0.05	**94.602**	**95.502**	0.025	0.05	**nd**	0.2	0.5
Barium	5400	-	-	**7.799**	**9.957**	0.025	0.05	**8.307**	**8.603**	0.025	0.05	**12.27**	**12.82**	0.025	0.05			
Beryllium	150	-	-	**0.076**	**0.081**	0.025	0.05	**nd**	**.031J**	0.025	0.05	**0.381**	**0.376**	0.025	0.05			
Cadmium	37	1.2	9.6	**0.259**	**0.323**	0.025	0.05	**0.241**	**0.248**	0.025	0.05	**0.196**	**0.174**	0.025	0.05	**nd**	0.2	0.4
Chromium	210	81	370	**52.33**	**60.87**	0.025	0.05	**25.54**	**28.81**	0.025	0.05	**297.01**	**301.31**	0.025	0.05	**0.2J**	0.1	0.5
Cobalt	900	-	-	**3.687**	**4.465**	0.025	0.05	**2.439**	**2.713**	0.025	0.05	**19.93**	**20.43**	0.025	0.05			
Copper	3100	34	270	**10.664**	**12.474**	0.025	0.05	**6.463**	**6.451**	0.025	0.05	**48.114**	**49.324**	0.025	0.05	**0.6J**	0.4	0.8
Iron	23000	-	-	**15510**	**18660**	1	5	**10160**	**9596**	1	5	**105600**	**107900**	1	5	**nd**	5	10
Lead	400	46.7	218	**3.862**	**4.418**	0.025	0.05	**2.41**	**1.899**	0.025	0.05	**14.95**	**14.93**	0.025	0.05	**0.13**	0.05	0.1
Manganese	18000	-	-	**172.4**	**211**	0.025	0.05	**116.8**	**119.9**	0.025	0.05	**624.8**	**634.1**	0.025	0.05			
Mercury	23	0.15	0.71	**0.029**	**0.028**	0.01	0.02	**0.011J**	**0.013J**	0.01	0.02	**0.034**	**0.021**	0.01	0.02	**nd**	0.01	0.02
Molybdenum	3900	-	-	**0.809**	**1.04**	0.025	0.05	**0.414**	**0.361**	0.025	0.05	**1.871**	**1.915**	0.025	0.05			
Nickel	1600	20.9	51.6	**13.75**	**16.13**	0.025	0.05	**8.672**	**11.46**	0.025	0.05	**66.18**	**67.18**	0.025	0.05	**0.3J**	0.2	0.5
Selenium	390	-	-	**3.658**	**4.464**	0.025	0.05	**3.816**	**4.141**	0.025	0.05	**3.943**	**3.912**	0.025	0.05	**nd**	0.2	0.5
Silver	390	1	3.7	**0.241**	**0.346**	0.025	0.05	**0.179**	**0.18**	0.025	0.05	**0.887**	**0.882**	0.025	0.05	**nd**	0.5	1
Strontium	47000	-	-	**2351**	**2968**	0.025	0.05	**3381**	**3915**	0.025	0.05	**507.8**	**534.7**	0.025	0.05			
Thallium	5.2	-	-	**0.025J**	**.028J**	0.025	0.05	**nd**	**nd**	0.025	0.05	**0.033J**	**0.034J**	0.025	0.05			
Tin	47000	-	-	**0.869**	**1.076**	0.025	0.05	**0.581**	**0.554**	0.025	0.05	**4.715**	**5.2**	0.025	0.05			
Titanium	100000	-	-	**1769.995**	**2025.995**	0.025	0.05	**898.095**	**968.395**	0.025	0.05	**11480**	**11660**	0.025	0.05			
Vanadium	78	-	-	**41.699**	**48.72**	0.025	0.05	**22.869**	**23.959**	0.025	0.05	**285.179**	**288.679**	0.025	0.05			
Zinc	23000	150	410	**20.779**	**22.489**	0.025	0.05	**13.319**	**11.349**	0.025	0.05	**77.249**	**77.759**	0.025	0.05	**2.7**	0.1	0.5
Base/Neutral Extractable Compounds (µg/kg)	**EPA PRG µg/kg**																	
Bis(2-ethylhexyl)phthalate (DEHP)	35000			**19.1**	**n/a**	5	10	**44**	**n/a**	5	10	**17.7**	**41.4**	5	10	**210.3**	5	10
Diethyl Phthalate	4.90E+07	-	-	**nd**	**n/a**	5	10	**nd**	**n/a**	5	10	**nd**	**7.4J**	5	10	**42.9**	5	10
Di-n-butyl Phthalate	6100000	-	-	**7.8J**	**n/a**	5	10	**6.8J**	**n/a**	5	10	**9.2J**	**8.5J**	5	10	**67.3**	5	10

Shaded Compounds and values indicate concentrations that exceed a PRG, ERM and/or ERL

J = trace amount. Detected, but below method reporting limit

Table 6. Chemistry analysis results (continued): Summary of compounds detected in project sediment composite samples collected from Hilo Harbor. HH1 = inshore composite sample, HH2 = Seaward composite sample, Reference = Reference site sediments, Field Blank = Rinsate from field equipment. See Appendix B for a complete set of results.

Compound	EPA PRG (µg/kg)	ERL (µg/kg)	ERM (µg/kg)	HH1	MDL	MRL	HH2	MDL	MRL	Reference	MDL	MRL	Field Blank	MDL	MRL
Polynuclear Aromatic Hydrocarbons (µg/kg)															
Acenaphthene	3700000	16	500	**1.9J**	1	5	**1J**	1	5	**1.6J**	1	5	**1.3J**	1	5
Anthracene	22000000	85.3	1100	**3.3J**	1	5	**2.2J**	1	5	**4.2J**	1	5	**nd**	1	5
Benz[a]anthracene	620	261	1600	**8.5**	1	5	**11**	1	5	**17.4**	1	5	**nd**	1	5
Benzo[a]pyrene	62	430	1600	**17.4**	1	5	**15.1**	1	5	**41.7**	1	5	**nd**	1	5
Benzo[b]fluoranthene	620	-	-	**11.9**	1	5	**12.1**	1	5	**28.1**	1	5	**nd**	1	5
Benzo[e]pyrene	*	-	-	**1.8**	1	5	**10.4**	1	5	**30.6**	1	5	**nd**	1	5
Benzo[g,h,i]perylene	*	-	-	**19.8**	1	5	**16.7**	1	5	**57.9**	1	5	**nd**	1	5
Benzo[k]fluoranthene	380(6200)	-	-	**14.7**	1	5	**13.4**	1	5	**27.7**	1	5	**nd**	1	5
Biphenyl	*	-	-	**nd**	1	5	**1J**	1	5	**2.4J**	1	5	**1.8J**	1	5
Chrysene	3800(62000)	384	2800	**12.1**	1	5	**10.4**	1	5	**22.3**	1	5	**1.9J**	1	5
Dibenz[a,h]anthracene	62	63.4	260	**2.5J**	1	5	**nd**	1	5	**4.1J**	1	5	**nd**	1	5
Fluoranthene	2300000	600	5100	**16.1**	1	5	**19**	1	5	**41.9**	1	5	**3.7J**	1	5
Indenol[1,2,3-c,d]pyrene	620	-	-	**15.5**	1	5	**15.3**	1	5	**45.2**	1	5	**nd**	1	5
Naphthalene	1700(56000)	160	2100	**6**	1	5	**4.8J**	1	5	**23.7**	1	5	**19.7**	1	5
Perylene	*	-	-	**12.4**	1	5	**7.4**	1	5	**62.7**	1	5	**nd**	1	5
Phenanthrene	*	240	1500	**5.4**	1	5	**4.2J**	1	5	**15.4**	1	5	**5.1**	1	5
Pyrene	2300000	665	2600	**14.3**	1	5	**14.3**	1	5	**39.3**	1	5	**1.8J**	1	5
Total Detectable PAHs	*	4022	44792	**173.6**			**158.3**			**487.8**			**48.6**		
General Chemistry															
TRPH (% dry weight)	*			**0.02**	0.01	0.02	**0.01J**	0.01	0.02	**0.02**	0.01	0.02	**nd**	1	5
TPH (Diesel, mg/kg)	*			**3.3**		1	**1.3**		1	**2**		1			
TPH (Oil, mg/kg)	*			**6.2**		5	**nd**		5	**nd**		5			
Dioxins (pg/g)	**(pg/g)**														
Dioxin (2,3,7,8-TCDD)	3.9			**nd**		0.22	**nd**		0.32	**0.76**		0.44			
Total Toxic Equivalency	3.9			**3.27**			**2.74**			**21.2****					

* EPA PRG not available for this compound

** Exceeds published EPA PRG

J = trace amount. Detected, but below method reporting limit

Table 7. List of Analyses performed on field rinsate blanks.

Priority Pollutants:	Method
Semi-Volatile Organic Compounds	625m
PAHs	625m
Chlorinated Pesticides	625m
Metals	
Arsenic	200.8m
Cadmium	200.8m
Chromium	200.8m
Copper	200.8m
Iron	200.8m
Lead	200.8m
Mercury	245.7m
Nickel	200.8m
Selenium	200.8m
Silver	200.8m
Zinc	200.8m
Other:	
TRPH	1664

4.4 Bioassay Testing Results

Detailed results from bioassay testing conducted by Weston are included in Appendix D and are summarized here.

4.4.1 Suspended Particulate Phase (SPP) Testing

SPP testing proceeded according to procedures and guidelines set forth in the ITM (USEPA/USACE 1998), OTM (USEPA/USACE 1991), American Society for Testing and Materials (ASTM) methods, and the Regional Implementation Manual (RIM, USEPA REGION IX/USACE 1997). Water collected from the project site had a salinity of 20.8 to 21.7 ppt. Hypersaline brine was added to increase the salinity to acceptable levels. The brine was prepared by freezing seawater and collecting the hypersaline liquid as the frozen seawater thawed. A brine control test was run concurrently to ensure that the brine did not have an effect on toxicity. A detailed description of the procedures followed, test conditions, relevant controls, and results can be found in Appendix D. Data sheets from all tests are included in Appendix E.

4.4.1.1 *Mytilus galloprovincialis* Test Results

The 48-hour testing of the bivalve *M. galloprovincialis* showed that the LC_{50} values for survivorship in elutriate samples from the inshore and seaward sites were greater than 85%. There was no significant difference between control and brine added treatments. For larval development, the EC_{50} values showed greater than 85% proportionally normal development. Mean percent control survival was 96.4% and 98% mean percent normal larvae. These values meet the threshold for acceptability for ocean disposal (≥70%, each parameter).

Copper sulfate and ammonium chloride reference toxicant tests showed that the organisms were within acceptable sensitivity limits and that ammonia did not significantly contribute to toxicity in the tests.

4.4.1.2 *Mysidopsis bahia* Test Results

The 96-hour shrimp (*M. bahia*) test did not show any substantial effects of the elutriate on the organisms. The LC_{50} value for survival was greater than 95% from both the inshore and seaward composites, and the control showed 92% mean survival. Both met the ≥ 90% minimum acceptable level. Two temperature deviations (out of range by 0.5 °C) and one salinity deviation occurred during the tests, but did not have any effect on results.

The copper sulfate sensitivity test did not show any anomalies, nor did reference toxicant tests with ammonia show that it played a role in toxicity.

4.4.1.3 *Menidia beryllina* Test Results

The 96-hour fish (*M. beryllina*) test did not show any substantial effects of the elutriate on the organisms. The LC_{50} value for survival was greater than 100 mg/L from both the inshore and seaward composites, and the control showed 98% mean survival. Both met the ≥ 90% minimum acceptable survival level. Copper sulfate and ammonium chloride reference toxicant tests showed that organism sensitivities fell within acceptable levels.

4.4.2 Solid Phase (SP) Testing

Solid Phase testing was conducted on polychaetes and amphipods under guidance of the ITM (USEPA/USACE 1998), RIM (USEPA REGION IX/USACE 1997), and ASTM methods, measuring survivorship over a 10-day period.

4.4.2.1 *Neanthes arenaceodentata* Test

Test conditions for the survivorship test fell within acceptable limits for the duration of the experiment.

Neanthes arenaceodentata mean survivorship in the control sediments was measured at 95% after removal of one statistical outlier from the data set. Replicate 1 of the control had a survivorship of 60% and was judged to be a statistical outlier using Dixon's Test for Detecting Outliers.

Mean survivorship in the reference sediments was 92%. Survivorship in the HH1 (inshore) composite sediment was 92% and 84% in the HH2 (seaward) composite sample. Sediments met the limiting permissible concentration (LPC) of no less that 10% lower than the 92% survivorship in the reference sediment.

Reference toxicant testing with cadmium chloride showed that the sensitivity of *N. arenaceodentata* fell within acceptable limits. Unionized and un-unionized ammonia testing showed that ammonia did not play a role in survivorship.

4.4.2.2 *Ampelisca abdita* Test

Water quality measurements were within acceptable limits for the duration of the survivorship experiment.

The results for the control sediments did not meet the survival criterion. Using Dixon's Test for Detecting Outliers, it was determined that control replicate 4, with a 70% survivorship, was a statistical outlier. Mean survival in the control was 92.5% after removal of one statistical outlier, meeting the required ≥ 90% survival criterion.

Mean survivorship in the reference sediments was low, at 49%. Elevated arsenic levels in the reference sediments may have been responsible for this. Due to the unacceptably low survivorship in the reference materials, survivorship in the project sediments was compared to the control sediment.

Survivorship in the HH1 (inshore) sediment composite tests was 70%. Survivorship in the HH1 composite did not meet the LPC criterion. Survivorship would have to have been 72.5% or greater. The sediments were statistically different ($p = 0.029$, Students t-Test, $df = 4$, $t_{crit} = 2.13$, one-tail). Taken at face value, this disqualifies the dredge material that the HH1 sample represents (inshore sampling points), or 100,800 cubic yards, from ocean disposal.

Survivorship in the HH2 (seaward) composite sediments was76% and met LPC criterion for ocean disposal (with a mean within 20% of the control sediment).

The cadmium chloride reference toxicant tests showed that the organisms were within acceptable sensitivity limits. Ammonium chloride reference toxicant tests did not suggest that ammonia played a significant role in the toxicity found in tests of project materials.

4.5 Bioaccumulation Potential Tests

Weston tested tissues of polychaetes and bivalves for bioaccumulation of chemicals present in the project sediments following a 28-day exposure period. Tests were conducted under the guidance of the ITM (USEPA/USACE 1998), OTM (USEPA/USACE 1991), RIM (USEPA REGION IX/USACE 1997), and ASTM methods and the *Guidance Manual for Bedded Sediment Bioaccumulation Tests* (USEPA 1993). Under these guidelines, Weston "separately purged [each organism] for 24 hours, prior to submitting their tissue for chemical analyses." Based on very low and/or absence of contamination based on the sediment chemistry analyses, the tissues were tested for a subset of compounds, including lipids, metals (including mercury), and PAHs.

4.5.1 *Macoma nasuta* Test

Survival of the organisms met the ≥75% minimum acceptable survival criterion. Mean survival in the control sediments was 99% and survivorship in the reference sediments was 98%. Similarly, survivorship was 99% in the HH1 (inshore) composite sediments and 98% in the HH2 (seaward) sediments (Table 8).

4.5.2 *Nereis virens* Test

Survival of the organisms met the ≥75% minimum acceptable survival criterion. Mean survival in the control sediments was 97% and survivorship in the reference sediments was 91%. Survivorship was 92% in the HH1 (inshore) composite sediments and 91% in the HH2 (seaward) sediments (Table 8).

4.5.3 Tissue Chemistry Results

No elevated contaminants of concern were detected based on Weston's statistical analyses of the *N. virens* tissues. Table 9 and Table 10 include summaries of tissue chemistry analysis results.

Selenium was statistically elevated in the tissues of *M. nasuta* exposed to both the HH1 and the HH2 composite sediments, though only at 1.2 times that found in the reference material. Day 0 tissues (tissue from organisms immediately prior to commencing the bioaccumulation experiment) in both composites showed higher selenium concentrations (0.28 mg/kg, both composites) than the mean selenium concentrations for both composites for the entire 28-day test period (0.22 mg/kg). The reference tissues showed selenium concentrations of 0.18 mg/kg, compared to the 0.22 mg/kg mean concentration for both the HH1 and HH2 composites. In essence, *M. nasuta* was removing contamination during the test period.

Table 8. Bioaccumulation survivorship results for *M. nasuta* and *N. virens.*

Sample ID	% Survival (Std. Dev.)	
	Bivalve - *M. nasuta*	Polychaete Worm - *N. Virens*
Control	99(1.3)	97(4.5)
Reference	98(2.6)	91(8.2)
HH-1 Comp	99(1.6)	92(9.7)
HH-2 Comp	98(2.4)	91(10.2)

Table 9. *N. virens* Tissue Chemistry Results. No statistically elevated compounds. Mean values are provided only for those compounds detected above the MRL in all replicates.

Compound	HH1 rep 1	HH1 rep 2	HH1 rep 3	HH1 rep 4	HH1 rep 5	HH1 Mean	HH2 rep 1	HH2 rep 2	HH2 rep 3	HH2 rep 4	HH2 rep 5	HH2 Mean	Ref rep 1	Ref rep 2	Ref rep 3	Ref rep 4	Ref rep 5	Ref Mean	Zero Time	MDL	MRL
Trace Metals (ug/ wet g)																					
Aluminum	2J	1J	1J	6	4J		1J	1J	1J	1J	3J		2J	2J	1J	2J	1J		1J	1	5
Antimony	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Arsenic	1.989	2.02	1.821	1.982	2.011	1.96	1.658	1.934	1.921	1.847	1.825	1.84	2.008	1.87	2.078	1.932	1.932	1.96	1.504	0.025	0.05
Barium	0.047J	0.053	0.047J	0.05	0.05		0.053	0.048J	0.048J	0.047J	0.053		0.051	0.055	0.046J	0.046J	0.051		0.053	0.025	0.05
Beryllium	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Cadmium	0.033J	0.036	0.033J	0.025J	nd		0.029J	0.026J	0.027J	0.025J	nd		0.026J	nd	0.029J		0.028J		nd	0.025	0.05
Chromium	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Cobalt	0.071	0.071	0.082	0.068	0.069	0.07	0.072	0.072	0.082	0.062	0.075	0.07	0.075	0.076	0.072	0.069	0.085	0.08	0.075	0.025	0.05
Copper	1.63	1.663	1.502	1.92	2.366	1.82	2.061	1.523	1.65	1.532	1.578	1.67	2.066	2.095	2.322	1.437	1.651	1.91	1.327	0.025	0.05
Iron	61	64	50	63	58	59.20	55	53	59	51	56	54.80	59	60	56	58	58	58.20	56	1	5
Lead	0.082	0.084	0.086	0.146	0.208	0.12	0.169	0.082	0.09	0.088	0.083	0.10	0.11	0.094	0.141	0.092	0.095	0.11	0.072	0.025	0.05
Manganese	0.584	0.366	0.323	0.675	0.536	0.50	0.646	0.34	0.823	0.487	0.563	0.57	0.549	0.376	0.387	0.53	0.85	0.54	0.278	0.025	0.05
Mercury	0.018J	0.014J	0.016J	0.011J	0.014J		0.013J	0.012J	0.015J	0.014J	0.014J		0.016J	0.014J	0.011J	0.013J	0.012J		0.014J	0.01	0.02
Molybdenum	0.117	0.138	0.133	0.13	0.129	0.13	0.132	0.152	0.137	0.124	0.128	0.13	0.151	0.151	0.149	0.134	0.171	0.15	0.089	0.025	0.05
Nickel	0.11	0.105	0.125	0.147	0.24	0.15	0.384	0.151	0.182	0.172	0.164	0.21	0.252	0.192	0.189	0.142	0.153	0.19	0.157	0.025	0.05
Selenium	0.248	0.221	0.204	0.271	0.236	0.24	0.255	0.221	0.295	0.231	0.26	0.25	0.239	0.218	0.227	0.242	0.301	0.25	0.209	0.025	0.05
Silver	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Strontium	4.2	3.94	4.3	4.16	4.18	4.16	4.32	4.26	4.21	4.29	4.84	4.38	5.12	4.37	4.16	4.48	4.1	4.45	4.04	0.025	0.05
Thallium	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Tin	nd	nd	nd	nd	0.027J		nd	nd	nd	0.026J	nd		nd	0.035J	0.027J	nd	0.027J		0.029J	0.025	0.05
Titanium	0.544	0.493	0.389	1.08	0.773	0.66	0.416	0.438	0.422	0.392	0.585	0.45	0.606	0.46	0.372	0.552	0.4	0.48	0.425	0.025	0.05
Vanadium	0.249	0.263	0.229	0.254	0.261	0.25	0.26	0.266	0.27	0.237	0.258	0.26	0.252	0.269	0.283	0.26	0.28	0.27	0.206	0.025	0.05
Zinc	14.175	7.953	7.228	23.615	12.37	13.07	27.165	7.397	29.145	10.635	16.915	18.25	16.49	14.42	14.96	15.21	41.93	20.60	6.464	0.025	0.05
Polynuclear Aromatic Hydrocarbons (ng/wet g)																					
Fluoranthene	nd	nd	nd	nd	nd		nd	nd	nd	nd	1.3J		1J	nd	nd	nd	nd		nd	1	5
Pyrene	nd	nd	nd	nd	nd		nd	nd	nd	nd	1.5J		1.2J	nd	nd	nd	nd		nd	1	5
Total Detectable PAH's	nd	nd	nd	nd	nd		nd	nd	nd	nd	2.8		2.2	nd	nd	nd	nd		nd		
Percent Lipids (% wet	0.38	0.24	0.12	0.24	0.25	0.25	0.12	0.1	0.19	0.32	0.3	0.21	0.43	0.37	0.13	0.11	0.1	0.23	0.27	0.01	0.05

J = trace amount. Detected, but below method reporting limit
nd = non-detect above the MDL

Table 10. *Macoma nasuta* Tissue Chemistry Results. Selenium statistically elevated. Mean values are provided only for those compounds and values detected above the MRL.

Compound	HH1 rep 1	HH1 rep 2	HH1 rep 3	HH1 rep 4	HH1 rep 5	HH1 Mean	HH2 rep 1	HH2 rep 2	HH2 rep 3	HH2 rep 4	HH2 rep 5	HH2 Mean	Ref rep 1	Ref rep 2	Ref rep 3	Ref rep 4	Ref rep 5	Ref Mean	Zero Time	MDL	MRL
Trace Metals (ug/ wet g)																					
Aluminum	111	94	153	128	128	122.8	27	34	30	30	36	31.40	16	12	17	27	31		13	1	5
Antimony	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Arsenic	1.591	1.529	1.641	1.738	1.636	1.63	1.467	1.474	1.614	1.523	1.518	1.52	1.368	1.29	1.451	1.522	1.348	1.40	1.855	0.025	0.05
Barium	0.119	0.127	0.147	0.12	0.13	0.13	0.122	0.131	0.115	0.124	0.111	0.12	0.1	0.09	0.133	0.11	0.132		0.151	0.025	0.05
Beryllium	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Cadmium	nd	0.029J	nd	0.025J	nd		nd	nd	0.029J	0.027J	nd		nd	nd	0.028J	nd	nd		0.034J	0.025	0.05
Chromium	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Cobalt	0.124	0.132	0.148	0.147	0.14	0.14	0.1	0.11	0.11	0.108	0.102	0.11	0.092	0.095	0.101	0.104	0.094	0.10	0.119	0.025	0.05
Copper	1.682	1.821	2.293	1.683	1.457	1.79	1.641	2.463	1.855	1.528	1.841	1.87	2.117	1.535	2.43	1.579	3.424	2.22	2.764	0.025	0.05
Iron	247	230	340	295	285	279.4	99	119	108	102	112	108.0	67	67	85	100	108	85.40	69	1	5
Lead	0.153	0.172	0.184	0.153	0.149	0.16	0.184	0.184	0.16	0.119	0.157	0.16	0.137	0.112	0.19	0.128	0.208	0.16	0.163	0.025	0.05
Manganese	2.409	2.241	2.785	2.631	2.515	2.52	1.163	1.244	1.218	1.219	1.313	1.23	0.721	0.756	0.989	1.096	1.04	0.92	1.071	0.025	0.05
Mercury	0.01J	0.01J	nd	nd	0.011J		nd	0.01J	nd	nd	0.01J		nd	nd	nd	nd	nd		0.011J	0.01	0.02
Molybdenum	0.138	0.168	0.156	0.183	0.187	0.17	0.159	0.193	0.172	0.172	0.173	0.17	0.168	0.15	0.165	0.187	0.165	0.17	0.233	0.025	0.05
Nickel	0.575	0.312	0.848	0.395	0.372	0.50	0.282	0.55	0.327	0.278	0.307	0.35	0.293	0.383	0.426	0.252	0.285	0.33	0.406	0.025	0.05
Selenium	0.186	0.168	0.146	0.209	0.203	0.18	0.217	0.204	0.228	0.206	0.221	0.22	0.22	0.221	0.214	0.222	0.215	0.22	0.279	0.025	0.05
Silver	nd	nd	nd	nd	nd		nd	0.036J	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Strontium	8.69	8.4	9.26	8.71	8.65	8.74	17.61	20.79	15.67	20.94	17.91	18.58	10.07	10.85	20.97	13.63	15.54	14.21	9.87	0.025	0.05
Thallium	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	0.025	0.05
Tin	0.041J	nd	0.066	nd	nd	0.07	nd	0.118	nd	nd	nd	0.12	0.039J	0.046J	nd	nd	0.09		0.286	0.025	0.05
Titanium	11.629	9.39	16.109	12.969	15.869	13.19	2.909	3.439	3.136	2.656	3.248	3.08	2.042	1.429	1.956	2.789	3.357	2.31	0.63	0.025	0.05
Vanadium	0.77	0.681	1.013	0.878	0.846	0.84	0.308	0.357	0.342	0.348	0.37	0.35	0.266	0.242	0.284	0.331	0.336	0.29	0.272	0.025	0.05
Zinc	9.025	9.485	9.042	8.558	7.868	8.80	8.678	8.665	7.88	8.451	7.746	8.28	7.839	6.731	9.248	7.799	7.884	7.90	9.85	0.025	0.05
Polynuclear Aromatic Hydrocarbons (ng/wet g)																					
1-Methylphenanthrene	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		2.8J	1	5
2,3,5-Trimethylnaphthalene	nd	3.1J	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		2.7J	1	5
2,6-Dimethylnaphthalene	nd	1.6J	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	1	5
Acenaphthalene	nd	1.1J	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	1	5
Anthracene	nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		3.6J	1	5
Benz[a]anthracene	nd	nd	nd	nd	nd		nd	1.5J	nd	nd	nd		nd	nd	nd	nd	nd		nd	1	5
Benzo[b]fluoranthene	1J	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	1	5
Benzo[k]fluoranthene	1.7J	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	1	5
Chrysene	nd	nd	nd	nd	nd		nd	1.3J	nd	nd	nd		nd	nd	nd	nd	nd		nd	1	5
Dibenzothiophene	nd	2.2J	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		nd	1	5
Fluoranthene	nd	nd	nd	nd	nd		nd	1J	nd	nd	nd		nd	nd	nd	nd	1.5J		1.6J	1	5
Fluorene	nd	2.7J	nd	nd	nd		nd	nd	nd	nd	nd		nd	nd	nd	nd	nd		1.1J	1	5
Phenanthrene	nd	2.4J	1J	nd	nd		1.2J	1.6J	1J	nd	nd		1J	1.1J	1J	1.8J	1.6J		7.2	1	5
Total Detectable PAH's	2.7	13.1	1	nd	nd	5.60	1.2	5.4	1	nd	nd	2.53	1	1.1	1	1.8	3.1	1.60	19	1	5
Percent Lipids (% wet weight)	0.11	0.29	0.1	0.1	0.08	0.14	0.11	0.19	0.09	0.05	0.01J	0.11	0.11	0.09	0.1	0.11	0.16	0.11	0.41	0.01	0.05

J = trace amount. Detected, but below method reporting limit
nd = non-detect above the MDL

5.0 DISCUSSION

5.1 Environmental Impact

5.1.1 Direct Physical Impacts & Disposal Site Capacity

The HODMDS is located at 19˚48'30.00"N 154˚58'30.00"W, which is approximately 4 nautical miles (nm) from the nearest land, and lies in 1083-1116 feet of water. A United States Geological Survey (USGS) multibeam sonar bathymetry of the area (Torresan et al 2000) showed sandy/softer bottom at the center of the disposal site, surrounded by a raised, hardened substrate—a lava flow to the North and West; reef to the east. Receiving 2% of the dredge volume from harbors in Hawaii, the Hilo disposal site is not characterized as near capacity. Mounds from previous dumping events were described as sparse. The USEPA (1980) described the seafloor as smooth silty sand and mentions that typical Hilo Harbor sediment is composed of 13% sand, 22% clay, and 65% fine sand. Accurate characterization of dredge material cover, beyond knowing its presence in low amounts relative to other Hawaiian disposal sites, is not available.

Dredging occurs relatively infrequently at Hilo Harbor. The 162,300 CY of material proposed for disposal is more substantial than recent maintenance dredging activities (Radio Bay, 3000 CY, 2005); however, it is not expected to contribute substantially towards reaching the capacity of the HODMDS.

Sediments proposed for disposal are coarser than those described by the USEPA in 1980. The most notable difference is the presence of coral detritus in the material proposed for disposal. While coarseness of the material may play a role in dispersion across the disposal site, it is not expected to significantly alter the substrate.

5.1.2 Impacts on the Water Column

Suspended particulate phase laboratory analyses conducted as part of this study showed that the material proposed for disposal will not have any impacts on the water column aside from the effects associated with the immediate release. All tests met the USEPA's criterion for suitability for Ocean Disposal.

Furthermore, laboratory tests revealed the absence of bioaccumulation potential in tissues of organisms for compounds found in the material proposed for disposal, also making the material suitable for ocean disposal under USEPA guidelines.

5.1.3 Benthic Impacts

Solid Phase testing of the sediments proposed for disposal showed that the sediments from the seaward locations sampled did not have significant effects on test organisms in the benthic environment, despite having to use the control sediments for comparison.

Tests using the inshore sediments and *Ampelisca abdita*, however, showed lower survivorship than anticipated. An effect on survivorship was not anticipated, and further investigation does not yield a clear explanation.

The effects of the physical characteristics of the sediment are not likely to be contributors to the lowered survivorship. *A. abdita* was predicted to do better in coarse sediments. *N. arenaceodentata*, the other organism used for the SP testing, is more sensitive to coarse sediments, yet its survivorship was slightly greater during the SP testing. Survivorship in the *N. arenaceodentata* SP test, as well as the chemistry analysis and SPP testing results, do not suggest that contamination as the cause for the lowered survivorship either.

The SP test using *A. abdita* is the only test that yielded results that did not meet the USEPA criterion for ocean disposal.

5.2 Need for Ocean Dumping

In evaluating alternatives for dredge material disposal from the proposed project site, three broad factors influence the selection of reasonable alternatives. First, Hawaii's, especially Hilo's, relative isolation influences resource availability, including equipment and disposal and reuse locations. Second, disposal activities must take into account Hawaii's sensitive inshore marine and coral reef ecosystems. Finally, project cost and ultimately funding availability influence the selection of disposal alternatives. After a complete evaluation, using guidelines set forth in the document titled Evaluating Environmental Effects of Dredged Material Management Alternatives–A Technical Framework (EPA842-B-92-008 Revised 2004), ocean disposal of materials proposed for dredging remains as the best alternative.

The proposed project is vital to the continued growth of Hilo and surrounding areas. Serving military, cargo and cruise ship clients, the existing piers are operating near full capacity. The recent addition of two cruise ships that make weekly port calls at Hilo further reduces available cargo terminal space. Dredging is a prerequisite to eventually accommodate the proposed improvements.

5.2.1 Confined (Diked) Disposal Alternative

Hawaii's sensitive inshore coral reef ecosystems make confined (diked) disposal an unsuitable alternative for dredge material disposal. Containment of effluent whether immediately adjacent to the project site or inland presents an unacceptable risk of contaminating inshore waters. In addition, sufficient space for construction of containment areas is not available.

5.2.2 Beneficial Use Alternatives

5.2.2.1 Land Disposal or Reuse Alternative

No landfills willing to accept the dredged material as "waste" exist within a reasonable distance of the project site. Transport and disposal at the Kona landfill (opposite side of the Island of Hawaii) was considered. Transportation cost estimates alone were estimated at $38 per CY based on a 90-mile trip with a 10 CY wet load, a $5.5 million dollar additional cost. Disposal costs double this amount.

During the preparation of the Environmental Impact Statement for the Hawaii Commercial Harbors 2020 Master Plan, the Hawaii County's Hilo Landfill disclosed that it will not accept dredge material (HIDOT 2001). More recently, however, landfill representatives have expressed the possibility that the portion of the material not suitable for ocean disposal could be stockpiled the in an abandoned quarry and subsequently utilize as cover material.

It is possible that small quantities of dewatered dredge material could be used as cover material; however, the logistics and economics of this alternative remain as obstacles. From a logistical standpoint, uncertainty remains with the quantity of material the landfill would be capable of accepting. In terms of economics, landfill representatives will only accept the material "at the door," meaning that the State assumes the cost of offloading barges and transportation. The State, lacking sufficient funding, is requesting a cost sharing arrangement. Funds are barely available to construct the pier associated with this dredging. Offloading barges, dewatering and transporting the materials to the landfill/quarry is estimated to cost $80 - $95 / CY. This estimate is based on a $50 - $60 / CY base cost for dredging and an additional $30 - $35 / CY handling and transport cost.

5.2.2.2 Construction and Industrial Reuse Alternative

The eastern portion of the island of Hawaii does not have any significant development projects planned in the immediate future. Hawaii County's Planning Office and Department of Public Works were not aware of any planned or permitted construction activities that would be in need of fill, especially in volumes expected for this dredging operation. Dewatering and storage facilities are also not available. Ultimately, storage and hauling costs would increase the projects estimated costs by 50%. A small quantity of dredged material will be used as backfill at the project site.

5.2.2.3 Material Transfer Alternative

Material transfer, such as reuse in dikes, levees, parking lots or roads, was also investigated as a reuse option. Perhaps more common in urban, mainland areas, these types of construction projects occur relatively infrequently in the Hilo area, confirmed through the county planning office.

5.2.2.4 Other Beneficial Reuse Alternatives

The following alternative uses were considered for reuse of dredged materials:

- Habitat restoration/enhancement—Materials not suitable for use in planned projects.
- Beach nourishment—Materials too coarse for nourishment.
- Agriculture, forestry, and horticulture—Sediments are too saline for these applications.
- Shoreline stabilization construction—Materials not coarse enough of this application.

5.2.3 No Action Alternative

Dredging is a prerequisite to the proposed improvements described in the Hawaii Commercial Harbors 2020 Master Plan. Without excavation of the sediments, vessels will not be able to reach the proposed pier location, thus the project will not move forward.

5.2.4 Ocean Disposal Alternative

From an environmental, technical, and economic standpoint, ocean disposal remains as the most viable alternative for disposal part of the proposed dredge volume. Discussed in Section 5.1 above, the potential for environmental impacts of ocean disposal is extremely low. Use of the offshore designated ocean disposal site wholly avoids the potential for physical impacts on the coastal reef and near shore marine environment associated with dewatering. The project area is also not substantial enough to support a dewatering area, processing, and storage for the proposed volume of dredged sediments. The costs of hauling dredge material off-site for upland reuse or disposal are prohibitive.

5.3 Impact of Proposed Disposal on Aesthetic, Recreational, and Economic Values

Disposal activities will affect recreational fishing activities in the vicinity of the disposal area. While bottom fishing does not generally take place at the ocean disposal site, it is possible that boats trolling would want to avoid the area during and shortly after disposal activities. This effect is not anticipated to last beyond a few days after disposal ceases.

Cruise ships making port calls might also encounter turbid waters in the vicinity of the ocean disposal site for a short period following disposal activities. While not affecting vessel traffic, guests' concerns may have to be addressed.

6.0 CONCLUSIONS

Sediments proposed for disposal mainly consist of coral fragments cemented together by a sand matrix, which, when disturbed, breaks down into its components. Grain size analyses showed that the sediments are relatively coarse compared to those reported from the disposal site.

Chemistry analyses did not find any significant contamination in the sediments. Both composite samples showed less contaminant present than that found in the reference sediment. Sediment chemistry analyses alone did not suggest contamination levels that would warrant more detailed investigation.

Furthermore, SPP and bioaccumulation analyses showed neither significant effects of the sediments on survivorship nor sequestration of contamination in tissues of test organisms, meeting all requirements for ocean disposal.

SP testing showed that sediments were suitable for disposal, with the exception of the test using *A. abdita* on the inshore composite of sediments. Survivorship was within acceptable limits using *N. arenaceodentata* on both composite samples. Mean survivorship of *A. abdita* was 70% in the inshore composite sediments but fell below the 72.5% cutoff. Sediment chemistry results do not suggest contamination as the cause for low survivorship. Physical properties of the sediments also do not appear to be the cause of the reduced survivorship. *A. abdita* is expected to do better than *N. arenaceodentata* in coarser sediments, yet the data showed the opposite. Overall, mean survivorship was higher for *N. arenaceodentata* compared to *A. abdita.* While sensitivity tests of the organisms were within acceptable limits, it is possible that test organism quality contributed to lower survivorship.

Considering analysis results as a whole, sediments proposed for disposal do not exhibit contamination at levels warranting automatic exclusion for ocean disposal. Sediment physical and chemical characteristics support this conclusion. Bioassay analysis results yielded a more complicated picture, but again, considered together with physical and chemical data, do not suggest substantial contamination.

Efforts will be made to reuse dredged material on site to the extent construction plans allow. Normally, beach nourishment would be considered a best alternative; however the material does not meet physical standards set for placement on beaches in Hawaii. Landfill cover, an alternative also explored, increases the cost of dredging by over 60% due to transportation costs alone. Presenting ocean disposal as the best option as the ultimate disposition for a majority of the dredged material is made based on a thorough review of factors related to Hawaii's (and Hilo's) relative isolation, Hawaii's coastal and nearshore reef ecosystems as well as financial resources.

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